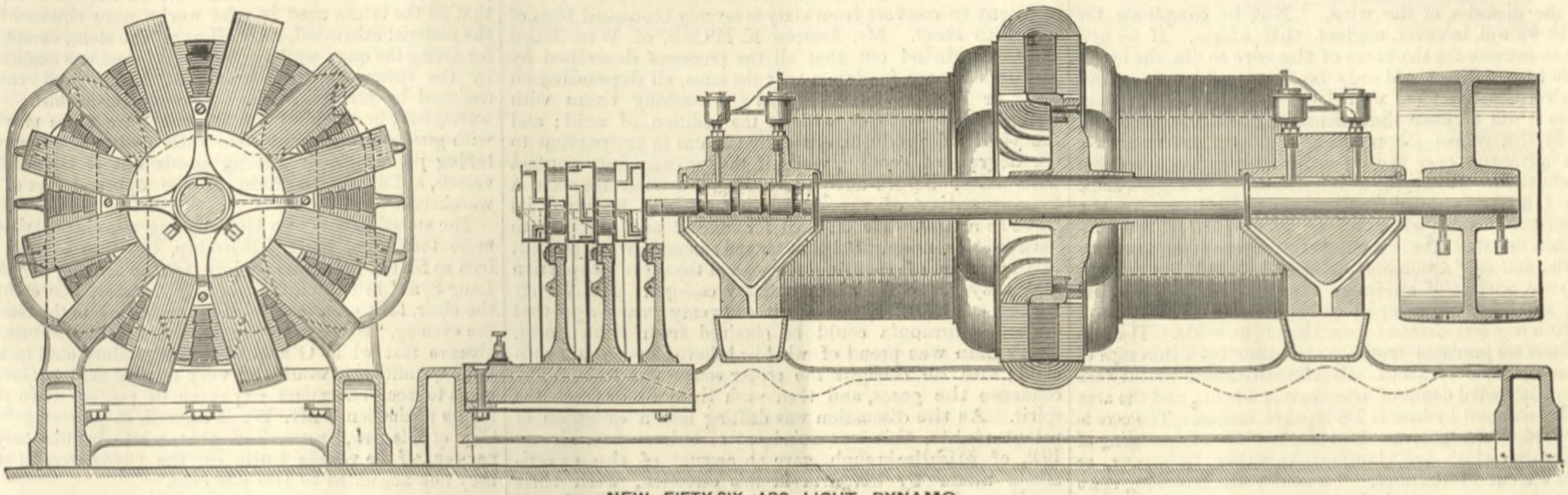
ELECTRICAL ENGINEERING AT THE INVENTIONS EXHIBITION.

No. XIII.

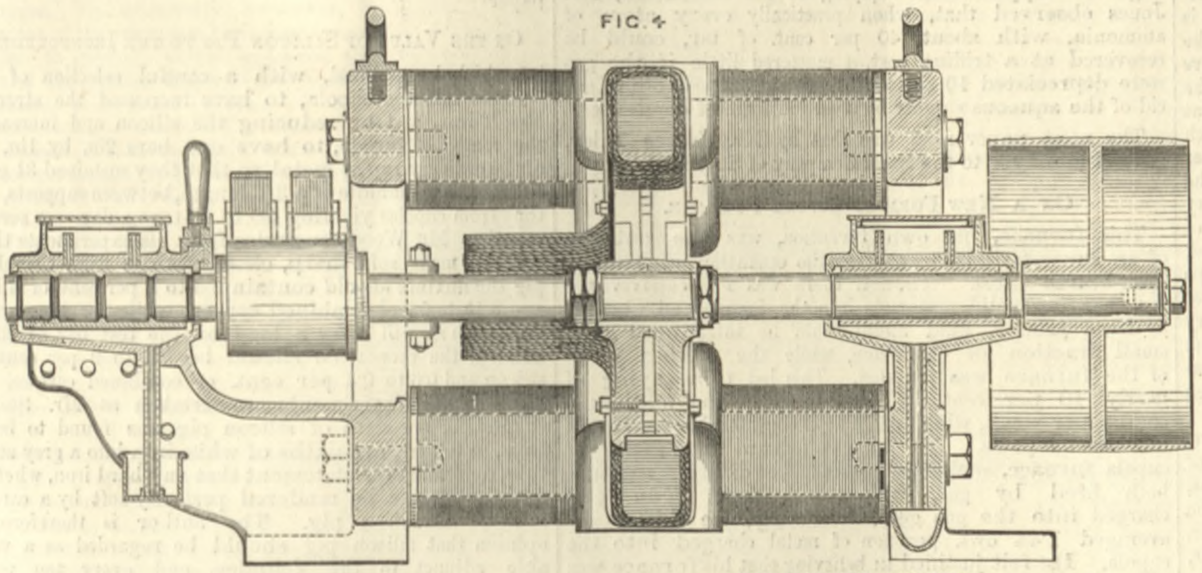
THE exhibits of the Anglo-American Brush Electric Light Corporation are amongst the most interesting at South Kensington. The improvements noticeable in the dynamos manufactured by the Corporation are in character similar to those introduced within the last year or two by other manufacturers, but, of course, different in detail. A large number of machines both for arc and incandescent lighting is shown. The improvement in the former consists chiefly in the substitution of wrought iron for cast iron in the armature core, whilst the incandescent lighting dynamos are a distinct advance over the original Schuckert machines, which they resemble in general arrangement. Taking the arc machine first, we find that the old Brush field magnets have been retained without any alteration. The armature, however, has been entirely re-designed. By the courtesy of the Corporation we are able to illustrate the new 56-light machine in the annexed engravings, Figs. 1 and 2. The frame and field magnets are the same as used in the original 40-light dynamo, and the magnet cores, as well as the pole-pieces, are made of cast iron. The core of the armature consists almost wholly of soft wrought iron. There is a central cast iron ring with four lugs projecting inwards, to which are bolted the ends of the four driving arms, as clearly shown in Fig. 2. On to this ring is coiled insulated iron tape of the same width as it is intended to make the inner portion of the core; but H-pieces are inserted in those places where the coils are to be wound, the centre bar of the H-piece being of the same width as the tape. In the machine under consideration there are twelve coils, and consequently twelve H-pieces to each convolution of iron tape. The internal width of all these pieces is constant, but the external width measured along the circumference varies with the distance from the centre, the pieces near the outer periphery being somewhat wider than those nearer the centre, as is indicated in our illustration by the saw-cut lines. The portions shaded dark represent those parts of the core which are not occupied by H-pieces, and the surface of which is consequently below the external surface of the coils. In these parts of the core layers of air and iron alternate, whilst within the coils the whole space is filled by the iron of the tape and H-pieces, and by a thin tape of insulation, which occupies about one-seventh of the total space. The connection between the coils, commutator, and field magnets is the same as in the old form of Brush machine, and, being generally known, needs no further description. We are, however, able to give the more important electrical data of this machine. The core of the armature is $4\frac{5}{8}$in. deep and $2\frac{3}{8}$in. wide within the coils, and $7\frac{1}{8}$in. over the projections without the coils. Each coil consists of twenty-two layers of ·083 wire, having thirty turns to the layer. There are therefore 7920 turns of wire on the armature counted all round. The mean perimeter of each coil is 19·5in., and the total length contained in these 7920 turns is about 4300 yards. At 650 revolutions a minute the external electro-motive force is 2700 volts, being at the rate of one volt for every 1·59 yards of conductor on the armature. As compared to the Thomson-Houston machine, this is a very good performance, and is probably due partly to the strong field—the Thomson-Houston field is purposely made weak, as explained in our last article—and partly to the cutting out of idle coils. The total weight of copper on the armature is 270 lb. As regards the density of current in the armature conductor, there is some slight difficulty in determining the way in which to calculate it. Since the whole of the current passes through those coils which at any given time happen to be in the position of best action, the density ought to be calculated on this basis. On the other hand, some of the coils are temporarily coupled parallel, and others are cut entirely out of the circuit. The density of current in these latter is *nil* for the time being, and that in the coils coupled parallel is half of the density in the series coils. If we take the mean between these three conditions, we find that the density in the Brush armature should be calculated in the same manner as in an ordinary Gramme armature, that is, on the assumption that half the total current circulates continuously through each coil. Reckoned on this basis, the density of current in the armature is only 930 ampères per square inch, the total current given by the machine being 10 ampères. At first sight it may be somewhat surprising that the density is fixed so low; but on closer inspection the reason will be obvious. With cylindrical armatures, and especially with those modern types where only one layer of wire is wound around the core, the cooling surface exposed is very large in comparison with the volume of copper that is heated by the current, and it is therefore quite safe to allow a fairly high rate of heating, or, in other words, a large current density. With the Brush armature the case is different. Since there are twenty-two layers of wire in each coil, the mass of copper contained in it is very large in comparison with its exposed surface, and if we were to allow the generation of heat per cubic inch of copper to take place at the same rate as in cylinder armatures, the heat so generated could only be carried off by the cooling effect of the surrounding air after the coil had attained a temperature so high as to injure the insulation. The exposed surface of each coil is about 90 square inches, whilst through its resistance about 100 watts are transformed into heat. This is at the rate of ·9 square inches for every watt, and on comparison with cylindrical armatures it will be found that this proportion is about the same in most modern machines.

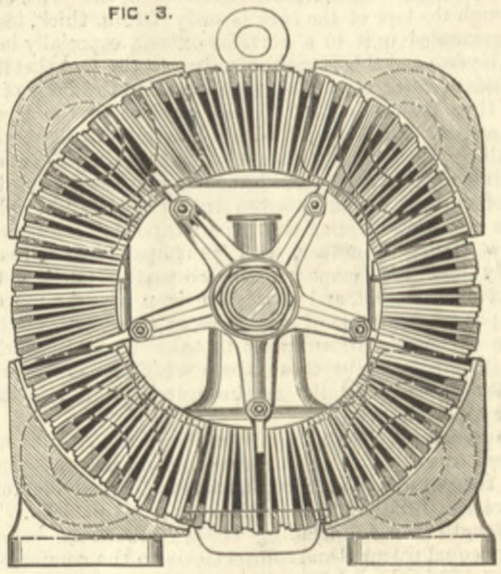
FIG. 1 FIG. 2



NEW FIFTY-SIX ARC LIGHT DYNAMO.

FIG. 4 FIG. 3





THE VICTORIA DYNAMO.

The cores of the field magnets are of oval section, 5in. thick by 13in. wide, having an area of 60 square inches, and the pole pieces of segmental form are part of the same casting. Each of the four coils exciting the magnets is 17in. long, and consists of twenty layers of ninety turns each of ·134 wire. The total length of field magnet wire is about 7500 yards, weighing 1200 lb., and the resistance of the four coils coupled in series is 14 ohms. The exciting power on each of the two horseshoes is 36,000 ampèreturns. The total weight of copper on the machine is 1470 lb., producing an electrical output of 27,000 watts, which is at the rate of 18·4 watts per pound of copper. The weight of the complete machine is 47 cwt. Its commercial efficiency is given by the Corporation as 73 per cent.

The other type of dynamo manufactured and exhibited by the Corporation is the Victoria machine used for charging accumulators, feeding incandescent lamps, and large search lights. This dynamo we illustrate in Figs. 3 and 4. It is a continuous current machine, with a Gramme armature in the shape of a ring of large diameter. Herr Schuckert, of Nürnberg, was probably the first who thought of improving the ordinary cylindrical armature by giving it the shape of a flat ring. This arrangement must have seemed advantageous for two reasons—in the first place, by increasing the diameter of the armature we obtain a higher speed of the wire at the same number of revolutions per minute; and in the second place, we expose nearly the whole length of armature conductor to the influence of the polar surfaces, instead of only half its length, as in the original Gramme armature. It would therefore seem as if the electro-motive force obtainable per yard of wire should in disc machines be double that obtainable in cylinder machines; and in the original Schuckert, Gülcher, Pilsen-Joel, and other early types of disc machines, it can be clearly seen that some such idea was uppermost in the designer's mind. There is a tendency to provide large polar surfaces so as to bring as much wire as possible under the influence of the poles, and the discs have therefore been made very deep radially and very narrow; whilst the pole-pieces were extended on either side of the magnet core, forming long segments curved to the same radius as the disc, and almost completely enclosing it. Modern practice, however, has shown that all this is wrong. The electro-motive force does not depend on the extent of the polar surfaces, but simply on the total number of magnetic lines of force which can be made to pass through the armature core. How the lines enter and leave the core is quite immaterial, and an extension of polar surface, if it does not increase the total number of lines, is perfectly useless, and may even do harm by bringing poles of opposite sign so close to each other as to cause a serious leakage of lines across the nearest points, with a corresponding loss of electro-motive force. In modern disc machines the pole-pieces have consequently been considerably reduced, and it has as a further consequence been found possible to increase the number of poles from two, as employed in the earliest machines, to four, six, and even eight, with a corresponding increase of current. As we have already touched upon this point in our article No. XI., we need not enter into the question again. It is, however, desirable to say a few words about the comparative merits of disc and cylindrical armatures. Experiments have proved that the number of lines of force which can be induced to go through a given armature core is a limited quantity, however much we may increase the magneto motive force or exciting power on the field magnets. The maximum number of lines is simply proportional to the cross sectional area of iron contained in the core. Now if we have two armatures of equal core area, one a flat ring, the other a cylinder, and if both are wound with the same number of turns, then at equal speeds the electro-motive forces will also be equal. On account of the space required for the internal attachment of the core to the spindle, and the space occupied by the internal wires, the radial depth of the core in both cases cannot as a rule be made greater than a quarter the diameter. In disc armatures a greater radial depth would also be objectionable on account of bringing the internal portions of the pole pieces of opposite sign too near to each other. In order to fix ideas by an example, let us assume that the cylindrical core be 2in. deep and 6in. long, whilst the disc core is 6in. deep and 2in. long. The external diameter will in the former core be 8in., and in the latter 24in. If both are rotated at equal speed—revolutions per minute—they will give the same electro-motive force. But the circumferential speed of the disc will be three times as great as that of the cylinder, and the centrifugal force tending to lift the external wires off the core will also be three times as great. For this reason it is in practice found impossible to run disc armatures as fast as equivalent armatures of the cylindrical type, and the necessary reduction of speed produces a corresponding reduction in electro-motive force. We come, therefore, to the conclusion that the disc form, instead of being better than the cylindrical form, is in reality worse; inasmuch as more wire is required to produce a given electro-motive force. It has, however, some practical advantages. In the first place, the speed of rotation is less—always a desirable object, but especially so when the dynamo must be coupled direct to its engine. In the second place, the wire is exposed to the cooling influence of the air on both sides of the disc, instead of only on the external circumference as in cylinder machines; and, moreover, the linear speed of the periphery being somewhat greater, is more effectually cooled. In the third place, the disc armature lends itself readily to the employment of four or more poles, making not only each single magnet less bulky, but also reducing the total weight of the machine in comparison with its output. As regards the question whether the disc ought to be thin or thick, it is easy to see that thin discs require more wire to produce a given electro-motive force. Referring to our previous example of a disc 2in. wide and 24in. in diameter, the length of one turn of wire on it is evidently a little more than the perimeter of the core, which is $2 \times (2+6) = 16$in., the excess being due to the thickness of insulation and the diameter of the wire. Not to complicate the matter we will, however, neglect this excess. If we now were to increase the thickness of the core to 4in. the length of one turn of wire would only be increased by 4in., whilst the electro-motive force would be doubled. From these figures it will be clear that thicker discs are preferable, and in this respect the modern Victoria machine has a great advantage over the dynamo originally introduced by Schuckert. The machine we illustrate in Figs. 3 and 4 is the D 2 type, intended for a current of 150 ampères at a pressure of 75 volts, when driven at a speed of 800 revolutions a minute. The external diameter of the armature is 21in., and its circumferential speed 4400ft. per minute. The core consists of an inner ring of wrought iron ½in. thick and 2⅝in. wide, upon which is coiled a tape of No. 30 b.w.g. soft charcoal iron also 2⅝in. wide. The convolutions are insulated from each other by a thin tape of insulating paper of about ⅓th the thickness of the iron tape. The radial depth of the core is 3$\frac{1}{16}$in., and the area actually occupied by iron is 7·8 square inches. The core is supported by five gun-metal arms, each arm consisting of two halves, which are clamped together by screws, as shown in our illustrations. To make the fastening more secure, slots are cut out of the wrought iron ring and part of the core into which the extremities of the arms enter. Although the tape of the core is only ·012in. thick, heat is still generated in it to a certain extent, especially in the outer layers; and this is probably due to the fact that there the lines of force must pass radially into the body of the core, thus penetrating the broad surface of the tape at right angles. This causes internal currents to flow, which heat the iron in spite of its being so very thin. To get over this difficulty the Corporation have in some cases adopted the plan of cutting circular grooves into the outer periphery of the core, thus dividing the broad tape into a number of narrow strips. Another, and perhaps more effectual, remedy would be to employ a core consisting partly of tape wound as at present, and partly of iron wire wound over the tape. A few layers of iron wire at the outer periphery of the core would be sufficient to take those lines which enter it radially, whilst those lines which enter the armature in a direction parallel to the spindle would be taken by the tape as at present.

The armature contains sixty coils of ·165 round wire, each coil consisting of six turns wound on in two layers of three turns each. We have, therefore, in all 360 turns, the average length of each turn being about 13in. The total length of wire, including cross connections between coils of equal potential and connections to the commutator, is about 170 yards, and the corresponding weight of copper is 42 lb. The calculated resistance of the armature is only ·0106 ohms, and the density of current 1800 ampères per square inch. The field magnets consist of four circular bars of wrought iron 3⅝in. diameter, each with a cast iron pole piece shrunk on in the middle. Part of each bar is cut away to form the polar cavity for the reception of the armature, the clearance at the sides being $\frac{3}{16}$in. and at the circumference about ⅜in. There are eight coils of exciting wire, each 7⅞in. long and containing four layers of ·500 × ·020 rectangular wire, through which one quarter of the external current passes, and twelve layers of ·095 shunt wire wound over the main. The eight main coils are coupled four parallel and two in series, and the eight shunt coils are all in series. Each layer of main wire consists of seventeen turns, making sixty-eight turns, and measuring twenty yards to each limb; whilst each layer of shunt wire contains seventy turns, or 840 turns in all, measuring about 420 yards. These lengths are calculated, and the weights corresponding to them are 4·5 lb. and 34 lb. respectively. The calculated resistance of the shunt when warm is 13·5 ohms, and the shunt current is 5·7 ampères. The exciting power on one horseshoe is therefore $2 \times 5{\cdot}7 \times 840 = 9560$ for the shunt, and $2 \times 68 \times \frac{150}{4} = 5100$ ampèreturns for the main; total, 14,660 ampèreturns. The density of current is 800 ampères in the shunt wire, and 1920 ampères in the main wire. The latter figure is considerably higher than generally found in modern dynamos. It should, however, be remembered that it is not the density of current *per se* which determines the heating of a coil, but the ratio which its cooling surface bears to the number of watts transformed into heat. It may therefore be quite consistent with good practice to allow rather a large density of current in some cases, whilst in other cases a density of less than 1000 ampères may produce excessive heating. In the present case the number of watts transformed into heat is small, notwithstanding the high density, simply because there is only a very short length of main wire on each magnet. On going into figures we find that the main circuit absorbs 315 watts, and the shunt circuit 430; total, 745 watts. The external cooling surface of each of the eight coils is 150 square inches, or 1200 square inches in all, being at the rate of 1·61 square inches for every watt transformed into heat. With this proportion the magnet coils will keep perfectly cool. The total weight of copper used in the machine is 350 lb. for an output of 11,000 watts, or 31·4 watts per pound of copper, whilst every 1·13 yards of armature conductor produce one volt in the external circuit. The complete machine weighs 13½ cwt.

THE IRON AND STEEL INSTITUTE.

THE members reassembled on Wednesday morning, September 2nd, in the Corporation Galleries, Sauchiehall-street, Glasgow, Dr. Percy again presiding. It may be remarked that the room did not prove particularly good for sound; and the arrangement of having the luncheon room adjoining, though convenient in saving time, is not to be recommended when access is obtained through the meeting room.

The subject of Mr. W. Jones's paper—the recovery of tar and ammonia from blast furnaces—possesses special interest for Scotland, where the furnaces are almost entirely fired with raw coal. Mr. Sutherland, of Birmingham, observed that the tar recovered at Gartsherrie was sufficient to convert from sixty to seventy thousand tons of iron into steel. Mr. Andrew K. M'Cosh, of Wm. Baird and Co., pointed out that all the processes described by Mr. Jones were fundamentally the same, all depending on more or less cooling the gases and washing them with water, either with or without the addition of acid; and the yield of products, especially tar, was in proportion to the degree of cooling, while, if the gas came into contact with water before adequate cooling, it carried forward a large quantity of vapour, which materially lessened its value as a fuel. He claimed for himself and partner to have first demonstrated that tar and ammonia were present in the gases of coal-fired furnaces in the same proportion that they were found in ordinary coal-gas. Mr. Henry Aitken, of Falkirk, was convinced twenty years ago that tar and ammonia could be obtained from such gases. Every man was proud of what he believed to be his own child; and he thought the proper course was to cool and condense the gases, and then wash them to extract the spirit. As the discussion was drifting into a question of patent rights, this was ruled out of order. Mr. Ernest Bell, of Middlesbrough, gave an account of the experiments made by his firm in this direction, with their results, and described the practical use to which the oil might be applied. In replying to the discussion, Mr. Jones observed that, when practically every atom of ammonia, with about 40 per cent. of tar, could be recovered at a trifling cost, it mattered little if the gas were depreciated 10 per cent.; but it was possible to get rid of the aqueous vapour by a certain form of condenser.

The next paper read was that by Mr. James Riley, general manager to the Steel Company of Scotland,

ON A NEW FORM OF CUPOLA FURNACE.

This furnace, his own invention, was the outcome of an earnest desire to shorten the operation of making open-hearth steel. Though there was no contrivance for charging solid materials into the furnace so cheaply as hand labour, fluid metal could be introduced in a small fraction of the time, while the cooling down of the furnace was avoided. This led to a saving of nearly 10 per cent. in time, equal to one additional charge per week, while effecting a considerable saving in fuel and repairs. He brought forward two types of cupola furnace, similar in principle but different in form, both fired by gas, with forced blast. The coal charged into the gas generator during nine shifts only averaged 1·44 cwt. per ton of metal charged into the cupola. He felt justified in believing that his furnace was also suitable for extensive iron foundry practice, where continuous melting is required, and also to Bessemer steel works where fluid metal is not available, while, inasmuch as the flame can be made to a considerable extent, oxidising or reducing at will, the composition of the metal need not be changed during the melting.

During the discussion Mr. John Head, of Landore, raised a laugh by observing that a furnace like one of Mr. Riley's had been put up there in 1861, only there was no cupola. Mr. Windsor Richards said it was natural to try and shorten the Siemens-Martin process, by which only one charge could be melted in twelve hours, and he had every confidence in Mr. Riley's success. An endeavour was now being made to charge the few Siemens furnaces at Eston with molten metal taken directly from the blast furnaces. Mr. Snelus said he was making arrangements at the West Cumberland Works, where there were plenty of converters, but only two 16-ton Siemens furnaces, to take molten pig to the converter, where the silicon would be more or less completely blown out, and then transfer it to the Siemens furnaces for completing the operation. While the Bessemer process was finished in a few seconds, the Siemens took so much longer that there was time to modify matters and alter the result.

Sir Henry Bessemer, on being called upon by the President, said that in all probability Mr. Riley's furnace would be successful. He thought it was not necessary at the present time to make an apology for Bessemer steel, and drily added that he had heard that orders for Siemens steel were not unfrequently supplied with another material. But he did not know one physical test by which it could be ascertained by which of the two processes a given plate had been made.

Mr. F. W. Webb said that he had made at Crewe, not merely 1000 boilers of Bessemer steel, as stated by Sir Henry Bessemer, but about 3000, working at pressures of 120 lb. to 190 lb., and over 2400 of them were for locomotives. He had also put to work a few boilers of Siemens-Martin steel, without any failure in either case. His experience was that well-made mild Bessemer steel could be quite as much depended upon as the Siemens-Martin. He preferred the latter when a hard metal was required, because the hardness was combined with a greater amount of elasticity. There had not been more than one broken tire during the past year, on a mileage equal to a journey round the world every four hours and ten minutes, to a mile and a-half for every second, or to ninety miles for every minute.

Mr. Riley, in replying to the discussion, observed that his furnace differed from all others devised for the same purpose in being fired by gas. He incidentally expressed the opinion that if the basic process was to be a success, it must be performed, not in the Bessemer converter, but in the open-hearth furnace, where the phosphorus first went off into the slag, which was skimmed off.

In the afternoon the members were divided and subdivided among the Govan Ironworks—commonly spoken of as "Dixon's blazes," from the flaring pipes where the excess of gas is consumed—Thompson's, Denny's, Napier's, and Elder's shipbuilding and engineering yards; the Caledonian Railway and Glasgow—Dubs'—locomotive works, Singer's sewing machine factory, recently erected at Kilbowie, and driven by a 100-horse power Corliss engine, and the new dock works at Greenock. Reserving the latter for more extended description, it may here be mentioned that the contractors, Messrs. Waddell and Sons, have executed in round numbers 1,500,000 cubic yards of excavation, of which 567,000 were in rock, and that all the bricks used in the works were obtained from the material excavated, as well as all the stone, except that for facing the quay walls. Great interest was manifested by the visitors in the travelling bridge and caisson designed by Mr. Kinipple, the engineer-in-chief. The warehouses, in course of construction, are to be provided with grain elevators, and also with hydraulic cranes with luffing jib, capable of lifting goods out of the holds of vessels, and delivering them at the upper storeys of the warehouses.

The annual banquet in the evening was characterised by more than usual good fellowship, the men of steel and iron so far unbending as to join in the singing of "Auld Lang Syne" in Scotch fashion. Dr. Percy, who occupied the chair, took occasion, while responding to the toast of the evening, "Success to the Iron and Steel Institute," to observe that while Glasgow could produce steel in such large quantities, it would be very unwise for any Government to incur enormous expenses in putting down plant for its production. Mr. W. Whitwell, in proposing "The City of Glasgow," remarked that, while in 1879 only 47 per cent. of the vessels built on the Clyde were of steel, they now amounted to 100 per cent.

On Friday the meeting first heard Mr. Charles Wood's paper

ON THE VALUE OF SILICON PIG TO THE IRONFOUNDER,

in which he claimed, with a careful selection of pig charged into the cupola, to have increased the strength of soft iron, and by reducing the silicon and increasing the combined carbon, to have cast bars 2in. by 1in. out of the ordinary run of metal, so that they sustained 31 cwt., or more, in the middle of a 3ft. length, between supports, and that from cupolas yielding 60 to 70 tons a day over several months. Mr. Wood concludes from his experiments that:—(1) To make soft, sharp, clean castings from Cleveland pig the mixture should contain 2·6 to 3 per cent. of silicon and 0·15 to 0·1 of combined carbon, while for heavy castings, such as will carry a load on the test bar of 30 to 31 cwt., the proportion should be 1·8 to 2 per cent. of silicon and 0·6 to 0·4 per cent. of combined carbon. In some further experiments undertaken at Mr. Stead's suggestion, one-sixth of silicon pig was found to bring back, as it were, five-sixths of white iron into a grey state, thus confirming the statement that any hard iron, whether scrap or pig, can be rendered perfectly soft by a careful mixture of silicon pig. The author is therefore of opinion that silicon pig should be regarded as a valuable adjunct to the founder, and every ton made be carefully set apart for special use, instead of being returned to the blast furnace. Mr. Wood concluded by advocating as careful an examination of foundry as of forge pig, to ascertain what amount of foreign elements may be combined with it without diminishing the strength of the castings.

The President, observing that the paper contained some important observations, said that thirty or forty years ago silicon was regarded as the great enemy of the blast furnace manager and every one connected with the iron manufacture, especially the unfortunate puddler. So much iron went to waste that he did not make a proper amount by his charge, and the ironmaster did not get what he expected.

Mr. T. Turner, of Sheffield, whose experiments had been referred to in the paper, said that the amount of silicon added to the pig to increase its tensile strength must depend upon the other elements present; and it remained to determine the limit. The addition of silicon to pig iron not only rendered it more fusible and more readily poured, but also made it softer, sounder, and stronger, while at the same time increasing its resistance to crushing strain.

On the other hand, Mr. E. J. Riley contended that the less silicon there was in pig iron the better; as the silicon went up the carbon went down, so that with 20 per cent. of silicon there was no carbon. Mr. J. E. Stead agreed with Mr. Riley that the less silicon there was the better, provided the carbon be kept in the graphitic condition. Silicon, if added to white iron, or iron deficient in silicon, caused the carbon to assume the graphitic condition, and made the iron very soft, the strongest iron for foundry purposes being that which contained just sufficient silicon to prevent the combination of the carbon with the iron. Mr. John Gjers observed that glazed pig might be used to advantage in melting down a lot of hard scrap, but no founder would adopt such a mixture for an important casting. The desirable composition of both forge and foundry pig had long been known, but the difficulty was to obtain it in the furnace. Mr. Windsor Richards thought that the silicon should be low for a strong casting, the great strength of cold blast iron being due to a low percentage of silicon.

The next paper read was by Mr. J. H. Biles, of Messrs. Thompson's Clydebank Ship and Engine Works.

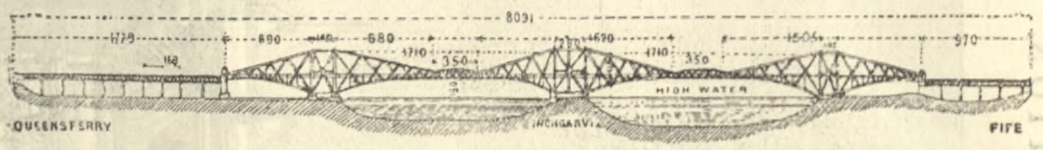
NOTES ON SHIPBUILDING.

Mr. Biles said he read them as one "in the thick of the work," chiefly with a view to elicit profitable discussion on the use of steel in shipbuilding. Mr. Biles started with the proposition that there were two questions to be considered in undertaking to build any ship—the constructive possibility and the commercial desirability—of which the former had become a certainty and the latter had often been demonstrated. He undertook to show that on the Clyde a relative price of steel to iron had been reached, where, for a given size, the cost is equal, with an increased carrying capacity in favour of the steel. With the necessary modification of design, a steel ship could now be constructed with as much certainty of success as one of iron. With Lloyd's 20 per cent. reduction, and the last new substitution of twentieths of an inch with steel for sixteenths of an inch with iron in thickness, the reduction, allowing for difference of specific gravity, was about 17 per cent.; but certain restrictions brought the amount of material actually saved per cent. to 13·9 in 1500-ton, 13·7 in 2500-ton, 13·5 in 3500-ton, and 13·3 in 4500-ton vessels. Steel would ultimately become the staple material for shipbuilding, because of the larger-sized plates for a given thickness, involving less laps and butt strips, less rivetting, scrap, and labour. Comparing the weights and prices of iron and steel, a ship could be built on the Clyde according to Lloyd's published tables at least as cheaply in steel as in iron. Consequently the advantage to the latter was obvious, if weight-carrying power is of any commercial value. It also followed that the steel ship must be cheaper per ton of dead-weight carried. Two objections had usually been urged against steel ships, the first of which was that, as steel is so ductile, ships built of it are less rigid than those of iron, and will soon begin to work. At Clydebank, twenty-eight steel ships, of great variety as regards size, and representing over 50,000 tons, had been built, without any structural defect due to material having been reported. The second objection was that steel corrodes more rapidly than iron. It was, indeed, certain that if an iron ship be not watched and carefully coated, she would soon receive considerable injury. But it was also certain that, if properly coated and watched, an iron ship is practically indestructible. It seemed, therefore, to be much more a question of relative care necessary to protect the material, than the relative amount of corrosion which will go on if no care be taken; and if a little extra care were required, it could not be anything like a set-off against all the other advantages. The Admiralty, however, having discovered that most of the corrosion that has come under their notice was due to galvanic action between the black oxide or scale and the metal, treated all their outer bottom plating floors, and lower plates of bulkheads, in a dilute acid bath to remove the scale. Messrs. Thompson had devised a fast running wire-brushing machine, which, after the acid-bath, burnishes the surface of the plate, an operation which did not cost more than 1s. per ton over the whole of the ship. Another method of meeting this objection to steel was to galvanise the plates most liable to corrosion, and it had been pointed out by Mr. Denny that unless something of this kind be done it will not be possible to take full advantage of steel having higher tensile strength than that at present in use. This question of corrosion had a similar bearing in ships to that in boilers, for it was certain that if the liability to corrosion is the same in both thick and thin plates, there must be a thickness beyond which it would not be advisable to reduce, however high a tensile strength of the material. If galvanising can be successfully and generally applied, this minimum would be much reduced, and the increase in tensile strength much further extended. At present the extra cost was its chief drawback; but if higher tension steels be adopted, some of the saving in cost due to them must go to pay for galvanising. The author urged that as Lloyd's insist on a breaking strain of 28 to 32 tons per square inch on a reduction of 20 per cent. in the thickness in passing from iron to steel, it would be only fair to insist on iron passing similar tests, but with the limits of strength reduced in exactly the same proportion as the thickness of steel has been reduced. In a paddle boat now being built by Messrs. Thomson, there were no reverse bars on the floors, the floor plates being flanged, thus saving one leaf of an angle and all the rivets connecting the reverse bar to the floors. This flanging was extensively adopted at Clydebank for all bracket and intercostal work, instead of plates and angles, for bulkhead plates, where flanging the plates was substituted for angle stiffening. For thin plates the flanging was done cold, but hot for plates above ⅜in. Z frames, extensively used, were cheaper than the ordinary method of frame and reverse, when of the same depth and thickness as the frame. In the National line steamship America all the steel contributing to longitude strength above the lower deck, which is practically at the neutral axis, was made of a tensile strength of from 32 to 36 tons; all below it from 27 to 31 tons.

In the absence of Mr. B. Baker, M.I.C.E., the secretary read a portion of Mr. Baker's paper

ON THE FORTH BRIDGE,

in which the author says that the chief desiderata in the biggest railway bridge ever proposed are durability, strength, and rigidity under express trains and hurricane pressures; facility and security of erection, high quality of material and workmanship, with economy in first cost and maintenance. These were met by a steel cantilever or continuous girder bridge, each span of 1710ft. being made up of two cantilevers 343ft. deep over the piers and 40ft. at the ends, projecting 680ft., and a central girder connecting them 350ft. in length. The bottom members consist of a pair of tubes tapering in diameter from 12ft. to 5ft., spaced 120ft. apart, centre to centre, at the piers, and 31ft. 6in. apart at the ends; and the top members of a pair of box lattice girders, tapering in depth from 12ft. to 5ft., spaced 33ft. apart at the piers, and 22ft. 3in. at the ends. Each tube has a maximum gross sectional area of 830 square inches, and each girder a maximum net sectional area of 506 square inches. Upon each cylindrical masonry pier is bolted a bed-plate carrying a skewback, from which spring vertical and diagonal columns and struts. The former are 12ft. in diameter, and from 368 to 468 square inches in sectional area, the latter being flattened tubes. Horizontal wind-bracing of lattice girders connect the tubes forming the bottom member of the cantilevers, and similar vertical wind-bracing connects the vertical and diagonal tubes, so that the whole structure is a network of bracing capable of resisting stresses in any direction and of any attainable severity. The rolling load provided for is—(1) trains of unlimited length on each line of rails weighing 1 ton per foot run; (2) trains on each line made up of two engines and tenders, weighing in all 142 tons, at the head of a train of sixty short coal trucks of 15 tons each. The wind provided for is a pressure of 56 lb. per square foot striking the whole or any part of the bridge, at any angle with the horizon, the total amount on the main spans being estimated at no less than 7900 tons. In practice, only two trains, weighing 800 tons in all, would be on this length of bridge at the same time; so the wind pressure—if such a hurricane as 56 lb. per square foot could ever occur—would be ten times as great as the train load. Under the combined stresses resulting from the test load in the worst position, and the heaviest hurricane, the



maximum stress on the steel will not exceed 7½ tons per square inch on any portion of the structure, and on members subject to great variation in the intensity and character of stress the maximum will not exceed 4 tons per square inch. For tubular columns and struts 34 to 37-ton steel, with an elongation of 17 per cent. in 8in., is specified, and for tension members 30 to 33-ton steel, with 20 per cent. of elongation. The quality of steel supplied by the Steel Company of Scotland and the Landore Company will stand the Admiralty temper tests, and is admirably adapted for bridge construction. In making the tubes the plates are heated in a gas furnace and bent hot, between dies, in a powerful hydraulic press, the slight distortion in cooling being corrected by pressing cold. After bending, all four edges are planed and the plates built up into a tube. Travelling annular drill frames surrounding the tube, fitted each with ten traversing drills, bore the holes at once through plates, covers, and stiffeners, so that when again fitted in place for erection, every piece comes into exact juxtaposition. Similar travelling drill frames deal with the lattice box girders, every hole being drilled as the machine advances. Generally the plant designed by Mr. Arrol for drilling the innumerable holes in the 42,000 tons of steel work for the main spans is of signal merit and efficiency, and well worthy the attention of practical engineers. For certain parts of the Forth Bridge steel is used of a higher tensile strength than is at present considered admissible either for ships or boilers, experiments having shown that steel with a tensile strength of from 34 to 37 tons per square inch offered a decided advantage over very mild steel, when compressive stresses and the flexure of long columns were concerned. In the compression members of the Forth Bridge the steel is subject only to a steady pressure of varying intensity, and a quality of steel was adopted which combined perfect facility in working with a high resistance to compression. Although an increased tensile strength is accompanied by a decidedly increased resistance to flexure in columns and struts, the latter is not proportional to the former. At least one-half of the 42,000 tons of steel in the Forth Bridge it in compression, so that the importance of gaining an increased resistance of 60 per cent. without any sacrifice in the facility of working, and safety belonging to a highly ductile material, can hardly be exaggerated. Sheared edges are a more fruitful source of fracture than partial tempering. All the bent plates are made red-hot, thus eliminating the effect of the shearing before planing. Those plates which are not heated have the edges carefully planed so as to leave no trace of the shearing, and the plates so treated, whether 30-ton or 37-ton steel, stand all the desired tests. Experiments on the resisting power of different classes of iron and steel to repeated bendings indicate that the superiority of low-tension steel is considerably greater than the increased ductility would indicate.

Mr. Biles' and Mr. Baker's papers were discussed together, as they both bore upon the suitability and application of steel to constructive purposes.

Mr. E. A. Cowper praised the machine tools at the Forth Bridge works, especially the drilling machines and an automatic machine for cutting slots in plates. He added that all the plates are planed on all the edges, and that the rivetting is done as much as possible by hydraulic machinery.

Mr. James Hamilton, of Messrs. R. Napier and Sons, said his firm's experience of steel, as extensive as that of Mr. Biles' firm, corroborated almost all the figures in that gentleman's paper. Where the superior strength of steel could be turned to account, it was preferable to use that metal; and if this were true of land structures, it had all the more force as regards ships, carried about on the ocean as an incubus. He, however, disagreed with Mr. Biles as to reducing Lloyd's thickness of butt strips, which he thought were not destroyed by punching.

Mr. Windsor Richards, who characterised Mr. Biles' paper as an excellent one, and the first read before the Institute that did not ask for a reduced price of plates, would like to know how large its author would like to have plates to be handled in the shipyard, because he could accommodate him up to 50ft. or 60ft. long by 5ft. wide.

Mr. Wales was applauded on expressing the opinion that it would be unsafe to allow the limit of strength in plates to go much above 32 tons per square inch, as the heating, especially at the edges, by hot rivets, and the gradual cooling might cause fracture.

Mr. Martell, of Lloyd's, said that notwithstanding his reputation of being an obstructionist, he was much in favour of steel for shipbuilding, and believed it would quite supersede iron at an early date, because it was a tested material, and the work of each plate was perfectly well known. An exhaustive inquiry had enabled him to set at naught two scares that had been raised with reference to the new metal, viz., that steel ships were deficient in structural resistance, and that they were liable to rapid deterioration from oxidation.

Mr. James Riley, on being pressed by the chairman to speak, complained bitterly "that no one would tread on the tail of his coat." He was expecting a fierce attack on steel, but all the evidence was in its favour, the only moot point being as to the limit of strength. His own opinion was that 32 tons should not be exceeded, while he would prefer to keep to 30 tons for boiler plates, especially if large.

Mr. Martell added that Lloyd's maximum was 32 tons—for framing 33 tons—which, he hoped, would never be exceeded.

Mr. Biles replied on the discussion that the question of butt strips was one rather of economy than structure. His firm used plates 16ft. by 5ft., and varying from $\frac{5}{16}$in. to ⅞in. thick; but there would not be much difficulty in working plates half as large again. They used steel from 32 to 36 tons without any fracture from heating and gradual cooling. In a collision a ship was dinged in, but there was no crack at the rivet seams; and he would prefer a larger number of light keelsons for local support, to fewer heavy keelsons.

Owing to want of time, three papers, viz., those by Mr. von Bergen on "A New Pyrometer," by Mr. Flower on "Tin-plate Manufacture," and by Mr. Blair on "Accessory Products of the Blast Furnace," were left over to the next meeting. The usual votes of thanks were passed, at the instance of the President, Sir H. Bessemer, Mr. Walker, of Leeds, Mr. Edward Williams, Mr. E. A. Cowper, and Mr. Jas. Riley.

In the afternoon excursions were made by special trains to the Glengarnock Steel Works at Kilburnie, Young's paraffine oil works at Addiewell, and to the historical Carron Ironworks.

The works of the Carron Company, on the river Carron, two miles north of Falkirk, are a mile from Grahamston on the North British Railway, and the same distance from Larbert on the Caledonian Railway, being connected by branch lines. The works were among the first established in Scotland, and are now the oldest in active operation, having been founded in 1759, and having had associated with them Dr. Roebuck, Smeaton, Watt, and Symington; and it is here that Cowper's blast-heating stoves were first applied in Scotland. The works gave the name to "carronades," lighter than the ordinary cannon, and much used in close naval engagements. On the present writer happening to remark to a gentleman not wholly unconnected with a leading metallurgical organ that among his earliest reminiscences was the word "Carron" cast on one of the most ordinary appliances of domestic economy, making a great impression on his juvenile mind, he replied that a similar article had made on him a very great impression indeed, when he unfortunately let it fall on his toe.

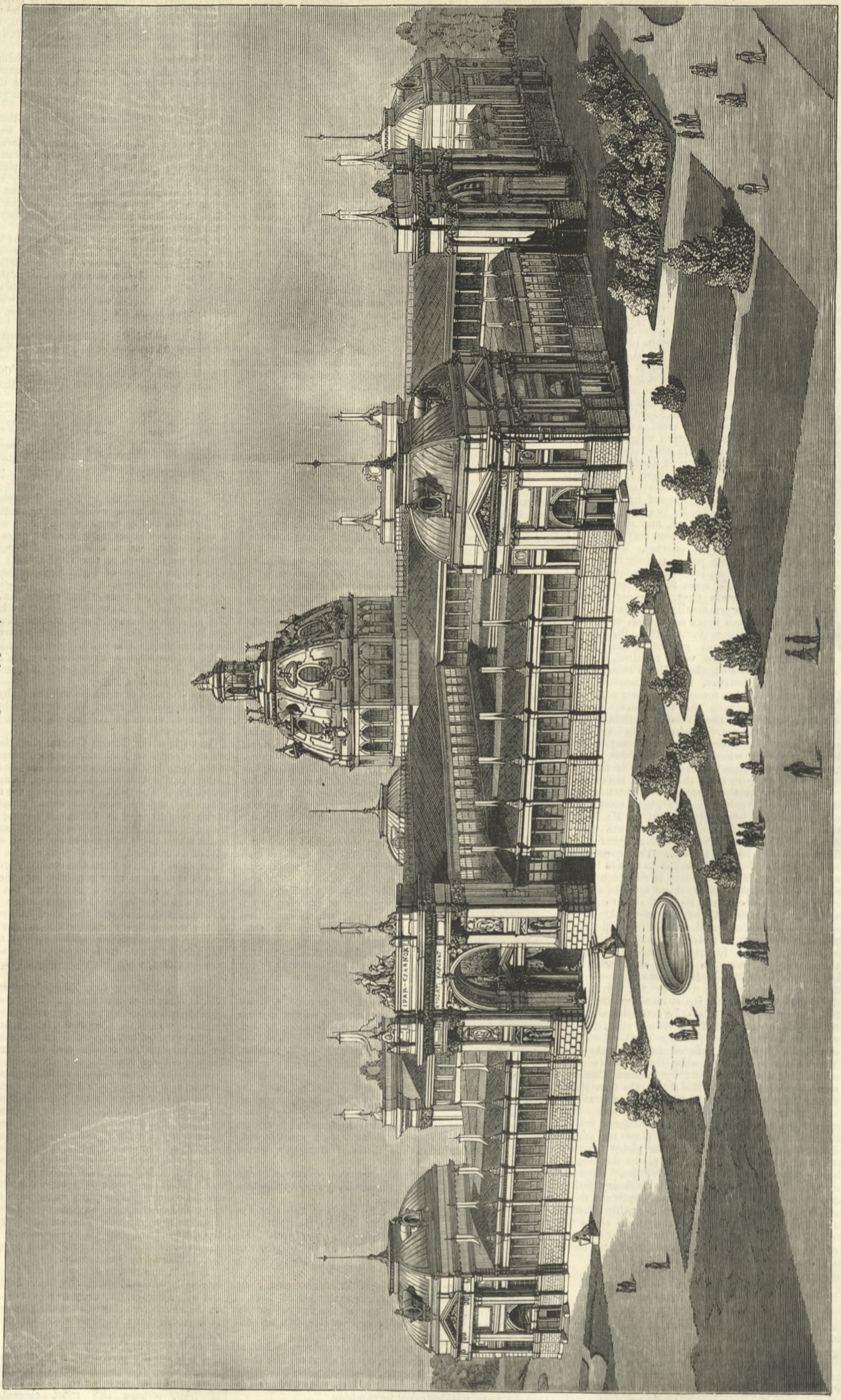
There are at Carron four blast furnaces 50ft. high and 16ft. in diameter at the boshes. Two are closed by bell and cone, and two others are to be raised to 70ft., and also closed at the mouth. The gases, besides heating the stoves and firing the boilers, are used in the other departments for all purposes for which coal was formerly employed. There are three blowing engines, one beam with air cylinder 102in. in diameter by 10ft. stroke, and the others vertical, with air cylinders 18in. in diameter by 4ft. stroke.

The works are now being reconstructed, and provided with every modern appliance for insuring economy and excellence of production, so that their ancient reputation will not only be worthily sustained, but probably also surpassed. In the foundry two pits are being lined with cement. So large are they as to raise a doubt whether the future castings can ever be conveyed to their destination. When complete the works will be provided with six circuits, one of high-pressure water pipes for the hydraulic cranes and other appliances, another of low-pressure water pipes for extinguishing fire, &c., a third of lighting gas pipes, a fourth of gaseous fuel conduits, a fifth of steam pipes, and a sixth of small gauge tramways connected from floor to floor by hydraulic lifts.

The foundry work, as of yore, is still the speciality. Intricate castings are made perfectly true, of only $\frac{3}{16}$in. thickness, and with a surface, due only to a coat of charcoal blacking on the moulds, that leaves absolutely nothing to be desired. It is related that a Yankee once brought over a casting, including some letters, and asked if the firm could come up to that. They did not know, but they would try; and they actually produced from the original a sharper casting, which they sent over to the States in triumph, and heard no more from their visitor. At a feast of fruit, perhaps the most elegant of the many

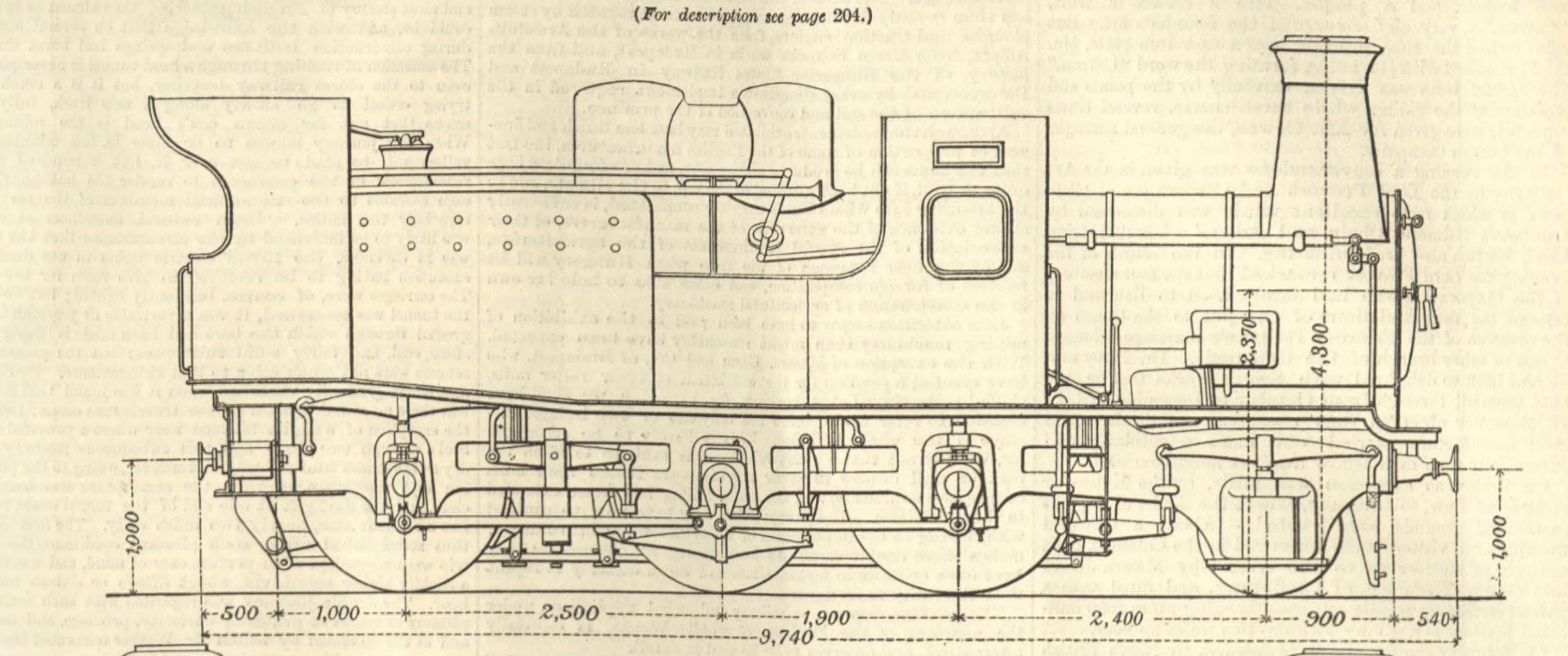
THE BUDAPEST NATIONAL EXHIBITION.

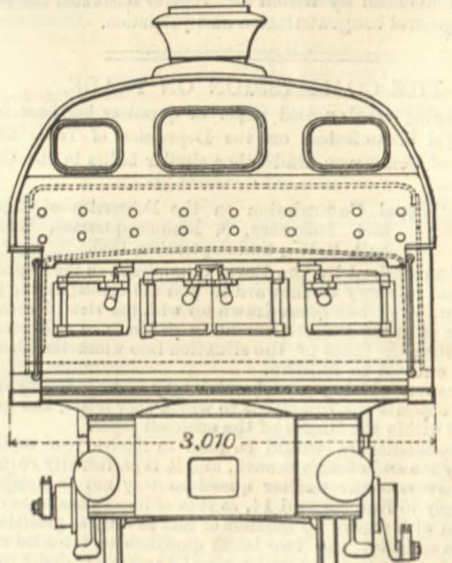
(*For description see page 198.*)

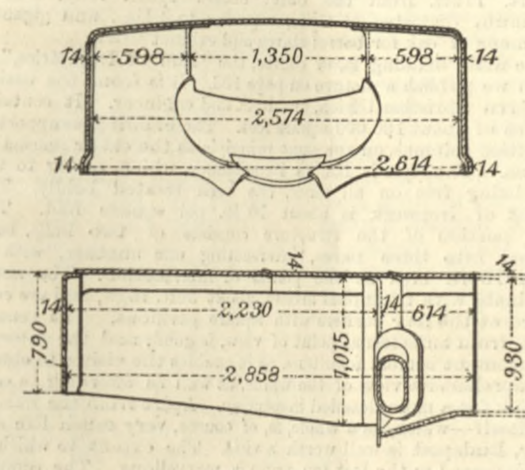


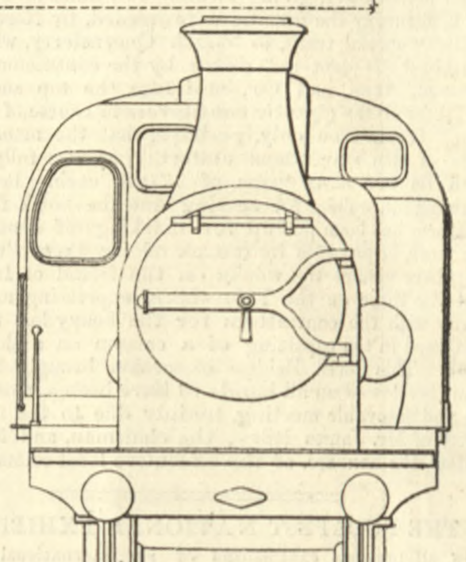
BELGIAN STATE RAILWAYS—EXPRESS PASSENGER ENGINES FOR STEEP GRADIENTS.

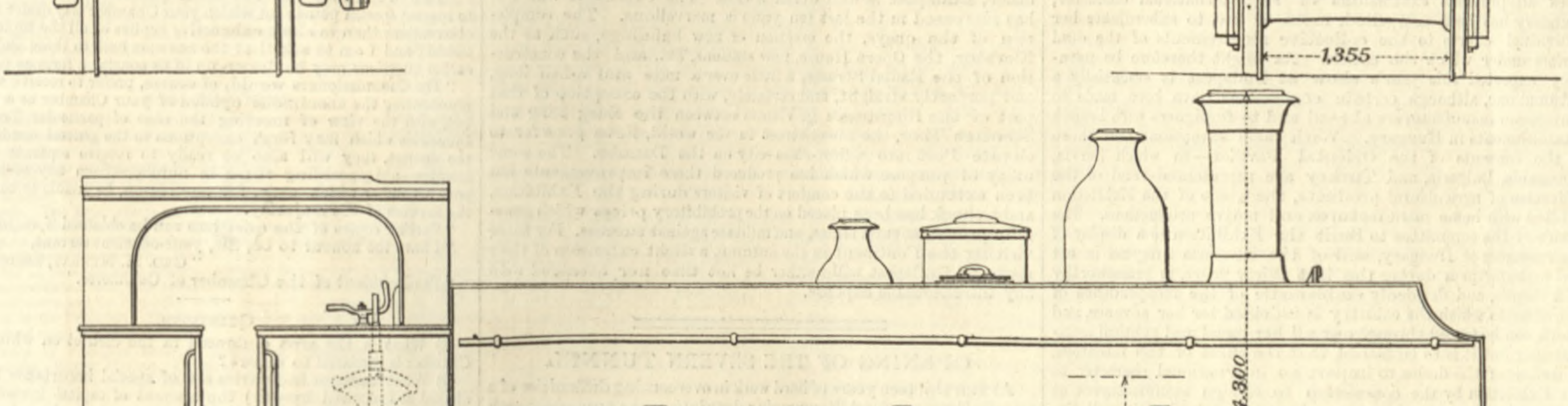
(For description see page 204.)

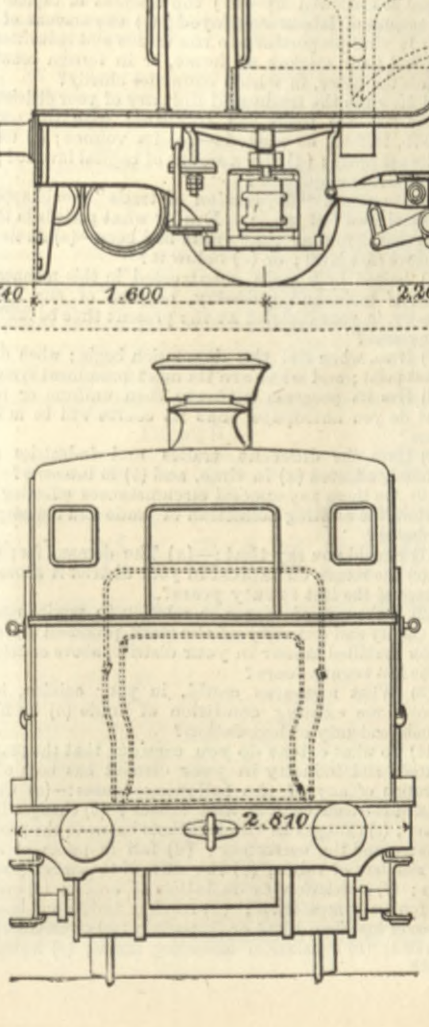


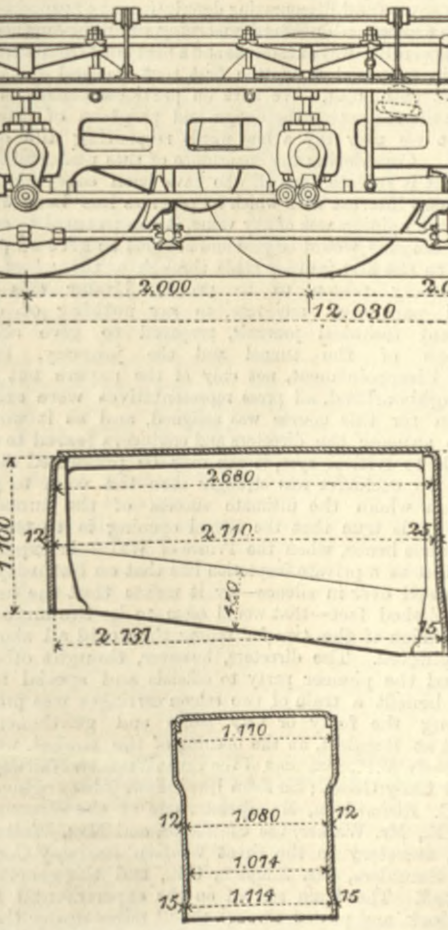


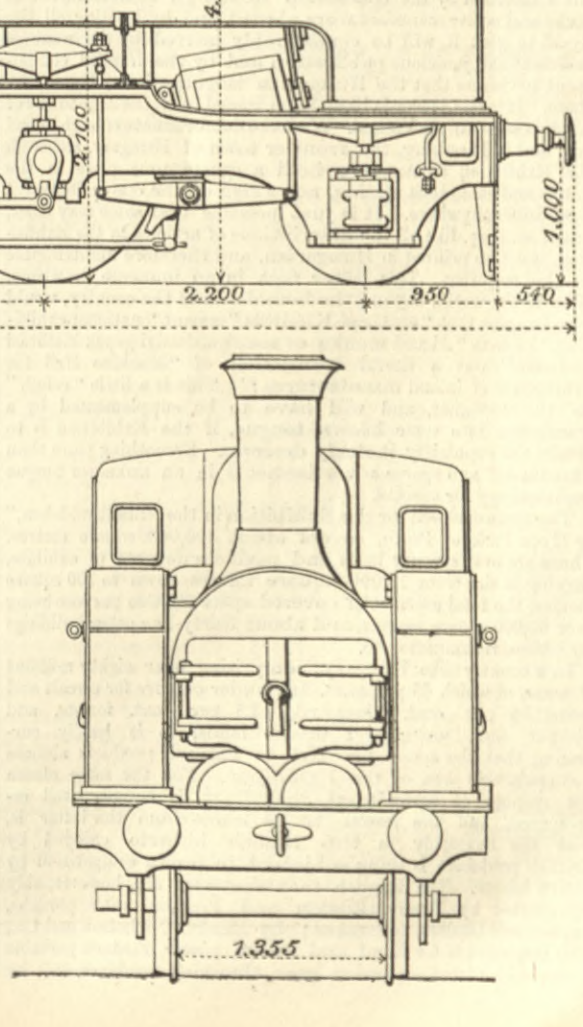












hospitable demonstrations during this Glasgow meeting, were shown copies of this celebrated casting, as well as card baskets, and a plaque, with a basket of fruit, "Carron," a very *chef d'œuvre* of the founder's art. But what caused the most interest was a cast iron plate, ⅛in. thick, punched with ⅛in. holes, forming the word "Carron." The special train was driven carefully by the points and crossings of the siding, while three cheers, several times repeated, were given for Mr. Cowan, the general manager of the Carron Company.

In the evening a conversazione was given in the Art Galleries by the Lord Provost and Corporation of Glasgow, at which most excellent music was discoursed by Lambeth's Balmoral Choir and Adams' celebrated string band, Scotish airs predominating. In the course of the evening the Lord Provost remarked that the four members of the Corporation who had lately been to Balmoral to present the congratulations of Glasgow to the Queen on the occasion of the Princess Beatrice's marriage belonged to one or other branch of the iron trade. Dr. Percy said he had been so delighted with Scott's works that he once read them all through from October to December, and Sir H. Bessemer observed that nowhere was the iron and steel manufacture carried out more scientifically and successfully than in Glasgow and the neighbourhood.

On Friday an excursion was made, by the Kyles—or straits—of Bute, to Inverary, where the Duke of Argyll's castle and grounds were visited. About a thousand members and visitors were conveyed in the Columba, built entirely of steel—even to the rivets—by Messrs. James and George Thompson, of Clydebank, and fitted with a pair of oscillating paddle engines working up to 2000 indicated horse-power, giving twenty-two miles an hour.

On Saturday the members proceeded, by North British Railway special train, to South Queensferry, where they examined the plant put down by the contractors, Messrs. Tancred, Arrol, and Co., and also the top and bottom members of the gigantic cantilevers in course of construction. It was then only, perhaps, that the actual magnitude of this stupendous undertaking was fully realised, with its two clear spans of 1710ft. each. Besides the drawing-office floor for setting out the work full size, a platform has been put up for marking off dimensions on the work in progress by means of the theodolite. Many members visited the works on the island of Inchgarvie, and also those on the Fife shore, expressing much sympathy with the contractors for the heavy loss they have sustained in the capsizing of a caisson on a sloping clay bank. This Forth Bridge excursion brought to a close what is allowed on all hands to have been a most successful and enjoyable meeting, mainly due to the indefatigability of Mr. James Riley, the chairman, and Mr. W. G. Millar, the hon. sec. of the executive local committee.

THE BUDAPEST NATIONAL EXHIBITION.

In all previous exhibitions of an international character, Hungary has been compelled, more or less, to subordinate her individual efforts to the collective requirements of the dual *régime* under which she exists. As might therefore be naturally expected this year's show at Budapest is essentially a national one, although certain concessions have been made to Hungarian manufacturers abroad and to foreigners with branch establishments in Hungary. With these exceptions and those of the contents of the Oriental Pavilion—in which Servia, Roumania, Bulgaria, and Turkey are represented—and of the collection of agricultural products, the whole of the Exhibition is filled with home manufactures and native productions. The desire of the committee to limit the Exhibition to a display of the resources of Hungary, and of the immense progress in art and manufactures during the last thirty years, is praiseworthy to a degree, and decidedly emblematic of the independence of character to which the country is indebted for her advance, and which can be traced throughout all her social and political institutions; but it is to be feared that the effect of this intention, as well as of the desire to impart an international character to the Exhibition by the concession to foreign manufacturers at home and native manufacturers abroad, and by inviting all the world to visit it, will be considerably marred by the want of sufficient and judicious publication and by the implied compliment to visitors that the Hungarian language is understood by them. It is said placards have been issued in all the large towns of Austria, especially in Vienna. We were not fortunate enough to find one, and in Pressburg, the frontier town of Hungary, although the Exhibition at Antwerp held a conspicuous place in the hotels and steamboat station, not a sign of the one in Budapest was visible anywhere. It is just possible that some may exist, but if so, they, like all the descriptions of articles in the Exhibition, must be printed in Hungarian, and therefore unintelligible to the majority. This latter fact in an immense drawback. Who in the world, beyond the boundaries of the country, would ever imagine that "országos Kiállitás" meant "national exhibition," or that "Ahazai munka es mezögazdasági gepek kiallitási csarnoka" was a literal translation of "Machine Hall for exhibitions of inland manufactures?" This is a little "rough" on the foreigner, and will have to be supplemented by a translation into some known tongue, if the Exhibition is to obtain the popularity it richly deserves. Something more than "tradition" and sparse advertisements in an unknown tongue are necessary for success.

The space enclosed for the Exhibition in the "Stadtwäldchen," or Hyde Park of Pesth, covers about 300,000 square metres. There are over seventy halls and pavilions devoted to exhibits, varying in size from 16,000 square metres down to 100 square metres, the total amount of covered space for this purpose being over 66,000 square metres, and about thirty-five other buildings for offices, restaurants, &c.

In a country like Hungary, comprising over eighty millions of acres, of which 65 per cent. are under culture for cereals and roots, 1½ per cent. vineyards, 28 per cent. forests, and 5½ per cent. water and waste lands, it is hardly surprising that the space devoted to natural products absorbs a considerable area of the Exhibition. For the same reason the display of agricultural machinery is equally well represented, and the lesson to be learnt from the latter is, that the monopoly in this branch hitherto enjoyed by English producers is being subjected to severe competition by native labour. The English manufacturers are, however, ably represented by Messrs. Ruston and Proctor, with ploughs, reapers, self-binders, and rakes; by Messrs. Nicholson and Co., with implements for hand and steam power, Foster's portable engine with patent expansion gear, thrashing machines, &c.; by Messrs. Robey and Sons, with portable engines, double flour mills, &c.; by Messrs. Marshall and Sons, with straw-burning portables, &c. But against this small contingent are ranged no less than seventy-five native manufacturers represented by steam ploughs and traction engines, from the works of the Archduke Albert, from Herrn Schlicks' works in Budapest, and from the factory of the Hungarian States Railway in Budapest and Diósgyor, and by every conceivable implement required in the cultivation of the soil and conversion of the produce.

Although the implements exhibited may lack the finish and fineness of proportion of some of the English manufactures, the fact that the same can be produced on the spot, and are found perhaps quite as well, if not better, suited to the soil, to the climate, and to the labourer into whose hands they are committed, is sufficiently strong evidence of the enterprise of the manufacturers, of their appreciation of the special requirements of the agriculturists, and of the near approach of the time when Hungary will be fearless of foreign competition, and quite able to hold her own in the construction of agricultural machinery.

Less attention seems to have been paid to the exhibition of milling machinery than might reasonably have been expected. With the exception of Messrs. Ganz and Co., of Budapest, who have erected a pavilion for the exhibition of their roller mills, chilled rolls, chilled shot, turbines, &c., to which we shall have occasion to refer again, there are only one or two isolated displays in the whole building. This is hardly to be accounted for, were it not that a great reluctance is said to exist on the part of mill owners to allow any strangers inside their mills during the exhibition, and the same feeling has been extended to the exhibition. The competition they have now to contend with, owing to the importation of American flour into Europe, makes them doubly careful to keep their own counsel, as they have once or twice in former times had cause bitterly to repent their liberality to foreigners.

The pavilion devoted to railway and naval appliances, under the auspices of the Ministry of Public Works, is especially interesting, and deserves to be treated in detail.

The display of timber in the grounds gives ample proof of the variety and wealth of the forests in Transylvania, Slavonia, and Croatia. There are larch stems 144ft. long, with a diameter of 2ft. 115ft. from the butt; others 110ft. long, with a maximum diameter of 6½in., tapering to 2¼in., and gigantic specimens of oak for barrel staves and cabinet work.

The main building is, of course, the "Hall of Industries," of which we publish a picture on page 196. It is from the design of Herrn Christian Ulrich, architect and engineer. It contains an area of about 160,000 square feet. The building is supported on lattice columns, on the same principle as the cattle market in Vienna. The style is Italian Renaissance, which, owing to the hall being free on all sides, has been treated boldly. The weight of ironwork is about 10 lb. per square foot. The main portion of the structure consists of two halls, each divided into three naves, intersecting one another, with a dome 150ft. high at the points of intersection. The naves terminate with triumphal arches, about 50ft. high, and are connected at the four corners with square pavilions. The general effect, from an external point of view, is good, and the internal arrangement is most felicitous, as it enables the visitor to obtain a comprehensive view of the whole, as well as affording an easy division for a more detailed inspection. Apart from the Exhibition itself—which, as a whole, is, of course, very much like any other, Budapest is well worth a visit. The extent to which it has increased in the last ten years is marvellous. The completion of the quays, the erection of new buildings, such as the Elevator, the Opera House, new stations, &c., and the construction of the Radial Strasse, a little over a mile and a-half long, and perfectly straight, and certainly, with the exception of that part of the Ringstrasse in Vienna between the Burg Ring and Schotten Thor, the finest street in the world, have gone far to elevate Pest into a first-class city on the Danube. The same unity of purpose which has produced these improvements has been extended to the comfort of visitors during the Exhibition, and a check has been placed on the prohibitory prices which generally prevail at such times, and militate against success. For those visiting the Continent in the autumn, a slight extension of their route to Budapest will neither be lost time nor attended with any unreasonable expense.

OPENING OF THE SEVERN TUNNEL.

After thirteen years of hard work in overcoming difficulties of a peculiarly severe and discouraging description, the tunnel beneath the Severn was opened on Saturday morning, when the engineers and Great Western Railway authorities and a party of friends travelled through in a special train, the first that crossed from shore to shore at this point. We have on previous occasions given ample details respecting the design and progress of this great work, but we may say a few words respecting the opening ceremony. Considering the importance of this undertaking, the great credit it reflects upon all who have been carrying it out, and the deep interest with which its progress has been watched by all whose opinion was of any value, it was natural to suppose that the company would be glad and anxious to give all possible publicity to the first journey made through a tunnel of which it has every reason to be proud. Under this belief the local papers, at any rate, to say nothing of distant papers and technical journals, prepared to give adequate descriptions of the tunnel and the journey, but to the keen disappointment, not only of the papers but of the whole neighbourhood, all press representatives were excluded. No reason for this course was assigned, and as it would be absurd to suppose the directors and engineers feared to expose their work to critical eyes, it can only be presumed that the desire to be exclusive was stronger than the wish to gratify those upon whom the ultimate success of the tunnel will depend. It is true that the formal opening is to take place some months hence, when the Prince of Wales is expected to officiate, but as a private inspection like that on Saturday could not be passed over in silence—for it means that the tunnel is an accomplished fact—that would seem to be the more appropriate occasion of the two for telling the world all about the success achieved. The directors, however, thought otherwise, and limited the pioneer party to officials and special friends. For their benefit a train of two saloon carriages was prepared, and among the forty or fifty ladies and gentlemen who assembled at Rogglett, at the opening of the tunnel, were Sir Daniel Gooch, M.P., chairman of the Great Western Railway Company, and Lady Gooch; Sir John Hawkshaw, joint engineer with Mr. W. C. Richardson, Mr. Bassett, one of the directors, Mr. Gooch, C.E., Mr. Walker, the contractor, and Mrs. Walker, Mr. Saunders, secretary to the Great Western Railway Company, and Mrs. Saunders, Mr. Simpson, C.E., and the general engineering staff. The train started on the experimental trip at eleven o'clock, and passed through the 2¼ miles under the river in half-an-hour, the rate being wisely limited to something like nine miles an hour. The engineers were naturally confident in the soundness of their work, but some of the passengers may be forgiven if they experienced some slight trepidation on finding themselves plunging into an unknown way beneath the widest and most stormy of English estuaries, then almost as full as it could be, and with the knowledge that on several occasions during construction both sea and springs had burst through. The sensation of rushing through a land tunnel is never pleasant even to the oldest railway traveller, but it is a much more trying ordeal to go slowly along a new track, fully conscious that not far above one's head is the rolling sea. When this journey comes to be done in ten minutes, travellers will be glad to get over it, but it required all the reassurances of the engineers to render the half-hour's passage bearable to the non-official members of the party, and especially the ladies. Such natural uneasiness as existed was likely to be increased by the circumstance that the tunnel was in darkness, the Brush electric lights in use during its execution having to be removed to give room for the train. The carriages were, of course, brilliantly lighted; but so far as the tunnel was concerned, it was a veritable *de profundis*. The ground through which the bore had been made is largely sandstone, coal, and fairly solid substances; but the pioneer passengers were not much alive to that circumstance. Doubts and misgivings gradually vanished when it was found that not only was there no sound or sign of the treacherous ocean; but, with the exception of a slight leakage near where a powerful spring broke through two years ago, this subaqueous roadway was as dry as the driest land subway. Moreover, owing to the powerful fan kept vigorously working, the atmosphere was beautifully clear, and the daylight at one end of the tunnel could be seen like a brilliant star, nearly two miles away. The first journey thus accomplished under such pleasant conditions, the return trip was undertaken with perfect ease of mind, and was done at a slightly higher speed, viz., about fifteen or sixteen miles an hour. The double journey was regarded with such feelings of pleasure as comes of gratified curiosity, privilege, and novelty; and at the luncheon by which Mr. Walker celebrated the event, there was general congratulation and jubilation.

THE COMMISSION ON TRADE.

The following circular and paper of questions has been issued by the Royal Commission on the Depression of Trade to the Chambers of Commerce and other similar bodies in the United Kingdom:—

"Royal Commission on the Depression of Trade and Industry, 8, Richmond-terrace, Whitehall, S.W., 2nd September, 1885.

"Sir,—I am desired by the Royal Commission on the Depression of Trade and Industry to forward to you the accompanying paper of questions, which has been drawn up with the view of obtaining information as to the present condition of Trade in this country, and of eliciting the facts of the situation into which the Commissioners are directed to inquire.

"Any answers which your Chamber may desire to return should be written opposite the questions to which they relate, and should be confined within the limits of the enclosed paper.

"The Commissioners would be glad to receive your replies, if possible, by the end of this month, and it is particularly requested that the answers to the earlier questions may not be delayed in order to reply to Nos. 13 and 14, as it is of importance to have the information with regard to matters of fact as early as possible.

"I am to add that the two latter questions are intended rather to suggest special points on which your Chamber may desire to offer observations than to elicit exhaustive replies on all the topics mentioned; and I am to ask that the answers both to these and to the earlier questions may be drawn up in as concise a form as possible.

"The Commissioners would, of course, prefer to receive answers representing the unanimous opinion of your Chamber as a whole; but, with the view of meeting the case of particular Trades or Industries which may form exceptions to the general condition of the district, they will also be ready to receive separate sets of answers—not exceeding three in number—from any sections of your Chamber which may, for any reason, be unable to concur in the answers of the majority.

"Further copies of the questions can be obtained if required.

"I have the honour to be, Sir, your obedient servant,

"Geo. H. Murray, Secretary.

"The President of the Chamber of Commerce."

Questions.

(1) What is the area embraced in the district on which your Chamber is prepared to report?

(2) What trades or industries are of special importance to that district as measured by—(*a*) the amount of capital invested; (*b*) the amount of labour employed; (*c*) the amount of production?

(3) In what proportion do the trades and industries of your district find their market at home, or in foreign countries; and, as regards the latter, in which countries chiefly?

(4) How has the trade and industry of your district been affected in the last five years, as compared with the periods 1865-70, 1870-75, 1875-80, as regards—(*a*) its volume; (*b*) its gross value; (*c*) its net profit; (*d*) the amount of capital invested; (*e*) the quantity of labour employed?

(5) The phrase "depression of trade" would appear to imply a "normal level" of trade. During what periods in the last twenty years should you say that trade had been—(*a*) At its normal level; (*b*) above that level; or (*c*) below it?

(6) Judged by a scale constructed in this manner, can the condition of trade and industry, or that of any special trade or industry, in your district at the present time be fairly described as "depressed?"

(7) If so, when did the depression begin; when did it reach its lowest point; and what are its most prominent symptoms?

(8) Has its progress hitherto been uniform or irregular; and what do you anticipate that its course will be in the immediate future?

(9) Have the different trades and industries affected been uniformly affected (*a*) in time, and (*b*) in intensity?

(10) Are there any special circumstances affecting your district to which the existing condition of trade and industry there can be attributed?

(11) Should you say that:—(*a*) The demand for; (*b*) the supply of; (*c*) the return on capital in your district is above or below the average of the last twenty years?

(12) Is the rate of wages in relation to service rendered, and to the quality and quantity of the work produced (*a*) for skilled, and (*b*) for unskilled labour in your district, above or below the average of the last twenty years?

(13) What measures could, in your opinion, be adopted to improve the existing condition of trade (*a*) by legislation, and (*b*) independently of legislation?

(14) To what extent do you consider that the present condition of trade and industry in your district has been affected by the operation of any of the following causes:—(*a*) Changes in the relation between capital and labour; (*b*) changes in the hours of labour; (*c*) changes in the relations between the producer, the distributor, and the consumer; (*d*) fall in prices, or appreciation of the standard of value; (*e*) the state of the currency and the banking laws; (*f*) restriction or inflation of credit; (*g*) over production; (*h*) foreign competition; (*k*) foreign tariffs and bounties; (*l*) incidence of taxation, local or imperial; (*m*) communication with other markets; (*n*) legislation affecting trade; (*o*) legislation affecting land?

TO CORRESPONDENTS.

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

**** 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.*

X. W.—*We do not know.*

I. E. A.—*We shall be glad to see the sketch to which you refer.*

W. J. (Colchester).—*The speed of your gig will be less with paddle-wheels than with oars. Assuming it to be five miles an hour, and the paddle-wheels to make 40 revolutions per minute, the centre of effort of the paddle-boards must be on a circle 11ft. in circumference. Allowing about one-fourth for slip, we have 15ft., so that your wheels would have a diameter over all of very nearly 6ft. We fancy you would find this a very inconvenient dimension in a gig drawing only 18in. of water. The area of the floats will depend on the power applied to the crank shaft; 6in. by 12in. wide would probably suffice.*

ERRATA.—*In the article on the Mail Steamer Ireland which appeared on pages 184 and 185 of our last impression, page 184, second paragraph, line 10 from top, instead of 9·57 read 9·51; second paragraph, line 3, for Mr. Messam read Mr. Messum; line 11, for Mr. Beavis read Mr. Bevis. Page 185, first column, line 11 from top, for each cylinder weighs 3·15 cwt. read 33 tons 5 cwt.; last column, line 5 from the end, for 2½ hours read 2¾ hours.*

COAL GRINDING MACHINE.

(*To the Editor of The Engineer.*)

SIR,—Will any reader tell me where I can get a machine for grinding a particular kind of coal as fine as the finest flour? W. D. G.
September 8th.

WIRE ROPE RAILWAY.

(*To the Editor of The Engineer.*)

SIR,—I should be obliged if any correspondent would give particulars of elevated wire rope traveller for small parcels, and where same can be obtained. TRAVELLER.

MICA PACKING.

(*To the Editor of The Engineer.*)

SIR,—Would any reader kindly let me know the address of the Mica Packing Company—if there is such a firm as the Mica Company—and if they have a patent for engine packing? J. R.
September 3rd.

ATMOSPHERIC CONDENSERS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers kindly inform me what proportion of cooling surface and quantity of condensing water to the weight of steam condensed are required in a surface evaporator condenser? N. H.
September 4th.

CURVED BRESSUMERS.

(*To the Editor of The Engineer.*)

SIR,—I have some shops to erect, two of which at corners have curved fronts. They are semicircular, and 13ft. 0in. radius. The party-wall carries the straight ends of the wrought iron bressumer, and I am allowed only two cast iron columns besides under each. The curved girders have to carry four storeys, in brickwork, and I have no idea what strength they ought to be, nor can I find any rule in any of several books on strains which I possess. There is obviously not only a breaking strain of the ordinary kind, but a twisting stress as well. Is the girder to be treated as continuous? Which is the best place to put the columns? A reply will very much oblige a BUILDER.
Hammersmith, September 7th.

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DEATH.

On the 4th inst., at Baddesley Vicarage, Atherstone, Warwickshire, WILLIAM YOLLAND, C.B., F.R.S., &c., Lieut.-Colonel late Royal Engineers, of 14, St. Stephen's-square, W., in his 76th year.

THE ENGINEER.

SEPTEMBER 11, 1885.

SIR LYON PLAYFAIR'S ADDRESS.

THE address delivered on Wednesday by Sir Lyon Playfair, on taking the chair at Aberdeen as President of the British Association, does not possess sufficient technical interest to entitle it to a place in our columns. It is, from beginning to end, a more or less extravagant laudation of pure science. It deals with a great many subjects of general interest, such as the relations of science and the State, science and secondary education, science and the Universities, science and industry, and abstract science a condition of progress; but in all cases science is lauded as the be-all and end-all of meritorious human existence. With much of the address we cordially agree; to portions of it we cannot help taking exception. The defect of the address is that its author exaggerates the value of what is commonly known as science. He exalts that to the position of master, which is, after all, only a servant. Nothing can be more certain, indeed, than that a great deal is taught now which possesses no value of any kind. Formerly there existed a society "for the diffusion of useful knowledge." In the present day there exists dozens of institutions for the diffusion of useless knowledge, and the worst of the matter is that the acquisition of this useless knowledge prevents the student from acquiring that which would prove really valuable to him. "Industrial applications," says Sir Lyon Playfair, "are but the overflowings of science welling over from the fulness of its measure." This is a pretty sentiment. Is it true? We think not. What is the true value of abstract science? "Few," says the President of the British Association, "would ask now, as was constantly done a few years ago, what is the use of an abstract discovery in science?" We are among the few. It would be as proper to assert that the sand dug up by the gold miner must necessarily possess value, as it is to say that because a discovery is "scientific" it must be useful. Every year, almost every day, new discoveries are made, but the vast majority of them possess no worth whatever as means of promoting the happiness or the welfare of the human race. In no single instance has the man of pure science, entirely unaided, done anything to make mankind richer, or happier, or better. In every instance we find that discoveries have had their value imparted to them by men of a very different type, and only too often the man of science follows slowly and heavily in a track first marked out by the much despised practical man. A host of examples might be cited. The puddling furnace was invented by a man who knew nothing of science. To Trevithick and George Stephenson science was but a name. Bessemer was in no sense of the word a scientific man when he devised his steel process. Cartwright, the inventor of the power loom, Arkwright, the inventor of the spinning mule, knew nothing at all about science. Indeed, it was not until the arts had made very considerable progress that science in the modern acceptation of the term was ever heard of. Let it not be supposed that we underrate the value of pure science; we fully admit that it has value, and great value too; but it is not everything, and to assert that to it we owe an enormous debt; that we have to thank it for all our industrial and social progress, is to make a demand on our credulity which we flatly refuse to honour. The whole thesis of Sir Lyon Playfair's address may be summed up in his own words: "Abstract discovery in science is the true foundation upon which the superstructure of modern civilisation is built, and the man who would take part in it should study science, and if he can, advance it for its own sake, and not for its applications." We have here a proposition of tremendous dimensions; but we seek in vain through the address for any attempt to prove its truth. We earnestly protest against the assertion that men should seek to advance science for its own sake and not for its applications. This is one of the clap-trap sentiments of the age. There is nothing about science or knowledge of any kind in the abstract which makes it worth while to acquire it for its own sake. Its entire worth depends on its power of adding to the general store of happiness, comfort, or goodness of mankind. In a word, science is only valuable because it may be made useful. When we have learned that light requires 700 years to traverse the distance between a given star and the earth, we have gained nothing. An error of a century in the statement would in no way affect a mortal for good or ill. But the knowledge that sound travels in air at the rate of 1090·6ft. in a second, while light travels at 200,000 miles, becomes of value the moment it is utilised for signalling purposes, as described, for example, in another page. To minds of a certain type, however, the storing up of scientific facts, or so-called facts, gives intense pleasure—a pleasure similar to that enjoyed by Mrs. Toodles, who bought things she did not want at auctions because they "might come in handy some time or other." We have no desire whatever to interfere with men of this calibre. By all means let them go on picking up facts—turning over tons and tons of sand, and possibly finding now and then a speck of gold. But we protest that this is not the highest end that education can attain, and that a fearful amount of time may be and now is wasted in cramming young minds with information as likely to prove useful in after life as a knowledge of the art of skating would be to a Hindoo. It is but just to Sir Lyon Playfair to say that he admits that, even without the aid of what is now known as science, men contrived to make some progress in the arts. "By the end of the fifteenth century," he says, "many important manufactures were founded by empirical experiment, with only the uncertain guidance of science. Among these were the compass, printing, paper, gunpowder, guns, watches, forks, knitting needles, horseshoes, bells, wood-cutting and copper engraving, wire drawing, steel, table glass, spectacles, microscopes, glass mirrors backed with amalgam of tin and lead, windmills, crushing and saw mills. Those important manufactures arose from an increased knowledge of facts around which scientific conceptions were slowly concreting." It is to be regretted that the speaker did not go on to say what abstract science had done for mankind.

One of the prominent defects in the address which we are criticising is that it jumps to conclusions without supplying the smallest scrap of evidence that those conclusions are justifiable deductions from proved facts. Take the following for example:—"Switzerland is a remarkable illustration of how a country can compensate itself for its natural disadvantages by a scientific education of its people. Switzerland contains neither coal nor the ordinary raw materials of industry, and is separated from other countries which might supply them by mountain barriers. Yet by a singularly good system of graded schools, and by a great technical college at Zurich, she has become a prosperous manufacturing country." This is pure assertion. Sir Lyon Playfair ought to have gone on to show in what way the great technical school at Zurich has helped Switzerland. The principal trade of this agricultural country is in cheap watches, wood carvings, and silk, and we are not aware that the technical schools have promoted these industries in the slightest degree.

On one point we thoroughly agree with Sir Lyon Playfair. It is that the system of teaching the upper and middle-classes now in vogue is far from being satisfactory. For years and years little but classical lore was imparted. There is now danger that everything under the sun will be taught. The curriculum of some schools which we could name is simply ridiculous. It is beyond question that there is growing up in our midst a generation of smatterers, who, knowing a little of everything, know nothing well. Nor can it be otherwise. Time and brains cannot acquire the information which it is deemed necessary to attempt to impart. The child, the youth, the man, have to run the gauntlet of a crowd of specialists, each of whom pretends to know but one thing well. First, we have the classical master; he knows nothing about French or German. Next comes the professor of foreign languages, who knows French and German, and nothing else. Then comes the professor of chemistry, who teaches that and nothing else. Then the lecturer on biology, who confines his attention to that subject alone will not extend the list. We find that four distinct brains are found necessary to acquire a competent knowledge of Latin and Greek, French and German, chemistry, and biology; but the single brain of the pupil is expected to hold as much as the four brains of the teachers. No one ever hears of one man teaching a dozen distinct subjects well. If we take a set of examination papers of any importance we shall find that they have been set by several men, and the certainty is that none of these men could answer all the questions set in such a way that he could pass the examination; but the candidate has to get through. This is not as it should be. The tendency of the age is to teach too much—a great deal more than can be learned. "A return," says Sir Lyon Playfair, "just issued on the motion of Sir John Lubbock shows a lamentable deficiency in science teaching in a great proportion of the endowed schools. While twelve to sixteen hours a week are devoted to classics, two or three hours are considered ample for science in a large proportion of schools." We see here nothing that calls for blame. Schools teach as a rule what pays best, and if classics are more useful to the pupil than science they will be taught. Let us take two important professions, the Church and physic. Neither can be entered or practised without a knowledge of classics. In the first modern science does not count at all; in the latter it does not count for a long time after the pupil has entered on his medical studies. Guy's Hospital annually awards two prizes each of the value of £110, that is to say, all the fees necessary for receiving a complete training in medicine and surgery. One of these is awarded for proficiency in classics and for modern language; the other for proficiency in science. But he must know Latin at least as well. It is obvious that if a boy has a turn for the classics, that even sixteen hours a week devoted to their acquisition would not be waste of time if it enabled him to win one of these prizes. As knowledge is accumulated by specialists the range of teaching must increase, and a point will soon be reached, if it is not reached now, when in the struggle to learn the pupil must succumb. Under a proper system no attempt whatever would be made to teach everything; but a judicious selection would be made by the teacher, and knowledge likely to be useless to the pupil in after life would be rigorously excluded. What will best serve one boy's purpose may be perfectly useless to another boy. We by no means advocate a classical education to the exclusion of everything else; neither would we have science, and science only, taught. Nothing of the kind; circumstances alter cases. There is no abstract good of any kind in education; its use lies in the fact that it is a means to an end. What that end may be depends on many things. It may be an improvement in morality or wisdom; or it may be the power of earning a living; or of becoming a great lawyer; a prime minister, or an engineer. But that only can be a successful system of education in the fullest sense that keeps the end to be attained in view, and results in giving the world sound minds in sound bodies.

LONDON AND THE LEA.

THE state of the river Lea is undeniably bad, and it so happens that the sufferings of the contiguous population are attracting a warm degree of sympathy from expectant candidates for Parliamentary honours. Clapton, Hackney, Homerton, and parts adjacent, literally turned out in their thousands last Saturday, and gathered in force on Hackney Downs, to protest against the continued pollution of the local river. The political clubs belonging to the district were strongly represented, in addition to other organisations, and there was a striking display of banners, bearing startling inscriptions, such as "Cholera invited," "Sewage and Starvation," and other lugubrious mottoes. The speeches generally were not remarkable for soundness of judgment, whether viewed from the standpoint of the sanitary engineer or of the enlightened politician. The chairman suggested that if a remedy for the terrible state of the river were not found before next summer, there would be danger of "riot, revolution, and bloodshed." This is not the only threat of revolution that has been launched against the peace of English society during the last few weeks, and this appears to be the recognised method just now for enforcing any desired measure of reform. There is evidently an idea in certain quarters that something of this kind is necessary, in order to quicken the naturally sluggish pace of the Legislature.

Unquestionably Parliament has a work to do in reference to this subject. On the same day as the demonstration on Hackney Downs, there was a deputation to the Home-office, in which the Hackney Board of Works took part, it being hoped that the Government would render important assistance in getting the Lea into a wholesome state. But resolutions, demonstrations, and memorials, have only a limited efficacy, and not even an Act of Parliament can repeal a physical law. The Home Secretary himself may be baffled, and the answer given by the Home-office to the deputation was little more than a confession of helplessness. Nobody seems to know exactly what to do; but everybody that can possibly get away is removing to a distance from that part of the river Lea which lies between Tottenham and the Thames. Here are some two hundred thousand people, all of whom would migrate from the spot if they could, and many of them are living in such fear of cholera that it would be no great wonder if the disease speedily appeared in their midst. The river has lately been flushed by the East London Waterworks Company, with the co-operation of the New River Company, and this has been of service for a time. But water is scant, and sewage is abundant, so that the process of flushing is only of temporary value, and discontent continues rife on the eastern borders of the metropolis. The filthy river is a sore infliction, especially as the stream was at one time a favourite resort on the part of the crowded population resident in its vicinity.

The irascibility—perhaps we ought to say the indignation—of the people who have to inhale the odours of the Lea, and who in many instances are suffering pecuniary loss by its noxious condition, is indicated by the peremptory propositions which they accept as the proper mode of proceeding. A resolution moved by a member of Parliament, and carried unanimously, declares the present polluted state of the river Lea to be disgraceful, as well as dangerous to the metropolis; and the popular will "demands that immediate action be taken to divert all sewage from the river." When this is done of course Hackney may be happy; but the sewage, if diverted from the Lea, must be conveyed elsewhere, and this involves consideration, especially in reference to the recent report of Lord Bramwell's Commission. Another proposition is that the President of the Local Government Board should send down an inspector to inquire into the causes of the present pollution, with a view to the construction of such a scheme of sewerage as shall restore the river to its original purity. This, however, scarcely offers anything very "immediate." A further poposition follows, namely, that in the ensuing Parliament there shall be a Select Committee to inquire into the privileges, powers, and duties of the water companies, the Lea Conservancy Board, and the local authorities, which in any way affect the condition of the river, with a view to such an amendment of the law as shall preserve the river from pollution. All this points to the consumption of a good deal of time, and possibly the expenditure of some money. But it is impossible not to sympathise with the popular demand. A river, once enjoyable and profitable, has become an intolerable nuisance. Thousands of people have to breathe a poisoned air, and many local industries are seriously injured. We must not criticise too nicely the remedies that are proposed. A scandalous nuisance exists, and it is simply lucky for the sufferers that a general election is close at hand. Those who seek the honour of representing the people in Parliament are just now in the right disposition of mind to listen to their complaints. From this fortunate combination of circumstances it may happen that the fearful pollution of the river Lea will serve to inaugurate a better system of dealing with town sewage. Great hopes were entertained some years ago when a Conservative Government came into power, that a law would be passed such as would restore every river in the kingdom to that state of purity that is desired for the river Lea. How far this has come to pass is partly indicated by the statement of Mr. Godfrey Lushington at the Home-office the other day, when he enumerated to the Hackney deputation the many difficulties that stood in the way of any effective remedy, and warned the gentlemen who came before him that "the Secretary of State could not by a wave of his hand, or a stroke of his pen, set the matter right." The deputation evidently wished that he could, and it is just such a summary remedy that East London is now practically demanding.

The discussion of this subject has brought into clearer light the complicated and unsatisfactory system which makes the law itself the shield of mischief. The Lea is a river polluted by Act of Parliament. It is not that engineering skill, or chemical science, cannot make an urban at least tolerable. In respect to the Lea a special clause in the Conservancy Act of 1868 allows the sewage of Tottenham to be discharged into the stream, providing it is first treated by the best known chemical process. Three other towns in the Lea Valley, one of which is Hertford, enjoy a similar privilege. In the case of Tottenham, the Conservators, however dissatisfied with what is being done, cannot take proceedings without the previous consent of the Home Secretary. Ten years ago the Conservators sought this consent and met with a refusal. Last year another attempt was made, and the Home Secretary then decided that the Tottenham sewage was not being properly treated. The Conservators accordingly gave the Local Board notice to amend their works. The answer of the Board was a law suit, but the Conservators gained the day. The time allowed for improving the works has expired, further litigation has followed, and the contending parties now find themselves in the Chancery Division of the High Court of Justice, or will do so at the close of the Long Vacation. In the meantime a contract is in progress for enlarging the Tottenham Sewage Works, the estimate being £15,000. Supposing that a good sewage process has been adopted, and that the works will be sufficiently extensive, we might hope for a marked improvement in the character of the effluent. But the estimated population of Tottenham at the present time is 50,000, and it still grows. In justice to the Tottenham Board it should be stated that in 1867 they supported a scheme, prepared by Sir J. Bazalgette, for the formation of a drainage district comprehending the entire valley of the Lea, the sewage to be taken to Barking Creek. The project was abandoned owing to the impossibility of getting the requisite union among the authorities concerned. A second attempt was made at a later date, the plan being remodelled, but the requisite parliamentary sanction was not obtained. In 1882 something of the same kind was repeated, but as the united action of no less than fifteen sanitary authorities was requisite, the project broke down through lack of unanimity. As far back as 1869 the Local Board sought parliamentary powers to obtain land for the purpose of treating the sewage agriculturally, but the opposition of the surrounding parishes proved fatal, and the more patriotic members of the Tottenham Board had to defray the expenses out of their own pockets. The latest effort of the Board, apart from chemical treatment, was to support a memorial addressed to the Metropolitan Board of Works, asking that the Tottenham sewage might be taken into the metropolitan system. Last February the answer to this application was given in a form which, while it opened up certain probabilities in the future, was yet for the present a negative. With this review of the facts, it would seem that the Tottenham Board were compelled to go on with the chemical treatment of the sewage, although it might prove to be only a temporary measure. Unfortunately the Board had fallen very much behind in the march of events, and had carried out the deodorisation of the sewage in a very imperfect fashion. We cannot help thinking they might have done greatly better, even with their existing means, had they set to work with determination. As it is, they seem more skilful in their litigation than in the disposal of the sewage. No doubt the plans of the Board have been somewhat checked by the prospect from time to time of some other scheme taking the place of chemical treatment. At last a deficiency in the rainfall, and the enlarged demands of the Water Companies for a supply, have united with a greatly increased population to aggravate the state of the river, and affairs have clearly reached a crisis. Major Laverock Flower, the Sanitary Engineer to the Lea Conservancy Board, has repeatedly stated in his official reports that until a main sewer, similar to that which has been designed by Sir J. Bazalgette, Messrs. Law and Chatterton, and himself, has been carried out, the river Lea below the intakes will remain a polluted stream. Major Flower seems to have little faith in the Tottenham Sewage Works, and looks for the day when the sewage will be carried entirely out of the district. It is rather to be apprehended that with the enlargement of the Tottenham Works there will be an increased nuisance from the sludge. This, although not affecting the river, will poison the atmosphere. In his evidence before the Royal Commissioners, Major Flower stated that there was not sufficient storage-room for the sludge at Tottenham, and an intolerable nuisance was created. The sludge was partly removed by a farmer twice a week, and the remainder was put on the banks of the Lea, where it lost its offensiveness and became like garden mould.

Notwithstanding all the excitement or enthusiasm that now exists with regard to the condition of the Lea, we perceive no immediate prospect of any final and satisfactory change. The state of the river, in all its horrid offensiveness, shows of how little value is the Act of 1868. The Conservators declare that they have done all it is in their power to do; yet so far as the existing results are concerned, it would seem that the river below Tottenham is none the better for all their efforts. The inhabitants of the locality may wait and see what good will come of an enlarged dose of chemicals and an extended series of settling tanks. This ought to accomplish something in the case of a river which is not used for a drinking supply; and if such a scheme were carried out with skill, aided by a liberal expenditure of money, the river must needs be greatly improved in its quality. If the Lea Valley, with its 800,000 inhabitants, is to have the benefit of a combined system of drainage, the question becomes a very large one, and connects itself with the relief of other localities contiguous to the metropolis. The engineer and the chemist will both have to be called into the field. The Metropolitan Board, in an elaborate report which they adopted some few months ago, in connection with the Tottenham memorial, shadowed forth some important changes. The main difficulty, in the judgment of the Board, was the settlement of the existing financial liabilities. But at the same time there was the declaration that if her Majesty's Government should decide to promote legislation with a view to bring outlying districts within the metropolitan area, the Board would not be unwilling to undertake the duty of dealing with the sewage of the lower valley of the Lea, as well as that of other outlying districts. When this comes to pass, the system of main drainage connected with the metropolis will, indeed, be vast, exceeding anything that was contemplated when the present works were commenced. Not only the sewage of London, but of a considerable portion of the Outer Ring, will be gathered up and carried away—the question arises, Whither? This is the grand difficulty of the sewage problem, and it would seem that in this matter the engineer must play into the hands of the agriculturist or the chemist. If neither will serve his turn, there is nothing left but the sea; and yet we cannot consent to have the pleasant shores of the sea made foul with the sewage of towns.

FOREIGN v. ENGLISH STEAM ENGINES.

It has come to our knowledge that certain engineers in this country feel themselves aggrieved because we have spoken of the steam engines exhibited at Antwerp in terms of praise. These gentlemen hold, it seems, that if we cannot find fault with what our competitors and rivals abroad produce, we ought to keep silence and say nothing at all concerning them. Others who do not go so far as this, tell us that the Belgian or French purchaser is willing to pay a much larger price than the English millowner is content to give. In other words, the English buyer will not pay for a first-class article and the foreigner will. The result is that the Belgian engine is admittedly better than the English engine. These assertions deserve some attention. We fancy that no defence of our own policy is necessary, but a few words of explanation may be expedient. We are told on the one hand that we should not give the English purchaser a hint that good steam engines are made and publicly exhibited abroad; and on the other, that the reason of the existence of foreign excellence is that long prices are asked and obtained. Now, if the English millowner will not give a long price for an English engine, why should he give a long price for a Belgian engine? It seems tolerably obvious that if the long price argument is sound, it matters not how many intending purchasers find their way to Antwerp. They will in the long run come back to England for what they want. Unfortunately the argument is not sound, and we shall endeavour presently to show that engines are not much dearer abroad than at home. But, setting this on one side for the moment, we proceed to explain that an important function of this journal is to keep its readers informed of what is going on in the engineering world abroad as well as at home. To permit our readers to live in a fool's paradise; to continually praise and laud English practice; to tell makers of engines at home that these are the best in the world, would be an extremely short-sighted policy, the effects of adopting which would without fail make themselves apparent in the loss of reputation for honesty of purpose, which no English journal can live without. We find at home that trade is falling off—going from bad to worse, indeed—and on every hand we are told that the foreigner is cutting us out of the world's markets. Are we to keep silence instead of using all the influence we possess to induce English engineers—English producers in general—to look around them and see for themselves why they are cut out of foreign markets? There can be but one answer to this question. We must speak. We must fearlessly bring the truth before our readers. If a number of firms make in Belgium steam engines better than those made in England by all but a very few firms, it is our duty to tell English makers what is being done while there is time for amendment, so that they can meet the foreigner on his own ground and beat him at all points. Far be it from us to say that Englishmen cannot build the best machinery in the world. But the power of doing this is useless unless it is exerted. The way in which mischief accrues here is not as clearly understood as it ought to be. The facts admit of illustration. Messrs. Crosshead, Bolt, and Co. build up for themselves in the course of years a nice and remunerative business as tool makers, let us say. One of the firm was brought up in the shops of Sir Joseph Whitworth and Company. The firm was fortunate enough to secure the services as leading draughtsman of a gentleman of very extended experience in more than one tool-making establishment. Under these conditions very excellent tools are turned out, and a capital foreign connection is got together. By-and-bye, however, it is found that profits are not quite what they were expected to be, and it is tacitly agreed to cut things down all round. The leading draughtsman gets his dismissal. His place is filled by a cheaper man. Less care is taken to finish things well. The weight and scantling of framing is reduced. The various bearings and rubbing surfaces are diminished, and in this way cheap tools are produced and the foreign market gets flooded with them. For a time all goes well. Then the German, the Belgian, or the Frenchman appears on the scene. He produces a much better article for a very little more money, and Messrs. Crosshead, Bolt, and Co., wake up some morning to find that their connection has practically disappeared. If they had kept their eyes open to what the foreign tool makers were doing, if they had believed the statements made by their representatives abroad, all would have been well. As it is all is ill. We paint no fancy picture. It is matter of common knowledge that the English tool trade in South Europe has been all but destroyed by sending out rubbish instead of honestly made tools. Time was when neither Germany, France, nor Belgium could compete for a moment with England in the production of machine tools. That day is for ever passed away. The same thing is true of steam engines. In the construction of these, enormous strides have been made abroad since the Paris Exhibition of 1878. To keep silence concerning this would be simply to commit a breach of faith with our readers. It is our duty to warn the unwary. It is for the engineers of Great Britain to exert themselves, and to prove that no people in the world can supply better machinery than they can.

The statement that foreign millowners will pay more for their engines than can be obtained at home, strikes us as being very remarkable, and needs confirmation. Owing to protection, the Belgian millowner may be assumed to have to pay more for his engines in any case, but why in addition to this he should be willing to pay a further sum for excellence, which the English millowner will not pay, requires explanation. Coal is dearer no doubt in Belgium than it is here, but not much dearer; and if protection tends on the one hand to raise prices, on the other the cost of labour being small, things are pretty nearly balanced; and besides all this there is a very keen competition indeed among Belgian and French engineers. To this competition we are disposed to attribute a great deal of the excellence which we find in the Antwerp Machinery Gallery. Foreign makers say, "Let us make a *better* engine than our rivals;" English engineers say, "Let us make a *cheaper* engine than our rivals." There can be no question at all which policy is the wisest—which will turn out the best in the long run. Even in this question of cheapness it is by no means certain that we have the advantage of our foreign rivals. We have already stated that steel engine castings can be delivered by German firms in England at a less price than home makers can supply them for; therefore it is certain that German steam engine makers can beat us on this item. We may cite an actual example of prices, however, which will be more instructive than any general statement. Herr A. Knoevenagel, of Hanover, exhibits at Antwerp a horizontal engine, illustrating a type which he produces in quantity of various sizes. This is a very well made engine indeed, with overhung cylinder, and Rider cut-off valve—or double-beat valves on a modified Corliss system can be had instead by the purchaser. In all respects this appears to be a satisfactory engine, and Herr Knoevenagel has had

THE EFFICIENCY OF AMERICAN STEAM BOILERS.

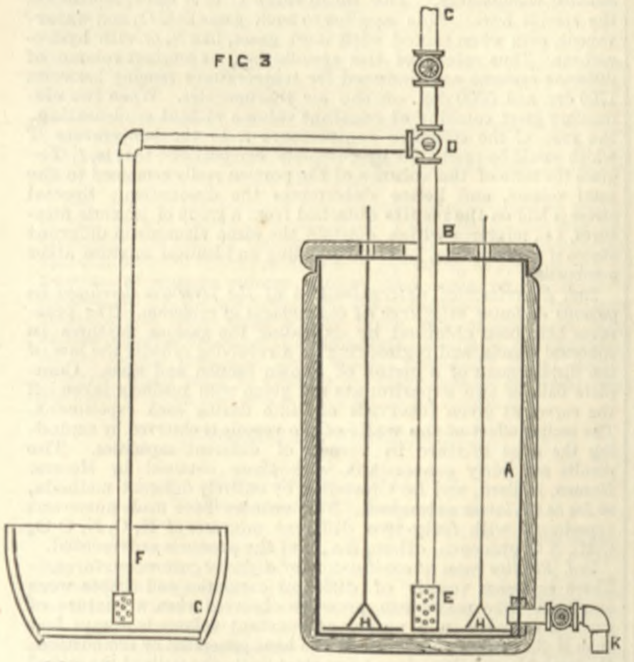
(*Continued from page* 188.)

Barrel calorimeter.—One apparatus used for testing the quality of the steam was an ordinary barrel resting on Riehlé's scales. A quantity of water was put into the barrel and its weight noted. Just before making the experiment the temperature of the water was noted. A steam pipe from the boiler led down to within a short distance of the barrel and was covered with felting. To the end of this pipe a short length of hose was attached. Everything being ready for the experiment, the steam was turned on the hose and allowed to blow into the air until apparently dry steam showed at the end of the hose. This end was then put into the barrel and the temperature of the water allowed to rise from 10 to 20 deg., the water being constantly agitated. The hose was then taken out and the temperature of the water in the barrel noted. The weight was then taken and the pressure of steam during the experiment noted. From this data the quality of the steam was calculated. In making the calculations allowance was made for the water equivalent of the barrel used. The barrel being partly filled with water to the level used in the experiments and its temperature noted, a quantity of warm water of known temperature was added and the resulting temperature noted. Knowing the weights of water used, the equivalent of the barrel was found as follows:—Multiply the added weight of water by the number of heat units lost by the warm water, and divide by the heat units gained by the cold water. This quotient, less the weight of cold water in the barrel, is the water equivalent of the barrel. Allowing the water to remain in the barrel for three minutes made no appreciable change in the temperature, showing that there was but little loss from radiation during each experiment, which did not generally last over two minutes. The following formula was used in making the calculations from data derived while using this apparatus, and an examination of the results will show that they vary surprisingly:—

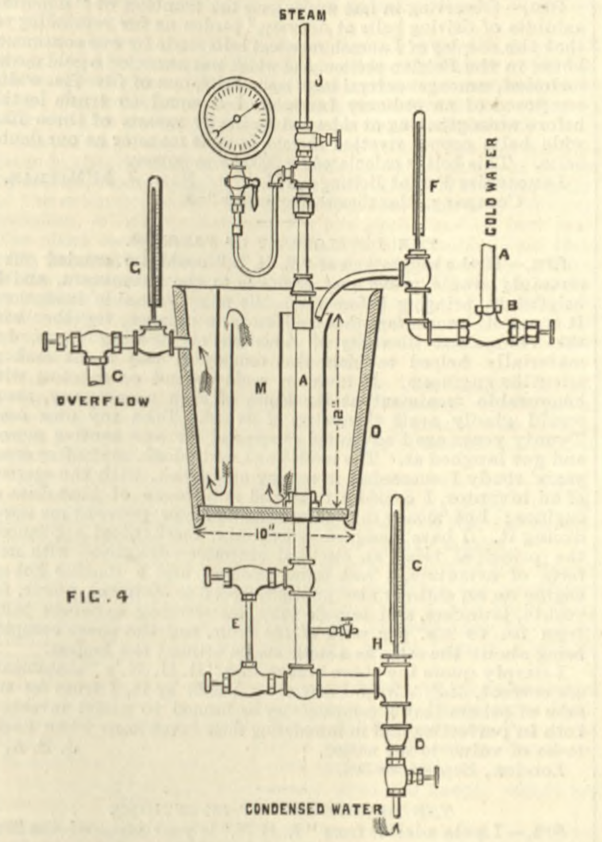
w = weight of cold water plus water equivalent of barrel.
g = heat units corresponding to temperature of cold water, counting from 32 deg. Fah.
g_1 = heat units corresponding to temperature of the mixture, counting from 32 deg. Fah.
H = heat units—latent—corresponding to the temperature and pressure of steam.
g_2 = heat units—sensible—corresponding to the temperature and pressure of the steam, counting from 32 deg. Fah.
w_1 = weight of water and steam added.
ϕ = water combined in w_1.

$$\phi = 1 + \frac{1}{H}\left\{(g_2 - g_1)\frac{w}{w_1}(g_1 - g)\right\}$$

The numerical quantities used in making these calculations were taken from Röntgen's "Thermodynamics"—Du Bois' translation—and are substantially the same as other tables derived from the same source, and were used because they were familiar to the young men making the calculations. The second apparatus used was on the same general principle, and only differed from the first in matters of detail. It is shown in Fig. 3. a represents a tin tank, high in proportion to its diameter, and heavily covered with



felt and canvas. A tin cover b fitting over this tank had an opening in its centre for admitting steam or cold water. c is the pipe from the boiler, branching at three-way cock d. One branch goes down into the tank a, and has the rose e at its lower end. The other branch terminates in the rose f, in the tank g, which is kept partly filled with water. k is the drain pipe and valve for emptying a. The method of operating the calorimeter is as follows:—The weight of the tank a is taken. It is then partly filled with water, and the weight and temperature is noted. Steam being off the pipe c, the three-way cock d is turned so that c and f are in communication. Steam is now turned on c and passes into the water in g. As soon as the pipe is heated and clear of any condensed water, the three-way cock d is turned and the steam allowed to pass into a. As soon as a sufficient quantity, say 10 lb., has passed into a, the three-way cock is turned into its original position and steam is shut off c. h h is an annular perforated plate, having two handles extending through the cover b, and is used to thoroughly mix the water in a. The temperature is now taken and also the weight of the tank and its contents. The pressure of the steam is noted, and the experiment is ended. The water equivalent of the tank is determined as for the simple barrel, and the calculations are made in the same way as before. When this and the previous method were used at the same time, the results entirely disagreed. The third method used was one devised by Mr. Barrus, a member of the committee on steam engines, and was used on both boiler and engine tests. Fig. 4 is a sketch of the apparatus. It consisted of a wooden vessel o, mounted on a frame at the proper height for use. Inside this vessel were two partitions, so that any water passing from the centre of the vessel must pass over one and under the second. In the centre of the vessel was a vertical cylinder m which confined the coldest condensing water to the centre of the apparatus. The condensing water passed down the pipe A, through a valve by which the quantity was regulated, and into the cylinder m, out at the bottom of m, and out through c. The pipe j was connected directly to the boiler or steam pipe from which the steam was to be taken. Below the globe valve is shown a branch pipe, forming a gauge syphon. Below the vessel o there is attached to the main pipe a glass water gauge e, and below this there was a globe valve d, which regulated the discharge of the condensed steam. A short piece of hose was attached, and the condensed water was drawn off into two buckets, set on accurate pairs of Fairbanks' balances. These buckets were partly filled with cold water, and their weights were taken. A quantity of the condensed water was run into one, and before the temperature had risen to 100 deg. Fah., the hose was moved to the other bucket. The weight of the bucket of warm water was noted, and the difference of the weights is the weight of the condensed steam. The bucket was emptied and partly filled with cold water again. The condensing water, after passing c, emptied into a tank, which was supported over two barrels. The water could be directed into either at will. The barrels were weighed empty and full, and the difference taken as the weight of the condensing water. The temperature of the condensing water was taken at f, before going into o, and at g, after doing its work. The temperature of the condensed water was taken at C, and the temperature of the live steam was taken from the corresponding pressure. The method of operating the apparatus was as follows:—One barrel under c was empty and its weight known, and one bucket was partly filled with cold water and its weight known. Any water passing through c flowed into the unweighed barrel, and was allowed to escape through a valve at the bottom. The small hose attached below d discharges into the air. The thermometers and gauge being in place, the valves b and c were opened wide and water allowed to flow through m. The steam valve was then opened, and steam allowed to condense in the pipe, the valve d being closed. As soon as the water got to a determined level in

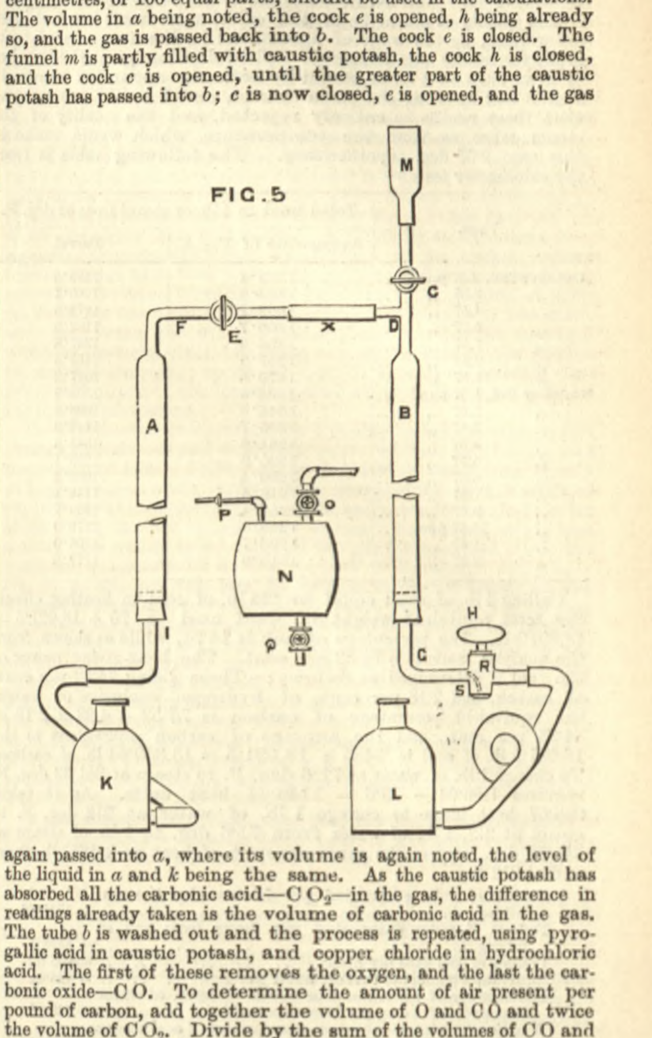


the pipe and in e, the valve d was opened sufficiently to allow as much water to escape as was condensed. The steam valve was opened wide, and the supply of cold water was regulated by the valve b, until the desired difference of temperature between A and g was obtained. The level of the water in e should be maintained. This being the case, the water at c was turned into the weighed barrel, and the hose from d put into the bucket containing the weighed quantity of water. Readings of the gauge and thermometers were taken every five minutes during the tests. While the barrel and bucket were filling, the others, which we will call 2, were being prepared. Barrel 2 had the valve at the bottom closed, and was weighed. Bucket 2 was partly filled with water, and weighed. Bucket 1 being filled, the hose was turned into No. 2, and No. 1 was weighed, emptied, and again filled with cold water, and weighed. The difference between the first two weighings of bucket 1 is the amount of condensed water. Barrel 1 being filled, the water from c was turned into barrel 2. Barrel 1 was weighed, emptied wholly or in part, and was again weighed. The difference between the first two weighings of barrel 1 is the amount of condensing water used. When it is desired to end the experiment, the barrel and bucket in use should be changed at the same instant, and weighed, and the steam closed off. One point to be particularly guarded against is the blowing of live steam into the buckets, as in that case the water in the buckets becomes part of the condensing water, and no provision is made for such a contingency. The calculations were made in the following way:—The total amount of condensing and condensed water was determined. The average of the readings of thermometers and gauge was found. Using the same nomenclature as before, with the following addition and change, the quantity of moisture was determined by the following formula:

g_1 = heat units corresponding to temperature of condensing water after passing through calorimeter, counting from 32 deg.
g_3 = heat units corresponding to temperature of condensed steam, counting from 32 deg.

$$\phi = 1 + \frac{1}{H}\left\{(g_2 - g_3) - \frac{w}{w_1}(g_1 - g)\right\}$$

Quality of gases of combustion.—The apparatus used for making these tests was loaned by Professor Denton, and a sketch of it is given in Fig. 5. The entire apparatus is mounted on a frame, so that it can easily be moved from place to place. It consists of two glass tubes a and b, each of about 120 cubic centimetres capacity, joined together by means of the necks d and f, connected by a piece of rubber tubing x. The neck of b extends vertically, and has a stop cock c above the connection with d, and above this the tube is tapered and ground to form a seat for the funnel m. To the bottom of a is attached, by means of a rubber cork, a piece of glass tubing i, to which is attached a piece of rubber tubing, leading to the bottle k. To the bottom of b a similar attachment is made, the only difference being that in the tube g a two-way stop cock h is fitted. One opening, shown at s, opens downward, so that the contents of b can be emptied without passing into l. The other opening is directly through the cock, and connects b and l, n is a small barrel having a pipe and valve o for filling it with water, q a pipe and valve for emptying it, and p a piece of gas piping with cock, the uses of which will be explained. The method of using the apparatus and making the tests is as follows:—The top of the tube b above c is connected with the chimney whose gases are to be analysed. The tubing connecting g and l is removed, and g and p are connected by means of tubing. The bottle k, being filled with water, is raised until the water runs through d, e being open, and fills d to its connection with b. The cock e is then closed, and k is lowered to its original position. The pipe o connected with a hydrant q is closed, the cock in p is opened, c is opened, and h is put in such a position that b and n are in communication. Water is allowed to run from the hydrant until n, b, and the pipe connecting with the chimney are filled with water. o is then closed, and q is opened. The water flows back through b, and the chimney gas follows. After sufficient gas has been allowed to pass through b, the cocks c and h are closed. The tubing connecting b and the chimney, and that connecting q and p, are taken off, and the bottle l is again attached to g. A certain volume of the chimney gas is now confined in b, and the apparatus can be moved to any convenient place for further work. The cock c being closed, e and h are opened, and the water is allowed to flow back into k until a certain quantity—say 100 cubic centimetres—of the gas is in a. The cock e is closed, and the gas allowed to assume the temperature of the air. The cock h is turned so that b can be washed out, c is opened, and the funnel m put on; b is washed out, and filled with clear water from l, the cock h being again turned and c being closed; k is now raised until the level of the water in a and k is the same, and the reading of the scale on a is noted. In the apparatus used, the volume was divided into cubic centimetres, beginning at the cock e, but any division into equal volumes would do equally well, and it is not at all necessary that 100 cubic centimetres, or 100 equal parts, should be used in the calculations. The volume in a being noted, the cock e is opened, h being already so, and the gas is passed back into b. The cock e is closed. The funnel m is partly filled with caustic potash, the cock h is closed, and the cock c is opened, until the greater part of the caustic potash has passed into b; c is now closed, e is opened, and the gas



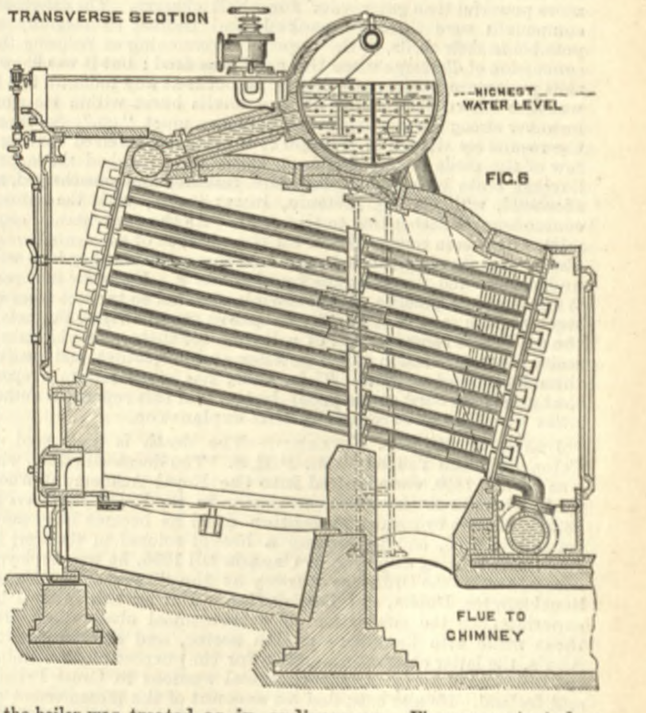
again passed into a, where its volume is again noted, the level of the liquid in a and k being the same. As the caustic potash has absorbed all the carbonic acid—CO_2—in the gas, the difference in readings already taken is the volume of carbonic acid in the gas. The tube b is washed out and the process is repeated, using pyrogallic acid in caustic potash, and copper chloride in hydrochloric acid. The first of these removes the oxygen, and the last the carbonic oxide—CO. To determine the amount of air present per pound of carbon, add together the volume of O and CO and twice the volume of CO_2. Divide by the sum of the volumes of CO and CO_2, and $\frac{4}{3}$ the quotient is the weight of oxygen present per pound of carbon. This result divided by ·23 is the weight of air used per pound of carbon, and this result divided by the percentage of carbon in the coal is the weight of air used per pound of coal.

Making the tests.—In making the boiler tests, steam was first raised to the working pressure in each boiler, and the fires were then hauled. All wood and coal used thereafter was weighed, and at the end of the test the fire was hauled, any unburnt coal credited to the boiler. Water in the boiler was carried as nearly as possible at one height, and at the end of the test was brought back to the same level as at the beginning of the test.

Duration of the tests.—Each test lasted thirty-six hours, except in the case of the Baldwin boiler, where the test was terminated at the end of twenty-four hours. The following are the results of the different tests, together with the results derived from the observed data.

ROOT BOILER.

Before testing this boiler—Fig. 6—the back was boarded up. No other preparations were made for the test, except cleaning the boiler the day before. Ordinary care was taken with the fires, and



the boiler was treated as in ordinary use. Fires were started at 2.15 a.m., October 2nd, and as soon as the pressure of steam to be carried was reached, fires were hauled, and again started at 3 25 a.m., with a weighed quantity of wood and coal. At 3.25 p.m., October 3rd, fires were hauled, and the test concluded.

Boiler made by Abenroth and Root Manufacturing Company.

Rated horse-power	150
Area heating surface:	
Having water on one side	= 1440 sq. ft.
Having steam on one side	= 360 sq. ft.
Total	= 1800 sq. ft.
Area of grate	= 50 sq. ft.
Steam space (approximate)	= 76·5 cub. ft.
Height of smoke stack	= 44ft. 6in.
Size of stack	= 30 by 30in.
Time of test	= 36 hours
Water evaporated in boiler	= 134,937·31b.
Mean temperature of feed-water..	= 71·6 deg. F.
Total weight of wood used	= 291·5 lb.
Total weight of coal used	= 18,021·5 lb.
Total weight of ashes	= 2666·75 lb.

Percentage of carbon in coal..	= 75·52
Mean temperature of air during test..	= 57·0 deg. F.
Mean barometer..	= 30·323in.
Mean pressure in boiler	= 91·41 lb.
Mean temperature of steam	= 341·32 deg. F.
Mean temperature of smoke stack	= 369·92 deg. F.
Mean draught in chimney in inches of water.. ..	= ·7
Time during which blower was in use	= 16 hours
Mean pressure in boiler pipe..	= 1·16in.
Mean area of blower pipe open	= 49·93 sq. in.
Mean pounds of air per pound of carbon..	= 16·83

The quality of steam from the calorimeter tests has not been determined, as the want of agreement in the two sets of tests make the results unsatisfactory. The following gives the number of heat units in 1 lb. of steam by both the apparatus shown in Fig. 3 and by using the plain barrel, and I would recommend that these results be entirely rejected, and the quality of the steam taken as from the temperature, which would make in this case 9·37 deg. superheating. The following table is from the calorimeter tests:—

Time.	Total heat in 1 lb. of steam from 32 deg. F.	
	Apparatus of Fig. 3.	Barrel.
October 2nd, 2.57 p.m. ..	1335·4	1185·5
" 3.57 " ..	1323·2	1290·1
" 4.57 " ..	1306·7	1272·5
" 5.57 " ..	1309·7	1192·8
" 7.57 " ..	1406·3	1367·8
" 9.57 " ..	1247·0	1485·5
" 11.57 " ..	1270·5	1047·2
October 3rd, 1.57 a.m. ..	1282·5	1396·8
" 2.57 " ..	1344·6	1003·2
" 3.57 " ..	1285·7	1142·8
" 4.57 " ..	1281·8	1343·3
" 5.57 " ..	1335·0	1205·1
" 6.57 " ..	1250·4	1093·2
" 7.57 " ..	1216·4	1158·1
" 9.57 " ..	1256·4	1329·7
" 12.57 p.m. ..	1268·8	1179·9
" 1.57 " ..	1296·7	1206·0
" 2.57 " ..	1313·9	1177·3

Calling 1 lb. of wood equal to ·24 lb. of coal in heating effect, the total equivalent weight of coal used is 70 + 18,021·5 = 18,091·5 lb. The percentage of ash is 14·74, while as shown from the analysis made it is 14·52 per cent. The heat-giving power of the fuel is determined as follows:—There being 75·52 per cent. of carbon, and 2·18 per cent. of hydrogen exclusive of water, the equivalent percentage of carbon is 75·52 + 4·28 × 2·18 = 84·85 per cent., and the amount of carbon equivalent to the 18,091·5 lb. of coal is ·8485 × 18,091·5 = 15,350·64 lb. of carbon. To change 1 lb. of water at 71·6 deg. F. to steam at 341·32 deg. F. requires 1186·04 − 39·6 = 1146 44 heat units. As it takes 966·07 heat units to change 1 lb. of water at 212 deg. F. to steam at 212, 1 lb. of water from 71·6 deg. to 1 lb. of steam at 341·32 deg. requires the same amount of heat as 1·1867 lb. from and at 212 deg.

Pounds of water evaporated per hour under the conditions	= 3748·26
Pounds of water evaporated per hour from and at 212 deg. F.	= 4448·0
Pounds of coal used per hour	= 468·87
Equivalent pounds of carbon used per hour	= 426·41
Horse-power of boiler (on the basis of 30 lb. of water from and at 212 deg. per horse-power)	= 148·27
Pounds of water evaporated per pound of coal under the conditions	= 7·9942
Pounds of water evaporated per pound of coal from and at 212 deg.	= 9·4866
Pounds of water evaporated per equivalent pound of carbon under the conditions	= 8·7903
Pounds of water evaporated per equivalent pound of carbon from and at 212 deg. F.	= 10·4313
Amount of air used in furnace per pound of coal $= \frac{16·83}{·7552}$	= 22·29 lb.

(*To be continued.*)

GUNNERY EXPERIMENTS.—The authorities of the War Department desire to have it known that the damage done to a gun during the recent experiments with high explosives at Lydd was due to no fault of the gun, but to the explosion inside the bore of a shell charged with the most violent of all explosive agents—blasting gelatine. The object of the experiments was to ascertain how far the tendency of such like varieties of the nitro-glycerine series to detonate on slight provocation could be brought under control, it being very desirable, if practicable, to use something more powerful than gunpowder for shell charges. The dangerous compounds were therefore packed and padded as carefully as possible in their shells, in the hope of overcoming or reducing the concussion of discharge when the gun was fired; but it was known that premature bursts were likely to occur at any moment, and it was also known that if one of the shells burst within the gun, however strong the gun might be, the gun must "go." So far as the results are allowed to transpire, it may be inferred that very few of the shells remained intact until they reached the target. Several broke up after leaving the muzzle, and one charged, as aforesaid, with blasting gelatine, burst inside, with the natural consequence of destruction to the gun. As the experimental committee have been congratulated on the absence of accidents, it may also be said that in all such hazardous investigation they keep well under cover and fire the guns by electricity. For some time past it has been the practice at Woolwich Arsenal to try test tubes of steel, an inch or so in diameter, to prove the quality of the metal, the artillerists being in want of a lining for their guns which shall resist the erosive action of the powder and projectiles, and some of these have failed at proof. This, also, has given rise to a report that guns have burst at the proof butts, and this report the authorities wish likewise to correct by this explanation.

DEATH OF COLONEL YOLLAND.—The death is announced of Colonel William Yolland, C.B., F.R.S. The deceased officer, who was born in 1810, was admitted into the Royal Academy at Woolwich, where he obtained his commission in the Royal Engineers in 1828. He rose by regular promotion until he became lieutenant-colonel in 1855, and he became a brevet colonel in the army in 1858. After being employed in Canada till 1835, he was employed successively at the Ordnance Survey at the Tower of London, at Southampton, Dublin, and Enniskillen. During this interval he superintended the publication of astronomical observations, first those made with Ramsden's zenith sector, and afterwards with Airy's, the latter observations being for the purpose of determining the latitudes of various trigonometrical stations in Great Britain and Ireland. He also compiled an account of the measurement of the Loch Foyle base, which was made during the years 1827-29. The article on Geodesy, which forms part of the mathematical text-book used at the Royal Military College, was written by Colonel Yolland at the express request of Colonel Harness, who was at that time Assistant Inspector-General of Fortifications. In 1854 Colonel Yolland was appointed one of the Inspectors of Railways under the Board of Trade. In 1856 he was selected as the engineer member of the Commission appointed by the Secretary of State for War to consider the best mode of re-organising the system of training officers of the scientific corps, with the special intention of abolishing patronage and opening the commissions in those corps to competition. The Commissioners, the other two of whom were Colonel W. J. Smith, R.A., and the Rev. W. C. Lake, visited France, Prussia, Austria, and Sardinia, and after studying the methods of appointment in use in those countries, drew up a report, which was printed by order of the House of Commons, Colonel Yolland died on Friday last at Baddesley Vicarage, Atherstone, Warwickshire. For many years Colonel Yolland's name has been frequently before the public in reports on railway accidents.

LETTERS TO THE EDITOR.

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

HAMMERSMITH BRIDGE.

SIR,—In your paragraph you seem to forget the fact that the traffic, both foot and horse, had all to go through the 12ft. wide arches of the towers, as the footpaths were not carried round the outside.

Now there is a good roadway for double line of traffic and a wide footpath as well. If stupids chose, against regulation, to cross the road, climb on the kerb and railings, and stick themselves in the way of danger, the man himself is alone to blame; at least the contractors have no option. JOHN DIXON.

1, Laurence Pountney-hill, Cannon-street,
London, September 7th.

THE ANTWERP EXHIBITION AWARDS.

SIR,—Observing in last week's issue the mention of "important exhibits of driving belts at Antwerp," pardon us for reminding you that the display of Lancashire patent belts made by our continental house in the Belgian section, and which was awarded a gold medal, included, amongst several large main belts, one of 5ft. 7in. width, composed of an ordinary Lancashire belt equal to triple leather before strengthening at sides and centres by means of three 10in. wide belts copper rivetted thereto, in same manner as our double belts. This belt is calculated for 2000-horse power.

Lancashire Patent Belting and Hose SAM. J. M'MECHAN.
Company, Manchester, September 2nd.

THE DEVELOPMENT OF PATENTS.

SIR,—If the suggestions of "R. H. N." could be carried out it certainly would prove very profitable to the promoters, and be helpful in bringing before the public many valuable inventions. It is a well-known fact that the reasonable charges, together with the recognised liberality of American engineering firms, has materially helped to place that country in the front rank as scientific engineers. If inventors could depend on meeting with honourable treatment at the hands of such a company, many would gladly avail themselves of its aid. Take my own case. Twenty years ago I advocated compressed air as a motive power, and got laughed at. The result was I set to work, and after seven years' study I succeeded in making one, which, with the egotism of an inventor, I consider to be still in advance of that class of engines; but money difficulties then and now prevent me introducing it. I have designed various other mechanical appliances, the principal being an electrical generator—dynamo—with new form of armature, a rock-boring machine, and a marine hot-air engine on an entirely new principle, from 5 to 50-horse power, for yachts, launches, and torpedo boats, the working expenses being from 5s. to 15s. per week of 168 hours, and the space occupied being about the same as a steam engine without the boilers.

I simply quote the above to show that "R. H. N.'s" statements are correct, and, though I may never benefit by it, I trust for the sake of others that a company may be formed to assist inventors both in perfecting and in introducing their inventions when likely to be of value to the nation. J. E. A.

London, September 3rd.

THE DEVELOPMENT OF INVENTIONS.

SIR,—I note a letter from "R. H. N." in your issue of the 28th ult. on the above subject. Just before the new Act on patents came into force a company here advertised that they would assist inventors. I called on them to make inquiries, when I found I had to pay fees similar to those charged by experienced patent agents; but if one required the needful to complete a model drawing, &c., he must help himself. There is a party in London who advertise that they will give professional and financial assistance. On inquiry it was not to my liking. There is also a patent agent in London who has it on his circulars of patent agency charges that he will give professional and financial assistance; but on submitting drawings to him the financial part was declined, on the ground of insufficient merit. Since then the efficiency of the article has been proved on two distinct occasions. I explained my idea of "assistance to poor inventors" to the company here, but they could not see it. I fancy it was because they were poor themselves. My idea of the subject is that a company could be formed for the assistance of poor inventors on the principle of fire, life, accidental, and security associations. Its leading members, directors or committee, and secretary, should be patent agents, mechanical engineers, and other experienced persons, and, if a private company, a few monied shareholders. Supposing a company was formed, and a poor inventor applied for assistance, he would be supplied with a copy of the rules, regulations, conditions, and form of application. He would fill in the form and submit his model or drawings. If, after examination by the sub-committee, they were not accepted, they would be returned to the applicant with the particulars of refusal, viz., "The like is now in the market"—if possible say by whom and where—"it is impracticable as submitted, requiring alterations"—state where—and submit it again, with other objections, &c., as they may arise. If the application was accepted, the company would provisionally protect it and advance a few pounds for making or completing the article full size, circulars, &c. In some instances, perhaps, only £10 or £15 would be required; in others a much larger sum. In some cases they would also have to complete the patent for the three years. The security to the company would be the holding of the patent documents, so that all business, such as royalty and the sale of the patent, would pass through their office for the security of their fees, commission, &c. I had a policy in a fire-office for £500—premium 17s. 6d.—on dangerous property; and if a company can afford to risk £500 against 17s. 6d. for twelve months, and pay a good dividend, surely a company could be formed for assisting the "poor inventor" with advice and a few pounds against a commission or percentage on the sale of the patent or royalty, which in some cases would be a large sum; in others perhaps only paying expenses; and again, it might be a failure—the article might be good, but the public may not appreciate it. The application being accepted, the cost would be, supposing the company stood the whole cost: Provisional protection, £4 4s.; cash assistance, say, £21; completion of patent for three years, £10 10s.; total, say, £36. Say the article sold for £500; commission—10 per cent.—£50, leaving a profit, after paying office charges in full, of about 40 per cent. Of course the expenses would vary, and so would the commission. In advancing the cash, and as security against fraud, the company would issue a form stating on it the amount they would advance. The applicant would take this with a loose form for agreement to his model-maker, machinist, or other party, who would fill in the form and return it to the company. The machinist would then draw the cash on completion of the work direct from the company. A list of patents for sale would be exposed at the company's office. I have tried to give you an outline of my ideas, however imperfectly, and hope it will be found admissible in your valuable columns, and that "R. H. N." and your subscribers will discuss its merits, and that a company will soon be formed with agencies in all large towns. W. S.

Manchester, September 7th.

UNIVERSITY COLLEGE, LONDON.—The Gilchrist (entrance) Engineering Scholarship at the college is open for public competition on the 28th September and following days. The scholarship is of the value of £35 per annum for two years, and candidates must be under nineteen years of age on 1st October. The subjects are mathematics, mechanical drawing, use of tools, &c.; several of them being optional. Full particulars can be obtained on application to the secretary of the college, Gower-street, W.C.

EXPLOSIVE GASEOUS MIXTURES.*

THE following is an abstract of a paper by Messrs. Berthelot and Vieille, published in the *Annales Chimie et de Physique*, sixth series, vol. iv., 1885, pp. 13-90. It is one of much importance as bearing on the theory of gas engines, and will be read with interest:—

"These experiments were made to determine the pressure developed and the heat generated by the explosion of various gaseous mixtures in closed vessels. Tables of results are given, and from them the authors deduce the limits of temperatures of combustion, dissociation, and the specific heats of the gases at very high temperatures. The results, methods of experiment, and calculation are discussed in eight papers.

1st. *On the calculation of the temperatures of combustion, the specific heats, and dissociation of explosive mixtures.*—This paper is the continuation of a memoir by Mr. Berthelot in 1877, and contains a theoretical consideration of the principles which have guided the authors in these investigations. Given the pressure P developed by the explosion of a gaseous mixture, the temperature of combustion is determined by the method of limits. In the case of no dissociation, a limit above or equal to the real temperature of combustion is given by the formula

$$t_1=273\left(\frac{P}{H}\frac{1}{g}-1\right),$$

where H is the initial pressure at 0 deg., and g is the ratio of the volume occupied by the burnt products completely combined to that of the same bodies entirely dissociated. If the initial temperature be above zero, say T, then $P\left(1+\frac{T}{273}\right)$ is used instead of P in this formula, which is deduced from the laws of Mariotte and Gay-Lussac. When there is complete dissociation and none of the products really combined, another limit t_2, below the temperature of combustion, is found from the equation

$$t_2=273\left(\frac{P}{H}-1\right).$$

The real temperature of combustion lies between these limits t_1 and t_2, which are brought much closer by the presence in the mixture of inert gases, such as nitrogen—in the case of combustion by means of air. Two sorts of systems are considered. Reversible systems where the compounds formed by combustion can, by dissociation, be split up into the original components; such are CO_2 forming CO and O, and water-vapour giving H and O. In non-reversible systems dissociation does not produce the original components. Thus a mixture of cyanogen and oxygen, on complete combustion, yields CO_2 and N, while dissociation tends to produce O and CO or even free carbon. Knowing Q the quantity of heat generated by complete combustion at constant volume, another limit t_4, intermediate between the preceding ones, is calculated for reversible and a few non-reversible systems. The mean of t_1 and t_4 gives a close approximation to T, the temperature of combustion. Then the total heat Q divided by the values t_1, t_2, t_4, T, gives a set of corresponding limiting values c_1, c_2, c_4, C, of the apparent specific heats of the system at constant volume between 0 deg. and T. The apparent specific heat includes the specific heat properly so-called, and the heat given up by the re-combination of the dissociated components. The mean value C of c_1 and c_4 represents the specific heat. This applies to such gases as CO_2 and water-vapour, even when mixed with inert gases, like N, or with hydrocarbons. Thus values of the specific heat at constant volume of different systems are deduced for temperatures ranging between 1700 deg. and 5000 deg. on the air thermometer. When two elementary gases combine at constant volume without condensation, the ratio of the effective temperature t, to the temperature T which would be produced by complete combustion—that is, t_1 T—gives the ratio of the volume of the portion really combined to the total volume, and hence determines the dissociation. Special stress is laid on the results obtained from a group of isomeric mixtures, *i.e.*, mixtures which contain the same elements in different states of combination, but all yielding an identical mixture after combustion.

2nd. *Experimental determination of the pressures developed in gaseous explosive mixtures at the moment of explosion.*—The pressures have been obtained by exploding the gaseous mixtures in spherical vessels, and registering on a revolving cylinder the law of the displacement of a piston of known section and mass. Complete data of two experiments are given with readings taken off the curves at given intervals of time during each experiment. The cooling effect of the walls of the vessels is observed by exploding the same mixture in vessels of different capacities. The results are fairly concordant with those obtained by Messrs. Bunsen, Mallard, and Le Chatelier by entirely different methods, so far as the latter extended. The authors have made numerous experiments with forty-two different mixtures of H, O, N, CO, CH_4, NO, cyanogen, ether, &c., and the pressures are recorded.

3rd. *Relative rates of combustion of different gaseous mixtures.*—Three explosion vessels of different capacities and shapes were employed. The maximum pressure observed when a mixture of gases is exploded in a vessel at constant volume is always less than if the system retained all the heat generated by combustion, the loss of heat being due to contact with the walls of the vessel and to radiation. This difference is greater the smaller the explosive vessel or the smaller the mass of gas with respect to the vessel, and it is also greater the slower the rate of combustion. The time required for the development of the maximum pressure is generally longer the larger the explosive chamber, and the greater the distance between the piston and the point of ignition. CO is slower than H; but for cyanogen and hydrocarbons rich in H the time is about the same as for H alone, and agrees with the calculated velocities of the explosive waves. The velocity of translation of the molecules governs the phenomenon. Assuming that the flame reaches the piston at the moment of maximum pressure, the absolute rate of combustion is about 100 metres per second for hydrogen, 8 metres for carbon monoxide, and 70 metres for cyanogen. This is diminished by an excess of one of the combustible gases, and even more so by the presence of the burnt products. An inert gas like N retards combustion not only by lowering the temperature, and thus diminishing the velocity of the molecules, but also by preventing contact between the molecules which act on one another. With a mixture of carbonic oxide and hydrogen in oxygen, each gas appears to burn separately at its own rate, the hydrogen burning before the carbon, and consequently the maximum pressure observed does not correspond with a uniform state of combustion of the system.

4th. *Influence of the density of explosive gaseous mixtures on the pressure.*—If, in a gaseous system to which heat is communicated, the pressures vary in the same ratio as the densities, it follows, independently of all hypotheses on the laws of gases (1), that the specific heat of the system is independent of its density—that is, of the initial pressure—and depends solely on the absolute temperature; (2) that the relative variations of the pressures at constant volume, produced by heat given to the system, is also independent of the pressure and is a function of the temperature alone. In fact, the pressure itself varies directly as the absolute temperature, and, according to the theory of perfect gases, serves to determine it. The authors overcame the difficulties attending direct measurements at high temperatures by two methods. One consisted in using a vessel, one part of which was maintained at the ordinary temperature in the air, and the other heated in an oil bath to about 153 deg., which reduced the density of the gas about a third. The second and more exact method consisted in experimenting on isomeric mixtures. From numerous experiments with isomeric mixtures, under different conditions as to density and heat generated, the observed results confirm the ordinary laws of gases. The authors conclude that for temperatures up to 3000 deg. or 4000 deg. on the air ther-

* "Proc." Inst. C.E.

mometer—(1) When a given quantity of heat is communicated to a gaseous system, the variation in the pressure of the system is proportional to its density; (2) the specific heat of gases is sensibly independent of the density at very high temperatures as well as at zero; (3) the pressure increases with the quantity of heat given to the system; (4) the apparent specific heat increases with this quantity of heat.

5th. Temperatures and specific heats calculated from the experimental results.—These are calculated by the methods described in the first paper, from the pressure P developed during the explosion, and the total quantity of heat Q generated by the complete combustion of the gaseous mixtures. The mixtures are arranged in four groups, and two tables are given for each group, containing the values obtained for the temperatures and specific heats.

6th. Specific heat of the elementary gases at very high temperatures.—The authors agree with Messrs. Mallard and Le Chatelier in the general conclusion that the specific heat of gases increases with the rise of temperature, and that the simple gases have sensibly the same specific heat at all temperatures. By supposing the increase to be proportional to the temperature between 2800 deg. and 4400 deg., the authors deduce from their experiments the empirical formula $C = 6{\cdot}7 + 0{\cdot}0016\,(t - 2800)$, which gives the specific molecular heat at constant volume of nitrogen, hydrogen, oxygen, and carbonic oxide. Between 0 deg. and 200 deg. the specific molecular heats at constant volume of these gases are about 4·8, and the authors find this number doubled in passing from 0 deg. to 4500 deg., becoming 9·8. The variation takes place at all temperatures; it is inappreciable from 0 deg. to 200 deg., but increases rapidly at high temperatures. The law of increase of the mean specific heat above 1600 deg. is expressed by the formula $4{\cdot}75 + 0{\cdot}0016\,(t - 1600)$. The real specific heat at constant volume, *i.e.*, the quantity of heat necessary to change the temperature 1 deg., is calculated by the formula $4{\cdot}75 + 0{\cdot}0032\,(t - 1600)$ for the elementary gases at temperatures from 1600 deg. upwards. The specific molecular heat at constant volume of chlorine is greater than that of the simple gases, being 6·6 between 0 deg. and 200 deg.; also at 1800 deg. the mean specific heat of hydrogen is 5·1, whilst that of chlorine is 15·3, thus approaching that of carbonic acid, which is about 18.

7th. Specific heats of steam and carbonic acid at very high temperatures.—The mean specific heat of steam at constant volume deduced by the authors from their experiments may be expressed by the formula $16{\cdot}2 + 0{\cdot}0019\,(t - 2000)$, where t is from 2000 deg. to 4000 deg. The mean specific heat of steam at constant volume between 130 deg. and 230 deg. being 6·65, it is doubled at 2000 deg. and trebled at 4000 deg. The heat of formation of water continually diminishes as the temperature rises. This is partly due to the heat spent in the work of molecular separation without decomposition, and partly to the heat absorbed in decomposition or dissociation. About 3000 deg. dissociation would absorb at most 6600 calories—that is, one-seventh of the heat of combustion—whilst molecular separation would absorb at least 8600 calories, or about one-fifth of the heat of combustion at this temperature. These numbers are given with all reserve. The mean specific heat of carbonic acid at constant volume between 0 deg. and t is given by the formula $19{\cdot}1 + 0{\cdot}0015\,(t - 2000)$, where t is from 2000 to 4300. As in the case of water, the results show that the heat of combustion of CO to form CO_2 diminishes with the temperature above 200 deg. The authors calculate that at about 4500 deg. the heat of combustion would be 28,000 calories, and dissociation would absorb at most 18,000 calories—that is, about two-thirds of the heat—whilst at least 22,000 calories of the heat is absorbed by intra-molecular transformation. Comparing the heat of combustion of H_2O and CO_2 at 0 deg., they are almost equal, being 58,700 calories and 68,000 calories respectively, whilst at 3000 deg. they become 26,000 and 38,000. Thus their ratio decreases as the temperature increases, and at very high temperatures the carbon tends to entirely decompose the steam.

8th. Scales of temperatures and molecular weights.—The results of the previous papers are considered. Two air thermometers are compared, the scale of temperatures of one being determined by the dilatations of volume at constant pressure, or by variations of pressure at constant volume, whilst the scale on the other is determined by the quantities of heat absorbed. At very high temperatures these differ widely from one another, and from similar chlorine or iodine thermometers, owing to the variations in the specific molecular heats which, especially in the case of chlorine, would point to changes in the ultimate molecular constitution of substances hitherto regarded as elementary."

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, August 28th.

The gatherers of commercial statistics are reporting a gradual improvement from week to week in the volume of business transacted by railways and by merchants in interior and Atlantic coast markets. There is a decided improvement to note, but it lacks the evidences of permanency. Negotiations are pending between railroad builders and bankers for funds to construct some 2000 miles of road. Rail makers have orders offered them for large lots of rails, but the terms of payment are not satisfactory in many cases. It is uncertain at present whether much construction will be undertaken this autumn. A large amount of building will be done in small lots of from five to twenty miles long, to develope traffic for trunk lines and other long lines. The effort of the Pennsylvania Company to purchase the franchises of the South Pennsylvania line will be contested by the smaller stockholders, and the sale will be, if possible, set aside, as it is in violation of the State Railway Constitution, which forbids any railway company from purchasing or controlling competing lines. During the past week the announcement of projected roads has been made in Pennsylvania, New York, and Ohio.

Four blast furnaces are to be built in Tennessee and Alabama, where the cost of pig iron making ranges from 10 to 11 dols. per ton. Special freight rates will be, if possible, secured, in order to deliver pig iron at Ohio River markets in competition with furnaces now supplying those markets. A vigorous effort will be made by the owners of Southern furnaces and Southern mineral properties to develope a pig iron traffic which will crowd out Pennsylvania and Ohio irons, now almost exclusively used.

The rail makers have not succeeded in advancing prices, but there are numerous inquiries on the market for early and late delivery. A few orders are being placed for Bessemer, spiegeleisen, and Scotch irons. Stocks are light, but buyers refuse to purchase for more than the most pressing requirements. Confidence does not exist in the permanency of prices, even at their present low limit. The possibility of failures in the iron trade is quietly talked of, because of the fact that a large amount of iron is being sold at cost, and in some cases below it, for sake of cash.

The bridge builders are peculiarly fortunate, and all that are working in the State are well supplied with orders. The bar mills throughout Pennsylvania are only partially employed. An improvement is reported at Pittsburgh, and several mills have resumed double turn. All the pipe and plate mills there are busy. In Eastern Ohio labour difficulties have been settled, and mills are at work. Along the Ohio valley, Cincinnati, Louisville, Portsmouth, and Ironton, iron makers are securing more orders, and report prospects favourable for a steady run. At St. Louis, Jolliet, Chicago, and Milwaukee the mills have within ten days received orders enough to run them steady for thirty days or six weeks. The copper market is without special feature. The production is heavy, and the exports continue large. The tin market is without any particular change. Building requirements are absorbing large quantities of sheet iron. The canning industry has recovered from last year's depression, and the manufacturers of canning materials are crowded with orders.

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

(*From our own Correspondent.*)

The stronger tone which was manifested last week was maintained on 'Change in Birmingham to-day—Thursday—and in Wolverhampton yesterday. Sellers were not prepared to give way in the firmer position which they have recently taken up. Pressure was brought to bear by some consumers, but without much success. It would, however, be incorrect to assume that all materials offered were worth more money. The stronger tone was mostly confined to Midland brands of pigs and to sheets.

A few finished ironmasters spoke of having more orders by some 25 per cent. than, say, six weeks ago; but these firms were the exception. Consumers of sheets were somewhat anxious to book forward at recent rates, but makers were indisposed to accept such contracts. They again demanded an advance of from 2s. 6d. to 5s. per ton, which makes 24 gauge for galvanisers' uses £7 2s. 6d. to £7 5s. per ton.

Upon orders already in hand the sheet makers are kept well going. Galvanisers' sheets are being well inquired after at £6 15s. per ton for singles. The demand for the galvanised material keeps large, the colonial and South American orders being of good extent. The declared advance of 5s. per ton is maintained.

One of the best pieces of good fortune which has occurred to trade in this district for a long time past is the purchase this week by Messrs. John Lysaght, galvanisers, Bristol and Wolverhampton, of the extensive works of the Osier Bed Iron Company, Wolverhampton, which has been standing idle since June of last year. The plant comprises three tin mills, four sheet mills, one plate mill, twenty-four puddling furnaces, and two ball furnaces. Three of the sheet mills and twelve puddling furnaces will be started immediately, and before long it is hoped that six or seven sheet mills will be running, which will give employment to at least 400 hands, who will receive some £600 per week in wages. The sale price has not been allowed to transpire.

For many months Messrs. Lysaght have been keeping in full swing the Swan Garden Ironworks, Wolverhampton, where eleven sheet mills are running, employing some 700 hands, who draw in wages £1200 a week. The new works will be run as an addition to this establishment.

Marked bars are in slightly better request, and for the medium and common sorts of bar iron there are more inquiries. £7 10s. still rules as the official price for marked bars, £6 10s. for second-class qualities, and £6 down to £5 10s. for inferior makes.

The view is by no means general, but in a few circles the opinion is finding expression that if the revival continues and progresses marked bars will at the quarterly meetings next month be officially advanced 10s. per ton. For more than 2½ years they have been stationary at £7 10s., with £8 2s. 6d. as the Earl of Dudley's quotations.

In the memory of most of the elderly Staffordshire ironmasters marked bars have been £8 and upwards eight times since 1836, when record shows them to have been £11 5s., and nine times less than £8. The lowest price recorded was in 1843, when they were £5, and the highest in 1872-3, when they were £16.

Several good foreign orders are on hand for hoops, which are now quoted £6 10s. downwards to £5 10s. per ton.

Gas tube strip is £5 7s. 6d. per ton. Some strip and hoop makers are obtaining 1s. 3d. per ton advance upon the late minimum, and are in hopes of getting a further 1s. 3d. on in a week or two's time.

Shropshire wire rod makers asked an advance this—Thursday—afternoon of 2s. 6d. per ton for forward contracts, but were not generally successful. If such a rise were established, rolled wire rods, Nos. 0 to 5, would become £6 2s. 6d. Liverpool; No. 6, £6 12s. 6d.; and drawn rods, Nos. 0 to 6, £9 5s. Liverpool.

It is a gratifying indication of improvement in the native pig iron trade that one of the Earl of Dudley's three blast furnaces at Coneygre, which have been blown out for a considerable period, is now again about to be re-lighted to make best Staffordshire pig. The prices of native pig stand at—All-mines, 59s. to 60s.; part-mines, 40s. to 45s.; and cinder, 33s. to 35s. Somewhat increased sales of native pig have taken place, and makers now hold firmly to the ruling rates, and look forward to being able to obtain better prices for some of the material they have in stock.

Derbyshire and Northampton pigs are being fairly well sought after, the former brands being quoted at the 1s. advance noted last week, making them 39s. to 40s. delivered to stations in this district. Lincolnshires are 41s. 6d. The Westbury, Wilts, brand is altogether withdrawn from the market, since the makers will not book orders at current rates.

In North Staffordshire purchasers of finished iron are showing a greater wish to buy for forward delivery. Some very fair quantities have been booked, and as most merchants' stocks are low, specifications on account of the same are likely to be sent out to makers at once. The export trade is not showing much improvement. Most of the works are making about four days a week.

Prices are a little firmer. Messrs. Heath and Sons quote, delivered Liverpool or equal, flats from 1in. by ¼in. to 6in. by 1in., and rounds and squares ½in. to 3in., £5 15s.; best, £6 5s.; and double best, £7 5s. Best grooved shoe iron from 1in., best turning bars to 3in. diameter, and angles from 1in. by 1in. by ¼in. to 9 united inches, and tees to 8in., all £6 5s.; best angle and tee iron, £6 15s.; and double best, £7 15s. Ravensdale best hoops of 1in. to 5in., £6 15s.; and best waved hoops, 1⅛in. to 16 w.g., £7. Best rivetted iron, from 9/16in., is quoted £8 5s., and plates are as follows:—Bridge or tank sorts or tank sheets not thinner than 13 w.g., £7; best boiler, £7 10s.; double best, £8 10s.; and treble best, £10 10s.

The South Staffordshire miners are again moving upon the wages question, though not much is likely to come of it. At a meeting of their representatives, just held at Brierley Hill, the following resolution was passed:—"That this meeting agrees to be represented at the conference to be held at Nottingham on the 24th inst., so that united action can be adopted on purpose to obtain a 15 per cent. advance on wages."

The cable chain makers in the Cradley Heath and Old Hill districts have, after a strike lasting over fourteen weeks against reductions ranging from 20 to 30 per cent., resumed work. Several weeks ago the principal masters agreed to pay the list demanded; but the smaller employers declined the concession, and their workmen who remained out on strike resumed work on Tuesday at the advanced rates.

Considerable opposition was expressed towards the employment of female labour by members of the Amalgamated Association of Chainmakers at a general meeting on Thursday last. It was stated that several members of Parliament had been written to, and that replies had been received expressing surprise at the state of things, and intimating the willingness of the writers to co-operate with the trade societies in putting a stop to the system.

The determination of the nail makers of South Staffordshire and East Worcestershire to embark upon a general strike is assuming a more serious aspect. A meeting of operatives has just been held, and a resolution was passed giving the employers fourteen days' notice for the 1879 list. As nearly 20,000 hands of one sort and another are concerned in the movement, a strike is not to be lightly thought of.

In the hardware trades colonial orders keep brisk, and the Indian Empire is proving a good buyer of miscellaneous hardware. South American orders are irregular, but mount up to a respectable total. In none of the lighter industries are stock orders of much size being received from home customers. Purchasers seem to be still determined to rely upon manufacturers' capabilities to supply goods to any quantity upon the shortest notice.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The recent suddenly-increased activity in the iron trade has kept the market in a generally animated condition during the past week, and there has been a good deal of inquiry with a large weight of actual buying. There is, however, no general feeling of confidence that the enlarged volume of business that has been done represents an actually established improvement in trade; the absence of any really increased trade coming into the hands of users of iron is an element of weakness which gives a doubtful character to the activity at present prevailing in the market, and whilst makers on the one hand are disinclined to commit themselves to large sales for forward delivery, buyers are not disposed to pay any very material advance upon late rates to secure the acceptance of orders. The sales made during the last few days have brought sufficient work into the hands of makers so that for the next month or two they are under no necessity to seek further orders, and they seem disposed to wait the further development of the market, whilst buyers, as a rule, are not anxious to go beyond the purchases they have already made unless they can do so at something like old rates. A decidedly stronger tone has, however, undoubtedly been established in the market; where buyers a short time back were altogether indifferent about giving out orders, business is readily to be done at an advance of fully 6d. to 1s. per ton upon the prices which but a week or two since were only being got with difficulty, and whether the increased weight of business which has been coming forward in the market be simply a temporary spurt or not, it is scarcely probable that prices will return to the lowest point at which they stood prior to the upward movement.

The Manchester iron market on Tuesday brought together a full average attendance, and inquiries were numerous both for pig and manufactured iron. Following upon tolerably heavy sales, chiefly of forge qualities made during the previous few days, makers of pig iron were asking advanced prices, and generally were indifferent about selling further to any large extent. For Lancashire pig iron makers were asking an advance of 6d. per ton upon late rates, the minimum quotations for delivery equal to Manchester being now 38s. 6d. to 39s. per ton less 2½, whilst in district brands it was difficult to place orders except an advance of 1s. to 1s. 6d. per ton upon the recent lowest prices, 39s. to 39s. 6d., less 2½, for Lincolnshire iron delivered here, being the average selling prices. In one or two instances makers were asking advanced prices that were practically out of the market, or had withdrawn their quotations altogether. Outside brands were also higher in price, both Scotch and Middlesbrough makers asking advances of quite 1s. per ton upon the rates of last week. It can scarcely be said, however, that there was any great eagerness to buy at the advanced prices asked by makers of pig iron, and the actual business done in the market was not of any very great weight.

In hematites, except that the very low prices which sellers in some instances have recently been open to take seem to have disappeared from the market, there is no very material change to report.

Following the upward movement in pig iron there has naturally been an increased inquiry for manufactured iron, and there has been a fairly large amount of business offering. Here and there, where makers are getting their order books filled up, they are holding out for a little above the lowest prices that have recently been taken, and the tendency is upward, but as yet there has been no general advance upon the basis of £5 5s. per ton for Lancashire and North Staffordshire bars delivered into the Manchester district.

The condition of the engineering trades remains without material change, except that the recent improvement in the iron market has a tendency to create a rather more hopeful feeling.

Messrs. Hetherington and Co., of Manchester, have secured a contract for the erection of twenty large overhead travelling cranes that are to be put up in the new workshops that are being built by the Lancashire and Yorkshire Railway Company at Horwich.

A large range of new workshops and warehouses has just been completed by Messrs. Marsden and Son, of Manchester, for their old-established trade of nut and bolt manufacturers. These works, which are probably the largest of their kind in Lancashire, occupy a covered ground area of 5000 square yards, and are so arranged that the raw material is received in on one side of the workshops, and is thence passed on through its successive stages of manufacture until it is finally delivered either into stock in the warehouse or on to the loading ways on the opposite side of the building. Throughout the works are fitted up with the most modern plant of special machinery, nearly the whole of which has been designed and patented by the firm. In the forging department the special plant for nut making includes a machine which turns out small square nuts forged and ready for tapping at the rate of two per second, and another hexagon nut-making machine for large sizes, which is capable of turning out from 3 to 5 tons per week, according to the class of work. For bolt making there is also a specially-designed plant, which includes a very large machine, weighing about 12 tons, for manufacturing bolts from 1in. to 1½in. diameter out of the solid bar at the same heat, and another machine for smaller sizes, which is capable of turning out as many as twenty-five gross per day. In the nut and bolt-making department alone there are nearly forty special machines, in addition to which there is a large plant of shearing and other machines and a completely fitted up mechanic's shop for keeping in order the plant in use in the works, and also for the manufacture of some of the smaller class of machines. The whole of the machinery is driven by a pair of compound horizontal engines of 400 indicated horse-power, which were made as a sample pair of engines by Messrs. Buckley and Taylor, of Oldham, and shown at the Oldham Textile Industrial Exhibition in 1883, where they were employed to drive the machinery throughout the building. The output of the works when in full operation is about 50 tons of bolts, nuts, &c., per week, whilst in the extensive warehouses occupying three floors 250ft. by 50ft. wide, a stock of about 800 tons is kept constantly on hand.

Messrs. Vaughan and Son, of West Gorton, have just completed an extension of their works by the erection of a new shop 120ft. long by 35ft. wide, with a gallery running along one side and fitted up with special plant for the manufacture of their patent steam traps, sight-feed lubricators, and split pulleys, together with various descriptions of millwright and brasswork. I may add that in their split pulleys Messrs. Vaughan have introduced a special feature that they make the rims and arms either of Bessemer steel or wrought iron, as desired, the bosses being manufactured of cast iron.

In the coal trade there is still an absence of any improvement beyond what is to be found in the increasing demand for the better qualities of round coal, as the usual orders for winter requirements gradually come upon the market. Common round coals, except that good hard qualities suitable for locomotive purposes seem to be inquired for just now in considerable quantities by some of the railway companies, still meet with only a very slow sale for iron-making and steam purposes, and engine classes of fuel continue only in very moderate demand. The bulk of the collieries in the Lancashire district are still not working more than an average of about four days a week, and prices remain without material change. At the pit mouth house fire coal still averages 8s. to 8s. 6d. for best, and 6s. 6d. to 7s. for second qualities, the only improvement being that there is less pushing at under quoted rates. Common round coals are quite as low as ever, and are bad to sell even at 5s. to 5s. 6d. per ton at the pit; burgy averages 4s. 3d. to 4s. 9d.; best qualities of slack, 3s. 6d. up to 4s. for some special sorts; and 2s. 6d. to 3s. per ton for ordinary qualities.

For shipment there is a moderate trade doing, but here and there complaints are made of extreme slackness, and it is only on an extremely low basis of prices that orders are got.

Barrow.—There is no change to note in the condition of the hematite pig iron of this district. Makers have not booked many orders lately, and it is evident that even with the reduced output of pig iron there is too much metal produced to meet the requirements of consumers. Deliveries are very limited, especially inland, but for the moment large deliveries are being made for shipping. This is usual at this time of the year, when foreign consumers are anxious to secure large consignments before the close of the shipping season. The demand for Bessemer descriptions of pig iron, which are the main feature of the production of this district, is exceedingly quiet, not only because of the paucity of the general demand, but because of the fact that makers of steel require such small supplies. The latter have a very limited number of orders in hand either for rails or merchant qualities of metal. The only two features of moment in connection with the steel trade are the production of a larger tonnage of tin-plates than have lately been manufactured here, and for which there is a fair market, and further, the development of a new branch of trade at the large steel works at Barrow in the shape of manufacturing steel nails from good scrap. The engineering works which were destroyed by fire at Barrow will, it is expected, soon be put in repair, and in the meantime the work will be carried on at the yards of Messrs. Caird and Purdie, of Messrs. Westay and Copeland, and at the Barrow Steel Works. By this means not only will the men temporarily thrown out of work be employed, but there will be no delay in the completion of the heavy engineering contracts which the Barrow Shipbuilding Company has entered into. Iron ore is in very quiet demand indeed. Coal and coke are in lessened consumption.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Board of Trade returns for August again disclose, under analysis, an increase of £140 in the exports of iron and steel as compared with the corresponding month of 1884, but a decrease of £1,999,883 for the eight months as compared with the first eight months of 1884. In coal and coke the values exported in August, 1884 and 1885, were respectively £982,945 and £998,713, an increase of £15,758. In pig iron the value fell from £264,849 to £183,279. Steel rails and railroad material of all sorts show a decided improvement, and bar, angle, and bolt iron a slight change for the better.

In steel rails the value has advanced from £202,617 in August, 1884, to £297,538 in August, 1885. The chief increasing markets are Sweden and Norway, from £15,612 to £16,261; British North America, from £15,212 to £50,473; British East Indies, from £19,911 to £129,624. Slight increases are also shown by Mexico, Chili, Peru, and British Possessions in South Africa, and other countries. The decreasing markets are Russia, from £3702 to *nil*; Spain and Canaries, from £8473 to £48; Italy, from £17,720 to £7045; the United States, from £6376 to *nil*; Brazil, from £20,393 to £16,827; Argentine Republic, from £38,709 to £21,563; and Australia, from £44,707 to £25,850. The increased business done with British North America and British East Indies is exceedingly gratifying, and if China should become open for railway enterprise, the rail trade will be anything but "played out."

In railroad material of all sorts the two markets already noted—British East Indies and British North America—are again the most important customers, the first having increased from £37,367 to £189,963, and the second from £17,139 to £51,664. Russia has dropped from £3702 to £72; Spain and Canaries, from £8518 to £609; Italy, from £17,720 to £8315; United States, from £6471 to £305; Brazil, from £24,469 to £20,230; Argentine Republic, from £67,664 to £30,545; Australasia, from £48,971 to £36,271. It may be noted that in August, 1883, the United States took a value in steel rails of £51,213, and in railroad of all sorts of £53,516. This shows a combined value of no less than £104,729; the combined value last month was £306, not a rail having been sent.

While these figures concern the whole country as well as the South Yorkshire district, the statistics of unwrought steel and hardware and cutlery are of special interest to Sheffield. In August, 1883, unwrought steel was exported to the value of £103,316; in August, 1884, £82,239; and last month, £80,248. France took in these periods £13,216, £8394, and £7974; the United States, £28,284, £17,488, and £17,808. Both markets, therefore, show an improvement, though slight, on the month. In hardware and cutlery—it is to be regretted the cutlery cannot be exhibited apart from the hardware—the values for August of 1883-4-5 are respectively £299,049, £246,418, and £224,073. The decreasing markets, comparing August of 1885 with corresponding month of 1884, are, Russia, from £4210 to £3142; Germany, from £15,314 to £11,830; Holland, from £9580 to £5997; Spain and Canaries, from £8700 to £4908; United States, from £27,372 to £23,542; Brazil, from £10,900 to £9338; British North America, from £12,134 to £9433. The following markets have increased:—France, from £9366 to £11,171; foreign West Indies, from £3261 to £4027; Argentine Republic, from £8022 to £8254; British Possessions in South Africa, from £5169 to £6366; British East Indies, from £19,536 to £21,176; Australasia, from £42,529 to £53,254.

September usually brings a slight advance in the prices of coal. This has been secured, as usual, by several colliery owners; but it is doubtful if it will be generally obtained before October. At the house pits an additional day is now being worked, and there is consequently less distress in the mining districts. The iron trade in this district has not yet felt any improvement such as is so freely reported from Wolverhampton. A firmer feeling, however, prevails in iron circles, and the confidence already noticed as prevalent among business men is deepening. In the lighter departments more cheering advices have been received from several markets at a distance. The country trade keeps quiet, with the exception of Ireland, where business is being resumed in many quarters which have long been all but closed against English goods. Saws, files, and similar articles are very languid; edge tools, artists' and carvers' tools, railway wheels, axles, &c., and certain classes of cutlery are in request. Silver and electro-plated productions keep in moderate demand, in spite of attractive novelties which are freely placed before the merchants. A few Christmas orders are now coming in.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

DURING last week a considerable amount of business was done in Cleveland pig iron at advanced prices, 32s. 3d. per ton being freely given by buyers for No. 3 g.m.b. At the market held at Middlesbrough on Tuesday there was a large attendance. Buyers did not, however, succeed in purchasing largely, as holders increased their prices, and would not sell freely either for prompt or forward delivery. A few sales were made early in the day of No. 3 g.m.b. at 33s. per ton, but at a later period it could not be had from merchants for less than 33s. 3d. per ton, or from makers under 33s. 6d. and even 34s. Forge iron is not more in demand, and there has been no change in price since last week.

A large quantity of iron is still going into Messrs. Connal and Co.'s store at Middlesbrough. On Monday last the stock was 81,702 tons, being an increase of 4340 tons for the week, and about 31,000 tons since the beginning of June.

Holders of warrants are reluctant to sell at present, and quote 34s. per ton as the lowest price they will accept.

Shipments of pig iron proceed at a satisfactory rate, 20,380 tons having been sent away between the 1st and the 8th of the month, as against 18,865 tons during the corresponding portion of August, and 15,163 tons in July.

There is no improvement in the finished iron trade; in fact, makers have great difficulty in getting specifications to keep their mills at work. Notwithstanding the advance in pig iron, the prices of manufactured iron are still unaltered. Ship plates can be bought at £4 15s. per ton at makers' makers, less 2½ per cent.; angles at £4 10s.; and common bars at £4 15s. to £4 17s. 6d.

The Darlington Steel Works are in operation this week, but the steel trade generally is very dull, especially in respect of rail orders. Steel plate and angle mills are fairly well employed, and prices are maintained at about £7 per ton for plates and £6 12s. 6d. for angles.

The Cleveland ironmasters' statistics for August, issued at the end of last week, show that ninety-five furnaces are now in blast, being two less than in July. The total quantity of pig iron of all kinds made in the district was 206,658 tons, being 4688 tons less than during the previous month. Makers' stocks decreased 10,753 tons so far as Middlesbrough is concerned, whilst outside Middlesbrough an increase of 3122 tons is reported. At Messrs. Connal and Co.'s store there was an increase during the month of 17,080 tons. The aggregate stocks in the whole district reached 430,208 tons, that being an increase of 14,194 tons over July.

The total value of exports from Middlesbrough last month—exclusive of coal and coke—was £197,802, being an increase, as compared with August, 1884, of £171,284. Newcastle exports last month amounted to £212,243, being a decrease of £56,715 compared with August last year.

The strike at Sir W. G. Armstrong, Mitchell, and Co.'s works proceeds apace. The men's committee meets daily to manage tactics, and to consider ways and means. Delegates have been sent off to various engineering centres to try to enlist the sympathies of other operatives and obtain subscriptions. Meanwhile the bulk of the strike hands wander listlessly about the streets of Newcastle, and loiter near the entrance to the works. What the employers are doing is naturally a question of deep interest to them, but one on which they do not succeed in obtaining much information. It is becoming clear, however, from various signs that fighting is intended to the bitter end. These signs may be formulated as follows, viz.: (1) The Iron Trade Employers' Association, a most powerful and wealthy body, have had a meeting whereat they passed a resolution approving the action of the firm, and agreeing to grant them moral and monetary support. (2) Agents of the firm have been seen in the various iron and engineering centres, no doubt with the object of engaging fresh hands to replace those on strike. (3) A certain number of these, variously estimated to number from 20 to 200, have already been introduced into the works; and although some half-dozen Scotchmen among them have been got at and persuaded to return on payment of their fares, the rest remain at work. (4) A large number of extra police have been imported into the town, and are located day and night in the neighbourhood of the works to prevent outrages by the strike hands. (5) A case of assault by two of the latter upon an apprentice and some policemen on Monday evening was brought before the Newcastle stipendiary the next morning, and promptly disposed of by a sentence of seven days' imprisonment in the one case, and twenty-eight days' hard labour in the other.

Indeed, everything goes to show that in dictating to their employers whom they should appoint as managers, and whom they should not, and in endeavouring to force their own views, the operatives have entered upon a course from which they will eventually be compelled to retreat with ignominy and loss. Everyone who knows intimately the distinguished man at the head of the firm in question, knows that behind his gentle and unassuming manner there is a determination of will that is not likely to be bent or broken. Under his able generalship the vast resources of an unusually wealthy company will certainly be employed to any extent to resist demands so preposterous as those which have been put forward. Should the operatives be successful, there is no manager of works anywhere whose position would be safe, or who would not feel that he must rather study popularity with his workmen than with his employer, whose interests he is paid to look after. It would appear that one of the reporters of a Newcastle paper has interviewed Mr. Macdonell, and the resulting conversation has been published. No one can peruse the same without feeling that the cases of alleged tyranny which the operatives consider justified them in petitioning for his removal, in refusing arbitration, and in refusing a decision by ballot, are of a most trivial character. Not even a dumb animal could be properly corrected and chastised upon such childish evidence, much less a gentleman of high position and attainments, whom few of his accusers have ever seen, and fewer still ever spoken to. That Mr. Macdonell was eighteen years at Inchicore, and received a valuable testimonial and address when he left, participated in by hundreds of his workmen, and that he was treated with similar cordiality at another works on leaving, proves that the strong feeling against him among the Newcastle and Gateshead operatives is undeserved. Their determined hostility, after a very brief acquaintance, savours rather of the impulsive impetuosity of childhood than of the calm reflection which should be the outcome of manhood and experience. It is sad to think of the suffering that is in store for these foolish men should they continue their present course, and still more sad to think of the troubles they will cause to other and innocent persons. But there is no help for it. "Wilfu' folk maun ha' their way." It is to be hoped that the struggle will be short and decisive. It is sure to be sharp.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been very excited this week, and a very large business has taken place in warrants at an advance in some cases of fully 2s. a ton compared with the quotations of the previous week. There is little doubt that the movement is far more due to speculation than to any actual improvement in business. At the same time some consumers appear to have made considerable purchases in view of the prevailing belief that prices were about as low as they were likely to be, at least, in the meantime. The current exports and home consumption do not show any improvement. In the past week the pig iron shipments were 7877 tons, as compared with 8258 in the preceding week, and 12,978 in the corresponding week of 1884. There is no alteration in the number of furnaces in blast. Stocks continue on the increase, fully 1500 tons of pigs having been added to the stock in Messrs. Connal and Co.'s stores in the course of the past week.

Business was done in the warrant market on Monday at 42s. 8d. to 43s. 5d. cash. On Tuesday forenoon the quotations were 43s. 4½d. to 43s. 11d. cash, but there was a reaction in the afternoon, when the market closed at 43s. 1d. cash. The market was irregu ar on Wednesday, with transactions between 42s. 9½d. and 43s. cash. To-day—Thursday—the market was still excited, with business up to 43s. 4d., closing at 43s. 3d. cash.

The values of makers' iron are higher in consequence of the upward movement in warrants. Free on board at Glasgow, Gartsherrie, No. 1, is quoted at 47s.; No. 3, 45s.; Coltness, 51s. and 46s. 6d.; Langloan, 48s. 6d. and 45s. 6d.; Summerlee, 47s. 6d. and 44s.; Calder, 52s. and 44s.; Carnbroe, 46s. and 43s. 6d.; Clyde, 46s. 6d. and 42s. 6d.; Monkland, 43s. and 41s.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 43s. and 41s.; Shotts, at Leith, 47s. 6d. and 46s. 6d.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 44s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 46s. and 42s. 6d.; Eglinton, 42s. 6d. and 40s.; Dalmellington, 44s. and 40s.

Several contracts for new vessels have been placed with Clyde builders since last report, including an order which has been given to Messrs. Murdoch and Murray, Port Glasgow, to build a steel screw tug to be employed at Cape Verde Islands, the machinery of which is to be supplied by a Glasgow firm. The past week's shipments of iron and steel goods from Glasgow include three locomotives, valued at £6502, for Sydney; a small screw dredger worth £2000, for Halifax; machinery to the value of £16,000; sewing machines £3615; steel goods, £5000; and general iron manufactures, £35,000.

Coalmasters report rather less inquiry this week, but the current shipments of coals are large. At Glasgow they have amounted to 24,712 tons; Irvine, 2856; Troon, 8771; Ayr, 7506; and Grangemouth, 20,542. As the orders slacken, it appears that, notwithstanding the low prices current for a long time, there has been a disposition to undersell, with the object of pushing business. This practice is perhaps considered necessary by those who resort to it. But it has at the same time been condemned on 'Change.

The Scotch miners sent delegates to the first conference of a national character that has been held for a long time, which took place in Glasgow a few days ago. There was a fair attendance. It was resolved that the eight hours' day be made general from the 14th current, that a demand of 6d. a day of an increase be made from the central Board, and that the miners of Scotland work only five days a week until further orders. It is doubtful whether the resolutions of the conference with respect to the restriction of labour will be generally adopted by the miners throughout the country. Their wages are already so low that they can ill afford to curtail them still further by working shorter hours.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

I NOTICED in my letter of last week a slight tendency in the iron and steel trade towards improvement. This continues, and a more cheerful tone exists, although I must admit prospects have not as yet culminated into certainties. The impression is gaining ground that the foot of the hill has been reached at last, and that we are beginning to ascend. Changing the figure, anyone conversant with the iron trade knows that its history is one of "ups and downs," and I quite agree and sympathise with the manager who said it was quite time now for one of the "ups." If it comes soon, capitalists may be induced to help some of the struggling concerns, otherwise their fate is assured. Treforest Rail Works, once the property of Mr. Fothergill, was inspected this week, but with what object is not stated. Mr. J. Lewis, of Aberdare, is now the owner. Treforest, Plymouth, Gadlys, Abernant, and Llwydcoed simply await the hand of the auctioneer.

Cyfarthfa is exhibiting a great degree of vitality, and the scene nightly is one of remarkable scenic display and energy. It is to be hoped that the enterprising brothers Crawshay will be recouped. I have all along contended that a better time, considering the labour market and price of food, for working stock has not been our lot to witness, and now if Sydney, and then China, come into the buying market, as the *Times* predicts, the wisdom of those who have stocked well will be exemplified. There is not much to record in connection with the tin-plate trade. The struggle between makers and buyers continues, and the latter are resolute in only putting in those orders that are absolutely necessary. On the other hand, makers are firm, and one large owner, who hitherto has held out, has joined the confederacy. In addition stocks are falling, and little of value in the shape of coke-tin can be had under 14s. Another week or two must tell a tale. 1200 tons left Swansea this week for the States.

Much regret is felt that a large firm of shippers and coalowners, Poingdestre and Mesnier, have fallen into financial difficulties, and are offering a composition. This, I hope, will be accepted. At present the shipping trade is as bad as it can well be, and the coal trade no better than what I have reported for the last two months. House coal is wretchedly dull, steam little better, and the anthracite districts of Swansea as bad. Last week no less than eighty wages cases were heard at Ystradgynlais, Swansea, against a coal firm.

Singularly enough Swansea enjoys a better trade for second-class steam coal than the other ports, and local collieries are in consequence kept going with some degree of regularity. Not so in the Newport and Cardiff districts, and many collieries are in a semi-stagnant condition. At the Gwerna, Maesycwmmes house coal, the men are all out to the number of 100. Many of the best pits are only half employed, and this is beginning to tell upon the colliers, who are migrating from one pit to another. A large number left Merthyr Vale five weeks ago when the breakage of the winding engine stopped the working of No. 1 pit. Now that this is restored a return of the men may be expected. The pit started this week.

The Nettlefolds Company, of Birmingham, are going to restart Rogerston Works, near Newport, as a nut and bolt works.

TENDERS.

HINCKLEY LOCAL BOARD.—WELL SINKING, &c.

THE following are the tenders for well sinking, &c., which were advertised for recently in THE ENGINEER:—

	£	s.	d.
E. Timmins, Runcorn	698	5	0
R. Speller, London..	570	0	0
E. Turner, Wolverhampton..	546	0	0
W. Taylor, Reigate	605	10	0
W. Bennett, Bromsgrove	661	2	0
J. Smalley, Hull—accepted	427	18	4

SOCIETY OF ENGINEERS.—By permission of Messrs. Westwood, Baillie and Co., arrangements have been made for the members and associates of the Society and their friends to visit the London Yard Engineering Works, Isle of Dogs, E., on Wednesday, the 16th September. The works in progress include several bridges of large spans for the Indian State Railways, the principal one being for a span of 800ft., part of the Sukkur Bridge over the River Indus. The train will leave Fenchurch-street at 12.10 p.m., and return from the Millwall Dock Station, which is within five minutes' walk from the works, at 4.55 p.m. Tickets for the visit, without which no one can be admitted, will be 5s. each, to be obtained from the secretary of the Society.

UNIVERSITY COLLEGE, BRISTOL.—The next session of the college will begin on 6th October. Lectures and classes are held every day and evening throughout the session. In the chemical department lectures and classes are given in all branches of theoretical chemistry, and instruction in practical chemistry is given daily in the chemical laboratory. A special practical class for clothworkers and dyers is carried on by correspondence, and excursions to some of the mines, manufactories, and chemical works of the neighbourhood are occasionally made. The department of experimental physics includes various courses of lectures arranged progressively, and practical instruction is given in the physical and electrical laboratory. The department of engineering and the constructive professions is designed to afford a thorough scientific education to students intending to become engineers, or to enter any of the allied professions, and to supplement the ordinary professional training by systematic technical teaching. This department includes courses specially arranged for students intending to become civil, mechanical, or electrical engineers, surveyors, or architects. Those who attend the mechanical engineering course enter engineering works during the six summer months, and, in accordance with this scheme, various manufacturing engineers in the neighbourhood have consented to receive students of the college into their offices and workshops as articled pupils; the engineering laboratory has recently been provided with a powerful testing machine, and instruction in the use of tools is given in the workshop. Special courses in surveying have been arranged, and excursions for field practice are frequently made. The department of geology, biology, and zoology include various courses of lectures in all the branches of these subjects, together with laboratory instruction. In the botanical department practical instruction is given by means of the botanical gardens, which contains upwards of 1000 specimens. Courses of lectures and classes are given in mathematics, political economy, logic, moral philosophy, modern history, English literature, Greek, Latin, Hebrew, French, and German. Medical education is provided by the Bristol Medical School, which is affiliated to the college. Several scholarships are tenable at the college.

NEW COMPANIES.

The following companies have just been registered:—

John Knight and Co., of the Cookley Ironworks, Limited.

This company proposes to take over the assets and liabilities of John Knight and Co., of the Cookley Ironworks, Stafford, and of the Brockmoor Iron and Tin Plate Works, Limited. It was registered on the 27th ult., with a capital of £50,000, in £10 shares, with the following as first subscribers:—

	Shares.
*Colonel F. W. Knight, C.B., M.P., Wolverley, Kidderminster	1
*E. Budd, Bond-court, Walbrook, merchant	1
*E. F. Budd, Bond-court, Walbrook, merchant	1
*J. E. Budd, Bond-court, Walbrook, merchant	1
*R. S. Casson, Brierley-hill, agent	1
*W. Hutchinson, Wolverhampton, manager	1
Henry Bennett, Cookley, Kidderminster, manager	1

The number of directors is not to be less than three, nor more than seven; qualification, ten shares or £100 stock; the company in general meeting will determine remuneration.

British and Belgian Steamship Company, Limited.

This company proposes to transact shipping business and to enter into contracts and through booking arrangements with railway companies of the United Kingdom and the Continent, and also to negotiate and conclude contracts for the carriage of her Majesty's mails between England and the Continent. It was registered on the 2nd inst., with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
D. Smith, 54, Alkham-road, Stoke Newington, accountant	1
James Nicholas, 17, Gainsford-street, Southwark, manufacturer	1
Arthur Moss, 7, Harbut-road, New Wandsworth, private secretary	1
A. Cape, 80, Thicket-road, Penge, cashier	1
J. Thorley, Salisbury Club, St. James'-square	1
Kenneth Ffarington Bellairs, 58, Lombard-street	1
Wm. Charles Freeman, 29, New-street, Kennington Park, clerk	1

The number of directors is not to be less than three, nor more than nine; qualification, £500 in shares; the first are Lord Suffield, Major the Hon. A. G. F. Jocelyn, Messrs. Wynne Patrick Hulm and Brook Greville; remuneration, £100 per annum each, and in each year in which at least 10 per cent. dividend is paid, the board will be further entitled to 10 per cent. of the net profits of the year.

Meux and Co., Limited.

This company was registered on the 27th ult., with a capital of £1,500,000, divided into 5000 ordinary shares of £200 each and 5000 preference shares of £100 each, to purchase the business of brewers, carried on in partnership by Sir Henry Bruce Meux, Bart., the Right Hon. Dudley Coutts, Lord Tweedmouth, the Right Hon. Lord Henry Bruce, Messrs. Edward Wingfield Guilding and Wm. Salmon Clark, trading as Meux and Co., at the Horseshoe Brewery, Tottenham-court-road. An agreement of 21st July regulates the purchase. The consideration will be the value of the properties on the 5th October next, as ascertained by valuation, and is payable by the allotment to the vendors in proportion to their present shares in the partnership business (other than the goodwill thereof) of 4400 shares of £200 each. The remaining 600 ordinary shares are to be allotted to Sir Henry Bruce Meux and Lord Tweedmouth on account of the goodwill. These shares will be credited as paid up to the extent of £100 each. If the result of the valuation is in excess of the amount represented by the said 4400 shares, the additional amount is to be transferred into the books of the company to the credit of the present partners, and will be a debt owing to them respectively from the company, and will carry interest at the rate of £5 per cent. per annum until payment, and so much of such excess as represent the shares of profits of Sir Henry Bruce Meux and Lord Tweedmouth from the business for the year ending 5th October, 1885, will be paid to them respectively, by twelve equal instalments during the year ending 5th October, 1886. The subscribers are:—

	Ordinary Shares.
*Sir Henry Bruce Meux, 41, Park-lane	2295
Lady Bruce Meux, 41, Park-lane	5
*Lord Tweedmouth, Brook House, Park-lane	2250
*Major, Lord Henry Bruce, 36, Eaton-place	200
*E. Wingfield Guilding, 19, Great Russell-street, brewer	100
*W. S. Clark, Richmond, Surrey, brewer	100
Richard Hunter, The Copse, Wimbledon	50

The number of directors is not to be less than three, nor more than six; qualification, 50 ordinary shares; the first are the subscribers denoted by an asterisk. The remuneration (if any) of the board will be determined by the company in general meeting.

Plashett's Coal and Coke Company, Limited.

On the 2nd inst. this company was registered with a capital of £25,000 in £10 shares, to purchase the lands, collieries, mines, works, and property of a co-partnership firm, styled "The Plashett's Coal Company." The subscribers are:—

	Shares.
G. N. Laws, Prudhoe Castle, Northumberland, shipowner	1
Herbert Laws, C.E., Ryton-on-Tyne	1
Robert Swann, Bedlington, Northumberland, farmer	1
J. Atchison, Plashett's Colliery, Northumberland, mining engineer	1
John Swann, Bebside, Northumberland, farmer	1
Isabella Fryar, Choppington, Northumberland	1
Wm. Hall, Ryote, Newcastle, solicitor	1

The number of directors is not to be less than five, nor more than nine; the subscribers are to appoint the first; qualification, 25 shares; the company in general meeting will determine remuneration.

William Johnson and Company, Limited.

This company proposes to purchase the cotton mills and premises of Mr. James Johnson, known as the Wood-street and Bradford-place Mills, Wigan. It was registered on the 2nd inst., with a capital of £40,000 in £10 shares. The subscribers are:—

	Shares.
Mary Johnson, Bradford House, Wigan, spinster	1
William Johnson Bound, Wigan, cotton spinner	1
W. Johnson Halsall, Wigan, cotton spinner	1
James Johnson, Wigan, cotton spinner	1
Annie E. Copland, Windsor-road, Southport, widow	1
J. Johnson Halsall, Wigan, mechanical engineer	1
J. Potter, Halsall, Wigan	1

Registered without special articles.

San Remo Waterworks Company, Limited.

On the 1st inst. this company was registered, with a capital of £100,000, in £10 shares, to purchase the concession granted by the town of San Remo to Giovanni Marsaglia, dated 12th July, 1883, relating to the supply of water to the town of San Remo, and for the supply to Poggio and Ospedaletto, in Northern Italy, for a term of eighty years; and also to purchase the lands, springs, and water sources acquired under the concession. The directors are empowered to pay not exceeding £60,000, this amount to include all remuneration for services in establishing the company and arranging for the acquisition of the concession. The subscribers are:—

	Shares.
Roderick Macay, 3, Lothbury, chartered accountant	1
Edward Boyle, 14, Clements-lane, Lombard-street, surveyor	1
E. E. Price, 3, Lothbury, chartered accountant	1
W. G. Paterson, 36, Grove Park-road, West-green-road, N., clerk	1
W. F. Mapleston, 9, Melrose Villas, Harlesden	1
T. Douglas, 15, Ryecroft-road, Lewisham	1
W. J. Stilwall, 69, Winchester-street, S.W.	1

The number of directors is not to be less than three, nor more than seven; qualification, 50 shares; the subscribers are to appoint the first; remuneration, £250 per annum, and an additional £100 for each 1 per cent. dividend in excess of 5 per cent. per annum.

Swindon Gas and Coke Company, Limited.

This company was originally constituted by deed of settlement dated 1st July, 1841, and was incorporated an unlimited company on the 6th of May, 1870. It was registered on the 29th ult. as a limited company, with a capital of £8000, in £10 shares, the whole of which are issued and are fully paid up.

THE EHRENBERG-MONTAUDON TELEMETER.

Lieutenant von Ehrenberg, an officer in the Baden Artillery, has invented a watch for estimating distances by sight and sound, and has had an instrument of the sort constructed according to his design. The watch is not too large for the pocket, with mechanism of such a sort that, as in the case of ordinary chronographs, the indicating finger returns automatically to zero after each observation. To insure simplicity and accuracy of observation the dial is divided into hectometres. Now sound, as is well known, travels at the rate of 334 metres a second, and the finger of the telemeter marks distances up to 10 kilometres by fractions of 50 metres, and this is all that is required for observation in the field of battle. By pressing the winding-up stud at the moment the observer perceives the flash of a hostile cannon or a rifle the finger begins to move. A second quick pressure when the report is heard indicates the distance desired within 25 metres. A third touch brings the finger back to zero. The telemeter has been improved by Major Montaudon, and is arranged in four divisions. The first gives the hours and minutes; the second, the seconds; the third constitutes the telemeter, properly so-called, and indicates fifths of seconds; and the fourth gives the distances in hectometres and demi-hectometres. According to experiments made not long ago at Thun, the variation in judging distances by the telemeter during calm weather does not exceed 50 metres, and this for all practical purposes is sufficiently close. During some recent manœuvres of a division of the Swiss army in the Grisons, an artillery officer made several interesting experiments with the instrument. Finding it impossible during a sham fight—owing to the configuration of the country—to judge distances by the map with sufficient accuracy, he succeeded in doing so with the help of the telemeter. The same at Ragatz, where, the position of the mountain guns of the enemy being masked by trees, nothing could be seen but the smoke. At the beginning of every action it was found easy to determine the distance of lines of infantry, and equally so after every pause in the combat. Infantry fire could be observed just as well as gun fire; and Herr Krupp is so well satisfied with certain experiments he caused to be tried that he has ordered a considerable number of these telemeters.

Pig Iron Trade in the United States.—A comparison of the pig iron districts in the United States, published by the *Iron Age*, shows that the Lehigh Valley district, which produced one-sixth of the whole product in 1872, has been receding during the last few years in relative importance, so that in 1884 it only produced one-eleventh of the entire product. The Pittsburg district, on the other hand, has been steadily gaining since 1876, and in 1883 and 1884 was at the head of the list. In 1872 Pittsburg produced only one-fourth as much pig iron as the Lehigh Valley, but last year it produced more than any other district. The Lower Susquehanna Valley and the western part of the State outside of Pittsburg and the Shenandoah Valley, show a similar rapid development. The Schuylkill Valley also increased its output until 1883, when it again began to decline. With regard to the trade generally, notwithstanding the fluctuations in various districts, the entire product of the country has doubled itself within ten years. The product of the last three years has been as great as for the preceding five years, in spite of the temporary decline experienced last year.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

1st September, 1885.

10,322. Joints of Stoneware Pipes, H. S. Thomas, London.
10,323. Pistons of Rotary Pumps, &c., F. M. Roots, London.
10,324. Pencil Cases, A. J. Halsey, London.
10,325. Hair Curler, J. C. Edwards, Manchester.
10,326. Reins, &c, J. Westaway, Barnstaple.
10,327. Taps and Valves, G. M Marchant, Halifax.
10,328. Fastening for Rails in Chairs, J. Lees and F. C. Lynde, Manchester.
10,329. Razors and Pocket Cutlery, &c., A. Pilley and A. B. Ball, Sheffield.
10,330. Nailing Machines, S. W. Robinson, Paris.
10,331. Preparing Pulp for Making Paper, &c., J. Plummer, jun., Edinburgh.
10,332. Preparing Chocolate, &c., W. Lucock, Birmingham.
10,333. Galvanic or Voltaic Batteries, A. Serraillier and F. Ducher, London.
10,334. Street Fire-alarms, J. M. Munro, Glasgow.
10,335. Electrical Mechanism for Forcing Air to the Flame of Oil Lamps, &c., J. H. Ross, R. Nolan, and A. Mackenzie, Dublin.
10,336. Secure Envelope and Paper Wrapper, J. Lang, London.
10,337. Life-saving Apparatus, J. H. P. Johnstone, Glasgow.
10,338. Lathes for Turning, C. Pendlebury, London.
10,339. Carrying Water off Roofs, M. Shelbourn, London.
10,340. Handle for Carrying Parcels, G. A. Nussbaum.—(*A. Gérard, France.*)
10,341. Store Service Apparatus, S. G. North, London.
10,342. Store Service Apparatus, I. Birge, London.
10,343. Store Service Apparatus, I. Birge, London.
10,344. Water Meters, J. Rowbotham, London.
10,345. Check Rein Holder, W. D. Taber, London.
10,346. Wheels for Road, &c., Carriages, W. S. Lockhart, London.
10,347. Sash Fastener, G. Blake, London.
10,348. Supply of Lubricating Material to Steam Engines, J. Snowden, jun., London.
10,349. Ventilating Water-closets, &c., J. Scholes and E. Hall, Kingstown.
10,350. Velocipedes, H. J. Haddan.—(*C. Stackfleth and K. Plettner, Saxony.*)
10,351. Frigorific or Compound for Producing Cold, H. J. Haddan.—(*H. T. Baeschlin, France.*)
10,352. Toilet Paper, C. A. Day.—(*O. H. Hicks, United States.*)
10,353. Safety Valves, A. Turnbull, Glasgow.
10,354. Lasts and Pillars, &c., J. E. B. Armytage, London.
10,355. Effecting the Absorption of Gases, E. Edwards.—(*G. Lunge, Switzerland, and L. Rohrmann, Germany.*)
10,356. Portable Forges, W. A. Barlow, London.
10,357. Making Tubing and Cord of India-rubber, A. W. L. Reddie.—(*V. and J. Royle, United States.*)
10,358. Drying Malt, M. Hedicke, London.
10,359. Medical Pipes, W. B. Robinson, London.
10,360. Wheeled Chairs, C. Dixon and C. Flatters, London.
10,361. Reaping Machines, R. B. Leeds, London.
10,362. Cement, G. Butehard, London.
10,363. Projectiles, C. W. Hayes and C. C. Duncanson, London.
10,364. Automatically Retailing Cigars, &c., W. P. Thompson.—(*C. Osterberg, Sweden.*)
10,365. Stench Traps or Gullies, T. Glover, London.
10,366. Compass Cards, J. Daniel, Liverpool.
10,367. Twisting or Doubling Yarn, J. King, jun., Liverpool.
10,368. Treating Paper Pulp, &c., J. B. Alliott.—(*H. Lahousse, France.*)
10,369. Sole Protectors for Boots, E. M. Bratt.—(*M. Ohlsson, Sweden.*)
10,370. Electric Telephony, J. G. Lorrain, London.
10,371. Machine for Drilling, &c., R. C. Mollon, London.
10,372. Cigarettes, W. R. Lake.—(*J. G. English, U.S.*)
10,373. Electric Lighting Apparatus, W. R. Lake.—(*H. P. Brown, United States.*)
10,374. Separating Dust from Air, W. R. Lake.—(*The Knickerbocker Company, United States.*)
10,375. Infusion of Coffee, W. R. Lake.—(*A. Moriondo, Italy.*)
10,376. Pianofortes, J. Perks, London.
10,377. Colouring Matters, W. Clark.—(*The Farbfabrik vorm. Brönner, Germany.*)
10.378. Furnaces for Burning Stained Glass, &c., G. J. Atkins, London.

2nd September, 1885.

10,379. Sanitary Urinals and Disinfectants, J. Peachey, Worcester.
10,380. Ash Receptacle for Grates, H. Taylor, Manchester.
10,381. Railway Carriage Door Fasteners, &c., H. G. Smith, Birmingham.
10,382. Fancy Weaving, J. Edelston, Manchester.
10,383. Bicycle Saddles and Springs, W. Cook, Birmingham.
10,384. Automatic Electric Fire-alarm, A. Dalziel, Manchester.
10,385. Getting Coal, Minerals, &c., W. E. Garforth, Leeds.
10,386. Presses for Baling Cotton, &c., H. S. Booth, Manchester.
10,387. Mechanical Telephone, J. Eaton and G. Durham, Manchester.
10,388. Wheels for Tram-cars, &c., G. W. Blake, London.
10,389. Regulating the Delivery of Thread from Reels or Spools, M. Moore, London.
10,390. Reservoir and Self-feeding Pen-holders, J. Husnik and H. Merryman, Sheffield.
10,391. Screw Sockets or Cups, W. J. May, Birmingham.
10,392. Apparatus for Holding Watches, &c., A. Berkeley, South Hackney.
10,393. Looms, F. H. Wilke, London.
10,394. Propelling and Steering Torpedoes and Boats, J. C. Threadgold, Luton.
10,395. Artificial Limbs, G. Beacock and T. Sparham, London.
10,396. Communicating with the Crews of Shipwrecked Vessels, H. M. Bennett, London.
10,397. Automatic Boiler Tube Cleaners, T. F. Veasey.—(*J. H. Lancaster, United States.*)
10,398. Gear for Transmitting Motion, J. M. Napier, London.
10,399. Cigar, &c., Boxes, W. H. Ireland, London.
10,400. Facilitating the Carrying of Hand Bags, M. Krumm.—(*L. Krumm, Germany.*)
10,401. Gas Engines, P. M. Justice.—(*W. E. Hale, United States.*)
10,402. Alarm Apparatus, W. L. Wise.—(*J. L. Petit, Belgium.*)
10,403. Making and Finishing Photographs, &c., W. Davey, London.
10,404. Compound Steam Engines, G. Downing.—(*A. Queruel, France.*)
10,405. Hydraulic Motors, J. Fielding, London.
10,406. Apparatus for Receiving Payment for and Delivering Prepaid Goods, P. Everitt, London.
10,407. Attaching and Detaching Traces to and from Carriages, A. J. Blew, London.
10,408. Feeding Wool to Carding Machines, H. H. Lake.—(*J. T. Lemaire, U.S.*)
10,409. Compound for Preventing Rust, H. Gardner.—(*D. Lublinski, Germany.*)

3rd September, 1885.

10,410. Gas Governors, J. Horton, Dudley.
10,411. Fixing Rain Water, &c., Pipes, W. Bruce, Edinburgh.
10,412. Shedding and Change Shuttle Motions for Looms, W. H. Hacking, Manchester.
10,413. Frames for Cutting Velvets, J. Platt, Manchester.
10,414. Foil, F. W. Schreiber, London.
10,415. Polishing and Cleaning Books, J. Cox, Hunstanton, St. Edmonds.
10,416. Water Closets, J. Shanks, Glasgow.
10,417. Water Gauges for Steam Boilers, H. S. Dunn and G. F. Loudon, Glasgow.
10,418. Tape Line or Measuring Tape-case, M. H. Golightly, Hartlepool.
10,419. Galloway Tubes and Attaching them to Boilers, G. J. Scott, Aberdeen.
10,420. Machines for Opening Cotton, &c., G. Young, Manchester.
10,421. Bicycles, &c., A. Birch, Manchester.
10,422. Registering, &c., Passengers entering a Tram-car, &c., W. Harvey, Manchester.
10,423. Preventing, &c., Incrustation in Boilers, A Roberts, Birmingham.
10,424. Expanding Corset, W. Connell, Dublin.
10,425. Fixed Fire Escape Ladder, A. Waite.—(*A. le Tellier, France.*)
10,426. Adjusting, &c., Carts, &c., E. and H. Roberts, London.
10,427. Bath for Toughening Steel, R. W. Taynton, London.
10,428. Bottles, J. Hale, London.
10,429. Heating Water by Gas, J. Hailwood and T. Kennington, Sheffield.
10,430. Tricycles, A. Ashby, London.
10,431. Attaching Cogs to the Shoes of Horses, A. F. Rogers, London.
10,432. Cigarette-making Machine, F. B. Hill, London.
10,433. Electric Tramways, F. H. Danchell, London.
10,434. Mill Wrappers and Lappings, J. Luke, jun., Glasgow.
10,435. Wheels, &c., for Corrugated Belting, J. G. Jebb, London.
10,436. Locking Bearing Screws, J. de L. Watson, London.
10,437. Ships and Boats, H. Stokes, London.
10,438. Compressing Coal and Introducing Same into Coke Ovens, H. J. Haddan.—(*J. Quaglio, Germany.*)
10,439. Metallically Renovating Gold and Silver Lace, &c., A. Söhner, London.
10,440. Detonating Fog Signals for Railways, W. F. Ruston, London.
10,441. Advertising, E. J. Hayball, London.
10,442. Manufacture of Letters, Numbers, &c., J. Blakey, Balham.
10,443. Liquid Meters, J. J. Tylor, London.
10,444. Closing Bottles, &c., H. W. Stevens, London.
10,445. Paving Bricks, G. Bird, London.
10,446. Ornamenting Lace, &c., R. Scott, London.
10,447. Securing the Corks of Bottles, J. W. Dixon, London.
10,448. Electric Ear Telephone, E. Spaulding, London.
10,449. Telephone Transmitters, C. A. Teske, London.
10,450. Telephone System, C. A. Teske, London.
10,451. Metal Pans, &c., F. Elmore, London.
10,452. Vermin Trap, W. B. Andrews, London.
10,453. Lighting and Extinguishing Device for Electric Lamps, A. Radiguet and E. Parenthou, London.
10,454. Cement, &c., for Paving, W. R. Lake.—(*F. J. Grenier, France.*)
10,455. Electric Generators, E. and A. E. Jon London.
10,456. Wire-netting, W. F. Dennis, London.
10,457. Displaying Advertisements, &c., F. D. Ewbank, London.
10,458. Rolling Trains, F. J. Brougham.—(*H. Bleckmann, Austria.*)
10,459. Watch Balance Regulator, W. Clark.—(*J. C. Levasseur, Algeria.*)
10,460. Automatic Platen Machine Feeder and Deliverer, J. Marles and J. H. Barry, London.
10,461. Umbrellas, A. Coke, London.

4th September, 1885.

10,462. Clearers used in Winding, &c., Yarns, E. L. Oliver and G. Ardern, Manchester.
10,463. Electric Current Meter, H. S. P. Watkin, Woolwich.
10,464. Rivetting of Ships, J. Stuart and J. Graham, Glasgow.
10,465. Solving Problems in Navigation, &c., C. Perks, Manchester.
10,466. Stop Motions for Doubling, &c., Frames, A. H. Dixon and W. J. Gradwell, Manchester.
10,467. Infants' Feeding Bottles, T. Hargreaves, Manchester.
10,468. Sliding Canopy Stoves, C. H. Perrot and A. Habershon, Rotherham.
10,469. Book-marker, J. Stewart, Musselburgh.
10,470. Automatic Contact Breaker, M. Selig, London.
10,471. Toy—Racing Tops, W. S. Whittuck, Bath.
10,472. Speed Indicator, J. Pearce, Glasgow.
10,473. Handles of Table Cutlery, F. Shaw, Sheffield.
10,474. Switch for Electric Lighting Purposes, W. D. Hassall.
10,475. Fastening Doors, P. W. Baldwin, Goosnargh.
10,476. Machines for Planing Wood, W. B. Haigh, Manchester.
10,477. Vermin and Animal Traps, J. Nichols, Birmingham.
10,478. Alarm Guns, T. Cheadle, London.
10,479. Ventilating, &c., Hot-houses, &c., J. Hansen, Tottenham.
10,480. Loading Cement Kilns, W. G. Margetts, London.
10,481. Backs, &c., of Pianos, E. Bishop, London.
10,482. District Fire-alarms, D. Sinclair and R. Wallace, Glasgow.
10,483. Tricycles, R. S. Crawford, Glasgow.
10,484. Turning Lathes, P. R. Allen, London.
10,485. Preventing Breakage of Cutting Tools, P. R. Allen, London.
10,486. Embroidering Lace, &c., H. S. Cropper and W. Birks, London.
10,487. Maps, E. McClure and H. F. Brion, London.
10,488. Screw-driver, H. C. Chocqueel, London.
10,489. Releasing Horses from Vehicles, H. Hall, London.
10,490. Skin Gloves, L. A. Groth.—(*G. Barbiani, Italy.*)
10,491. Extracting Nickel and Cobalt from Ores, L A. Groth.—(*D. Mindeleff, U.S.*)
10,492. Wall Coverings, &c., W. Clark.—(*E. E. Fagnet, France.*)
10,493. Cranes, A. Greig and R. H. Shaw, London.
10,494. Indicating the Class of Railway Carriages, B. Looker, London.
10,495. Pulleys or Wheels, E. P. Alexander.—(*J. Lathrop, U.S.*)
10,496. Air Pump, W. R. Lake.—(*P. Wrady, Russia.*)
10,497. Upholsterers' Trimmings, W. and A. C. Cameron, London.
10,498. Bagatelle Table, E. Edwards.—(*A. Portal, France.*)
10,499. Cab Fare Controller, L. E. de Hoven and B. Lewis, London.
10,500. Railway Carriages, A. Browne.—(*J. Walzer, Switzerland.*)
10,501. Bottle Stoppers, W. P. Thompson.—(*H. Spriegel, Germany.*)
10,502. Looms for Weaving Carpets, &c., J. Wade, London.

5th September, 1885.

10,503. SIMPLEX BALL CASTORS, L. Sergeant, London.
10,504. MOTIVE POWER to BICYCLES, W. Martin, Manchester.
10,505. DOBBIES, W. Slater and J. Eckersley, Manchester.
10,506. POTATO RAISERS, J. Mellor, Manchester.
10,507. SHARPENING the KNIVES of REAPING MACHINES, R. H. C. Nevile and E. Whitworth, Grantham.
10,508. BREAKING, &c., FIBROUS MATERIALS, R. Wild and H. Ledger, Leek.
10,509. BREAKING, &c., FIBROUS MATERIALS, R. Wild and H. Ledger, Leek.
10,510. VICES, P. Minea, London.
10,511. VENTILATION of SEWERS, J. King, London.
10,512. COOLING MILK, F. Carruthers, Lockerbie.
10,513. SIZING MACHINES, G. Whewell and J. A. Slater, Manchester.
10,514. VENTILATORS, E. G. Wood, Manchester.
10,515. RINGS of SPINNING FRAMES, T. M. Gribbin, Manchester.
10,516. FEEDING MACHINERY for GRINDING GRAIN, C. Clough, Halifax.
10,517. SEPARATING DUST, &c., from AIR, A. Sutcliffe, Liverpool.
10,518. CONDUITS used in ELECTRIC RAILWAYS, P. R. Allen, Hammersmith.
10,519. METHOD of APPLYING POWER, J. Murrie, Glasgow.
10,520. CLOSING FEED-HOLE of OIL CANS, I. Webster, Halifax.
10,521. ROLLERS of GILL BOXES, &c., J. and A. Holmes, Halifax.
10,522. TRANSMITTING MOTION to VEHICLES, P. Allen, Hammersmith.
10,523. WREATH CASES, W. Ritchie, Glasgow.
10,524. INSCRIPTIONS for WREATH CASES, W. Ritchie, Glasgow.
10,525. COMBINATION LACE and TASSEL FRINGES, J. F. Waters, London.
10,526. LENSES for SPECTACLES, &c., J. Pillischer, London.
10,527. REFRIGERATORS for LIQUIDS, H. T. Warne, London.
10,528. AMALGAMATING, &c., ALUMINIUM, J. H. Williamson, London.
10,529. ADJUSTMENT of ELECTRIC LAMPS, T. T. Smith, London.
10,530. HEAD RESTS for BARBERS' CHAIRS, H. L. Provis, London.
10,531. FLAT METAL HEALDS, J. Marshall, London.
10,532. STRETCHING SPRING BEDS, &c., J. H. Knowles, Sheffield.
10,533. PHOTOGRAPH STANDS, A. Rocholl, London.
10,534. FOUNT and FOOD HOLDERS for CAGES, J. Nichols, Birmingham.
10,535. GAS MIXTURE, H. J. Haddan.—(*W. St. Martin, Belgium.*)
10,536. READING INDICATIONS of BAROMETERS, I. Joseph, London.
10,537. GENERATING STEAM, J. Walshaw, London.
10,538. GAS BURNER with ELECTRIC IGNITION, F. Giraud and E. Neo, London.
10,539. CHAIN CABLES, A. McShain, London.
10,540. ELECTRIC MEASURING INSTRUMENTS, J. G. Statter, London.
10,541. BOTTLES and STOPPERS THEREFOR, D. W. Bell, London.
10,542. MOORING BREAKWATERS, &c., W. R. Lodge and J. Holmes, London.
10,543. PAPER, C. J. Richardson, London.
10,544. KILNS for MAKING LIME, M. B. Parrington, London.
10,545. VENTILATING the STOKE-HOLES of FURNACE ROOMS, C. Lawrence, London.

7th September, 1885.

10,546. CINDER SEPARATOR, J. Pearson, Ashton-on-Ribble.
10,547. DRIVING VENTILATORS in DWELLING HOUSES, E. L. Lange, Manchester.
10,548. BLIND CORD BRACKETS, T. Taylor and J. Hunt, Birmingham.
10,549. STRETCHING WOVEN FABRICS, J. Salter, Manchester.
10,550. TRAM and other FARE CHECKS, B. W. Spittle, Wednesbury.
10,551. ENAMELLING CASKS, J. Death, jun., Cheshunt.
10,552. TENNIS BALLS, D. Allport, London.
10,553. COMBINED FORK and SPOON, L. W. Goold, Birmingham.
10,554. WATER-PROOF CLOTH, W. H. Slade, London.
10,555. RAPIDLY HEATING WATER, W. Foulis, Glasgow.
10,556. CRANKS, C. E. Stretton, Leicester.
10,557. VELOCIPEDES, R. J. Powell and S. Watts, Bath.
10,558. BOTTLE-STOPPERS, T. Thompson, Blackpool.
10,559. ROTARY ELECTRIC MOTORS, C. de Salazar, London.
10,560. SPADES or KNIVES for CUTTING HAY, J. Locksmith, Halifax.
10,561. SECURING PRINTING PLATES or BLOCKS to STEREOTYPE PRINTING PLATES, R. Brown, R. W. Barnes, and J. Bell, Liverpool.
10,562. TANNIN and the TREATMENT of VEGETABLE FIBRES, W. M. Riddell, Forest Hill.
10,563. LINSEED MEAL for CHEMICAL PURPOSES, T. H. Williams, London.
10,564. FEEDING FIRES and FURNACES with FUEL, T. H. Williams, London.
10,565. COUCH for INVALID'S BED, S. Taylor and J. Mutch, London.
10,566. ASPIRATING APPARATUS, E. and G. H. Ritzenfeldt, Liverpool.
10,567. MAPS, &c., J. A. Griffiths, London.
10,568. UMBRELLA STAND, C. West, London.
10,569. SHIRTS, &c., R. Ripley, Liverpool.
10,570. FILTER PRESSES, B. H. Remmers and J. Williamson, Glasgow.
10,571. WATER SUPPLY APPARATUS, D. S. Keith, Glasgow.
10,572. AUTOMATICALLY ACTING CANDLE EXTINGUISHER, G. H. Sayer, London.
10,573. PUMP, G. Murray and R. Turnley, London.
10,574. PIANOFORTES and ORGANS, R. A. Kemp, London.
10,575. FILTERS, T. L. Robinson.—(*T. Grant, United States.*)
10,576. SIFTING or BOLTING, H. J. Haddan.—(*F. Winkler, Germany.*)
10,577. FILTERS, W. L. Wise.—(*L. Pommeray, France.*)
10,578. PROPULSION of SHIPS, &c., H. N. Crellin, London.
10,579. STOPPERED BOTTLES and JARS, H. Brecknell, Bristol.
10,580. PROPULSION of SHIPS, F. Girein, London.
10,581. LETTER BOX, W. H. Tonks, London.
10,582. CARDING ENGINES, J. A. Hart and C. Baynes, London.
10,583. STEAM BOILERS, J. Harrison, London.
10,584. DRYING ANIMAL MATTER, &c., J. S. and J. Edwards, London.
10,585. KILNS, G. Butchard, London.
10,586. INTRODUCING FRESH AIR into BUILDINGS, W. Pope, London.

SELECTED AMERICAN PATENTS.

(From the United States' Patent Office Official Gazette.)

323,246. PIPE LINE, *George Westinghouse, jun., Pittsburg, Pa.—Filed February 24th*, 1885.

Claim.—(1) In a double pipe-line system having an inner or main conduit adapted for the conveyance of gas under high pressure, and an outer casing containing gas at lower pressure, the combination, with the pipe sections, of a series of detachable coupling sleeves each connecting two adjacent casing sections and surrounding a joint of the inner line, and a series of partitions each fitting tightly between the inner and outer lines adjacent to the couplings, and forming separate compartments between the same, substantially as set forth. (2) In a double pipe-line system of the class described, the combination of an inner line, an outer casing having its sections connected by detachable coupling sleeves, each surrounding a joint of the inner line, a partition interposed between two compartments of the casing adjacent to a coupling sleeve, and a communicating pipe connecting the compartments on opposite sides of said partition, substantially as set forth. (3) In a double pipe-line

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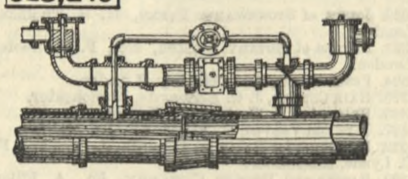

system of the class described, the combination of an inner line, an outer casing divided into compartments and having its sections connected by detachable coupling sleeves, each surrounding a joint of the inner line, a communicating pipe connecting two of said compartments on opposite sides of a coupling sleeve, and a relief valve and vent pipe leading out of said communicating pipe, substantially as set forth.

323,270. VALVE GEAR, *Peter Brotherhood, Lambeth, county of Surrey, England.—Filed March 24th*, 1885.

Claim.—(1) The combination, with a cylinder of a multiple cylinder engine, of the slide F, located entirely beneath and having its seat upon the lower surface of the cylinder cover M, the lever D, pivotted between its ends, and the cam B, substantially as described. (2) The combination, with the cylinder of a multiple cylinder engine, of a semi-cylinder slide F, seated upon the lower surface of a cylinder cover, a lever D, pivotted between its ends and having a cup-

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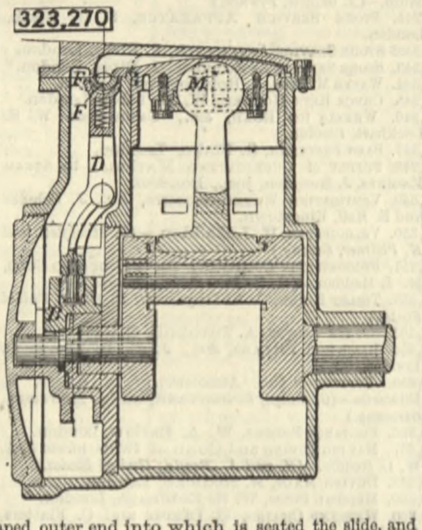

shaped outer end into which is seated the slide, and the cam B, substantially as described. (3) The combination, with the cylinder of an engine, of the slide F, seated upon the lower side of a cylinder cover, the lever pivotted between its ends, a spring G, carried by the lever and pressing the slide upon its seat, and the cam B, substantially as described.

322,916. ELECTRIC SWITCH, *Leo Daft, Greenville, N.J.—Filed March 9th*, 1885.

Claim.—(1) An electric switch consisting of an increasing cam with a sudden drop, having peripheral conducting strips arranged partially around its surface and a transverse conducting strip arranged across its highest point, substantially as described. (2) In an electric switch, the combination, with a gradually-increasing cam having peripheral conducting strips, of spring contacts bearing upon said cam and an actuating worm gear for said cam, substantially as described. (3) The combination in an electric switch of a gradually increasing cam of insulating material, having peripheral conducting strips arranged circumferentially and transversely, spring contacts bearing upon said cam, and connections, substantially as described, whereby the circuit may be opened, closed through a resistance, and then closed direct through the working circuit, as set forth. (4) The combination, in an electric switch, of a gradually-increasing cam having a sudden drop, circumferential and transverse conducting strips on the periphery thereof,

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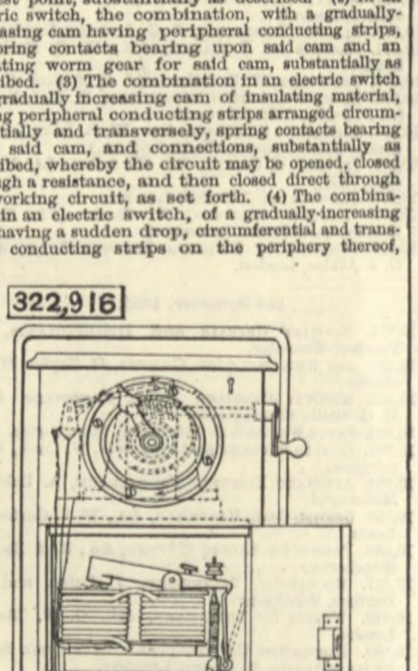

spring contacts bearing on the cam, a worm and gear for operating the cam, and an indicator for showing its position, substantially as described. (5) The combination, in an electric circuit, of a resistance, a switch for varying the resistance, and a worm gear for operating the switch, whereby a slow movement of the resistance-varying apparatus is insured, substantially as described. (6) The combination, in an electric circuit, of a resistance, a switch for varying the resistance, a worm gear for operating the switch, and an automatic cut out, substantially as described. (7) The combination, with the increasing cam switch and contacts, and an automatic cut out and connections, substantially as described.

323,361. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES, *B. F. Orton, East Saginaw, Mich.—Filed May 10th*, 1884.

Claim.—(1) In a commutator, a supporting hub or block of insulating material for the commutator segments, mounted on a shaft and having a lateral extension or flange parallel to said shaft, as and for the purpose described. (2) The combination, with the flanged insulating cylindrical support, of commutator plates or segments secured to the outer surface thereof, and wires or conductors, as G, carried to the inside of the flange and electrically united by suitable devices with the segments. (3) The combination, with the insulating hub or support, of the lateral flange or extension, bolts or pins extending through the commutator segment and the flange to the inner side of the latter, and a wire or conductor attached to the inner end of the pin or bolt. (4) The combina-

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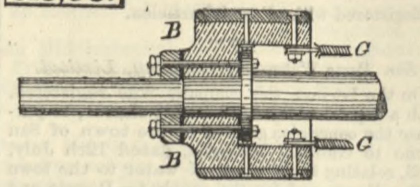

tion, with the insulating support for the commutator segments, of a lateral extension or flange, and connections from the segments extending through said flange to the under side thereof for attachment of the wire or conductor to be electrically connected with the commutator. (5) A commutator support formed in a single piece and having recesses or depressions at points beneath the openings between its conducting segments or plates. (6) The cylindrical hub B, of insulating material, having the recesses or depressions, as *e*, for the purpose described. (7) A commutator support of insulating material having depressions or recesses formed in the surface upon which the commutator plates or segments rest, and at portions thereof coinciding with the slots or openings between the segments.

323,410. PISTON VALVE, *Frederick Fosdick, Fitchburg, Mass.—Filed June 16th*, 1884.

Claim.—(1) In a piston valve for steam engines, the combination, with an expansible shell having tapering or conical ends and tapering plug co-operating therewith, of heads engaging the ends of the said shell, the faces of the said head which engage the ends of the said shell being tapering, whereby the shell, when adjusted by the plug, is prevented from further expansion, substantially as described. (2) In a steam engine, the steam chest *a*, having ports b b^2 leading therefrom to the cylinder and steam passages connecting the steam spaces at opposite ends of the valve heads, combined with a piston valve acted upon at each end by live steam, the valve being provided with

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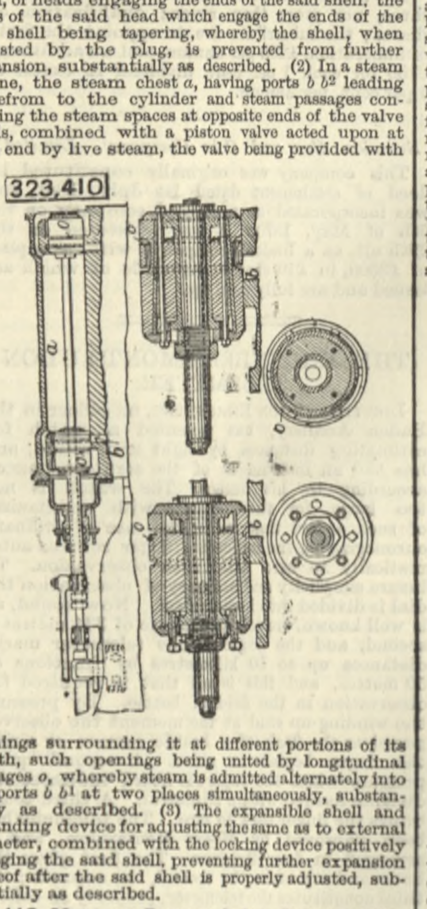

openings surrounding it at different portions of its length, such openings being united by longitudinal passages *o*, whereby steam is admitted alternately into the ports b b^1 at two places simultaneously, substantially as described. (3) The expansible shell and expanding device for adjusting the same as to external diameter, combined with the locking device positively engaging the said shell, preventing further expansion thereof after the said shell is properly adjusted, substantially as described.

323,446. METALLIC PACKING, *Jackson Richards, Philadelphia, Pa.—Filed May 15th*, 1884.

Claim.—(1) A packing composed of a spiral spring having a coiled or spiral packing between its coils, the inner and outer circumferential edges of which packing project beyond the corresponding edges of said spring, substantially as shown and described. (2) A packing composed of two intercoiled spirals having the inner and outer circumferential edges of one projecting beyond the corresponding edges of the other, substantially as shown and described. (3) A packing

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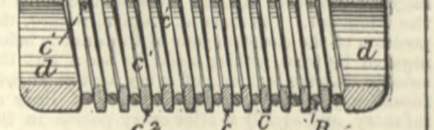

composed of intercoiled metal spirals B and C, of unlike density or hardness, and having different diameters and mandrel openings, substantially as shown and described. (4) The metal packing herein described, comprising a spiral spring B, and a soft metal spiral C, having projecting edges c^1 c^2, substantially as shown and described. (5) The packing A, composed of spiral spring B and intercoiled spiral C, having ends *d d*, substantially as shown and described.

323,460. ELECTRO-DYNAMIC MOTOR, *Frank J. Sprague, New York, N.Y.—Filed March 12th*, 1885.

Claim.—The combination, in an electro-dynamic motor, of main field coils in shunt relation to the armature, differential field coils in series with the armature and inside the terminals of the armature

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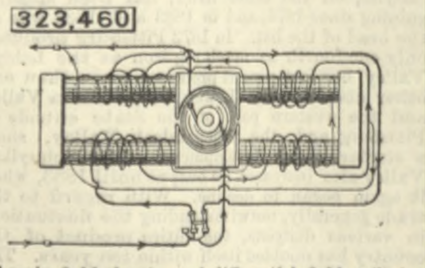

and main field shunts, and differential field coils in series with the armature, and outside the terminals of the armature and main field shunts, substantially as set forth.

323,458. SAND-PUMP, *William S. Smith, Chicago, Ill., and Charles W. Clift, Rockville Centre, N.Y.—Filed June 5th*, 1884.

Claim.—The combination of a water receiver having a semi-spherical deflector thereon, a suction pipe entering said receiver at one end, a discharge pipe at

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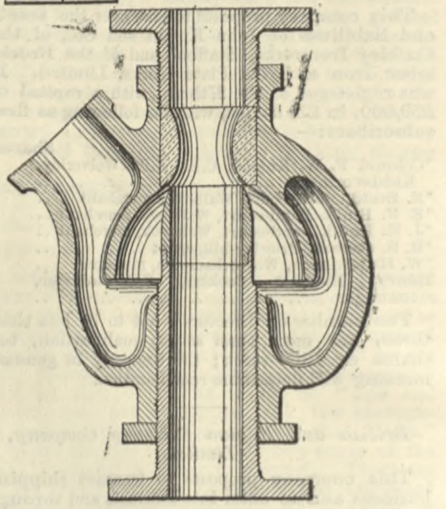

the other end, and a compressible throat-piece between said pipe, substantially as and for the purpose described.

323,510. FEEDING MECHANISM FOR ROLLING MILLS, *Robert W. Hunt and Maximilian M. Suppes, Troy, N.Y.—Filed February 5th*, 1885.

Claim.—(1) In a feeding-mechanism attachment to a rolling-mill train, the combination of the shaft S^1, having the coupler wheel W^1, the clutch C^2, constructed and connected to receive power, and made with a pivotted couple-lever L, the chains C^1 C^1, and the carrier bar B^1, made with the dog d^1, the said parts being constructed and arranged to operate substantially in the manner as and for the purposes set forth. (2) In a feeding-mechanism attachment to a rolling-mill train, the combination of the shaft S^1, made with the coupler W^1, the clutch C^2, constructed and connected to receive power, and made with the pivotted couple-lever L, the carrier bar B^1, made with the dog d^1, the chains K^4 K^4, pulleys p^2, and the weights W^3, said parts being constructed and arranged to be operated substantially in the manner as and for the purposes set forth. (3) In a feeding-mechanism attachment to a rolling-mill train, the combination of

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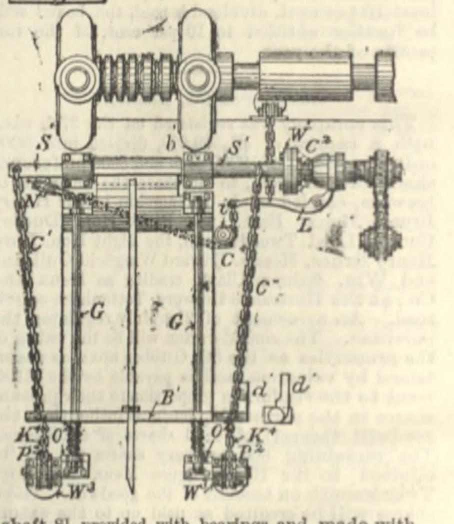

the shaft S^1, provided with bearings and made with the coupler wheel W^1, the clutch C^2, constructed and connected to receive power, and made with pivotted couple-lever L, the carrier B^1, having the dog d^1, and sliding on guides G G, the chains K^4 K^4, the weights W^3, the pulleys p^2, and the stops O^2 O^2, said parts being constructed and arranged to operate substantially in the manner as and for the purposes set forth. (4) In a feeding-mechanism attachment to a rolling mill, the combination of the shaft S^1, made with the coupler wheel W^1, the clutch C^2, constructed and connected to receive power, and having the pivotted coupler-lever L, the carrier bar B^1, having the dog d^1, and sliding on guides G G, the chain C^4, and the pulleys N and *i*, said parts being constructed and arranged to operate substantially in the manner as and for the purposes set forth.

323,600. ELECTRIC LOW-WATER ALARM FOR BOILERS, *William P. Ryman, Wilkes-Barre, Pa.—Filed February 6th*, 1885.

Claim.—The combination, in an electric low-water alarm, of two poles or electrodes of an electric battery with a hollow metallic float of good electrical conductivity attached to one of these poles or electrodes, and so arranged that the other pole or electrode, passing through a hole in top of float and terminating within

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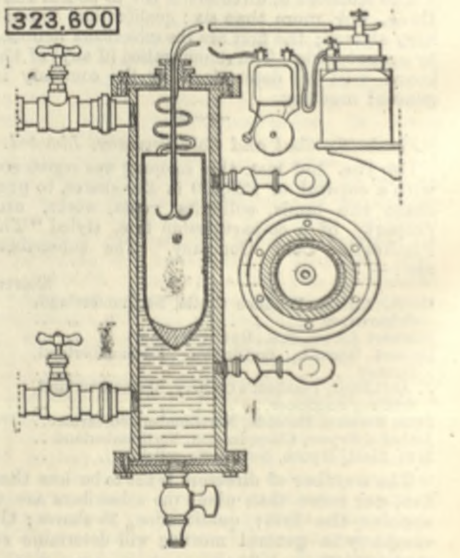

the float, will touch at top and bottom inside the float with the fall and rise of the water in the boiler, thereby closing and opening the circuit of the electric battery, and indicating both the low and high water in boiler, substantially as and for the purpose set forth.