Mr. Bessemer committed a great mistake when he claimed for his plan the production of that quality known as charcoal-iron, simply from the refining being conducted without contact with mineral fuel. A superficial acquaintance with the subject would have shown that the quality of the fuel used in the manufacture of a moiety of the bar-iron, so far as regards the usual contaminating ingredients, sulphur and phosphorus, has nothing to do with the ultimate quality of the bar. In the puddling, boiling, and heating furnaces, the fuel is kept separate from the iron; where the refinery is employed, the earthy matters of the fuel pass into the cinder, but the gaseous constituents, from being cooled above the liquid iron, have very little influence on the quality of the product of such fires as receive the iron direct from the blast furnace. Charcoal-iron is a product of the blast furnace, and cannot be produced in any subsequent stage of the manufacture.

I cordially agree with Mr. Sanderson, that the iron, after treating by Mr. Bessemer's process, possesses the qualities neither of wrought iron nor cast steel. I will not trouble you with extracts from my work bearing on this point, but would remark that malleability is a property never yet communicated to iron at varying temperatures, other than by manipulation in some one or other form. The mere removal of a portion of the impurities with the iron by fusion does not, of itself, convert cast into malleable iron. Castings with a slight degree of malleability, at low temperatures, are common in this country and abroad; at high temperatures they lose this, are equally brittle with other cast irons, and are utterly devoid of the welding principle.

Mr. Bessemer estimates his malleable cast ingots to lose 5½ per cent. in the finishing rolls. How can pure malleable iron, as he asserts the ingots to be, lose so much in the mere rolling to a bar? If it is thus reduced in weight more than 1 cwt. per ton, the action of the rolls must squeeze out of the so-called pure iron a very large quantity of cinder. In ordinary rolling, the loss of weight in these rolls amounts to no more than 15 lbs. or 16 lbs. to the ton.

Mr. Bessemer heads his paper 'Manufacture of Iron and Steel without Fuel,' whereas it appears to be a proposition for making wrought iron and steel from liquid cast iron. I say a proposition, because it is not yet known that a process exists for making either. No one has seen the malleable iron equal to charcoal in point of quality, to be made by the means described from common irons; there has not been any made and forged into articles to demonstrate the correctness of the patentee's statements. The cast steel of excellent quality, which it is to produce as cheap as finer's metal, has yet to be made, and exhibited in the shape of articles of cutlery, as a test of quality. A few pieces of refined iron were displayed at the meeting, but these were no more like bars of wrought iron or steel, than chilled cast iron is like tempered steel. I see chemists and others apparently delighted at some discovery, but the evidences of this discovery are wanting, and until they are forthcoming no one can affirm that there has been any made. Nevertheless, I shall be glad to hear that Mr. Bessemer's description of his invention is more faulty than the process itself."

Some of Mr. Bessemer's practical tests have done much to sustain his side of the question. We shall see what further arises before our next publication.

THE INSTITUTION OF MECHANICAL ENGINEERS IN GLASGOW.

The first Scottish meeting of this most important Society—as announced by us in August last—took place in Glasgow, on the 17th and 18th of the past month. The Scottish, or rather the Architectural Exhibition Rooms in Bath Street were placed at the disposal of the members and their friends on this occasion, and were finely fitted up in honour of what mechanical men cannot but look upon as a pointed demonstration of engineering progress. The attendance, we are glad to say, was extremely good, including a great many of the leading English members who came from afar to aid in the inauguration of the Society's practical movements amongst their friends of the North. Mr. Joseph Whitworth of Manchester, the president of the Institution for the year, took the chair, and delivered a most interesting opening address, and said:—

"The city of Glasgow is peculiarly interested in the mechanical arts, for the minerals of making iron are found in great abundance in this locality; indeed, it is to this neighbourhood, more than to any other, that the world is indebted for the cheapest and most abundant supply of iron. Here, too, that metal is converted into a great variety of machinery. There are large manufactories of the steam-engine—fixed, marine, and locomotive. Cotton manufacturing and various other kinds of machinery are also made here in considerable quantities. With such points of connection amongst us, I trust that this our first meeting may be the forerunner of many others, and that we shall add many valuable members to our Institution.

With regard to the manufacture of malleable iron and steel, it was with great gratification that I read the account of Mr. Bessemer's process, so beautiful and simple as apparently to leave nothing further to be desired in that part of the process. I need not tell you of what vast importance it must be to those who are more immediately connected with those branches of mechanics requiring nicety of workmanship, to have iron and steel of a better quality. I may mention, that in making rifle barrels for the experiments which I have undertaken for the Government, one of the greatest difficulties I encounter in attaining the degree of accuracy that I require, arises from the defects in the iron. What we want is iron of great strength, free from seams, flaws, and hard places. Inferior iron (with the use of other defective and improper materials) is perhaps the main cause of one of the greatest errors committed in the construction of whatever in mechanism has to be kept in motion. I mean the increase of size of the parts of a machine or carriage in order to get strength, thereby adding weight until they are considered to be strong enough.

In our vehicles of draught and carriages this is strikingly the case Now, this ought not to be. Lightness is the thing to aim at, and safety should be sought in the elasticity, form, and good quality of the material. Should a carriage be found to twist, and get out of form, that would be a proof of its being too light. But to prevent a carriage breaking down by increasing the size of its parts, and thereby adding weight, is mechanically wrong. Indeed, it is quite distressing to see the enormous weight of our carriages, particularly those drawn by animal power. It should be an axiom in mechanics, that whatever has motion should be as light as circumstances will admit, and this applies equally, whatever the scource of power may be, whether the motion is produced by human, horse, or steam power.

I would next call your special attention to the vast importance of attending to the two great elements in constructive mechanics, viz., a true plane, and the power of measurement. The latter cannot be attained without the former, which is therefore of primary importance, and its accomplishment is so easy and so simple as to leave without excuse any establishment neglecting to secure it. It is necessary to make three planes in order to obtain a perfect one, and cast-iron is the best material generally to use. Whatever the size of the plane required, the tripod form is absolutely essential for its support, and the strengthening ribs must be placed with reference to these supports. I cannot impress too strongly on the members of the Institution, and upon all in any way connected with mechanism, the vast importance of possessing a true plane as a standard for reference. All excellence in workmanship depends upon it. I may mention that it was at the meeting of the British Association, held in Glasgow in 1840, that I read a paper on the mode of producing a true plane, to which I would refer those desiring information on the subject.

Next in importance to a true plane is the power of measurement. I have brought with me, for your inspection at the close of the meeting, a small machine, by which a difference in length of the one-millionth part of an inch is at once detected. The principle is that of employing the sense of touch, instead of sight. If any object be placed between two parallel true planes, adjusted so that the hand can just feel them in contact, you will find, on moving the planes only the fifty-thousandth of an inch nearer together, that the object is distinctly tighter, requiring greater force to move it between them. In the machine before you, the object to be measured is the standard inch, being a small square bar, both ends being true planes; and in this case, in order to measure with the utmost accuracy, a thin flat piece or bar is introduced, having its two sides made also perfect planes. This is placed between the inch bar to be measured and one of the end surfaces of the machine. This thin bar, which I name the gravity piece, is brought into contact with the two planes, so as just to allow it, on being raised, to fall by its gravity, and you will find that, by bringing the planes into closer contact by even the one-millionth of an inch, the gravity piece will be suspended, friction overcoming its gravity. This machine, and a larger one, are used for making standards of length. When the standard yard, which is a square bar of steel, is placed in the larger machine, and the gravity piece adjusted so as just to fall by its weight, the heat imparted from the slightest touch of the finger instantly prevents its fall, thus showing the lengthening of the bar by so small an amount of heat as that I have indicated. We have, therefore, in this mode of measurement, all the accuracy we can desire; and we find in practice in the workshop, that it is easier to work to the ten-thousandth of an inch from standards of end measure than to the one-hundredth of an inch from the lines on a two-foot rule. In all cases of fitting, end measures of length should be used instead of lines.

This question of correct measurement is in immediate connection with another, which will repay all the attention that can be given to it, and I think there is no subject that can be more profitably discussed amongst us—I mean that of proper gradations of size in all the various branches of the mechanical arts. I think no estimate can be formed of our national loss from the over-multiplication of sizes. Take, for instance, the various sizes of steam-engines—stationary, marine, and locomotive. In the case of marine engines, the number of sizes up to one hundred horse-power will probably not be short of thirty, where ten perhaps would be ample. If so, look at the sums expended in patterns, designs, and in the number of tools for their manufacture. Nor is this all; for, if there were only ten sizes instead of thirty, there would be three times the number made of each pattern, and, as you know, the very soul of manufacture is repetition. By attention to this, the shipowner would be benefited by getting a better engine at a less price. In the case of locomotives and carriages, I would urge the subject on the attention of our members, the engineers of the great lines of railway—the London and North-Western, the Midland, the Great Northern, for instance. I hope they will permit me to suggest that they should consider and determine, not only the fewest possible number of sizes of engines and carriages that will suffice, but also how every single piece may have strictly defined dimensions.

This question is also well worthy the attention of our architects and builders. Suppose, for instance, that the principal windows and doors of our houses were made only of three or four different sizes. Then we should have a manufactory start up for making doors, without reference to any particular house or builder. They would be kept in stock, and made with the best machinery and contrivances for that particular branch; consequently, we should have better doors and windows at the least possible cost. Our friends across the Atlantic manage matters in connection with their buildings much better than at present we do. I hope the members of this Institution will join me in doing what we can with reference to those two important subjects—correct measurement, and its corollary, proper gradations of size. The want of more correct measurement seems to pervade everything. Take, for instance, the case of the common brick, which ought to be three inches thick. Who is there that has made an addition to a building that has not felt inconvenience from the irregularity of size?—the new brick being perhaps too thick, and so not allowing sufficient mortar to be used; or too thin, and requiring too much mortar. Perhaps one of the most effectual means that could be adopted, in the first instance, to remedy this unsatisfactory state of things, would be for the Government to supply corporate bodies with proper standards of length—such as the inch, the foot, and the yard. The corporate bodies themselves might then have their own standards of size, founded on these, and made to suit the particular wants of the different trades in the locality. The only standard of length at present supplied by the Government and kept by the corporate bodies, is the standard yard; but there is so little attention paid to accuracy, that to the engineer and machinist it is not of the slightest use, and is only employed to adjust yard sticks for measuring woven goods. There is also another subject which bears upon this question, and which has lately been brought before the Legislature, that of decimalising weights and measures. There can be no doubt of the beneficial results that would follow the passing of such a measure. There may be a difference of opinion as to what the unit or integer of lineal measure should be; but I am of opinion that it should be the inch, for, from the accuracy with which we can now measure that length, there would be no difficulty in determining and fixing the length of its multiples. The most important divisions of length in mechanism are those of parts of an inch, and if the length of the inch were altered it would cause much confusion. Small accurate standards of length of the decimal parts of an inch, would be of much service to some trades. There is now no standard of appeal; and the different wire and other gauges differ so considerably, that the manufacturer, in the case of small wire and sheets of metal, has to send a sample of what he wants, there being no means of correctly expressing its size.

Although I have said so much to you with reference to the desirableness of further improvement and greater perfection in the mechanical arts, I congratulate you on the success which in our time they have attained, and the high consideration in which they are held. Inventors are not now persecuted as formerly by those who fancied that their inventions and discoveries were prejudicial to the general interest, and calculated to deprive labour of its fair reward. Some of us are old enough to remember the hostility manifested to the working of the power-loom. the self-acting mule, the machinery for shearing woollen cloth, the thrashing-machine, and many others. Now, the introduction of the reaping and mowing machine and other improved agricultural machinery is not opposed. Indeed, it must be obvious to reflecting minds that the increased luxuries and comforts which all more or less enjoy, are derived from the numerous recent mechanical appliances, and the production of our manufactories. That of our cotton has increased during the last few years in a wonderful degree. In 1824, a gentleman with whom I am acquainted sold on one occasion one hundred thousand pieces of 74 reed printing cloth at 30s. 6d. per piece of 20 yards long; the same description of cloth he sold last week at 3s. 9d.

One of the most striking instances I know of the vast superiority of machinery over simple instruments used by the hand is in the manufacture of lace, where one man with a machine does the work of 8000 lace-makers on the cushion. In spinning fine numbers of yarn, a workman on a self-acting mule will do the work of 3000 hand-spinners with the distaff and spindle, and there are other striking facts of a similar kind mentioned in my report on the New York Industrial Exhibition.

Comparatively few persons, perhaps, are aware of the increase of production during our lifetime. Thirty years ago, the cost of labour for trueing a surface of cast-iron, by chipping and filing with the hand, was 12s. per square foot; the same work is now done by the planing machine at a cost of labour of less than 1d. per square foot, and this, as you know, is one of the most important operations in mechanics. It is therefore well adapted to illustrate what our progress has been. At the same time that this increased production is taking place, the fixed capital of the country is, as a necessary consequence, augmented; for, in the case I have mentioned of chipping and filing by the hand, when the cost of labour was 12s. per foot, the capital required for tools for one workman was only a few shillings; but now the labour being lowered to 1d. per foot, a capital in planing machines for the workman is required, which often amounts to £500, and in some cases more. This large outlay of capital, invested in machinery to increase production, makes it impossible to curtail the hours of working machinery as much as could be desired. In some cases two sets of work-people have been employed in relays, each working eight hours a day; and this system perhaps may in time be extended, although it is attended with certain inconveniences. If, however, the relay system could be so improved and organised as to allow more time for the better education of young operatives, none would more cordially rejoice than myself. I believe that mechanics, though a mere material power in itself, may, if rightly used, become a moral lever, by which, like Archimedes of old, we may seek to raise the world.

There is at the present time a very gratifying circumstance in connection with the extension of machinery, viz., the large remuneration which the operatives receive compared with those who perform hand labour without the help of machinery. I would here mention, with reference to the amount of wages paid to the operative, that it does not solely depend on the master manufacturers of this country, but is governed in some measure by what is paid by the manufacturers of other countries who are in competition with our own. When in America in 1853, I found that the American operatives received somewhat more wages than are paid in this country; but they work much longer hours, although the climate during some parts of the year is so unfavourable. The longer hours enable the American manufacturer to turn over his capital more frequently."

Mr. Whitworth concluded his address with some general remarks touching political economy; after which the business proper of the meeting was commenced by the reading of the following papers:—

"On a Steam Riveting Machine," by Mr. Robert Cook of Glasgow. This was a description of the useful tool which we have already illustrated at page 119, for August last.

"On Apparatus for Grinding Grain," by Mr. A. White, Incorporation Mills, Partick, Glasgow. This invention has also been fully detailed in our Plate 191, for June last.

"On a Compressed Air Engine at Govan Colliery," by Mr. C. Randolph, Glasgow. This is an engine constructed to compress air to 30 lbs. on the square inch, for working a winding and pumping engine, fixed under ground at the extremity of the colliery, the compressed air being conveyed from the surface by a pipe about half a mile in length. The object of the arrangement is to get a convenient mode of conveying power from the surface to the place required, as an engine under ground was inadmissible. It had answered the purpose satisfactorily, having been in constant use for upwards of six years without causing any trouble or stoppage. The pumps for compressing the air are of peculiar construction, having water constantly upon the valves to prevent leakage and heating from the compression of air.

Mr. Kennedy's "Water-Meter," which we have frequently discussed, formed the subject of the next paper, followed by the "Direct-action Marine Engines for Screw Propulsion" of Mr. Hunt; Mr. Downie's "Cast-Iron Moulding Processes;" Mr. Chattaway's "Buffing and Drawing Apparatus for Railways;" Mr. Harvey's "Sugar Evaporating Apparatus;" and Mr. Joule's "Surface Condenser." A conversazione and exhibition of models closed the day's performances. On the following day, nine other papers were read:—"On Dr. Boucherie's Mode of Preserving Timber," by Mr. Reid. Dr. Boucherie, the French chemist, has for twenty years directed his attention to this subject. He was the first to discover that the tubes which run through the trunks of trees have no lateral connection, and the chief part of his invention was a plan suggested by this discovery for expelling the sap of trees, that being the principal agent in the decomposition of timber. An interesting illustration of the fact that the tubes of trees have no lateral connection, was afforded by the exhibition of a section of the trunk of a tree, on which the name "Faraday" was distinctly legible, the letters having been formed at one end of the tree with a chemical substance which penetrated the pores of the trunk from the one extremity to the other, so that at whatever place the trunk was cut the name appeared. Quantities of sap which had been expelled from several trees were also exhibited in a singularly pure condition.

"On Grooved Surface Frictional Gearing," by Mr. Robertson. This ingenious invention, so often referred to by us in our recent pages, after meeting with the usual opposition of old and deeply-seated prejudices, was finally received as a very great accession to the modern system of gearing of all kinds.

"On a Steam Boiler with external and internal Furnaces," by Mr. John Stephen, Glasgow. This is a boiler so contrived as to combine the heating effects of furnaces placed both inside and outside of the boiler—gaining a superior concentration of heating power, and a very obvious saving of fuel. We shall hereafter notice this invention in full detail.

"On an Improved Ladder for Dredging Machines," by Mr. M. Scott, London.

"On a New Construction of Ships," by Pietro Conti, commissioner of the Sardinian Government. The author stated that the ravages of a worm in the Sardinian harbours entailed a heavy expense upon the government of his country, if they would maintain a sufficient navy of wooden vessels. The use of iron was therefore most desirable, but hitherto it had been found that when a cannon ball penetrated the side of an iron vessel, the wall of the vessel was much more injured than if it were of wood, in which case there would be a clean aperture and no fracture. By constructing war vessels on the plan which he proposed, he expected to obviate that objection.

Mr. Fairbairn stated that he had attended experiments at Woolwich by desire of the Government, and the result was on the whole decidedly unfavourable to the use of iron when exposed to shot.

"On a Machine for Forging and Cutting Files," by Mr. J. Ross, Glasgow.

"On a New Locomotive Boiler," by Mr. A. Allan, Perth.

"On an Improved Locomotive Engine Boiler," by Mr. Walter Neilson. Mr. Neilson makes the crown of the fire-box of superior strength, by introducing a peculiar mode of construction, which we shall shortly explain in detail. He also contrives, that should a shortness of water occur, the crown of the fire-box shall not be the first part to give way. In the new boiler, also, the chance of deficiency of water is materially lessened.

"On a Steam Dash-Wheel for Bleaching," by Mr. J. Wallace, jun., Glasgow. This dash-wheel, under one modification, was described at page 270 of our eighth volume.

"On an Improved Water-Meter," by Mr. W. Gorman, Glasgow.

A dinner in the evening, and a trip on the following day down the river, concluded the proceedings of a gathering which, we trust, is the solid commencement of a long series of successful meetings of the Institution of Mechanical Engineers in Scotland.

MANUFACTURE OF CARMINE.

Carmine is a colouring matter, contained in the body of an insect about the size of a small currant, which feeds upon the leaves of succulent plants belonging to the Cactus tribe, in hot countries. Certain salts are used to precipitate the colouring matter, after it has been taken up by the water in which the bodies of the insects have been boiled. Many recipes have been published for conducting the process, but success depends on the skilful manipulation of the workmen employed in this delicate operation, since great experience is requisite to enable the operator to seize the right moment at which to commence, continue, and stop the boiling, and when to add the precipitating salts. Carmine is known in the state of an impalpable powder, in that of a liquor, and as a solid substance. The last, however, is simply the powder united by albumen. Its price is high and variable, and endeavours have been vainly made to substitute other colouring matters for it. It is frequently adulterated with vermilion and albumen, but these alter its beautiful colour; and their presence may be immediately detected by dissolving it in ammonia: when the pure carmine is entirely dissolved, the adulterations fall in the shape of sediment.

This test will also show the exact proportions in which carmine and albumen exist in the various carmine cakes. Ordinary carmine is composed of

144	drams	of cochineal, reduced to powder.
4	do.	carbonate of potash.
9	do.	pulverized alum.
4	do.	isinglass, or white of egg.

The four drams of carbonate of potash are dissolved in about nine gallons of water in a copper boiler, and are moderately boiled for five minutes, care being always taken to keep the liquor at a cherry red, which is done by adding a little cold water as the boiling goes on. The vessel being removed from the fire, alum is added, by which, as the liquor gradually cools, the cherry-red is converted into a carmine colour. Ultimately the carmine is precipitated in the shape of a fine powder, and the supernatant liquor becomes clear. The whole is then transferred into a larger boiler, containing a perfect solution of pure isinglass, and heat is applied until ebullition commences, which is allowed to go on until the carmine rises to the surface, coagulated with the albumen, when it is removed from the fire, and, by agitation and cooling, the carmine is precipitated. The liquid is then decanted, the precipitate washed in cold distilled water, and then dried, at a low temperature, in a stove.

The decanted liquid contains a large portion of colouring matter, which is used in the manufacture of carmine cakes. Carmine can also be prepared with alum alone. In this case, 16 parts of cochineal, in powder, are boiled for ten minutes in 580 parts of distilled water. After the boiling has been continued for five minutes, one part of alum is added, and the mixture is withdrawn from the fire; the liquor thus obtained yielding, when filtered and slowly cooled, from one to two parts of carmine. Carmine may also be obtained with cream of tartar. In this case, 512 parts of water are boiled for twelve minutes with 32 parts of pulverized cochineal, and 2 parts of cream of tartar. When these have been boiled together for eight minutes, the mixture is withdrawn from the fire, and 3 parts of alum added. From one to two parts of carmine are yielded, as the mixture cools.

This product can also be obtained by the use of nitrate and binoxalate of potash. In this case about 2¼ lbs. of cochineal are boiled for two hours in about 27 gallons of water, the heat being moderated by the occasional addition of cold water. Then about 6¼ ounces of nitrate of potash are added, and afterwards about 7 ounces of binoxalate of potash, when, by agitation and cooling, the carmine is deposited. In China, carmine is prepared with various chlorides. One pound and a half of pulverized cochineal, and about 1¾ dram of alum, are boiled for seven minutes in spring water, and to this mixture is added, drop by drop, a liquid composed of 1¾ lb. of common salt, 1 lb. of nitric acid, and 67 drams of tin. The carmine is precipitated as the liquid is added. An improvement was recently made by Mr. Wood, which promises to be of great practical value. The carmine obtained is of a beautiful colour, which does not change either with time or exposure to the air. His process is this:—9 ounces of perfectly pure carbonate of soda are dissolved in 27 quarts of water, to which is added 8 ounces of citric acid. When the whole has nearly arrived at the boiling point, 1½ lbs. of good pulverized cochineal is added, and the boiling is continued for an hour, or an hour and a half. The liquor is then filtered, and allowed to become cool; and when once clear, it is again boiled for five minutes with 9 ounces of alum, and a second time filtered, after which it is allowed to remain undisturbed for two or three days. A deposit is thrown down, and the supernatant fluid is carefully decanted. The deposit is washed in cold distilled water, and dried at a low temperature in a stove. The impalpable powder thus produced may, if thought desirable, be again dissolved in water, rendered alkaline by ammonia, and mucilaginous by gum arabic. By evaporating the liquid, the residue can be moulded into cakes. A peculiarly brilliant red may be given to carmine by mixing with the 9 ounces of alum a few grains of a salt of tin, either a sulphate or nitrate of the protoxide or chloride of tin.

A process for the manufacture of lake colours was lately patented by Mr. F. A. Gatty, in which chloride of antimony is used to precipitate the colouring of dye materials, such as logwood and cochineal.