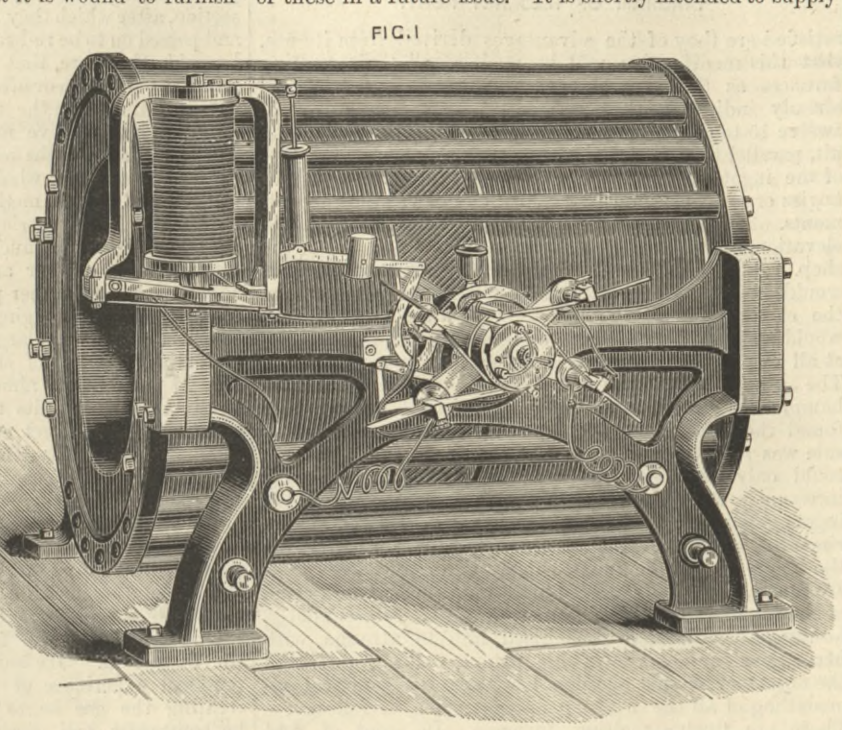
ELECTRIC LIGHTING AT MONTREAL.

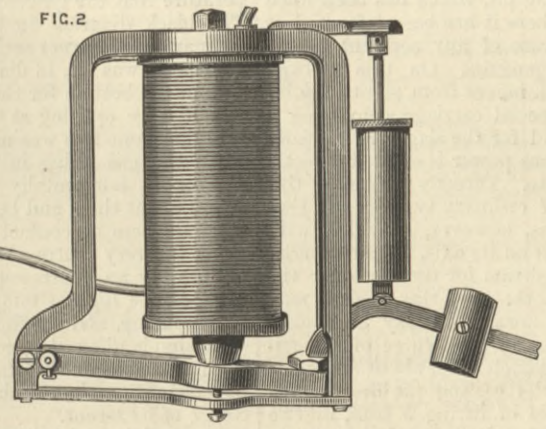
The absence of the incandescent electric light in the city of Montreal was commented on in the discussion which took place after the reading of Mr. Preece's paper on "Domestic Electric Lighting" at the meeting of the British Association. The great natural water power, with which several of the largest Canadian cities are so well provided, has yet to be taken advantage of, and should enable a general supply of electricity, both incandescent and arc, to be furnished at a rate that would be much cheaper than gas.

In common with most American cities, the streets are lit by electricity, and as the system adopted is one which has not been introduced into this country, we propose describing it in full. The Thomson-Houston dynamo machine is of the continuous current type, and approximately resembles the Brush in that it is wound to furnish a current of 2000 volts electro-motive force, the lamps being differential and worked in series with 10½ ampères current. In detail, the construction of the machine is peculiar to itself, and consists of a spherical armature made up of three coils of wire which are wound in the Siemens' form on the outside of a Gramme ring composed of soft wire. This armature is revolved between the cheeks of two cup-shaped electro-magnets, thus enclosing nearly the whole of the armature where the electricity is generated in a powerful magnetic field, which is concentrated where it should be applied to give the best results. The three coils are joined together at one end of the armature, and at the other they pass through a hollow in the shaft until they come out at the end, where they are connected to the commutator which has only three segments. The electricity is led off by two pairs of brushes which are coupled together and their position adjusted by means of suitable levers which are worked by the automatic current regulator Fig. 2, which is shown in its place on the left side of Fig. 1. The regulator consists of a single pole electro-magnet with a peculiar shaped armature, which is a hinged bar of iron having a conical recess, through which the pole of the electro-magnet enters; by this ingenious arrangement the pull of the magnet is the same at whatever distance the armature is from the pole. The current regulator is actuated by a controller magnet Fig. 3, which is placed in the line of the main circuit, and by its delicate contact instantly alters the amount of current passing round the regulator, which controls the output by moving the position of the brushes, and thus more or less cutting out the magnetic field.

FIG. 1

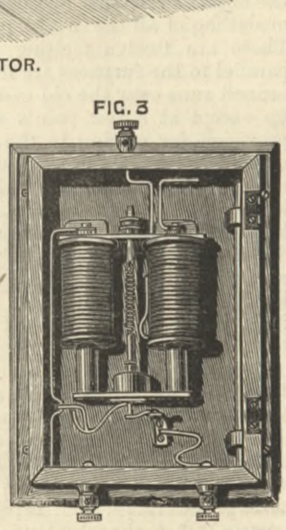


THE THOMSON-HOUSTON GENERATOR.



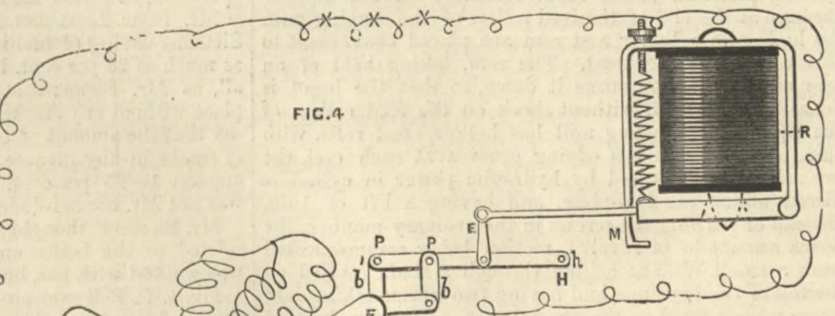
AUTOMATIC CURRENT REGULATOR.

FIG. 3



CONTROLLER MAGNET.

The position which the pair of brushes occupy to each other, and the mode of coupling up, will be better understood by reference to the accompanying diagrams, Figs. 4 and 5, in which S is the commutator divided into segments K^1, K^2, and K^3, to which are connected the coils 1, 2, 3. From the brushes y and y^3 the exterior circuit, after passing through the field magnets, is led to the controller magnet, which is fixed on a wall where convenient, and then —after more or less electricity has been shunted through a carbon resistance to the current regulator, which it enters by wire at R—after working the lamps, returns to the machine by the brushes y^2 and y. As shown in Fig. 4, the brushes are in a normal position. Should less current be required, the armature M will be attracted, and each pair of brushes will tend to separate; so that if all the lights be extinguished, the coils of the machine will be short-circuited, the magnetic field being almost entirely cut out.

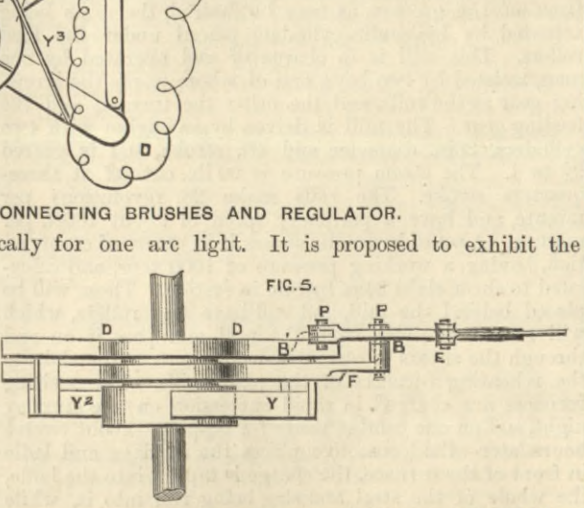


MODE OF CONNECTING BRUSHES AND REGULATOR.

It will be seen that one great difficulty is overcome in the Thomson-Houston system, namely, the adjustment of brushes, which are often badly placed by unskilled attendants. Another ingenious arrangement in this system is the air-blast spark controller, which the inventor, Professor Elihu Thomson, claims to provide a complete solution of the problem of controlling the sparking or flashing liable to be so troublesome at the commutators of all dynamo machines. The invention consists in forcing a thin jet of air square against the ends of the brushes where they bear on the commutator segments; the air blast, which is produced by a small blower fixed on the side of the commutator, carries with it a certain quantity of oil, which thus lubricates the commutator, and does away with the wear both of the segments and of the brushes to a very large extent.

The Thomson-Houston system is worked in Canada by the Royal Electric Company. In Montreal this company has a lighting station which at present supplies 180 arc lights fixed in various parts of the city; besides these there is a continual demand for temporary lights, which are quickly provided by running overhead wires. The company is an offshoot of the American Electric and Illuminating Company, of Boston, which already has some ten thousand lamps at work. The system adopted by this company in starting its numerous electric lighting stations is very complete, and we shall describe the general arrangements of these in a future issue. It is shortly intended to supply incandescent lamps on the same circuit as that used for arc lighting, by a new invention of Professor Thomson, which enables groups of eight incandescent lamps, of 12 to 16-candle power each, to be substituted automatically for one arc light. It is proposed to exhibit the system at work at the International Electrical Exhibition, Philadelphia.

FIG. 5

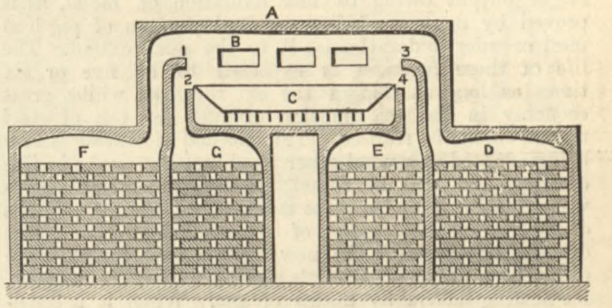


THE IRON AND STEEL INSTITUTE.

As stated in our last impression, three papers were read consecutively on Wednesday, the 24th ult. The first of these was by Mr. F. Siemens, C.E.,

On a New Method of Heating the Regenerative Gas Furnace.

In every description of furnace which has hitherto been designed, either for heating or melting, it has always been considered that the first condition of successful working was to make the space to be heated as small as circumstances would allow, so that the flame might be brought into as intimate contact as possible with the inside lining of the furnace, and more especially with the material under treatment. This method of constructing and working furnaces, which was a necessary condition of success in all cases in which it was proposed to obtain a high temperature with the use of solid fuel, was also adopted in regenerative gas furnaces, which until quite recently were heated on the same principle; the author, however, has for some time doubted the correctness of this view, and from experience gained in the practical working of this class of furnace, after long and careful trials, has satisfied himself that they should be arranged so that the flame should only radiate heat upon the material to be heated or melted, and not come into actual contact with it, as has hitherto been the case. The diagram gives a sectional view of the furnace as now constructed for various purposes. A is the roof, B are the working doors, C the bed of the furnace upon which the materials are melted or heated, D and E are one of the pair of regenerators, and F and G the other pair, between which should



be placed the pockets used for arresting the dust from the waste gases, as shown. The gas and air are alternately brought into the melting chamber by the ports 1 2 and 3 4, therein forming the flame which traverses it from end to end. It will be observed that the gas and air ports, instead of being so arranged that the flame shall impinge upon the materials placed on the bed of the furnace, as hitherto, open at some distance below the roof of the melting chamber, and at some distance also from its side walls, so that the gas and air after ignition have unobstructed space for entering into combustion, and for the free development of the flame, which is kept as much as possible from contact with the roof, wall, or materials on the furnace bed; and when these are crucibles, ingots, blooms, or packets of iron, they should be placed sufficiently far apart to allow the radiant heat to have free access all around them. Where there are working doors, the flame should pass above their level; in this way the men will not be inconvenienced while watching operations inside the furnace; but as already mentioned, the main object to be secured is to avoid contact of the flame with the materials under treatment, or with the walls of the furnace. In order to realise the circumstances under which these benefits are obtained, it must be borne in mind that in the regenerative gas furnace the amount of fuel used does not depend so much upon the intensity as upon the quantity of heat required; whereas in the old furnaces, in which direct combustion of solid fuel takes place, intensity can only be obtained by means of a strong chimney draught or a blast, and the consumption of very large quantities of the best fuel; and even with their use the highest temperatures required in the arts are difficult to get, and still more so to maintain, the difficulty and expense increasing with the size of the furnace. Thus it has been ascertained that in an ordinary crucible steel-melting furnace, heated by means of solid fuel, about 2 per cent. only of the heat developed is taken up by the steel, so that nearly the whole of the great mass of coke used is expended in getting up and maintaining the furnace at steel-melting temperature. In a regenerative gas crucible steel-melting furnace, on the other hand, when once the steel-melting temperature has been reached, it is easily maintained with a moderate chimney draught, and therefore by the burning of a comparatively small quantity of fuel, which may be of a poor quality, so that the greater part of the heat of combustion is taken up by the steel, while what remains amply suffices to maintain the crucibles and furnace at the necessary temperature, and only a very small quantity escapes through the chimney. The following is an actual comparison between an ordinary reheating furnace using solid fuel and one on the regenerative gas principle. The former uses about three tons of a fair quality of coal in a shift of ten hours, while a regenerative furnace of equal capacity takes about two tons for the same time, there being a saving of 33⅓ per cent. But if both furnaces are merely kept at a welding heat without any cold iron being charged, then the solid fuel furnace requires about 2½ tons of coal per ten hours, while the regenerative gas furnace takes half a ton at the outside; so that, when it is only necessary to maintain a certain temperature, the regenerative gas furnace shows an economy of 80 per cent., whilst it is 33⅓ per cent. when both furnaces are bringing iron up to the welding heat. The results here given are from the author's personal observation, but in some cases the advantages gained by the use of the regenerative gas furnace for heating purposes have been greater, reaching from 40 to 50 per cent. But besides the circumstance that solid bodies are injured by flame, it can be easily shown that when flame is brought into contact with any solid body, it is more or less quenched according to the substance, size, and temperature of the body. To show more clearly the advantages which have been so far derived from the application of this new system, it will be well to give a few examples of comparative results in working regenerative gas furnaces constructed on the old and the new principle. A glass pot furnace built at Dresden ten years ago, and which has been reconstructed for experimental purposes, shows the economy of this method of heating most effectively. This furnace held ten pots, and melted glass every night which was worked out during the day, giving a daily production of about 3000 bottles in a shift of seven hours, or, after allowing for pot breakages, a monthly production of 70,000 to 80,000 bottles. The pots lasted about three weeks, and the furnace itself about six months; during this time it required many repairs, which naturally interfered with its production. At present the same furnace, supplied with the same quantity of fuel, and working the same charges, produces daily 5000 bottles in a shift of nine hours, amounting to a monthly production of 130,000 to 140,000 bottles. Fewer pot breakages also occur, less repairs are required, and the amount of waste has decreased; moreover, the glass metal is obtained from a cheaper composition than hitherto used, and proves to be of a far superior quality. The pots last fully double the time, and melt more than three times the quantity of material, whilst the furnace itself stands for three years. Similarly advantageous results are attained in the open-hearth steel smelting furnace. At the Landore Siemens Steel Works, near Swansea, the furnaces which were altered at the end of last year and at the beginning of this to this new method of heating have already outlasted the furnaces reconstructed upon the old type at the same time, whilst they work more uniformly, giving an improved and larger output owing to less oxidation of metal, as is proved by more ore being required per ton of pig iron used in order to decarbonise it to the same extent. The life of these furnaces is expected to be five or six times as long as that of the old furnaces, whilst great economy in the consumption of fuel per ton of steel melted should be realised. This method of heating is now being adopted at several other steel-melting works in this country, and will be found particularly advantageous where steel is intended to be made from inferior qualities of pig iron by the adoption of a basic lining. For many other applications of the new system experiments have either been prepared, or trials already made; for instance, for heating boilers by means of gas. When it is considered that the temperature of the water in a boiler working at 60 lb. pressure on the square inch is only 311 deg. Fah., whilst the temperature of gaseous flame may be taken at 4000 deg. Fah., it will readily be perceived what a quenching effect the metal of the boiler, which is, of course, at the temperature of the water, has upon the flame. In this case the principle has been followed of letting the active flame consume itself in the open space of the tube without allowing it to touch the sides until after complete combustion has been effected, when the products of combustion may be brought into direct contact with solid bodies. By such an arrangement, complete and smokeless combustion is obtained, with the result of longer life to the boiler, the sides of which more readily deteriorate through direct contact with the flame than from any other cause. As the heat of the flame which is not transmitted by radiation comes after complete combustion into direct contact with the sides or flues of the boiler and its regenerators, it is completely utilised, and a saving of fuel to the extent of 25 per cent. is secured by this method of heating. The results obtained in actual practice show that there can be no doubt that almost all heating apparatus used in the arts, in which direct contact of flame with the substances treated is not necessary for chemical reasons, will be materially improved by the application to them of the principle of transmitting the heat of flame by radiation only, while the heat of the completely burnt products of combustion is better utilised by contact.

The next paper was by Mr. James Riley, Glasgow,

On Recent Improvements in the Method of the Manufacture of Open-Hearth Steel.

The author, after giving a *resumé* of experiences under the old system, described the new arrangement. The remodelling of the Blochairn Works, after they were acquired by the Steel Company of Scotland, gave the opportunity of embodying in the results of previous experience at Newton, more especially in the melting department which had to be created. The author's first plans were for a shop with twenty 12-ton furnaces, afterwards modified to twelve 15-ton furnaces. He had for some time been extremely anxious to try the "Pernot" furnace. Now the opportunity offered, and the first furnaces erected were two 20-ton Pernot's. These were hurried on as quickly as possible, so that by the results obtained from them he might be guided in deciding what type of furnace should be adopted for the whole shop. They were fine furnaces, admirably designed and constructed, as he had the advantage of some drawings given him by their lamented friend Mr. Holley. The mechanical arrangements were perfect, but the results were not satisfactory, and in the then circumstances he was compelled to stop them after three months' trial, and proceed to erect, as rapidly as possible, Siemens furnaces, as perfect in every respect as they could make them. In 1880 experiments were made, extending over some weeks, with a Siemens furnace lined with basic material, under the personal superintendence of Messrs. Thomas and Gilchrist. The process had to be abandoned principally on account of the difficulties and troubles caused by the fluxing of the lining at the lines of division of the basic and acid material, in spite of every precaution then possible to them. He might also state that for some months past they had had at work furnaces of the type known as the "Batho" furnace; and although time is required for the realisation of all the economies promised by the inventors, yet they have been so satisfied with their suitability to the circumstances that his directors have arranged for a few more to take the places of the older Siemens furnaces which now require to be renewed. In this connection he might also be allowed to call attention to a valuable modification of the Siemens furnace, known to them as the "Hackney" port, shown in the annexed sketch. So

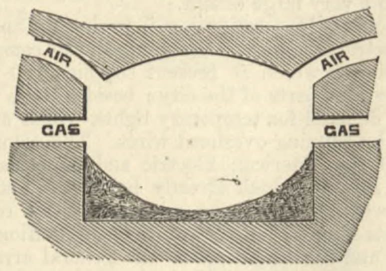


DIAGRAM OF HACKNEY PORT.

satisfied are they of the advantages derived from its use, that this modification will be made at all their melting furnaces as they are stopped for repairs. As he had already indicated, they erected at Blochairn a row of twelve 15-ton furnaces; the ingots were cast in one long pit, parallel to, and close in front of, the furnaces, the tops of the ingots being level with the general floor, so that bogies or wagons could be rapidly passed to other departments. The charging floor was, of course, at a higher elevation, approached by a slight incline at one end of the shop. At Blochairn he made the relative positions such as would, he hoped, enable them to transfer the ingots from the casting pits to the hammers at a temperature that would perhaps allow them to dispense with re-heating, or, at all events, to reduce this re-heating to a minimum. The author's hopes were not fulfilled. When he tried to hammer the ingot with only its initial heat, he either found the centre too soft, or, on the other hand, the outside was so cold and hard that it cracked, and the slab could only be rolled into a defective plate. They were incessantly at work upon this matter of preventing the ingots getting cold. At last the author devised and experimented with a movable set of soaking pits for conveying the ingots to the hammers shortly after they were cast. By this means he was enabled to accomplish the hammering of the ingots into slabs without re-heating. Subsequently, however, his directors authorised him to arrange with Mr. Gjers for the use of his patent soaking pits, and the outcome of this decision has been the practical remodelling of all the working arrangements, as follows:—There are twelve melting furnaces. In front of and parallel to the furnaces are lines of railway, of which the nearest runs over the old casting pit, which has been filled up except at a few points where it has been left open as provision for casting in the case of any accident to the machinery in the new arrangements. On this railway runs a small locomotive, which moves from point to point in front of the furnaces, a special carriage conveying a ladle for the steel and a mould for the slag. A specially designed hydraulic lift of 20 tons power is erected directly over the railway just referred to. Directly in front of this lift is a 20-ton casting crane of ordinary type, except that it is not made to lift. It is, however, provided with hydraulic engines for turning it on its axis, and also carries on one side a small cylinder and ram for turning over the casting ladle after each cast, so that any slag or skull may be easily cleared out, and the nozzle pot may be readily changed. This crane is placed in the centre of a semi-circular casting pit 40ft. in diameter and about 3ft. deep. At convenient points round the casting pit are erected three ingot cranes, each capable of lifting 5 tons, in two powers of 3 tons and 2 tons each. Between the cranes are two sets of soaking pits, each with six cells of differing capacity for ingots of 30 cwt. or 60 cwt. each. The two outer cranes set the moulds in the pit ready for casting, and afterwards strip the ingots and deposit them in the soaking pits. The centre crane lifts the ingots from the soaking pits and places them vertically on the tipping carriage at the end of the feed rollers of the cogging mill. An hydraulic cylinder and ram are placed convenient to this tipping arrangement. The ram, taking hold of an arm of the carriage, turns it down, so that the ingot is deposited easily and without shock on the feed rollers of the mill. The cogging mill has hollow steel rolls, with 32in. centres, and has edging grooves at each end, the top roll being balanced by hydraulic power in cylinders placed under the bed-plate, and having a lift of 14in. Instead of turning the screws in the ordinary manner, the boxes are made to revolve, motion being communicated from a small Willans engine through a shaft carried on the top of the housings, and having two worms taking into worm wheels fixed on the screw boxes. Between the feed rollers of the mill are arms designed for handling the ingot, which is turned by them on flat or edge and placed in front of the grooves, as may be desired, the arms being actuated by hydraulic cylinders placed under the feed rollers. This mill is in charge of and operated by one man, assisted by two boys, one of whom works the screwing gear at the rolls, and the other the turning and the feeding gear. The mill is driven by an engine with two cylinders, 36in. diameter and 4ft. stroke, and is geared $2\frac{2}{3}$ to 1. The steam pressure is 90 lb., cut off at three-quarters stroke. The rolls make 28 revolutions per minute, and have a periphery speed of about 180ft. per minute. A set of hydraulic shears is in course of construction, having a working pressure of 1000 tons, and calculated to shear slabs 24in. by 8in. in section. These will be placed behind the mill, and will have feed rollers, which will receive the slab from the mill and pass it on and through the shears to carriages, which convey the slabs to the reheating furnaces of the plate mills. The melting furnaces are charged in rapid succession on the Sunday night, and on one coming ready for tapping—about twelve hours later—the locomotive places the carriage and ladle in front of the furnace, the charge is tapped into the ladle, the whole of the steel and slag being run into it, while the latter overflows into the slag mould on the carriage. Being brought under the lift, the ladle is raised until certain brackets or horns, placed on each side of its pouring lip, come in contact with brackets, attached to the lift, and so placed that they keep the pouring lip of the ladle in the same horizontal plane, until all its contents are discharged into the second or casting ladle, which is easily brought about by continuing the lifting of the ladle after the pouring lip has become stationary in the brackets. The casting crane having received into its ladle the whole contents of the first ladle, is now moved round over the moulds in the casting pit, into which the charge is cast in the ordinary manner. The time occupied by the operations of tapping the furnace, transferring the steel to the second ladle, and casting into moulds, is fourteen to fifteen minutes, a shorter time than is required by the old method. After standing about twenty minutes from casting, the moulds are stripped and the ingots placed in the soaking-pits, where they remain about fifty-five minutes, being then passed through the cogging-mill and reduced to the required section, after which they are sheared to the specified weight and passed on to be re-heated and rolled into plates. It may be said, therefore, that the slab is finished in ninety-five minutes—fourteen or fifteen minutes for tapping and casting, twenty minutes in the moulds, fifty-five minutes in the soaking pits, and five minutes in cogging and shearing. The advantages of the new casting arrangements are very considerable. The whole operation is much more under control, and is more methodically carried out; less plant is required in ladles, carriages, travelling cranes, and moulds; the cost in labour is much reduced; the shop is freed from *débris*, and is cleaner and pleasanter to work in. The advantages of the other portions of the arrangements—the soaking-pits and cogging-mill—are great in every way. The cost of labour is largely reduced, that of fuel is saved altogether; the loss of steel by re-heating is reduced from, say, $2\frac{3}{4}$ per cent. to almost *nil*, the returns showing this loss in the soaking-pits to be only 0·02 per cent., and, in addition, the indirect economies by reason of improved quality of slabs, less defective plates, &c., are more important than would be credited if he were to venture to state them.

The third paper was by Mr. Dicks, of Glasgow, on a new form of regenerative furnace. A very full abstract of this paper will be found on page 263. After these papers had been read the meeting was adjourned till the next day, the whole party proceeding to Crewe.

On Thursday, the 25th ult., Mr. Cowper opened the discussion. He said he had had a pretty large practical experience of the results that followed in so treating the gas as to give space for combustion, as he constantly had occasion to produce products of combustion in very large quantities of the highest temperature that the gaseous fuel was capable of producing. The black diagram on the wall would show them a very ordinary sized burner such as he used himself. They would see that it was 7ft. in diameter, and there were two large slits in the bottom for the admission of the gas, and there was a large opening at the side for the admission of air; but the flame flue was much larger than those openings. Then the gas rising in two vertical sheets and the air passing in horizontally entirely enveloped them, going round about them and between, thus forming four separate large surfaces of contact and four smaller ones of gas and air in the very centre of the 7ft. flame flue, with the result of forming an enormous single flame some 40ft. or 50ft. high, of the highest temperature that the gas was capable of producing, and much higher than if the gas and air were simply allowed to go in in two streams into a smaller sized and irregularly shaped flame flue, and much higher in temperature than if obstructed by any brickwork in the course of its ascent.

Mr. Josiah Smith said he wished to bear testimony to the excellent arrangements of the Steel Company of Scotland's works. He had an opportunity of visiting them some weeks ago, and it appeared to him that Mr. Riley had come nearest to the cheapest way of getting to an ingot where the Siemens-Martin furnace had been in operation, or rather the cogging mill.

Mr. Isaac Lowthian Bell wished to know about Mr. Siemens' saving of fuel in his furnace, where he spoke of as much as 25 per cent. being saved. He had no doubt at all, as Mr. Siemens stated, that the combustion took place without any smoke; but surely Mr. Siemens did not say that the amount of carbon which escaped in the shape of smoke in any furnace, by its perfect combustion would amount to 25 per cent. in the fuel. That, he supposed, was not Mr. Siemens' meaning.

Mr. Siemens thought that the 25 per cent. spoken of related to the boiler on the wall. The boiler formerly was worked with gas, but according to the old principle.

Mr. I. L. Bell said probably Mr. Siemens would explain that in his reply. The only idea that they could have, supposing it to be apart from that, would be that boilers under ordinary circumstances had not sufficient air to effect perfect combustion. There was no doubt that, however dense the smoke might be, the quantity of air passing into any boiler furnace was very much in excess of the quantity required for combustion. In using gas from the blast furnace for raising steam in the boilers, the excess did not exceed 20 per cent.; but there was enough for complete combustion under any circumstances. The hydrogen of the hydrocarbons in the air was oxidised. He was not aware that free hydrogen had ever been detected there, and the only unconsumed matter was the smoke, the carbonaceous matter being precipitated in the hydrocarbons in the form of smoke.

Mr. Dick desired to call attention to the first sentence in Mr. Siemens' paper. Mr. Siemens said:—"In every description of furnace which has hitherto been designed either for heating or melting, it has always been considered that the first condition of successful working was to make the space to be heated as small as circumstances would allow, so that the flame might be brought into as intimate contact as possible with the inside lining of the furnace, and more especially with the material under treatment." He begged to submit that the very opposite was the case. For years every one who had the practical working of a Siemens furnace had gone on the very opposite tack. He had no doubt that with this furnace a great advantage was gained over those designed on the old principle, because he did not find that it was owing to radiant heat, but simply because there was room for the combustion of gas. The Steel Company of Scotland they had long recognised that fact, and they persistently raised the roof of the furnace. It was first called attention to in the heating furnace. They had three heating gas furnaces, and it became necessary to alter one in order to take in heavy forgings. This was done with great reluctance. The roof was raised to a height of 7ft., but they found afterwards that it was the best heating furnace, even for small ingots and plate slabs. Since then they had raised the roofs of melting furnaces, and he thoroughly believed that the advantage in these furnaces consisted as much in the fact that there was plenty of room for combustion, as in the fact that the gas was beaten down upon the metal. It was considered that one of the advantages of round furnaces was that the flame was kept off the sides. In his furnace there was plenty of room for combustion in height, and the flame did not carry across; it ceased before it reached the opposite side.

Mr. Edward Riley said, in reference to the remarks of Mr. Dick and Mr. Thos. Riley on the basic trials, although correct enough in themselves, they might in the absence of explanation lead to some misapprehension as to the actual state of the basic Siemens process which had been in regular operation in several works, and had been for some time past. The difficulty that Mr. Riley had referred to had long been surmounted.

M. Gautier observed that he might say in support of Mr. Riley, that in France now the basic process was spreading only in the shape of the open-hearth. The great difference that was experienced from the two kinds of material being employed was very important for the basic process by Thomas and by the Bessemer converter. They must have a special quality of pig iron; so much silicon and so much manganese, and so much phosphorus. For the open hearth, they had no limits at all. They could employ 5 per cent. of silicon if they liked. It was a consumption of lime only; they did not want manganese or phosphorus. In France, he might mention also, that some works were employing it for a special purpose, making the softest quality of steel, mixed with scrap and pig iron, containing only ·5 per cent. of phosphorus. The basic process was not only to get rid of the phosphorus, it was only the employment of a new method of obtaining the softest quality of metal. With such a process they had only a limit of elasticity of 20 tons in the square inch, and a breaking strain of 23 to 24 tons per square inch, and they found that it was a competitor with the best quality of best iron.

Mr. Gjers wished to make a correction in Mr. Riley's paper, and to point out that whenever steel had to be cast at some little distance from the converter or the furnace, as the case might be, there were only two courses open—either to transfer the ladle or take the other course mentioned by Mr. Riley. He was quite pleased with the success of Mr. Riley at Blochairn. Still, at the present time, there were some 350,000 tons passing through soaking pits, which, considering the difficulties they had to contend with, was very fair.

Mr. Wailes said the Hackney port had been patented for some time. The arrangement of the air port was vertical, or nearly so, above the gas port. The two columns of gas and air were mixed at the point of combustion. They were not deflected, as in the old Siemens furnace, by a curved roof. The roof was kept out of the way of combustion.

Mr. John Head said that what was known as the Hackney port was shown and described by Sir William Siemens in patent No. 3077, in the year 1871, so that it was not such a novelty as was supposed.

The President said they had nothing to do with the question of priority of patents.

Mr. Colville said that cogging, in substitution for hammering for boiler-plate manufacture, was a very expensive process indeed. He thought there were very few gentlemen who would not acknowledge the fact that hammered steel was very much better than cogged steel.

Mr. Daniel Adamson said, with reference to getting the highest results in the manner that Mr. Riley had adopted, he was one of those who never believed in the occluded gas theory of the ingot, and he held that if Mr. Gjers or Mr. Riley would follow out the experiment of cutting from an ingot left to cool in the soaking pit, they would find that it would have the reverse effect of what they anticipated, and it would have a more solid interior, if not an altogether solid interior; and if so, then their friends' notion of getting strength and ductility would be of no value. In the case of 2ft. square he held that we could not have the ingot solid if the outside was cut into holes; and all ingots cut through under circumstances of that sort showed that the cooling action had set in through the exterior. Putting an ingot into the pit the reverse way with the conditions of the outside atmosphere, they would get a much more solid ingot, and much greater advantages in the soaking pit than by getting the heat from the interior. He would as soon have a plate made by Mr. Riley—and he had used many of Mr. Riley's plates—as by any one else.

Mr. Edward Williams said that so far from hammering bringing about a better result than blooming, he held that exactly the reverse was the case.

Mr. Martin did not see that hammering would improve the nature of the plates, seeing that the ingot was never raised to a welding heat. Supposing for a moment that there was a hollow, it would mean the flattening down of that hollow, and it would be no better or worse by hammering than by cogging.

Mr. Colville said if round steel bars were rolled and hammered they would turn out as clear as a shilling, and as sound as a bell, whereas from the cogging bloom they showed the blow holes quite distinctly. A hammered bar made a better bar than a cogged bar.

Mr. Frederick Siemens, in reply, referred first to Mr. Bell's remarks on the 25 per cent. saving simply by having good combustion. There were several reasons for the saving of fuel. The first was by good combustion; another was by increasing the intensity of the heat, and allowing the flame to radiate heat. If the flame touched the sides of the boiler, there would naturally be smoke on the sides, and the radiating heat could not pass through this atmosphere of smoke, and the boiler consequently did not get the advantage of the heat. The preservation of clear combustion was also an important element in economy, for with a higher temperature you could abstract more heat from the product. Thus there were many causes producing this economy of 25 per cent., which might under certain circumstances be exceeded. In Dresden and elsewhere in Germany, where work was continuous, there had been a greater saving than 25 per cent. In cases where works were stopped at night the saving from the use of gaseous fuel was not so great. Now, as to Mr. Dick's remarks, that gentleman said he had been using high roofs. The diagrams exhibited by Mr. Dick did not seem to show that he used the high roof, but rather that he threw the flame downwards. But supposing that Mr. Dick did use the high roof, and had got good results, it only confirmed the statement in his (Mr. Siemens) paper, and he was quite satisfied to let the matter rest there. He would have had nothing to add to his paper, if he had not thought it was rather deficient in treating the subject in a general way, and leaving out the scientific bearing of the matter, which he intended to deal with on some future occasion—a course for which he had very good reason, as the theory of combustion had not yet been satisfactorily settled, and one did not know which of the various theories to accept. It was necessary to assume one of the theories of combustion, and he had adopted the electrical theory as having the greatest probability of truth. According to this theory, the flame was nothing but a multitude of small explosions of lightning, very minute and very numerous. Taking this theory, it was easy to see at once why a solid body, if brought into such a flame, would obstruct its action; the solid bodies had in effect to fix down the gas by adhesion and attraction. In the second place, the gas was considered to revolve continually, and when this motion could not take place, combustion could not continue, with the consequence that there was less intensity of heat, and that smoke was produced. Further than this radiation could not act, as it could not pierce the cloud of smoke. The fact that anybody would soon succumb to the action of this lightning accounted for the fact that bodies were so soon destroyed when exposed to the action of the flame, and the presence of the innumerable electric flashes accounted for the radiative power. Now, the flame radiated better than a solid surface, because it radiated right through and from both sides; while the surface radiated only from its outer surface and only in one direction. The result was that with the diameter doubled the flame radiated four times as much, while the solid body only radiated twice as much. That explained why such a large volume of flame was required in the use of radiative power. The method could be universally employed, and would tend very much to do away with the smoke nuisance, and would save a great deal of fuel and material. The blast furnaces lasted nine times as long since he introduced the system, and he would be much pleased if by its adoption the trade and the people of this country should benefit from the absence of that smoke which was at present so oppressive.

Mr. James Riley replied on the questions arising out of his paper. Referring to the question by Mr. Smith as to whether slag moulds were in use, and whether the mode of running slag into the ladle and of allowing it to overflow was in use, that method was in use, and might be seen by any gentleman who chose to look at it. As to his remarks on the basic trials, he had simply been recounting a matter of history, and had no intention of arguing the success or failure of the basic process. Mr. Jenkins asked a question about a constant succession of ingots. His paper showed that he laid considerable stress on this point, and showed also how he had been foiled in many previous efforts to keep the ingots hot; but finally he was able to accomplish what he had so long desired. As to Mr. Colville's remarks, he might say that he had no great preference between hammering or cogging the ingot, but having tried both, and having both at work, he preferred the cogged ingot.

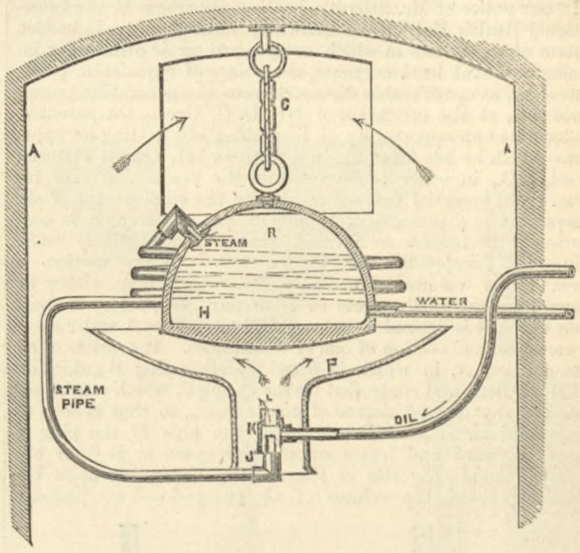
Mr. Dick then replied, and directed his observations to Mr. Head's remarks. Mr. Head, he said, seemed to be afraid of melting the gas tubes. It was a common experience, both in the Siemens and the blast furnace, that the lining of the material wore away until radiation seemed to balance the heating effect. Mr. Head had spoken about the extensive difficulties in the Siemens furnace being purely imaginary. As to the complication of the flues, as to which Mr. Head had spoken, he did not think that the addition of one damper formed very much complication. That was all that had been added—one single damper. So far from the construction of the furnace rendering the damper necessary, the fact that the flue of the regenerator had been made higher than the rest of the regenerator assisted them in getting a sharper draught.

The President, in summing up the discussion, said they had had three very interesting papers, and a very interesting discussion, in the course of which they had very nearly had the theory of combustion illustrated. He moved a cordial vote of thanks to the authors of the papers.

The motion was carried. Papers were then read on coke-making, and the utilisation of bye products obtained in the process, a notice of which we must defer until next week. Subsequently an excursion took place to Northwich.

THE FORTH BRIDGE WORKS—EXPERIMENT WITH NEW FUEL.

In working one of the engines used on the Forth Bridge Works for pumping compressed air into this chamber an experiment was conducted a few days ago with the view of testing the substitution of crude shale oil for coal in feeding the furnace. It resembles coarse butter in appearance, and is so crude that it will not burn by contact with a match, a burning coal, or even a red-hot poker. It was taken from the Dalmeny oilworks just above the Forth Bridge. For application it was stored in tanks or reservoirs near the furnace, and these tanks are connected with the furnace by a series of tubes. The grates or fire-bars of the furnace are taken out, and instead of them a cylindrical retort is suspended in the furnace, which retort is surrounded by a spiral tube. From the reservoir of the oil, which is always under pressure, and from a water main, two pipes and valves convey oil and water to the retort and the coil or tube. The retort being warmed by any convenient method, the water valve is slightly opened, and a fine stream passing into the retort is at once converted into steam, which is carried through a superheating coil to a jet or burner underneath the retort, from which jet it issues in a powerful stream by the force of its own expansion. The oil is then admitted in the same manner, and carried by another heating tube to the same jet, which it reaches in a nearly gaseous condition. It is then caught by the superheated steam, and hurled against the convex bottom of the retort, the force of the impact breaking up into finely-divided vapour any portion of the oil which the heat may not have already converted into gas. In a short time the retort and heating tubes become red, and now begin a chemical change and nearly perfect combustion. The steam has become a dry gas, which is thoroughly intermixed with heated carbon. The immediate effect of this appears to be the formation of carbonic oxide and free hydrogen. The force of the jet produces a partial vacuum and sucks into the centre of these flaming gases a powerful current of air, which apparently completes their combustion, converting them into carbonic acid and water vapour, without smoke, dirt, or residue.



In our engraving of the apparatus, R is a retort suspended from the top of furnace, or from crown sheet of a fire-box. A piece of burning waste saturated with oil, or any convenient method, heats the bottom of retort. A needle valve admits water from a pressure tank, through pipe W, directly into retort R. Steam issues through S, and passing round the spiral coil or superheater, is led to and escapes in a powerful stream from J, by the force of its own expansion. Oil is now admitted from another pressure tank, through another needle valve, through pipe O, which, though not so shown, should pass through a spiral round the retort, reaches the junction K, where it is caught by the steam and hurled through nozzle L against the convex bottom of retort. The burning waste having ignited the vapours, there is now a powerful flame deflected to all parts of the furnace. In a few minutes the retort and coil get very hot, the steam becomes dry, the oil thin vapour or carbon gas ere they reach the jet. The expansive force increases, the impact of the gases and vapours against the retort breaks into atoms, and distributes any particles of oil which the heat may not have separated. A shield P, which should be as wide as the furnace, directs the natural draught to the centre of the fire for equal and proper action, which natural draught is aided by the vacuum produced by the jet, drawing in air rapidly through the funnel T, and also through the bottom of K. There is now in the furnace a thoroughly mixed combination of hot and flaming carbon, superheated steam, and air oxygen, in perfect combustion.

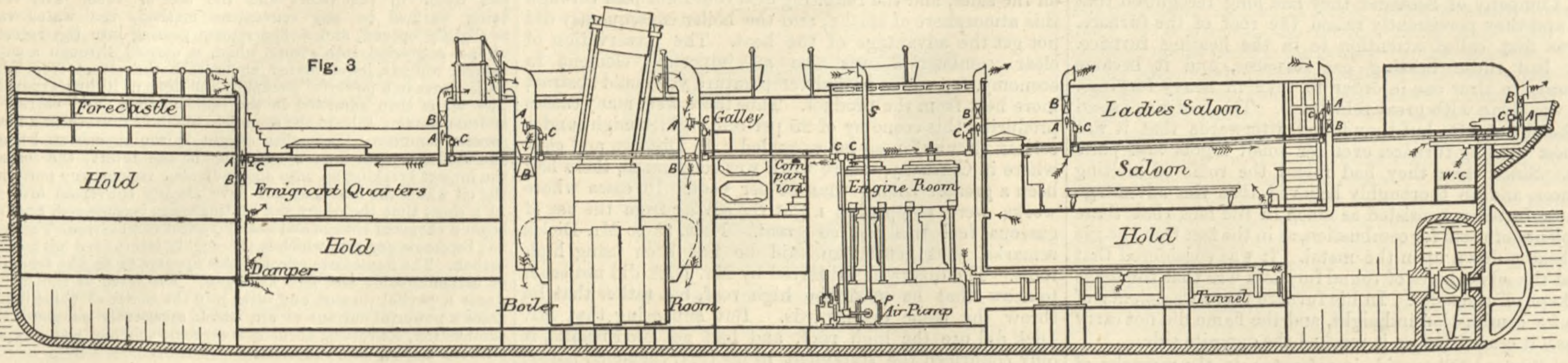
A contemporary says that the result of the whole process is almost perfect combustion—an immediate and an intense heat which consumes all the products, or, in other words, leaves, practically speaking, no residue to be cleared away. Th advantages claimed by the inventor of this system over other methods of burning hydrocarbon liquids are, that the retort acts, first as a boiler, or steam generator, to start the fire, while by other methods a second boiler with steam up is necessary; secondly, the retort is an atomiser, breaking all possible lumps into atoms; thirdly, the retort is a deflector or director of the flame, distributing it equally to all parts of the furnace; and, fourthly, its internal cubic area acts like the air chamber of a pump to keep a steady flow from the jet. Instead of taking moist steam from the boiler to hurl the oil into the furnace, dry superheated steam is furnished by the apparatus itself, and a directed forced air supply added to the natural draught, the result being greater economy and better combustion. The experiments were regarded as having been perfectly satisfactory. The experiments were conducted by the inventor, Mr. C. Burgess.

Engineering Lectures at University College, London.—The commencement of the engineers' and other lectures, under Mr. B. W. Kennedy, at the University College, London, begin on Friday, and the Laboratory, which can be entered at any time, opens next week. In particular we may call attention to the lectures on "Valve Gears,"—for "practical men"—which commence on Tuesday evening. The first lecture is open to the public. The hour, 6 p.m., is such as to make it possible for men who are in town all day to attend.

Ship Lighting.—The paddle steamer Saturno built by Messrs. A. and J. Inglis of Glasgow, a magnificent saloon vessel—300ft. by 60—for river service in the La Plate, has been lighted throughout by Messrs. W. Starire and Co. of Glasgow, the well-known ship lamp patentees, who have secured a license for the manufacture of "The Elphinstone and Vincent Dynamo Electric Machine." The installation consists of 320 Swan Lamps of 20-candle power. Each of the three decks has two separate circuits, one for lighting the passages and centre lights of saloons, and lights required all night; the other for state rooms and table lights of saloons. Each state room has a separate lamp and switch, and the saloons are also controlled independently. There are six circuits on the main switch board, each controlled by a double contact switch to ensure good connection, also a fusible plug. Close to the main switch board is an adjustable resistance in the field magnet circuit, and an "Aulds" reducing valve for controlling respectively the electro-motive force and speed of the dynamo. The current is supplied by an Elphinstone and Vincent dynamo, size F, for supplying 400 20-candle power lamps. The steadiness of the light and general good working of the machine was much appreciated by the owner and builders of the vessel, and also a large party of visitors to whom it was exhibited before proceeding down the Clyde. The machine used is in every respect similar to that now working at the International Health Exhibition, where it is lighting numerous stands &c. The circuit is continuous, and of low tension, the terminals or any of the wires may be held in the bare hand without inconvenience whilst the machine is giving its most powerful current.

GREEN'S VENTILATING APPARATUS.

Fig. 3



In our notice of Mr. Stirrat's heating apparatus at the International Health Exhibition, we briefly alluded to an induction system of ventilation in which compressed air is utilised for inducing powerful local currents, the points of application being, if need be, at considerable distances from the generating power. Since this, at the invitation of Mr. D. C. Green, the patentee, we have had an opportunity of inspecting and testing an apparatus which he has fitted up in a room at 147, Queen Victoria-street, E.C., in order to demonstrate the practicability of his ideas. The essential feature consists in the employment of air, compressed to a pressure of some 5 lb. per square inch, in connection with nozzles so formed that a comparatively small volume of compressed air issuing out sets in motion a much larger volume of ordinary air, which may either be drawn from external sources or from any hold, cabin, or room from which it is desired to extract foul air. Figs. 1 and 2 show an elevation and section of one of the nozzles. It consists of an external shell A, in which is fitted a sliding plug B guided on radial feathers, and controlled by the spring C, which can be adjusted to any desired degree of compression, so that as soon as compressed air is admitted through the pipe D the plug is pressed forward and leaves an annular space at E E for the escape of the air, the size of the opening depending upon the relation between the volume of air pumped and the pressure

FIG. 2

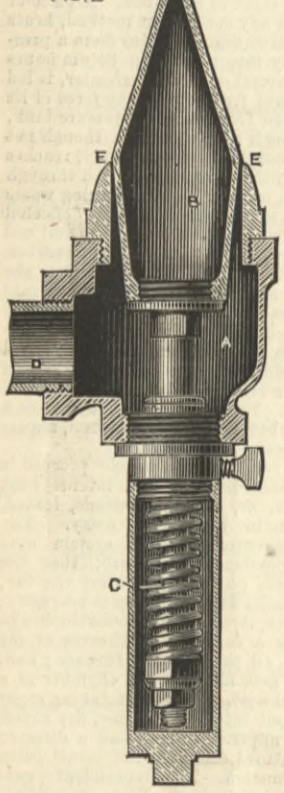
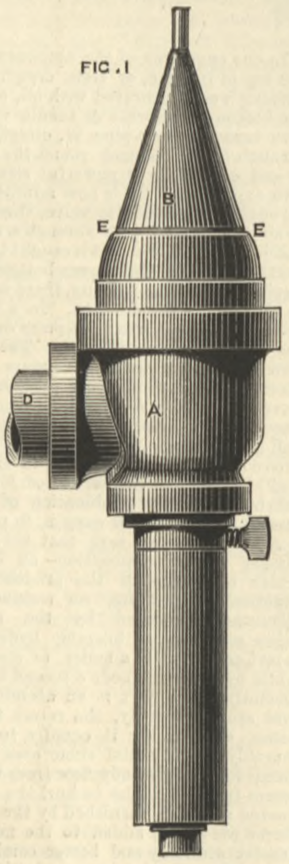


FIG. 1

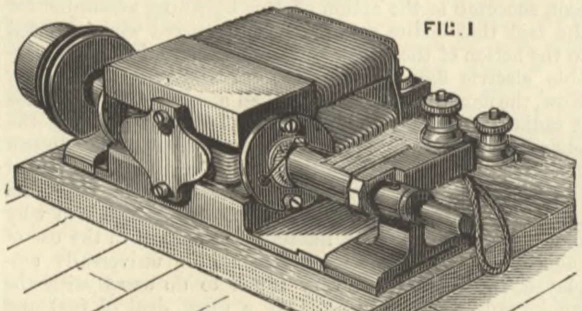


exerted by the spring. The nozzle is therefore automatic in action, and adjusts itself according to the speed of the pump or the supply of compressed air, so as to maintain the pressure practically constant. Fig. 3 shows the application of the whole system on board a steamer. The compressor P is situated in any convenient position, and supplies air at the required pressure through small wrought iron pipes which traverse the vessel. A are the nozzles placed in the ventilating pipes, and having in front of them the contracted pipes B for the purpose of inducing the current of air, the jets being directed so as either to exhaust the foul air or to supply fresh air from the outside. In the experiments at which we were present about 150 cubic feet of ordinary atmospheric air per minute was compressed to $4\frac{1}{2}$ lb. per square inch by means of a Blake's pump and passed through a nozzle. The main pipe was 14in. square, contracted to 8in. in front of the nozzle, and the observation on the induced current was made at a point about 4ft. in front of the contraction. The mean velocity was here found to be about 38ft. per second, which in a pipe 14in. square is equivalent to a discharge of about 3100 cubic feet per minute. The ratio of air passing through the compressor to the total volume delivered was therefore as 1 to 20·6, and this represents the gain by induction, though, we understand, that with a circular contracted pipe of somewhat different proportions a still better result can be obtained. The chief advantage of such a system of ventilation consists in the facility of application, a fact which is of great importance on board ship, where it is generally extremely inconvenient to introduce the large air ducts which are required in any system in which a single or even several fans or blowers are used. But the advantage is not confined to vessels, for it is only too well known that in many cases the ventilation of public buildings has been crippled owing to the difficulty in providing proper air passages. In these cases, however, by the use of compressed air with induction nozzles there should be no difficulty in obtaining all that is required, as the large pipes would be localised and could be introduced even into old buildings without any great degree of inconvenience. Another application contemplated by Mr. Green is the ventilation of underground railways by means of continuous troughs, with deflectors placed directly above the funnels of the locomotives, the smoke and gases being withdrawn as they are discharged from the engine without mixing with the air in the tunnel. In this way the volume to be dealt with would be minimised, and the difficulties of removal considerably reduced. No special shafts or openings into the streets would be required, as the gases would be carried along by relays of nozzles placed in the trough, and discharged through outlets at the stations, where they might be dealt with by water spray, or treated in some other manner, so as to render them less offensive. We understand that Mr. Green's invention, though comparatively new in this country, is already being fitted up in several large steamers, notably in the Cunard liners Umbria and Etruria, which Messrs. John Elder and Co. are now building. In the United States, we believe that the system has been well tried, and has given great satisfaction.

CUTTRISS' SMALL ELECTRO-MOTORS.

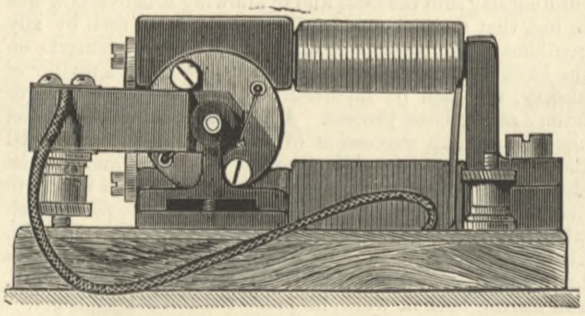
The accompanying engravings illustrate two forms of reversible electro-motors made by Messrs. Cuttriss and Co., of New Briggate, Leeds. Figs. 1 and 2 represent a very simple motor

FIG. 1



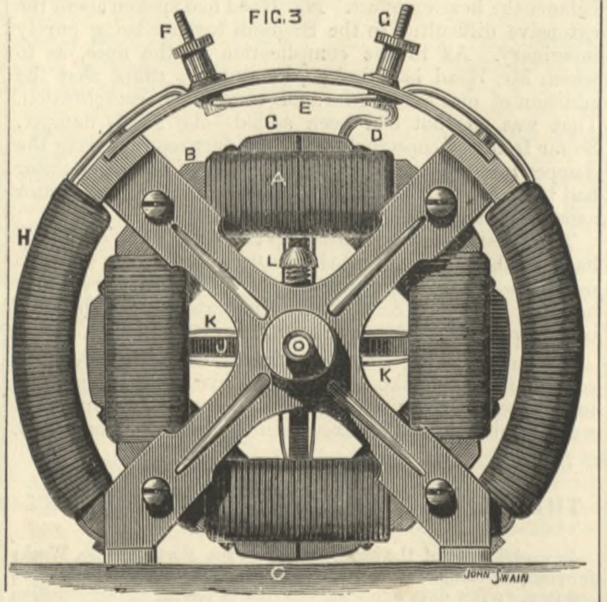
now made reversible, and Figs. 2 and 3 represent a motor of quite new design. The armature is in two separate parts, each containing four magnets A, and set upon the spindle, the one an eighth of a revolution in advance of the other, so that there

FIG. 2



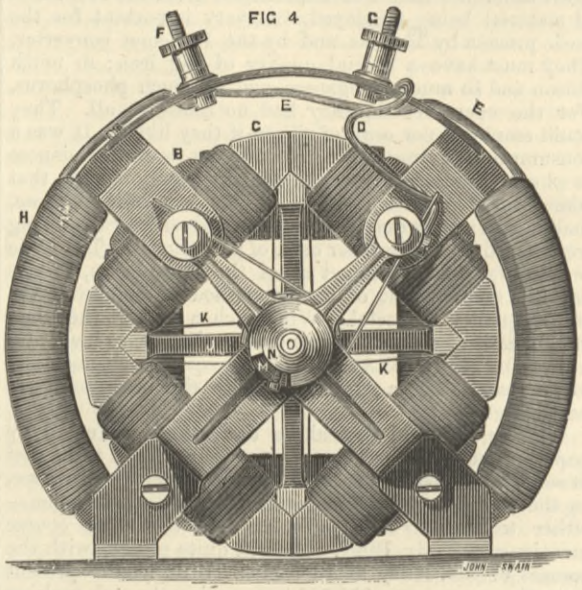
is only an eighth of the circular path of the centre of gravity of the pole pieces C of the armature magnets. The poles of the field magnets H are of a double form and channelled, so that they surround the armature magnets on three of their

FIG. 3



sides, and the magnet field is thus well cut through. It will be seen from both Figs. 3 and 4 that two of the magnets of each half the armature are made in one piece. The field magnets are coiled so that one end of the wire is fixed by a screw at the bottom poles, and the other ends brought to the terminal marked F. The two brushes are held by the two armed casting shown mounted on the gun-metal bush N on the spindle. The boss M can, it will be seen, be turned through about a quarter of a revolution, the movement being limited by the pin, which is housed in the quadrant slot. By this means the brushes are shifted so as to take a return current to an alternate pair of commutator sections, and the machine is reversed. The wire D from the lower brush is connected to the positive terminal D. The communicator has eight sections, and the sixteen armature coil ends are attached to the commutator by screws, not soldering. The machine is excellently well made and finished, and will no doubt be very largely used. The machine, Figs. 1

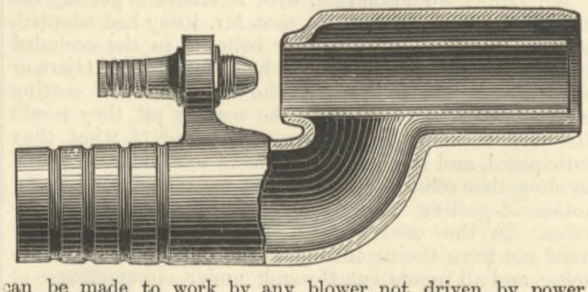
FIG. 4



and 2, is made reversible by mounting the brushes on one piece of ebonite, which may be in the position shown at Fig. 1 or Fig. 2, and will, of course, run in opposite directions accordingly. The smaller machine will work sewing machines, while that shown at Figs. 3 and 4 will give off about a quarter man power.

FLETCHER'S LARGE BLOW-PIPE.

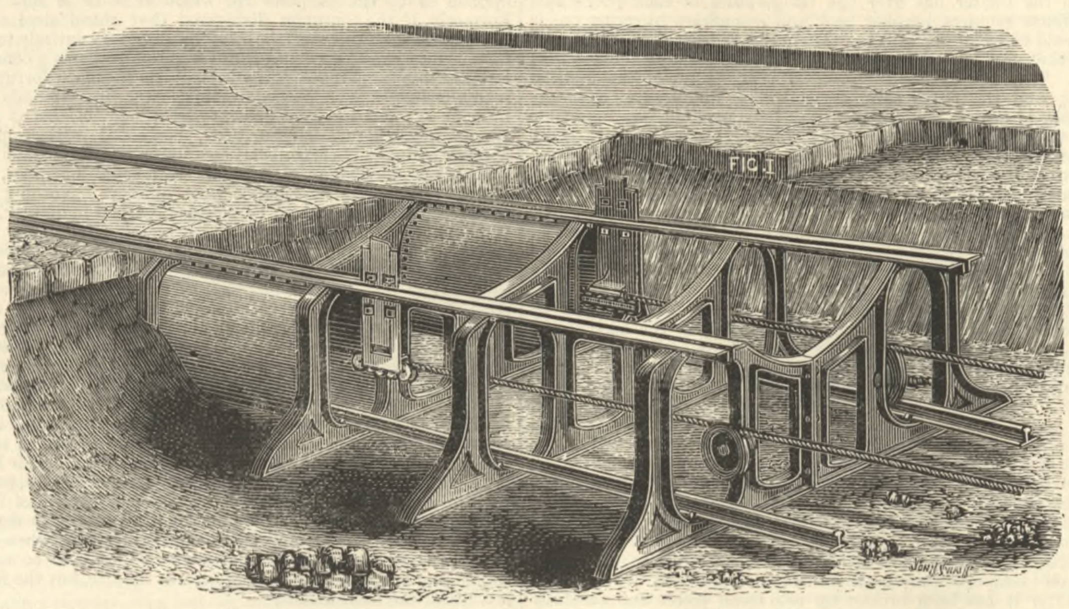
The accompanying engraving, partly in section, illustrates a new powerful blow-pipe, made by Mr. Fletcher, of Warrington. It is made for repairs of machinery without necessity for pulling down and re erecting. It works as an ejector, with one of Fletcher's No. 5 foot blowers, which supplies about one-fifth the air necessary, the remainder being pulled in by the momentum of the air from the blower. The blow-pipe illustrated will burn at full power 300 cubic feet per hour, requiring a $1\frac{1}{4}$in. main to supply it. At a recent trial one of these gave a good brazing heat on a T-joint, in a 3in. bore wrought iron pipe, in five minutes from the time of starting. The same blow-pipe is made in the usual form to take a supply from smiths' bellows without injector, and in this form it has the same power. Mr. Fletcher considers this size to be the most powerful blow-pipe which



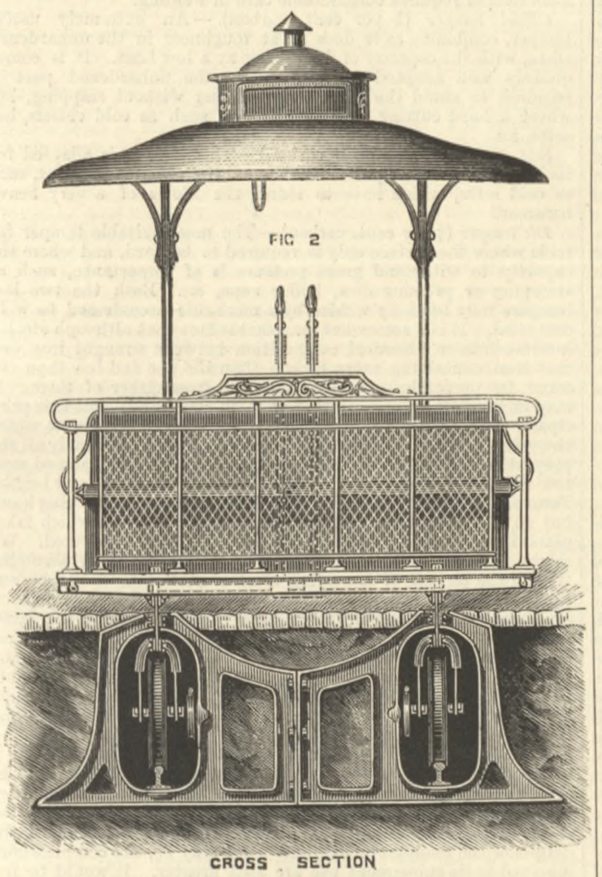
can be made to work by any blower not driven by power. At an emergency two or more can be used at once, with separate blowers, on the same point. The blow-pipe never gets hot, and can easily be held in the hand, although it is so large. Weight has been kept down for the convenience of holding and handling, but they can easily be fixed on a stand if necessary. Each burner of this form, or of the similar form as made for the smiths' fire, will generate steam for about 4 indicated horse-power.

The Association of Municipal and Sanitary Engineers and Surveyors.—Simultaneous with the session of the Sanitary Institute which is now taking place in Dublin, the Association of Municipal and Sanitary Engineers and Surveyors announced its conference at the Health Exhibition. Sir Charles Dilke, the President of the Local Government Board, has announced his intention of presiding. This Association, founded in 1873, comprises amongst its members, the engineers and surveyors of the principal towns in the kingdom, and is thus intimately connected and acquainted with all the sanitary works in our cities and towns. The authorities are now recognising the efforts which this body is constantly making to develope the simplest means of affording the sanitary protection that is everywhere so essentially requisite. In sanitary engineering there is so much that is affected by circumstances, that the members of such an association are particularly in want of the advantages which must be derived from the interchange of opinion and experiences, and local authorities derive indirect profit. We are informed that the Society is rapidly gaining in influence and numbers, and no doubt the conference will be well attended.

ORVIS AND ADAMS' CABLE RAILWAY.



The accompanying engravings show a proposed form of cable tramway system differing in many respects from those heretofore constructed or projected. The cable is duplex, the car being propelled from both sides by grips dependent from the centre of length of the car sills. Each rail is in a tunnel or subway, the wheels of the car travelling in these subways, and being connected to the body of the car by horn plates passing through the grip bar slots. The twin cables travel through the twin tunnels of the "up" track, and return through the twin tunnels of the "down" line. The skeleton or framework of the subway consists of a series of cross members of cast iron placed at suit-

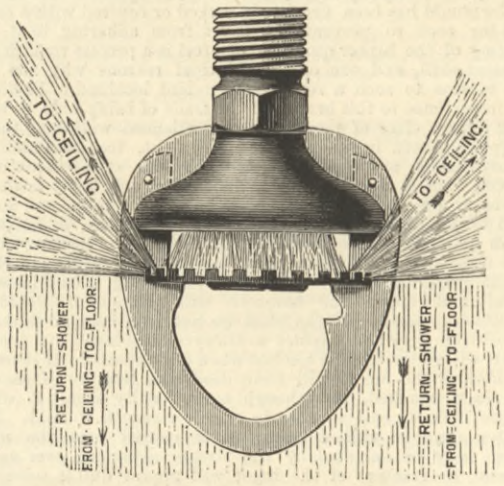


CROSS SECTION

able intervals, these being held together lengthwise by the rails and by the longitudinal members forming the walls of the slot. The walls of the tunnels or subway may be either of iron plate and cement concrete or concrete alone. Manholes are provided for attending to and oiling the cable supporting pulleys. The flange plates forming the slots through which pass the grip bars and the connecting plates between the wheel pedestals and the sills of the car are flush with the level of the street, forming a level plateway for vehicles. The body of the car comes almost down to the street level.

THE GRINNELL AUTOMATIC FIRE EXTINGUISHER.

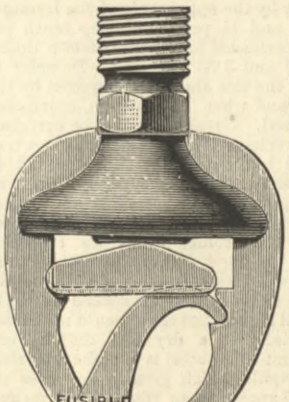
We illustrate a fire extinguisher which has been invented by Mr. Grinnell, of Rhode Island, United States, and which has been very largely adopted by millowners, manufacturers, and others in America, and also, though in a lesser degree, in this country. The general arrangement of the system is as follows: Lines of small pipes are carried through the buildings close to the ceilings, and from 8ft. to 10ft. apart, and these are connected with the public water main, a tank at the top of the building, or in such other way as will insure a pressure in the pipes. To each of the suspended lines of pipes, and from 8ft. to 12ft. apart the extinguishers are attached. The construction of the extinguisher is very simple, and can be readily seen from our illustration. A thin metallic diaphragm, capable of yielding to the internal water-pressure, forms the bottom side of the extinguisher body. In the centre of this diaphragm is an opening about ½in. in diameter, through which the water is discharged. Around this opening is a raised ring or valve seat formed on the diaphragm. The valve proper, or cover which closes this opening, is a disc of soft metal which is held in a circular brass plate, which plate has a toothed edge, and is a deflector, by means of which the stream of water issuing from the opening is cut into spray and distributed. The soft metal disc or valve proper is held against the seat ring on the diaphragm by a pair of compound levers, one of which bears centrally on the deflector which holds the disc. Both the levers have their fulcrums on a brass yoke, which is $\frac{1}{16}$in. thick, and which is secured to the body of the extinguisher. The long arm of the second lever is attached to the yoke by fusible solder. Solder that will fuse at a low temperature, say, 155 deg. Fah., is the only substance which, owing to its strength when cold, can be relied on to hold a previously locked device, and that is also so certain of destruction by heated air, that it can be equally relied upon when so exposed to liberate the same device, and thus set free a shower of water upon the fire. To return now to the system. Each extinguisher will cover and protect about 100 square feet of surface; and being, as we have suggested, not over 8ft. to 12ft. apart, a fire cannot occur more than 7ft. from four of them. As soon as a fire occurs, the hot air at once rises to the ceiling, where the temperature is very soon sufficiently raised to melt the fusible solder which secures the valve of the extinguisher, and the valve being released, the water which is under pressure in the pipes is profusely distributed on the fire in fine sprays, the deflector with the valve having dropped into the notches which formed the fulcrums of the levers. In the first moments of danger a single pail of water will put out a fire, and the great merit of the Grinnell extinguisher is that it applies this



GRINNELL EXTINGUISHER IN OPERATION.

pail of water just where it is required, and nowhere else, and this without admitting air, which would support combustion.

The extinguisher is furthermore automatically adapted as a fire alarm, so that the attendance of some one may be secured to shut off the water when the fire has been completely subdued. The device for this purpose consists of a check valve placed in the main supply pipe to the extinguishers, which valve is at once opened by the current of water flowing through the pipe. When an extinguisher is in operation, or if a leak should develope in any of the pipes, the movement of the valve is communicated to a mechanism which sounds a gong or whistle. Messrs. Mather and Platt, of Manchester, are the European licensees of the patent, and recently we were present at a demonstration of its efficiency conducted by Messrs. Lewis Olrick and Co., of 27, Leadenhall-street. A temporary building of very light wood, some 50ft. long by 20ft. broad, had been constructed for the purpose. Along the ceiling ran two lines of ¾in. gas piping about 10ft. apart, and on each of these pipes were three of the extinguishers. On the occasion of our visit the whole area of the floor was covered with dry shavings, which were afterwards saturated with some gallons of petroleum. Fire was applied at about eight different places simultaneously to this heap of highly combustible material, but scarcely had it blazed more than ten or fifteen seconds when the six extinguishers began their work, a gong on the outside of the building giving notice the instant the water began to flow. In about three minutes the fire was entirely out, though the building was densely full of smoke, and as soon as this had cleared away we were enabled to see how thoroughly the Grinnell extinguishers had done their work, for the shavings bore the appearance of having been merely touched by fire before being put out. Mr. Olrick tells us that some hundreds of thousands of these extinguishers have been applied in the States, and their adoption in this country will probably be rapid, more especially as the apparatus are now so very simple and easily fixed. Their use in theatres is especially to be commended, as well as in cotton and other factories and mills.

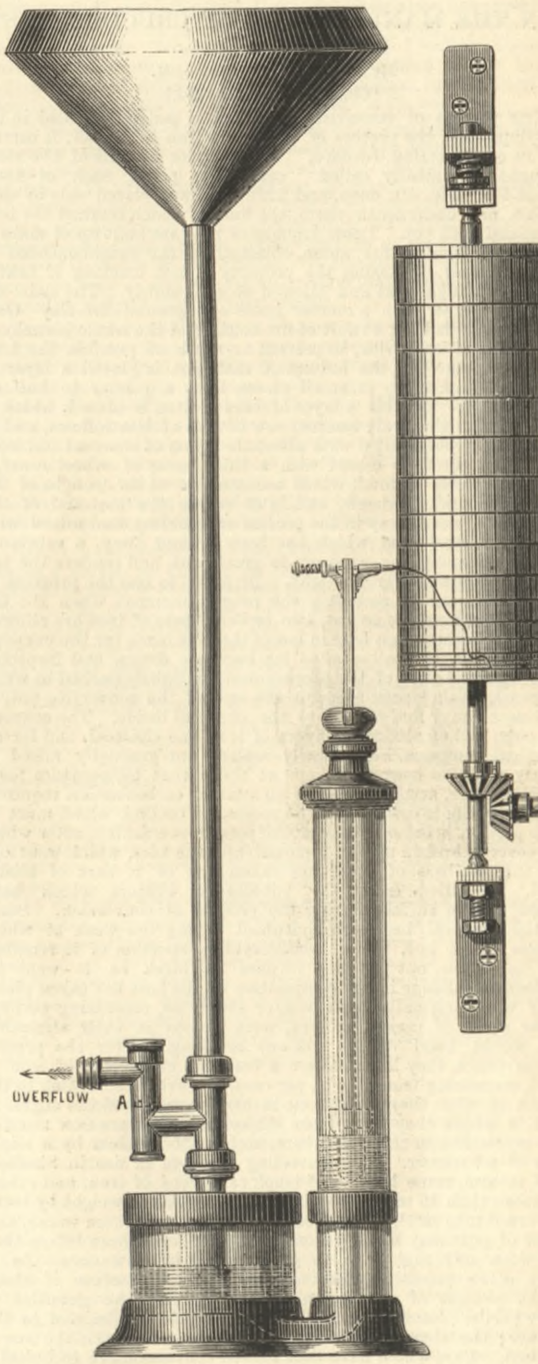


GRINNELL EXTINGUISHER.

NEW RECORDING RAIN GAUGE.

So far as we are aware, there has not hitherto been brought into use any instrument which engineers and meteorologists can rely upon for indicating graphically or otherwise the varying intensity of rainfall at all times of the day. There is a small instrument employed at some observatories which indicates approximately the intensity of rainfall, but as the operation of the instrument is rendered intermittent by the action of a syphon, the curve recording the rainfall is broken up and does not truly indicate variations in the rate of fall. That the indications of a reliable instrument are of value cannot be questioned. Whether the subject of rainfall has to be studied in relation to undertakings for the supply of water by surface collection, or for guidance in the construction of systems of sewerage, it is of the first importance that there should be a reliable record, not only of the diurnal rainfall in the gross, but of the varying rate at which the rain descends. The proportion of surface water that actually flows off the ground is, after all, the question that concerns engineers, where water supply by surface collection is the object in view, and the proportion of available rainfall depends in great measure on the intensity of the fall.

Mr. A. Jacob, of Salford, has contrived an instrument which gives a perfect record of the rate at which rain descends at any moment during the day and night. The instrument consists of two cylindrical vessels of different heights fixed vertically, and connected with each other at the bottom, so that when a certain quantity of mercury is introduced it will stand at the same level in both vessels. To the top of the shorter cylinder



is attached a tube of the form shown in the engraving, which is connected with an ordinary funnel or rain gauge, either square or circular. The funnel is fixed at a height of several feet above the instrument, for convenience on the roof of the building in which the instrument is placed. Within the tube at the point A is fixed a disc of agate, or other hard material, which has in it a small perforation, through which the rainwater issues after it is caught by the funnel and passes into the connecting pipe. Within the taller cylinder a float is placed, which rests on the surface of the mercury. To the float a stem is attached, which passes between a pair of rollers at the top of the cylinder, and upon the stem is fixed a punch, which presses by the action of a spring upon the surface of a vertical cylinder. This cylinder carries a properly constructed paper diagram, and is caused to rotate by means of a clock, so that one revolution of the cylinder is made in twenty-four hours. The circular motion caused by the revolution of the cylinder, when combined with the vertical motion of the punch actuated by the rise and fall of the mercury, produces a continuous curve, which shows the time and amount of rainfall with accuracy.

When rain begins to fall, it is received by the funnel, which has an area of a definite number of square inches. From the funnel it passes through a small straining chamber down an ordinary service pipe of about ½in. diameter to the shorter cylinder. Here the water in the pipe exercises a pressure on the mercury due to the charge or height at which it stands in the pipe. The water at the same time escapes through the orifice in the disc fixed at A, at a speed which is proportionate to the pressure, and passes away by an overflow to a vessel in which is measured the total daily rainfall. As the amount of water which escapes bears a fixed proportion to the head in the pipe leading from the funnel, this height may be taken as the measure of the rainfall for the time being. The pressure on the surface of the mercury in the short cylinder raises the column in the longer cylinder to a height which is proportional to the charge of water above the overflow, but in the inverse ratio of the specific gravities of mercury and water.

The float is somewhat peculiar in shape, and it is provided with four small pins or studs which prevent it from touching, or coming very near to the inside of the cylinder; thus the deranging effect of clinging to the cylinder by capillary attraction is counteracted.

Several cases of legal proceedings against corporations and local boards have arisen from damage caused by the bursting of sewers during heavy falls of rain. At Manchester, Halifax, and Bolton, within five years past, considerable injury has been caused by excessive falls of rain, overloading sewers and destroying private property. It is hardly possible, and seldom advisable to construct sewers of such capacity as to carry away rainstorms of preternatural severity, but when local authorities are on their defence, and endeavour to show that the rainfall which caused the damage was excessive beyond precedent, they nearly always fail for want of adequate means of proving their case. It is not sufficient for judges or juries to show them that the total rainfall for the day was very heavy, unless it can be proved to demonstration that the intensity of the fall immediately before the damage occurred was unprecedented, and therefore greater than it was reasonably possible to provide for. In cases of this kind it is that accurate recording instruments are of so much value.

ON THE MANUFACTURE OF CRUCIBLE CAST STEEL.*

By Mr. Henry Seebohm.

(Continued from p. 236.)

The process of converting, or, as it is generally called in the encyclopædias, the process of cementing iron into steel, is carried on in a converting furnace. This furnace consists of two stone troughs, technically called "converting pots," each of them about 4ft. wide, 4ft. deep, and 12ft. long, and placed side by side, with a fire underneath them, the flues of which conduct the heat all round each pot. These troughs or pots are built up of slabs of a peculiar kind of fire stone, obtained in the neighbourhood of Sheffield, and possessing the property of not cracking if heated slowly to a high heat and allowed to cool slowly. The slabs are united together with a mortar made of a ground fire-clay. Over the two pots is built a vault of fire-brick, and the whole is enclosed in a dome of red brick, to prevent as much as possible the heat from escaping. At the bottom of each pot is placed a layer of charcoal, broken up in small pieces, from a quarter to half an inch square. On this a layer of bars of iron is placed, which is covered with charcoal; another row of bars of iron follows, and so on until the pot is filled with alternate layers of charcoal and iron; it is then carefully closed with a thick cover of wheel swarf, a silicious species of mud, which accumulates at the troughs of the Sheffield grinding-wheels, and is of course the material of the grindstone, worn away in the process of grinding, and mixed with the finest steel dust which has been ground away, a substance which will resist long exposure to great heat, and renders the top of the pot practically air-tight. In order to test the progress of conversion, and to ascertain the precise moment when the fire should be allowed to go out, two or three bars of iron are allowed to protrude through a hole in one of the pots made for the purpose. These bars, technically called tap bars, are drawn and inspected at or near the close of the process, and are tightly packed in white ashes where they pass through the end of the converting pot, so that no air may find its way to the charcoal inside. The converting pots, full of alternate layers of iron and charcoal, and for all practical purposes hermetically sealed, are gradually raised to nearly a white heat, and kept at about that temperature for a week or more, according to the amount of carbonisation required. Another week is occupied in the process of cooling, which must be done slowly, in order to prevent the pots from cracking, after which the cover is broken up and removed, and the bars, which went into the furnace bars of iron, are taken out of it bars of blister steel, so called from the bubbles or blisters which have arisen on the surface during the process of conversion. Some of the charcoal has been consumed during the week at which it was white hot, but a considerable proportion of it remains, and is taken out of the furnace as black as it went in. A chemical change in the composition of the bars has taken place. They were originally pure iron, or nearly so, containing perhaps $\frac{1}{4}$ per cent. of carbon or less, were fibrous in their structure, and would bend double without breaking. After the process of conversion they have become a carburet or carbide of iron or steel, containing from $\frac{1}{2}$ to $1\frac{1}{2}$ per cent. of carbon, according to the length of time they have been in the furnace, and the degree of heat to which they have been subjected. They are now more or less crystalline in their structure, and can be broken by a slight blow of a hammer. The converting furnaces in use in Sheffield vary in size, some holding as much as 30 tons of iron, and others not more than 15 tons. The iron gains slightly in weight by being converted into steel. The process occupies about three weeks, and a pair of pots may be used from twenty to forty times before they are worn out and have to be replaced by new ones. As in every other process connected with the manufacture of steel, in the process of conversion it has to run the gauntlet of many perils. Sometimes the pots crack; air is admitted to the furnace; the charcoal is burnt, and in bad cases even the iron is oxidised. Bars which have thus missed conversion are technically said to be aired; and even when very slightly affected may easily be discovered, in consequence of their having almost lost the tendency to become rusty. If the furnace be raised to too high a heat the surface of the bars well melt, and when they are drawn it will appear glazed. There are even instances handed down by tradition in Sheffield of unskilful converters, who had heated the furnace under their care to such a degree that the whole mass of iron and charcoal had become fused together, and the end of the furnace had to be taken out to remove the contents. During the process of conversion the outside of the bar of iron is turned into steel the first, and in a spring heat the centre or the bar remains iron, though when the bar is broken the crystals of iron have lost their brilliancy; in technical language, the bar is said to be full of sap, though the sap is killed and no longer looks raw or stares. In a country heat the sap is still more killed, and the crystals of steel on the edges have become more distinct. In a single-shear heat the fracture shows more steel on the outside and less iron in the centre, until in a double-shear heat the fracture shows about equal proportions of iron and steel. It is important that the transition from one to the other should be as gradual as possible. When the line of demarcation is violent or sudden, the process of conversion has been carried on too rapidly, and bars of blister steel so converted are said to be flushed. In a steel through heat, as its name implies, all trace of iron in the fracture has been lost sight of, but the crystals of steel are small. A short time longer in the furnace will make the steel a melting heat; the crystals will be large, and in exceptional cases their facets will reach across the bar. The melting furnace consists of a row of oval melting holes large enough to contain two melting pots, one in front of the other, and deep enough to allow of sufficient coke to cover the lids. From each melting hole a flue leads in old-fashioned furnaces into a flat stack, each hole having a separate flue in the stack, but many furnaces are now made with short flues from each hole leading into a main flue, which ends in a single square chimney. The application of gas to the melting of steel has been successful, but for the highest qualities coke is principally used, as the control which the melter has over the temperature of each pot, which sometimes requires keeping back and sometimes hurrying on, is supposed to be more absolute. There can be little doubt, however, that the adoption of gas-melting furnaces is only a question of time. The furnace floor is on a level with the top of the melting holes; and the grate bars, as well as a flue leading into the chimney by which the draught may be controlled, are accessible from the cellar. The pots in which the steel is melted are generally made in a room adjoining the melting furnace. They are composed of a mixture of Burton and Stannington clay, to which is sometimes added a proportion of Stourbridge clay, and if the pots are required to stand a great heat, a china clay from Devonshire. A small quantity of ground coke as well as of old pots ground is also added. Great care is taken that the clay be absolutely disintegrated and perfectly mixed together. This is accomplished by treading it in a trough, the pot-maker and his assistant kneading it with their bare feet. The pots are moulded in an iron flask by means of a wooden plug, and are slowly dried at the back of the stack, and the night before they are used, gradually heated to a dull-red heat—a process called annealing. Pot-making is a very important part of the manufacture of best cast steel. It is absolutely impossible to make good cast steel if the pots are defective. Each pot lasts a single day, and is used three times, containing severally about 50 lb., 44 lb., and 38 lb. of steel each round. The object of lessening the weight of each successive charge is to bring the surface of the molten metal to a different place in the pot, because the flux or scum which accumulates on the surface has a chemical action on the silica of the pot, which is consequently decomposed for some depth just at that point, and the pot is reduced in thickness. The bar steel is first carefully selected of the exact temper required, all flushed or aired bars are rejected, and after it has been broken up into small pieces and carefully weighed, it is conveyed to the pot, which has already been placed in the melting hole through an iron funnel called a charger. The lid is carefully adjusted, and the melting hole filled with coke. The degree of heat to which the furnace is allowed to go is carefully regulated by the puller-out, who is technically said to work the holes, and who has perfect control over them by means of the two flues, into either of which he can insert a fire-brick if required; a brick in the melting hole flue lessens the heat by lessening the draft; one in the cellar flue increases the heat by increasing the draft. The head melter periodically inspects the pots, and gives the final instructions to the puller-out, and decides the precise moment when the steel is dead melted, and the holes sufficiently burnt down to allow of its being teemed or poured into the mould with a fair chance of producing a sound ingot. When the puller-out has put on his clothes, by which is meant a series of sacking wraps which envelope the arms and legs, and are soaked with water to protect him from the heat, he raises the pot with a pair of pulling-out tongs, and lifts it from the hole to the floor of the furnace. The lid is instantly taken off with a pair of lid tongs, and the scum or flux is removed by a skimmer from the surface of the molten steel, which is then poured into a cast iron mould formed of two halves tightly ringed and wedged together. The interior of the mould has been previously reeked or covered with a coat of coal-tar soot to prevent the ingot from adhering to it. The melting of the higher qualities of steel is a process requiring the greatest skill, and one of the principal reasons why the trade has become to such a remarkable extent localised in Sheffield is the importance to this branch of the trade of being able to select, from a large class of more or less experienced workmen, the few exceptional men in whom sound judgment, technical skill, and steady habits are combined. The chances of accident in the melting of steel are many and various. Not only badly-made pots, but badly annealed or badly worked pots, are sure to run, and the steel to be deposited amongst the ashes, where it imbibes so much sulphur as to be practically of no value. Should a piece of coke accidentally find its way into the pot, the ingot will show a bright sparkling fracture; technically speaking, it will be said to stare, and under the hammer will prove hot short and crumble to pieces. If the steel be not long enough in the fire, it will teem fiery and produce a honeycombed ingot, and the same result will follow if it be too hot when it is poured. If it remains too long in the fire it will teem dead, the fracture of the ingot will look scorched, and though exceptionally sound, it will be brittle if hard, and wanting in tensile strength if mild. If the molten steel be chilled before it is poured into the mould, which may be detected by the stream skimming over as it is teemed, the fracture of the ingot will appear dull in colour, and full of small holes or honeycombs. All ingots having a proportion of 1 per cent. or more of carbon, if properly melted will pipe; that is to say, the steel in the centre of the ingot will settle down as it cools, leaving a hollow space in the middle at the top of the ingot to the depth of from three to five inches. When the ingot has become cold it must be topped, that is to say, the hollow part must be broken off, until the ingot shows a sound fracture, and before this fracture has had time to rust, the ingots must be carefully examined; the ingots which are not properly melted must be rejected, and the exact percentage of carbon which each ingot contains must be marked upon it. An experienced eye can judge of the percentage of carbon contained in an ingot to a wonderful nicety by the appearance of the fracture. Between 1 per cent. of carbon and $1\frac{1}{2}$ per cent. every tenth per cent. is well marked, and an experienced hand will detect a difference between, for example, 1·3 and 1·35 per cent. In order to reduce the ingot of cast steel to the size and shape required by the consumer, it must be reheated, and when hot enough, hammered or rolled to the dimensions ordered. Great care must be exercised in this process not to burn or overheat the steel; and to prevent this the half cogged bar must be continually turned round in the fire, and ground fire-clay or sand and borax sprinkled upon it. In many cases it is necessary to give the surface of the bar, after it has been once drawn down under the hammer, a welding or wash heat, to close the small honeycombs which are scattered here and there on the surface of the ingot. It is a matter of great importance, especially with large ingots, that they should not be hammered until they are thoroughly heated or soaked through, and it is of equal importance to all ingots that they should not lie too long soaking in the fire, especially in a dry fire, that is, one without blaze. The effect of hammering steel is to make it crystallise in very small crystals, a result which greatly improves its quality, but at the same time exposes it to the risk of various accidents in the process. The forging, tilting, and rolling of cast steel all require very experienced workmen, and a considerable outlay of expensive machinery. It is seldom that a workman attains exceptional skill in many departments, and great loss is sustained by too often changing faces or rolls, so that these processes cannot be satisfactorily or cheaply carried on upon a small scale, and this is one of the chief reasons why the crucible cast steel trade has to such a large extent become localised in a single town. It might be supposed that when the best quality of iron had been selected, and the greatest care used in all the processes of manufacture—the converting, the melting, and the forging—the result must of necessity be good steel, and the troubles of the steel manufacturer would be over. But this is not the case by any means. So far from being over, the greatest difficulty has yet to be faced. The result may be good steel, but good steel only for certain purposes. There was a time, in the golden age of steel manufacturing, when steel was steel, and if it did not answer the purpose for which it was required, it was taken for granted that the fault lay with the workman. In some cases the manufacturer altered the percentage of carbon, but the temper of the steel was kept a profound secret from the consumer; in most cases, no doubt, because the manufacturer had very vague ideas on the subject himself. Chemical analysis was unknown in the trade; the despotic sway of the rule of thumb reigned supreme. Now it is customary for the manufacturer to take the consumer into his confidence, and not only to inform him of the percentage of carbon which the steel contains, but also to give him the benefit of his opinion as to the purposes for which it is or is not suitable. Formerly, if the consumer discovered that chisel steel contained less carbon than tool steel, he owed his discovery entirely to his own wit. There can be no doubt that for many purposes a considerable latitude may be permitted, if the steel has the good fortune to fall into the hands of a clever workman who understands how to humour it; but next to quality—by which is meant percentage of phosphorus, sulphur, &c., combined with some other obscure points of crystallisation—the most important thing is temper, or percentage of carbon. For some purposes, indeed, temper is of more importance than quality. Nothing is more common than for steel to be rejected as bad in quality, because it has been used for a purpose for which the temper was unsuitable. We may divide consumers of steel into three classes. First, those who use their own judgment of what percentage of carbon they require, and instruct the manufacturer to send them steel of a specified temper; second, those who leave the selection of the temper to the judgment of the manufacturer, and instruct him to send them steel for a specified purpose; and third, those who simply order steel of a specified size, leaving the manufacturer to guess for what purpose it is required. Fortunately, the size and shape generally furnish some clue to the purpose for which it is likely to be used. For example, oval steel is almost sure to be used for chisels, and small squares for turning tools, but $1\frac{1}{4}$ square may be used for a turning tool or a cold sett, or $1\frac{1}{4}$ round for a drill or a boiler cup, and the manufacturer has to puzzle his brain to discover whether the chances are in favour of its being used in the lathe room or in the blacksmith's shop. It cannot too often be reiterated of how much importance it is, when ordering steel, to state the purpose for which it is going to be used. Of course, the number of tempers of steel is infinite, but the following is a list of the most useful:—

Razor temper ($1\frac{1}{2}$ per cent. carbon).—This steel is so easily burnt by being overheated that it can only be placed in the hands of a very skilful workman. When properly heated it will do twice the work of ordinary tool steel for turning chilled rolls, &c.

Sawfile temper ($1\frac{3}{8}$ per cent. carbon).—This steel requires careful treatment; and although it will stand more fire than razor steel, should not be heated above a cherry red.

Tool temper ($1\frac{1}{4}$ per cent. carbon).—The most useful temper for turning tools, drills, and planing machine tools in the hands of ordinary workmen. It is possible to weld cast steel of this temper, but only with the greatest care and skill.

Spindle temper ($1\frac{1}{8}$ per cent. carbon).—A very useful temper for circular cutters, very large turning tools, taps, screwing dies, &c. This temper requires considerable care in welding.

Chisel temper (1 per cent. carbon).—An extremely useful temper, combining as it does great toughness in the unhardened state, with the capacity of hardening at a low heat. It is consequently well adapted for tools when the unhardened part is required to stand the blow of a hammer without snipping, but where a hard cutting edge is required, such as cold chisels, hot setts, &c.

Sett temper ($\frac{7}{8}$ per cent. carbon).—This temper is adapted for tools where the chief punishment is on the unhardened part, such as cold setts, which have to stand the blows of a very heavy hammer.

Die temper ($\frac{3}{4}$ per cent. carbon).—The most suitable temper for tools where the surface only is required to be hard, and where the capacity to withstand great pressure is of importance, such as stamping or pressing dies, boiler cups, &c. Both the two last tempers may be easily welded by a mechanic accustomed to weld cast steel. It is a somewhat remarkable fact that although steel is intermediate in chemical composition between wrought iron and cast iron, containing more carbon than the one and less than the other, its properties are quite different from either of them. It may be made to resemble either of them alternately, but it is principally used in a third condition, in its capacity to assume which the great value of steel consists. Annealed steel has nearly all the properties of lead, being very soft and malleable. Hardened steel has nearly all the properties of glass, being very hard and brittle. Tempered steel has most of the properties of whalebone, being hard, but at the same time elastic. The chemical change which takes place during these processes has not yet been discovered. We might evolve a very pretty theory to account for it, by assuming that in the process of annealing some of the combined carbon was liberated, and existed in the steel in the form of free or uncombined carbon; but such a theory only explains part of the facts, and is not, I am afraid, borne out by the results of chemical analysis, so that we must fall back upon the mysterious and unknown laws of crystallisation. The effect cannot be due simply to the increased density of the hardened steel caused by the contraction of the steel by sudden cooling. It is a remarkable fact that the specific gravity of hardened steel is less than that of unhardened steel. Steel of course expands with heat, and when it is allowed to cool slowly regains its original size; but if it be cooled suddenly—the only known way in which it can be hardened—although it contracts very much, it does not quite reach the small size of the unhardened state. However complicated the details of the manufacture of cast steel may be, the complications involved in its subsequent use are still greater. It would be impossible to lay down exact rules for each of the thousand-and-one tools in which steel is used. The treatment of each tool in each process which it undergoes is an art that can only be learnt by practice, and can no more be taught in a book than the arts of skating, riding, or swimming. The utmost that can be done is to lay down certain general rules, which may explain to some extent, if they fail to teach, the most important details of manipulation. All steel may be regarded as involving a question of compromise. Each tool requires a certain degree of hardness; the problem is how to secure the maximum amount of toughness that is compatible with it. To secure this, the first step that must be taken in bringing the steel into the shape required is to heat the steel as little as may be before it is forged, and in the process of forging to hammer it as much as possible. The worst fault that can be committed is to heat the steel more than is necessary. When steel is heated it becomes coarse-grained; its silky texture is lost, and can only be restored by hammering or sudden cooling. If the temperature be raised above a certain point, the steel becomes what is technically called "burnt," and the amount of hammering which it would require to restore its fine grain would reduce it to a size too small for the required tool and the steel must be condemned as spoilt. Overheating in the fire is also the primary cause of cracking in the water. One of the principal reasons why a high quality of steel is required for certain purposes is, that it will suffer less injury by being heated to a greater degree, or by being heated and reheated a greater number of times, than inferior qualities of steel. In heating steel the happy medium must be attained between heating it too much or too little, and between letting it lie too long "soaking" in the fire, and not "soaking" it through. Both the degree of temperature and the duration of the heat must be carefully watched. Some tools, such as circular cutters, files, &c., after they are forged into the shape required, must have teeth cut into them. Before this can be successfully accomplished a preliminary process has to be gone through. The process of hammering, or forging the steel into the shape required has hardened it to such an extent as to make the cutting of teeth into it impossible or difficult, and it must consequently be annealed. This process consists in reheating the steel as carefully as before, and afterwards allowing it to cool as slowly as possible. Many tools are only required to be hardened on a small part of their surface, and it is important that the unhardened parts should possess the maximum amount of toughness, the minimum amount of brittleness, that can be attained. The process of annealing, or slow-cooling, leaves the steel coarse-grained, gives it its maximum of ductility, and causes it, in fact, to approach in its properties those of lead.

(To be continued.)

* Iron and Steel Institute.

RAILWAY MATTERS.

Mr. John W. Garrett, president of the Baltimore and Ohio Railway, died on the 25th ult., aged 65. His son, Mr. Robert Garrett, succeeds him.

We are informed that a meeting of the friends of the killed and injured in the Penistone disaster, is to be held on Tuesday, the 7th instant, at the Queen's Hotel, Manchester, to arrange for some joint action, with a view to recover damages from the Manchester, Sheffield, and Lincolnshire Railway Company.

A gang of Italian labourers near Saratoga were recently cut down 10 cents a day. Instead of striking, they cut an inch off their shovel blades at night. The "boss" asked what it meant, and *Baldwin's Guide* reports that, one of the men replied: "Not so much pay, not so much dirt lift; all right, job last the more long. Italian no fool like Irishman; he no strike."

A long article appears in the *Annales Industrielles* proposing another Alpine tunnel, as necessary to meet the growing traffic between France and Italy, for which the Mont Cenis is not sufficient. The tunnel would be part of a line connecting Martigny and Aoste, the tunnel being 9·48 kilometres long, between the Glacier de Laneuva and the Glacier de Rochefort, and the line passing between Mont Blanc and Great St. Bernard.

The New South Wales Government railway proposals, submitted to the Legislative Assembly on the 24th ult., comprised the construction of 1490 miles of railway, including extensions of twenty different lines, traversing some very fertile parts of the colony. Light lines will be made where the nature of the country permits. The total estimated cost of the works is £14,000,000, to be raised in loans from time to time as required, the amount being probably spread over the next seven years. The net return from the present railways is 4½ per cent. on the capital invested.

A circular is being distributed by Mr. Thos. Marshall, of 86, New Walk, Leicester, who lost his only son in the Penistone accident. He says:—"It is now nearly two months since this fearful accident occurred, and I think it is high time some steps were taken by the friends of the sufferers to bring the Manchester, Sheffield, and Lincolnshire Railway Company to a sense of their duty. If you are of the same opinion, be good enough to reply, saying if we had better call a meeting—say at Manchester, Sheffield, or some central position—so that we may come to some understanding as to what we ought to do in the matter." All the replies he has received are in favour of a test action.

A case in which things turned out to be "bad for the coo" was recorded last week by the *Leicester Daily Post*. The London and North-Western passenger train from Market Harborough to Rugby, timed to leave Market Harborough at 7.42 p.m. on Wednesday night, when about three-quarters of a mile past Harborough, ran into a bullock straying on the line. The engine and the remainder of the train passed over the obstacle, but the last two carriages and a meat van were thrown off the metals, happily without injuring any one. The goods and passengers were transferred to the front part of the train, which had kept the rails, and proceeded after a delay of about three-quarters of an hour. The vehicles off the line were left for the breakdown gang. The bullock was completely cut in pieces, part of it being carried upwards of 300 yards.

The agitation of the enginemen and firemen of the London, Brighton, and South Coast Railway, which at one time threatened to be a serious affair, is now said to be in a fair way of being amicably settled by an adjustment of their claims with respect to hours and wages. In the early part of 1883 a definite arrangement was arrived at, and on that occasion the unanimity of feeling was shown by the fact that out of a total of 660 locomotive men 616 attached their names to a memorial to the directors. According to the 1883 agreement the men had a right to claim six days' pay for 54 hours' work, and to be paid at the Sunday rate for the hours worked on Sunday. An attempt, it is stated, having been subsequently made in the southern division of the system to evade some of the clauses of the agreement, the men in all the divisions organised themselves to resist this to the uttermost. The men have just had an interview with the locomotive superintendent of the line, who received them kindly, and a promise has been made that their claims shall be decided early next month.

The report of the directors of the Waterford and Limerick Railway gives the following figures for the half-year ending 30th June, 1884:—Maintenance of way, works, &c., salaries, office expenses, and general superintendence, £531 9s. 6d.; maintenance and renewal of permanent way, wages, £6529 3s. 10d.; materials, £6614 18s. 11d.; repairs of roads, bridges, signals, and works, £3047 1s. 5d.; repairs of stations and buildings, £1102 10s. 11d. Miles maintained, double, 32¼; single, 238½; total, 270¾. Locomotive power, salaries, office expenses, and general superintendence, £179 10s. 8d.; running expenses, wages connected with the working of locomotive engines, £2900 15s. 9d.; coal and coke, £4347 9s. 3d.; gas and water, £613 6s. 7d.; oil, tallow, and other stores, £447 16s. 3d.; repairs and renewals, wages, £2418 3s. 10d.; materials, £1035 7s. 10d.; one new engine purchased, £2350. Repairs and renewals of carriages and wagons: carriages, salaries, office expenses, and general superintendence, £86 4s. 4d.; wages, £428 15s. 10d.; materials, £610 15s. 6d.; wagons: salaries, office expenses, and general superintendence, £86 4s. 4d.; wages, £1307 8s. 2d.; materials, 1158 0s. 10d. Miles worked by company, 271m. 7f.; train mileage, passenger and goods, 435,313.

The other day a railroad man said:—"I know a case where some misplaced wool wrecked an entire train, killed half-a-dozen men, and cost the company thousands of dollars. The wool was on a sheep." "I don't doubt it," chimed in one of his listeners; "I had rather run into a tree blown across the track any time, than to run into a sheep. I remember one night on the M., K., and T., just after a terrific storm, I was riding in the cab. We were making forty miles an hour at least, and it was so dark we couldn't see 50ft. ahead of us. Suddenly we whirled round a curve, and there straight across the rails lay the trunk of an enormous tree, which had gone down in the gale. There was no time to think of stopping, and I was about to leap from the cab, when Jim, the engineer, shouted, 'Sit still, you —— fool, and hang on like grim death.' With that he yanked open the throttle, and quicker than I can tell it, the thing was over. There was a pretty severe shock, but the next instant we were flying along the rails, and all right. That tree must have been a foot in diameter, but the wheels went through it like a cheese knife, and you could have split it up lengthwise, and use the sticks for gauging track. Another time I was in a coach on a train that struck a sheep, and we were all in a ditch before you could wink. I never exactly understood why it was until I saw the remains of the engine. Then everything was plain. The wool had become entangled up in the machinery wherever there was a chance for it to catch. The connecting rods were bent and broken, the steam chests exploded. and every light piece of metal about the machine demoralised in some way. It was the wool that did the business." "Pigs are bad animals to hit, too," said number three. "I came over the Vandalia lately, and one of the connecting rods struck the head of a pig, who had been caught in a cattle guard, and was running his snout up through the ties. The engine leaked steam all the way to St. Louis, and had to go into the shop next day for repairs. Sometimes cattle are rough on a train, and sometimes not. I went through a herd down in Texas one night, and we killed twelve before we could stop, yet never left the rails. On other occasions I have seen one old cow make chaos of a whole freight train. I suppose a spike is about the meanest obstruction you can strike in a track. It is not big enough to be caught and knocked off by the pilot, and, unless the train is going at a very fast rate, it rarely fails to derail it. Of course, all accidents are determined by circumstances, which in some instances may cause destruction, and in others prove harmless. The *St. Louis Globe Democrat* says, you'll find, though, that all engineers have a holy horror of sheep and spikes."

NOTES AND MEMORANDA.

The death-rate of Hampstead during the year 1883 was but 11·26 per thousand.

A return issued last week shows that there are now 225,619 Martini-Henry rifles in the hands of British troops; 171,032 volunteers are at present without that weapon, and there are 281,178 rifles in store.

The *St. Petersburg Herald* reports that Captain Kosztowitz is building at Okhta a large cigar-shaped balloon, 200ft. in length and 80ft. in height, including the car, which he has furnished with a screw and also with wings. He considers that he will be able to take a crew of sixteen men and 250 lb. of ballast, at the rate of forty German miles an hour, and the experimental trip is expected to take place early next month.

The total output of the New South Wales collieries for 1883 exceeded two and-a half million tons, the exact figures—2,521,457 tons 1 cwt.—being 412,175 tons in excess of the output for 1882. The average price per ton in 1883 being 9s. 6·40d., as against 8s. 11·97d. per ton in 1882. A large quantity of coal is annually exported, even to England, and the inferior kinds in the inland districts are said to be quite as well fitted for immediate local use, as a great many coals worked in Great Britain, France, United States of America, and elsewhere, and to be especially suitable for smelting purposes.

There are twenty-eight states and territories in the United States in which coal is produced; and in 1883 the aggregate output of coal was 96,159,719 tons, being an increase of 9,310,283 tons over the returns for 1882. Pennsylvania, the greatest of the coal fields, alone produced in 1883 55,793,000 tons; Illinois yielded 10,508,791 tons; Ohio, 8,229,429 tons; Iowa, 3,881,300 tons; Indiana, 2,400,000 tons; Maryland, 2,306,172 tons; Missouri, 2,250,000 tons; Virginia and West Virginia, 2,475,000 tons; Kentucky, 1,650,000 tons; Tennessee and Colorado, 1,000,000 tons each; Alabama, 1,400,000 tons; Kansas, 850,000 tons; Wyoming Territory, 700,000 tons; and the rest of the States and territories 2,040,000 tons.

Speaking generally, the rain in New South Wales is heavy compared with that of England; that is, when falling, much less falls per hour in the English metropolis than in that of New South Wales. Sydney in 152 days has 50·05in. rain, while London, with 146 days, has only 24·76in. rain. So also with regard to dry intervals. Forty years' experience in Sydney has seldom furnished one month entirely without rain, but in dry periods several months sometimes pass consecutively during which the fall is too small for water supply; and of England a somewhat similar remark has been made. No complete month has ever been without rain, but at times several months are consecutive during which no rain falls available for water supply.

The saw was, it is said, invented by Dædalus, according to Pliny, but Apollodorus says the inventor was Telus. It is stated that the latter, having found the jawbone of a snake, employed it to cut through a piece of wood, and then formed an instrument of iron like it. Becher says saw-mills were invented in the 17th century; but this is not so, it appears; for they were erected in Maderia in 1420, at Breslau in 1427. Norway had the first saw mill in 1530. The Bishop of Ely, ambassador from Mary of England to the Court of Rome, describes a saw-mill there in 1555. In England, saw-mills had at first the same fate with printing in Turkey, the crane in Strasbourg, &c.; the attempts to introduce them were violently opposed; and one erected by a Dutchman in 1663 was forced to be abandoned.

Wages and money have curiously changed values since the fourteenth century. In the year 1352, 25th Edward III., wages paid to haymakers were 1d. a day. A mower of meadows, 3d. a day, or 5d. an acre. Reapers of corn in the first week of August, 2d.; in the second, 3d. per day, and so on till the end of August, without meat, drink, or other allowance, finding their own tools. For thrashing a quarter of wheat or rye, 2½d.; a quarter of barley, beans, peas, and oats, 1½d. A master carpenter, 3d. a day; other carpenters, 2d. A master mason, 4d. per day; other masons, 3d.; and their servants, 1½d. per day. Tilers 3d., and their "knaves" 1½d. Thatchers 3d. per day, and their "knaves" 1½d. Plasterers, and other workers of mud walls, and their knaves, in like manner, without meat or drink, and this from Easter to Michaelmas; and from that time less, according to the direction of the justices.

A feature of the Philadelphia Exposition is the important part taken therein by gas, in one form or another. The *Scientific American* says it might fairly be claimed for the gas-motor that it is part of an electric-lighting plant. It would, however, be a refinement of sarcasm to set up such a claim for the gas lamp. But the gas lamp is there; not the little, flickering jet, combined, by reason of a clogged aperture, into one long, thin prong of flame, but represented in all the grandeur of a Siemens regenerative gas burner—intense and mellow. It must be said that the big gas lamp cuts a good figure. Subjoined is the consumption of gas per hour and the candle power of the gas burners at the Exposition:—100 cubic feet per hour gave 1000 to 1200 candles; 75 ditto gave 750 to 900 candles; 50 ditto gave 450 to 500 candles; 35 ditto gave 300 to 350 candles; 25 ditto gave 200 to 250 candles; 14 ditto gave 100 to 125 candles; 8 ditto gave 70 to 80 candles. This, even if not an underestimate, shows that these lamps, with gas at 2·25 dols. per 1000 cubic feet, are fully as expensive as the arc lights, if the figures at which they are rented are reliable.

In a paper recently read before the American Institute of Mining Engineers, Mr. Dudley, of Cincinnati, called attention to the extended application of iridium to art and manufacture. Iridium is usually classed as one of the rare metals, it being usually found with either platinum or gold, and being extracted from those ores as a by-product. The principal sources of supply are Russia and California, the iridium in the former country being obtained from the platinum mines of the Urals, and in California from the placer gold washings, where, indeed, it is a source of considerable annoyance, on account of its specific gravity, which is about 19·3, nearly the same as that of gold. Consequently, it is impossible to separate the gold from the iridium by the process of washing, and it has to be effected, therefore, by amalgamation of the gold, or dissolving it out in aqua regia. Notwithstanding its comparative abundance, up to the present time, iridium has only been applied (with the exception of alloying with platinum) for pointing gold pens, forming what is called "diamond" point, and being, in reality, a small grain of iridosmine (or alloy with osmium) soldered on to the tip of the pen. About four years ago a well-known American gold pen manufacturer brought out a stylographic pen, and found it necessary to have larger pieces of iridium than had been previously used; and it was then discovered that by fusing the metal in a crucible at a white heat and adding phosphorus, a perfect fusion could be obtained, with all the hardness in the resulting material of the iridium itself. For mechanical applications this combination is exceedingly useful, as in the case of pen points; and its adaptability is being proved in many ways. It is employed as a draw plate for drawing heavy wire, and for this it is rapidly superseding the ruby plate, hitherto always used in drawing gold and silver wire. Agate, which has hitherto been employed for fine chemical balances, is now giving place to iridium, which takes a finer edge, and is not so liable to catch or break. Its application is now being made to electrical purposes; but the phosphorus in the experiments has to be removed, as being an obstacle to success. This being done, the iridium is available for contact points, and they are found to be far superior to platinum, the iridium outliving the platinum, and not being subject to oxidation or sticking, as are the latter points, all that is necessary to clean the iridium being to pass emery paper over its surface. Mr. Dudley is now engaged in experiments for plating with iridium, and has succeeded in obtaining a bright reguline deposit of iridium on base metals, which deposit resembles the natural metal, being quite hard and resisting the action of acids.

MISCELLANEA.

The Birkenhead Agricultural Show next year will be held on Wednesday, Thursday, and Friday, the 10th, 11th, and 12th June.

Common bricks impregnated with asphalte have been used about twelve months in Berlin for street paving, and are said to wear well.

Messrs. Archibald Smith and Stevens have been awarded a silver medal at the Crystal Palace Exhibition, 1884, for Stevens and Major's silent closing door spring.

A new small motor actuated by explosion of small charges of gun cotton has been made by Mr. E. Sturge, and is said to be applicable wherever small powers are required.

The Russian Customs Department has issued an order, dated 3rd September, 1884, that goods bearing trade marks with effigies of the Holy Virgin, Saint George, or other saints, will not be admitted into the Russian Empire.

The hydraulic engineer of Adelaide reports that the sewage system is working exceedingly well, and that the plan of erecting ventilating shafts, which has been adopted in North Adelaide, to prevent stenches arising from the drains, has been successful in abating the nuisance.

The body of Signor Nizza, C.E., employed by the Government on the new railway from Rome to Sulmona, was found shortly after he had left his abode at Carsoli to inspect the boring of a tunnel near there, on the 20th ult. He had received three gunshots from behind, and had been robbed of his purse and watch.

On Saturday evening last an attendant of the Hochhausen machines of Messrs. Edmonds and Co. at the Health Exhibition put one hand on each of the two brushes of a machine or on some parts near the commutator, in such a way as to complete a circuit through himself instead of through the 25-arc lamps which were on the machine, and was killed.

The Council of the Sanitary Assurance Association have resolved to present to the free public libraries of the country copies of Mr. Mark H. Judge's "Sanitary Arrangements of Dwelling Houses; Notes in Connection with the Sanitary Exhibits at the International Health Exhibition," recently published by the Sanitary Assurance Association, of which Mr. Judge is the surveyor.

The water supply of Alnwick having been unsatisfactory during the recent dry season, the local authorities have determined to take the matter thoroughly in hand, and have instructed Mr. J. P. Spencer, C.E., of Newcastle-on-Tyne, to report upon the subject, and advise them as to the best means of providing a sufficient supply, and also with a view of providing additional storage and enlargement of the present waterworks, so as to provide for the increased demands of the district. It is expected the report will shortly be sent in, and the requisite structural works will be commenced as early as possible next winter.

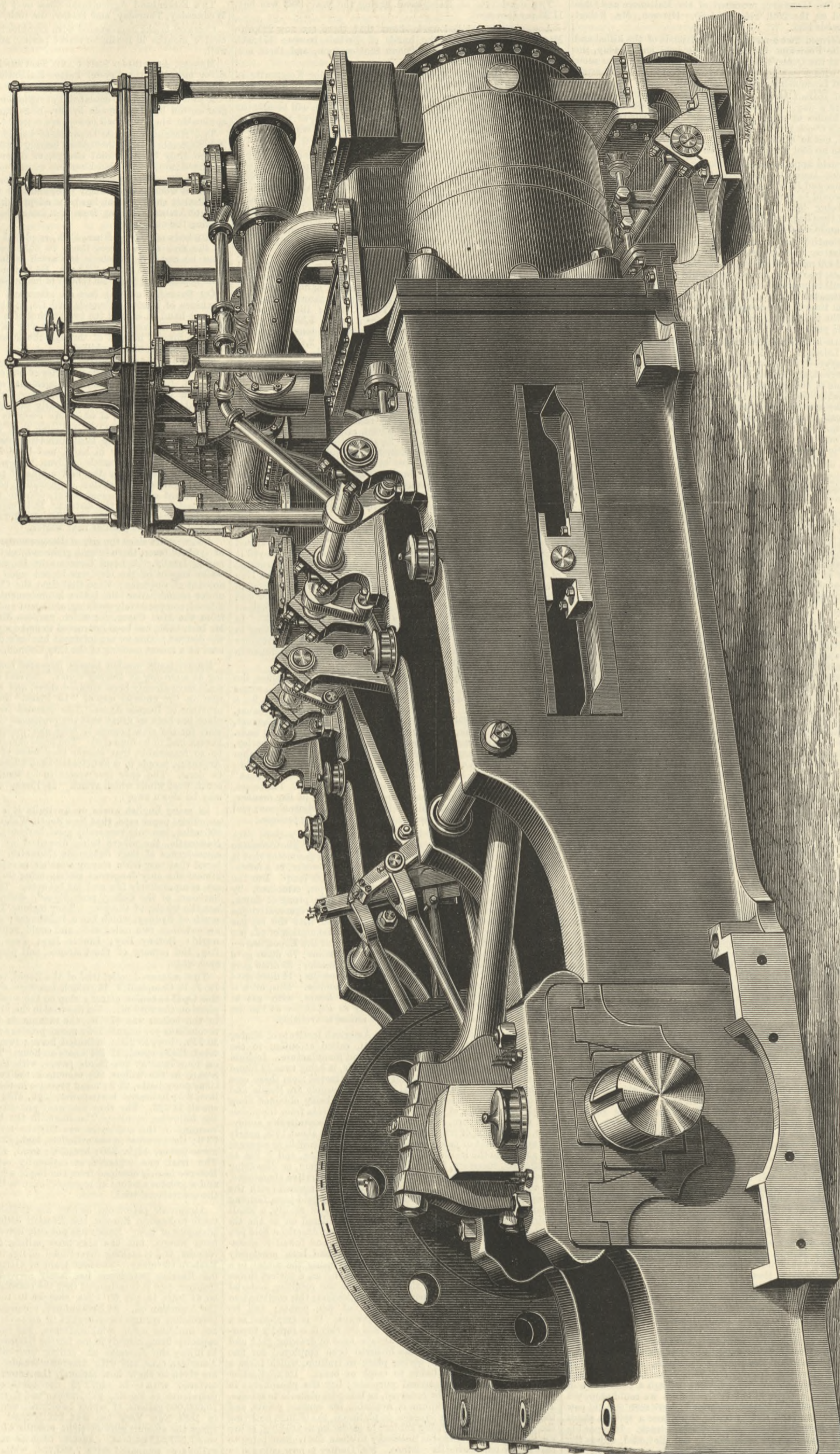
A few years since the city of Bangor suffered from an epidemic of typhoid fever, there being a great number of cases, many terminating fatally. A Local Government Inquiry was held, and the water supply of the city was looked upon with a considerable amount of suspicion; since that time the City Council have had under consideration the better improvement of the hitherto considered, comparatively speaking, abundant and pure supply of water from the Afon Caseg, for which purpose Mr. Edward Pritchard, M. Inst. C.E., has been instructed to make a personal inspection of the district; this we are informed has been done, his report being read at a recent meeting of the City Council.

Ready-made wooden houses, imported from America, are selling as a novelty at Buenos Ayres. Several shipments on a large scale have already been received there, and are in course of erection in the embryo city of "La Plata," the new capital of the province of Buenos Ayres. The demand for habitations at that place has been so great that the provincial Government could not wait for the slow process of brick and mortar; hence ready-made houses had to be imported. The price charged for them is said to be so reasonable, that should they meet the expectations of the Argentine people it is anticipated that a large trade in them will be done. The only fear seems to be that, owing to the heavy south-west winds which attack "La Plata," the ready-made houses may be blown away.

In many English works on Australia it is erroneously assumed, an official paper says, that New South Wales, with its coast line of 800 miles, has only two really good harbours, those at Sydney and Newcastle, the others being described as practically useless in consequence of their dangerous character. It should be remembered that very little stormy weather is experienced on the coast, almost the only dangerous storms being the easterly gales, which are comparatively few and far between. This renders the minor harbours of the Colony perfectly safe during the greater part, if not the whole, of the year. They include Twofold Bay, 228 miles south of Sydney, which has a lighthouse; Jervis Bay, which has an entrance two miles wide, and could hold all the navies of the world; Botany Bay; Broken Bay; Port Stephens; and Shoal Bay, the estuary of the Clarence, and possessing plenty of safe anchorage.

The measured mile trial of the Rapid, screw corvette, Captain H. J. F. Campbell, C.B., which has been commissioned to relieve the Opal as senior officer's ship on the west coast of Africa, took place on the 29th ult. On the trial in the first four runs the steam in the boilers was 87·5 lb., the vacuum in the condenser 25, the revolutions per minute 105; mean pressure in the cylinders, high, 39·7 lb.; low, 13·9 lb.; indicated horse-power, high, 642; low, 671; total, 1313; speed, 12·484 knots an hour. The ship was then put on four runs at two-thirds power, with the following results:—Steam in the boilers, 90; vacuum in the condenser, 25·6; revolutions per minute, 91·3; mean pressure in the cylinders, high, 33·6; low, 8·5; indicated horse-power, high, 475; low, 357; total, 832; speed, 11·125. The ship was next put on one-third power, with the following results:—The steam in the boilers was 90 lb.; the vacuum in the condenser was 26; the revolutions per minute, 73·6; the pressure in the cylinders, high, 13·3; low, 7·7; indicated horse-power, high, 250; low, 257; total, 457; speed, 9·62 knots. The trial was regarded as eminently satisfactory, the Steam Reserve having obtained from the Rapid a higher amount of steam and a greater amount of registered results than were chronicled at the contractors' trial.

American petroleum owners are anxious about their export trade to Eastern Europe, the Russian article having made great advances of late. Russia has not only driven American petroleum from Russia, but has also been selling crude oil to Austrian refiners, and is making determined efforts to obtain a foothold in Eastern Germany. The first train of German car-tanks containing Russian petroleum has lately arrived at Gaudenz on the frontier, and it is estimated that the petroleum by this route will be at least 1s. per 50 kilos. cheaper in the Berlin market than the American oil. At Eydtkuhnen, the proprietors of the Caucasus petroleum springs have bought 10 acres on the railway bank, and are building large establishments, 200 car-tanks of 60 barrels capacity being already in use for the German town. To add insult to injury the Russians are selling their oil largely in Austria in American cans, and with American brands. The following figures are given to show how seriously the American trade is being interfered with:—In 1872-73 the total exports of American petroleum to Russia, *viâ* Russian and German ports, was nearly 15,000,000 gallons, of which two-thirds went to Russia direct; but in 1884 New York has sent but 103,981 gallons, less than ten times the amount sent in eight months of 1883, when the export was 1,267,512 gallons. Austria likewise has taken only 3,341,163 gallons as compared with 7,893,734, while Turkey also is beginning to diminish from 4,446,485 gallons last year to 4,402,180 this year. The action of Germany in commencing so brisk a petroleum trade is looked upon as a continuation of the German Chancellor's policy to make Germany independent of all American products.



REVERSING RAIL MILL ENGINES, CYFARTHFA IRONWORKS.

MESSRS. J. AND W. GALLOWAY AND SONS, MANCHESTER, ENGINEERS.

(*For description see page 261.*)

TO CORRESPONDENTS.

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 1d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

GRINDING SULPHUR.—*Communications await the application of this correspondent.*

A STUDENT.—*We fancy you will find what you want in the "Journal of Gas Lighting."*

CARBON.—*About* 1000 *deg.; but much depends on the conditions under which combustion is effected.*

ALPHA BETA.—*Your gear would work, but no one would use it instead of a simple arm, which gives no trouble whatever.*

W. F.—*We fail to find anything new in your rudder. Balance rudders have been used for years in the British Navy, and there is nothing novel in putting a rudder in the bows of a boat. Messrs. Yarrow and Co.'s torpedo boats have bow and stern rudders.*

O. W.—*We think that a careful perusal of the letters which have recently appeared on the subject of brakes will modify your views. Neither Mr. Moon nor Sir Edward Watkin is in any sense of the word competent to pronounce a valuable opinion on technical subjects connected with the working of railways. Such matters are outside their province.*

A. T. L. (Finger-road).—*We cannot tell what books would suit you best without knowing what your attainments are. If you are a good mathematician, then the works of Rankine and Weisbach will suit your purpose; if you are not, you will find a great deal of information in the various volumes of Weale's Series, published by Messrs. Crosby Lockwood and Co., than which you cannot have a better introduction to technical literature.*

R. W.—*You can obtain from any maker of chemical apparatus all that is necessary for carrying out a few simple tests of water, but we fear these will be of little avail for your purpose. It is pretty certain that the only enemy you have to contend with is lime, and this is best dealt with by putting a small quantity of caustic soda into the boiler. You will find a great deal of valuable information in "Fuel and Water," by Browne and Schwackofer.*

J. F. *For engines running at so slow a speed as yours a lead of about one-sixteenth of an inch will be ample—that is to say, the steam port should be one sixteenth of an inch open when the crank is on the dead point. We could not answer your second question without setting out the valve gear on a drawing board. By far the best plan is to fix the excentrics with set screws, take off the valve chest covers, put in the slides and turn the engines by hand, shifting the excentrics on the shaft till you get the best result; then make the joints, turn on steam, and take some indicator cards. The set screws will hold the excentrics sufficiently tight. You can then make small alterations till the results are satisfactory, and the keyways can then be cut in the excentrics.*

CANE LUBRICATORS.

(*To the Editor of The Engineer.*)

SIR,—I shall be obliged if any of your readers can give me the name of the makers of cane lubricators. T. S.

Sheffield, September 29th.

CORRUGATED PROPELLERS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your numerous readers inform me who are the makers of a new patent steel propeller with corrugated blades?

Constantinople, September 27th. W. V. S.

QUARTZ MINING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Would any reader kindly oblige me, if possible, with the addresses of engineering firms furnishing plant and tools for quartz mining operations? W. S.

Greenwich, September 29th.

GRAPHIC SOLUTIONS OF ALGEBRAICAL PROBLEMS.

(*To the Editor of The Engineer.*)

SIR,—Will any reader kindly give me the name of a book which treats of the solutions of questions, such as the following, by geometrical operations? Water is poured at a uniform rate into a hollow right cone, vertex down, axis vertical. Draw a curve which will represent the rate at which the surface will rise. J. S.

Tamworth, September 24th.

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Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.

Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of THE ENGINEER, 163, *Strand.*

MEETING NEXT WEEK.

SOCIETY OF ENGINEERS.—Monday, Oct. 6th, at 7.30 p.m., a paper will be read "On Modern Bronze Alloys for Engineering Purposes," by Mr. Perry F. Nursey, Vice-President, the leading features of which are as follows:—Ancient bronzes and their analyses. Modern bronzes, comprising phosphor bronze, silicium bronze, manganese bronze, delta metal, phosphor copper, phosphor manganese bronze, phosphor lead bronze, phosphor tin, aluminium bronze, silveroid and cobalt bronze, their composition, leading characteristics and special uses.

THE ENGINEER.

OCTOBER 3, 1884.

THE NAVY.

WE published on the twelfth of last month an article setting forth the position of the British Navy as compared with that of France. That article was prepared with great care; the sources of information from which it was derived were to some extent exclusive; the data set forth were marshalled in a novel way; and the result of the whole went to prove, in a fashion absolutely conclusive, our Navy to be at the present moment barely equal in strength to that of France. Our statements attracted the attention they deserved. The *Morning Post*, by reproducing them, took care that they should reach the ears of a non-technical, but intelligent, public; and the *Saturday Review* summarised our statements, and referred to them as a "remarkable article which appeared in THE ENGINEER, which has, we trust, been as widely read as it deserved to be." Our contemporary, the *Pall Mall Gazette*, less honest, and imitated by other journals less competent, without saying one syllable concerning the source of its inspiration, followed THE ENGINEER with an article ten columns long, to the same effect. This united action has borne fruit, and the weakness of the British Navy is talked of everywhere. The late First Lord of the Admiralty has lifted up his voice with effect. Sir William Armstrong has, in public, urged the construction of fast cruisers. What we have said has been translated into various French journals, and we need hardly say that our statements have given satisfaction in France. All this publicity has not elicited a single expression of denial. Sir Thomas Brassey's arguments do not need demolishing, for they are unable to support themselves. No one, so far as we are aware, has attempted to dispute the accuracy of our statements; the propriety of our estimates of the relative naval strengths of the two nations; or the soundness of the deductions we have drawn from our figures. It may be taken as indisputable, that the Navy of England is at this moment barely equal in fighting power to that of France, while the combined fleets of France and almost any other naval power would be far more than a match for England.

Such a statement means much more than Parliament, at all events, seems to suppose. If we attempt to reason on the subject with the optimist section of the public, we find that two or three stock arguments represent the sum of human intelligence so far as it is concerned. These arguments are:—That our shores are well defended by forts; and that British waters could be so thickly sown with torpedoes that no hostile ironclad dare enter them; that one English sailor is worth five Frenchmen, and so on. We have even been told on the one hand that we have now as many ships as we can find crews for; and, on the other, that there is no use enlisting more men, because we have no ships into which to put them. Lastly, it is urged that it is waste of money to build ships of war. Some of these arguments may be dismissed as unworthy of serious attention. The first is, no doubt, that mainly responsible for our naval weakness, and it consequently demands refutation more than any other—and this although nothing can be more erroneous than the assumptions on which it is based. Let us suppose, for a moment, that war were declared between England and France, and consider what would take place—how, in short, the war would be carried on. It will be at once conceded that France could not permanently hold English territory. That would be prevented by Germany, if by no other nation. On the part of England such a war must be purely defensive. We have no troops with which to invade France, and, if we had, we should not use them for the purpose. We do not want French territory, nor do we covet our neighbour's goods. In short, neither country would or could waste time and life in invasion or attempts at invasion. France might, indeed, make demonstrations, like that of Hoche in the last century on the coast of Ireland; and so might we. As a matter of fact, France could bring England on her knees, without ever sending a war ship within sight of her shores. Our coast defences of all kinds would be about as useful as Greenwich Observatory or the Tower of London. Their existence would be ignored by an enemy, whom they would in no way incommode, simply because he would never go near them. France would attack, not England, but her commerce, and in doing this she would be perfectly successful. It may be said that in writing thus we are only going over old ground, and using arguments that have often been used before. This, to some extent, is quite true, but we are going further than others have ever gone. We wish to show that France, at a very moderate expenditure of life and treasure, could ruin England. This is a point which is entirely overlooked by all writers on the subject. Napoleon Bonaparte perfectly understood the system, and only failed to carry it out because we had too many frigates. In 1779 we had 293 ships of the line, 258 frigates, and 557 smaller vessels of war, while France had but 87 ships of the line, and 60 frigates. This numerical superiority gave us an immense advantage. In fact, without it, the ruin of the nation would probably have been complete. It is generally assumed that for France to carry on a war with England would be an enormously expensive affair. In truth, it would be nothing of the kind. France would have to do very little indeed. We have recently been told so by French authority. Her armoured ships might be kept in harbours, to defend them, with all the advantages that position could give, from English attack. Her armies need not leave the shores of France, and yet in less than one month France could completely upset all our commercial relations, and go a long way towards starving us into submission. The work would be done by light, fast, cheap cruisers, which would play havoc with our mercantile marine. The story of the Alabama and Captain Semmes should never be forgotten. A single unarmoured, and not very speedy steamer, commanded by a resolute sailor, actually swept the merchant ships of the Federals off the sea. What would fifty such ships do with our commerce? It is true that large numbers of vessels might be transferred to a foreign flag, and in this way a certain amount of commerce might be carried on; but it requires no special knowledge to understand that trade worked under such difficulties and restrictions as would exist would not be worthy of the name of trade at all. We are told—and no doubt with truth—that even moderate Government changes in certain directions, as, for example, embodied in Mr. Chamberlain's Merchant Shipping Bill, might work serious mischief; if so, what would be the effect of wars fought out on the ocean, under conditions which would effectually drive the British flag off it? British ironclads might thunder against French forts; they might fight naval battles until the French fleet was wholly consumed; yet the progress of events would be uniformly disastrous for England, and this must be so as a result of the adoption of tactics which we are totally unprepared to deal with. All comparisons of naval strength must be misleading as far as this country is concerned if they are based solely on ironclad fleets, simply because ironclads are not the only weapons with which we could be attacked, nor are they the weapons from which we have most to dread. If it could be shown to-morrow that England had twice as many ironclads—line-of-battle ships—twice as powerful as those of France, there would hardly be less cause for anxiety than we have now. The conditions of England's existence are different from those of every other powerful nation under the sun; and it by no means follows that because ironclads are good things for France or for Italy, they are also good things for England.

We write thus because the present wave of popular feeling will probably possess sufficient force to compel the Government to add largely to our naval strength, and it is to the last degree important that a mistake should not be made in the direction taken in building more ships. We do not say that more ironclads should not be built; but we do say that if the sum to be expended is limited, then it ought to be devoted to the construction of vessels competent to clear the seas of the only foes which our mercantile marine need really fear under existing circumstances. France dare not send her ironclad ships far from home, because they might be wanted at any moment to prevent a British descent on her coasts. England, for the like reasons, must keep nearly all her line-of-battle ships at home. The two heavy fleets would thus be employed in watching each other, while the lighter and swifter class of ships which France might employ for the purpose would so harass our merchant ships that, as we have said, they would not dare to attempt to leave harbour. In Nelson's time, and before it, our commerce, comparatively small as it was, could not have been carried on at all without the aid of a multitude of fast frigates intended to beat off the enemy's privateers, and to act the part of convoys. In the present day the tactics of the last century would still be employed. The method of fighting adopted would be the same, only the weapons used would be different. The urgent want of Great Britain at the present moment is the equivalent of the old-fashioned frigate. We ought to have at least twenty-five new and extremely fast ships, unarmoured, but mounting shielded guns of very great power, and plenty of machine guns. Such vessels, of moderate dimensions and moderate price, would be no contemptible foes, even for the most powerful ironclad afloat. The guns of such cruisers might easily be of sufficient power to punch 14in. or 15in. of armour, and their superior speed would enable them to fight ironclads, if driven to it, just how, when, and where they pleased. It would, however, be quiet foreign to the purpose of this article to go deeply into the question of the merits of such cruisers. There is a universal consensus of opinion that cruisers of the kind are wanted. Our purpose will be served if only we can succeed in convincing the country that such ships are far more necessary to England at the present moment than enormously expensive ironclads. But it must not for a moment be forgotten that there are cruisers and cruisers. We have now in the Navy several useless little ships called cruisers. They do not carry an armament with which to fight, or engines with which to run away. Nothing could be worse policy than to build more vessels of this type. The cruisers we want are entirely different craft.

We have space now to consider but one more of the arguments we have named as being urged against an augmentation of our naval power, namely, that money spent on ships of war is money wasted. In one sense of the word this is quite true. It is in the same way true that the money spent on the maintenance of a police force is wasted. On the other hand, seeing that human nature is what it is, it is impossible to regard an expenditure which adequately protects life and property as waste. But there is another point which must not be lost sight of. We are, as a nation, in the fortunate position that we can produce within our own shores everything that is needed for a ship of war. When a million sterling is spent on the Navy, it goes into British pockets, and employment is found for men who would otherwise be idle. For considerable classes of the community the construction of an ironclad is simply an unmixed good, and the fact should not be lost sight of as it often is by certain political economists. Here we leave the subject for the moment. We cannot conclude what we have written with more appropriate words than those of the *Saturday Review*:—"Dealing only with what is certain, the position appears to be as follows: Dependent in the most literal sense of the words on other countries for our daily bread, and obliged, therefore, to guard our food supplies in case of war; with a vast commerce to protect and with no defence but the Navy—not having a great standing army as other European countries have—we have an ironclad fleet which is somewhat superior to that of France, but may before long be equalled, if not surpassed, by her, and an unarmoured fleet larger than hers, but in no way adequate to the work it would have to do in war." Just so; in no way adequate to the work it would have to do. To supply an unarmoured fleet of the proper kind, and that without delay, is the paramount duty of any Government with the true interests of the country at heart. "To be at peace we must be prepared for war.

FIRE RISKS IN LONDON AND IN NEW YORK.

The "Transactions" of the American Society of Civil Engineers for last June contains a paper by Mr. Edward B. Dorsey "On Fires in Cities." Any publication treating of the preservation of life and property must be interesting to a nation like Great Britain, and of all risks to which both life and property are subject with us, fire stands foremost. Mr. Dorsey selected London and New York as typical cities, and commencing his paper with an analysis of the respective conditions, favourable and unfavourable, for preserving property in both from fire, he draws conclusions from that analysis which, while showing that London is the safer city of the two, gives the reasons why it is so, and these form a valuable lesson, teaching what we should do now and hereafter not only to maintain our present degree of safety, but to increase it. We are aware that much of what Mr. Dorsey told his hearers and tells his readers is not new, and that the principle enunciated in his paper may be admitted to be correct by all who have given their attention to its subject. But the immense value of the property stored, even within the limits of the Lord Mayor's jurisdiction, so much of which is stored, too, in a manner contrary to that principle, leads us to say that public attention cannot be too often or too forcibly directed to the matter with the view of improvement.

We may divide the list of advantages possessed by London over New York, as named by Mr. Dorsey, into three sections—prevention, isolation, and facilities for extinction. Under the first title may be placed (1) the use of more brick and less wood in buildings; (2) the absence of all frame buildings; (3) absence of all wooden additions, outbuildings, or timber fences; (4) fireproof roofing; (5) absence of ash barrels or boxes; (6) the mildness of the winter climate; (7) the greater care exercised by the authorities in prohibiting the manufacture or storage of combustible materials in the populous portion of the city. Under the second title comes (1) the high and effectual fire walls between adjoining houses; (2) the moist or wet climate which prevents sparks or weak flame from igniting wood; (3) the parks and River Thames which divide the city into distinct sections; (4) the numerous squares, private grounds, wide streets, and railways, all of which are effectual barriers to the extension of fire. Under the third title we place (1) the small size of most of the London houses, which confines the fire to a very limited space within brick walls; (2) the low, strong, well-braced walls, which enable the firemen to approach them without much danger; (3) the great benefit derived from the houses being low and small, enabling the firemen to throw water easily all over them, and with comparatively short ladders to reach their roofs, and also avoiding the great draught drawing the fire up the stairways and wells of high buildings; (4) the very few telegraph wires in the streets above ground which can interfere with the work of the firemen. The author of the paper lays stress also upon the much greater density of population in New York, whose most crowded districts show in round numbers 14 persons per dwelling, while those of London possess about 7, or, taking the figures in another way, the former city has an average population per acre of 208, while the latter holds 191·5. Taking the most densely-populated ward in New York it contains 466 per acre, and the most crowded parish in London has 255.

We must take exception to some of Mr. Dorsey's deductions; these we will deal with first, and begin with prevention. He states that to accommodate the greater population of New York, buildings involving the extensive use of wood are necessary, and this, coupled with the great dryness of the climate, increases the chances of fire. We must dissent from this theory. The risks attending upon the use of wood in buildings depend greatly upon the sort of wood introduced and upon the manner of its introduction. For example, oak, elm, beech, as well as certain hard woods possessed by American builders, though not much imported by us, will, if well seasoned, resist the action of fire for a longer period than some of the so-called fire-proof substances, such as limestone, granite, cast, and even wrought iron, all of which the captains of our own Fire Brigades have often shown to fall easy victims. Stone splinters, cracks, or calcines; cast iron either melts or else, if struck with water while hot, splits in pieces. Hard, well-seasoned wood, where uncovered by plaster or other protection, should be round in section and of good, stout scantling. Unfortunately, however, hard woods are either too expensive, or not procurable of the requisite straightness. Softer woods, such as the pines, so extensively used for building purposes, are highly inflammable, especially pitch pine, but they may be rendered much less combustible if chemically treated; and even without such treatment may be and are constantly introduced with much safety, simply by being protected by a brick or plaster covering; and perhaps the two best fire-proof materials a builder can use are good, sound brick and well-seasoned timber. In connection with this, we may take Mr. Dorsey's statement that our damp climate influences fires. Here, again, if not positively dissenting, we very nearly dissent. In house basements and damp, low-lying places, or where very porous brick or highly absorbent stone is used, no doubt the adjacent wood-work will become affected, but examples of this sort are not sufficiently numerous to sustain effectually Mr. Dorsey's theory, while destruction from dry rot is not rare, we fancy, even in a humid London atmosphere. Regular painting, also, will neutralise atmospheric influence to a great extent. Besides this, all exposed wood-work sufficiently close to a fire to be reached by dangerous sparks will generally be also within reach of the heat, and even if the weather be very damp such heat would effectually dry up the wood; hence, whatever way we regard it, climatic conditions can and do exercise little influence on fires.

Having said so much of adverse criticism on Mr. Dorsey's excellent paper, in order to preserve public confidence in a very excellent and almost indispensable building material, we turn with pleasure to make favourable comment on the other statements it contains. So far as London dwellings are concerned, their lack of height, as compared with some in New York and other cities, affords all the advantages attributed to it, and while the walls of London houses on a twenty-one years' building lease are ever a topic for the satirist, it would seem that an American engineer speaks of them as being strong and well braced. The advantages possessed by low buildings in cases of fire do not avail, however, to prevent the erection of high ones, nor can they ever do so, for time is money, and men working with each other naturally desire to work as near each other as possible. Buildings used only for offices may be be raised to great heights, because if fire does break out, there is little risk of loss of life, such edifices being only inhabited, except by a housekeeper and family, during the daytime; and, for the same reason, conflagrations are little likely to occur at night, as all the office fires are presumably out at that time; and even if fire does take place, the rooms are not filled with goods, so the firemen can bring their jets to bear with effect. Hence the rules which ought to be observed with other buildings need not be rigidly adhered to for offices. Altogether different are the conditions attending hotels, and warehouses or stores. The great extension in the use of hotels is a natural result of steam travelling, and they are rapidly increasing, both in number and size. The latter condition, involving greater height, they as a consequence break through the principles which Mr. Dorsey affirms must be observed if the greatest safety is desired. We have shown that wood is not dangerous if properly used; but in the immense hotels now erected at least the top story is in some cases constructed entirely of wood; and here is a source of danger, for this system places virtually a pile of faggots on top of the building—faggots so arranged, too, that their rapid destruction by fire if once ignited is almost matter of certainty; and they are at a height beyond the range of ordinary fire engines. Hence such structures demand the greatest care to protect the woodwork, either by chemically treating it or else by coating it with some incombustible substance. Hotels, too, may be built fire-proof with some advantages, because iron can be employed in them owing to the fact that, unlike warehouses, they are not packed with combustible goods. It is, and events have proved it, of no use to introduce iron or stone into buildings which are to be thus filled; the only combustible goods that need be introduced into hotels are the furniture and the draperies, the use of wood floors is not essential, and even if they are used, they may be laid on iron joists and concreted. The whole of the furniture is not combustible. Iron bedsteads and their bedding, carpets, and silk or woollen hangings will not burn, although they may be destroyed by fire. Stone or iron staircases may be constructed, and if fire-places and flues are properly arranged and the electric light used, the public confidence in the safety of our modern hotels can remain undisturbed. The two classes of buildings to which Mr. Dorsey's remarks are peculiarly applicable are places of public amusement—especially theatres—and warehouses. Both classes stand in direct opposition to almost every one of the conditions and principles which have been shown to reduce fire risks to a minimum. Theatres and music halls are not only built to take fire easily, but also to obstruct all attempts to extinguish it. They are in very inaccessible places, which entails that evil and also another still worse—the audience cannot escape rapidly; and to this last cause is due the terrible loss of life attending fires in such structures. If no means were known of increasing the safety of public buildings, it would be the duty of architects and builders to seek for them. Means are known but are not adopted, partly from expense attending or supposed to attend their adoption, and partly perhaps from sheer force of habit; and the terrible lessons taught, not only to ourselves but foreigners also, seem forgotten nine days after they have been received. Builders, architects, and managers are not so much to blame as the public themselves. Not very long ago it was thought inadmissible for the public to interfere in railway management. A long list of shocking railway accidents, however, years ago, excited public feeling so much that railway men were compelled to use locking points and signals, and now continuous brakes are being insisted upon also, and at present, after much rivalry and a battle likely to be hereafter known as the battle of the brakes, there seems a fair prospect of the adoption of the best being forced by public opinion on all the railways in the kingdom; and until the same coercion is applied to managers and builders, or rather on their employers, no radical improvement need be expected in theatres. The remedy, is in fact, in the hands of the public themselves.

Turning from fire to life risks, we direct attention to those threatening property, and it is hardly too much to say that the greater proportion of stores and warehouses are opposed to every one of the conditions of safety enumerated by Mr. Dorsey. They are of great height, they are closely crowded together; in many of them wood is extensively used, and used so as almost to invite fire. Their receiving windows are in most cases closed by wooden shutters, unprotected in any way from spark or flame from an opposite fire; they open right down to the floor level, so that if a shutter takes fire, that fire is quickly communicated to the floor. They are crammed with goods, and the fireman and his hose are obstructed at every turn. Numerous small passages, holes, and corners exist, within which fire can lie dormant, defying all attempts to reach it with water, so that as fast as it is quenched in one place it breaks out in another. Notwithstanding our humid climate the woodwork in these warehouses is dry as tinder; indeed, were such places damp enough to merit all that Mr. Dorsey says, they would be useless, as they often contain goods of a nature easily destroyed by damp. Warehouses are placed in such close proximity, that really we might say of them that they are built only just far enough apart to ensure a good air supply to a fire. The streets dividing them, too, are so narrow that in many places there is not room for more than one or two fire engines. The terrible lesson taught by the great fire in Tooley-street seems already forgotten.

If anyone doubts this, let him visit the block of buildings between St. Mildred's Church in the Poultry and the General Post-office, east and west boundaries, and Gresham-street and Cheapside, north and south. This district contains goods of enormous value, and the fire within its boundaries in Wood-street must still be fresh in the public mind. So long as land is of immense value in the City, so long will buildings and goods be piled like Pelion upon Ossa, and no improvement can be expected until merchants and their customers get rid of the idea that the City alone is the place where business can be transacted. Before the extension of City railways such a theory might be sound, but such facilities exist now for transport, that there does not appear to be great necessity for overcrowding. We do not think we are wrong in stating that each month tons and tons of valuable goods, such as German glass and china, silks, &c., are bought from the docks simply to be sent back again for re-shipment. To outsiders like ourselves this seems a waste of labour. Why cannot firms doing an import and export trade have their warehouses near either the import or the export dock, and thereby save both transport expenses and enhanced fire risks? Were fire to get good hold of some of the warehouses about either the districts we have named, or about Thames-street, Tooley-street, or other like places, no one could tell where it would stop; and although nominally the loss of property falls on insurance companies, in reality it ultimately falls upon the nation at large. As long as we have amongst us hunger, exposure, and rags, a better use can be found for food, dwellings, and clothes than burning them.

THE WIGAN RAILWAY ACCIDENT.

An alarming accident occurred at Wigan on the 26th of August. An excursion train from Morecambe to Manchester broke in two while it was descending the incline to Wigan station, and the rear portion ran into the front portion, which had been brought to a stand. Three persons were injured. The experiences of the driver and his fireman were varied and amusing. The train was a special excursion, of twenty coaches, drawn by a six-coupled goods engine. There was a guard at the front end of the train who could apply Clark and Webb's chain brake to the van and four coaches; there was a guard at the rear end of the train with similar brake power. The driver states that in going up Farrington bank the leading guard put on the brake, and very nearly pulled up the train, without reason. We can fancy how much pleasure this little freak gave a driver doing his best to get up a bank with a heavy train on a wet night. Coming down the incline near Coppul Hall he put the brake on suddenly, and sent the driver and stoker into the corner by the weather board. We are not surprised to hear that the train being thus nearly stopped, the fireman got off the engine to remonstrate with him. The facetious guard told him it was "all right." He then let the train run until it had attained a good speed, when he put the brake on again, with the result of rapidly transferring the driver and stoker from one end of the foot plate to the other, and then he took it off again, with the result that the fireman was jerked over the brake wheel into the coals in the tender. Yet another application, and the train broke in two. The driver expected this would happen, and as soon as the break-away took took place he tried to run on ahead, but the indefatigible guard would not have it. He pulled up the train with full steam on, and the rear portion ran into it. Colonel Rich reports on the accident, and states that the guard was not drunk or incapable. The man denied positively that he put the brake on. No one seems to have suggested that it went on of itself, but this is by no means improbable. Colonel Rich concludes his report with the following outspoken statement:—"I would strongly recommend the London and North-Western Railway Company to adopt one of the automatic continuous air brakes. The company considered the sectional patent chain brake a very good one some years since, when all other unprejudiced persons, who were qualified to judge of such matters, considered it a very faulty mechanical contrivance, and in no way suited to the requirements of the day; and it does not fulfil the Board of Trade requirements. I am informed that the London and North-Western Railway Company are now adopting for their main line trains a collection of several kinds of patent brakes, amongst which is the Smith's plain vacuum, with an automatic arrangement on the last brake coach, by which the brake is brought into action. The railway inspecting officers of the Board of Trade were asked by the company's locomotive superintendent to inspect this arrangement about two years since, when it was applied to the Irish Mail. All the inspecting officers disapproved of it after inspection and consideration. I understand that the London and North-Western Railway Company propose to continue the use of the chain brake on their local and branch trains. I would suggest to the directors the desirability of giving this matter their consideration. The liability they are incurring by using an inferior kind of brake, which does not comply with the requirements of the Board of Trade, and the outlay that the company are incurring by fitting their stock with brakes which cannot be approved, and which must sooner or later be again changed, are serious. The company should be warned, by the slight collisions that have occurred on the railway with the brake now used, all of which have cost money, and many of which would have been prevented by the proper use of a good, continuous, automatic brake. The automatic air brakes have now been successfully used for several years by many of the large railway companies in the United Kingdom. They meet the requirements of the Board of Trade. If the special train had been fitted with a good automatic continuous brake, this collision would not have occurred." The dangers attending the use of inefficient brakes have been the subject of much writing lately, and are likely to be the subject of a good deal more, if steps are not taken to prevent their use. The failures of vacuum brakes are not confined to one or two causes, but, on the contrary, offer a certain amount of variety, which, however, is in no way calculated to remove the very unpleasant feelings which those who read and note, their experience when tearing down some of the steep inclines on certain railways. The 11.55 a.m. express from Manchester to London, *viâ* Leicester, was recently deprived of its brake power, under circumstances which might have been very critical. When running, between Leicester and Bedford, at a speed of over sixty miles an hour down a heavy gradient, the vacuum in the gauge suddenly disappeared. This should have at once applied the brakes on the whole train, and it might have done, but if so, they took no effect at the high speed, and the train proceeded to London without brake power other than that provided by the hand brakes on the vans. It was afterwards found that the copper vacuum pipe was broken under the foot-plate. Had the Manchester train met with similar circumstances to those at Penistone, we should have had a repetition of that calamity, although the train was fitted with the Midland Clayton brake, which professes to comply with the Board of Trade conditions, but which the Inspectors have frequently condemned, and not without good reason. Whether it will be necessary to wait for a repetition of the Penistone disaster, before some steps are taken for the better protection of those who use the Midland route, remains to be seen.

NEW RAILWAY IN WESTERN AUSTRALIA.

THE Legislative Council of Western Australia has accepted the proposals of Mr. John Waddington for the construction of a railway from Guildford to Geraldton. The proposal was first made in November, 1883. The district around Geraldton is said to be the richest in mineral treasure in the whole colony, while the fertility of the land between Guildford and Champion Bay, through which the proposed line is to run, is said to be greater than that of any other part of the colony. The line will pass through Northam, Newcastle, Toodyay, Bejoording, to New Norcia, on to Berkshire Valley and Dongarra districts, whose progress has been much retarded by the lack of facilities of transit to a port, but which have flourished. The total length of the line will be about 300 miles, and as the district through which it passes presents no steep gradients, and offers no special engineering difficulties, it is anticipated that a single line of the usual 3ft. 6in. gauge will not cost more than £3500 per mile fully equipped. On the completion of every section of 20 miles the Government will grant to the concessionaire 12,000 acres of land, which the latter will have the opportunity of choosing in blocks within a belt extending at least thirty miles on each side of the proposed route. The amount of land to be ultimately available for the benefit of the concessionaire is roughly put down at three and a half millions of acres. There are a good many who hold the opinion that it is not wise for the colony to give away its lands in this wholesale manner, and that the money for the construction of the proposed line should have been raised by means of a loan. The total debt per head of the population, however, is already over £12, and over £1,000,000 would be required for the construction of the line. Although this colony is the largest of the Austral group—having an estimated area of over 1,000,000 square miles—and is by far the nearest to England, the distance between port and port being only 10,950 miles—the popularity of the colony has never been very great; yet its climate is admitted to be one of the finest and most salubrious in the world, the mortality of Western Australia since its occupation having averaged only 1 per cent., while the last census returns show ¾ per cent. only. The chief cause, no doubt, is the poorness of the soil in many parts, although in one respect the country is eminently suited for pasturing purposes, the severe droughts and the heavy floods experienced in the other Australian colonies being unknown in Western Australia.

THE STEAM ENGINE MAKERS' SOCIETY.

THE secretary of the Steam Engine Makers' Society in his report for the past month, just issued to the members, expresses regret that the sanguine anticipations which were entertained a few weeks back with regard to the prospects of an improvement in trade have not been realised. Taking the number of unemployed as a test, the decline in trade would seem rather to have further extended. The chief centres of depression, however, continued in the shipbuilding districts, the reports from nearly all these being still of a depressing character, and when the fact that in many of the marine engineering centres of industry the society men were in a minority was taken into consideration, the considerable percentage of their own members who were unemployed must show that there was a large percentage of the working class waiting for work. They could not, however, see that there had been any serious decline at stationary engine, locomotive or tool works, their returns from these branches being much the same as in previous reports, and the Lancashire branches, with the exception of those on the coast, were fairly well employed. The number of members now on the books of the Society in receipt of out-of-work support amounts to about 3 per cent. The report also refers to an attempt made by one of the Barrow firms to reduce wages, but this had been met by the men ceasing work.

THE UNDERGROUND HAULAGE OF COAL.

ONE of the companies which mine coal in the extreme south-eastern portion of the Durham coalfield is now substituting machine haulage for that of horse-power in its colliery, and though the result cannot be yet stated in detail, it is probable that it will in the end lead to good results in the shape of lessened expense of haulage. This is one of the things that needs to be kept in mind, increasing in the coal trade as the colliery grows older, and as the distance of the coal from the shaft becomes greater or surrounded with some of the difficulties that are often known to exist in mines as they grow older. It is impracticable to at all times sink new shafts or alter the course by which coals are brought to the surface; but one of the items of expense that continually grow under certain circumstances. is the cost of the transit of the coal, a cost that grows even with the yield, for, there is under the general plan a larger staff of horses to be kept, larger stables, and other attendant expenses. If, then, the system of haulage by machinery can be substituted cheap and efficient, there would be an enormous gain to the coalowner. This has been shown to be practicable in other parts of the coalfield of the country, and the attempt to carry out the system in that part of the northern country to which we have referred, is one which has great interest—the more so when the circumstances of the winning and working of coal there are borne in remembrance.

ANOTHER MANCHESTER SHIP CANAL SCHEME.

WE have received from Mr. James Johnson, a veteran engineer of the City-road, Manchester, a number of letters concerning a new scheme for the construction of a ship canal between Manchester and Liverpool. These letters are too long and too rambling for publication in our pages. The suggestion they contain is, however, worthy of attention, inasmuch as it settles a host of difficulties at one stroke. It is to construct a high-level canal, which would run over roads and railways, and to keep this canal supplied with water by pumping. Mr. Johnson calculates that 1800 indicated horse-power would keep the canal full. Part of the canal would be in cutting, part on embankment, and it would practically be on a dead level from Manchester to Liverpool. This level would be that of the Bridgewater Canal, while Mr. Leader Williams' canal level is 34ft. lower. Mr. Johnson appears to have gone very fully into his calculations, and certainly makes out a very good case for consideration.

LITERATURE.

The Electrician's Pocket-book: The English edition of Hospitalier's "Formulaire Practique de l'Electricien." Translated, with additions, by GORDON WIGAN, M.A. Cassell and Co. 1884.

IT is difficult to notice this work without instituting a comparison, but nevertheless we shall attempt to avoid comparison, because we think there is room for more books than one of this kind. Indeed, we may go so far as to say that although the work above mentioned is called a pocket-book, we incline to doubt the title. At any rate, the volume is 6·5in. long, by 1in. thick, and if many more are issued correspondingly increasing in size, the tailors will have to devise new patterns of pockets. Putting aside the frivolous consideration of mere size in connection with pockets, and coming to the more weighty matters, we may say at once that the compiler has throughout the book shown a lively appreciation of the wants of electrical engineers. The work is divided into five parts, each dealing with a separate branch of the subject, having a very complete table of contents, and an index. While Mr. Wigan is responsible for the translation and the additions to Hospitalier's work, he duly acknowledges the assistance he has received from various sources, and especially to that of Mr. A. J. Frost, who corrected the final proofs, &c., when the translator was unable to attend to any business.

The parts into which the work is divided are as follows:—(1) Definitions, First Principles, General Laws; (2) Units of Measurement; (3) Measuring Instruments and Methods of Measurement; (4) Practical Information, Applications, Experimental Results; and (5) Recipes and Processes. Each main division is again split up into sub-divisions, and the subject matter is brought prominently to the eye of the reader by the judicious use of Clarendon type, giving a distinct entity to each paragraph. We are not quite sure that a better title for the book would not have been a pocket dictionary, for it partakes more of the nature of an electrical dictionary than of a pocket-book. We do not pretend to have done more than looked through the original book of Hospitalier, reading more carefully some of the pages, yet we have been struck with the general accuracy of the figures. Generally, in any book containing figures, there will be, however careful the editor and reader, a fair amount of errata. But in a few pages of the translation we notice too many figures which should be altered. Thus, on page 41, "Paris, 1871," should be "Paris, 1881;" same page in table, the – sign has dropped out, and $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{2}$ should be $M^{\frac{1}{2}} L^{\frac{3}{2}} T^{-2}$. Instead of the foot note page 43, Lord Rayleigh's measurement, accepted by Sir W. Thomson, viz., ·98677, should have been given. On page 47 ·9935 should be ·9985, and on page 48 should not 10^{9} be 10^{10}.

We have similarly tested other pages of the book at random, but have not found many errors, so that we are fain to believe that by some mischance the sheet containing the pages above mentioned slipped through without the final corrections. The value of such works depends mainly upon accuracy of figures, and it is because of the general excellence of this work that we have ventured to say so much about figures. The amount of information given is very great. Every book, every periodical, and every series of experiments of repute seems to have been laid under contribution and the gist abstracted for use. Details are collected here that will not be found between the covers of any other book; and not only are details given, but they are such details as are required in practice and not such as commend themselves to a mere bookmaker. M. Hospitalier evidently knows from experience what is wanted, and has not followed the fashion of giving this or that matter because certain tables were required or because certain men framed the tables. Utility with authority combine to secure a place, but the latter without the former is ignored; and would it not be well in future editions to make the columns of the tables relating to the details of dynamos similar throughout, that is, have the same columns of details? Thus, p. 239 we get ten columns of details of Siemens machines; on p. 238, five columns for Schucker's machines; on p. 240, eleven columns for Edison; on p. 241, four columns for Edison-Hopkinson, and so on. One more suggestion, viz., an extended index; we look for "meter," but it is not in the index yet; p. 80, 81, 82, &c., we note Ayton's, Carden's, Crompton, and Kapp's, and other "meters," or "ammeters," or "indicators" mentioned. The book is far too valuable to be put aside because of these minor blemishes, and we refer to them merely as suggestive that the editor should, by removing, them, increase still more the utility of the work.

TORPEDO CRUISERS.

A LARGE number of Royal Engineer officers have been making a tour of inspection of some of the principal engineering establishments and works in the country, under the guidance of Colonel Seddon. Amongst other places of interest they have visited the large engineering and shipbuilding works of Messrs. Palmer Bros. at Jarrow-on-Tyne, the Forth Bridge, and the works of Messrs. J. and G. Thomson at Clydebank. The last-named establishment has been recently very much enlarged, and is now the largest shipbuilding and engineering works on the Clyde. As the builders of such well-known river steamers as the Columba and Iona, and such Atlantic liners as the Servia, Aurania, and America, as well as a great variety of cargo and passenger steamers, the reputation of this firm is well-established. But though the types of vessels produced by them is very varied, they probably have never had such a difficult task to perform as they have undertaken in the building of the torpedo cruiser Scout, which they have been entrusted by the British Admiralty to carry out. As this vessel's armament consists principally of torpedoes, she was inspected with especial interest by the Royal Engineer officers, who are generally as intimately acquainted with the working of torpedoes as are the naval officers. In view of the recent discussions upon the state of our Navy, we have thought that it may not be uninteresting to give a description of this latest novelty in war ship design, or, rather, as much of it as was shown to the engineer officers in their recent visit to the Clyde.

The Scout is a vessel of 1500 tons displacement, her length being 220ft. between perpendiculars; breadth, 34ft. She is built of steel throughout, and her form is not unlike that of the cruisers of the Iris and Leander class. She has a long, closed-in forecastle, high bulwarks in the waist of the ship, and a long, closed-in poop. On the forecastle is an armoured conning tower, 2in. thick, and also two 5in. guns, mounted on the Vavasseur carriage. On the top of the high bulwark amidships there are six Nordenfelt machine guns, which will be worked from behind the topsides. On the poop, at the fore end, are two other 5in. guns, mounted similarly to the forward ones. Ranged along the upper deck are ten torpedo-launching tubes. Two are fixed, the remainder having varying degrees of training. There are three under the forecastle, one of which fires right ahead, the other two on the broadside. Four are arranged in the waist of the ship, and therefore in the open, and two on each broadside. The remainder are under the poop on each broadside, and one capable of firing right aft. In addition to these ten there is one under-water torpedo tube in the bow, which will fire right ahead. The lower deck forward is occupied by a crew space, store-rooms, and workshops for torpedo gear. Amidships the deck is formed whale back shape, and is ⅜in. thick; the outer edge of it extends down to about 3ft. below the water-line. The space over this deck is occupied at the middle line by machinery openings, air hatches, and stokers' rooms, but the sides for about 6ft. are occupied by coal bunkers for the whole length of the machinery space. Coffer-dams are fitted round all the openings, so that though the lower deck over the machinery is only ⅜in. thick, the protection afforded by the coals and stores is very great. The lower deck aft is occupied by the officers' quarters.

Below the lower deck forward, and therefore below the water-line, are the magazines and store-rooms. Abaft of these, and occupying a total length of over 100ft., are the machinery and coal. There are four boilers of the Navy type, each 10ft. diameter by 18ft. long, in two separate boiler-rooms. The sides of these spaces have coal bunkers about 5ft. thick, affording good protection to the boilers. There are two pairs of horizontal engines, each capable of developing 1600 indicated horse-power, and each driving a separate screw. The cylinders are 26in. and 46in., and have a stroke of 30in. The boiler pressure is 120 lb., and it is expected that the engines will run at about 150 revolutions per minute. Arrangements are made for working the boilers by forced draught in closed stoke-holes, as well as with natural draught. It is anticipated that about 2100 indicated horse-power will be developed with natural draught, but 3200 with the forced draught. All the refinements usually adopted in war-ship engines are introduced here, and every contrivance to save weight is adopted. It is confidently expected that the weight of machinery complete will not exceed 320 tons, which is about 2 cwt. per indicated horse-power. If the horse-power expected is realised this will be a wonderful result for sea-going engines. Abaft of the machinery the space is occupied by a steam steering engine and steering gear, magazines and store-rooms. The steering gear is wholly under water, the stern being swelled out in a long easy line to give sufficient space to work the gear. The twin screws are carried from cast steel brackets passing under the keel. The stern and stern post are of cast steel, made by the Steel Company of Scotland. It is expected that the Scout will steam at 15 knots with natural draught, and 16½ knots with forced draught.

If Messrs. Thomson succeed in realising the powers and speeds expected, the Admiralty will be in the possession of a very valuable vessel. She will virtually be a sea-going torpedo boat, and one which will be capable of keeping the sea with a fleet. She has gun power enough to enable her to give a good account of herself against any unarmoured vessel of greater speed, though these will be very rarely met by her. Her own great speed will enable her rapidly to close with a slower antagonist, and with such a powerful torpedo armament she can scarcely fail to succeed in hitting her. The cost of one of these vessels is not great, we believe not more than £70,000 complete, and we think that if the recent revelations about our Navy lead to spending more money at once upon our ships, the Admiralty would act very wisely if they ordered three or four more of the Scout type. From what we know of their construction they seem to be vessels which have been designed with the greatest care, but they can be very easily duplicated, and in the present depressed state of shipbuilding it is not unlikely that they could be produced for considerably less money than the sum mentioned above. We have heard that representatives of other Powers are watching this type of vessel very narrowly, and that it is not unlikely they may place orders for duplicates in this country.

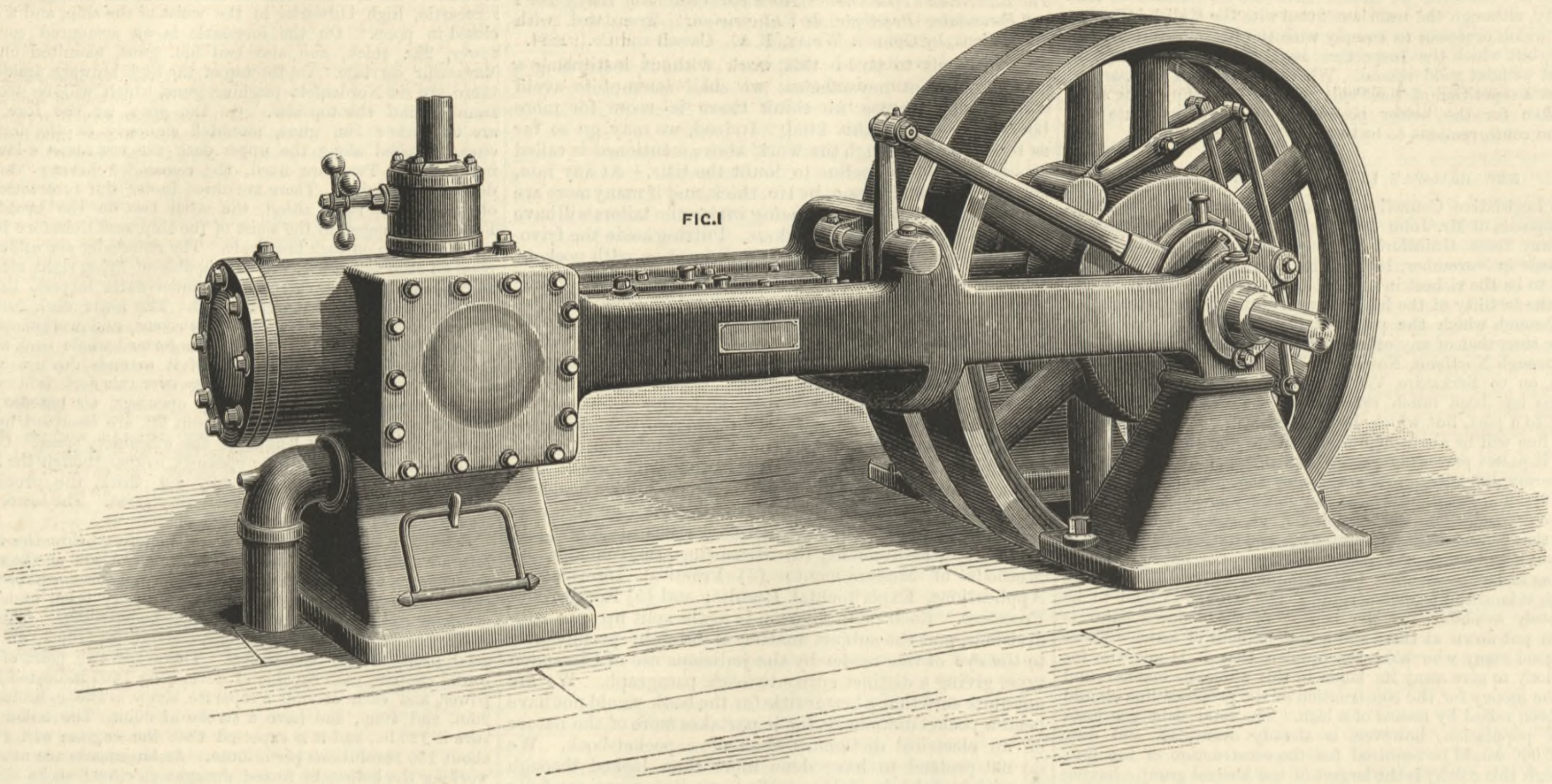
The torpedo-launching apparatus will not be completed in these ships for some time, so that the part which was most specially interesting to the engineer officers was not to be seen. They, however, saw a great deal in the vessel to interest them, and also went through the whole of the newly laid-out works of Messrs. Thomson. They also spent a considerable amount of time in the drawing and designing departments of the works, and were very much interested in the scientific apparatus and investigations shown them by Mr. Biles, the naval architect of the establishment.

REVERSING RAIL MILL ENGINES.

THE accompanying engraving represents a pair of high-pressure rail finishing engines, recently erected by Messrs. W. and J. Galloway and Sons, Knott Mill Ironworks, Manchester, for the Cyfarthfa Works of Messrs. Crawshay Brothers, South Wales, under the approval of their consulting engineers, Messrs. Williams and Godfrey, of Middlesbrough. The pair of engines has cylinders 50in. bore, and a stroke of 4ft. 6in., the pistons being unusually deep, to dispense with back slides. The crank shaft is of the double sweep description, with journals 18in. diameter, the crank pin being of the same diameter by 15in. long. As will be seen from the engraving, the framing is of most substantial character, and one of the principal features in connection with these engines is the arrangement of the steam admission and exhaust valves, which consist of simple flat plates, which are found in practice to maintain during wear their original efficiency and tightness. The exhaust valves being placed underneath the cylinders, enable any water that may pass into the cylinders to be discharged freely, without the necessity for special relief valves. The engines are fitted with link motion of the Allen type; the reversing is effected by a steam cylinder, the piston being suitably cushioned, and actuated from the stage where the driver stands.

We may say that Messrs. Galloway have also constructed for the same firm cogging engines of similar type, but of somewhat smaller proportions, having cylinders 40in. bore by 5ft. stroke, the crank shaft being geared to a second motion shaft by means of spur wheels 8in. pitch, 24in. width of tooth, shrouded at both sides, the second motion shaft varying from 20in. to 24in. diameter. Both pairs of engines seem well suited to their work, of extra strength, and, we have no doubt, will thoroughly fulfil what is expected of them.

STRAIGHT LINE ENGINE, PHILADELPHIA EXHIBITION.



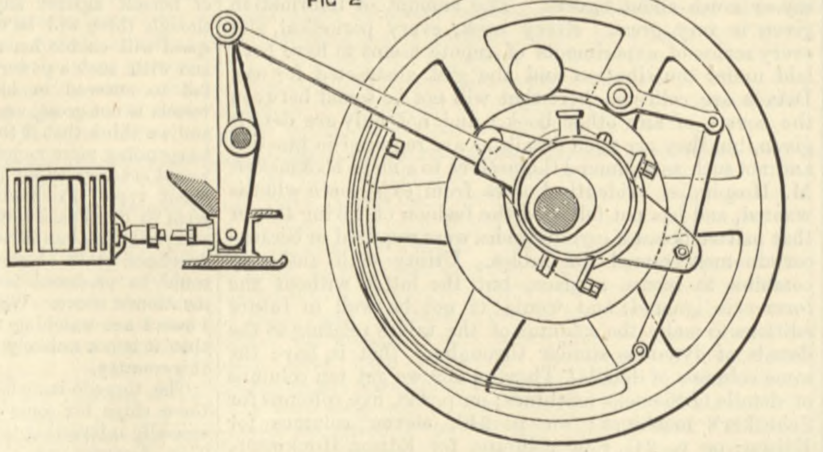
THE PHILADELPHIA ELECTRIC EXHIBITION.

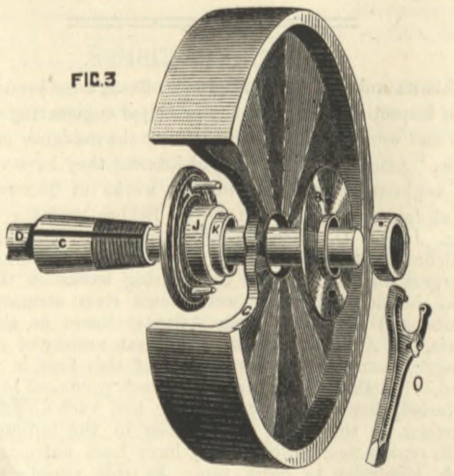
In accordance with the plans laid down and announcements made, the International Electrical Exhibition, under the auspices of the Franklin Institute, was duly opened on September 2nd. Compared with former exhibitions this is the smallest as regards space occupied, but one soon sees that the affair is of a highly practical character, and that there are many high-class exhibits and fewer of the galvano-medical and silver-plating class. The building, which is constructed of rough wood with little attempt at internal decoration, is in West Philadelphia, and is easily reached by the tramway which passes over the Schuylkill by a singularly frail bridge consisting of wooden lattice work. The history of the construction is that during the Centennial Exhibition an extra bridge was required, and this was put up as a temporary erection in the short space of thirty days. It has been condemned as unsafe for some time, and the work of building a permanent structure is slowly progressing.

As regards the international character of the Exhibition, one is struck by the almost entire absence of the well-known European exhibitors. All that are represented have placed their goods in the stands of American firms; for instance, the stand of the Electrical Supply Company, of New York, includes a splendid collection of measuring instruments from Elliot Brothers, Callender's bitumen covered wire, which is largely employed both for overhead and underground work, and Hedges' patent cut-outs and safety fuses, which are also used for the protection of the electric wires in the building. The arc light is well represented by the well-known systems of Brush, Weston, Hochausen, as well as the newer inventions of Thomson, Houston, Van der Poeler, and the Western Electric Company. The incandescent display is represented by only a few exhibitors, the principal being the Edison Company, who have a most magnificent show of some 2000 lamps, maintained partly by one of the large 1600-light dynamo machines, which is shown at work. The Weston system, exhibited by the United States Electric Lighting Company, is very complete, and is the most interesting in the Exhibition, in that it embraces some sixty-five Weston arc lamps, 1100 16-candle power lamps, and 160 large incandescent lamps of 125 candles each. We intend shortly illustrating this system, which has undergone considerable alteration. The gridiron form of filament introduced by Maxim has been discarded for a serrated kind, which is made from thin sheets of celluloid, the exhaustion process being carried out at the Exhibition by means of a specially designed mercury pump. Both Edison and Weston show their most recent designs for working incandescent lights at a distance, with high electro-motive force and corresponding saving of copper. It is well understood that any system of incandescent lamps must be supplied in this manner, in order to compete with the cheaper arc light, which owes some of its success to the ease in which the No. 6 b.w.g. wire can be led into the building to be lighted.

The motive power is obtained from several descriptions of steam engines, one of the most novel, and at the same time the most practical, is that known as the straight line engine, which has been designed by Mr. J. E. Sweet, especially for electric light work. The general arrangement, Fig 1, is not unlike other high speed engines, but in details, we find, has many points of novelty. The slide valve is worked by a single excentric, which is shifted by a governor, Fig. 2, automatically controlling the cut-off, as the excentric is so pivotted and the valve motion so designed that the steam admission or lead is constant. The excentric can be shifted from its greatest throw, which gives steam during three-fourths of the stroke to its least throw, which only equals the lap of the valve, and as the governor is very powerful, and the work it has to perform is light, the speed is maintained practically uniform independent of the work. The engine exhibited at work is one having a 10in. cylinder by 16in. stroke, it runs at 222 revolutions per minute, and indicates 50-horse power at its maximum speed. The line of shafting driven by this engine runs at the high speed of 350 revolutions—in fact, all shafting may be taken as running much faster than is common here. Most of the pulleys, both on the dynamos and shafting, are of the class shown in Fig. 3. They are constructed of wooden segments with wooden rims, securely built on, and are fixed to the shafting either by a taper sleeve or by bolting on in halves. A better adhesion of strap is secured by their use, and a lighter shafting will carry them. American practice seems to favour high speed horizontal engines, but the single-acting rotary kind is also represented largely by the Westinghouse and Brotherhood engines, which we have already illustrated. In order to facilitate the work of the Board of Examiners, the Exhibition has been divided into twenty-nine sections, of which all the details have been settled. Each section will send a report in to the executive committee, which will publish the results. The examiners have already commenced, and by the plan of subdivision it is expected that their labour will be much facilitated.

FIG 2

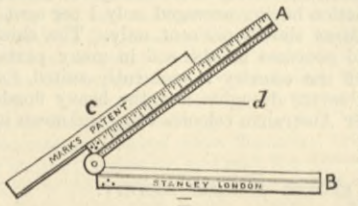




THE old German ironclads, Kronprinz and Friedrich Karl, are to be equipped with torpedo apparatus.

MARK'S LINE DIVIDER.

THE instrument illustrated below is made by Mr. W. F Stanley for dividing any space into a number of equal parts. The following is a description of the parts:—A B a hinged rule with firm joint, the limb A fitted to slide in an undercut groove upon the plain rule C. C has needle points on the under side to prevent it from slipping when placed in any position. The limb A of the rule is divided on both edges into eighths, quarters, half-inches and inches, which are consecutively numbered so that any set may be taken. As an example of the use of the line divider, suppose the space *d* to *e* is to be divided into any number of parts—say thirteen. Taking the half-inch line, hold the rule B on the line *e* and open the rule A until the division marked 13 on the inside edge is coincident with the line *d*; now notice that the single line on the rule C is opposite the 13, and in this position press it down so that the needle points on the under side get sufficient bite to prevent it slipping; placing the fingers firmly on C, slide the part A upwards so that it may stop consecutively opposite each of the thirteen divisions, as indicated opposite the line on the rule C, a pencil line drawn along B across *d e* at each stoppage opposite the numbers 12, 11, 10, 9, &c., will give the required divisions. To produce the lines in ink, the rule, after setting, may be moved to the upper line first and the division lines be drawn downwards. The rule may be worked in any direction for drawing line, vertical, horizontal, or oblique, and for any division of a space from 2 to 80 parts, and for several other purposes.

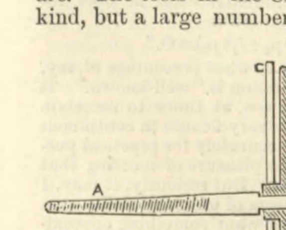


MASON SCIENCE COLLEGE.—The 1884-85 session of the Mason College of Science commences to-day. The Civil and Mechanical Engineering section, which is under Professor Robert H. Smith, includes an extension of the usual studies aided by the new laboratory and workshop appliances, which now include a 100-ton testing machine. The plan of instruction is, firstly, to describe the facts of engineering practice, that is, the tools, machinery and methods used by engineers; secondly, to develope theoretical engineering science as based on these facts; and thirdly, to apply the scientific knowledge of facts and theory to practical problems in engineering design. The whole of the teaching in Professor Smith's classes is practical and technical in its aim, no theory being introduced except such as has a direct bearing upon the problems of professional practice, and no theories being taught until the facts upon which they are based have been fully explained. The practical work in the drawing, exercise and laboratory classes is designed to give familiarity with the processes, calculations, and materials, used in engineering establishments and in surveying. In the laboratory the student makes experimental investigations of the properties of tools, machines, and materials, such as he can have no opportunity of making during an apprenticeship at works. College study cannot, however, supersede the desirability of a formal or informal apprenticeship, but the apprenticeship may be shortened by two or three years if the student follows the engineering course offered in Mason College.

THE YORKSHIRE COLLEGE.—The college session begins on October 7th, when the new and extensive permanent premises of the college will be opened. With the increased facilities offered by these new college premises, a much more complete system of instruction is rendered possible. The engineering courses have been entirely re-arranged, and more extended courses in chemistry and in physics are provided than formerly. The complete courses in civil and mechanical engineering will extend over three sessions, and will comprise lectures on engineering principles and practice, instruction in geometrical and technical drawing, and demonstrations and practice in the engineering laboratory. The work of the classes is not intended in any way to supersede the usual requirements of pupilage or apprenticeship in engineering, and may be attended with advantage, either before or after pupilage or apprenticeship, but those who have their engineering education to begin, are advised to take the college course first. Though the engineering courses are designed primarily to suit students intended to be civil or mechanical engineers, many of the subjects in the civil engineering course are intended for mining engineers and architects, and the mechanical engineers' course, or parts of it, would be for students of electrical engineering. The council of the college have authorised the building of an engineering laboratory, which is to be commenced at once. Mr. Archibald Barr, B. Sc, is the professor of engineering.

THE LONDON AND NORTH-WESTERN RAILWAY WORKS, CREWE.

On Tuesday afternoon the members of the Iron and Steel Institute proceeded to Crewe Works on the invitation of the chairman and directors of the London and North-Western Railway. A special train of seventeen vehicles—which were well filled—drawn by one of Mr. Webb's compound engines, left Chester shortly after one p.m., and arrived at Crewe a little before two, where the guests were received by Mr. Webb and conducted at once to the drawing-office, where luncheon was served. About three p.m. the party were conveyed by the special train to the Bessemer steel works of the company, in which are four converters, one of which was shown in action. A good deal of interest was excited by the process of casting steel wheels, invented by Mr. Webb, and used with excellent results. The tire mould is mounted on a vertical spindle and revolves at a considerable velocity. The molten metal from a Siemens-Martin furnace is brought up in a ladle running on wheels on an overhead gantry and poured into the mould. The centrifugal force drives it powerfully to the outside, and an extremely solid casting is the result. The steel works, which consisted, at the time of their opening in 1864, of a converting house, with two converters, cogging shop, and a small forge, have been much enlarged, the steel-making plant, now capable of producing 30,000 tons of steel per annum, comprising four 5-ton Bessemer converters and five Siemens furnaces. One furnace is used entirely for the production of steel castings, of which the locomotive engine wheels are the most important, these having been successfully cast up to 6ft. 3in. diameter, thus doing away with a great amount of forged work. In 1874 a spring steel mill, and a three-high rail mill for the manufacture of rails direct from the ingot were added. Adjoining the rail mill is the points and crossings shop, which is fitted with tools specially designed for this class of work, and at the time of our visit was partly occupied on Webb's patent trough sleeper permanent way, which seems to be giving very great satisfaction. Next is the boiler shop, where boilers, both locomotive and stationary, may be seen in every stage of construction. The whole of the stationary and locomotive boilers, with the exception of the tubes and fire-boxes, are constructed of steel made in the works. A locomotive fire-box, and a complete locomotive boiler, were sent from this shop to the International Exhibition in London in 1873, both constructed entirely of steel. The greatest care is taken to ensure trustworthy plates for the boilers, test pieces being cut from each plate. A small hole ⅝in. diameter is punched into one of these plates, and is widened out by taper drifts until it becomes a hole 2in. diameter; another is bent nearly double. These pieces are cold when the test is made, and unless they stand these severe tests the plates are rejected. A piece is also tested for tensile strength, and analysed for carbon, and a complete register is kept of all the tests, and the position which each plate occupies in every boiler. In the boiler shops the visitors had ample facility afforded them for seeing the class of work made. Mr. Webb appears to have entirely abandoned the use of steel fire-boxes—at least, we saw nothing but copper being employed for this purpose. The whole of the work is sound and excellent, but not equal in finish to that turned out in other railway shops, where, perhaps, first cost is not regarded as of so much importance. Mr. Webb has the reputation of being able to build cheaper locomotives than anyone else; and it is, we suppose, impossible to combine first-rate finish and moderate price. He is now freely adopting the water bottom fire-box, introduced many years ago for portable engines, and since abandoned. This water bottom has, of course, to be stayed with copper stays 4in. apart. A large manhole is worked in it, and also a rectangular aperture in front, for the admission of air to the furnace. Against all the labour and material thus introduced there is nothing to set off but the saving of a foundation ring; possibly there are other advantages entailed, but we confess we do not know what they are. The tools in the Crewe shops are all good of their kind, but a large numbei are old-fashioned. The tapping of fire-box holes for the stays is effected by a very simple tool, shown in the annexed sketch. A is the tap, B a pulley driven by a fly-rope, and C C two discs or guard plates. These are held by the workman in front of him, and the tap is readily screwed into one hole after the other, the motion of the driving rope being reversed to withdraw it. A device like this cannot be compared with such a machine as that used by Messrs. Aveling and Porter for drilling and tapping their fire-boxes, in which the boiler having been clamped, six drills or taps work simultaneously, the distances and direction of the holes being fixed beyond the possibility of error.



The engines now made at Crewe are the express passenger engines, having outside cylinders 16in. diameter by 24in. stroke, and single driving wheels 7ft. 6in. diameter; the coupled passenger engines, having inside cylinders 17in. diameter by 24in. stroke, and two pairs of driving wheels 6ft. 6in. diameter coupled; the three-cylinder compound passenger engines, with 6ft. 6in. wheels, designed by Mr. Webb, having two outside cylinders 13in. diameter by 24in. stroke, working on to a pair of driving wheels placed behind the fire-box, and a single large cylinder 26in. diameter by 24in. stroke, placed between the frames, and working on to a single crank in the middle pair of wheels. One of the chief features of this class of engine is, that, although there are two pairs of driving wheels, coupling rods are dispensed with, the high and low-pressure engines being free to work independently of each other. There are now thirty of these engines at work. The leading type of goods engines consists of a six-wheel coupled engine, with wheels 5ft. diameter, and cylinders 17in. by 24in.; the coal engines for coal and heavy goods traffic, a six-wheel coupled engine similar to the goods, but with a larger boiler, and wheels 4ft. 3in. diameter, the latter locomotive having been arranged as a side tank engine, with an additional pair of wheels, fitted with radial axle-box under the trailing end, to carry the hind tank and coal bunker. There is another class of goods engine for express traffic with six coupled wheels 5ft. diameter, and a boiler the same as the coal engine, but having cylinders 18in. diameter by 24in. stroke. The total number of locomotive engines in stock at the end of May, 1884, was 2462.

Outside the offices were drawn up specimens of all the engines we have described. The compound system was represented by the Dreadnought, a larger engine than anything yet built of its sort, and intended, we believe, for the Carlisle traffic, which is carried on over very heavy gradients. The Dreadnought has 6ft. driving wheels, the two high-pressure cylinders are 14in. each in diameter, and the low-pressure cylinder is 30in. in diameter, the stroke being for all 2ft. The boiler-pressure is the highest yet carried, we believe, in an English railway locomotive, viz., 175 lb., the safety valves blowing freely at 180 lb. The fire-box is of great size, the grate being 1ft. 5in. longer than that of any other locomotive on the line. The fire-box will hold something like a ton of coal. The total weight of the engine full we should take to be 43 or 44 tons, but on this point we have no information. We are rather surprised that the fire-box has been augmented in dimensions, for if a real saving in fuel is effected, a smaller rather than a larger box ought to suffice. Among the other engines we noticed an old four-wheeled, by Bury, date about 1832 or 1833; the Dwarf, a little Crampton engine, built many years ago by England for working the engineer's inspection saloon; and the Lady of the Lake, outside cylinder, single drivers, which attracted so much attention in the International Exhibition of 1862. The Lady of the Lake is still in very good order.

It would be impossible within reasonable limits to give anything like a detailed account of these works, in which everything is made that a great railway company can need. The works have, indeed, been more frequently visited and described than perhaps any other in Great Britain. A mere list of the shops is enough to convey an idea of the magnitude of the place. Thus, there are the boiler, smithy, and plate stores, four locomotive repairing shops, copper smithy, forge with plate axle and tire mills, wheel-tiring shop, forge and mills for merchant bars, engine paint shop, brass foundry and tender shop, iron foundry, brickyard with Hoffman kiln, and plant for the manufacture of drain pipes, &c. These buildings are all situated on the north side of the Chester line. On the south side are a carriage repairing shop and washing sheds, and a store shed capable of holding 300 carriages; while the buildings in course of erection comprise a new signal shop and steel foundry, and an extension of the paint shop. In detail the places thrown open to the Iron and Steel Institute were (1) steel foundry; (2) Siemens furnaces; (3) rail mills; (4) points and crossings department; (5) boiler shop; (6) boiler shop smithy; (7) flanging shop; (8) boiler fitting shop; (9) engine repairing shop; (10) iron foundry; (11) steel forging department; (12) wheel and tire shops; (13) iron forge; (14) new signal and paint shops; (15) chain testing shop; (16) millwrights' and pattern shops and saw mills; (17) wheel forge and spring smithy; (18) locomotive erecting and fitting shops. The number of persons of all classes employed in and about the works is 6850. The covered area of the works now exceeds 35 acres, and the enclosed area 116 acres. On Thursday excursions took place to the river Weaver and Messrs. Verdin's salt mines at Northwich, a notice of which we must postpone till next week.

ON A NEW FORM OF REGENERATIVE FURNACE.*

By Mr. F. W. Dick, Glasgow.

I have pleasure in bringing to your notice a new form of regenerative furnace, in which considerable departures are made from the usual practice of furnace building. The furnace—which is the joint invention of Mr. James Riley and myself—presents several novel features, and in its design we have aimed at decreasing the cost of construction and maintenance, and at the same time retaining, and even adding to, the good points of the ordinary Siemens furnace. The new furnace does not in any way differ in principle from the Siemens furnace, but only in construction and arrangement of the various parts. Thus in the model before you—which is that of a 12-ton steel-melting furnace—there is the melting chamber or furnace proper, and four regenerative chambers, two for gas and two for air. But instead of the furnace and regenerators forming parts of one structure of brickwork, they are separate from each other, and are contained in circular casings of wrought iron or steel plates rivetted together; and not only are the regenerators separate from the furnace, but they are separate one from the other, as shown by the model and the diagrams. From these it will be seen that the arrangement consists of a circular furnace body, placed on a platform supported by girders, while the regenerative chambers are placed in pairs at each end of the furnace. The furnace is thus left entirely clear underneath, a condition of things which insures the bottom being kept cool, and lessens the likelihood of the charge breaking through. The regenerators not being underneath the furnace, are out of harm's way in the event of a break out; and further, it will be observed that the regenerators have nothing but their own weight to carry, and can never get out of shape. The furnace is not supported in any way by the generators, and this is a feature in the design which must commend itself, for a worse support than a mass of white-hot brickwork, on which to carry the weight of a furnace and its load of metal, can scarcely be conceived.

With the exception of using dampers to separately control the passage of the products of combustion through the gas and air chambers, no change has been made in the flue and valve arrangements. It is very necessary to be able to regulate the relative amounts of the heated gases passing through the regenerators, because it is thereby possible to regulate the relative amounts of heat stored up in the different chambers. Without this separate control, the tendency is for the gas regenerator to get more than its share of the waste heat, whereas it is more necessary that the air regenerator should be the more highly heated.

Before describing the furnace in detail, it may be of interest to show how it originated, the more especially as the steps are instructive. The design is really the outcome of experiments instituted by Mr. Riley, in 1880, at the Newton Works of the Steel Company of Scotland, to determine the fitness of the basic lining for use in the Siemens furnace. The difficulties then encountered gave rise to various changes in design, which eventually culminated in the form now before you.

A 14-ton furnace of the usual type was used for the trials. The first trouble encountered arose from the excessive quantity of slag. This difficulty Mr. Riley successfully met by placing a slag-spout at a higher level than the tap-hole. The bottom of such a large furnace proved troublesome and expensive to keep in repair, more especially as the best basic mixture had not at that time been positively determined. For this reason it was resolved to build a smaller furnace for experimental purposes. I therefore designed a 2-ton furnace for use in this work. It was of the common class, and with the exception of the slag-spout, contained nothing new in the design. At this time considerable difficulty was experienced from the fluxing of the lining of the furnace at the junction of the acid and basic material. In the two-ton furnace this difficulty was not sufficiently met. The design was therefore abandoned, and I designed—under Mr. Riley's direction—another two-ton furnace, having a movable bottom resting on a carriage, in order that repairs might be more quickly and easily executed, and that the separation of the acid and basic linings might be more complete. On estimating the cost of this last furnace, we found, to our mutual astonishment, that it was actually less than that of the first two-ton furnace, notwithstanding the increased complication. An analysis of the costs showed that this was due to the disposition and the difference of amount of the cast iron work in the two designs. This led us to originate the design of the body of the Batho furnace, as it is erected at our Newton Works. In this furnace horizontal cast iron girders, of the whole length of the body, are placed along the lines of pressure, *i.e.*, along the sides of the bath at the level of the metal, and along the springing of the straight roof. These girders are held apart by light cast iron uprights. The whole furnace is self-contained, and sits in a frame of malleable iron beams, and is well clear of the floor. The cast iron work was designed in such a way that one pattern did for all the girders, and one for all the uprights. This was a notable departure from the usual conglomeration of differently shaped buckstaves, binders, and tie-rods, &c., which go to make up the case of an ordinary Siemens furnace. Although we had thus to some extent simplified furnace construction, the part which the casing and binding of furnaces played in the first cost had been so forcibly brought under our notice, and so much trouble had been experienced by furnaces going out of shape, that we resolved to push the search for improvement further. The circular form was at once looked to as a means of attaining sameness of form in all the buckstaves and bottom plates, and of dispensing with tie-rods and binders. We were the more inclined to favour this shape from its extreme suitability for the reception of a basic lining. The circular form once adopted, the transition from the heavy, expensive, and easily cracked cast iron casing to the shell of rivetted wrought iron or steel plates was an easy and natural step. The next thing was to support the furnace body independently of the regenerators. Being now freed from conventional notions in furnace design, it was at once recognised that more than equal advantages would be obtained by treating the regenerator chambers in the same way as the body, and inclosing them also in circular iron casings. The bricks, therefore, came to be used simply as non-conducting linings, and were not required to support the weight of any part of the structure; the quantity required being thus reduced to a minimum. Other refinements followed, such as the building of the roof of the furnace and the covers of the chambers in iron rings, in order that the walls might be relieved of side-thrust, and also that these parts might be lifted bodily and removed for repair, and for giving access to the checker-work. The flues were also reduced to mere iron shells lined a single brick thick. The regenerators were placed in pairs, gas and air together, at the ends of the furnace, and close to it. Small blocks were employed for the introduction of the gas and air to the furnace. These were used in order that the roof might be above all, and easily removable, so as to facilitate the charging of large pieces, and of pig iron and scrap in bulk. In passing, it should be mentioned that the roof and covers rest loosely on sand joints on the tops of the side walls. Owing to the difficulty experienced in handling so heavy a piece as the main roof, it was found advisable simply to pierce it with a central charging hole, and use a supplementary roof or cover. This arrangement left us free to adopt the one thing required to make the furnace perfect, namely, the Batho connecting tubes; and our experience of them has been so favourable that we intend to use them in all furnaces of this class.

An experimental furnace of four tons capacity, was erected at our Blochairn Works five months ago, and has been in constant work ever since. For the last four months steel of soft quality has been produced by it, 3½-ton charges being got out under eight hours by the Siemens pig-and-ore process. For the last month the furnace has been used for melting up broken rolls and large pieces of metal. The pieces, up to eight tons weight, are lifted by a crane and charged through the roof. A three to four ton piece takes about two hours to melt. A considerable saving is effected. It was our former practice to break these rolls by blasting with dynamite, at a cost of 12s. 6d. per ton. The resulting pieces, from their size, were only worth 30s. per ton. The rolls are now being melted at a total cost of 6s. 8d. per ton for fuel, labour, and fixed charges, and are run into a marketable pig of superior quality. This furnace has been quite successful in its working from the beginning; none of the hitches usually looked for in new things have occurred. Some useful experience and a good deal of confidence have been derived from its working; so much so, that we are now proceeding with a 12-ton furnace, of which Figs. 1, 2, 3 and 4, show the design. It was at first thought that, as the flame does not travel along the roof, it would be possible to use common firebricks for the crown. These bricks began to run in a short time, and had to be replaced by silica bricks. Shortly after the furnace started work, one of the gas regenerators got choked owing to a careless furnaceman neglecting to reverse. The cover was lifted, a few of the top courses of bricks raked out, fresh ones put in, and the furnace started within three hours, and without being appreciably cooled. In emptying and renewing an ordinary Siemens chamber—and it usually must be completely emptied, no half measures being possible—the quickest time on record that I know of is twenty-one hours, and that is a remarkable feat.* The saving of time in repairs is thus not one of the least advantages in this type of furnace. There is likely also to be less occasion for repair than usual. The furnace has been at work for too short a period to enable us to give this assertion all the weight we could wish. It can only be said that after five months' work the furnace is practically as good as new. The furnace is lined with 14in. of silica bricks, and the regenerators with 9in. of firebrick work. The radiation is very slight indeed. The hand can be held within ¼in. of the iron casing without discomfort. The body has a 14in. silica brick wall built in an outer shell of $\frac{5}{16}$in. steel plates. The internal diameter is 11ft. 6in. The roof is of silica bricks 9in. thick, is dome-shaped, and is bound by a T-iron ring, so that there is no thrust on the furnace walls, and the roof may be lifted off or on in one piece. There being no blocks in the furnace, and no thick places in the walls, it is equally cool all round. The bottom rests on the common flooring plates, and the air has perfectly free access to these plates. The gas regenerators and the air regenerators are 6ft. 6in. internal diameter, are lined with 9in. firebrick work, and have outside casings of $\frac{3}{16}$in. steel plates. They stand loosely on the floor, carry only their own weight, and are only connected to the furnace by the Batho tubes. They are provided with doors at different levels for convenience in filling in or emptying the checker work, and have sight holes well above the floor level, by which the

* Paper read at the Chester meeting of the Iron and Steel Institute.

* It usually takes about a week to change the checker work in a Siemens furnace.

REGENERATOR FURNACE, BLOCHAIRN WORKS.

Fig. 1.

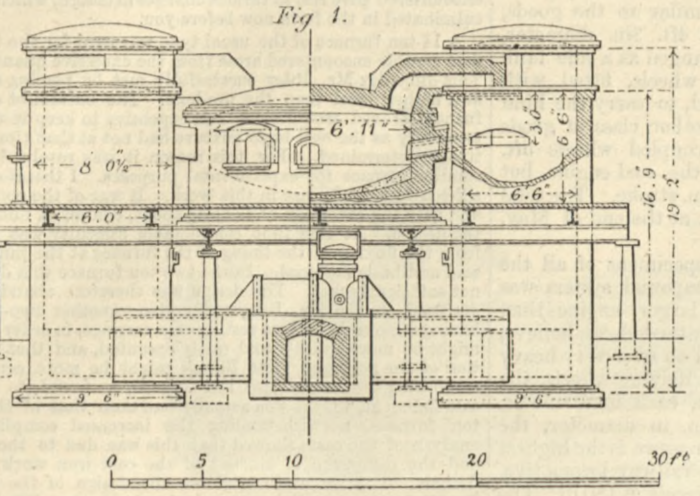


Fig. 2

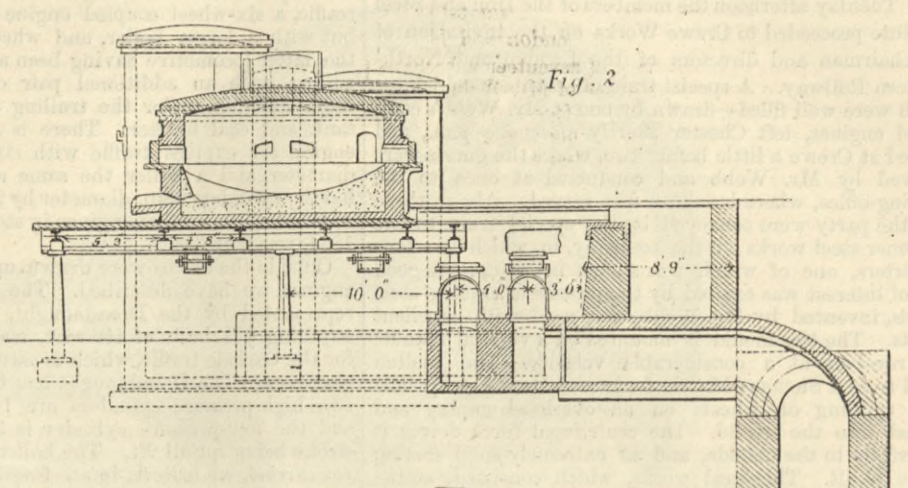
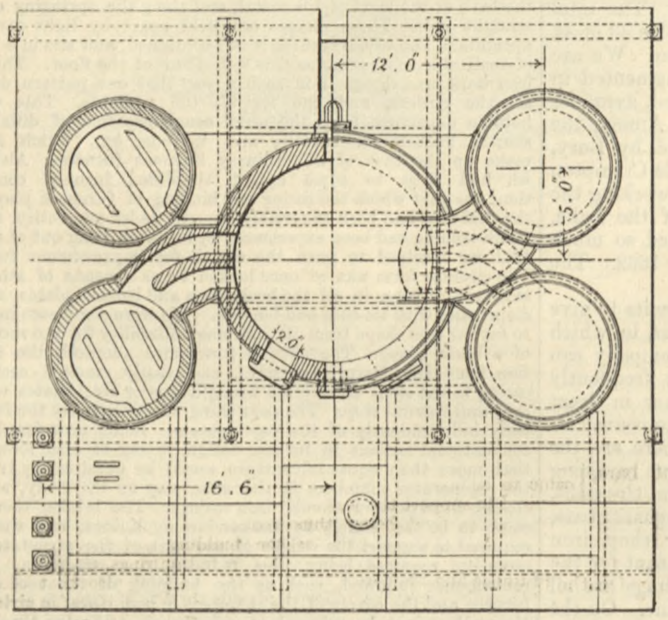


Fig. 3.



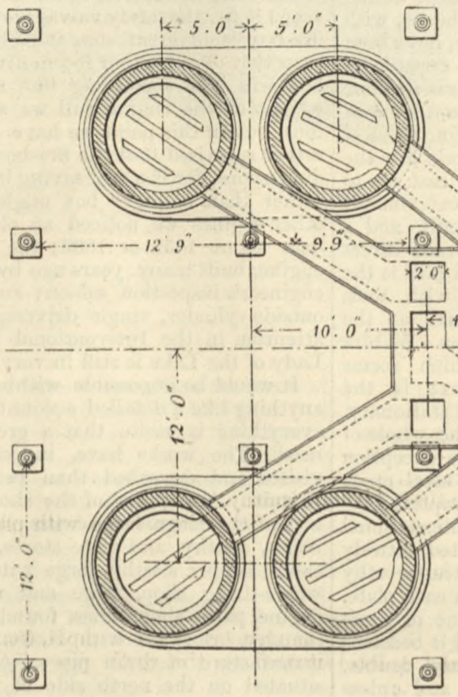


Fig. 4

condition of the interior may be observed while the furnace is at work. At their bottom parts they are connected by iron-plated flues lined 3½in. thick with firebricks to the usual reversing and air and gas valve arrangement. The two dampers already referred to are shown, one controlling the gas chambers, and the other the air chambers. It will be observed that from the position of the floor line very little excavation is required. It may interest some of you to know that furnaces on this plan are likely to come into use for foundry purposes and for glass making. The circular body is peculiarly adapted for glass-making purposes, where several men have to work round one furnace. The advantages of the system are briefly these:—From the independence of the parts, from the fact that the brickwork has not to be made to support heavy weights, and from the simplified casings possible with the circular form, the amount of material required in the construction, the labour in erecting, and, as a consequence, the first cost is reduced to a minimum. The cost of melting furnaces on this plan is less than three-fourths of the cost of the common type of furnace of equal capacity. The repairs and up-keep are slight. That this is not altogether a matter of belief is shown by the condition of the 4-ton furnace after five months' work, and by the case I have instanced of a speedy repair of a choked regenerator. In this connection it should be pointed out that a spare furnace cover may be kept; or, if this is not considered desirable, then, in the event of the roof falling in, the binding ring may be lifted off and placed on the floor, a new roof built in it, and the whole lifted bodily into place in the course of four or five hours, without specially cooling the furnace. When a roof collapses in a Siemens furnace the whole structure has to be cooled down and centreing put in on which to re-build the roof. The roof of the new furnace is not, however, much affected, as it is removed from the cutting action of the flame.

From a consideration of the form of the parts and the manner of casing, it will be admitted that the furnace is not likely to give trouble by getting out of shape. The lining of the furnace cannot readily drop in, as it is "arched" all round. It will be noticed from the plan that what are practically idle corners in a rectangular furnace are filled up. No partial vacuum can be formed there by the entering gases; eddies are prevented, and the flame pursues an even course across the furnace, instead of clinging to the walls. Further, the furnace walls recede just where the flame is most expanded. For these reasons the lining is much less liable to cut than in the rectangular furnace. This statement is borne out by our experience. The whole surface is so open to the air that a break-out is not likely to occur; but should it happen, very little harm can be done, since there is nothing under the furnace to come to grief.

As the regenerators are quite separated from each other, and as the gas and air tubes are also apart, there can be no leakage from one to the other, and therefore no combustion can take place except in the furnace. This is a very important point, and rids us of a very pregnant source of trouble in the shape of undue wear and tear caused by gases burning in the ports and chambers. Being cased in tight iron coverings, no cold air can be drawn into the regenerators or flues. Leakage in this direction frequently gives rise to much loss of heat. When the regenerators become choked, the covers may be lifted and the chambers examined separately before commencing operations. Any one chamber, or the furnace itself, may be cut out of the system, cooled down and repaired, without cooling or in any way disturbing the other parts. The saving of time in effecting repairs is very great. The removal of a few of the top courses of checker bricks will generally be found to put the regenerators in order. Compare this with the usual necessity of waiting till the whole mass of a furnace cools, and taking out the whole of the checker-work to get at those bricks on the top. It seems to me almost superfluous to point out the peculiar adaptability of this furnace for the basic process. It is not even necessary to use basic bricks, since the circular body can be rammed with the same ease as a Bessemer converter. The easy and complete severance which can be made between the basic and acid lining renders the production of basic steel in the open hearth furnace both possible and feasible. It is the intention of the Steel Company shortly to resume experiments in basic working, and, with the new furnace, success is confidently anticipated.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents.*]

THE ROCKET.

Sir,—I trust that your efforts to elucidate the history of the Rocket will be successful. I have been very much interested in what has already appeared in your columns upon the subject. In reply to the letter in yesterday's Engineer from "I. W. B.," I should like to remark that although his assertions are very emphatic and positive, they are, for all that appears to the contrary, made entirely from memory. After the lapse of fifty-four years a man may be most mistaken when he is most assured. It is difficult, indeed, to believe that Mr. Nasmyth, with his power of grasping details and his admitted skill in free-hand drawing, would produce a sketch so misleading as "I. W. B." represents it to be. I hope, therefore, that some other surviving spectators of the opening of the Liverpool and Manchester Railway will come forward with further evidence on the subject. As regards the difficulty raised by him about the date appended to the sketch, I should like to know if the error has arisen through the indistinctness caused by the great length of time which has elapsed. That the sketch was not made on a Sunday, as suggested by "I. W. B.," is clear from Mr. Nasmyth's autobiography, page 156:—"The coach reached Liverpool on Sunday night. . . . Next morning, without loss of time, I made my way to the then terminus of the Liverpool and Manchester Railway, and there, for the first time, I saw the famous Rocket. The interest with which I beheld this distinguished and celebrated engine was much enhanced by seeing it make several short trial trips under the personal management of George Stephenson, who acted as engineman, while his son Robert acted as stoker. During their trips of four or five miles along the line the Rocket attained the speed of thirty miles an hour—a speed then thought almost incredible! It was to me a most memorable and interesting sight, especially to see the father and son so appropriately engaged in working the engine that was to effect so great a change in the future communications of the civilised world. I spent the entire day in watching the trial trips, in examining the railway works, and such portions of their details as I could obtain access to. About midday the Rocket was at rest for about an hour where I stood, and I eagerly availed myself of the opportunity of making a careful sketch of the engine, which I still preserve. The line was opened on the 15th of September, when the famous Rocket led the way in conducting the first train of passengers from Liverpool to Manchester."

I await with much interest any further light which may be thrown by any of your correspondents upon the subject of the development of the Rocket, and in the meanwhile think your suggestion of the 12th inst. not at all improbable, that the name only was retained on the engine with which the railway was opened.

J. P. D.

Leeds, September 27th.

BRACED IRON ARCHES.

Sir,—In your issue of September 12th you give a sketch and general description of the new bridge at Blackfriars. It would be of great interest if you or some of your correspondents can give a simple method of ascertaining approximately the strains in the arched and horizontal members and spandril bracing of this or similar structures. Many months ago I wrote to you under the above heading, in the hope of eliciting some correspondence and information on the subject, but without success. Probably the reason was that the subject is difficult, and those that do understand it do not care to impart their knowledge gratis. This is, no doubt, as it should be; but still, much information is given almost weekly in your paper. At present it is on a kindred subject—continuous girders. In his article on the braced arch, Rankine himself says, in his Civil Engineering, p. 569, case 2, that "the exact determination of the state of stress at different points becomes a problem of almost impracticable complexity, but an approximate solution . . . may be obtained as follows." He then goes into a series of computations, which, I am bound to admit, are beyond me. For this reason, when information of the above nature is requested, it is not desirable that it should take the form of a deeply-learned mathematical dissertation. This, I think, nullifies its general interest and utility. Let us take the example at present before us. On page 171 of your issue of September 5th, a beautiful paper is contributed by Messrs. Turner and MacKenzie, on "The Application of the Theorem of Three Moments," &c. Ordinary working engineers will admire the undoubted ability and deep research herein manifested, and I suppose they will all admit the immense advantage that this publication ensures to science; but beyond that, of what use, practical applicable use, is it to them? I should also like to draw attention to the reply to this paper in your issue of 12th September, bearing the well-known signature of M. am Ende. Here that gentleman gets the total deflection at the free end of his girder—you will excuse my reproducing, to save reference:—

$$y = \int_0^l \frac{M x \, d x}{E J}$$

and after a few more lines, manœuvring with a diagram, introducing values (1), and integrating (2), he gets, "quite simply," the following very pleasant little thing in equations—

$$X^1 l + 2 X^{11} (l - l^1) + X^{111} l^1 - \tfrac{1}{4}(w l^3 + w^1 l^{13}) = 0$$

Mr. M. am Ende is then "sure that not many people would consider the method by which it was obtained troublesome and confusing." I had partially recovered from that statement, when this week again I am stricken down by the same talented calculator. After giving a brand new formula of surpassing simplicity and ability, he again puts values (1), and eliminates what he does not want. "Then we get the well-known equation—

$$B l + 2 (l + l_1) C + l_1 D - \tfrac{1}{4} (l^3 p_2 + l_1^3 p_3) = O."$$

Now, it would be interesting to know to what percentage of, say, the Institute of Civil Engineers this equation is "well-known." It has been my duty, and a pleasant duty too, at times to ascertain the moments of strain and points of contrary flexure in continuous girders, and I have done so sufficiently accurately for practical purposes without ever once having had the pleasure of meeting that very refreshing and well-known equation. But seriously, it may, I think, be taken for granted, that engineers of ordinary ability cannot tackle such formulæ as these. They want something approximating accuracy, and moderately simple. Personally, when I meet these long differential equations and formulæ, bristling with big $\int$'s, I pass on to other authors and simpler means of obtaining the desired information. The higher branches of mathematics involved by these are beyond the capacity and education of the average working engineer, and are therefore useless to him. Far be it from me, however, to dispute or disparage the utility of their publication in the cause of science, and for that reason I trust that the gentlemen whose names I have taken the liberty to mention will accept this letter in the spirit in which it is written, and pardon any apparent levity therein.

September 30th. J. C. C.

THE CAPE TOWN DRAINAGE COMPETITION.

Sir,—We have pleasure in heartily endorsing the expression of gratitude to you, by your correspondent "Sanitary Engineer," for your able and fair statement of the facts of this competition. We think, however, as authors of one of the competing designs, that something further should be done towards exposing the gross injustice of the award, and we would invoke your powerful assistance in endeavouring to bring home to the Corporation of Cape Town the general sense of the engineering profession and its English press. To this end we would suggest a combined protest from the competitors, requesting either a fair re-examination of the designs in view of the conditions under which they were drawn up; or the payment of at least a portion of the expense to which each competitor has been uselessly put, out of the said sum of £250 so unfairly awarded.

Two points especially strike one in considering the case, to both of which your article on the 12th inst. referred. The first is that while engineers, invited by the advertisements which appeared twelve months ago, entered the competition trusting to the good faith of the Cape Town Corporation, the latter has on its part distinctly broken faith with those who trusted it. Assuredly the conditions—be they bad or good—which bind competitors should also bind the party offering the premium. The three judges might properly advise the Council not to carry the sewage to Salt River, but they had no right whatever to advise the payment of the premium for a scheme in direct opposition to the Council's own regulations. The use of conditions and instructions in competitions is to leave the competitors as little at the mercy of the opinions and idiosyncracies of the judges as possible. We intended at first to submit two schemes, one emptying the sewage into deep sea water, the other into filtration works at Salt River; but a careful consideration of the report convinced us that it would be a useless waste of time to elaborate the former, and any design of that kind ought to have been at once disqualified and placed out of court, not necessarily as regards carrying out, but as regards being premiated. The second point is, that a person on the spot had evidently strong reasons for supposing that the conditions were not binding on him, and that he would not by any means be disqualified if he proposed to deal with the sewage in the one way forbidden to everyone else. A somewhat interesting sidelight is thrown upon Mr. Harpur's position at the Cape by the following from the *Western Mail* of August 27th:—"A Merthyr man's success at the Cape; award of £250.—Our readers will be pleased to learn of the honour recently won by Mr. Isaac Harpur, son of Mr. S. Harpur, and brother of the Cardiff borough surveyor. Mr. Harpur was one of nineteen competitors for a premium of £250 for the best sewage scheme for Cape Town, which place Mr. Harpur went to some time since for the benefit of his health; and Mr. Harpur's scheme was considered the best, and was awarded the prize of £250." The reference to the gentleman's health is very *naive*, as if the writer were struck with the hygienic qualities of a prize of £250.

We have further cause of complaint against the authorities of Cape Town, in that we have received no official intimation of the result, nor have our drawings, &c., been returned, although your article refers to a decisive meeting on August 1st, and the advertisements last year distinctly guaranteed the safe return of the designs. This is, at any rate, discourteous, even if they do eventually arrive. The moral of the whole affair seems to be, put not your trust in corporations, nor in the fairness of any board of examiners. A Competing Firm.

September 29th.

CONTINUOUS BRAKES.

Sir,—Many of the incorrect and misleading statements contained in Mr. Martin's letter were fully and completely answered by your correspondents last week, but it appears to me that one remark requires further attention and consideration—I refer to the statement that the failures are "550 per cent. in favour of the vacuum brakes." Mr. Martin, Mr. Moon, and others who wish to advocate vacuum brakes, either cannot or will not see that there are many degrees of "failure," and that a delay of a minute, or a leak in a pipe, is a very different thing to an actual failure to act, or a collision with buffer stops, or with another train.

I have before pointed out in your columns that in consequence of some companies making incorrect returns, the information, instead of being a valuable guide, has been rendered perfectly useless for purposes of comparison; but, incorrect as it is, a great improvement could be made if the Board of Trade were to publish a summary, in which the number of failures could be properly classified and recorded under one of the three heads:—(1) Failure in case of accident. (2) Failure under ordinary circumstances. (3) Delay caused by material or by servants. It would further be an advantage if a column were provided in which to record "brake successes," or instances in which accidents have been averted or the consequences mitigated; as it now is, a fuss is made about a delay of a minute, but if a brake saves the lives of a train full of passengers, that fact is not mentioned, and very seldom becomes known outside the railway circle. In the last brake return it will be seen that the companies record twenty-eight cases under Class 2, against Smith's simple vacuum brake, and six other cases of failure and overrunning are given, but placed under the wrong heading.

The simple vacuum brake has therefore to account for thirty-four cases, and the Westinghouse automatic for ten instances. Mr. Martin makes a great point of "complicated valves;" it will therefore be interesting to consider if they caused any of the ten Westinghouse cases under notice. Eight of these are charged as neglect of servants, and no fault is mentioned against the brake itself. In one instance the pipe became jammed by the bogie beam of Great Eastern engine 581; details are unfortunately not given, but it is clear that either the pipe had been fixed too near the bogie, or the bogie itself was out of place. The tenth case is a straw at which Mr. Martin and his followers will catch; one triple valve on one carriage was set fast, and in conjunction with another vehicle with the gear shut off, resulted in a train passing a platform the distance of twenty-five yards. The triple valve was, as Mr. Harrison remarked, made a "bugbear," but its working proves it to be a most perfect piece of mechanism; the leak hole, which was to be such a simple thing, is clearly showing its defects. It is only necessary to refer to the Great Western Company's returns to see the numbers of cases in which it was choked. It will also be evident that if the leak hole be choked so that air cannot pass in one direction to release the brake, neither can it pass in the other when it is required to create a vacuum with which to apply the brakes; in fact, therefore, a leak hole choked is practically a failure of the brake to act upon the vehicle. With reference to the Penistone disaster, it is satisfactory to find that the friends of the deceased and the sufferers are taking active steps to test the liability of the company.

Efficient brakes are well known to be necessary to the safety of a train, and it therefore follows that to send out a train without such a necessary appliance, is a "wrongful act, neglect, or default." The Board of Trade considers automatic action necessary, the passengers and the railway servants are of the same opinion, and now even the chairman of the Vacuum Brake Company, Limited, has found that "an automatic brake is desirable." This latter fact is considered of great importance by those who are about to bring an action against the Manchester, Sheffield, and Lincolnshire Railway Company, for it shows that this company not only neglected to adopt the most efficient brakes in use, but that it did not even provide the best appliance which Mr. Martin says he is able to supply. All impartial persons will agree that the brake question should be fairly dealt with; the subject is simply one of public safety; the public does not care what brake is employed so long as it is the best in use. Personally I have not the slightest interest in any system, but knowing which is the best brake, I have, of course, advocated its use; but being disinterested and unprejudiced, hope Mr. Martin will lose no time in demonstrating "that his automatic vacuum brake is equal to all others in efficiency." The brake question now simply rests between air pressure and "vacuum." Surely it would not be a difficult matter for a series of experiments to be made by competent authorities or experts not connected with any railway or brake. Many trains are now running fitted with both brakes; nothing therefore could be more fair than that one of these should be experimented upon, because the circumstances would be precisely similar. At present it appears to me that Mr. Martin's statement cannot be accepted until proved by actual facts. Clement E. Stretton.

Saxe Coburg-street, Leicester, September 29th.

Sir,—I note you are just now giving a good deal of space to brakes. Engine-drivers say they are the first to see danger and the first to be killed, but I don't know that the guard in the front van is not about as bad off as the driver. I note, Sir, you are in favour of brakes that guards can put on; so we all are. We have so many parcels and letters in our vans that we can't always keep just as good a lookout as we would like to, so we have to leave much of the lookout to the driver. In case of accident we know the cord communication is likely not to work, so the thing we want is a tap in the vans and automatic brakes.

I also note that in your paper, and in others, complaints have been made that failures are not reported. Well, we know they are not. We guards always report the cases on our journals, but if our chief don't send them into the Board of Trade we can't help it. Is there a law about the reports? If so, you will, perhaps, in your next oblige us with a remark as to what happens to a company that breaks it. From what I read and hear, it seems some lines would look foolish if they had to report all cases. That affair at Leicester, mentioned last week, might have been a bad job. I know the road well, and oftentimes have ran into this station on the up road with a train crossing at the far end. If the brake don't act there is no help for it, you must run through the other train. Our Railway Society has for years had this brake question on hand, and we are always trying to get the automatic brakes adopted.

I hope now there is so much calling attention to it in the papers that the passengers or the directors will look into the subject. I see, Sir, you refer to "personal prejudices." Here you knock the right nail on the head. Some time ago one of my superiors rode in the van with me. He admitted that the Westinghouse was the best brake, but hoped there would be a good English brake yet. That is about six years ago, but the English brake does not seem to come to the front. If the best brake is American—and there is no doubt that it is—why we must have it. What does the name matter when life is concerned? A Passenger Guard.

September 29th.

Sir,—I see the newspapers give a long portion of room to Mr. Martin to sit upon my letter to the *Times*. I see also he has got it put in Manchester, Leeds, and other papers as an advertisement. I can't afford to do so, so he has an unfair advantage over me, and I hope you won't deny me room to defend myself.

My letter wasn't to advertise the Westinghouse, but just to show what we drivers feel about the brake matters. Mr. Martin calls me an "anonymous" express driver, so I suppose he wants you to think I am not a real, living man. He knows, and you know, that I daren't have had my name printed because of being discharged, and I couldn't quote the Board of Trade returns because of the same reason; but the *Times* had my name, address, names of the brakes, references, and all about it before they put in my letter. You see, Sir, it stands to sense, a big paper does not put in a letter and write an article on it without being sure.

Next Mr. Martin says he does not know of a line which has tried four brakes. Why, Sir, some have tried six or seven. Only look at the North-Eastern, Great Eastern, Brighton, Midland, South-Western, Lancashire and Yorkshire. Come, Mr. Martin, had not all these over four sorts? To say which four I used would be at once to say who I am; but I will say this much, one of those I found I daren't trust was the Smith's vacuum, and another the automatic vacuum. He goes on to say the Westinghouse takes time to get pressure, but he doesn't say it has a stock of air ready in the big reservoir; and his vacuum has to get its power when wanted. He says, no matter how often the vacuum is used it is not impaired. That tale won't do for us drivers. What, get a vacuum in a train instantaneously? It can't be done; no, never! Mr. Martin says, leave the selecting of a brake to those "who alone have the necessary knowledge." Hear, hear, we drivers reply. We are, according to that, to be the men to choose; we have the knowledge and the moral responsibility he speaks of, and I don't think that any man that has to choose a brake ought to have a "pecuniary incentive in a company to induce him to do so."

I am glad my letter has made a stir in the matter, and I hope it may do good and make things safer for me, my mates, and all the passengers as well. An Express Driver.

September 30th.

Sir,—You have no doubt seen the report of Colonel Rich on the accident at Wigan on the London and North-Western line. I do hope you will publish it in full, since his remarks should be read by every one who travels by rail; the only regret is that the Board of Trade have no power to compel the adoption of their inspectors views. I think it well to point out that it will not be long probably before Colonel Rich has some other collisions to investigate on the same railway, due to the failure of the vacuum makeshift he so strongly condemns.

Coming to London on the 13th of last month by the midnight train from Carlisle, we overran Oxenholme station by some 500 or 600 yards owing to the failure of the vacuum brake, and I was informed that the driver was unable to get any vacuum owing to his ejector lifting the water out of the boiler instead of pulling the air out of the train. I am also informed that this is by no means the first time such a thing has occurred, for Preston station was also overrun a few weeks ago. Can any of your readers say whether the above is a common cause of failure with vacuum brakes?

September 30th. Experience.

MANCHESTER SHIP CANAL AND TIDAL ACTION.

Sir,—I have read with pleasure Mr. Boult's very interesting letter on tidal action, but I fail to see in it any arguments bearing upon the point I raised. I should not therefore have again trespassed on your space had not Mr. Boult expressed a hope that his reasoning might induce me to modify my opinions "upon the importance of maintaining the tidal capacity of a river unimpaired." Must I repeat that this question of the value of tidal water has not been raised at all by me? I have only questioned the method usually accepted of estimating the quantity of tidal water that passes in and out of an estuary over the bar, and the reasons I have given so far in support of my views have not yet been assailed.

I am tempted to follow Mr. Boult, with your permission, a very little way into his own special subject. After emphasising the fact that high water is almost simultaneous over a large portion of the Irish Sea—Strangford Lough, Bray Head, Liverpool Bay, &c.—he states that it is quite impossible for all the water occupying the depth of the tidal range to be discharged through the two outlets—one north and one south. He then asked the question, whither is the residue carried? and replies, "Clearly into the lower reaches of the various rivers, &c." Now, seeing that when it is high water in Liverpool Bay, there is practically no more water to enter the Mersey—the ebb being about to commence there—it is not at all clear to me how the withdrawal of water from the Irish Sea between the times of high water and low water can in any way be accounted for by the absorption of such water into the Mersey, at all events, as one of the "various rivers," because the emptying, so to speak, of the Irish Sea must be simultaneous, or nearly so, with the emptying of the Mersey. Again, the statement as to the incoming flood at the Scilly Isles meeting the ebb from Morecambe Bay "somewhere between those places" seems to me somewhat vague. Surely this junction occupies successively all positions from the Scilly Isles to Morecambe Bay as the tide advances, and is not, it seems to me, a fixed point lying "somewhere between those places." A. C. Hurtzig.

Hull, September 23rd, 1884.

CANADIAN ENGINEERING.

Sir,—Having been myself resident for four years in Canada, it was with very great interest indeed that I read the late Mr. Browne's "Notes on American Engineering," and it must be a matter of sincere regret to many on both sides of the Atlantic that he was not spared to complete the series of letters which he had proposed writing. I must certainly endorse Mr. Browne's statement that Canada is not a field for English engineering in the light of a market for machinery exported from this country—if for no other reason than the high import duty on finished machinery, amounting to, in some cases, 35 per cent. *ad valorem*. On the other hand, what are the prospects, as Mr. Browne suggests, for a young man going out with the intention of eventually starting for himself? There is no doubt he will much more easily make a start there than in this country, as he can begin on a comparatively small scale without being swamped by large, old-established firms, as in this country; but having made a start, what are his prospects of remuneration? In the first place he will have to give very long credit; two or three years is not an uncommon time on which to sell a steam engine. If he can discount his own bills, good and well; he will make a good thing out of that, as the banks will charge from 5 to 6 per cent. interest, according to security offered. In the second place, I think in the older provinces the business is pretty well filled up. As an example, I would cite the city of Hamilton, which may be considered at the head of the manufacturing interests in Ontario, where I can personally vouch for the difficulty of always getting work at anything like a remunerative figure, so keen is the competition. To give you an idea of the size of the engineering establishments, the largest that I know of—Messrs. Goldie and McCulloch, of Galt—employ when in full work between three and four hundred men; but the generality of shops are much smaller. One of the most successful engine-building establishments in the Dominion—Messrs. J. H. Kilby and Co.—employ about one hundred men. Five miles from Hamilton, and in communication thereto by telephone, tramway, and steam, is the lively little town of Dundas, having a population of 4000, a marine engine shop and tool works, the latter—Messrs. McKechnie and Bertram—the same as referred to in Mr. Browne's letter as makers of some of the towers he saw in Sherbrook.

What I would suggest for any young man going out to Canada as an engineer would be, that he should, as Mr. Browne suggests, go into an old-established general engineering shop in Ontario or Quebec, and having become acquainted with the ways of the country, and unlearned much, as well as learned, he should then go to the north-west, and start a small repairing shop, and grow with the country. It will be uphill work, but in the long run he will be repaid. W. C. Wallace.

Dumbarton, September 28th.

LOCOMOTIVE CRANK AXLES.

Sir,—I have read with interest the letter signed "N. P.," in your issue of the 19th. He says the Board of Trade returns for 1883 show that 245 locomotive crank axles failed. Of these 173 were of iron, giving an average mileage of 213,719 miles; and seventy-two were of steel, giving an average mileage of 199,471 miles. His interest seems to be confined to the question whether iron or steel crank axles in locomotives are most liable to failure. My interest mainly centres in the question whether crank axles, iron or steel, are not essentially appliances of so dangerous a character as to deserve exclusion, at all events, from locomotives destined or liable to be used for express passenger service.

With a view to further the elucidation of this question, I shall be greatly obliged if "N. P.," or any other of your correspondents, can give statistics showing how many plain driving axles—that is, axles driven by outside cylinders—failed during 1883. May I add that my ideal type of an express engine, both for safety and efficiency, is the Great Northern engine, with outside cylinders, all plain axles, and a bogie in front. As to brakes, I quite agree with our mutual friend, the "Express Driver," that the Westinghouse is the only one up to modern requirements; and the sooner all companies are forced to adopt it, the better for the public, and indeed for themselves.

Your North-country Correspondent.

Middlesbrough, September 22nd.

DOUBLE BOGIE LOCOMOTIVE.

Sir,—My attention has been called to an illustration and description of a double bogie locomotive in your issue of last week, by a Mr. Christy, of Melbourne. Mr. Christy cuts the Fairlie boiler in two, so as to form two ordinary boilers, requiring two drivers and two firemen. This plan was originally proposed by me, and I believe it will be found in some of my patents; but I found so many disadvantages attached to it that I gave it up.

Some years ago Mr. James Reid, chief of the Neilson Locomotive Works, Glasgow, proposed a locomotive nearly identical with that of Mr. Christy. I notice that he has borrowed my carrier frame, and as to the system of steam pipes—*i.e.*, steam pipes through the bogie centre—I adopted this method in the construction of the Tarapaca, the first Fairlie engine sent to Peru. This system was also carried out by Mr. McDonald in the two Fairlie engines running on the Great Southern and Western Railway of Ireland. If the idea is altogether new to Mr. Christy, then I consider his scheme of engine most creditable to him; but if, as it would appear, he knows all about the Fairlie engine, then I conclude he has made a mistake. Robt. F. Fairlie.

Westminster, September 24th.

CONTINUOUS GIRDERS.

Sir,—I must thank Mr. Max am Ende for drawing our attention to the last paragraph of our paper on continuous girders. It was an oversight on our part to state that the greatest strain on the bridge could be ascertained from the diagram, for, as he points out, the strains due to partial loading of different spans may in some cases exceed those which we considered. I remember that we considered the point in designing the bridge, but did not make actual calculations for it owing to the shortness of the time at our disposal.

I have not my copy of The Engineer for last week by me, and can only speak of the formula which Mr. Max am Ende gives from memory, but I think that it only enables one to find the strains over the piers in the cases of partial loading, and does not give the bending moment at any intermediate point between the spans. I may very probably be in error, as I have not been able during the week to give the subject much attention owing to business engagements, but I should be very glad if he would inform us how he deduces the formula. I suppose Mr. Max am Ende uses the strain over the pier, given by his formula, to find the bending moment at any other point; in that case I think I understand him.

5, Ardwick-terrace, Manchester. T. K. Mackenzie.

September 25th.

THE MAXIM MACHINE GUN.

Sir,—Your notice of Mr. Maxim's gun compels me to say that to my mind it furnishes another proof as to how a poor inventor is obliged to shelve his ideas. With me this is a personal question. Within the last twelve years nearly the same number of inventions have come into use that had existed previously, in my mind, almost to the letter, but never were to me anything more than visions or projects. I should like to quote the following from a letter of mine in The Engineer, December 30th, 1881:—"I have a breech action by which a man could fire twelve shots in six seconds, and he would be able to fire sixty rounds a minute from the shoulder, supposing, of course, that he was able to stand the recoil. After placing the rifle to his shoulder he would have nothing to do but keep on pulling the trigger till the magazine was empty. I only mention it to say that the law, as it now stands, prevents me from doing anything with it." In this rifle the recoil opens the breech, ejects and inserts the cartridges, closes the breech, and, when desired, fires the charge. My drawing is where it was, nothing has been done with it, though on the appearance of that letter more than one, in different parts of the country, tried to draw me on the subject. I considered them unlikely, however, so the invention has been kept secret till now. Whatever my object in writing this letter, it tends to show that a poor inventor has to endure as much as the manufacturer who, to hold his ground, is obliged to shift his standing as the tide of invention rolls on. EDWARD HOYLE.

Pleasant View, Todmorden,
September 29th.

ORDNANCE SURVEYING.

SIR,—A few months ago I had occasion to tie in some levels to ordnance B M's in Glamorganshire upon a turnpike road, and to my surprise I found the B M's cut on wood telegraph posts—things that are constantly shifted or renewed—while on the same road there were permanent milestones within a few yards. I wrote to the authorities on the subject and received the usual kind of reply. I have since found the same kind of thing in Monmouthshire, with the exception that instead of telegraph posts, the surveyors have selected the posts of a wood fence. In a year or two these B M's will have disappeared, and all the cost of the levels thrown away.

September 22nd. S. D. T.

UNDERGROUND LOCOMOTIVES.

SIR,—In your impression of the 19th inst. I notice there is an article on "Small Locomotives," made at Pittsburgh. It may interest some of your readers to know that I sent a small locomotive there this year, and I understand it is working in a mine one mile underground. The cylinders are 5in., with a stroke of 12in. There are six coupled wheels, 20in. diameter. The working pressure is 250lb., and the total height of the engine 5ft. 13in. I enclose an extract from my customer's letter. He says: "We are pleased to say that the engine is doing daily service, and is doing much better than we ever expected. The engine is one mile underground, and never comes to daylight. We are not doing full work at present, but when trade revives we expect to move 1000 tons of coal one mile daily. At present we are moving each trip thirty wagons, each wagon containing 3300 of coal, weight of wagon empty being 1225 lb., making a gross load of 67 tons, and can add ten wagons to above load if need be."

Castle Engine Works, Stafford, W. G. BAGNALL.
September 30th.

TENDERS.

STRATFORD-ON-AVON WATERWORKS.

E. PRITCHARD, C.E., engineer, Westminster and Birmingham. Contract No. 4.—For construction of reservoir, filter-beds, conduit, and the laying of eleven miles of cast iron pipes.

	£	s.	d.
Hilton and Sons, Birmingham	23,170	0	0
Crea and McFarland, Westminster	20,455	4	5
Evans Bros., Wolverhampton	17,600	0	0
B. Cooke and Co., London	16,700	0	0
Currall and Lewis, Birmingham	16,300	0	0
John Jevons, Dudley	15,282	18	3
George Law, Kidderminster—accepted	14,077	0	0

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, Sept. 17th.

THERE is a slight increase of activity in trade and business circles this week, and the general tone is more hopeful; but still everything is backward for the season. The movements in the iron trade are far below what is usual at this date, and from all indications, there will be less than the usual amount of business transacted through the fall. The attempt to organise a restriction of production of pig iron has really failed, though there is some effort still being made in that direction. The determination of the Connelsville coke pool, in Western Pennsylvania, to keep coke prices up, will probably lead to the banking of a few coke-using furnaces in the east, as eastern furnacemen say that present prices of iron do not warrant them in paying the prices asked by the combination. The production of pig is, from one cause or another, declining slightly, and should demand improve ever such a little, the output would no more than fill requirements. No further decline in prices is to be apprehended. During the past week makers of standard and special brands have been refusing all concessions, and are asking stiffer prices, but quotations show no material change. No. 1x foundry iron of good quality sells at from 19 dols. to 20.50 dols.; No. 2x foundry, 18 dols. to 19 dols.; and gray forge, at 17 dols. to 18 dols.

Foreign material is not in very active demand. There is a rumour that 1500 tons of steel wire rods are about to sell at 44.50 dols., and there is some inquiry for additional lots; 80 per cent. ferro-manganese has sold at 73.50 dols., and 20 per cent. spiegel at 26.75 dols., though nominal quotations are a good deal higher. Arrivals of Scotch irons are light.

For some weeks past negotiations for a huge sale of lake copper to a pool of manufacturers have been in progress. The sale of 20,000,000 lb. was completed a few days ago, at 13c., the lowest price ever accepted for lake copper. Prices have declined from 14c., which has been the ruling rate for a long time, and small lots can now be had at 13½c. Other kinds are quoted at 12½c. to 12¾c. Tin-plates have declined slightly under the dull demand. Imports for week last reported were 44,788 boxes, and for year, to date, 1,399,964 boxes, against 1,622,049 boxes for a corresponding period last year. Exports of copper from this port since January 1st, 9,702,477 lb., against 12,015,775 lb. for a corresponding period last year.

The activity reported in steel rails continues, though sales have not been for such large amounts. The mills are now pretty well supplied with orders to keep them busy through the rest of the year, and manufacturers are consequently asking better prices. For the past few days 27 dols. has been the ruling price, though this is shaded to large buyers. Western Pennsylvania makers have reduced prices, in order to be better able to compete with the eastern mills. Additional inquiries are in the market, with every indication that there will be activity in this branch of trade through the next two or three months.

The textile mills of the country are not increasing output. Some are in operation which were idle a week ago, but a great many have shut down, and restriction will be continued until a better state of trade exists.

The coal trade of the country is in a rather discouraging condition, owing principally to the dulness in manufacturing. The immense producing capacity has led to reductions in wages, and in many sections strikes are in progress. The anthracite region of Pennsylvania is working full this week, but restriction will be necessary at intervals until the end of the year, as the production of full time is far beyond the requirements of the country.

Latest statements of railroad earnings are rather disappointing, and a war of rates is threatened. The traffic of the country for the past month has not been up to expectations, the pools are not living up to their agreements, and some interesting developments are looked for during the next week or two.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE mills and forges continue fairly active, and this week a works which has been standing for a considerable time in the Dudley locality is stated to have been re-started. The new proprietors are understood to be a large firm of chain makers, who already manufacture part of the iron which they consume, and who desire to be in a position to manufacture the whole of it.

The market has a firm attitude, notwithstanding that, consequent upon the near approach of the quarterly meetings, which occur next week, merchant orders have received a temporary check. Although it is not expected that there will be any alteration in crucial prices at the gatherings, yet these buyers prefer to hold off until all uncertainty is removed.

Best—thin—sheet makers again reported on 'Change in Wolverhampton yesterday, and in Birmingham to-day—Thursday—that they are greatly pressed for deliveries. One or two firms, indeed, announced that they were never before so pressed. A sensible proportion of the activity is due to the demands of the north of Europe, since merchants especially wish that deliveries for these markets shall be hurried forward before there is any stoppage of trade due to the closing of the ports by winter weather.

Galvanising and merchant sheets are £7 to £7 5s. for singles, £7 10s. to £7 12s. 6d. for doubles, and £1 additional for lattens. The advance of 10s. per ton in galvanised sheets, announced by Messrs. Braby and Co., London, is favourably commented upon by the galvanisers in this district, who hope that it will "hold." Tank plates are £7 10s. upwards, and boiler plates £8 to £9 easy, with but little business.

Branded bars are £7 10s., and last month it was thought that the value would have had to come down to the lowest known point in recent times, viz., £9, which prevailed from April to September, 1881, but the stiffening up of the inferior qualities has prevented this. To some extent the firmness or advance in prices of iron has been caused by the extra cost of fuel, consequent on the colliers' strike.

Marked bars in this district have now remained at £7 10s. for nearly a year and three-quarters, and this price is likely to prevail certainly up to the end of the year. Just now the realised prices are nearer the quoted prices than they have been for three months past. Medium quality bars are £6 10s., and common, £6.

Angles and tees do not show much improvement in demand, but rivet iron of good quality is in fairly brisk request. An increased business is doing in wire rods.

The pig iron market is firm in tone, and there is a hopeful feeling on the part of smelters in regard to higher values. In such cases, where supplies have been partly arranged for the winter, makers have not been altogether successful in realising such enhanced prices as they had hoped for; although the tendency of quotations is undoubtedly upwards. Best-mine pigs stand at about £3, £3 2s. 6d., £3 5s., and £3 7s. 6d. per ton, according to quality or number; part-mine, £2 5s. and £2 7s. 6d.; common iron, £1 17s. 6d. to £2. Vendors of Derbyshire, Northampton, and Lincolnshire pigs are not pressing their goods upon the market, since to do so would mean to lose the advantage which, in the matter of price, they have lately won. Buyers hold off for the present, but vendors are satisfied with the considerable sales recently made. Northampton pigs are 41s. to 41s. 6d.; Derbyshires, 42s. to 42s. 6d. delivered; and hematites, 55s. to 56s.

Supplies of coal keep abundant for all purposes, notwithstanding the continuance of the strike, and prices are rather firmer. At Cannock Chase, whence large supplies are coming, prices vary from 5s. 6d. per ton for forge coal up to 10s. for deep house sorts.

We are not without some fears of a strike of the Cannock Chase colliers. The employers have refused to give the advance in wages asked for by the men, but have expressed their willingness to consider the question of a sliding scale whenever the men's representatives are in a position to propose one. This reply has greatly dissatisfied the men, and they threaten to give in notices at the pits to come out.

Sir Rupert Kettle, who, it will be remembered, was knighted for the services which he rendered as an arbitrator between capital and labour, has this week openly expressed the opinion that the colliers' strike has now assumed the proportions of a great public calamity, and that it is the duty of everyone who has an interest in the district to try and make peace. He ventured to suggest that there should be a cessation of hostilities, that the men should go to work again, and that men and masters, without temper on either side, should agree to form a legally constituted Wages Board for the district. It would not, however, appear that the men are much inclined to take this advice, for at mass meetings held this week it has been resolved "to play on until Christmas, or until the old wages are given."

An important legal decision in connection with the strike was given on Monday by Sir Rupert Kettle, sitting as judge of the Dudley County-court. A test action, the result of which governs similar claims made by 350 colliers employed by the Sandwell Park Company, was brought by a collier employed by the company for £2 16s. wages in lieu of notice. The notice by the company that they should enforce on June 28th a drop in wages in accordance with the arbitrator's award was not given until June 17th, and when, on the 28th, it was attempted to enforce it, the men refused to go to work on the ground that they had not received a full fortnight's notice. The company argued that the notice was a superfluity, and that the men were really bound by the arbitrator's award. The men's counsel had, however, no difficulty in showing that the award had no legal force, and after an ineffectual attempt at compromise, his honour gave judgment for the full amount claimed. Notice of appeal was given.

At the annual meeting in Wolverhampton on Wednesday of the South Staffordshire Mines Drainage Commissioners it transpired that in the Tipton and Bilston district there are seventeen pumping engines, five of the number being worked by colliery proprietors. When the Commissioners took to the work there were in the corresponding area seventy-seven engines, raising 22,750,000 gallons per twenty-four hours, at a cost of £76,344 per year. The seventeen engines now going are releasing about 14,000,000 gallons per twenty-four hours, at a yearly expenditure of £24,163. Two new engines are now being erected in localities known as Bradley and the Moat, and a loan of £30,000 was closed on Wednesday—the last to be incurred, the Commissioners agree, with the mortgagors during the ensuing twenty-two years, over which the repayment of the loan is to be extended. Two new engines and some important levels are being got down, and the engines now running will be reduced in number, and the cost to £10,000 a year. The pumping going on has mastered the "corne," and it is now sinking the "pound," though water is coming in at the lowest levels, whose source—supposed to be the Birmingham Canal—has not been yet traced.

The autumnal meetings of the Associated Chambers of Commerce took place in Wolverhampton on Tuesday and Wednesday. There were 161 delegates present, who were presided over by Mr. C. M. Norwood, M.P. In his address, Mr. Norwood hoped that the Railway Regulation Bill would be re-introduced next session, with modifications in terminal charges. Then he thought it would meet with the hearty support and concurrence of the mercantile community. He also advised that the constitution of the Board of Trade should be inquired into. The most important subject dealt with on the first day was that dealing with the Railway Regulation Bill. The Bristol Chamber moved for the Government to re-introduce the Bill with new clauses inserted to meet the views of the Chambers of Commerce and Agriculture. Derby received the support of the Birmingham Chamber on the understanding that railway terminals would be dealt with as a separate measure. The Derby Chamber, however, could not agree to this, but wished that the Bill should enlarge the powers of the Railway Commissioners, and was in this point supported by Gloucester. Wolverhampton, however, desired that other bodies, consisting exclusively of traders, should also have a *locus standi* before the Railway Commissioners; but upon a division that amendment was lost. Ultimately the Derby motion was passed. On the second pay the question of the assessment of machinery was the most interesting subject. Mr. Marshall, of Leeds, proposed that all machinery, with the exception of engines and shafting, should be exempt from assessment for Poor-law purposes. As the law on the subject was very uncertain, there should be passed, urged Mr. Marshall, a short Act every year defining what classes of machinery should be rated, the same as existed in regard to commercial stock. It was impossible, however, for this to be done unless some private member would undertake to pilot the Act, since if they went to the Government, the reply would be that the subject would have to wait until the whole question of rating could be dealt with. The Conference unanimously adopted the resolution. Thursday and Friday were devoted to excursions.

The mails have not been of great value this week to the hardware manufacturers. Most of the countries are complaining of the low price alone procurable for produce of nearly every description. South Africa is showing only the faintest signs of revival; yet miners' miscellaneous requirements, both of a trade and domestic sort, are less quiet in demand. South America looks well; and of the Australian Colonies, New South Wales keeps most valuable. The trade with New Zealand is still experiencing the advantage of the new lines of communication, and of the extent to which the competing steamers strive to get the lion's share of the carrying.

The good and evil to be derived from the proposed International Inventions Exhibition forms the subject of an interesting letter which has been forwarded to the secretary of the Exhibition by the well-known needle manufacturers, Messrs. H. Millward and Sons, of Redditch. Replying to an application asking them to exhibit, they state that they intend to do so only for reasons of self-defence, as they would be ashamed to acknowledge that there had been no inventions in their particular branch. For this reason, they say, we are forced to show inventions of machinery which have hitherto only been known by the patent specifications, and have never been seen in actual operation. They point out that the competition which British commerce has to contend with in all parts of the world at the present time is unbearable, and they question the wisdom of opening exhibitions at which foreigners can "pick up the collective brains of the nation for the modest sum of one shilling."

The tramways' question continues to occupy considerable attention in Birmingham, and it is shortly to be discussed by the Town Council, upon a proposition submitted by the Public Works Committee, that the tramway company's lease granted at a rental of £1680 a year, and which expires next May, shall be renewed. The present lines the committee propose shall be taken up and relaid on a narrower gauge—3ft. 6in. instead of 4ft. 8in.; and the company is also to relay its lines outside the borough boundary, to the same gauge, at a heavy cost for new rails, &c. The cost of the alterations to the corporation is estimated at £45,000. It is proposed to give the company a lease for twenty-one years at a rental which will cover the corporation's annual outlay; and the company is to establish a sinking fund so as to pay the whole capital sum at the expiration of the lease. The corporation reserves the right to grant to other companies running powers, and it retains power to grant or refuse the use of steam.

The manufacturers of Kidderminster are pushing forward with praiseworthy vigour their new attempt to obtain the best railway facilities for the district. Undoubtedly such a line is needed, for as was pointed out by Mr. R. Smith-Casson at a meeting convened to consider the question, it is cheaper when manufacturers wish to go to Birmingham to book first to Dudley and then to Birmingham rather than to take a through ticket. The upshot of the gathering was that it was decided to ask the various railway companies supplying the district to construct a line connecting Wolverhampton, Cookley, Kidderminster, and Bromsgrove, by a new line. The Chambers of Commerce in the town and neighbourhood have been invited to take up the matter, and it is hoped that the new movement will end in the formation of the much-needed line.

The Staffordshire Potteries Manufacturers' Association have given notice to their workmen that they intend to apply for a revision of the wages' scale at Martinmas.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—A continued firmness in prices, but very little real improvement in the actual condition of trade, sums up the general position of the iron market here. A few fairly large sales made recently, with inquiries coming forward rather more freely, have encouraged makers to hold out for slightly better prices, and generally there is a disinclination to entertain offers at under list rates, but there is a continued lack of animation in the market, and an absence of anxiety with regard to any material upward movement in prices, which induces an indifference on the part of buyers. Occasionally a moderately large order is placed out under special conditions, but the bulk of the business doing is from hand to mouth, and neither buyers nor sellers care to commit themselves very far ahead.

There was but a quiet market at Manchester on Tuesday, with prices, where business was done, about the same as last week. Enquiries were, perhaps, not quite so numerous as they were a week back, but the condition of the market was no worse, and the now generally accepted belief that prices are not likely to come lower, encourage the hope that trade may be on the turn for the better, but it does not stimulate any great weight of buying. Lancashire pig iron makers are doing a moderate business, and are very firm at 41s. to 42s., less 2½ per cent., for forge and foundry qualities delivered equal to Manchester, with contracts limited to the end of the present year. In district brands makers also continue firm, with 42s. to 43s., less 2½, for Lincolnshire iron delivered, about the minimum prices now quoted. In odd cases there are sellers to be found who would book orders at about current rates for delivery over the first half of next year; but as a rule makers are not quoting for longer delivery than the next three months or so.

Hematites continue extremely low in price, and there are good foundry brands still to be bought at about 53s. 6d., less 2½ per cent., delivered into this district.

In the manufactured iron trade orders are reported to be coming forward better both on home account and for shipment, and there is a moderate business doing with the colonies in bars, hoops, and sheets. Most of the forge proprietors in this district are now fairly well off for work, and prices show a tendency to stiffen. In some cases £5 15s. is now being quoted for good qualities of bars delivered into the Manchester district, but £5 12s. 6d. remains about the average price that is being got where orders are given out, and there are some local makes which can still be bought at under this figure. Hoops are quoted at £6 2s. 6d., with £6 taken where prices have to be cut to secure orders, and good qualities of sheets at about £7 5s. up to £7 7s. 6d. per ton.

The reports as to the prospects of the engineering trade continue unsatisfactory; although locomotive and railway carriage builders continue busy, in most departments there is a falling off, and toolmakers have comparatively few new orders coming forward.

Sir Joseph Whitworth and Co. have just completed the largest gun tube ever made in this country, or probably in the world. This is a steel tube for one of the 110-ton breech-loading guns now being built for the Government at Elswick; the length of the tube is 42ft. 6in., the outside diameter 27·1in., and it is made with a forged hole 14¾in. in diameter. The total weight of the tube as sent out from the works is 26 tons, but this if it had been a solid casting would have exceeded 40 tons, and the tube is a splendid specimen of one of Sir Joseph Whitworth's specialities in hollow steel forgings.

The firm have also in hand several other exceptionally heavy steel forgings, and so busy are they in their steel department that further extensions of this branch of their works are being carried out; one recent addition being an improved Siemens-Martin furnace capable of turning out 35 tons at a single cast. A number of very heavy marine cranks and shafts are in hand both for home and abroad, and amongst these is a steel shaft for a new steamboat which is being built for the City of Dublin Steam Packet Company by Messrs. Laird and Co., of Birkenhead, and which I understand is intended to be the swiftest paddle-wheel steamer ever sent out. The maximum outside diameter of this shaft is 30½in., the mini mum 24in., with a hole from 14in. to 15in. diameter; the throw of the crank is 51in., the total length of the shaft 55ft., and the total weight 48 tons. This is a built up shaft forged hollow, which reduces its weight about one-third as compared with a solid shaft, and it will be finished ready to drop into its place on the steamship.

In the coal trade of this district the month has opened with a general upward movement in the price of all classes of round coal, ranging from 6d. to 1s. per ton, and in anticipation of this advance there has been rather a push of orders; but at the higher prices now being asked the giving out of further business has been checked. At the pit mouth prices now average about 9s. 6d. for best coals, 7s. 6d. for seconds, and 6s. to 6s. 6d. for common round coals, with a few collieries quoting about 6d. per ton above these figures. Engine classes of fuel have been advanced 10d. per ton in the Manchester district, but in other districts it is only in exceptional cases that burgy has been put up about 5d. per ton; and with the plentiful supplies of slack in the market, any general upward movement in this class of fuel would certainly seem to be out of the question. Good qualities of burgy can still be got at about 5s., good slack at about 4s., and ordinary qualities at about 3s. per ton at the pit.

For shipment there has been a moderate demand, and quotations for delivery at the high-level, Liverpool, or the Garston Docks, have been put up about 6d. per ton, 7s. 9d. being about the average for good qualities of Lancashire steam coal.

Barrow.—The improvement noticed in the hematite pig iron trade of this district last week I have to report has not been well maintained, and this week business has lapsed into its old dull state. The turnover is just now confined to the barest requirements of purchasers, and therefore transactions are not of large extent. The shipments of pig iron for September were not only small, but they have kept at a low price during the past week. Foreign demand has, I notice, dropped off considerably, and there are at present few signs of a revival. The number of blast furnaces now at work in the district is about the same. Stocks, however, are not diminishing, and some time must elapse before they will be worked off. Prices, though not quoted higher, are somewhat firmer, mixed Bessemer parcels being priced at about 44s. per ton net at works, and No. 3 forge 43s. 6d. per ton. The tone of the steel trade is, perhaps, a little more cheerful in some departments, but on the whole the trade cannot be said to be in anything like a satisfactory condition. Rails are remarkably quiet both on home and foreign account, and prices continue very low, orders being booked at about £4 15s. to £5 per ton. A fair demand continues for merchant samples, special steel, hoops, and wire. In the iron ore trade not the least improvement can be reported. Prices are nominally the same as they have been for some months past. Shipbuilders are quiet, and few orders are being booked. Coal and coke easier. Shipping inactive.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

At the Cleveland iron market, held at Middlesbrough on Tuesday last, there was but little business done. The improvement in tone previously noticed was, however, again discernible, and the firmer prices for foundry qualities of pig iron which have ruled during the past fortnight were maintained. Merchants' quotations for No. 3 g.m.b. were 36s. 6d. per ton, but as they had but little for prompt delivery, the lion's share of the business was done by makers at the combination figure of 37s. per ton. Forge iron was scarcely so firm in price. Smelters obtained 34s. to 34s. 6d. per ton for it, sales at less than the former figure being rare.

There is nothing new to report as to the finished iron trade. Few orders have been recently given out, and these for small lots only. Quotations are unchanged, ship plates being offered at £5 per ton, angles at £4 15s., and common bar iron at £5 2s. 6d. Exceptionally favourable specifications can be placed at prices slightly below these.

The quarterly meeting of the Cleveland iron market will be held on Tuesday next.

Messrs. Connal and Co.'s stocks of pig iron, both at Middlesbrough and Glasgow, continue steadily to decrease. On Monday last the Middlesbrough stock was 54,739 tons, being equivalent to a reduction of 300 tons during the week. In their Glasgow store the quantity was 583,697 tons, or a decline of 505 tons.

Shipments of pig iron from the Tees were remarkably good during September, 89,751 tons having been sent away. This is the best return since May, when the quantity was 92,750 tons. During August only 71,815 tons were shipped. The principal items in the returns for September were as follows:—Scotland, 24,845 tons; Germany, 21,036 tons; France, 7990 tons; Holland, 7867 tons; Wales, 6848 tons; and Russia, 6270 tons.

Messrs. Irvine and Co., shipbuilders of West Hartlepool, have been awarded a silver medal at the London International Exhibition, for the apparatus they employed to raise the ship British Enterprise, which was sunk in the Tyne last year.

Messrs. Sir W. G. Armstrong, Mitchell, and Co., Limited, Newcastle, pay a dividend at the rate of 7¾ per cent. per annum.

Owing to dulness of trade, the Consett Iron Company has given notice to about 100 of its colliers to terminate their engagements at the end of next week. About thirty men will be paid off this week at the Grosmont Ironworks, near Whitby.

The Newcastle Corporation has decided to set aside £5000 for the wages of operatives to be employed on public works during the coming winter. This will provide sustenance for a few of the many who are now involuntarily idle.

The whole of the plant, stock, and stores at the Carr House Ironworks, West Hartlepool, will, by order of the trustee, be sold by auction on Thursday and Friday next. The principal items of plant are three trains of rolls for merchant iron, together with some good shears, steam hammers, and two locomotive engines.

Messrs. Bolckow, Vaughan, and Co. have decided to erect four Siemens furnaces instead of two, as at first reported. It is expected that they will commence the manufacture of steel plates in about three weeks—that is if they can get any orders, which is doubtful. A mill has already been started for the manufacture of tin bars, and orders have been received which will last several weeks. These bars are 8in. wide by ½in. thick, and are rolled into thin sheets by the stamped goods manufacturers and then coated with tin.

The great sensation in the North at the moment is Sir W. G. Armstrong's speech about the Esmeralda gunboat. Were Sir William not in so high a position as a man of science, and were his character not above all suspicion, he would at once be supposed to have been merely advertising the wares made and sold by his "great and magnificent company." But his opinion deliberately and clearly expressed upon a subject that he has studied more deeply than any man living, cannot wisely be pooh-poohed in that way. It is a serious matter for England and Englishmen to devise and supply to possible enemies the means of crippling their own trade and commerce, and of destroying their own national defences. And it is an equally serious matter to proclaim from the house-tops, as it were, what and where are our vulnerable points. It is to be hoped that when Parliament reassembles, attention will be called to Sir William's speech, and a committee will be appointed to inquire into the truth of his observations. If such committee should report—as doubtless they will—that his views are sound and correct, then the sooner the Admiralty builds a few cruisers of the Esmeralda type the better. And the sooner Sir William is retained as the adviser of the Admiralty, and prevented from supplying foreign nations with gunboats superior to our own, and from telling them our most vulnerable points, the better also.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*

The Nunnery Colliery Company, Sheffield, has had another tartling reminder of the danger in which it is perpetually working from the liability to flooding. Early in February the Sheaf broke into their workings underneath the Midland station, which is erected over that river. On the afternoon of the 25th inst. the day shift employed at the Nunnery pit were within an hour of ceasing their work, when they had to take to their heels, such as could get away, for safety. 180 men and boys were then in the workings. Coal was being got about two miles from the bottom of the shaft, when two men who were driving a heading suddenly tapped water, which rushed out with tremendous velocity. The two men were able to slip into slits at the side in time to avoid being washed away, and the two in the gate were in greater peril; but one managed to grope his way through into an old path and scramble out, while the other, crouching in a slit, was imprisoned for three hours till the manager—Mr. W. J. Jones—and a party of explorers waded through the water and rescued him. Another poor fellow, in hurrying to escape, stepped into the spokes of a wheel on which an endless rope revolves, and the spokes cut off his foot as clean as if it had been done with a knife. With remarkable fortitude, how ever, notwithstanding that his foot was torn away, he succeeded in extricating himself from the wheel before being rescued by his mates who had been working with him at the time. By clinging to the corves he kept himself from being washed away by the flood. All the other men got out without injury; but it was several days—though the machinery is capable of pumping 6000 gallons a minute—before work could be resumed in the portions of the pit affected by the outburst. It ought to be mentioned that the triers had bored in the usual way, but, owing to the plan of the old workings at the Woodthorpe pit—where the work had been pent up—being incorrect, they had just missed the perilous spot. Every drop of water which falls into the Nunnery pit has to be pumped to the surface a height of 100, 160, and 210 yards, as it is brought up at the Soaphouse, Manor, or Nunnery pumping shaft.

The first note in the coal trade comes from the Mexbrough district, where, it is said, the price of coal for home consumption is to be raised in October—probably the first week—by 1s. a ton. Mexbrough has been better off than other districts in regard to shipping orders, and it is not unlikely that the coalowner may thus be emboldened to try for an improvement in price. If he does so, the voice of the miner will be promptly heard on the wages question. In Lancashire an advance of 1s. to 1s. 8d. per ton is notified, to date from the 1st of October; and in this district the coalowners, contrary to expectation, have determined to impose the usual 10d. to 1s. a ton extra which is generally added in October.

The Barrow Hematite Steel Company, in a notice to the colliers employed in the Parkgate and Silkstone mines, deny that the men employed in the Thorncliffe seam would be secured five days' work in each week for the coming twelve months, and state that, when notice was given to discontinue working in the Thorncliffe mine because it did not pay, no suggestion was made by any member of the miners' deputation that there had been any such pledge. According to the employers' statement, they offered to continue the working in one district of the Thorncliffe mine, provided they could be met by a concession on the part of the men to the extent of working an extra man in each "benk." For the remainder of the men it was suggested that work should be found for them in the Silkstone and Parkgate mines upon the same conditions. This offer, however, was considered by the men and refused. They made another offer, which the men also declined, and they now suggest that Mr. William Pickard, of Wigan, should be invited to arbitrate. If the men accept this offer, the company purpose, pending a settlement, that the Silkstone and Parkgate men should continue their work on the present terms.

The President of the Sheffield Chamber of Commerce—Mr. J. Willis Dixon—addressing a meeting the other day, stated that trade was not good, and the prospect was not cheering. The causes were not far to seek. Sufficient explanation could be found, owing to the excessive railway rates, foreign hostile tariffs, Canadian tariffs, and to the condition of things at the Cape and in Egypt and Madagascar, as well as in China and other Eastern countries. Of course foreign countries could do as they liked with their own tariffs, and would not admit of any interference from the British Government. But he contended that our Government need not have practically told Lord Derby he could do what he liked in Madagascar, and Britain would not interfere. This was plainly contributing to the decline of British trade. For the past eight months the trade returns for the Cape were only five millions, compared with eight millions during the corresponding months of last year, showing a decline of about 40 per cent. Mr. Dixon then gave statistics showing the decline of Sheffield trade. Quoting from the summary given from the Board of Trade returns in The Engineer, and practically applying these and other figures, he pointed out how the imports had increased since 1869 in proportion to the exports. In 1869 the imports into this country were of the value of 295 millions, and in 1883 they were 426 millions. The exports in 1869 were 189 millions, and in 1883, 239 millions, so that whilst the imports had increased by 150 millons, the exports had only increased by 50 millions, and none of the increase had come to Sheffield. "The steel rail trade," added Mr. Dixon, "has gone; the ship plate trade—not armour-plates—has gone; steel and cutlery all show tremendous drops, whilst it is now said that the Government contemplate competing with four of our leading firms in the manufacture of steel guns. Such is the state of things, and I can see no way to improvement until we have lower railway rates, foreign tariffs less hostile, and a more business-like Government. When that time comes, Sheffield will compete with the world, and we shall have a glorious trade again."

The Ambergate Patent Railway Wheel and Wagon Company has been finally wound up, the liquidation closed, and the company dissolved. The last meeting for this purpose was held at the office of the surviving liquidator, Mr. W. Fisher-Tasker, Wharncliffe-chambers, Sheffield, on Tuesday.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

A fair business has been done in the Glasgow warrant market in the past week, although much less animation has prevailed than was the case a week ago. The amount of the shipments has always an appreciable influence on business, and those for the past week were unsatisfactory. They amounted in the aggregate to 9242 tons compared with 11,021 in the preceding week, and 13,238 in the corresponding week of 1883. These figures were somewhat disappointing, because in certain quarters the hope was growing that the exports were destined to be heavy week after week for a considerable time. The inquiry on the part of Germany has been improving, and the business with the United States and Canada is better than before, but the shipments elsewhere are small. Since last report a furnace has been extinguished at Dalmellington Ironworks, leaving a total of 93 in operation, as compared with 114 at the same date last year. The stock of pigs in Messrs. Connal and Co.'s stores is 485 tons less than last week.

Business was done in the warrant market on Friday last at 41s. 8d. cash. On Monday the tone was firm at 41s. 7½d. to 41s. 9d. cash in the forenoon, but in the afternoon 41s. 8d. was quoted. Transactions took place on Tuesday at 41s. 7d. and 41s. 7½d., and back to 41s. 7d. cash. Business was done on Wednesday at 41s. 6½d. to 41s. 7½d. cash. To-day—Thursday—the quotations were the same as yesterday, the tone of the market being quiet.

The quotations of makers' pigs have been remarkably firm; indeed, in some instances they are again slightly higher:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 56s. 6d.; No. 3, 57s.; Coltness, 60s. 6d. and 62s. 6d.; Langloan, 58s. and 52s. 6d.; Summerlee, 54s. and 47s. 3d.; Calder, 43s. 6d. and 47s. 6d.; Carnbroe, 51s. and 47s.; Clyde, 48s. 6d. and 45s. 6d.; Monkland, 43s. 9d. and 40s. 9d.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 43s. and 40s. 9d.; Shotts, at Leith, 54s. 6d. and 52s. 6d.; Carron, at Grangemouth, 49s. (specially selected, 53s. 6d.), and 48s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 50s. 6d. and 43s. 6d.; Eglinton, 45s. and 41s. 6d.; Dalmellington, 47s. 6d. and 43s. 6d.

The manufactured iron and steel goods shipped from Glasgow in the course of the week embraced machinery valued at £31,070, five locomotives worth £8500 for Calcutta, £3820 sewing machines, £6650 steel goods, and £56,240 general iron manufactures.

In the coal trade a large business has been done, the shipments at most of the ports being heavy. The cargoes despatched from Glasgow included 2865 tons for Genoa, 3470 to Cronstadt, 3058 to Demerara, 1979 to Canada, 2158 to San Francisco, 1785 to Bordeaux, 1257 to Odessa, 1098 to Alexandria, and smaller quantities elsewhere. At Grangemouth, 18,292 tons were shipped; at Ayr, 7867 tons; Troon, 6156 tons; and Irvine, 1381 tons of coal. The quotations are without material change.

No real progress has yet been made with the threatened agitation against the payment of mineral royalties.

Messrs. William Baird and Co. are now engaged opening up the Barrwood minerals which they recently acquired from the feuars of Kilsyth. The firm have other large works in the immediate neighbourhood, and the railway facilities in the district were lately much improved, so that the probability is that the Barrwood Collieries will be conducted with energy and spirit.

The amount of new shipping launched from the Clyde shipbuilding yards in the course of September has been above the average in tonnage. There were 25 vessels put into the water, with a total gross register of 37,012 tone, as compared with 23 vessels and 31,510 tons in the corresponding month of last year. During the nine months the launches number 192, with an aggregate tonnage of 226,877, against 214 vessels and 291,330 tons in the same period of 1882. Taking the three quarters of the year, there is thus a decline of 62,450 tons. But the present state of the trade is far more unsatisfactory than these figures would appear to indicate. The new contracts placed in September were few and comparatively unimportant, and not nearly sufficient to fill the vacancies caused by the finished vessels. They are almost exclusively sailing ships, and the marine engineers are practically receiving no fresh work at present. Many workmen are being paid off in the shipyards and engine works, and the coming winter threatens to beeome one of the quietest on record in this important industry.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A possible element of mischief is being industriously worked at Dowlais amongst the colliers, who have for some time been antagonistic against the present arrangements of the medical staff. They have sent in a request for amendment to the chief surgeon, but obtained no reply, the medical officer assuming that the complaint came from a few discontents only. Upon this a vote was taken, and 4000 colliers declared themselves in sympathy with the complaints, only ten colliers refusing to vote. Matters now look serious, and a rupture is imminent.

The strike amongst the men of the Gloucester Wagon Works continues, and it is expected that the services of other men will be forthwith obtained.

The fortnightly pay system is being widely adopted amongst the colliers in the Neath and Swansea district, and at a late meeting at Landore, Swansea, it was hoped that it would be the general rule throughout the collieries. This I cordially endorse. Long pays are pernicious, and lead to a good deal of improvidence.

The staple industries of Wales show little change. Tin-plate is drooping more, and while stocks are increasing, prices are lowering. The expected demand from America still lags, and in consequence makers are offering ordinary coke for as low as 14s. 6d., to effect a clearance.

In the steel trade there is the same inaction as I have so long recorded, and a good steel rail order is never seen. Works manage to rub along with a few turns per week on small orders, alterations, and stock; but there is not a healthy sign to be noted anywhere.

The iron clearances from the Welsh ports last week were uncommonly small, as will be seen from the list—480 tons of tin-plates to New York, 272 tons of iron to Rouen, and 258 tons to Rio Grande. The condition of the iron trade could scarcely be worse. I heard of sales effected at Cardiff this week for 10s. 3d. per ton, but can only hope it was under some exceptional circumstances. That trade is bad, and prices ruinously low, there can be no doubt.

In the coal trade we are met with a more vigorous condition of things, though even there all is not of the best character. Prices, for instance, are low. No. 2 is quoted at 8s. 3d. to 8s. 6d.; No. 3, 9s. to 9s. 3d.; and the best colliery screened fluctuates from 10s. 3d. to 11s. per ton. Pitwood is quoted at 18s. Small steam is becoming a drug, partly from home requirements being small, but in greater part from the cholera in Italy, which has told seriously upon that branch of trade at Cardiff.

The large coalowners are moderately well occupied, but I have noticed a congestion on the Taff Vale Railway at times, which is not due to faulty railway arrangements, but simply a dearth of business at Cardiff docks. On Monday last, for instance, the road collierywards from Cardiff to Cathays was a mass of coal wagons. Fortunately the congestion was not continued long. The clearance from the docks at Cardiff last week to foreign destinations reached 127,000 tons. From Newport there was not a marked export, although there is increased coal traffic coming from the Rhondda. The total export and coastwise was near 50,000 tons.

One fine steamer of 3000 tons is now loading at this port. This is the Dundee, and she is going to take the Powell Duffryn coal to India, all of which will be run upon the new Rhondda line at a saving of time and rate.

The Taff Vale Railway Company contemplates more extensions. For half a century it has been one of the most unprogressive of lines, but in its old age it rivals the youngest. The latest idea is to run a line from Penarth railway to Barry.

The Barry Dock and Railway prospectus is now before the public. First issue, £100,000 in 10,000 shares of £10 each. The directorate is of unquestioned standing and financial capacity, and the character of support guaranteed may be inferred from the fact that the list closes on the 19th October. The time estimated for completion will be from three and a-half to four years, during which a good deal of angular difference may, by modification and concession, be smoothed away.

The Gelli strike continues, and I see it was mentioned at the Rhondda monthly meeting that large numbers of colliers contribute to the relief of the men, though arbitration has been openly offered. This is going direct in the face of the sliding scale, and should not be countenanced. The coal development continues. In addition to the new sinkings reported lately, I hear of extensive projects in the Ely Valley.

At Llantrissaint the Llantwit Red Ash Colliery is to be re-started. At Plymouth the old Abercannaid pit will be in working order in a few days.

Business at Swansea is brisk, and the average export is well maintained, but why is the North Dock crowded to so inconvenient an extent, while the Prince of Wales and South tips are comparatively idle?

There has been a good week's work in the Forest of Dean, and what with new companies and changes, prospects in the district are decidedly improving.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—W. E. Beade, chief engineer, to the Pembroke, for service in the Rambler; George M'Ewen, acting chief engineer, to the Indus, for service in the Acorn; W. Scott, engineer, to the Cambridge, for service in the Bullfrog; George White, engineer, to the Asia, for service in the Scout; James Stiven, chief engineer, to the Indus, additional, for service in the Resistance.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office Officials, by giving the number of the page of* The Engineer *at which the Specification they require is referred to, ins'ead of giving the proper number of the Specification. The mistake has been made by looking at* The Engineer *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

** When patents have been "communicated," the name and address of the communicating party are printed in italics.

23rd September, 1884.

12,684. Pianoforte Vans for Removing, E. Price, Devizes.
12,685. Railway Signals, C. A. Peltzer.—(*H. Wiesenthal, Aachen.*)
12,686. Safety and Alarm Tills, J. W. Blakey, Leeds.
12,687. Making Steel with Open-hearth Furnaces, J. Riley, Glasgow.
12,688. Coupling Railway Wagons, G. Richard, Plantation.
12,689. Handles for Flush Rings, &c., J. Walker, Birmingham.
12,690. Consumption of Smoke, &c., W. Kneen, Barrow-in-Furness.
12,691. Sheep Shears, D. Ward and P. Ashberry, London.
12,792. Indicating Amount of Liquid in Lamps, J. Hargrave, Burley.
12,693. Spring Saddle Bars, W. J. Langdon, London.
12,694. Filtering Machines, J. A. Crocker, London.
12,695. Cleansing Barley or Grain, &c., W. Bone, London.
12,696. Bicycles, &c., H. Cooper, London.
12,697. Unctuous, &c., Mixture, for Toilet, F. Oppenheim.—(*E. Dautrevaux, Paris.*)
12,698. Collars for Horses, &c., R. King, Bristol.
12,699. Abstracting Water from Atmospheric Air, J. W. Furrell, London.
12,700. Holding and Igniting Matches, A. Berkeley, London.
12,701. Valve, W. R. Oswald, London, and J. R. Williams, Brockley.
12,702. Metallic, &c., Jointing Material, W. R. Oswald, London, and J. R. Williams, Brockley.
12,703. Electric Railways, J. Y. Johnson.—(*E. M. Bentley and W. H. Knight, U.S.*)
12,704. Steam Excavators, E. de Pass.—(*L. G. le Brun, Paris.*)
12,705. Looms for Weaving Loop Fabrics, R. Blake, Glasgow.
12,706. Valves, W. W. Adams, London.
12,707. Connecting Animals to Vehicles, J. I. Emanuel, Canonbury.
12,708. Employing Heated Air in Drying Vegetable and other Substances, S. C. Davidson, London.—*29th July*, 1884.
12,709. Applying Veneers of Wood to Cloth, C. O. G. Napier, London.
12,710. Steam Washing Machine, &c., C. O. G. Napier, London.
12,711. Smoke Consuming Furnaces, &c., A. C. Henderson.—(*M. Krudewig, Germany, and W. Kloh and I. Hymes, U.S.*)
12,712. Felt for Roofing, S. Frankenberg, London.
12,713. Disinfectant, &c., W. G. Gard, London.
12,714. Gas Engines, A. W. L. Reddie.—(*P. Murray, U.S.*)
12,715. Boots, &c., W. Freeman, London.
12,716. Button-hole Mechanism for Sewing Machines, D. Mills, London.
12,717. Safety-stopper, L. A. Groth.—(*F. F. Almquist, Stockholm.*)
12,718. Treating Phosphatic Materials, H. Brunner, Liverpool.
12,719. Shuttles, J. Harvey, London.
12,720. Lard Refining, &c., C. F. Hodges, Waterford.
12,721. Swiss Embroidery, E. Aeschlimann and H. Triggs, London.—(*Kuhn Bros., Degersheim.*)
12,722. Extinguishing Fires, H. H. Lake.—(*J. W. Bishop, U.S.*)
12,723. Cleaning Tobacco Pipes, S. Grafton, London.
12,724. Two-wheeled Vehicles, G. H. Morgan, London.
12,725. Electrolytic Extraction of Copper, E. Marchese, London.
12,726. Printing Machinery, H. J. Haddan.—(*A. Kolb and A. Tischler, Vienna.*)—*8th July*, 1884.
12,727. Transferring Designs, H. J. Haddan.—(*A. Kolb and A. Tischler, Vienna.*)—*8th July*, 1884.
12,728. Safety Handle Bar for Bicycles, C. S. Snell, London.
12,729. Ammunition for Ordnance, W. Hope, London.
12,730. Row Boats, S. Pitt.—(*J. Prince and F. C. Clark, Paris.*)
12,731. Chime Clocks, A. L. A. Remané and E. Roberts, London.

24th September, 1884.

12,732. Bleaching Fibrous Materials, &c., R. and A. W. Townsend, Glasgow.
12,733. Lubricating Pistons, &c., of Motive Power Engines, W. M. Musgrave and J. Prestwich, Manchester.
12,734. Utilising Tides and Streams, W. Walton and T. Irving, Bishopwearmouth.
12,735. Automatic Motor, J. Horton and J. T. Armstrong, Hanley.
12,736. Pointing Tool, J. Blacka, Todmorden.
12,737. Brace, &c., Buckles, C. N. Eyland, Birmingham.
12,738. Combined Automatic Bolt, Lock, and Burglar Alarm, W. W. Crowder, Birmingham.
12,739. Rims and Tires of Wheels, G., J. H., and F. Taylor, Nottingham.
12,740. Wheel Bearings for Traps, &c., G., J. H., and F. Taylor, Nottingham.
12,741. Expansion of Air or Gases by Heating, R. Kennedy, Glasgow.
12,742. Musical Instruments, W. C. Jones, Chester.
12,743. Cooking Utensils, J. Simmonds, Bristol.
12,744. Cartridges, W. P. Thomson (*L. G. Bachmann, Brussels.*)
12,745. Looms for Weaving, J. Edelston, Manchester.
12,746. Machines for Combing Wool, &c., J. Midgley and J. E. Beanland, Halifax.
12,747. Stoves and Cooking Ranges, W. Shaw, Glasgow.
12,748. Effecting Gradual Pressure, A. Porecky, London.
12,749. Automatic Railroad Gates, W. Clark.—(*O. H. P. Cornell, U.S.*)
12,750. Wooden and other Chimney-pieces, S. B. Sutcliffe, London.
12,751. Stoppers for Bottles, W. J. Hanson, Halifax.
12,752. Printing from Engraved Plates, H. E. Newton.—(*C. Chardon, Paris.*)
12,753. Spring Power for Driving Machinery, E. Marshall and G. Phillips, Birmingham.
12,754. Covering Electrical Conductors, G. C. Taylor and E. T. Truman, London.
12,755. Manufacture of Hydrates of Barium and Strontium from their Ores, H. L. Pattinson, jun., London.
2,756. Fabric Gloves, H. Weston and C. Lunn, London.
2,757. Cardboard Boxes, W. Page, London.
2,758. Fastening Air-tight Boxes, C. A. Morris, Herne Hill.
12,759. Removing Intermediate Threads of Silk Lace produced on Embroidery Machines, J. Ramsauer, London.
12,760. Fastenings for Cravats, &c., T. K. Scruton, London.
12,761. Locks and Latches, &c., C. D. Douglas, London.
12,762. Producing Stereotype Plates, C. J. Richardson, London.
12,763. Straightening Wire Drawers' Plates, W. Millington and R. Woodhouse, London.
12,764. Electrical Conducting Cables, J. D. F. Andrews, London.
12,765. Kilns for Burning Bricks, W. Day, London.
12,766. Safety Valves for Kitchen Ranges, W. Dilworth, London.
12,767. Manufacturing Pigments, W. D. Curzon and G. Jones, London.
12,768. Constructing Deck Houses of Ships, A. B. Bolt, London.
12,769. Fire-guard, H. Plunkett, London.
12,770. Ratchet Drills or Braces, H. A. Stuart, Fenny Stratford.
12,771. Screw Lifting Jacks, H. A. Stuart, Fenny Stratford.
12,772. Photographic Cameras, F. Shew, London.
12,773. Piercing Wood, G. Lines and A. Bridgman, London.

25th September, 1884.

12,774. Filling Bottles with Aerated Waters, W. Bruce, Birkenhead.
12,775. Closing Vessels of Various Forms, &c., G. Wicks, Berwickshire.
12,776. Tramway Engines, R. Wilson, Manchester.
12,777. Tramway Engines, R. Wilson, Manchester.
12,778. Coverings for Ships' Decks, &c., D. W. Cuthbert, Glasgow.
12,779. Needles, A. W. Perkins, Birmingham.
12,780. Sewer-gas Interceptors for Drains, W. J. Hinitt, Birmingham.
12,781. Covers for Corks, J. F. Smyth, Belfast.
12,782. Vertical Roll Sugar Cane Crushing Mills, W. Renwick, Glasgow.
12,783. Trapless Wash-out Basins, P. Mooney, Manchester.
12,784. Manufacturing Types for Printing, F. Wicks, Glasgow.
12,785. Apparatus for Indicating Signs by Electricity, G. Binswanger and F. Walker, London.
12,786. Bolt and Nut for Railway Purposes, W. Corteen, London.
12,787. Opening and Closing Windows, W. Corteen, London.
12,788. Drawing Corks, J. R. Leonard, Birmingham.
12,789. Bottling Aerated Liquids, &c., T. Cockcroft, London.
12,790. Rotary Pumps, J. H. Storey, London.
12,791. Penholders, C. S. Ware, London.
12,792. Electric Lamps, C. A. Allison.—(*C. A. von Welsbach, Vienna.*)
12,793. Compound Applicable for Welding Iron, H. Campbell.—(*W. W. Ker, United States.*)
12,794. Convertible Sofa, A. Darbord, London.
12,795. Horse Shoes G. J. Harcourt, London.
12,796. Shaping Eye-handles for Shovels, J. Richards, London.
12,797. Bending Shovel or Spade Handles, J. Richards, London.
12,798. Adjustable Electrical Resistance, H. F. Joel, London.
12,799. Long Boots, D. Wiltshire, London.
12,800. Actuating Shuttle Boxes in Power Looms, W. T. Whiteman.—(*G. Schwabe, Biala.*)
12,801. Treating Natural and Artificial Grasses, E. Sundell, London.
12,802. Voltaic Batteries, D. G. Fitz-Gerald and T. J. Jones, London.
12,803. Compound Chemical Cements, E. Robbins, London.
12,804. Corkscrew, M A. Wier, Norwood.
12,805. Seamless Tubes, E. de Pass.—(*La Société Industrielle et Commerciale des Métaux, Paris.*)
12,806. Converting Petroleum into Acids, &c., J. Imray.—(*E. Schaal, Stuttgart.*)
12,807. Production of the Acid Ethers of Resinous Gums, J. Imray.—(*E. Schaal, Stuttgart.*)
12,808. Aerial Machines, P. D. Hedderwick, London.
12,809. Utilising Waste Gaseous Products of Combustion, E. Biedermann and E. W. Harvey, London.
12,810. Calico Printing Machines, T. McKillop, London.
12,811. Graving Docks, J. Donald, London.
12,812. High-pressure Cistern Valve Apparatus, F. W. Mann, London.
12,813. Traction Engines, &c., S. Lawrence, London.
12,814. Voltaic Batteries, E. P. Timmins, London.
12,815. Lock Nuts, W. Saunders, London.

26th September, 1884.

12,816. Heating Apparatus, J. Stephens, Stonehouse.
12,817. Couplings for Carriages, C. P. Sharpley, Leek, Staffordshire.
12,818. Measuring Tap, J. Tucker, Walthamstow.
12,819. Measuring Apparatus of Machines for Beaming Yarn, H. Barnes, Halifax.
12,820. Securing Metal Eyelets, F. O. Levander and E. Hill, Manchester.
12,821. Water Meters, T. Robinson, Bristol.
12,822. Hydrocarbon Burner, C. Barton, London.
12,823. Fish-plate Bolts, J. Glover and C. Walton, Liverpool.
12,824. Electrodes for Secondary Batteries, R. Tamine, Liverpool.
12,825. Boxes for Matches, &c., S. B. Whitfield, Birmingham.
12,826. Check-straps, &c., for Looms, J. Hardacre, London.
12,827. Bench Cramp, J. Horner, Leeds.
12,828. Strainer for Soap Boxes, E. B. Baller, Birmingham.
12,829. Dress Improvers, C. Reubens, London.
12,830. Agents for Treating Sewage, J. W. Slater, London.
12,831. Feeding Cakes for Animals, B. C. and L. C. Tipper, Birmingham.
12,832. Iron Last, C. Varley, Durham.
12,833. Drying Wet Clothes, A. H. Kuhlmann.—(*O. Schimmel and Co., Chemnitz.*)
12,834. Chromic Acid, &c., W. A. Rowell, London.
12,835. Regulating Balloons, &c., W. T. H. Carrington.—(*E. F. Law, U.S.*)
12,836. Kite, I. K. Rogers, London.
12,837. Cutting Hedges, W. Houseman, Yorkshire.
12,838. Telemeters, H. J. Haddan.—(*L. P. Charlier, Charleroi.*)
12,839. Umbrellas, A. Coke, London.
12,840. Construction of Subways, &c., P. Bovill, London.
12,841. Soap, C. Harrison, London.
12,842. Gas Engines, A. Davy, London.
12,843. Hydraulic Hoisting Gear, A. Steven, London.
12,844. Telephonic Apparatus, D. Sinclair, London.
12,845. Making Collars, &c., from Feathers, P. Jensen.—(*Messrs. Cohn and Eichel, Berlin.*)
12,846. Ovens, S. Peacock, London.
12,847. Crank Shafts, J. P. Hall, London.
12,848. Playing Chimes, &c., J. Berry, London.
12,849. Cylinders for Hydraulic Presses, W. R. Lake.—(*La Société Anonyme des Anciens Etablissements Kail, Paris.*)
12,850. Electrical Signal, &c., J. D. F. Andrews, London.
12,851. Removable Huts, &c., D. Nicoll, London.
12,852. Paper Fasteners, P. M. Justice.—(*E. W. Ball, U.S.*)
12,853. Directing Head for Down Cast Ventilating Shaft, S. Low, London.
12,854. Electric Telephone Transmitting Instruments, A. F. St. George, London.

27th September, 1884.

12,855. Camera Tripods or Supports, W. Watts, Manchester.
12,856. Bottle Washing Machines, J. B. Foxwell, Manchester.
12,857. Coats, Vests, &c., R. J. Spink, Oswestry.
12,858. Felt Carpets, W. Mitchell, Manchester.
12,859. Securing Railway Wheel Tires, T. Foster and E. Morris, Manchester.
12,860. Stoppers for Bottles, A. Morris, Walton-on-the-hill.
12,861. Driving Belts, W. P. Thompson.—(*C. O. Gehrckens, Hamburg.*)
12,862. Slag Boxes, E. P. Johnson, Liverpool.
12,863. Pea Trainers, W. C. Perrins, Birmingham.
12,864. India-rubber Tires, C. Moseley and B. Blundstone, Manchester.
12,865. Guard Forks, A. Copley, London.
12,866. Tobacco Pipes and Cigar Holders, G. C. Braendlin, Olton, near Birmingham.
12,867. Letters for Writing and Printing, T. Moir, Glasgow.
12,868. Accommodation and other Ladders, J. Linkleter and T. Linkleter, Tynemouth.
12,869. Softening, &c., Fibrous Materials, R. Townsend and A. W. Townsend, Glasgow.
12,870. Steam Trap, R. Hargraves, Bolton.
12,871. Ecclesiastical Flower Preserving Vase, W. M. Meredith, Edinburgh.
12,872. Wrenches, W. H. Ratcliff, Birmingham.
12,873. Bicycle Saddle and Spring Combined, W. C. Herring and M. H. Hay, London.
12,874. Miners' Safety Lamps, W. Morgan, London.
12,875. Sash Fastener, W. J. Stokes, London.
12,876. Laminating Metals, C. Cheswright.—(*H. Cheswright, Bordeaux.*)
12,877. Illuminating and Heating Gas, H. W. Wimshurst, Anerley.
12,878. Draw-off Bottle Stopper, C. Kilmister, Brighton.
12,879. Taking Casts of Teeth and Gums, W. R. Wheelock, London.
12,880. Lock Protector, G. Trice, London.
12,881. Cutting and Shaping Stone, J. Menzies, London.
12,882. Washing Machines, W. H. McDougall, London.
12,883. Automatically Mooring Submarine Mines and Torpedoes, C. L. Ottley, Chiswick.
12,884. Reheating Furnaces, E. de Pass.—(*L. Joubert, Paris.*)
12,885. Socks and Stockings, the Seamless Hosiery Company, Limited, and C. James, London.
12,886. Jointing of Pipes, E. B. Ellington, London.
12,887. Hydro-pneumatic Gas Stove, W. H. Beck.—(*J. Schneur and N. Despotopol, Paris.*)
12,888. Bricks for Building, W. B. Smith, London.
12,889. Tubes for Spinning, &c., H. Parker, London.
12,890. Regulating the Supply of Water into Steam Boilers, W. R. Alexander and W. H. Tooth, London.
12,891. Precipitating Water from Atmospheric Air, J. W. Furrell, London.
12,892. Carriage Brakes, H. J. Haddan.—(*B. Nicaud, Charenton.*)
12,893. Drying Kilns, H. J. Haddan.—(*P. Colpaert, Audenarde.*)
12,894. Textile and other Fabrics, W. Jackson, London.
12,895. Electric Railway Signals, W. Vogel, London.
12,896. Weaving Cloth, W. B. Robinson, London.
12,897. Stoppers for Bottles, F. H. Fearns, London.
12,898. Sharpening Cutting Tools, W. L. Wise.—(*C. S. Thomasen, Indore.*)
12,899. Engines Worked by Fluid Pressure, J. C. Chapman, London.
12,900. Markers, H. C. Seddon, Rochester.
12,901. Imparting to Glass the Appearance of Marble, J. Budd, London.
12,902. Decorating Glass, J. Budd, London.
12,903. Utilisation of Muscular Power, W. R. Lake.—(*A. C. Patard, Paris.*)
12,904. Distribution of Steam, W. R. Lake.—(*C. A. de Landsée, Constantinople.*)

29th September, 1884.

12,905. Injector, W. Brierley, London.
12,906. Application of the Electric Light to Lighting the Interior of Baking Ovens, W. D. Gooch and S. Sharp, London.
12,907. Opening and Closing Windows, E. Smith, Birmingham.
12,908. C-spring Carriages, H. and H. G. Longhurst, Liverpool.
12,909. Pipe Studs, J. Lucas, Birmingham.
12,910. Closing and Opening Bottles, S. Bunting and F. O'Rorke, Dublin.
12,911. Butt Straps, &c., for Steam Boilers, J. Thom, Barrow-in-Furness.
12,912. Retorts, J. Hislop, Glasgow.
12,913. Corrugated Furnaces and Flues, J. G. Lawrie, Glasgow.
12,914. Railway Signals, J. Gaskell and S. Wilcock, Manchester.
12,915. Self-acting Coupling for Railway Rolling Stock, J. Lees, Clarksfield.
12,916. Self-feeding Gas-heating Apparatus, S. Lampard, Portsea.
12,917. Hydro-electric Battery, G. Bolle, London.
12,918. Carbonising Retorts, E. Johnson, London.
12,919. Applying Embossed Patterns to Fabrics, B. M. Hood, London.
12,920. Hydraulic Forging Machinery, C. Davy, London.
12,921. Water-waste Preventing Cistern, A. Whincop, London.
12,922. Mending Masts of Ships, &c., S. Bellotti, London.
12,923. Regulating the Valves of Engines, &c., W. Stevens, Halifax.
12,924. Shuttle Pegs, J. Haydock, Halifax.
12,925. Stoppering Bottles, P. Fagan, H. Bagnall, and S. Skerritt, Sheffield.
12,926. Curing Toothache, S. Goldmann, Saxony.
12,927. Belt Fastener, P. Koch, London.
12,928. Furnaces, R. H. Hepburn, London.
12,929. Preserving Smoked Fish, O. Syllwasschy, London.
12,930. Amalgamating Gold and Silver with Quicksilver, G. W. Moon, London.
12,931. Candles and Holders, J. Y. Johnson.—(*C. Goublier, Paris.*)
12,932. Sighting, &c., Breech-loading Cannon, R. Holt.—(*A. Joyeux, Sèvres.*)
12,933. Producing Different Sounds, A. C. Hill and C. R. G. Smythe, London.
12,934. Fitting Seats or Saddles on Velocipedes, J. K. Starley, London.
12,935. Auger Bits, A. M. Clark.—(*W. M'I. Dimitt and C. H. Irwin, United States.*)
12,936. Pipes for Heating, &c., Purposes, T. Christy, London.
12,937. Cement Testing Machine, V. D. de Michele, London.
12,938. Spring Attachment for Braces, &c., J. Caulkin, London.
12,939. Aluminium and its Alloys, J. G. Willans, West Hampstead.
12,940. Malt Ploughs, M. Robertson, London.
12,941. Vessels for Food and Water for Horses, &c., J. R. Cunnington, London.
12,942. Shaping Steel, &c., J. Dixon and C. J. Appleby, London.
12,943. Condensing the Exhaust of Steam Engines, A. Greig, London.
12,944. Ornamenting Ceramic Articles with Glass, H. Imray.—(*A. Schierholz, Plaue.*)
12,945. Facilitating the Tapping of Casks, &c., A. H. Mure, London.
12,946. Brickmaking and Pressing Machines, T. Palmer, London.
12,947. Vent Pegs, J. West, London.
12,948. Pipes and Cigar, &c., Holders, S. S. Allin, London.
12,949. Demolition of Sub-aqueous Objects, W. R. Lake.—(*J. Lauer, Vienna.*)
12,950. Rotary Engines or Turbines, A. J. A. Dumoulin, London.
12,951. Joining Railway, &c., Rails, J. M. Burke, London.
12,952. Slow Motion Focussing Adjustment for Simple or Compound Microscope, J. Swift, London.
12,953. Printing Telegraphs, W. H. Davis.—(*G. B. Scott, United States.*)
12,954. Candles, L. J. Pirie, London.
12,955. Tills, T. A. Davies, London.
12,956. Utilising Compressed Air as a Motor, W. R. Lake.—(*Viscount A. du Breuil and J. P. de Coëtivy, Paris.*)

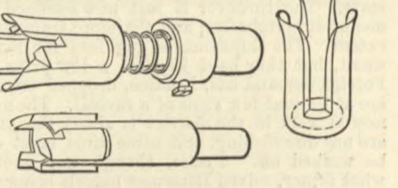
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

303,432. Tool for Turning Round Tenons, *Chas. Howind, Jackson, Mich.—Filed January 23rd*, 1884.

Claim.—(1) A tool for turning round tenons, consisting of a mandrel carrying the cutters, and a reciprocating centreing guide sleeved outside of said mandrel, substantially as and for the purposes described. (2) A tool for turning round tenons, consisting of a hollow mandrel, and cutters secured thereto and projecting beyond the end of said mandrel, in combination with a reciprocating centreing guide consisting of a collar with fingers secured thereto and projecting therefrom, between the knives, substantially as and for the purposes specified. (3) A tool for turning round tenons, con-

303 432



sisting of a hollow or partially hollow mandrel, cutters secured to the same and projecting beyond the end of said mandrel, a collar sleeved on said mandrel, with projecting fingers bevelled on their inner and projecting ends, and a resistance spring on said mandrel, the parts being constructed, arranged, and operating substantially as and for the purposes set forth.

303,790. Adjustable Crank Shaft, *Edward Barrath, Brooklyn, N.Y.—Filed January 9th*, 1884.

Claim.—(1) An adjustable crank shaft constructed substantially as herein shown and described, and consisting of the shaft sections having heads provided with excentric female screws of different diameters and reverse screw threads, the male screw having oblong central opening, the screw having exterior and interior screw threads, and the crank having oblong ends and male screw threads, as set forth. (2) In an adjustable crank shaft, the combination, with the shaft sections A, having heads B, provided with excentric female screws C D of different diameters and reverse screw threads, of the male screw E, having

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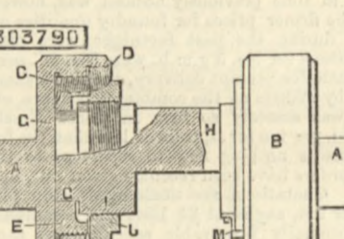

oblong perforations, the crank H, having oblong ends G and male screws I, and the screws J, having exterior and interior threads, substantially as herein shown and described, whereby the crank can be readily adjusted and will be securely held, as set forth. (3) In an adjustable crank shaft, the combination, with the shaft sections A, having heads B, and the crank H, of the index M, substantially as herein shown and described, whereby the throw of the crank will be indicated, as set forth.

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The Engineer, October 3rd, 1884.