THE PARIS ELECTRICAL EXHIBITION.

No. XIV.

In our last impression we described Hopkinson's electrical hoist, exhibited by Messrs. Latimer, Clark, Muirhead, and Co. The same firm exhibited a dynamo machine designed by Mr. Andrews. The object of the designer is to obtain simplicity of construction without sacrificing efficiency. Fig. 1 shows a perspective view, and Fig. 2 a section of a 6-light machine, which, we understand, will be shown at the forthcoming Exhibition at the Crystal Palace. The field magnets are built up by means of two castings, which form two complete horseshoe magnets, the like poles of which are combined in one casting. The faces of these magnets are presented to the armature, and the extremities are connected together by the ribs outside. Round each of the poles is placed a coil of No. 10 wire, which is first wound on a wrought iron envelope, and then slipped upon the pole piece with the envelope. In consequence of the large mass of iron constituting the poles, there is a probability of a pole of opposite character presenting itself in the centre, and to prevent this the extreme part of each pole is cast hollow.

FIG. 1.

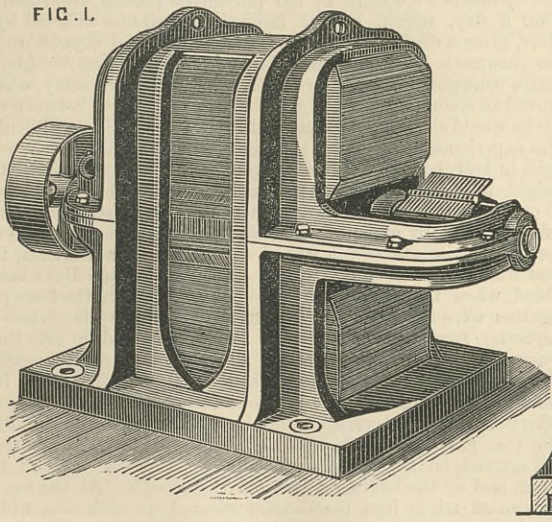


FIG. 2.

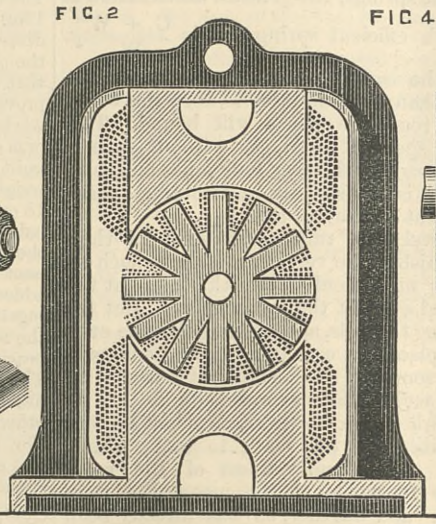


FIG. 4.

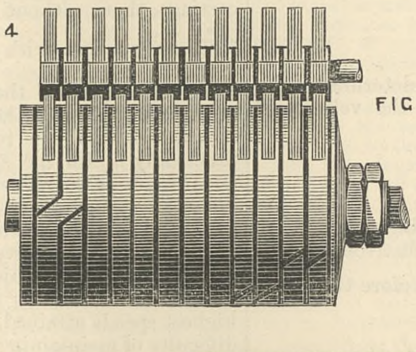


FIG. 5.

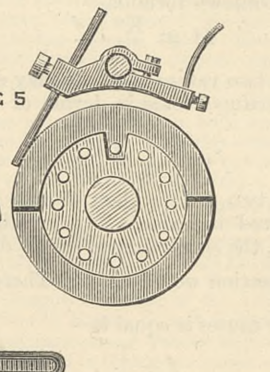


FIG. 6.

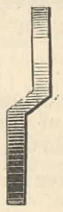
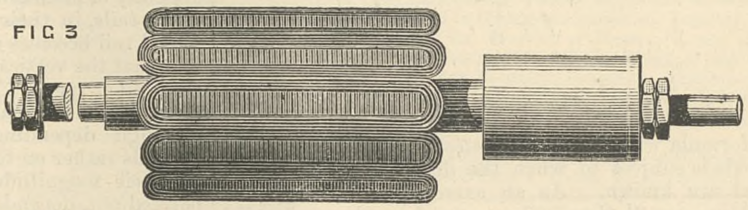
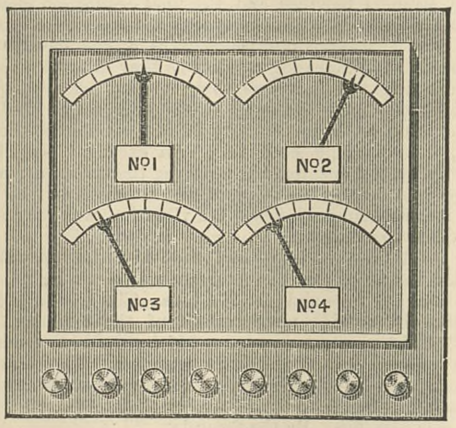


FIG. 3.



ANDREWS' DYNAMO MACHINE.

FIG. 7.



The armature consists of a long cylinder with radial projections, round which coils of wire are wound. The armature is shown in section in Fig. 2, and in elevation in Fig. 3. The cylinder is built up of a number of stamped stars of No. 16 B.W.G., which are separated by tissue paper to give greater facility to the magnetic changes, and also to prevent the passage of induced currents through the iron. These stars are threaded upon the spindle with their radial arms corresponding in position, which thus form cores for the insulated coils of wire wound lengthwise round them. Upon rotation of this armature between the poles of the field magnets four currents are generated in each coil during each revolution, which are carried to a suitable commutator and collected by brushes. There are twelve of these coils, and those opposing each other are joined into pairs by their united ends, the twelve coils thus making six pairs, each pair having its own commutator, consisting of two insulated parts, one for each of the outside ends of the pair of coils. Each part of the commutator consists of a cast brass ring somewhat resembling half a split key-ring, as shown in side view Fig. 6. Two of these rings fit into each other, and resemble a complete key-ring, with, however, the two parts insulated by vulcanised fibre from each other. This compound ring, Fig. 4, is fitted upon a small drum of wood with twelve equidistant holes pierced through it as in Fig. 5, which shows a complete commutator for one section of the armature. The twelve ends from the six pairs of coils are passed through the twelve holes in the wood as each commutator is slipped upon the spindle. The ends for each commutator are connected to their respective parts by the small boss cast upon each ring. As each commutator is placed upon the spindle of the armature, the connecting boss is brought one-twelfth in advance of its neighbour, in order that the same end shall not pass into two commutators. Thus the ends of all the coils pass through the wood of all the commutators, but they can only become electrically connected with their parts, which renders the connection very simple. From this it will be evident that the pair of brushes for each commutator must be side by side and on the top, this position giving great facilities for adjustment. It will be seen from this description that the arrangement followed admits of six circuits, one of which is used to excite the field magnets. The remaining five circuits can be connected as required for the particular purposes in hand, thus can be used as five separate circuits, or quantitatively, or in series as desired.

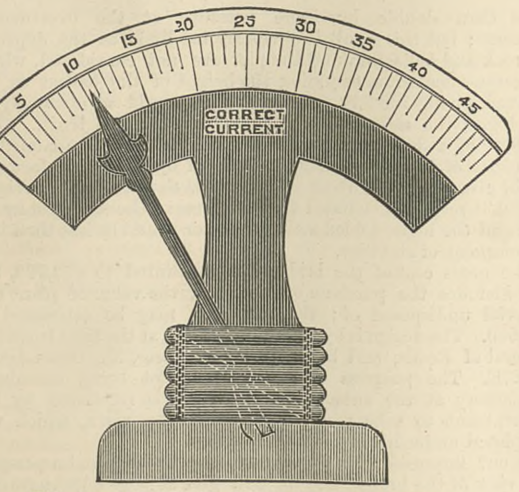


FIG. 8.—ANDREWS' CURRENT INDICATOR.

Besides the machine Mr. Andrews has designed an electric light indicator. This indicator is shown by Messrs. Clark, Muirhead, and Co. It takes the place in the electric light circuit that the ordinary galvanoscope does in a telegraphic circuit. It indicates at all times whether a current is circulating, and to within half-a-veber its amount. Fig. 7 shows a board of such indicators arranged for four circuits. Fig. 8 shows the construction of the indicator. It mainly consists of a coil of wire wound on a brass box. Fitted into this, but removable from it, are two brass pieces connected together by the fixed half of an iron core. The other half core is hinged at its centre, so that the combination somewhat resembles a pair of scissors. To the movable half-core is attached an index, which by means of a scale indicates the quantity of current passing. The magnet being made entirely of soft iron, and there being no permanent magnets employed, there is no liability of the constant, which may be taken once for all, being altered by strong magnetic influence. The instrument is altogether very simple and hardly liable to get out of order, and will no doubt be found useful in all electric light work.

THE LIMITS TO SPEED.

By Professor Osborne Reynolds, M.A., F.R.S

No. II.

To obtain an idea of the effect of accelerations, we may take an instance of a moving machine, and supposing its speed to increase, consider which of its parts would give way first. The locomotive seems to afford the best example. Imagine, then, a locomotive to be started down a long incline with the steam fully on; what part of the machine would give way first? In the case of an engine with its wheels coupled, the question may be answered with certainty. The coupling rods would be thrown off. Although perhaps not generally known, this has been shown both theoretically and practically. Anyone with the smallest mechanical insight, observing from a distance a coupled engine in motion, cannot fail to perceive that the rapid up-and-down motion of these rods, which are held only at the ends, must call for great strength to prevent them breaking in the middle. That the strength so called for approaches the actual strength of the rods can, of course, only be ascertained by definite calculation. Six years ago the case of one of these rods was taken as an example to illustrate to the engineering class at Owen's College the effect of accelerations, and the result of the calculation then made was to show that the strength called for when the engine was running at 70 miles an hour was nearer the limit imposed by the actual strength of the material than is usually considered safe in estimating the size of such structures. Thus, instead of 10,000 lb., the stress amounted in this example to 15,000 lb. The fact was surprising enough to arrest attention, and raise a question as to the considerations which had led to the proportions of these rods. On reference to the text-books and manuals it was found that the effects of accelerations had no place in them, so that it would appear that engineers have had no rule to go by but that of experience; or, in other words, that the dimensions of these rods have been arrived at by the process of trial and failure. All these facts considered, the matter seemed one of no small mechanical interest. For apart from the importance of these rods and the desirability of supplying a theoretically derived formula in place of empirical rules, the experience of the fitness of these rods has been so ample that as soon as we are in a position to calculate the stresses in their material they furnish a very important test as to the factor of safety for such parts of machinery. Thus, it appears that while a rule has been laid down that a certain stress is the greatest which the iron in any important part of a machine should bear, these very important parts have been unwittingly allowed to bear, and have borne safely, half as much again as that given by the rule. That the stress in these rods may be as great as appeared from theoretical consideration, or, at least, that they are the parts of the engine which first give way when an undue speed is attained, has been confirmed by the records of railway accidents. Shortly after the first investigations were made, a train having on it three similar coupled engines ran away down an incline, the brakes being overpowered, and eye-witnesses described how the first symptom of disaster was the flying off of the coupling rods from one of the engines, those from the others following immediately after. In 1878 attention was called to these facts at a meeting of the Manchester Literary and Philosophical Society, and they excited the interest of Dr. Joule, who has kindly sent the author published accounts of several instances of the failure of these rods in cases of high speeds. Amongst these was the following extract from a letter published in the *Manchester Courier*. The accident occurred on the Cheshire line from Manchester to Liverpool, on which the speeds are very high. The author of the letter has clearly used the term connecting rod in the sense of coupling rod. "Shortly after we had passed one of the small stations on the way, and before reaching Warrington, the connecting rod of the engine, or some other material portion of that part of the mechanism, became broken, and flew off with such force as to strike the embankment on the near side, and thence rebound with terrible power into the window of one the third-class carriages immediately behind, completely smashing in the woodwork, as well as all the glass, to the great danger of one or more passengers within, but who escaped uninjured. I was a passenger on another occasion, on the same journey, when the connecting rod snapped in two, and the two pieces continued to whirl round until the train could be stopped, to the great risk of driving the engine and carriages from the metals. And I have heard it said that accidents of a similar kind have occurred on other occasions."

The theory of these rods has been taught in the engineering classes at Owen's College for several years, but its first appearance in print seems to have been in a letter in The Engineer of May 27th, 1881, signed "S. R.," dated Manchester, May 11th; and more fully in an article which appeared in The Engineer, of Sept. 9th, 1881. Leaving what we may call the swinging forces out of consideration, the coupling rods are designed to withstand certain forces which cannot exceed a definite amount. This amount may be estimated for each particular case. The utmost one rod can be called upon to do is to turn one pair of wheels against the whole friction between the wheels and the rail, which latter may be sanded. In such a case, F, the coefficient of friction, would be about ·3. Let R be the radius of the wheels in inches, L the length of the cranks, P the pressure between the wheel and the rail in pounds; then taking T for the force in pounds, tension or compression, in the rod necessary to cause the pair of wheels to slide when the other rod is in the line of centres.

$$LT = FRP,$$

or

$$T = \frac{FRP}{L}$$

T may be either tension or compression, but it is the latter that is the most important for the present consideration. If now we take the swinging action into account, we have to add the effect of the vertical force which must act on each point of the rod in order to change its vertical motion. Relatively to the engine each point of the rod will describe a circle exactly similar to that described by either crank pin. In describing its circle each portion of the rod will be subject to centrifugal force. Consider a cubic inch of material of weight w, the centrifugal force of this by the well-known formula is

$$C = 12\,\frac{w v^2 L^2}{g L R^2} = 12\,\frac{w x^2 L}{g R^2}.$$

Where v is the velocity of the engine in feet per second, and g = 32·2 the acceleration of gravity. The direction of the centrifugal force will be parallel to the line joining the centre of the crank shaft with the centre of the crank pin, and consequently will be vertical and directly across the rod when the cranks are vertically up or down.

We have then a force C, acting upwards or downwards, on each cubic inch of the rod. When the cranks are down this force must be added to the weight of the rod, which will then act in the same direction. Then the effect to break the rod will be the same as if the engine were standing, and the weight of the material of the rod were increased in the ratio $\frac{C + w}{w}$. So that as regards this force the rod may be considered as a loaded beam. Let the rod be of uniform section of length H_1, area S, and depth $2y$, also let K be the radius of gyration of the section. Then the load on the rod is $(C + w)$ S H, and the greatest bending moment in inch-lb. is $(C + w)\frac{S H^2}{8} = M$, and if f be the greatest stress in the rod, the resistance to bending we have the well-known formula—

$$M = \frac{K^2 S f}{y}$$

Comparing these two values of M we may determine f the stress due to centrifugal force in terms of the velocity of the crank pin—

$$f = \frac{C + w}{8}\,\frac{H\,y}{K^2}$$

We have thus two independent forces, to which the material of the rod is liable. The bending moment M and the thrust T, the stress caused by T distributed uniformly over the section would be $\frac{T}{S}$. Therefore the stress due to both these causes is equal to—

$$f + \frac{T}{S}$$

and

$$f + \frac{T}{S} = \frac{c + w}{8}\,\frac{H y}{K^2} + \frac{T}{S}$$

which formula will give the greatest stress which one of these rods is subject to when the dimensions, speed, and material are known. As an example let us suppose, H = 108in., $y = 2\frac{1}{4}$, S = 7·87, w = ·28, L = $8\frac{1}{2}$, v = 100 (70 miles an hour nearly), R = 39in., P = 26880 (12 tons), F = ·3.

Substituting these quantities, which correspond to the dimensions of an express passenger engine on the North British Railway described in THE ENGINEER, vol. l., 1878, and we find

$$f = 11357,$$
$$\frac{T}{s} = 4700,$$

so that the greatest compressive stress in the rod when the engine is running at seventy miles an hour is 16,000 lb. per square inch. This stress is applied and reversed from tension to compression every revolution of the wheel, so that the fact that these rods do safely withstand these stresses affords sufficient proof that the material of which they are composed will safely bear a repeated load of 16,000 lb. on the square inch. As they are constructed, however, these rods clearly impose a limit on the possible speed of the engine, and a limit very close to that which is actually attained by passenger engines. There is no necessity, however, that this limit should be so low. The simple bar form which is usually that given to these rods is about the worst shape they could have to resist the centrifugal forces. By making them hollow or with flanges, it would be perfectly easy to extend the limit considerably without adding to the weight of the rods. Examples of such rods are considered in the article of September 9th.

The coupling rods are those parts of a locomotive in which the accelerations produce the greatest effect, but all the reciprocating parts of the engine are subjected to similar forces. The connecting rods differ from the coupling rods, in the fact that it is only one end that swings, and hence that the effect of the acceleration varies from nothing at the piston end to the value given by the formula at the crank end. Thus while the coupling rods may be regarded as a beam loaded uniformly, the connecting rods are subject to loads varying uniformly from the piston to the crank end. But the result will be the same, and the liability of the connecting rod to break under its swinging action would impose a limit to the speed were it not for the inferior limit imposed by the coupling rods. Let alone the swinging motion, the mere reciprocation would impose a limit to speed. Thus to stop and start the piston and its attachments requires a force which is given by the same formula $\frac{W\,v^2\,L}{g\,R^2}$, L now being the length of the crank, and W the weight of the piston and its attachments. At moderate speeds these forces are small compared with the forces produced by the pressures of the steam, but increasing, as they do, as the square of the speed, they soon leave the others behind. By diminishing the lengths of the cranks in proportion to the diameters of the wheels, and the consequent amplitude of reciprocation, the accelerations are proportionally diminished; but then, in order to transmit the same power, the size of the pistons and the dimensions of all the parts must be proportionally increased, and then the heating of the bearings comes in to limit the speed. Thus with high speeds of pistons the forces arising from reciprocation limit the speed, while with low speeds the difficulty of the bearings limits the speed. There is, therefore, a middle course between these two extremes, and it is this medium course to which experience has led, although the determining causes have been but very imperfectly recognised.

So far the accelerations spoken of have been those which result from the regular motion of the internal parts of the engine. But in the case of all carriages there is another class of accelerations, which, although less regular, act a similar part in causing a limit to the speed, and which follow the same laws. These are the vertical accelerations which arise from the inequalities of the road. If the road be uneven—as all roads are, more or less—the wheels, and to some extent the carriages, move up and down according to the inequalities. This up and down motion, although not regular, necessitates up and down accelerating forces, which will be proportional to the square of the velocity of the carriage, so long as no limit comes in to prevent the wheels following the inequalities of the road. The upward acceleration is caused by the pressure of the road on the wheel, and the limit to this is obviously one of strength. So long as neither the road nor the wheel give way, the motion must ensue. But the downward acceleration can only result from the force of gravitation acting on the wheel, and the pressure exerted by the carriage to keep the wheel down. Where springs are used this pressure will be maintained nearly constant, whatever the acceleration may be; but without springs the greatest acceleration is that of gravity—for the carriage will have to follow the wheel in its vertical motion, and the greatest acceleration is when they are both free to fall.

If W be the weight of the wheel and C the load of the carriage, then, without springs, the greatest acceleration is 32·2, or g; but with efficient springs it is $\frac{C + W}{W}\,g$.

When the speed of the carriage is such as to require an acceleration greater than this in order to keep the wheel in contact with the road, the wheel will bound. This practically limits the speed of carriages without springs on ordinary or paved roads to three or four miles an hour; but with springs there is no difficulty in attaining speeds equal to the highest that horses can maintain.

The use of the level iron rails maintained in their proper position diminishes the vertical motion to such an extent, that there is no difficulty from this cause at the highest speeds attained even at the present day. But the difficulty of maintaining the rails, and particularly the ends of the rails, in their places, is considerable, and one misplaced rail becomes a source of danger, so that it cannot be said that the vertical accelerations exercise no influence on the limit of speed. This action, however, must not be confused with the liability of the train to rock, which, although depending on the unevenness of the road, depends rather on the frequency of the inequalities than on their magnitude; and further, as has already been pointed out, depends on the elastic properties of the train. This rocking will be considered in another article.

THE FITZROY BRIDGE, ROCKHAMPTON, CENTRAL QUEENSLAND.

THE Fitzroy Bridge, the first bridge erected in Australia on the suspension principle, crosses the Fitzroy River at Rockhampton, Central Queensland, and was opened for traffic on New Year's Day of the present year. Owing to several difficulties and delays, the work of construction was extended over a period of nearly four years, otherwise it might have been completed in little more than half that time. One of the chief causes of delay was the inability of the contractor to fulfil his engagements for the cylinders, which necessitated re-letting the contract to another firm—Messrs. Mort's Dock and Engineering Co., of Sydney, N.S.W.; but here a fresh difficulty occurred. Owing to the great bulk and weight of the cylinders, it was almost impossible to obtain freight on reasonable terms, so that after a part had been forwarded to Rockhampton it was finally decided to cast the remainder, which comprised the superstructure, on the spot, and a contract was accordingly entered into with Messrs. Burns and Twigg, of Rockhampton, which was carried out satisfactorily, without further delay.

The length of the suspended portion of the bridge is 1104ft. between the stone abutments, divided by five river piers into four main spans of 232ft., and two end spans of 88ft. The piers are formed of two cast iron columns 30ft. apart from centre to centre. The cylinders of these are 6ft. 6in. diameter, 1in. in thickness, in 6ft. lengths, bolted together by thirty-two $1\frac{1}{4}$in. bolts, and filled with concrete to within 7ft. of the under portion of the flooring. Above this they are surmounted with cast iron flanges cast in the form of capitals, which act as supports to the cantilevers of the balconies. The columns are braced together under the capitals and at half-tide mark with wrought iron girders 18in. in depth, and built diagonal braces of timber 10in. square, stiffened on each side by a midrib of 5in. T iron, which thus act both in compression and tension. From the roadway upwards the columns taper to the bearing of the saddles, where they are 4ft. in diameter, and are braced together by cast iron girders 2ft. in depth, relieved by spandrils, which form an ornamental arch between the columns. The space through which the chains pass is surmounted by castellated octagonal capitals of cast iron, which give the columns the appearance of embattled towers.

The chains are composed of hammered iron links 6in. by 1in. or $1\frac{1}{8}$in. in section, according to position, and there are seven links in each panel 14ft. 6in. long, pinned together by Bessemer steel pins $4\frac{1}{2}$in. in diameter. There are sixteen panels, or intervals, between the suspension rods, exclusive of the saddle links, which are 6ft. by 12in., by 1in. or $1\frac{1}{8}$in. The minimum section of the two chains is 100 square inches. They have been tested to $13\frac{1}{2}$ tons per square inch without elongation, and are equal to a strain of 1300 tons within safe limits. The ends of the chains, after forming the half or end spans from the piers to the stone abutments, are turned over a land saddle and down through an arched channel in the concrete of the abutments, to cast iron anchor plates, at a distance of 24ft. vertically and 44ft. horizontally from the saddles. The anchor plates are of cast iron with wrought iron plates, behind which the chains are held with steel pins, the whole being built into the concrete of the abutment, which is faced with stone. A tunnel, to which access is afforded by a shaft opening on the level of the street, connects the two anchor plates.

The suspension rods are in pairs, one vertical and one diagonal, to give increased stiffness. They depend from the connecting pins at each panel joint, and are in two pieces, joined together by a right and left-hand adjustable screw. To the lower length of each rod a stirrup, made of 1in. plate 6in. in width, is attached by a 2in. pin, which sustains the ends of the double transoms of I rolled iron 8in. in depth, which carry the whole weight of the flooring. The chains and suspension rods are inclined inwards at an angle of 5 deg., the lugs of the stirrups being bent correspond. The roadway is attached to the bottom chords of a timber Howe truss, the chords resting on the ends of the iron transoms, between which the $1\frac{1}{4}$in. round iron verticals of the truss are passed and bolted under them. The truss is 8ft. in depth, in panels of 7ft. 3in., the top chord is 6in. by 10in., the bottom 12in. by 10in., the braces are double 6in. by 3in., and the counter braces single 6in. by 4in., each stepped into cast iron shoes spiked to the top and bottom chords. The roadway is composed of timber transoms 6in. by 12in., resting on the bottom chords, four to each panel. On these the 4in. by 8in. longitudinals are placed 20in. apart, and bolted to them at each intersection by $\frac{5}{8}$in. bolts, and upon this 6in. by 3in planking is laid diagonally and spiked down. The whole is further stiffened by diagonal braces of $1\frac{1}{4}$in. round iron passing through the lower chords of the truss and bolted against cast iron washers on each side by a 6in. by 6in. kerb, fastened to each brace and counter-brace along the whole length and through the planking to the transoms. A balcony runs round each of the columns to continue the pathway for foot-passengers.

The bed of the river is of Devonian shale, seamed in parts with soft limestone, but so hard when penetrated a little below the surface as to afford a thoroughly satisfactory foundation, and in this the cylinders were sunk to a depth of from 3ft. 9in. to 9ft. The depth of the water was from 12ft. to 21ft. at low tide, making operations easy, except at the deepest piers, of which 91ft. from foundation to top is the deepest, sunk to a depth of 4ft. 9in. in the rock, and surrounded to a further depth of 20ft. with stone ballast. These could not be carried on above half-tide, and were stopped altogether during any fresh on the river. The cylinders were sunk, by the pneumatic process, from 8in. to 13in. a day, which, against 3in., the maximum effected by a diver, gives a decided preference both in cost and expedition to the pneumatic method. Punts being available, it was considered that a continuous staging across the river was unnecessary, which proved an error, as the convenience of communication between the works would alone have balanced the extra cost. Some difficulty was experienced in hanging the suspension chains. These were built in half lengths depending from each side of the piers; the weight in each half length to be lifted was reduced to 6 tons 18 cwt. by supporting the first panels on trestles stepped on the balconies, and by omitting links successively in each panel, viz., the first at its connection was of seven links, the next six, the next five, and so on to two at the ends, the omitted links being added when the connection was made. The lengths thus put together were allowed to hang from the trestles to the surface of the water, from whence they were folded back, and up into their bearing on the trestles, awaiting the operation of connection. The great height of the piers (from 78ft. to 91ft.) made it a necessity that this should be done simultaneously in each span, otherwise the great leverage would have endangered the columns. For this purpose a mast, 40ft. high, strongly stayed and braced, was erected on staging constructed on punts for three of the spans, and on the landing wharf for the fourth. At the top of each mast triple iron blocks were secured on each side, which lifted the two ends of the chains, whilst they were drawn together by similar blocks, about 10ft. down, at the level of the top of the staging; tackles of $4\frac{1}{2}$ Manilla rope were reeved through these, and double blocks at the end of the chain, at which a lowering tackle was also reeved, the fall being let down to four winches on the punts and down the columns. At a signal the triced-up ends of the chains were lowered simultaneously, the slack being taken up by the tackles from the punts. This method was entirely successful, the ends were lifted and strained together, and the final connection made by mauling in the last pin, when the eyes of the links were brought opposite. The remaining operations were comparatively easy, and carried on with increasing rapidity as they drew to a close.

The great height of the piers, their comparative slenderness, and the light appearance of the whole structure, raised doubts in the public mind as to its stability in case of sudden shock, a hurricane, or even a high flood tide. An excellent test of the first occurred at the opening, when during the ceremony, whilst the bridge was densely crowded, a fire occurred in the town causing a regular stampede, when the vibration was very slight and the deflection only half an inch. Investigations as to the wind and flood pressure have been made with the following results. The weight of one pier and span is — chains 44 tons, truss and floor 131 tons, and pier 274 tons. The base of the pier being 36ft. 6in. outside measurement of the cylinders, the surface exposed to pressure is, chains 350 square feet, truss and floor 2808 square feet, and pier 321 square feet. The centres of wind pressure will be half the heights from low water mark plus depth of columns thence to their base, or chains 66ft. 6in., truss 60ft. 6in, pier 57ft. 6in. By the formula

$$\frac{\text{Weight} \times \frac{1}{2}\text{ base}}{\text{Surface} \times \text{centre of wind pressure.}}$$

We have 44 + 131 + 274 × 18·3 = 8194·25 tons, and 350 × 66·5 + 2808 × 60·5 + 321 × 57·5 = 211616·5 foot pounds = 94·47 tons. Therefore, $\frac{8194 \cdot 25}{94 \cdot 47}$ = 86·73 lb. per square foot, or more than double hurricane pressure at the overturning moment; but this result is obviously too little, as the depth of the rock and ballast around the pier are not considered, whilst the same calculation, assuming the height of the ballast as the fulcrum, giving 148·5 lb. per square foot, would as obviously be too high; the mean 117·6 is probably near the truth. The pressure of a flood current, the highest known, and assumed at a velocity of 10 miles an hour, calculated by the same formula, would give a mean of about 30 times less than the static weight, so that it may be concluded that the force of the strongest hurricane and the highest flood acting together would be less than half the moment of stability.

The gross cost of the bridge has amounted to £53,700, but this includes the purchase of land and the value of plant and material undisposed of; the real cost may be estimated at £51,000. The design is by Mr. F. J. Byerley, at the time Inspector General of Roads, and his assistant engineer, Mr. Owen Jones, A.I.C.E. The progress of construction not being considered satisfactory at the outset, Mr. Byerley was requested by the Government to take personal charge of the work, which was completed under his immediate direction.

In our impression for November 4th will be found a perspective view of the bridge, and we now give at page 360, engraving of details, which explain themselves.

THE INSTITUTION OF CIVIL ENGINEERS.—At the meeting on Tuesday, the 8th of November, Mr. Abernethy, F.R.S.E., president, in the chair, the paper read was on "Iron Permanent Way," by Mr. C. Wood, M. Inst. C.E. On Tuesday, the 15th, the discussion upon Mr. Wood's paper on "Iron Permanent Way" was continued and concluded. It is not necessary to give any lengthened notice of this paper, inasmuch as the whole of the information it contained has been published several times before, and more has been published in our series of nine illustrated articles on Iron Railway Sleepers, published in THE ENGINEER, extending from 12th September, 1879, to 2nd April, 1880. The author's system has been fully illustrated in a paper of the Iron and Steel Institute, published in our columns, and published elsewhere. Our articles, moreover, gave statistics of cost and weight, showing the relative cost of nearly every system that had been tried, the whole being referred to that on trial on the North-Eastern Railway as a standard for comparison in this respect.

RAILWAY MATTERS.

The Cape Town Railway Station has been successfully lighted by electricity.

The Victorian Government are seeking a loan of £4,000,000, of which £2,500,000 is to be used for railway purposes.

The total length of the branches from the central section of the Canada Pacific Railway is 1035 miles, the main section itself measuring 900 miles.

The Beaumont Company's compressed air engine is now in daily use on the lines of the North Metropolitan Tramway Company between Stratford and Epping Forest.

At the close of last year the number of miles of railway in course of construction in the Australian colonies was as follows:—New South Wales, 456; Victoria, 14½; South Australia, 319; Queensland, 171½; New Zealand, 208. Total, 1169.

Severe storms, with a heavy fall of snow and high winds, are reported from the Far West. A passenger train on the Colorado Central Railroad was blown from the track. Two coaches were demolished and thirteen passengers injured. A cyclone in Mississippi injured seven persons.

The Midland Railway Company is about to make an important experiment with the electric light, viz., the lighting of the whole of the Erewash Valley, stations, sidings, and signals. Power is to be obtained from one engine at Chesterfield to light as far as Alfreton, and by another engine at Nottingham to light as far as Pye Bridge. The Erewash Valley has been selected for the experiment on account of there being so many stations, junctions, sidings, and branches within so short a distance.

The Great Northern Railway Company has accepted the tender of Messrs. Baker and Firbank, of Lincoln, for the construction of a junction curve at Barkston, near Grantham. The works are to be proceeded with at once, as it is desirable that the curve should be opened early next year in order that trains from the north may run direct by way of Sleaford on to the new Great Northern and Great Eastern joint line from Spalding to Lincoln, on which Messrs. Baker and Firbank are also contractors.

We have to record the death of Mr. George Stephenson, manager of the Darlington section of the North-Eastern Railway, on the 11th inst. He was seventy-five years of age. He became first connected with the old Stockton and Darlington Railway in 1834. He began, it is said, as a guard, and was at one time an engine-driver; but, exhibiting good business talents and displaying great practical knowledge, he gradually worked to the front, and about twenty-seven years ago he was appointed goods manager of the line, the office of passenger superintendent being afterwards added.

On the 11th inst. a meeting was held in the Mechanics Hall, Rothwell, in order to hear the particulars respecting the proposed East and West Riding Railway, which will closely affect that district by running through it. The chairman moved:—"That this meeting warmly approves of the proposed scheme as affecting Rothwell and district, and pledges itself to use its best endeavours to give further support to the scheme and to promote its passing through Parliament." This was unanimously passed, followed by the appointment of a large committee, and a number of additional subscriptions.

The proposed new railway between Skipton and Ilkley will commence in the township of Skipton by a junction with the Midland—Leeds and Bradford Railway extension from Shipley to Colne—Railway, and terminate in the township of Ilkley by a junction with the joint line of the Midland and North-Eastern Railway Companies near Ilkley Station. The railway will connect Skipton, Millholme, Embsay-with-Eastby, Embsay, Eastby, Skibeden, Halton East, Draughton, Bolton, Bolton Abbey, Bolton Bridge, Beamsley-in-Skipton, Beamsley-in-Addingham, Beamsleys Both, Farfield, Addingham, Nesfield-with-Langbar, Nesfield, Langbar, Middleton, Netherwood, Holling Hall, and Ilkley, all in the West-Riding of the county of York.

The promotion order for the South Staffordshire Tramways project, just issued, authorises the construction of tramways from Wednesbury to Dudley *viâ* Ocker-hill, through Prince's-end, Bloomfield, and Tipton to Dudley. The starting place is to be near Wednesbury Railway station, and the terminus on Tipton-road, three chains north of the centre of the front of Dudley Railway station. Subject to certain regulations, authority is given for the use of steam or other mechanical power. An important privilege is conferred on the local boards through whose districts the tram lines pass. They may use the lines at any time between twelve at night and six in the morning for sanitary purposes, and for the conveyance of scavenging stuff and night soil.

An accident of an alarming character happened a few miles north of Lancaster on the night of the 10th inst. A passenger train, consisting of three third-class carriages, two composite carriages, two guards' vans, and three trucks, was approaching Carnforth from Barrow, and in passing the bridge which spans the river there four carriages and the rear van left the rails. One composite carriage and two third-class carriages, each containing passengers, were thrown completely over on their sides. A scene of great confusion ensued, but fortunately the train was soon brought to a standstill. Some of the passengers scrambled out as quickly as possible, and others were liberated by means of ladders. All, it is stated, were considerably shaken; but, with the exception of one gentleman, they were able to resume their journey after some delay.

The directors of the London and North-Western Railway, in their notice to go to Parliament next session for fresh powers, mention, among other things, that they propose to construct a railway to be called the Wednesbury Curve. It is to be wholly situate in the parish of Wednesbury, commencing by a junction with the Tipton branch of the company's South Staffordshire Railway, at a point 100 yards west of the bridge carrying the Great Western Railway over the South Staffordshire Railway, and terminating by a junction with the Darlaston branch of the last-mentioned railway at a point 35 yards south of the bridge carrying Victoria-street, Wednesbury, over that branch. The local authorities of Smethwick, South Staffordshire, in order to obtain a *locus standi* in the matter, are going to oppose the London and North-Western Railway Company in its forthcoming application to Parliament for permission to make certain alterations in level crossings and station accommodation.

On Tuesday a meeting of gentlemen representing the landowning and colliery interests on the line of route of a projected new railway direct from Leeds to Hull, was held in Leeds by adjournment from the previous Tuesday. On the first occasion it was stated that the scheme for the East and West Yorkshire Union Railway had assumed a definite shape. It is proposed to construct a railway which shall form a junction with the Great Northern Railway at East Ardsley, and extending thence almost due east through Rothwell, Oulton, Woodlesford, Allerton Bywater, Fairburn, Burton Salmon, Birkin, Burn, Camblesforth, and terminating by a junction with the authorised Hull and Barnsley Railway, now in course of construction, at Drax. Junctions are proposed with the Midland system at Woodlesford, which will give a direct route between Leeds and Hull, and at Burton Salmon, which will give a new export outlet to the towns in the Calder Valley. By the line a new route will be opened up between the northern section of the Yorkshire coal-field and the port of Hull. The projected line will be 25½ miles in length, and cost, including plant and rolling stock, £510,000. Mr. G. Hopkins, of London, was appointed consulting engineer; Mr. Malcolm Paterson and Mr. J. W. H. White, local engineers. At the adjourned meeting held on Tuesday about fifty persons attended. Resolutions were passed directing the engineers and solicitors to proceed with the work of preparing plans and other matters necessary for the promotion of the Bill in the ensuing session of Parliament.

NOTES AND MEMORANDA.

The following figures give the miles of telegraph wire open, at December 31st, 1880, in our Australian colonies. New South Wales, 13,188; Victoria, 6019; South Australia, 6904; Queensland, 8150; Tasmania, 1096; Western Australia, 1592; New Zealand, 9401. Total, 46,350.

At the end of December, 1880, the number of acres under crops of various sorts in Australia was as follows:—New South Wales, 706,498; Victoria, 1,993,916; South Australia, 2,574,489; Queensland, 112,290; Tasmania, 140,788; Western Australia, 63,902½; New Zealand, 917,660. Total, 6,509,543½.

The following is given by the American *Mechanical Engineer* as the work performed by moulders of the Singer Sewing Machine Company, Elizabeth Port, N.J. Each item mentioned is one day's work:—160 flasks sewing machine wrenches, eight pieces in flask; 138 tables; 260 flasks arm covers, two pieces in flask; 300 balance wheels; 178 band wheels, 350 belt wheels. All machine moulded. On the floor: 54 legs, or frames; 69 crosspieces; 96 treadles.

An American contemporary states that copper can be welded by the use of concentrated lye such as is sold in stores for soap-making. That of the Pennsylvania Salt Company is best. Melt the lye over the fire in an iron kettle, and when the copper is at the proper heat, dip it into it quickly and unite the two scarfs as in any welding. It may require experiment to hit the heat, but we know it can be done, with the lye as a flux, because we have done it. We have an idea that the name of the flux is not spelt quite right.

To remove bolts that have rusted in without breaking them, the most effectual remedy that is known to the *Boston Journal of Commerce* is the liberal application of petroleum. "Care must be taken that the petroleum shall reach the rusted parts, and some time must be allowed to give it a chance to penetrate beneath and soften the layer of rust before the attempt to remove the bolt is made." Bolts and studs on which the nuts are fixed with rust are often broken off through impatience. In most cases a small funnel built round a stud or bolt end on the nut with a little clay, and partly filled with any of the searching petroleum oils, and left for a few hours, will enable the bolt or nut to be moved.

An interesting experiment and simple way of making imitation flowers has been described by the Belgian physicist, M. Plateau. He bends fine iron wire so as to present the contour of a flower of six petals. The central ring to which the petals are attached is supported on a forking stem, which is stuck in a piece of wood. After oxidising the wire slightly with weak nitric acid, the flower is dipped in glycerine liquid, so as to receive films in the petals and the central part. It is then turned up, placed on a table near the window, and covered with a bell jar. For a little at first it appears colourless, but soon a striking play of colours commences. In the experiment M. Plateau describes the flower continued showing modifications of colour for ten hours, when dusk stopped observation. Next morning several petals had burst. The liquid used was of very mediocre quality. M. Plateau recommends preparation of the liquid thus:—Dissolve a fresh piece of Marseilles soap, cut up into small pieces, in 40 parts by weight of hot distilled water. Filter after cooling, and mix thoroughly three volumes of the solution with two of Price's glycerine. The solution should be left at rest till all air bubbles are gone.

In a telephone connected by a wire between the roofs of houses, and connected with the water or gas pipes, sounds are heard immediately on the occurrence of lightning, whatever the distance of the latter. Even when no thunder was heard, and the discharge must have been at least twenty-one miles away, M. René Thury, of Geneva, observed these induction effects. The sound is like that of a Swedish match rubbed on the box. M. Lalagade amplified the sounds by placing two microphones on the plate of the receiving telephone. The arrangement is set up in a quiet room and he is able to hear the least sound at a distance of a metre from the second telephone. Again, M. Landerer, at Tortosa, finds currents produced in his telephone circuit by atmospheric electricity in three different ways. First, the condensation of aqeous vapour results in a sound recalling the cry of tin. A sensitive galvanometer in the circuit is not, or hardly, affected. These sounds are strongest at night. Next, there are the sounds which occur during lightning, and the currents producing which effect a galvanometer considerably. Thirdly, the wind generates currents which do not act on the telephone, but act on the galvanometer strongly. At Tortosa, the very dry west winds produce the greatest oscillations. Telluric or earth currents act both on the galvanometer and on the telephone; they are distinguished from atmospheric currents by the regularity and continuity of their action, during pretty long intervals.

The effects of different poisons have usually been ascertained by injecting a given quantity of each into the veins of animals, and noting the effects. M. Richet has recently tried poisoning the medium in which the animal breathes. If a fish be put in a poisonous solution it dies sooner or later according to the concentration of the poison. M. Richet adopts as the "limit of toxicity," the maximum quantity of poison—referred to one litre of water—allowing a fish to live more than forty-eight hours. This limit he has determined for various metals, always using the same acid radical—viz., chlorides. The limit of toxicity was calculated, not per weight of chloride, but per weight of combined metal. The figures show that there is no precise relation between the atomic weight of a substance and its poisonous power. Copper is 600 times as poisonous as strontium, though its atomic weight is less. Lithium, with an atomic weight only the twentieth of that of barium, is three times as poisonous, &c. Even with metals of the same family, no relation between the two things was discoverable. Cadmium (112) is only about half as poisonous as zinc (65); lithium (17) is seventy times as poisonous as sodium (23). Nor could any relation be made out between the chemical function of a body and its toxical power. Thus, potassium and sodium, the chemical properties of which are so similar, have very unequal toxicity; one gramme of potassium is nearly 250 times as poisonous as one gramme of sodium.

M. Cherbonneau has published some interesting particulars relating to the money in circulation in Tunis and of the measure in use in the *Revue de la Géographie*. The smallest and least valuable coin is of copper and called *fetous-rekik*—small money—and by abbreviation *fetous*. Like similar coin, known as the *demi-aspre*, it is disappearing from circulation, from the fact that prices of articles have risen of late years even in Tunis, and it is found inconvenient to bargain in such infinitesimal moneys. The *aspre*, called by the natives *naceri*, is divided into 12 demi-aspres, and it takes 52 aspres to go to the piastre, this latter being of the value of 80 centimes. The *kharroube* or *garouba* is equivalent to 3¼ aspres, and a sixteenth part of a piastre. It bears the words "Sultan Selim" on one face, and on the reverse "*Douriba fi Tounès*, 1803." According to the observations of Marcel, the Orientalist, the weight of the *kharroube* is one gramme—rather over a pennyweight. The piastre, called in Tunis the *rial*, is a silver piece with some alloy, and is worth 16 kharroubes, but it has undergone a good many modifications, both in value and weight. In point of fact, the weight of the old piastre was 15¼ grammes, while that of the present one is only 11½. For the last fifty years a piece has been struck at Tunis, which represents two piastres, and is called *rialëin*, the value being 1f. 60c. The *soultani* is a gold coin, something like, but not so thick as the Venetian sequin. Its legal value is 4½ piastres, but in reality it is current at Tunis for nearly 6 piastres, and on the Marseilles Exchange at 6f. 25c. The *nousf-soultani* is equivalent to the half sequin, and the *rouba-soultani* to the quarter sequin, and on some of the older of these coins is the legend "The Sultan Mahmoud Khan, Sovereign of the two continents and the two seas, may God give him victory," and on the reverse "Struck at Tunis, 1809."

MISCELLANEA.

The Oxford Local Board proposes to rebuild and widen Magdalen Bridge. The proposal is received with considerable opposition.

Sir John Bowring's scheme of 1859 for a canal through the Isthmus of Kraw, situated in the upper part of the Malay Peninsula, is being revived under French auspices.

Efforts are at present being made by the leaders of the operative engineers to extend their organisation to several districts in Scotland, where the men have hitherto been outside the union.

The Dewan of Mysore has decided to form an Agricultural Department for Mysore, and is importing improved ploughs, water-lifts, and sugar-cane mills from Cawnpore. An exhibition, the *Colonies and India* says, will shortly be held.

It has been ascertained that the shipments of gunpowder from Glasgow during the ten months ending with October, amounted to 1,214,000 lb., valued at £23,469, as against 1,274,900 lb., and the value of £26,560, in the same period of 1880.

Sheffield exports to the United States during the month of October last show a total of £77,756, as compared with £93,770 for the corresponding period of 1880. The steel exports are less by £5549, the cutlery exports by £2483, and the total exports are decreased by £21,013.

According to the *Weser Zeitung*, the estimates for the administration of the Imperial Navy for the fiscal year 1882 and 1883 includes the cost of 228 Hotchkiss revolving cannon and accessories. The estimates have been increased this year on account of the purchase of revolving cannon, which have become indispensable for protection against hostile torpedo boats.

Mr. H. J. Allison, for many years known to the frequenters of the Patent-office Library as ever ready to afford every facility to inquirers, has, we are glad to learn, been appointed librarian, in succession to the late Mr. G. Atkinson who held that appointment. We hope that this change will not put him out of sight, but that he will still be found in the library.

Electric lighting is making considerable progress in Glasgow and neighbourhood. The Clyde Navigation trustees are at present experimenting with the light at their docks, and it is their intention to adopt it permanently, at least for the graving docks, so that operations may be carried on during the night. This week the galleries of the Glasgow Institute of the Fine Arts were lighted up for the first time by Messrs. D. and G. Graham.

The Water Commissioners of Paisley began the construction of the important extension to their waterworks on Tuesday which is to be carried out under the direction of Messrs. J. and A. Leslie, C.E., Edinburgh; the contract for piping being in the hands of Messrs. McLaren, Eglinton Foundry, Glasgow. The new reservoir will be constructed with an area of 140 acres, which will contain 750,000,000 gallons, equal to 180 days' supply at the rate of 3,000,000 gallons per day.

Sheffield armour-plates are in future to be still more severely tested. Up to the present time a 12-ton muzzle-loading gun has been used on board the Nettle turret ship, in Portsmouth harbour, the distance between the gun and the target being only nine yards. The Admiralty have resolved to replace this weapon by an 18-ton breech-loading gun, which will undoubtedly possess greater penetrating power. The Admiralty intend, however, to complete the experiments with plates for H.M.S. Collingwood, which will extend over a period of three months.

A hygienic exhibition, under the patronage of her Imperia Majesty the Empress of Germany and his Imperial Highness the Crown Prince, will be held next year in Berlin. The exhibition will be especially devoted to the various departments of hygienic, sanitary, and economic sciences and trades, and great efforts are being made to make it a success. Foreign manufacturers are especially invited by the committee to exhibit, although it is not, strictly speaking, an International Exhibition. All inquiries may be addressed to Mr. David Grove, Friedrich-strasse 24, Berlin, S.W.

An interesting excursion was made on Thursday by a number of the members of the Manchester Geological Society to several of the large collieries in the Wigan district, and the glass works belonging to Mr. Stock, at Plank-lane. The collieries visited included the Sovereign Pit, belonging to Wigan Coal and Iron Company, when the members had an opportunity of inspecting the long-wall system of working in the Wigan 6ft. or 9ft. mine, and the method of working with the absence of explosives, together with other underground and surface arrangements now adopted in the most modern systems of mining.

We have received a copy of a finely executed folio catalogue of the manufactures of Messrs. Buckley and Taylor, of the Castle Ironworks, Oldham. The principal articles illustrated are double and single face slide water valves for mains and towers, up to 28in. in diameter, equilibrium, junction, and governor valves, air pump buckets, pistons, pedestals, plummer blocks of various designs, wheel moulding machines, compound steam engines, steam hammers, boilers, engine parts, spur gear, and fly-wheels, with or without spring ring fittings to prevent leakage by backlash, &c. The drawings are nearly all working drawings, and are excellently well done. The designs are good, and Messrs. Buckley and Taylor's catalogue would really make an excellent copy-book for young engineer students.

The Italian National Exhibition in Milan, which was opened on the 5th May last, came to a close on the 1st inst. Its success has surpassed the most sanguine hopes. Upwards of 7150 objects or groups were shown, by more than 6000 exhibitors, an area of over 40,000 square metres being occupied for the purpose. About 1,250,000 visitors entered the Exhibition during the six months it remained open, and the sales effected during the period amount to an important cypher. Among the buyers are the King and Queen of Italy—who largely patronised the show—and several noteworthy English and French firms, who have made considerable purchases, in the silk departments chiefly. With few exceptions, all the Exhibition buildings will be pulled down, and when the ground is thus cleared, and the special lottery over, the committee expects to show unlooked-for returns.

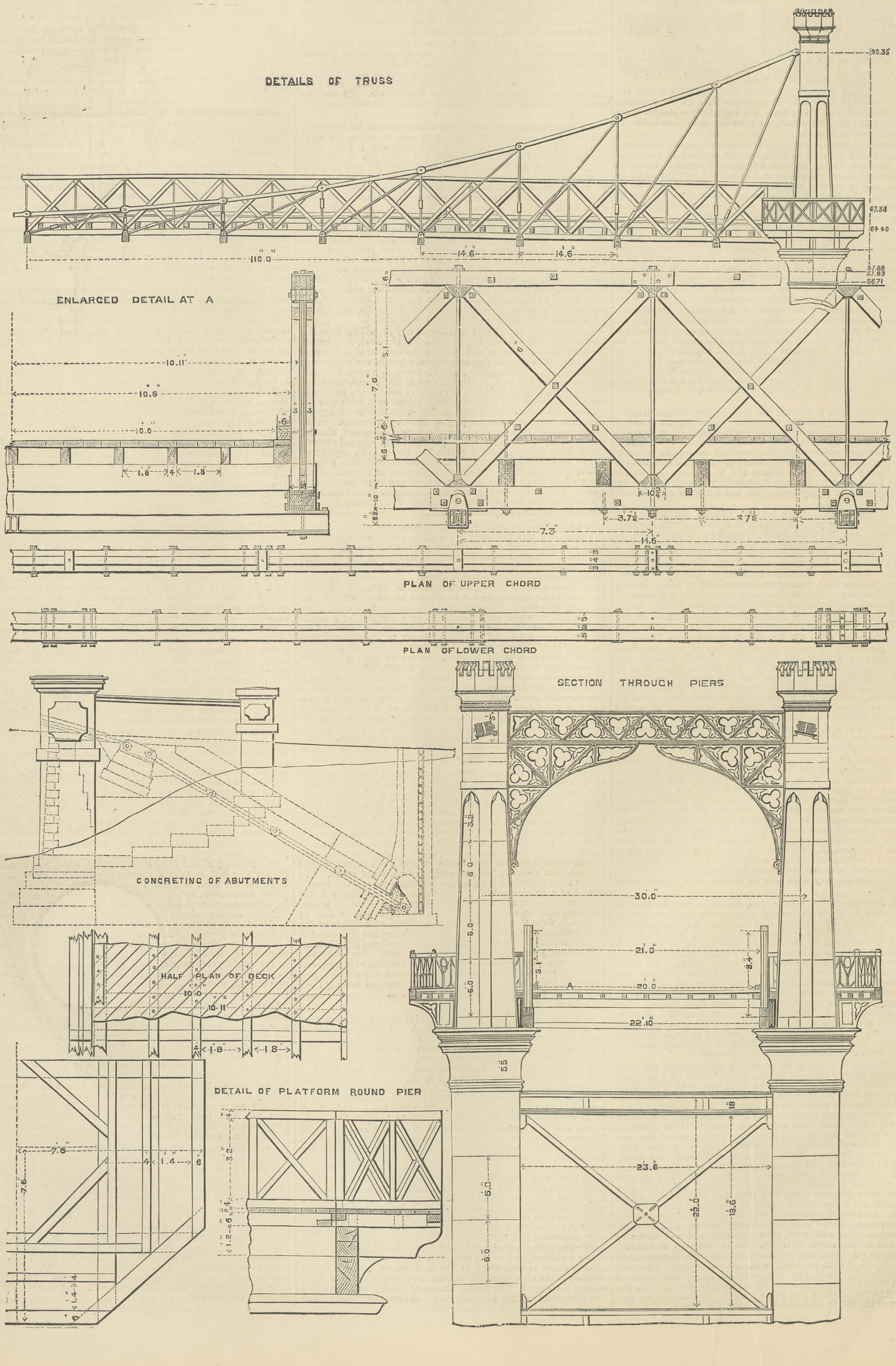
Whatever probability there is of gas being superseded by electricity for lighting purposes, its employment as a heating and motive power is certainly extending. The recent improvements in gas stoves have largely extended its application in this direction, whilst for gas engines there is a growing demand. Considerable improvements, both in greatly increasing the working power and in effecting a more economical consumption of gas, are also being gradually made in these engines. Messrs. Crossley Bros., of Manchester, are at present, our Manchester correspondent writes, making for a Birmingham house a 25-horse engine to indicate 60-horse power, which is the most powerful engine of the kind the firm have yet constructed, and they are erecting a large new establishment, where the whole of the plant will be driven by gas engines supplied from Dowson's economic gas producers.

At a recent meeting of the Royal Agricultural Society, it was resolved, on the recommendation of the implement committee, that prizes be offered for the best mechanical means of draining land, and for the best portable straw compressing and binding machine to be worked in conjunction with a threshing machine. Mr. Aveling said it was the duty of the council, especially at the present time, to do anything they could to promote the agriculture of the country. There were very large tracts of land uncultivated from want of draining, and the cost of draining was now much more than it had ever been. Mr. J. Howard said the intention was to offer inducements for the invention of an automatic excavating machine. There could be no question but that a vast deal of land would have to be drained during the next few years, and that an appliance of the nature contemplated would be a very great advantage. It was further resolved that the question of offering a prize or prizes for the best method of drying hay and corn crops artificially be referred to the implement committee.

FITZROY BRIDGE, ROCKHAMPTON, CENTRAL QUEENSLAND.

MR. F. J. BYERLEY, C.E., QUEENSLAND, ENGINEER

(*For description see page 362.*)



AIR PUMPS AND CONDENSERS.

MR. C. BROWN, ENGINEER, WINTERTHUR.

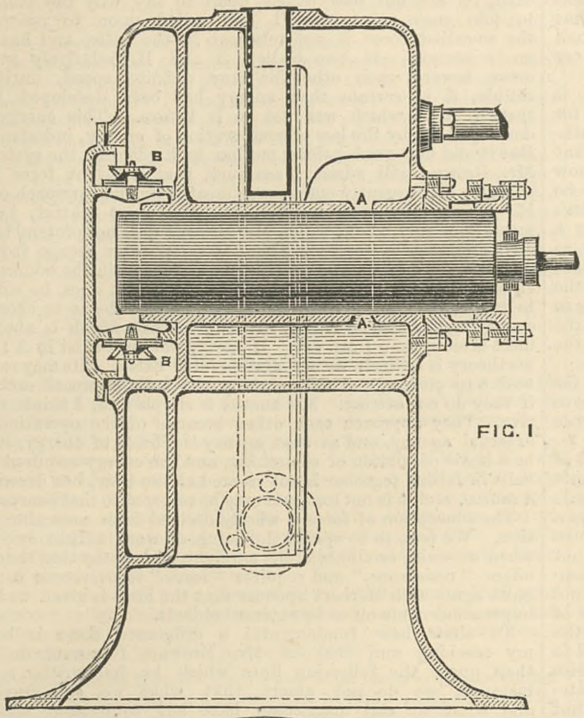


FIG. I

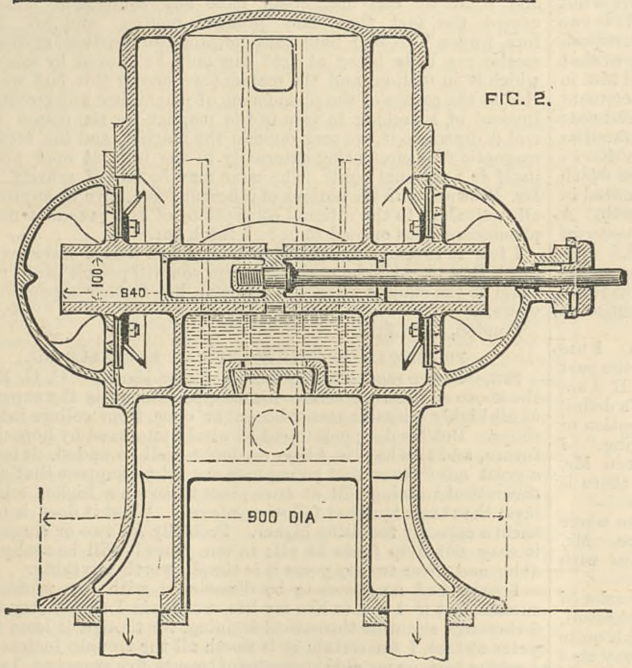
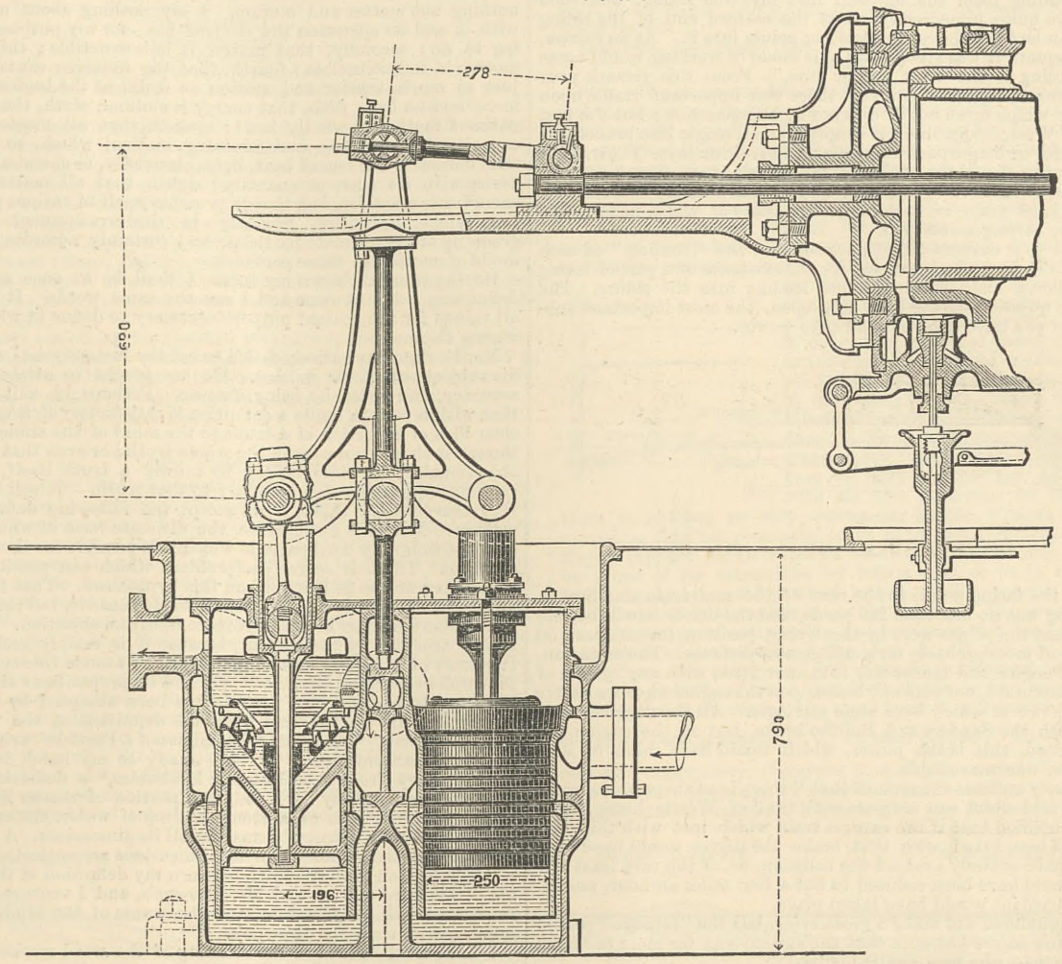
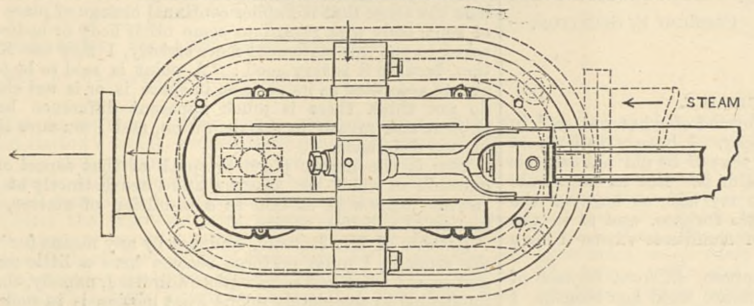


FIG. 2.

FIG. 3





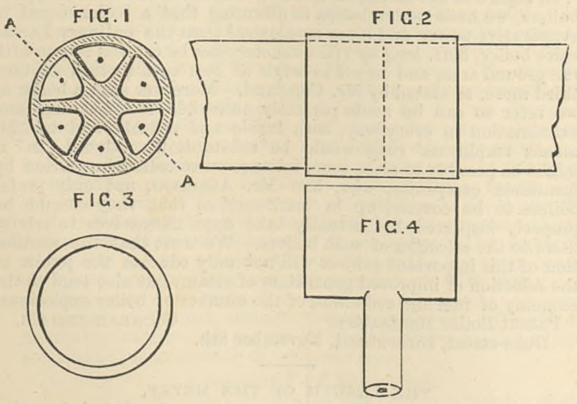
PLAN

We illustrate above air pumps designed by Mr. Brown, of Winterthur. Mr. Brown has called our attention to the fact that the air pump used by Messrs. Bates and Co., and illustrated in our impression for July 29th, resembles this type, and is not new. They were first employed by the late Mr. Bodmer in the year 1847. Fig. 1 is a single-acting pump, very nearly the same as that of Messrs. Bates, only that it is a plunger instead of piston pump. The inlet for air and water is at A A, entirely round the circumference; the discharge valves at B B are eight in number arranged circumferentially. Fig. 2 is an improvement on the above, being double-acting. Fig. 3 shows a double vertical pump with annular brass valves of the same type.

IMPROVEMENTS IN LAYING TELEGRAPH WIRES.

The accompanying engraving illustrates a new system of laying telegraph wires patented by Mr. W. B. Espeut, Spring Gardens, Jamaica. In order to ensure proper insulation in an inexpensive manner, when telegraph wires are carried under the earth instead of on poles or other fixtures above the surface of the ground as for the most part is usual, Mr. Espeut employs,

FIG. I FIG. 2 FIG. 3 FIG. 4

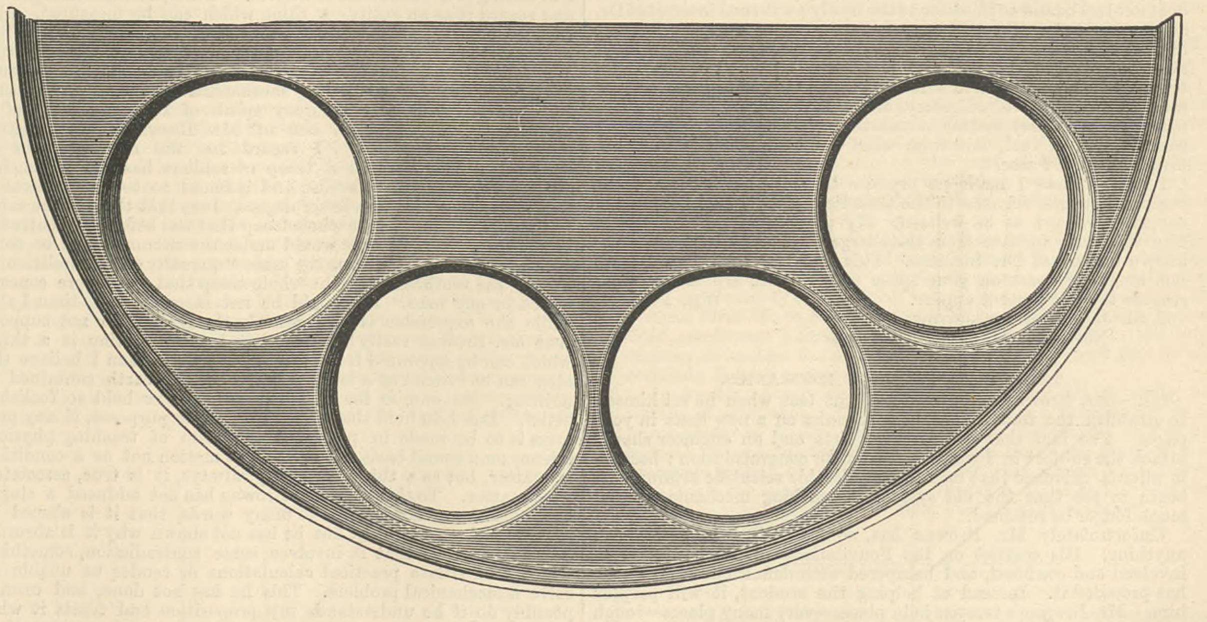


where there is heavy traffic, an iron tube lined inside with porcelain, such lining being formed in one or more longitudinal compartments as desired; or where there is not the risk of breakage from heavy traffic, he uses tubes or pipes made of porcelain ware in lengths of suitable and convenient size, and connected by thimbles, to allow the end of one pipe to touch the end of the other pipe, care being taken to cement the two ends with white lead; these thimbles may be of iron or ware as desired.

Fig. 1 is an end view of a tube; A A are the telegraph wires lodged in the several compartments of the tube. Fig. 2 is a side elevation of two such tubes butted end to end as they are to be laid out with a thimble, consisting of a short length of metal or porcelain ware or earthenware tube covering the ends. The thimbles should be an easy fit, and should be put on with white lead mixed to the consistency of paint, so that a perfectly water-tight closing may be ensured. Fig. 3 is an end view of a thimble. Fig. 4 is a side elevation of a T-piece, which takes the place of a plain thimble at any point where a wire is to be let out or in.

STEEL FURNACE FRONT PLATE, S.S. ABYSSINIA.

At present there exists a tendency among engineers and shipowners to augment the diameter of boilers, at the same time that pressures are increased. We shall not stop to inquire whether this is right or wrong, contenting ourselves with saying that we believe it to be an unwise policy. But it would have been impossible to adopt it had not manufacturers of steel and iron been able to meet the demands made on them for large plates. To give an idea of what is being done in this direction, we illustrate above one of several furnace plates supplied to Messrs. John Jones and Sons, Liverpool, by Messrs. John Brown and Co., Sheffield. The plates in question are for the Atlantic steamer Abyssinia, which is being fitted with new boilers by Messrs. Jones and Sons. The plate we illustrate is of steel; its flanged diameter is 16ft. 6in.; the flange is 8⅜in. deep, and the four furnace holes are each 3ft. 8in. diameter and 4⅞in. deep in the flange; the plate it ⅝in. think, and 8ft. ½in. wide. It is, we believe the largest steel boiler plate ever made, and it was flanged by hydraulic pressure. When the boilers are completed, we shall have something more to say concerning them. They are intended to carry a heavy pressure.



The Servia.—The new Cunard steamer Servia, which has just been completed by her builders, Messrs. James and George Thomson, Clydebank, Glasgow, is the latest addition to the Cunard fleet and also the largest. Her gross tonnage is 8500 tons, with a cargo capacity of 6500 tons, besides having accommodation for 1800 tons of coal and 1000 tons of water ballast. The horse-power of the engines is 10,500, and the guaranteed speed 17½ knots an hour, which was exceeded on Monday, when, on the official trip, a speed of 20½ miles was obtained, or about 18 knots an hour. The Servia is a five-decker, having orlop, lower, main, upper, and promenade decks; and her length over all is 530ft. She is divided into nine water-tight compartments, and the bulkheads are built, according to the Admiralty requirements for war purposes. The lower deck forward is fitted to accommodate 500 steerage passengers, while the after part of the deck contains 80 state rooms for cabin passengers. There are other 86 state rooms on the main deck aft of the main saloon. The main saloon is of unusually large dimensions, being 76ft. long, 49ft. wide, and capable of seating 308 persons.

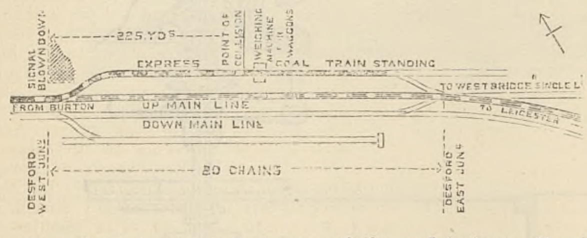
LETTERS TO THE EDITOR.

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

THE DESFORD JUNCTION ACCIDENT.

SIR,—I have read with very great interest the opinions expressed in the article upon the Desford accident in your issue of this week. This disaster is, in fact, due to the existence of a pair of facing points leading from the up-main line into the siding, and such points are quite unnecessary, as at the eastern end of the siding trains can be backed over the trailing points into it. As an excuse, at the inquest, it was stated that this mode of working would cause the "fouling of the West Bridge line." From this remark your readers would at least think that there was important traffic upon this line which must not be delayed at this junction; but the fact is, the "West Bridge line" is simply a small single line branch; it is closed for traffic purposes every night, and on Sundays. The traffic is worked upon the "one engine on the branch at one time" system, and consists of three—goods and coal—trains running to Coalville, and one local train, in each direction, some of which have a few passenger carriages attached.

I think your readers will at once see that the "fouling" of such a small branch can be no excuse for the existence of a pair of facing points upon a main passenger line leading into the siding. The points in question having been left open, the most important subject is, as you have shown, the brake power.



From the facing-points to the rear of the coal train standing in the siding was no less than 225 yards, and the driver would be able to see that the points were in the wrong position for at least 50 yards, and most probably for a still greater distance. The train consisted of engine and tender No. 101A, not fitted with any system of continuous brake, nor with any brake upon the engine wheels, and five vehicles, two of which were bogie carriages. All the vehicles were fitted with the Sanders and Bolitho brake, but as the engine was not so fitted, this brake power, which would have been of such great use, was unavailable.

I entirely endorse the remark that "there is no air pressure brake in the world which can compete with that of Westinghouse," and I am of opinion that if the express train which met with this accident had been fitted with that brake the driver would have been able to have entirely avoided the collision, or at the very least the speed would have been reduced to but a few miles an hour, and no serious accident would have taken place.

The signalman did make a great error, but the "censure" passed by the jury showed at once that the system was far more to blame than the man who now awaits his trial.

CLEMENT E. STRETTON.

Saxe Coburg-street, Leicester, November 11th.

PRICE'S RETORT FURNACE.

SIR,—Dr. Siemens thinks I am ill-informed of what was said in the discussion on Colonel Maitland's paper. I have a full report before me, and I adhere to the opinion that if he did not criticise the Price furnace he went far on to claim it. But as he admits the points of difference I set forth in my last, as between the retort furnace and the regenerative gas furnace, and as in the specialities of the furnace no point of similitude exists, I may dismiss this matter as settled.

With regard to the other and, I suppose, different furnace of Dr. Siemens, I never heard of its existence until last month. I have never seen a sketch of it; I cannot therefore institute any comparison. But he would be a bold man who claimed at this time of day anything original in the retort; it is only in its application that any merit can consist, and unless these two retorts are used in the same way for the same purpose, all pretension to parallel falls to the ground. It is certain the description given of the action of his retort does not harmonise with the action of the Price retort; and as his experiences with his retort appear the reverse of those of the Price retort, I think it is obvious we have not been travelling on the lines of this exhumed failure of Dr. Siemens.

The next practical question is one more frequently asked than answered. When first the Price furnace was discussed, and when it was not twitted with being "an imperfect imitation" of something then in use, I took some pains to furnish facts with regard to fuel consumption. These Dr. Siemens treated as flights of the fancy; once the subject of contemptuous treatment, one does not feel bound to minister to the newly awakened interest of Dr. Siemens. But this I will say, that in place of using double the fuel of the regenerative gas furnace, the merits of which I have never disparaged, he will find it no easy task to keep on equal terms of fuel economy. We do not profess to hold any subordinate rank in any point of efficiency, and in fuel economy claim to be first. It is no easy matter to ascertain what is being done in the consumption of fuel, but from what I have gathered I am confirmed in what I assert.

I beg to state I made no promise to write the history of the regenerative gas furnace in the Gun Factories; I said the correct narrative was yet to be written. My purpose in writing was to free the Price furnace from the charge of identity with the well-known furnace of Dr. Siemens. This end is served, and I shall not longer trespass on your space unless there are more urgent reasons than at present appear.

WM. PRICE.

2, St. John's-terrace, Jarrow, November 16th.

THE FOUNDATIONS OF MECHANICS.

SIR,—Mr. Browne undertook no light task when he set himself to establish the foundations of mechanics on a new basis in your pages. The fact that a Master of Arts and an engineer should attack the subject is, I think, a matter for congratulation; because it affords evidence that men of considerable scientific attainments begin to see that the old system of teaching mechanics cannot much longer be retained.

Unfortunately Mr. Browne has, so far, failed to accomplish anything. His treatise on the Foundations of Mechanics is as involved and confused, and hampered with definitions as any that has preceded it. Instead of helping the student, it will perplex him. Mr. Browne's treatise is in places—very many places—tough reading, demanding much inward reflection and cogitation before its meaning can be ascertained, and in not a few instances this return cannot be obtained for the labour spent upon it.

I could not think of asking you to give me space sufficient to criticise so important a work as that of Mr. Browne at full length. To do this efficiently I should require as much space as he has occupied; but without making extravagant demands on your indulgence I can point out a few of the most prominent of Mr. Browne's fallacies. My object in writing is not to attack Mr. Browne's views because they are his; I hold that all personalities are out of place in scientific discussion. My object in writing is the same as Mr. Browne's—to simplify the teaching of mechanics and to enable the student to arrive at sound conclusions without puzzling his brains over unnecessary abstract conceptions. I have already more than once put my views before the public, through the correspondence columns of THE ENGINEER, and if I am not mistaken Mr. Browne has kept my expressed opinions in view in all that he has written. There is now a good opportunity for comparing the two systems of dealing with the foundations of mechanics, that of the school which I for the moment unworthily represent, and that of the school which Mr. Browne represents. Mr. Browne has occupied many columns in endeavouring to state his views in such a way that they shall be intelligible. I can state mine in a very few lines, and it will be well to do so before going further.

I would teach the student, first, that in the universe there is nothing but matter and motion. I say nothing about mind, for with it and its operation the student has—for my purpose—nothing to do; secondly, that matter is indestructible; third, that motion is indestructible; fourth, that the universe contains now just as much matter and motion as it did at the beginning—no more and no less; fifth, that energy is motion; sixth, that matter without motion is wholly inert; seventh, that all matter has a capacity for receiving and retaining motion, which, so long as that motion is not one of heat, light, electricity, or chemical action, varies with its mass or quantity; eighth, that all matter is the same fundamentally, but that it presents itself in various guises to our senses, according probably to the arrangement of the grouping of its ultimate particles, and certainly according to the mode of motion of these particles.

Having thus laid down my thesis, I shall be at once asked for definitions. Mr. Browne and I use the same words. It is above all things for the present purpose necessary to define in what sense we use them.

Mr. Browne has entirely failed to get the metaphysical aspect of his subject out of his writing. He has sought to attain minute accuracy, and ended by being obscure. Perhaps he will concede that within certain limits a definition is satisfactory if it conveys a clear idea of a portion of a truth to the mind of the student, even though it should not convey the whole truth; or even that it is not objectionable, if while failing to convey a truth itself, it conveys the equivalent of or corollary to that truth. It will be found very convenient, I think, if we accept the following definition of matter:—Matter is a substance, the ultimate form of which is the smallest infinitely hard particle which it is possible for the mind to conceive. There is scarcely a problem which can possibly arise which may not be fully solved on this hypotheses. That the statement will not satisfy all objections I freely concede, but there is not a definition of matter in existence more free from objection. It is one readily accepted by the student, because it is readily understood. It chimes in in perfect accord with Dalton's atomic theory, so that the student learning chemistry will find its propositions aid him in learning dynamics. The particle has been accepted by eminent mathematicians as the only available definition of the ultimate form of matter. The words "Dynamics of a Particle" are familiar to every mathematician. I have ready to my hand, in Kerr's "Elementary Treatise on Rational Mechanics," a definition which meets my case exactly: "A *body* is a portion of matter limited in every direction, such as a stone, a drop of water, the earth. A *particle* is a body extremely small in all its dimensions. A *material point* is a particle whose form and dimensions are neglected."

A comparison may be drawn between my definition of the meaning of the word matter and Mr. Browne's, and I venture to think that mine will be found to meet the wants of the student more satisfactorily than Mr. Browne's.

I have next to define the meaning of the word motion. I use it in the sense that it implies continual change of place on the part of some body with regard to some other body or bodies. If I am asked to put this statement more strictly, I may use Kerr's definition, because it is very good: "A point is said to be in motion or at rest according as its position in space is or is not changing." I do not think there is much apparent difference between Mr. Browne and myself in this definition, and I am sure that there is no real difference.

This is the proper place to speak of that aspect of the whole question on which Mr. Browne and I are distinctly at issue. Mr. Browne deals with motion as a condition of matter, I deal with motion as a distinct entity.

Because of Mr. Browne, and not by any means for the sake of the student, I must perforce become here a little metaphysical, and repeat what he has heretofore admitted, namely, that it is quite impossible to completely define what motion is in such a way that it will leave no desire for knowledge on the subject unsatisfied. If I please to regard motion as a thing, while Mr. Browne regards it as a condition, no man can say that either of us is positively right and the other absolutely wrong. But I can show—and, with your permission, will show—that while Mr. Browne's views lead to nothing but confusion worse confounded, my views simplify the whole science of dynamics; supply us with a key to unlock many secrets of the universe; and explain much that without it is wholly unintelligible. For example, it is impossible to prove the conservation of energy on the theory that motion is a condition. But if we accept the view that motion is an entity, it can be shown that the conservation of energy must exist as a law. Mr. Browne himself, if he would only look the matter fairly in the face, would see that the question stands thus: He admits that it is impossible to define motion with accuracy; in other words, we do not know what it is. He insists on following a very old lead and calling it a "condition of matter." I adopt a different system, and regard it as an entity—a thing which can be measured. Mr. Browne objects to the words "quantity of motion." Yet he has to admit that the quantity of condition of motion is a constant. We cannot at all dispense with this word "quantity." We must have some means of comparing mechanical influences and effects. But can we with any accuracy speak of the "quantity of a condition?" Let me use one of Mr. Browne's own illustrations slightly modified. I regard for the moment pain as an entity. One man in a troop of soldiers has the toothache. After a time the pain subsides, and is found to be communicated to all the other men in a lesser degree. I say that there is the same "quantity of pain" in the whole troop that was before concentrated in one man. Mr. Browne would under the circumstances be compelled to say that there was the same "quantity of the condition of having the toothache" in the whole troop that was before concentrated in one man. He would be not more accurate than I am, while the expression is inexpressibly clumsy. I do not suppose that Mr. Browne really believes that I think motion is a thing which can be separated from matter, any more than I believe the idea can be formed of a body of water on the earth contained in nothing. No one, so far as I am aware, ever held so foolish a belief. But I do hold that, for all practical purposes, if any progress is to be made in putting the system of teaching physical science on a sound basis, we must treat motion not as a condition of matter, but as a thing, an entity, always, it is true, associated with matter. To this view Mr. Browne has not adduced a single real objection. He says, in so many words, that it is absurd to regard motion as a thing, but he has not shown why it is absurd; he has to prove that it involves some contradiction, something which will vitiate practical calculations or render us unable to solve a mechanical problem. This he has not done, and cannot possibly do if he understands my proposition and treats it with fairness. After all my views are only those of mathematical giants who lived before Mr. Browne or I was born.

With his definition of force up to a certain point I agree. If he uses the word merely for convenience of expression, and for want of a better, I am willing to concede that he is right, and I am prepared to use the word in the same way myself, namely, to express in conventional language certain phenomena. But the moment he goes further, and attempts to prove that force is a something which exists apart from motion, then I raise my voice against what I hold to be a pernicious fallacy which has done a world of mischief. It is here again necessary that I should define, in order that my meaning may be clear. It is laid down in very many text-books, and is, I know, maintained by Mr. Browne, that matter can attract matter. If two leaden balls are freely suspended near each other they will move towards each other. Mr. Browne says that this is due to the force of attraction. Force may therefore be defined as a form of energy independent of motion, for even though the balls do not approach each other, yet the force of attraction exists all the same. Now I categorically deny that any such force can exist. I am not now called upon to say why the balls tend to join each other, but I am called upon to prove that the so-called force is not inherent in the balls, and has really no existence. If two bodies, A and B, relatively at rest, move toward each other at any definite speed, until they collide, it is certain that energy has been developed in the system A B which was not in it before. This energy, once developed, is, by the law of conservation of energy, indestructible. But it did not exist before motion took place in the system, for Mr. Browne will admit, I am sure, that a latent force is not energy; consequently energy was created by the approach of A to B. Now matter is in itself inert. But inert matter, in some mysterious way, about which Mr. Browne does not pretend to know anything, creates energy. There is no possible escape from this dilemma; either energy without motion exists in the bodies A and B, or it does not. If Mr. Browne thinks that it does, he will have to try his hand anew at definitions, and how he is to succeed in conveying the idea of energy existing in that which is absolutely inert is more than I can say. If energy does not exist in A B, then his theory is entirely wrong, and no force exists. He may retaliate with a *tu quoque*, and ask me why the balls approach each other if they do not attract. My answer is simple and, I think, conclusive. They approach each other because of the operation of an external agency, and as that agency is a form of energy, it must be a mode of motion of something, and the energy acquired by the balls in falling together is not created at the time, but drawn from a source, and it is not lost, and may be restored to that source again.

The conception of force is wholly derived from muscular sensation. We feel, so to speak, the doing of work within our bodies when we walk, or climb, or lift a weight, and we say that the weight offers "resistance," and requires "force" to overcome it; but I quite agree with Herbert Spencer that the idea is given us by the impressions made on us by external objects.

To show how fundamental a difference there is between my teaching and that of Mr. Browne, I cannot do better than quote the following lines which he has written:—"For instance, we do not assert that what we call gravitation and what we call magnetism have any connection whatever, except the fact that they produce motion, and are, therefore, forces." Now I hold that nothing can produce motion but motion; a body being at rest can only be moved by something which is in motion, and the moment we accept this fact we get a clue to the causes of the phenomena of magnetism and gravitation. Instead of searching in vain in the magnet for the reason why a nail is drawn to it, we seek outside the magnet, and the idea of a magnetic fluid circulating externally to the iron, at once presents itself in a rational light. The same may be said of gravity. Can Mr. Browne, with his notions of inherent force, give us anything at all equivalent to the rational conceptions of the causes of natural phenomena thus opened to us? I think not.

I fear to extend this letter further. I feel that I have omitted much that ought to be said. Perhaps you will permit me to return again to the subject when Mr. Browne has further expounded his views.

Φ. H.

London, Nov. 7th.

PRACTICAL AND THEORETICAL ENGINEERING.

SIR,—I have read with interest a letter signed "C. G. E." on the above subject. I believe his disappointment is the experience of all highly scientific men who go at once from college into the shops. But his disappointment is wisely tempered by hope in the future, and this hope is, I have no doubt, well grounded. It is really a great misfortune that young men are led to suppose that a good theoretical training will at once place them on a higher scientific level than their ignorant fellow-creatures. What it does is to give them a capacity for rising higher. Probably for two or three years it may not help them at all; in ten years it will be really valuable, and after twenty years it is simply worth anything.

I have had no cause to be dissatisfied with my professional success, but if I had to live my life over again I should try to get a thorough scientific theoretical training, for though it loses a few years at first, I am certain it is worth all the trouble in later life. Looking back on my old shopmates of twenty-five years ago, I should say that no man has got on well who neglected the practical, but of those the most successful have been those who had also a good theoretical training.

A MIDDLE-AGED ENGINEER.

BOILERS IN IRONWORKS.

SIR,—In your report of the last meeting of the Mechanical Engineers, it is somewhat interesting to note the amount of attention given to the introduction of tubular boilers into iron and steel works, and not at all surprising that this new departure should meet with unqualified opposition from Mr. Adamson. As the discussion seems to have been carried on by those who have little or no experience in tubular boilers of what is termed the marine type, we venture to address you, as we fully believe that it will be found that Mr. Copeland's adoption of Turner's boiler will eventually effect an entire revolution in boiler practice in iron and steel works, and hasten on the time when flue boilers will be as little known ashore as they now are afloat. At the present moment the majority of land boilers are no more efficient than they were in the days when Mr. Henry Booth's arrangement of flue tubes revolutionised, in the hands of Stephenson, the carrying trade of the world.

It is gratifying to observe, in spite of the weight of adverse criticism Mr. Copeland received, that he still had the courage of his convictions, and we trust that at no distant date he will be able to record his success in your columns.

In regard to the saving of space by the use of the marine type of boilers, we have no hesitation in affirming that a boiler equal in evaporative power and more economical than the ordinary Lancashire boiler, 30ft. long by 7ft. diameter, can be erected in one-fifth the ground area, and be set to work at less cost instead of one-third more, as stated by Mr. Copeland. Moreover such a boiler as we refer to can be made perfectly accessible for cleaning and examination in every way, both inside and outside, and by this means employers' risks would be substantially reduced, and it might be possible to place some reliance on so-called inspection by insurance companies, who, like Mr. Adamson, not only prefer boilers to be covered up in brickwork so that they cannot be properly inspected, but actually take upon themselves to advise users to the selection of such boilers. We trust that the ventilation of this important subject will not only educate the public to the selection of improved generators of steam, but also tend to the economy of fuel and reduction of the number of boiler explosions.

COCHRAN AND CO.

Patent Boiler Manfactory, Duke-street, Birkenhead, November 8th.

THE LENGTH OF THE METRE.

SIR,—Messrs. James Chesterman and Co., in their interesting communication to you of the 8th inst., with reference to the length of the metre, make no mention of the Weights and Measures Act, 1878, which appears to legally settle the question they have raised by providing for use in trade a lawful equivalent of the metre.

The equivalent of the metre is given in the Act of 1878 as 39·37079in., and as this equivalent is both for scientific and for commercial use, it would appear that the author of the "Conversion Tables" referred to in the above communication was not in error in constructing his equivalents on the basis given in the Act. Instead of 39·37079in., Messrs. Chesterman and Co. state that they have used for many years a length of 39·3808, which their extensive experience tells them is equivalent to the mean expansion of brass and steel, the two metals of which commercial standards are stated to be most commonly made. There is, however, a large use of metric measures made of other materials, as wood, ivory, &c., the rates of expansion of which differ considerably from those of brass and steel. If the principle of allowing in the construction of a metre for its expansion from 32 deg. to 62 deg. is to be extended, then should we not ultimately have as many equivalents of the metre as there may be different rates of expansion. To set aside a legal equivalent for a so-called commercial one would therefore hardly appear to remove confusion.

Whatever material a standard measure may be made of, whether a yard, metre, or archive, it is not for the maker to graduate it at its legal temperature, leaving the use of such a standard on those occasions when accuracy may require it to allow for the expansion of his standard when it is used at other temperatures.

In common trade the difference between 39·3708in. and 39·3808in. is doubtless inappreciable, but even this difference might, perhaps, be lessened if all manufacturers were to graduate their measures at the temperatures prescribed by law. So long as different countries adopt different normal temperatures—as 62 deg. for the British yard and 32 deg. for the French metre—and different materials for their standards—as bronze for the yard and platinum for the metre—so long it would appear, however, that their standards cannot be strictly comparable. UNIFORMITY.

London, Nov. 16th.

THE FELIXSTOWE DOCK.

SIR,—In your issue of the 11th inst. we notice a paragraph referring to a contract for a deep water tidal basin at Felixstowe, which, seeing that the contract is entered into with our firm, unless explained is likely to be prejudicial to us.

The estimates were prepared by Mr. Brereton, M.I.C.E., an engineer of high standing and considerable experience in deep water work. The prices were what we asked. The principle adopted, viz., that of building by monoliths, lessens the cost of work of this nature considerably; also, at the same time, assures its absolute safety. The railway consists of sidings from the main line of about 1500ft. altogether.

From the tone of your paragraph, we must assume that your informant is ignorant of what is intended to be done, and has therefore misled you. S. LAKE AND CO.

Westminster, S.W., 15th November, 1881.

[We understand that the deep water tidal basin to be constructed at Felixstowe for Colonel Tomline will be 600ft. long, 300ft. wide, and have a short entrance from deep water 100ft. wide as stated in a paragraph in our last impression. The basin is to have 23ft. of water at low water, and the walls which are to be of concrete will be 48ft. in height. The railways referred to will be only 1500ft. in length in all, and as the warehouses mentioned are four iron sheds 200ft. long by 30ft. wide, and the shingle for the concrete is on the spot, we may correct what was said last week and admit, in accordance with Messrs. Lake and Company's letter above, that things are not unduly cheap at Felixstowe and that people do not work for nothing. The contract is let to Messrs. S. Lake and Co., and the contract sum is £80,000.—ED. E.]

COLD-AIR MACHINES.

SIR,—It may be information for such of your readers as take an interest in the theory of cold air machines, and have doubts about the mechanical theory of heat, for me to describe an experiment I made a few days ago. The experiment was made with a Bell-Coleman machine, in which compressed air is as usual cooled by the agency of water to somewhere about the initial temperature of air before the compression, which in this case was about 48 deg. Fah. This cooled and compressed air was expanded in the one case in the usual way by making it work a piston, which returned power to the crank shaft working the compressor, when the temperature of the expanded air registered 20 deg. below zero, the density of the compressed air before expansion being 2½ atmospheres absolute. The machine was then stopped and the piston-block slipped off the expansion cylinder rod, and after starting, the air entering the expansion cylinder was throttled, so that the compressed air behind the throttle valve was kept at the same density, viz., 2½ atmospheres absolute—a little more steam being required so as to make up for the want of power caused by the expansion cylinder doing no work.

The expanding air was allowed to blow through the barrel of the expansion cylinder into the throat of the exhaust, and at a point where its velocity was that of a gentle breeze, its temperature was found to be very near that of the temperature after cooling by water and before expansion. No cooling whatever had occurred; or if any cooling did occur it was behind the throttle valve, and compensated for by the heat produced by the collision of the air molecules after expansion, and coming nearly to rest, and confirms the thermo-dynamic theory that air cannot be cooled by simple expansion unless external work is performed.

I shall return to this subject after some more experiments, in a paper "On Cold Air Machines," promised to the Institution of Civil Engineers, and merely mention in the meantime that the experiments were performed with the Bell-Coleman machine recently erected for cooling the ships' provisions of the Cunard line s.s. Servia, which takes in air into its compressors at the rate of about 5000 cubic feet per hour, and which was referred to in the last paragraph of your article of last week, but in which the word "Inverness" has been inserted by some error.

45, West Nile-street, Glasgow, J. J. COLEMAN.
November 2nd.

A PHOTOGRAPHIC EXPERIMENT WITH SWAN'S INCANDESCENT LIGHT.

SIR,—Some trials I have recently made with Swan's incandescent electric lamps give results that may possibly interest your readers. I employed throughout an electric stream of the same energy—that generated by thirty Grove cells—and as the whole experiment lasted but an hour, it may be assumed, for all practical purposes, that the strength of the current was uniform throughout.

I made use of four lamps in all, supplied promiscuously from Newcastle, their resistance being respectively: No. 1, 67 ohms; No. 2, 59 ohms; No. 3, 58 ohms; No. 4, 52 ohms. My object was to ascertain their actinic power upon a gelatino-bromide film, individually, collectively, and in groups. To do this I exposed a gelatino-bromide film to the action of one light at a distance of 14ft., the sensitive film being placed behind a screen more or less transparent. The screen was divided into small squares, each representing different thicknesses of fine tissue paper. Thus square marked No. 1 represented one thickness, No. 2 two thicknesses, and so on, the last square being almost opaque and representing twenty-five thicknesses of tissue paper. The exposure in every case was ten seconds, the distance of the film from one light or lights always 14ft., and the number of cells thirty. The development was confined to two minutes exactly, an oxalate developer of normal strength being employed. Developer:—Saturated solution of oxalate of potash, three parts; saturated solution of protosulphate of iron, one part.

Result of First Experiment.

	Number of square through which the light penetrated.
Group of four lamps (Nos. 1, 2, 3, 4)	13
,, ,, three lamps (Nos. 2, 3, 4)..	15
,, ,, two (Nos. 3 and 4)	19
,, ,, one lamp (No. 4, low resistance)	23
,, ,, one lamp (No. 3, high resistance)	20

As it was a matter of difficulty to judge the exact square or number printed through, the mean result of three observers or readers was taken. So that the development should be the same throughout all plates were developed simultaneously in the same dish.

The result may not permit us to estimate with scientific accuracy the value of the lights under the above conditions, but it proves practically: First, that the amount of light given off by four lamps is less than that given by three, and that the electricity is employed most economically for lighting when only one lamp is used; and secondly, that at any rate in the conditions described, a comparatively low resistance lamp gives more light than a comparatively high one.

In my second experiment I estimated the actinic power of single lamps, when one or more were in circuit, the photographic arrangements being the same.

Result of Second Experiment.

	Number of square through which the light penetrated.
One lamp, No. 4 (only one in circuit	23
,, ,, ,, (two in circuit)	18
,, ,, ,, (three in circuit)..	14
,, ,, ,, (four in circuit)	9
Arc light (with thirty cells) upwards of	25
Ordinary fish-tail burner (burning five cubic feet per hour)	7

The result here is interesting in showing the comparative strength of the lamps by themselves, to what extent the light, so to speak, is "turned down" by bringing another lamp into circuit. As my screen was only graduated as far as twenty-five, it was impossible to estimate the comparative value of the arc light, for it went above the degree, while a low resistance Swan lamp only gave as far as twenty-three. This last lamp, No. 4 in the series, was the one always tested, and therefore the results shown may be considered the most favourable. The result given by a good fish-tail burner permits us to make some comparison between gas and the Swan light.

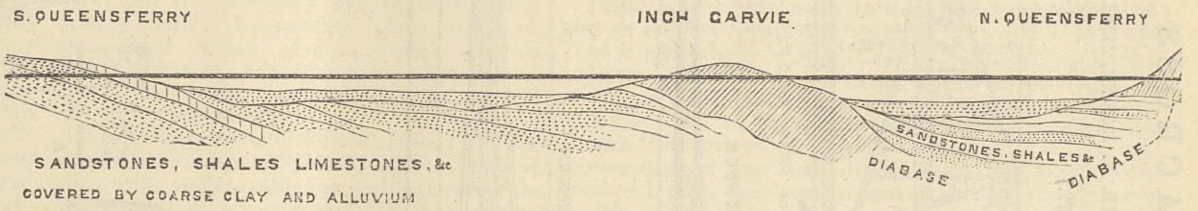
It says something for the skill with which the sensitive gelatino-bromide is prepared commercially now-a-days, when we find it so uniformly sensitive that in the two trials—where square twenty-three is recorded—there should be so unanimous a result.

Woolwich, 12th November. H. BADEN PRITCHARD.

THE FORTH BRIDGE.

SIR,—I have read with great interest the article which appeared in your last impression on this subject. The matter is one of very great importance, and I hope that it will receive that criticism which it deserves. Parliamentary notice has been given, and it is to be supposed that the necessary Bill will be passed next session. It is much to be feared that it will not be opposed as it ought, because the true nature of the issues involved are not understood.

Without attempting to detract from the merits of Messrs. Fowler, Baker, and Barlow, the engineers who have designed the proposed bridge, I may point out that not one of the three gentlemen has had any experience in the construction of large bridges, and, I may say, that no information whatever has yet been brought before the public concerning the details of the structure which they propose to erect; nor have we any definite information concerning the cost. We do know, however, that the expense cannot be less than about £1,200,000, an enormous sum, which must heavily overload the companies agreeing to supply it, and apparently incapable of returning any adequate profit.



My object in writing now is not to criticise Messrs. Fowler, Baker, and Barlow's bridge, because these gentlemen have not even yet made up their minds concerning anything more than the general features of the structure, but to ask, Why build a bridge at all, when a tunnel can be made for less than one-half the sum? Sooner or later the engineers must answer this question. They are called upon to carry a railway over or under an obstacle, namely, the Firth of Forth. It is their duty, before deciding on a bridge, to consider the alternative scheme of a tunnel, and to adopt that which is best. Can it be shown that they have considered a tunnel at all? I think not. It is very probable that they have talked a tunnel over, but have they, in the full sense of the words, considered its merits and demerits? This is a question they will have to answer.

I append a sketch showing the strata. It will be seen that a good deal of diabase, one of the varieties of green stone rock, will have to be cut through. It is very hard, but in the present day of rock drills and dynamite, this is a small objection. The length of the tunnel, even to secure good land approaches, would be insignificant. The portion under water would be but a mile long, and by sinking a shaft through Inch Garvie, the work could be driven from four headings. I would undertake to say that with due diligence the tunnel may be made in less time than the bridge, on which no work can be done in the winter months.

I trust that someone will take up this subject and deal with it better than I can. The bridge may be magnificent, but it is not engineering, in the true sense of the term.

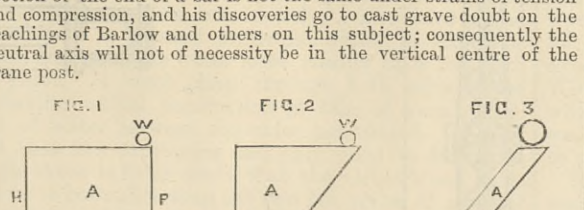
Dundee, November 4th. C.

STRAINS ON CRANE POSTS.

SIR,—Will you permit me to say a word in the very interesting discussion now going on in your pages? It admits, I think, of being clearly shown that the strain on the breast of a crane must be greater than that on the back, even on the assumption that the post and jib are homogeneous and rigid.

It will be conceded that the neutral axis will pass through the centre of gravity, assuming that the resistance of the material strained is the same to compression and extension, and on no other basis. Now in a homogeneous crane post certain of your correspondents who repeat Mr. Pendred's views locate the neutral axis at the centre vertical line, because that is the centre of gravity. Now, Mr. Kirkaldy has carried out a very large number of experiments on the stretch and compression of both wrought and cast iron, and has proved, I understand, that the range of motion of the end of a bar is not the same under strains of tension and compression, and his discoveries go to cast grave doubt on the teachings of Barlow and others on this subject; consequently the neutral axis will not of necessity be in the vertical centre of the crane post.

FIG. 1 FIG. 2 FIG. 3



I shall now proceed to show that it must for another reason be nearer the breast than the back of the crane. The whole crane being rigid by supposition, and homogeneous with its suspended load constitutes a single mass, and the neutral axis must be as near the centre of gravity of this mass as it can get. Let A, Fig. 1, be a plate of cast or wrought iron, 3in. thick, and 10ft. square. Let W be a weight of one ton. Let C D be two supports, both jointed to the plate A. May I ask any of your correspondents to show me where the neutral axis is located in A?

I now take A and treat it, as in Fig. 2, and I ask again, where is the neutral axis?

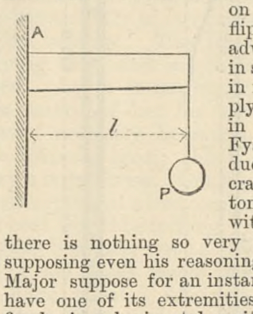
Once more I take A, and treat it as in Fig. 3, and I ask again, where is the neutral axis?

It matters nothing at all that there are joints at the base, for there must be either joints or something else, and no matter what else, the strains we have to contend with are self-contained in A, as shown by your correspondent "Parallel Motion."

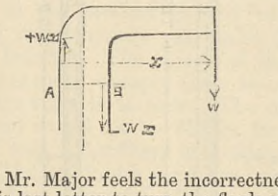
Now I contend that W must be included in the weight of the crane when we are ascertaining its centre of gravity, and this being so, the neutral axis will fall of necessity nearer the side P than the side H, Fig. 1; and consequently although the safety-valve lever theory is not quite the right way to put it, still Mr. Pendred is right in his views. I await the reply of your correspondents before going further. BUSTER.

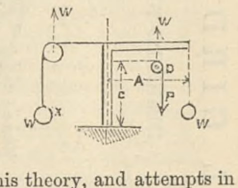
Lambeth, November 16th.

SIR,—The numerous letters addressed to your paper on the subject of strains on crane posts contain, apparently, but one correct solution—Mr. Fyson's. I say apparently, for Mr. Fyson's reasoning can scarcely be said to be very clear, and I have not taken the trouble of checking his figures. Perhaps, on the whole, Mr. Fyson is better at calculations of the kind, than at setting forth his ideas in a letter; but if such is the case, it by no means justifies the ridicule heaped on him by Mr. Major. "Chaff," as a rule, might be excluded from such discussions, but, in all cases, the man who ventures to use it should make sure of having truth on his side. For no amount of easy flippant wit, sarcasm, aptitude at taking advantage of an adversary's weak points in style or exposition of ideas—no amount, in fact, of controversial ability, will supply for the one great deficiency of "being in the wrong." Mr. Major taunts Mr. Fyson with using his 40 tons load to produce tension and compression in his crane post, and finding another 40 tons to stick on the top of it. Now with all due deference to Mr. Major, there is nothing so very outrageous in Mr. Fyson's so doing, supposing even his reasoning to be otherwise incorrect. Let Mr. Major suppose for an instant a beam or girder of any length to have one of its extremities let into a wall, or to be maintained firmly in a horizontal position by any similar means, and to be loaded with P at the other of its extremities. The weight P will produce strains of compression and tension in the beam, the maximum value of these strains being Pl at A. It will also produce a vertical reaction at A, equal and of contrary direction to itself. If the same girder be allowed simply to repose on two supports, and P be applied to its centre, the same force P will produce flexion in the girder, and reactions $= \frac{P}{2}$ on each support. There is no such manifest impropriety, therefore, in a single external force applied to a structure producing two kinds of strains in that structure. If Mr. Major is not satisfied, let him take any horizontal section in



the post of the crane under consideration A B. Let x be the leverage of W (measured from the vertical passing through the point of application, to the neutral axis of the upright portion). The post will have to support a bending moment Wx, which will resolve into a compressive force Wx at B, and a tensile one Wx at A. Will Mr. Major be so kind as to inform us how the three forces $+Wx$, $-Wx$, and W, are to produce the equilibrium which must reign in all parts of the structure for stability to ensue? The forces $+Wx$ and $-Wx$ constitute a couple which has no resultant, and to equipoise the weight W, the elastic efforts of the metal in the section A B must produce a resultant applied to the centre of gravity of that section, equal, parallel, and of cont trary direction to W, which is as much as to say, the weigh W must be considered as applied to that centre of gravity.





Mr. Major feels the incorrectness of his theory, and attempts in his last letter to turn the flank of the difficulty by opposing to the overturning action of the weight W an equal weight attached to a cord passing over a pulley; but unless his pulley be of the nature of Mahomet's coffin, it must be supported by something, and that something must support the vertical action of 40 tons which Mr. Major is so anxious to get rid of. Then again, in attempting to show how the vertical moment W A may be converted into an equal one of horizontal direction, Mr. Major makes two mistakes: Firstly, in neglecting the vertical effort equal to W and contrary to it, which must be supported by the pulley D; and secondly, in making the flexional strain on the post at the height C equal simply to P, whereas for all parts of that post it is equal to P C, putting out of the question the slight variations arising from deformation.

Lastly, let us suppose the crane to have two jibs of equal length and equally weighted. The flexional strains in the mast will then counteract each other, and entirely disappear, and the only effort to be supported by the post will be purely compressive—in fact, the vertical force W, to which Mr. Major is so averse, unless, indeed, that gentleman manages to support the two jibs in the same manner as he does the pulley in his diagram, in which case he will certainly deserve encouragement.

As for Mr. Pendred's "safety valve theory," it is really not worthy of discussion. If Mr. Louis Seguin is a Frenchman, as his name seems to imply, I cannot too much recommend to him the perusal of one of the many excellent works on resistance of materials written by countrymen of his—say Bresse, for instance, who treats the subject of vertical supports under compression not applied to their axis in a very clear and scientific manner.

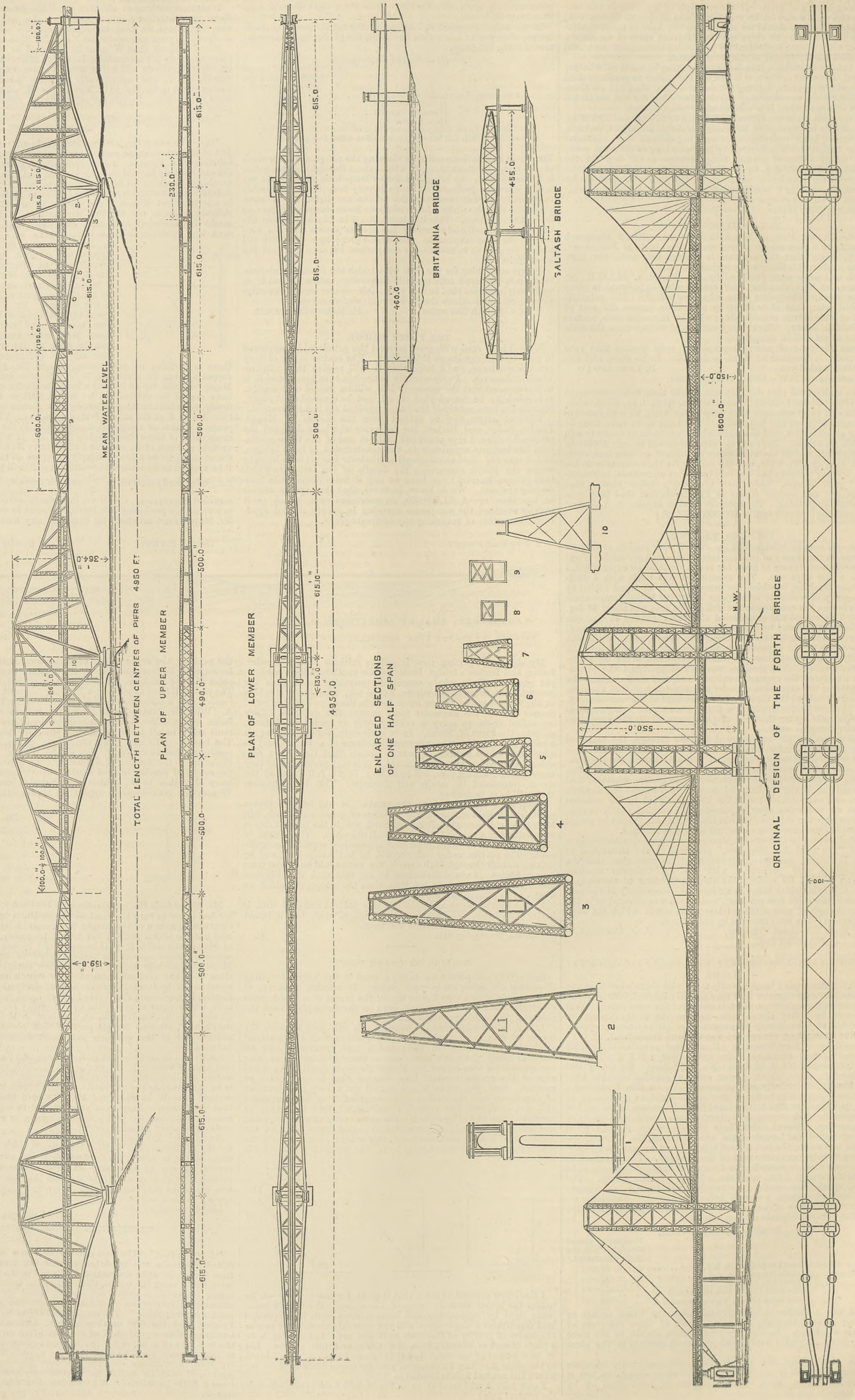
Liege, November 14th. H. S.

"KNOWLEDGE."—The first number of a new weekly magazine called *Knowledge* was published on the 4th instant. We learn from the introductory article that "*Knowledge* is a weekly magazine intended to bring the truths, discoveries, and inventions of science before the public in simple but correct terms—to be, in fact, the minister and interpreter of science for those who have not time to master technicalities." The magazine is edited by Mr. Richard A. Proctor, and the first number is quite satisfactory. We need hardly say that a good deal of space is given to astronomy, and the first part of a paper by Dr. W. B. Carpenter, on the relation of food to work, gives promise that the whole will be interesting. Mr. Mattieu Williams contributes a very amusing article, and a good deal will be found to interest any general reader who cares a little for science. We wish our new contemporary every success.

CONTINUOUS STEEL GIRDER BRIDGE ACROSS THE FIRTH OF FORTH.

DESIGNED BY MR. JOHN FOWLER, AND MR. B. BAKER, MM.I.C.E.

(For description see page 372.)



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TO CORRESPONDENTS.

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

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

B. F. Redtenbacher Turbine.—*Letters await the application of this correspondent.*

Miller.—*Messrs. E. R. and F. Turner, Ipswich; Messrs. Whitmore and Binyon*, 28, *Mark-lane, and Stowmarket; J. H. Carter*, 82, *Mark-lane; A. B. Child and Son*, 70, *Fenchurch-street; W. R. Dell and Son*, 26, *Mark-lane; Bryan, Corcoran, and Co.*, 31, *Mark-lane.*

R. R. (Clayton le Moors).—*A letter sent to you on the 5th inst. has been returned. In reply to your inquiry dated the 2nd inst., your opponent may proceed against you or against your patrons, and although it is usual to give full notice, he may proceed with or without doing so.*

Engineer.—*Half an inch in thickness would be enough if the flues are large and if thoroughly supported by gussets reaching the flues and with efficient staying, but broadly speaking, the ends should be an eighth of an inch thicker, and the staying very well done even then.*

R. T.—*The heaviest British tender engine weighs empty about* 36 *tons; its tender empty about* 16 *tons. The engine full will weigh about* 39 *tons, and the tender* 34 *tons, or a gross weight of* 73 *tons. We do not know the weight loaded of the Lancashire and Yorkshire engine to which you refer.*

Alex. B.—*Blue heat plainly means the temperature necessary to cause a roughly brightened forging to assume the blue tint. Scantling applies to all three dimensions, and really means size, except that the term is not applied to boards, flags, or plates, or pieces having one dimension of small value. With respect to "under drawing" and ground glass, we cannot help you. There is not any ground stronger than plain glass of the same quality and thickness. Hammer-faced or wavy glass may have been used, and this is strong greenish glass, usually of considerable thickness.*

W. D. S.—*The proportions you give for your tank will do, but they are quite light enough. A wrought iron tie-rod should be put in at every* 6*ft., crossing the tank. It may be secured by forked ends to suitable projections cast on the flange of the plates. The ties should be* 3*ft. from the bottom, and provision must be made for tightening them up, but the tightening must not be overdone;* 1⅛ *round rods will be strong enough. They must be examined and painted from time to time, or they will corrode rapidly. The girders are not of the proper section. Make the bottom flange* 1*in. thick and* 12*in. wide, taking the metal out of the top flange by making it* ¾*in. thick and narrower. Take great care to provide good castings. It would be well to use one more girder. See that the tank is properly bedded on them, and on the walls.*

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MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, Nov. 22nd, at 8 p.m.: "Forces and Strains of Recoil in the Elastic Field-Gun Carriage," by Mr. Henry Joseph Butter, M. Inst. C.E.

Society of Telegraph Engineers.—Thursday, Nov. 24th, at 8 p.m.: "Report upon the International Exhibition of Electricity in Paris, 1881," by Sir C. T. Bright, Member, and Prof. D. E. Hughes, F.R.S., Member.

Society of Arts.—Monday, Nov. 21st, at 8 p.m.: Cantor Lectures. Lecture I., "Some of the Industrial Uses of the Calcium Compounds," by Thomas Bolas, F.C.S. Wednesday, Nov. 23rd, at 8 p.m.: Ordinary meeting. "The Storage of Electricity," by Prof. Sylvanus Thompson, D.Sc.

DEATH.

On the 7th inst., at 75, Welbeck-street, Cavendish-square, Chevalier Beneditto Albano, M.I.C.E., aged 85.

THE ENGINEER.

NOVEMBER 18, 1881.

SUBMARINE ARTILLERY.

On Monday a public trial of Ericsson's torpedo boat—the Destroyer—took place at New York. According to the telegrams which have supplied the information, the experiment was in every way successful. We have already illustrated the Destroyer. She is an armour-clad torpedo boat 130ft. long, 11ft. deep, and 12ft. wide. Her engines can indicate about 1000-horse power, and her speed is said to be 16 knots. The novel feature about the craft is that she carries a long tube on her keelson, the muzzle of which is 6ft. below water, and from this tube she discharges extremely elongated projectiles of wood, and capable of carrying very heavy charges—as much as 350 lb. of dynamite. The tube is a steam gun, and a very simple arrangement, resembling in principle the slides of the charger of a shot pouch, suffices to exclude the water. Minute details of the construction of the gun and its projectile have not been as yet made public. It is not clear that silence is in this case due to official reticence. The fact seems to be that the experiments hitherto made have not been uniformly successful, and modifications have been introduced from time to time. If, however, the latest announcements are to be credited, these difficulties have been overcome, and ironclads have yet another foe to fear. On Monday the projectile travelled 600ft. under water. It contained a small bursting of 12 lb. of powder. It passed clean through a target 5ft. under water and traversed a torpedo net. Of what the target was composed we have no means of knowing, but it probably represented a section of the bottom of an ironclad.

It may perhaps surprise some persons to hear that a shot can be fired under water, but there is nothing novel in the idea. Indeed, from a very early period proposals have been made to destroy ships by firing shot into them below the water-line from submerged cannon. Robert Fulton, of steamboat fame, carried out a series of experiments in 1813 to ascertain what could be done by guns fired under water. In *Scribner's Monthly Magazine* for August, 1881, will be found a very interesting paper on the subject by Professor Thurston, in which are printed some previously unpublished manuscripts of Fulton's. "I ordered," says Fulton, "a frame to be made of two pine logs each 13in. square, 45ft. long, on one end of which I placed a Columbiad carrying a ball 9in. in diameter, 100 lb. weight; on the other end I erected a target 6ft. square, 3ft. thick, of seasoned sound oak, braced and bolted very strong. The Columbiad, except 2ft. of the muzzle, was in a box; the muzzle 24ft. 6in. from the target; the charge of powder 10 lb. When fired, the ball entered only 9in., that is, its diameter, into the oak. This experiment proved the range of 24ft. 6in. through the water to be too great." In a succeeding experiment:—"I loaded the Columbiad with 12 lb. of powder, and placed the muzzle 6ft. from the target; the muzzle of the gun 2ft. under water; the place where the ball struck the target 5ft. under water. In this case the ball went through the target 3ft. thick and where is not known. The target was torn to pieces. In this experiment I fortunately proved beyond a doubt that Columbiads can drive balls of 100 lb. through 6ft. of water and the side of a first-rate man-of-war." Fulton then goes on to describe the construction of a ship fitted to discharge broadsides of submarine ordnance, illustrating his remarks with rough but sufficient pen-and-ink sketches. He suggests the construction of a small fleet of little vessels. Seven of these he could construct for 600,000 dols.—the cost of one 74-gun ship. "Were they to attack a 74, she could not dismast the whole of them. Some one must get within 8ft. or 10ft. of her, where one fire from any one of them would certainly destroy her." In another place he says, "The steam engine would give a vessel of this description the means of playing around the enemy." The novelty of Ericsson's invention lies in matters of detail. History repeats itself.

Nothing seems to have come of Fulton's invention; nor was much done with the idea until Whitworth gave the world a new sensation by firing flat-pointed projectiles from a submerged howitzer through a very strong target at a range of many feet. It was found that, as might be expected, elongated projectiles fired from rifled guns travelled much further through water than round shot could, and it was also shown that such projectiles were not deflected. It is said that this was first discovered by Captain Thomas Boys, of Liverpool, who long before the Whitworth era had made flat-headed shot to shoot whales with in the North Sea. Whitworth's experiments were made in the winter of 1857 and spring of 1858. The gun fired was a brass howitzer of between 13 cwt. and 14 cwt., and but 4ft. 8in. long. The shell weighed exactly 24 lb., and the charge employed was 2½ lb. of powder. In the first experiments the gun was fired above water, the shot striking it at an angle of about 7 deg. The official report of the eighth round, which may be taken as a specimen, says "the shell entered the water 17ft. from the submerged butt, passed through the butt about 3ft. 6in. from the bottom in the same direction as it was fired, entered the mud 17ft. 6in. beyond, and penetrated 18ft. 6in. into it about 2ft. below the surface. Total penetration through water, wood, and soft mud, 53ft." The target consisted of two 4in. thicknesses of oak plank. The results were so encouraging that others were carried out. A 110 lb. Armstrong gun was used. It was fixed on a platform below high-water mark at Portsmouth; loaded when the tide was out, and fired by a Bickford fuse when it was in, with charges of 12 lb. of powder. This gun, at a range of 25ft. from the muzzle, sent its projectile clean through the target, cutting a 13½in. balk in two. It was, in a succeeding experiment, trained on the quarter of the hulk Griper, 20ft. distant; a flat-fronted 110 lb. shot was fired with 14 lb. of powder, when the gun was 6ft. under water. According to the official report, "shot struck ship's side about the spot at which gun was directed, penetrated outer planking of 6in. sound oak, cut through an 8in. oak timber, sound, penetrated the inner lining of fir, not sound, and struck a large oak rider 18in. square, into which it penetrated 2in., ship's side shaken to a considerable extent round fracture, into which water poured with great violence, filling the ship immediately." The third round was fired with a pointed projectile, which, as might be expected, traversed the water more readily than one with a flat point. It went clean through both sides of the hulk, making a total penetration of 33in. of sound wood, and 4ft. of water between the sides penetrated. It may be said that the projectiles had only wood to deal with, although there is little doubt that the Griper's oak sides offered more resistance than the two ⅝in. plates of many of our ironclads. But in September, 1862, six ½in. thickness of boiler-plates superimposed were bolted on the side of the Griper and fired at as before with a conical shot. The official report says:—"This shot broke through all the plates, driving the fragments through the side of the ship, making an irregular fracture in the target 12in. by 9in., shelf piece broken, and ship's side destroyed to a considerable extent." It is not remarkable that when these facts come to be known inventors were encouraged, and a large number of schemes were devised for firing guns below water. We need not stop to describe them. The Patent-office library is sufficiently accessible. As bearing particularly on Ericsson's work, however, we may state that in 1862 Mr. Forbes, an American, made a number of experiments with submerged guns, and actually entered into a contract with the United States Government for the construction of a gunboat partially plated to carry a submarine gun; the contract was, however, never carried out.

It is quite clear that Ericsson can discharge a projectile with perfect safety from bursting his gun under water—what the range of the projectile will be remains to be seen. It is quite possible to discharge it by an explosive instead of driving it out by very high-pressure steam admitted into a long tube behind it; and of course used in this way its range would be extended. It would not be difficult to combine with Ericsson's system, however, one now being tested by our own Government for the first time, although suggested, we believe, long ago. For the costly and complex fish torpedo is substituted a light iron case of the same shape, loaded to be of just the same density as water. This is propelled by what is neither more nor less than an enormous rocket, discharging its gas at the tail end of the torpedo. It is well that the especial value of the Ericsson system should be clearly understood. It consists entirely in the power of discharging a torpedo at a high velocity. The fish torpedo might be discharged at a flying ship, and might fail to overtake her for lack of speed. Again it might, if fired at right angles to her, pass astern of her for the same reason. The Destroyer must of necessity be much more expensive than an English torpedo boat; she is also much slower, and must carry a larger crew. Consequently, if destroyed herself, she would represent a loss compared with which that of an English boat would be trifling. If, however, she can do what the English boat may not be able to do, strike with certainty at 300 or 400 yards range, she will be superior to anything we have afloat. Meanwhile it is worth considering whether, if such a ship as the Polyphemus were fitted with a long breech-loading submerged gun, capable of firing shell carrying 50 lb. of gun-cotton or dynamite, and propelled by a charge of, say, 150 lb of powder, results would not be obtained which would far transcend anything which torpedoes can now effect? The whole subject of submarine warfare deserves to be reconsidered, and dealt with on the new basis which progress in the construction of artillery has opened up.

THE FUTURE OF GAS LIGHTING.

There is no longer room to doubt that electricity will play an important part in providing the world with light. That it will wholly supersede gas is, however, unlikely; and even if it did take the place of coal gas as a lighting agent, gas would still be extensively employed for heating purposes. Up to the present, the introduction of the electric light seems to have rather operated to increase the consumption of gas than diminish it. Gas engines are employed to a considerable extent in driving dynamo machines; and even where the electric light is used regularly, we find it still supplemented by gas lamps. But it is not to be denied that the introduction of the electric light has done a great deal to improve gas. It supplied a stimulus which was much wanted, and a marked improvement in the lighting of many of our thoroughfares has been the result. A comparison, for example, of Parliament-street, Westminster, with the Strand, or any neighbouring street, will show of what gas is capable when properly used. Can it be said that finality has been reached in the production, transmission, and consumption of gas? We think not; and it may yet be found that as the rivalry of the electric light becomes sharper and sharper, so will improvement after improvement take place in the production and use of gas. The direction which improvement may take can be indicated without much trouble. The objects of the inventor must be to produce gas more cheaply than is now possible, and to make it better than it is now. The simplest way to secure the first end would be to obtain more gas than ever from a ton of coal. But there is nothing to be done in this direction. The maximum yield has been secured for many years in our best gasworks. Thus, at Beckton the average yield of Newcastle coal with 7 per cent. of cannel is 10,334ft. per ton. It is very unlikely that this result can ever be exceeded; it is not often equalled. Again, the use of machinery for charging and drawing retorts; the favourable contracts made for coal; the success which has followed judicious endeavours to prevent waste, and, in one word, the perfection of the whole system of gas making, seems to have done all that can be done to directly reduce the cost of production. The South Metropolitan Gas Company supply gas at 2s. 10d. per 1000 cubic feet—a wonderful fact, bearing all the conditions of locality in mind. As the quantity of gas per ton cannot be directly augmented, and as the cost of labour and general expenses does not seem to admit of diminution, it would appear to be impossible to do more with gas than has been done; and it might be taken for granted that gas will have to fight electricity just as it is, and has no reserves to draw upon. Such a conclusion would, however, be erroneous. Invention never reaches its limit, perhaps, in any department of the arts and sciences. It has certainly not reached it in gas making. We shall not here go into any elaborate investigation of what is and what is not possible in this manufacture, but we can indicate three directions in which progress seems to be possible.

It has recently been announced that by passing the electric spark through coal gas, its volume may be doubled and also its illuminating power. This is a startling statement, and further experiment conducted on a large scale is required before it will be safe to pronounce an opinion as to the value of the suggestion. There is, however, at least a basis of truth for what has been said. When sparks from an induction coil are passed through coal gas, acetelyne—$C^2 H^2$—is produced. The volume of the gas is augmented, and perhaps its lighting power. This is, however, only a general statement, and little or nothing outside the laboratory is known on this point. What is known is encouraging. There are, however, difficulties in the way of adopting the process, however successful it may be. The first is that when acetelyne is produced, there is a strong tendency to throw down carbon developed in the gas. The carbon assumes the condition of a black tarry deposit, or in some cases benzine—$C^6 H^6$—is produced. There are serious objections to the adoption of any process which entails the deposit of carbon from coal gas. Further, acetelyne attacks copper and produces acetelyde of that metal, which is probably explosive, like one of the compounds of ammonia with the same metal. There is always present in coal gas about ·06 per cent. of acetelyne, and this has been said to attack copper pipes with the effect we have named. It is by no means clear how and why the presence of acetelyne should improve coal gas. It contains less carbon than any other hydrocarbon known. The augmentation of volume may be due to the setting free of hydrogen previously combined with carbon. Next to nothing has been done as yet to ascertain on a practical scale of what the scheme is capable. But enough is known to render it desirable that further experiments should be made. It would be very easy to ascertain at any of our gasworks the effect of passing a current of sparks from a dynamo machine through a few thousand feet of coal gas. Should the result be satisfactory much advantage may be anticipated. Even though the volume and lighting power of the gas should not be doubled, yet if either or both be materially augmented the result could hardly fail to be contenting, because the cost of carrying out the process would be small. As to the danger of producing acetelyde of copper little perhaps need be feared. There is reason to think that brass is not freely attacked, and even if it were, nickel-plated fittings could readily take the place of those of brass now in use. A second scheme relates to the production of the very valuable bye-product, ammonia. For ammonia there seems to be a practically limitless demand. It is now manufactured in our gasworks by washing the gas with water, which absorbs the ammonia. The water is sold in many establishments as ammonia liquor. In large works, however, sulphate of ammonia is made. Sulphuric acid is placed in a large leaden pan. The ammonia liquor is pumped into a boiler and heated. The ammonia, in the form of gas mixed with steam, passes over into the sulphuric acid in the leaden pan. The process is continued until the acid is nearly neutralised. The contents of the pan are then drawn off and permitted to cool, when the sulphate of ammonia crystallises out. The price of the sulphate varies, but may be taken as from £17 to £18 per ton. A ton of cannel produces 20 lb., and of north-country coal about 16 lb. The net profit got from the manufacture of ammonia may be taken at about 2s. per ton of coal carbonised. It has been recently stated that the production of ammonia can be much simplified and reduced in cost, with the result of considerably increasing the profit to be derived from it. Extravagant assertions have been made on this subject. Thus it has been said that gas will become the bye-product, and ammonia the principal article of manufacture in our gasworks. This is obviously impossible, seeing that the quantity of ammonia to be had from coal is limited to a few pounds per ton; but there is every reason to believe that it is quite possible to effect certain valuable economies in this direction by the substitution of what is known as the dry process for that now in use.

Turning to another aspect of the question, there seems to be some reason to think that all that is possible has not yet been done in the way of carburetting gas. The difficulty hitherto met with has been to a large extent mechanical. The carbon is taken up freely by the gas, and its lighting power is very much augmented; but the gas will not "carry." It deposits its carbon as readily as it absorbs it. If this difficulty could be got over a great deal would be gained. Is it not possible that inventors who have handled the subject have given up too readily, or have not possessed the information necessary to enable them to deal with it satisfactorily? It may be found worth while to try again even schemes which have been proposed and tried several times already for producing a gas of low illuminating power—for instance, by projecting steam among burning coke, and so obtaining hydrogen. This gas might readily be carburetted up to the point requisite to make it a good illuminating agent. There is, of course, nothing new in this idea. It will be seen from what we have said that there are three distinct directions which inquiry may pursue, namely:—Firstly, the effect of passing the electric spark through coal gas, which undoubtedly produces acetelyne, with, it is said, an augmentation of volume and lighting power. Secondly, the production of the bye products, and more especially ammonia, in great quantity, and at a cheaper rate than heretofore; and, thirdly, the augmentation of the light-giving powers of coal gas by carburetting it. It is not too much to hope that 16-candle gas may yet be sold in London at 2s. the thousand feet. If this could be done, gas companies might regard the progress of the electric light with unimpaired equanimity. But it certainly cannot be done unless the managers of the great companies bestir themselves. Something more is wanted just now than men who can keep a great manufactory going as a paying concern. It will not do to go on for ever making gas just as it was made ten years ago. The modern gas manager should be a man of invention and enterprise; his resources are practically enormous. Investigation and inquiry are essentially necessary to keep the gas manufacture in its proper place. Such men as we speak of are not lacking; knowing this, we believe that gas has still a great future.

THE EXPORT OF RAILS.

In the ten months of the present year for which we have now the official statistics we find that we have been very largely increasing our export trade in rails—in steel rails, that is, for it is in that class of rails that we have enlarged our trade. In the ten months of this year we exported 108,606 tons of iron rails, the quantity exported in the corresponding period of last year being 116,568 tons. The chief purchasers of iron rails for the past two years have been the United States and India, the former buying from us increased quantities and the latter lesser quantities. In steel rails there is a more general increase—we exported in the ten months of the present year 512,370 tons, and in the same ten months of last year 408,280 tons. America has very largely increased her demand, India has materially decreased hers, and the quantities we send to Northern Europe show that slow decrease that has for some time been marked. The special feature of the return is our great dependence upon America for the rail trade. Out of the 620,000 tons of rails of both classes we exported in the present year, we sent not less than 260,000 tons to the United States alone; as well as 100,000 tons to British North America; we are dependent upon that country for more than one-half of the present export demand for rails. It is gratifying to notice the extent of the demand for our rails in America, but in this great dependence of our manufacturers on the demand from one part of the globe, and in the dependence on a demand that has been proved by bitter experience to be very fluctuating, there is a great danger. The terrible depression that set in in the iron and steel trades a few years ago was traceable to the large dependence of the iron rail trade on the American demand, and it appears that at the present time we are depending almost as largely on it for iron and steel rails as we did on it for iron. It would be well for our manufacturers to endeavour to develope the trade with Southern Europe, with Australia and with our own colonies, which seems to be to some extent neglected at the present time owing to the briskness of that with the United States. The latter depends upon the continuance of railway construction on a large scale, and it is a demand that is being increasingly met by the home makers. Hence, there is the greater need for our rail makers to endeavour to keep and to increase their hold on those neutral and non-producing markets that in an early future may need increased quantities of steel rails. The growth of this trade betokens the prosperity of our iron and steel industries, and whilst we retain and increase our hold on the sea carrying trade of the world, and on its construction, it is to be hoped that we may tighten our grasp on the rail trade, and increase the area over which the productions of our rail mills spread from year to year. Other fields than America's are to be covered with railways, and it is our duty to keep in the foreground as the greatest rail-making nation.

LAKES ONTARIO AND ERIE.

It has for some time been stated that the mean level of Lake Ontario and of Lake Erie is falling, and from recent statements there appears to be no doubt that this is taking place. The continued fall in the level of Lake Ontario is giving rise to a general feeling of anxiety as to the future of the several harbours along the two shores of the lake. From a datum line on a rock in Toronto Harbour the levels in inches above zero for the three nonades from 1854 to 1880 inclusive, have been taken, and are thus given by the *Toronto Globe* :—

	1854-62.	1863-71.	1872-80.
January	17·7	9·4	2·6
February	16·4	8·4	3·6
March	16·5	8·1	4·4
April	20·5	13·9	9·9
May	27·6	23·1	16·7
June	33·2	27·7	19·2
July	34·8	27·3	19·2
August	33·4	23·4	17·3
September	29·4	18·0	13·0
October	25·3	14·6	8·4
November	20·5	10·9	4·2
December	19 2	7·8	4·0
The Year	24·54	16·05	10·18

From these figures it will be seen that there has been a mean fall of nearly 14in. per year during the last period as compared with the first, and that the October fall has been 16·9in. It will, however, be noticed that though the fall in the first period was 8·49in., it has only been 5·87in. in the latter period, so that it may be that the operating cause of the fall is being removed, or that the fall may be cyclical, and a period of fall is drawing to a close. The reduction in the average depth of water in the harbours to the extent of from one foot to nearly a foot and a-half is, however, a serious matter, especially as the opening of the Welland Canal has rendered the lake accessible to vessels of larger draught than formerly. Various explanations have been offered. The last is that the improvement of the outflow by the St. Lawrence, consequent upon the lowering of the Gallop Rapids, gives the true solution. The Gallops, it is contended, form the natural dam of Lake Ontario; and it is urged that lowering of the dam will necessarily lower the average level of the lake. Whatever the true cause may be, it is evident that either the draught of vessels using the harbours will have to be lessened, or, what is more likely to be done, the wharfs will have to be pushed further into the lake.

LITERATURE.

Minutes of Proceedings of the Institution of Civil Engineers. Vols. LXV. and LXVI. Session 1880-81. Edited by James Forrest, Secretary.

Subject-Matter Index to the Minutes of Proceedings of the Institute of Civil Engineers. Vols. I. to LVIII. London: The Institution. 1881.

The first of these volumes contains two papers which elicited long and somewhat important discussions, and eleven papers which were not read or discussed at the meetings. The number of "Other Selected Papers" now regularly printed in the "Proceedings" gives a good idea of the growth of the Institution, and shows that to be able to write a very good paper is not now looked upon as derogatory to the claim to be considered a practical engineer. The two papers above referred to are, "On the Comparative Endurance of Iron and Mild Steel when Exposed to Corrosive Influences," by Mr. D. Philips; and upon "The Actual Pressure of Earthwork," by Mr. B. Baker. Mr. Philips's paper described a series of experiments made with the object of ascertaining the relative corrosion of several sorts of wrought iron and mild steel, chiefly under artificially-produced corrosive conditions. The result of these experiments tended to show that best irons and mild steels corroded rather more than common irons. Besides his own experiments, he discussed some of the experiments made by the Admiralty Committee appointed in 1874 to inquire into the causes of the deterioration of boilers, and upon which he served. In the discussion on the paper the advocates of mild steel were in full force, and though there were plenty to take the part of iron, the battle was best fought on the side of the new material. It is generally well known that since it was first announced that mild steel corroded under some conditions so rapidly as to cause considerable apprehension to shipowners, it has been stoutly maintained by those interested in the manufacture or use of steel that there was no foundation for the statement. In a few instances it has been admitted that steel had rapidly corroded, but then it was said to be because the steel was used in such a way as to give rise to feeble electric currents, which were the cause of the trouble, and even now it is urged that the combination of iron and steel in a structure is productive of galvanic action, and that steel of different qualities will cause it. There is, however, no doubt that mild steel does corrode when in the form of boilers, boiler tubes, or ships' hulls, rather faster than common hard irons; but it seems to be generally conceded that if mild steel is freed from the thin but hard and firmly adhering magnetic oxide scale left on it in rolling, the corrosion is but slightly more rapid than with good irons. This fact—and it seems to be a fact—was much discussed in the report of the Admiralty Committee, and though announced as a new discovery, it was put forward as long ago as 1843 by the late Robert Mallet, in one of his reports to the British Association, when he mentioned that iron and steel were electro-positive to their own oxides. The paper by Mr. Baker is not quite correctly entitled, for strictly speaking it contains much less new information of the actual lateral pressure of earthwork against revetment walls than it does of the modern practice in this branch of engineering. It gives a large number of instances of failure or partial failure of walls under a head of earth which they were calculated to retain, and a few experiments with pressure boards. The paper is one of the most valuable ever printed on the subject of retaining walls, and would be so if it gave no more than the numerous illustrations of such walls as employed at different times by our leading engineers, and the record of the causes of failure where that has happened; but the paper is much more than this. It is really a satisfactory text-book on retaining walls, and a text-book in which the examples are of the best sort, namely, examples on the practical scale. As a result of his own experience—and it is extensive—the author makes the thickness of retaining walls, in ground of average character, equal to one-third of the height from the top of the footings, and if any material is taken out, three-fourths of it are put back in the form of pilasters. The whole of the walls of the District Railway were built on this basis and have stood well. Mr. Baker's paper is extremely lucid, and conveys that sort of information that engineers would be most likely to look for in the fewest words. It only lacks a little more consideration of the conditions under which lighter or heavier walls than those founded on the above rule could be employed, for it is obvious that, in very many cases, to make walls one-third their height in thickness would be a waste of money. Examples, experimental and practical, of very light walls are given in the paper, but there is room for a somewhat fuller digest of these data. On this paper, as well as on that of Mr. Philips, the discussion was lengthy, and in the second case it was particularly good. The discussion, by correspondence, which is now printed in the Proceedings, with a reply thereto by the author, forms a valuable contribution to the subjects discussed, particularly as a written discussion is likely to be carefully thought out.

A very useful contribution to this volume is made by Sir G. B. Airey. It is a set of tables giving the logarithms of the values of all vulgar fractions with numerator and denominator not exceeding 100, arranged in order of magnitude.

Vol. lxvi. opens with a paper on the relative value of tidal and upland waters in maintaining rivers, estuaries, and harbours by Mr. Walter R. Browne. This paper excited the most hostile discussion that has been heard for a long time at the Institution. It was almost unanimously opposed by all those who are known to have been practically experienced in river hydraulics. Mr. Browne's theory is that the most effectively active agent in keeping the channels of tidal rivers clear is in general the low-water flow and not the tidal flow. This hypothesis his paper was written to support on the following line of argument:—(1) The silt which tends to choke up tidal channels is almost wholly due to tidal water, and not to the fresh water. (2) The tidal water brings up more silt on the flow than it takes down on the ebb. (3) That the low-water flow if left to itself scours away the deposit, and keeps the channel open; and (4) that, therefore, where the two act together the scour must be due mainly to, if not entirely to, the low-water flow. None of those who took part in the discussion admitted Mr. Browne's conclusions, though several remarks were made which were partly in support of some of his premises. The theory led the author to the proposition that embankment of rivers so as to exclude much or most of the tidal waters would have no detrimental effect on the maintenance of the channel of a river, and instances were given which tended to support this, and some to disprove it, though all were given as against the author. The effect of land reclamation in the lower tidal portion of the Dee was one of the most serious instances cited as against the theory, and there the navigable channel has been most seriously affected; vessels which formerly reached Chester easily can only do so now with great difficulty. The subject is much too extensive to permit a discussion to be entered into upon it here, but it must be admitted that though the bulk of evidence is against Mr. Browne's theory, there is much to be said in favour of some of the propositions he has put forward, for there can be little doubt that upland waters play in most tidal rivers a very important part in aiding the scouring power of the ebb, and it is very well known that the estuaries of several rivers, where the fresh water flow is small, have to be kept open by dredging. Instances are, moreover, not wanting where draining and embanking have been attended with beneficial results. The conditions affecting every case are so numerous that it is not surprising that though most engineers gave illustrations supposed to disprove Mr. Browne's conclusions, many of these same illustrations might be used in argument in favour of these conclusions. Altogether Mr. Browne received very little avowed support; but there are not a few who lean to most of his views, though probably no one agrees with him in his generalisation that the volume of fresh water determines the size of the estuary.

The second paper in this volume is by Mr. J. I. Thornycroft, "On Torpedo Boats and Light Yachts for High Speed Steam Navigation," and it contains more detailed information on the boats made by the author's firm than had previously been made public; but even here the author did not commit the sin of enlightening the outer world too much. The discussion on this paper was, however, somewhat lengthy, and elicited a good deal of useful information on steamboats of this and other classes, which, to some extent, made up for what had not been said in the paper. Admiral Selwyn took part in this discussion, and occupied a good deal of time that many present thought could have been much more profitably employed, especially when part of this was used to make a set of bare statements to the effect that if engineers would do away with forced draught and instead "have a vacuum in the funnel," they might evaporate 60 lb. of water with 1 lb. of coal plus 1 lb. of steam; and he went so far as to say that he had seen it done with a common Cornish boiler! To our surprise nearly four pages are occupied with a report of the speech of Admiral Selwyn, including this about 60 lb. evaporation.

Amongst the Other Selected Papers is one by Mr. B. Baker, on railway springs, which will be found useful to engineers. Having found in practice that the elastic flexure of springs of same dimensions varies very considerably, the author made a series of experiments, the results of which are given with a new expression for deflection. Electricians will be interested in the paper by Dr. Paget Higgs on the construction of electro-magnets, although some will have already become acquainted with it in the French of Count Du Moncel, which, with modifications, forms the paper here given. Three short but useful papers are given on earthwork slips, by Mr. E. Parry, Mr. J. W. D. Harrison, and by Mr. W. G. Laws. These three papers are examples of the short communications which have been solicited by the Council. They describe three cases of railway embankment failures, and the methods adopted to remedy them. The value of such notes on actual practice is known to all, and it would be a pity that they should be withheld, because those who can contribute a note have not time to compile an exhaustive paper. A useful paper on centrifugal ventilators for mines is contributed by Mr. A. Bache as a translation of a paper by D. Morgue from the *Bulletin de la Société de l'Industrie Minerale*. A paper, giving the results of trials of a rotative engine working a reciprocating pump is contributed by Messrs. Bryan Donkin and Co. The trials were superintended by Mr. T. H. Martin, Mr. B. Donkin, and Mr. F. Salter. The engine was of the well-known compound horizontal condensing type of Messrs. Bryan Donkin and Co., as designed by Mr. B. W. Farey, and may be taken as an example of what can be done under best circumstances. The results were one indicated horse-power with 19·291 lb. of steam at an average of 50·5 lb. pressure, the consumption of fuel being on an average 2·125 lb. per indicated horse-power per hour, with an evaporation of 9·1 lb. per pound of coal, the feed being at about 90 deg. Locomotive superintendents will be interested in the paper by Mr. A. McDonnel on the repairs and renewals of locomotives, a supplementary paper to that which was read in the previous session, and printed in vol. xlviii. Three papers by students of the institution are here given, and show that some good work is done by this class. One is on wood-working machinery as applied to the manufacture of railway carriages, by Mr. J. B. Hunter; one on the prevention of waste of water, by Mr. T. Stewart; and the third, by Mr. L. Burnett, entitled, "A Description of a Cargo-Carrying Coasting Steamship, with Detailed Investigation as to its Efficiency." Memoirs of eight deceased members are given, followed by a large number of abstracts of useful articles from foreign societies' proceedings and periodicals.

It would be impossible in our columns to devote more space to these volumes, for each of the four now published per year by the Institution contains an amount of technical reading not to be found in the proceedings of any other institution, and all edited and arranged with the greatest care. We may suggest that as the names of speakers in discussions are now printed in the margin for facility of reference, that a return to marginal subject matter notes throughout the papers, as they were printed in some of the earlier volumes, would be of great assistance, and an improvement upon what is already eminently well done.

Most engineers other than members of the Institution will be interested to know that the subject-matter index to the "Proceedings," from vol. i. to vol. lviii., that is, for the sessions 1837 to 1878-79, which has been some time in progress, has been published. The subjects of the papers have been divided into classes, but cross-referencing has been so completely carried out that no difficulty will be experienced by anyone in finding the class in which any subject has been placed, as it is only necessary to look down the sub-heads of the class to find any subject referred to in the "Proceedings." Artillery, for instance, carries thirteen sub-heads, railways thirty-two, and permanent way sixteen. There may be difference of opinion as to the wisdom of this division of subjects, and no doubt many would have preferred the strictly alphabetical arrangement like that adopted for the old indexes to subjects and names. Such an arrangement, however, does not admit of such copious indexing as that adopted, and if a subject is worth finding, it is worth thinking under what head it should be found. The index is printed in very clear type, and the subjects, printed in large capitals, are sufficiently separated to make each stand out clear and distinct.

The three volumes are turned out with, in all respects, the finished character which has marked them for several years.

Railway Accidents in America.—The *Railroad Gazette* record of train accidents in September shows for that month a total of 144 accidents, in which 56 persons were killed and 227 wounded. Of these accidents 29 caused the death of one or more persons, and 27 caused injury but not death, leaving 88, or 61·1 per cent. of the whole number, in which no serious injury to persons is recorded.

ROBERT MALLET.

No. II.

Although, as was mentioned in our last impression, the activity in practical engineering during the years 1844-51 fully occupied the works of which Mallet was then the managing partner, he nevertheless found time for the pursuit of those scientific questions which he had taken up with such marked freshness of thought, precision, and energy. As early as 1838 he wrote on the uselessness of accumulating facts of a geological order without a guiding and arranging theory, and began to insist upon the application to geology of chemistry and mechanics, and to show the necessity for discarding the ordinary generalities of geologists for much more exact and definite observations. Geology, though destined to remain very far from an exact science, he insisted might be made much more exact and vastly more useful by the application of those sciences to the study of its phenomena. He directed special attention to these subjects in a paper "On Causes of Elevation and Degradation" read before the Royal Irish Academy in 1838, and in another paper "On the Relation of Molecular Forces to Geology," read before the Geological Society of Dublin in 1844, the action of heat and water in modifying the crust of the earth and producing motion in different ways, was set forth with much clearness; the paper containing a mass of physical data of great use in the present day. As illustrating his remarks on the part played by these molecular forces, the results are given of numerous experiments, by himself and others, on the expansion and the contraction of bodies on combination, and on changing the state of their arrangement or aggregation. On taking the chair as president of the last-mentioned society in 1846 his address was on certain observed secular and diurnal motions of the earth's crust, and was to a considerable extent anticipatory of the recent and still-continued observations of M. Plantamour on the constant changes in the relative levels of different parts of a country in summer and winter, due apparently to the varying intensity of the outward of the two waves of heat of which the earth's surface is the medium of transmission, and consequently to the expansion and contraction of the materials of the crust which follow the period of rise and fall of the isogeothermal plane.

Amongst the papers read before the Royal Irish Academy at this time are one on improvements effected in the art of glass making for optical purposes; another on the manufacture of sulphuric acid; and one on the power of the light emitted by incandescent coke to blacken photogenic paper, in which it was proposed as a cheap means of obtaining continuous photographic records of certain kinds of observations. A short paper on molecular changes in the structure of recent shells, showing the influence of structure of bodies undergoing fossilisation on the crystalline form of the fossilising substance, was also read before the Dublin Geological Society, as well as one on the movements of post tertiary and other discontinuous masses, showing how scratching and grooving may be and is largely the result of the movement more or less gradual, as in Switzerland and elsewhere, of discontinuous masses over rocky beds. He was of opinion that much of the work attributed to glaciers was the result of this movement, which is to be seen in progress on a large scale in several mountainous districts, and that many of the hypotheses advanced to explain the formation of some lakes would bear very little dynamic examination. To Weale's Quarterly Papers he contributed, in 1849, one on the principles and practice of water power, and in the succeeding year appeared the first of the series of reports to the British Association on the facts of earthquake phenomena.

Returning to practical engineering, we find him in 1849 engaged on the design and construction of the iron station roofs of Belfast, Portadown, and Armagh. He also constructed the large engine shed of the Lancashire and Yorkshire Railway at Miles Platting, of which Mr., now Sir John Hawkshaw, was engineer-in-chief. This was called the Irish shed, owing to the curiosity then excited by the idea that an Irish firm should be contractors for such buildings for England. The large market and bazaar at Cork, with iron roof supported on cast iron columns, was designed by him and erected in 1850.

The Fastnet Rock Lighthouse, from the designs of Mr. George Halpin, then engineer to the Corporation of the Port of Dublin, was built by Mallet in 1848-9. It is placed on an isolated rock off Cape Clear, which, though 90ft. above sea level, is often overswept in storms. It is in form a frustrum of a cone, built of cast iron plates, varying from 1⅛in. in thickness at bottom to ⅞in. at top. It is lined with masonry and brickwork, has five floors, and a central cast iron column. On the upper part of the tower is a floor and gallery, upon which the lantern stands. The tower is 63ft. 9in. from base to gallery, and the lantern is 30ft. in height, constructed of brass. During erection no communication could be made with the rock for seven weeks, but a knowledge of the coast and its storms had dictated an ample supply of provisions for such a length of time. In 1850 the Wakefield passenger shed on the Lancashire and Yorkshire Railway was designed and constructed by him. The main roof is 95ft. in span, and 750ft. in length, and the whole structure was erected without any obstruction to the traffic, though there were fifty-nine trains passing during the day, and goods traffic at night. That this structure should be constructed in Ireland also caused great surprise at the time, but there were not so many firms then as now who could undertake work of this class.

About this time he was engaged on the experimental determination of the limits of transit rate of the propagation of waves of impulse similar to those of earthquakes through solid substances. The results were recorded in the "Proc." R.I.A., vol. v., and in his second "Report on the Facts of Earthquakes" to the British Association. The velocities of transmission were determined in wet sand, discontinuous granite, and more solid granite, respectively on Killiney Strand and Dalkey Island. The mean velocities then obtained were, in wet sand, 824·9ft. per second; in discontinuous granite, 1306·4ft. per second; and in solid granite, 1664·57ft. per second. Though not in chronological order, it may be here mentioned that he carried out a series of exhaustive experiments on this subject in 1860, the results of which are fully recorded in the Transactions of the Royal Society in 1861. These experiments were conducted at Holyhead during the progress of the quarrying there on a large scale for material for the construction of Holyhead Harbour. Enormous blasts were fired for this purpose, and by means of specially constructed seismometers and an arrangement of time recorders, started and stopped by electricity, the rate of wave transmission was obtained for metamorphic quartz, rock, and slate. In 1854 he received a severe blow in the loss of his wife.

About 1850 Mallet turned his attention to the construction of large guns, and in 1854 designed his monster mortars for throwing 36in. shells. Two of these mortars were constructed from the orders of Lord Palmerston with the approval of Prince Albert, with the intention of sending them to the siege of Sebastopol. The large iron rafts upon which they were to float were not, however, completed when peace was made. The design of these mortars was the origin of his investigation of the principles and method of constructing ordnance in superimposed rings with initial tension, as now universally employed for large rifled cannon. His investigations on this subject were communicated in a lengthy paper to the Royal Irish Academy in June, 1855, and were subsequently reprinted by Longmans as a quarto volume entitled "The Physical Conditions Involved in the Construction of Artillery, with an Investigation of the Relative and Absolute Values of the Materials Principally Employed, and of some hitherto Unexplained Causes of the Destruction of Cannon in Service." This book was published in 1856, and contains a mine of information which has formed the storehouse for most of the subsequent books on ordnance, and on casting and founding. In the preface to this book he gives his opinion that, though Government factories and foundries for the manufacture of ordnance are a necessity, the construction of ordnance is essentially a work of mechanical engineering. All subsequent experience has proved that it is to the mechanical, and not the military engineer, that the greatest improvements in gunnery have to be credited, and that only thoroughly educated engineers have fully appreciated the conditions involved. It would take up a great deal too much space to give any idea of the vast quantity of original information on the metallurgical and physical properties and behaviour of materials in the foundry, smiths' shop, and fitting shops, contained in this book. It will ever continue to be a text-book for the constructors of ordnance and those requiring information on the resistance of cylinders to internal pressure; the molecular constitution of crystalline bodies; the physical condition induced in casting and forging, especially on a large scale; effects of fluid or gaseous pressure, expansion by heat, and numerous questions relating to metallic alloys; the action of repeated strains, and various questions determining the strength of metals and alloys. In it was first investigated the theory of the ringed structure for ordnance, and its advantages, and the law announced that in cast iron the principal axes tend to place themselves perpendicular to the cooling surfaces, and the importance of this discovery in relation to castings of various kinds pointed out, as well as the importance of a thorough consideration in the design of large cast and wrought iron masses, of the law of crystallisation, and the relations of the ultimate, ductile, and elastic values of these metals.

The large 70-ton sheer legs at the Victoria—London—Docks were designed by him, and erected in 1856 by the late firm of C. J. Mare and Co., Blackwall, to whom he entrusted the work. These sheer legs were at the time the most powerful in this country, and were the first of very large dimensions then constructed of iron. They were fully illustrated in our impression for 31st October, 1856, from which it will be seen that they were a fine piece of work, their design having formed the model upon which all subsequent sheer legs have been built, with the exception that instead of employing a fourth back leg to control the hauling in and lowering when the load was hanging over water, the back leg is in modern construction carried by a crosshead in a slide bed and worked by a powerful screw. In 1856, however, a screw of about 9in. diameter and 40ft. in length was not so easily or cheaply made as now. In 1857, a good deal of work was done at the Victoria Foundry in connection with the Londonderry port and harbour improvements. From 1852 to 1858 he was employing his spare time in conjunction with his son, Dr. J. W. Mallet, in the preparation of the great earthquake catalogue and seismic map, published in several volumes in 1858. He was elected Member of the Academie de Dijon in 1853, and Fellow of the Royal Society in 1854, of which, in later life, he was Member of Council.

Some time previous to the year 1856 a good deal of discussion took place of the relative amount of deflection of girders or bridges under static strain, and during the passage of a rapidly passing load. The fact that there was an increase in girders under a heavy passing load was, however, established by experiments made by Captains James and Galton, and by Professor Willis, but it was left to Morin to point out the true cause of the phenomenon. Professor Willis covered the question with a heap of mathematical investigation, which left it in an unsatisfactory state. Morin made things clearer, and showed that the increased deflection was due to the centrifugal action of a rapidly moving body on a curve. This paper of Morin's was reduced to a few pages in the Proc. Inst. C.E.I., and greatly simplified by Mallet, who reduced the expressions to a brief and practical form, and drew those deductions which make a paper of the kind instructive and valuable to engineers. He had a most remarkable capacity for at once perceiving the essential elements of any set of problems placed before him, or the fundamental principles upon which any question depended. Previous identical experience was not at all necessary to him. The law involved and its application were the first and immediately succeeding thoughts upon the presentation of any question or project. Owing to this capacity he was enabled, as shown in many papers, to state and elucidate a question or subject in the clearest manner, as will be shown further on, and as is exemplified in his preface to the paper by M. Cousté on incrustation of steam boilers, translated by his son, R. T. Mallet, M.I.C.E., in which the several questions involved in deposition and incrustation are most clearly set forth in a few pages, *vide* Proc. Inst. C.E.I., 1855. Many much more extensive papers might be mentioned as better examples of this. In 1857 occurred the great Neapolitan earthquake, and upon this he spent much time, and sent in a report to the British Association on his survey and determination of the depth of the focus of impulse and the direction of transmission of the elastic wave. In the same year he was elected honorary member of the United Service Institution, before which he gave several lectures on ordnance and military subjects. In 1859 he for the second time received the award of a medal and premium from the Institution of Civil Engineers for the well-known paper on "the coefficients of elasticity and rupture in wrought iron." Here again a complex problem was reduced to one of a comparatively simple order. The object of this paper was to show the relative structural value of different materials, and it was probably never of more value than at the present time, now that new materials having new relations of physical properties are in use, and the data for making the comparison are available. In this same year he became a Fellow of the Geological Society of London. During these latter years and in 1860 engineering work became scarce in Ireland. Railways were completed for the time, drainage operations had ceased, and ironworks had so increased in number and variety in England and Scotland, that after importing iron and coal to Dublin, prices became too high to permit profitable competition with English and Scotch firms, while the state of Irish industries afforded but very little employment for engineers or engineering works. He, therefore, entertained the idea of closing the works and taking up his residence in London, where the practice he already had in England made it necessary for him to reside a considerable part of the year. About this time the Dublin Corporation were greatly extending the arrangements for water supply, and in the Victoria Foundry large numbers of slide stop valves, &c., had been made as part of this work. The order for a large quantity of pipes was, however, sent to Scotland, and this fact, with the then ever-increasing evidence that the advantages were continually increasing on the side of the English and Scotch makers for the kind of work which had been carried on in Mallet's foundry, seemed to be one of the few last determining points of evidence in favour of closing the establishment. The accepted tender for these pipes was only about £200 below Mallet's, a very small percentage on the whole. The contract was evidently expected at the Victoria Foundry, and preparations had at some expense been made for it, but it went elsewhere. Just previous to the time when the foundry was closed, the wages paid weekly ranged from £300 to £380. The whole establishment, after Mallet and his father had, as they considered, satisfactorily shown that such works could not receive support in Ireland, was placed by them in the hands of Messrs. Wheatley, Kirk, and Price.

In 1861 Mallet gave up his residence at Glasnevin, near Dublin, where he lived in a house known as Delville, formerly occupied by Dean Delaney, and made historic by the several references to it by Swift. He married a second time, and came to live in London. In 1861 he edited the *Practical Mechanic's Journal*, at the time an excellent magazine with an unfortunate title. In 1862 he edited the Record of the International Exhibition of that year, himself writing the masterly introduction—which is a history of exhibitions from the earliest times to 1862—several of the sections, and the interesting and suggestive "Retrospect—the Future." At this time was published his "First Principles of Observational Seismology," a development of the article "Earthquake Phenomena," written at the request of the Admiralty for the "Admiralty Manual of Scientific Inquiry." In 1863 he was employed by the proprietors of the Hibernia and other collieries in Westphalia to report on the best means of sinking and ventilation of their pits, with which they had encountered considerable difficulties. About the year 1864 the honorary degree of LL.D. was conferred upon him by Trinity College, Dublin; and in that year he, in conjunction with Mr. J. S. Burke, obtained an Act for the Dublin Trunk Connecting Railway. This railway was fairly started, but owing to some financial and legal difficulties which arose the works were stopped in 1866, after a large sum of money had been expended on the excavation and masonry of the shaft on the southern side of the Liffey for the tunnel under that river, which formed part of the line. Work was actually going on from early in October, 1865, to April, 1866. While this was going on, plans were prepared by him and Burke, and a prospectus of what was to be the Dublin Southern Dock were drawn up, but this scheme fell through. The object of the railway has since been attained by the Great Southern and Western, and Midland Great Western Railways.

Even so hurried a glance as we are giving at this remarkable career, occupies so much space that we must still reserve for another impression a short notice of the more recent scientific work.

THE FORTH BRIDGE.

We give on page 368 a series of diagrams, showing the general features of the continuous girder design referred to by us last week; and for purpose of comparison we give also diagrams to a similar scale of the original design for a suspension bridge by Sir Thomas Bouch, and of the two greatest railway bridges yet constructed in this country, namely, the Britannia and the Saltash Bridges. It will be seen that the latter famous structures are entirely dwarfed by comparison with their gigantic neighbour, and it need hardly be said that thirty years ago it would have been impossible to have satisfied engineers of the practicability of building a girder bridge nearly four times the span of either of these great girder bridges. In our last article we remarked that the design of Mr. Fowler and Mr. Baker was analogous in principle to the Britannia Bridge, and in detail of construction to the Saltash Bridge. This may not be apparent at once to every observer, and therefore a few explanatory remarks may be added here.

The Britannia Bridge, as all the world knows, was constructed by building rectangular tubes about 460ft. long by 28ft. high by 14ft. wide, as shown, and floating them out into position between the piers. During the process of erection the tubes were suspended at each end, and had to carry their own weight of about $3\frac{3}{4}$ tons of iron per lineal foot of tube as independent girders. The resultant strain upon the metal at the centre of the span was upwards of five tons per square inch, and there would thus be no sufficient margin of strength to provide for the rolling load of one ton per lineal foot, if the girders remained "independent." By connecting the tubes together with an initial strain over the piers the condition of the stresses was entirely altered, the "independent" girders in fact were then transformed to "continuous" girders, and were competent to sustain double the rolling load with less strain upon the metal than had occurred with the unloaded tubes before connection. The advantage of continuity increases with the span, and what was strikingly advantageous in the case of the 460ft. span becomes indispensable in that of a 1730ft. span. The essential principle is the same whether the girder be a massive tube or a skeleton truss, or whether the structure be rivetted up or free to move at the points of contrary flexures. The sources of economy in a continuous girder are, first, that the effective span of the opening is reduced; and secondly, that the mass of the metal lies near the piers, where it acts with the shortest leverage instead of near the centre as in an independent girder.

The latter element has been taken advantage of in the Forth Bridge design to a far greater extent than in any previous continuous girder bridge, and to this is due the economy of the structure. Thus the central portion of the bridge is light in appearance and in fact, weighing only some three tons per lineal foot, whilst the part near the piers weigh five times that amount. The former weight acts with a leverage of nearly half the span, and the latter with that of but 100ft. and upwards. Again, regarding the all important question of wind pressure, it will be seen that the surface exposed is proportionally small at the centre of the span where the leverage is greatest, and the resultant stresses are thus minimised. A reference to the plan of the bridge will show that the wind stresses are transferred direct by the verticals to the lower member of the girder. This member consists of two steel tubes about 12ft. diameter, and of immense strength "straddled" out to a distance of upwards of 100ft. apart, where they abut on the massive masonry piers. The twisting action of an unequal blast of wind is resisted by the great mass of this masonry, and such strength and stability are given that at any stage of the erection and after completion a tornado of any width, great or small, and of the impossible force of 112 lb. per square foot, would fail to injure the bridge.

The Saltash Bridge has tubular compression members like those proposed for the Forth Bridge. Great depth of girder is given and is necessary as the advantage of continuity is not enjoyed by the Saltash girders. It is doubtful whether the question of wind pressure was ever considered by Brunel when designing the Saltash Bridge, and it is certain that if considered at all but little importance was attached to it. Probably a compression strain of about twelve tons per square inch would cause the arched upper member of the girder to fail, as it is practically a column of the ratio of thirty diameters in length not fixed at the ends. With the ordinary rolling load the strain is about $4\frac{1}{4}$ tons per square inch, and with a wind pressure of 56 lb. the strains would far exceed the ultimate resistance of the tube. It is within the mark to say that the Forth Bridge as designed, possesses three times the strength and stability of the well tested, strong, and satisfactory Saltash Bridge.

Wind pressure was considered briefly by Mr. Edwin Clark in connection with the Britannia Bridge, in his work on that structure, but a clerical error must clearly have passed unobserved in his calculations, as he gives the increased strain due to a wind pressure of 20 lb. per square foot at the "insignificant" amount of $\frac{1}{2}$-ton per square inch, whereas on the same basis, but making a proper allowance for rivet holes, we estimate it to be nearly two tons per square inch in tension. It is certain that with a wind pressure of 56 lb. the Britannia Bridge would be bent out of a straight line, and be otherwise seriously damaged, and it is clear, therefore, that neither the Britannia nor the Saltash Bridge has encountered wind strains approaching 56 lb. per square foot. In Sir Thomas Bouch's original bridge, provision was, in accordance with the Astronomer Royal's report, made for a wind pressure of but 10 lb. per square foot. The resultant stresses were resisted by a horizontal girder at floor level. Vertical stiffness within certain limits was to be attained in the usual way by means of a stiffening girder, but the wave of deflection accompanying the passage of a train at high speed would relatively have caused as much tremour and vibration as the passage of a fire-engine at a galop over such a structure as the Chelsea Suspension Bridge. There is, in fact, no analogy whatever between the original and amended design for the Forth Bridge, and it may be taken as tolerably certain that no further propositions will be submitted for the construction of a first-class railway bridge on the suspension principle.

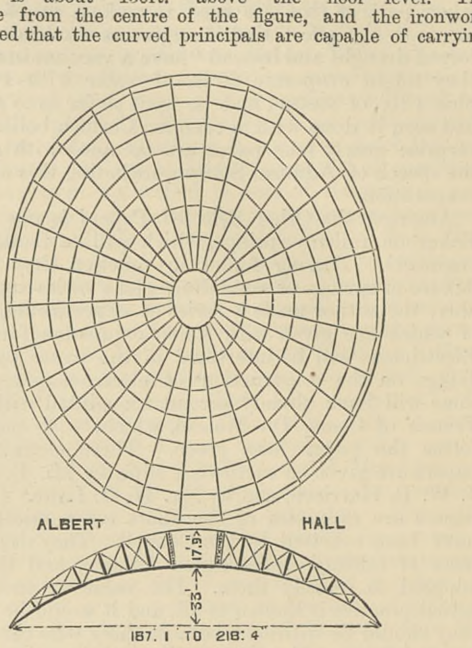
Society of Arts.—The following are among the papers which will be read during the session:—"The American System of Heating Towns by Steam," by Captain Douglas Galton, C.B., F.R.S.; "Practical Hints on the Manufacture of Gelatine Emulsions and Plates for Photographic Purposes," by W. K. Burton; "Stained Glass Windows," by Lewis Foreman Day; "Photometric Standards," by Harold Dixon; "Telephonic Communications," by Lieut.-Colonel C. E. Webber; "The Causes and Remedies of Bad Trade," by Walter R. Browne, M.A.; "The Native Tribes of the Hudson's Bay Territories," by Dr. Rae, F.R.S.; "The Manufacture of Ordnance," by Colonel Maitland; "Some Practical Aspects of Recent Investigations in Nitrification," by R. Warington; "The Production and Use of Gas for Purposes of Heating and Motive Power," by J. Emerson Dowson; "Gas for Lighthouses," by John Wigham—illustrated by an exhibition of some of the gas flames and apparatus used in lighthouses—"The Relation of Botanical Science to Ornamental Art," by F. Edward Hulme, F.L.S., F.S.A.; "The Storage of Electricity," by Prof. Sylvanus Thompson, D.Sc.; "The High-pressure Steam Engine," by Loftus Perkins; "The Industrial Resources of Ireland," by J. Philips Bevan; "A New Chemical Compound, and its Application to the Preservation of Food," by Prof. Barff, M.A.; "The Distribution of Time by a System of Pneumatic Clocks," by J. A. Berly; "Tonnage Measurements," by Admiral Sir R. Spencer Robinson, K.C.B., F.R.S.; "Tools and Cutting Edges," by D. A. Aird; "The Teaching of Forestry," by Colonel G. F. Pearson; "The Art of Turning," by P. W. Hasluck. The usual short course of juvenile lectures, given during the Christmas holidays, will be by Mr. W. H. Preece, F.R.S., the subject being "Recent Wonders of Electricity."

IRON ROOFS.

By Mr. A. T. Walmisley, C.E.

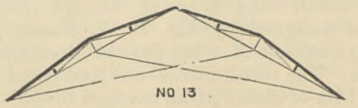
[*Continued from page* 345.]

As an example of an oval roof may be cited that over the Albert Hall. The plan of the building is nearly a true ellipse, and the span of the roof is 219ft. 4in. by 185ft. 4in. The principle adopted has been the construction of a continuous wrought iron kerb resting on the top of the wall about 120ft. high from the level of the Kensington-road. This kerb may best be described as a flanged girder laid down on its side, upon which cast iron shoes are secured by the keys, from which the main curved ribs, thirty in number, spring, and in the centre of the roof another rigid kerb has been formed, to which are fastened the top extremities of the main ribs. The top of the lantern surmounting the roof is about 150ft. above the floor level. The ribs radiate from the centre of the figure, and the ironwork is so arranged that the curved principals are capable of carrying

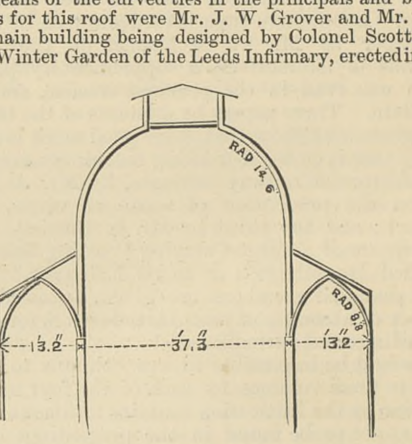


ROOF OVER THE ALBERT HALL.

their own weight, together with the weight of seven rows of purlins, between them and the rafters of the roof and ceiling. The thrust thus produced on the main ribs is taken by the curved ring forming the wall plate, while the strains of these ribs can be adjusted by means of wedges between the wall plate and the foot of each rib, by the slackening or tightening of which the whole of the outward thrust is brought to bear upon these curved ties, resting on the wall. The top flange of the rib acting as an arch communicates



the strains produced under every variety of loading, pressure of wind, snow, &c. The wall plate and ribs are retained in their position by means of the curved ties in the principals and bracing. The engineers for this roof were Mr. J. W. Grover and Mr. R. M. Ordish, the main building being designed by Colonel Scott. The roof over the Winter Garden of the Leeds Infirmary, erected in 1868,

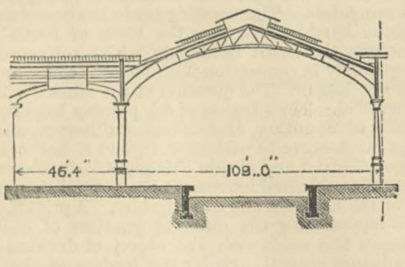


ROOF OVER THE WINTER GARDEN, LEEDS.

presents the appearance of being constructed on the principle of an arch, but is, strictly speaking, on the principle of a dome. The infirmary walls surrounding the Winter Garden do not sustain any portion of the outward thrust. The internal dimensions of this structure are 151ft. by 63ft. 6in. The main roof is carried by the four corner rafters or hip ribs, which having thus to perform the chief portion of the work are constructed stronger than the ordinary ribs. The roof is carried on twelve columns 32ft. high by 24ft. 10in. apart, six on each side of the building, leaving a space of 37ft. 3in. between the rows and an aisle on each side 13ft. $1\frac{1}{2}$in. wide. From these columns spring ornamental spandrils to a lower frame of lattice girders connecting the tops of the columns firmly together and forming a rectangle in plan 124ft. 2in. by 37ft. 3in. At each column similar spandrils to those forming the arches between the columns are placed over the side aisles, and are surmounted by cast iron rafters with perforated webs inclined at an angle of 30 deg. from the brick wall of the infirmary to the level of the top of the columns. The main arched ribs are also of cast iron with perforated webs, and are bolted to this bottom frame of lattice girders and at the top to a similar rectangular frame 99ft. 4in. by 12ft. 5in. This top frame is braced by cross pieces of cast iron 12ft. 5in. apart, and is thus rendered exceedingly rigid. The weight of the upper frame as well as the weight of the greater part of the lower roof is transmitted to the corner ribs, which in return transmit a horizontal thrust upon the upper frame. The lower frame acting as a tie has now to receive this horizontal strain on the bottom of the ribs. The load on the intermediate ribs, although producing no outward thrust, is sustained partly by the corner ribs, partly by the upper and lower lattice girders, and partly by the intermediate columns. Both tiers of girders are 5ft. deep, and the vertical distance between them is about 15ft. 2in. There are two rows of cast iron purlins connecting the main ribs and a single row between the aisle rafters half-way between their extremities. Two rows of moulded cast iron gutters are fixed at the base of the arch pieces or spandrils at their junction with the lower girders, and also above the aisle rafters against the brickwork forming the walls of the central hall. The summit of the ridge piece is 60ft. $6\frac{1}{2}$in. above the floor level. Exclusive of glazing, the cost of this hall was about £31 6s. per square. The whole of this construction of this iron building was designed by Mr. R. M. Ordish, and approved by the late Professor G. Gilbert Scott, the architect of the infirmary building. Generally speaking the hips of a roof over a rectangular area are of special construction, but by making the ribs spring diagonally over the space to be covered and at equal distances apart, they will by their intersection divide the entire central area into equal squares, and thus make the hip ends the same as the sides and similar all round the roof. This plan was adopted in the building of a kiosk for India made entirely of cast iron. The ribs were supported on columns placed 10ft. apart round the exterior of the structure, which was 80ft. long, 40ft. wide and 12ft. high in the centre. The base of each column was attached by bolts to a girder running inwards for a distance of 10ft. beneath the floor level, thus enabling each column to resist the tendency of turning under the influence of strain produced by the load on the roof. A considerable amount of ornamental effect was aimed at and secured in the design.

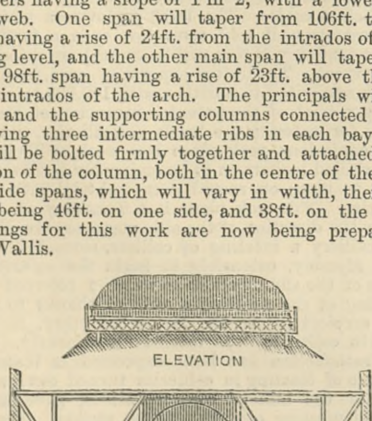
Another good example of cast ironwork as adapted to roofing is to be found in the Santiago Market, designed by Mr. C. H. Driver, architect, and Mr. Edward Woods, civil engineer. The building occupies a rectangular space surrounded by a low corridor which separates it from a one-storied building. The market is divided into nine squares, over which are constructed separate roofs carried on columns and girders. The central roof is the highest, and is surmounted by a dome. The roofs over the four squares at the angles are less in height than the central one, and the roofs over the middle squares along each side are at a lower level again. Each roof is hipped each way, and their varying height enables their louvred faces to be well exposed to the air. The new Central Fruit and Vegetable Market now in course of construction, designed by Mr. Horace Jones, the City architect, is situate at the junction of Charterhouse-street with Farringdon-road. This site is likewise divided into nine squares by sixteen columns placed at the angles of the squares, and connected at the top by girders which carry the roofing. The roofs over the outside squares are of timber, with clear spans of 47ft. 6in. and 56ft. respectively. The girders forming the centre square are united at the corners by girders of the same depth, 22ft. in length, so as to form an octagon in plan, measuring 25ft. parallel to the columns. The roof consists of eight wrought iron ribs springing from the angles with a rise of 22ft. 6in., and united at the top by an octagonal ring measuring 10ft. 3in. parallel to the line of columns, and 9ft. at the angles. Wrought iron purlins are placed round the dome, the construction forming a rigid skeleton of ironwork, which is filled in with ornamental woodwork, and fitted with eight large glass louvres, affording an ample amount of ventilation, so essential for a market of this description, while at the same time, the building is well lighted without admitting the glare of the sun.

The area occupied by the various lines and platforms in the terminus station of the Great Eastern Railway at Liverpool-street is covered with a roof in four spans, the two central ones being



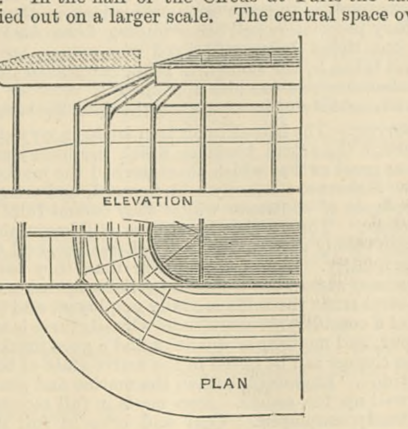
GREAT EASTERN RAILWAY LIVERPOOL STREET.

109ft. each, and the side spans 46ft. 4in. and 44ft. 8in. respectively. The central span consists of two cantilevers supporting a girder similar to the truss shown in No. 8, but with the diagonals placed in the opposite direction, that is with their top ends pointing towards the centre of the span. The principals over each span are secured to each other over the supports, and form a continuous girder anchored down at the ends by the arches forming the wall and bolts built into the brickwork. Cast iron columns form the supports at the junction of the roofs, and are placed double in the centre at the meeting of the two main spans on account of the extra weight to be sustained at this point, compared with that at the junction with the side spans. The centre columns are placed 5ft. apart transversely, so as to reduce the strains on one span caused by unequal loading on the other. The columns act as rain water pipes to drain the roof, and are placed 30ft. apart under each principal longitudinally. The main ribs are connected by trussed purlins divided into three bays, and glazed upon the ridge-and-furrow system resting upon the diagonal bars of the truss, and the whole roof is further stiffened by special spandril castings springing from column to column between the principals. A transept is formed in one part of the roof where it was required to place the columns as far apart as possible, and diagonal ribs intersecting each other, similar in construction to the transverse principals, are here introduced, together with a special principal between the spans, by which means a clear space of 90ft. between the columns longitudinally is here obtained, and great lateral stiffness given to the whole structure. The roof was designed by the late Mr. Edward Wilson. The roof over the Aldgate Station of the Metropolitan Railway is constructed of principals somewhat similar in construction to the centre span of the roof last described, but wholly of wrought iron. They are 82ft. 4½in. span, and are placed 18ft. apart. The new Brighton Station of the London, Brighton, and South Coast Railway is to be divided into four spans and supported on columns. The centre line of the station will have a radius on plan of 1148ft., and the spans will taper from one end to the other. The principal spans will resemble those last described, and will be formed of upper straight rafters having a slope of 1 in 2, with a lower curved rib and lattice web. One span will taper from 106ft. to 117ft., the 106ft. span having a rise of 24ft. from the intrados of the arch to the springing level, and the other main span will taper from 98ft. to 75ft., the 98ft. span having a rise of 23ft. above the springing level to the intrados of the arch. The principals will be placed 25ft. apart, and the supporting columns connected by spandril girders carrying three intermediate ribs in each bay. The main principals will be bolted firmly together and attached rigidly to a raised portion of the column, both in the centre of the station and also to the side spans, which will vary in width, their maximum dimensions being 46ft. on one side, and 38ft. on the other. The detail drawings for this work are now being prepared by Mr. Henry C. Wallis.



CANTERBURY HALL.

In the Canterbury Music Hall, Westminster Bridge-road, novel arrangements have been adopted to insure free circulation of air. The open central space over the pit is 36ft. long, by 18ft. wide, fitted with a special movable covering, which slides laterally in one piece. The side walls of the building are connected by main girders united by transverse girders, which are likewise attached to other girders running at right angles to them and parallel to the main girders, the whole framework being firmly braced together by diagonal ties, forming a very rigid and strong construction. The sliding portion rests on a continuous line of rails 37ft. apart, fixed to longitudinal bearers attached to all the transverse girders. Such an arrangement enables the interior to be speedily freed from all vitiated air, and would prove of advantage in the event of fire, enabling firemen the more readily to direct the hose to the parts most affected. The plan was the invention of Mr. Robert Edwin Villiers, the late manager (patent, A.D. 1877, No. 4581.) The work was completed in 1876. In the hall of the Circus at Paris the same idea has been carried out on a larger scale. The central space over



PARIS HIPPODROME.

the arena is surmounted with a special movable covering 177ft. long, by 57ft. wide, which divides into two equal parts longitudinally, each resting on wheels, so as to be pulled aside right and left, when the weather permits, on outside girders, and thus completely to disappear from the audience inside. The fixed roofing which surrounds the space closed by the sliding portion is supported on columns. The hall was built in 1877, under the direction of Mr. E. Lantrac, the engineer to the Circus Company, by whom the work was designed.

(To be continued.)

BLASTING IN MINES.

At a recent meeting of the North Staffordshire Institute of Mining and Mechanical Engineers, Mr. Ernest Craig read a paper "On Some Experiments made with Compressed Air for bringing down Coal." The machine for the purpose, known as Reuss's, consists of a drilling or circular cutting machine, a cartridge, and a blasting or air-pumping machine. To place the drilling apparatus in position a hole from 8in. to 10in. deep must be made by hand in the face of the coal, and in that the leg of the machine is fastened by means of a nut, which, being turned, wedges some taper keys securely against the side of the hole. The cutting tool is then fixed, and made to revolve, and the boring of the main hole, which may be directed to any angle, is commenced. Behind the cutter there is a double archimedean screw, which, as the depth of the hole increases, it is necessary to lengthen, and in preference to having one long screw, it is best to keep adding 6in. lengths till the desired depth is reached, by which means a straighter hole can be drilled than by one long screw. The cartridges are simply hollow cast iron cylinders, varying in strength to suit the class of coal. To burst a cartridge ½in. in thickness a pressure of 6700 lb. per square inch is necessary, and for every additional $\frac{1}{16}$in. in thickness an increase of 1000 lb. to 1500 lb. per square inch is required. The pumps are of simple construction, and the whole machine worked by two men. The machine runs on rails, and would stand about 3ft. 6in. in height. The connection between the machine and the cartridge is made by means of hydraulic tubing, which has an internal diameter $\frac{1}{16}$in., the whole machine and connections being made capable of standing a pressure of 20,000 lb. per square inch. Having described the charging of a hole, he said that a sufficient length of hydraulic tubing was connected with the blasting machine, and the latter being placed in a secure position, the pumping began. A gauge fixed on the machines showed how the pressure was increasing. With the air a small quantity of water was also pumped into the cartridge to act as a slight check upon the violence of the expansion at the bursting of the cartridge. When the pressure reached about 6700 lb. the cartridge exploded, and the coal was brought down. The explosion was not accompanied by any great noise, and pieces of coal were not thrown any distance. From what he had seen the coal simply fell, and it was not necessary for the machine to be more than half a-dozen yards from the face. In the Bullhurst seam at the Harecastle collieries, a hole 2½in. in diameter was drilled in the coal 9in. deep by hand, and the time occupied in fixing the drilling machine was fifteen minutes. The time taken in drilling was 4 min. 15 sec. Time taken in lengthening the drill, 7 min. 58 sec. Fifteen minutes were then expended in removing the cutting machine, inserting the cartridge, and stemming the hole. It afterwards took 26½ min. connecting the cartridge to and to fix the blasting machine. Two men then commenced to work the machine in order to fill the cartridge at 12.26½ p.m., and at 1.11 the pressure was 7600 lb., when the cartridge exploded. It was apparent that, with the exception of accidents and delay, the time taken in fixing the cutting machine, boring the hole, and exploding the cartridge would have been 47 min. 13 sec. Allowing ten minutes for stemming the hole and making the connection with the air pumping machine, the time occupied would have been 57 min. He saw the machine experimented with at the Manvers Main Colliery, Yorkshire, and the time taken up with the most successful experiment, from the fixing of the boring machine to the explosion of the cartridge, when some 15 tons of coal were brought down, was about 35 min. It was in a long wall face, the coal being holed 4ft. 6in. under. Mr. Craig added: There is one objection to the use of this machine which is evident, viz., that while it is travelling from one place to the other to explode a cartridge the roads in that district must be occupied by it, causing thereby, in many instances, great inconvenience. The chief advantages claimed for this method of blasting are, according to Mr. Reuss—(1) Absolute safety to life and limb, there being no necessity to retire from the place while blasting is going on. (2) The coal is brought down in large pieces, realising a higher price in the market than when shattered by powder; there is very little waste. (3) The air is not vitiated at all; on the contrary, it is cooled and purified, and no time is lost in clearing the coals away as soon as brought down. (4) The cost is no greater than getting coals by gunpowder; it many cases it is less.

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

(From our own Correspondent.)

On 'Change in Birmingham to-day—Thursday—and in Wolverhampton yesterday, bars were to be had without much difficulty at £6 10s. per ton. From this figure up to £7 10s. for such brands as B.B.H., and £8 2s. 6d. for Earl Dudley's make, there were numerous quotations varying with quality. Bar orders were offered at both markets, but they were not to be placed with freedom, most makers of the reliable brands being fairly well supplied with work for some weeks ahead. The producers of the best qualities have not been better off than now for a long time past.

Hoops were in quieter demand. The orders arriving at the works are insufficient to compensate for those which are being worked out on account of United States requirements. Such quotations as £7 at the works will not bring new business. To-day specifications might have been placed at £7 5s., delivered in Liverpool, though £7 7s. 6d. and even £7 10s. were asked, and £7 15s. delivered in London.

Sheets were less inquired for, yet makers did not seek orders. Few are likely to need to do so for a month hence. To-day and yesterday, therefore, prices were upheld, and ranged, for corrugating and galvanising purposes, at from £11 for latens down to £8 for singles. The last quotation applied to firms who required the full £1 10s. difference between singles and doubles, even as they were equally resolute in demanding the same difference between doubles and latens. Offers at less money were promptly rejected to-day and yesterday by Messrs. E. T. Wright and Co., and similar firms. Some other makers sought £8 5s. to £8 10s. for singles in a mixed order; but they would not accept for doubles less than £9 10s., nor for latens less than £11. Messrs. E. P. Baldwin and Co. required £12 to £18 and upwards for their stamping sheets; and these were mostly the quotations of other similar firms.

Engineers' plates were to-day quoted at £8 to £8 10s. At such figures makers are resolute, for the mills are in better employment upon this denomination than in November for several years past. Still there are few engineering concerns which could not take more work. Roofing orders are the most numerous, and there is a fair extent of activity upon bridge work. Much more of this latter description of business is looked for, and preparations are in hand to enable South Staffordshire and Birmingham to compete for the work in which the use of steel in heavy quantities will be specified.

Boiler-plate orders were sought after both in Wolverhampton and Birmingham, but they were difficult to secure. Nevertheless, makers of high-class kinds demanded full list prices.

Pig iron could not be sold freely. Most consumers are well bought. The quotations varied from £2 5s. for cinder qualities up to £3 5s., and £3 7s. 6d. for all-mine sorts. Good hematites were procurable at from 75s. down to 72s. 6d. High-class Derbyshire and Lincolnshire pigs were held at from £2 10s. to £2 12s. 6d.

Coal would rarely be sold of other than poor kinds if transactions had not previously taken place between buyers and sellers.

Machinery engineers continue fairly active. The contracts are largely on foreign account, and even the United States is included in the category of customers at date. France, India, Australia, and the Brazils are all buying, and steam engines are going to Spain. Messrs. Tangye, of the celebrated Soho Works, are extending their establishment. Portions of the extensions are understood to point in the direction of steel making by that firm. There are some good gasometer contracts under execution, and mains for water conveyance are being sent away from some of the district ironfoundries in heavy quantities.

Hot water engineers and stove and range manufacturers are now in the height of their season, and they report that the demand shows an improvement upon a year ago.

India is a good customer just now, and has been for some time, for metal sheathing, and the demand from certain of the Eastern markets, and from France and Germany for copper goods, is of satisfactory extent.

The wrought iron tube makers continue busy on gas and water and steam goods, and the combination which has been formed in this trade for keeping up prices is working with much success. Copper locomotive tubes are being supplied to the railway companies with some vigour, as also to private locomotive builders. Brass bedstead tubes are quiet of sale.

Gas corporations are making some good profits just now. An abstract of the accounts of the West Bromwich Improvement Commissioners' gas department up to March 25th last has just been issued. It shows that of the total amount of loan capital authorised—£148,200—£140,977 has been already borrowed, all but £50,000 at 4½ per cent. interest. The total expenditure is £146,391. During the nine months for which the return is made £10,306 was expended on the manufacture of gas. The total expenditure, including management expenses, &c., amounted to £14,696; total receipts from sales were £15,855, and the residuals produced £6623. For gas-fittings £1000 was received. Thus the receipts for the nine months aggregated £23,479, which was a gross profit of £8782.

A seam of house coal, 4ft. in thickness, has been found 150ft. below the surface at some sinkings near Warrington, North Staffordshire.

The colliers continue unsettled upon the wages question, and this leads some coalowners to believe that the Earl of Dudley will before long again advance his prices. The latest locality which has decided to join the other districts of East Worcestershire and South Staffordshire in agitating for an advance of 6d. "per day" in thick coal seams is that of Hales Owen.

At the extensive Podmore Hall Colliery, near Newcastle-under-Lyne, the workmen have arranged terms of mutual assurance with their employers against accidents. The scheme just agreed to is the outcome of conferences begun between the masters and workmen when, at the beginning of the year, the question was under the consideration of the owners and men in the West Lancashire colliery district. The Podmore Hall men have agreed to enter into assurance upon their employers paying 50 per cent. upon their contributions, which thus secures to the men from the North Staffordshire Permanent Relief Society, without the necessity of their further increasing their contributions, 9s. a week in case of accident instead of only 6s. as heretofore. This arrangement will comply with the terms of the Employers' Liability Act. It is expected that other large colliery concerns in North Staffordshire will adopt a similar course.

Sheet glass has this week again been advanced 12½ per cent. This leaves the price exactly 50 per cent. higher than on the 23rd July last. Belgian glass is raised proportionately.

The earthenware trades of the Potteries are this week largely disorganised by the great strike, which I last week intimated was likely, having now begun in earnest. Nearly all the towns in North Staffordshire are more or less affected, and various estimates are given of the number of operatives already "out." Some authorities put the number down as 30,000, many of whom are women. The men are seeking an advance of one penny in the shilling, and also an alteration of the hiring time from Martinmas to Midsummer. It is said that if the men continue recalcitrant the masters may resort to a general lockout.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

The activity in the railway branches, to which I recently directed attention, still continues. During the past fortnight an immense amount of work has been given out by railway companies in England and Scotland. A large share of the orders has come to Sheffield. Messrs. Craven Brothers, of Darnall, have been among the successful contractors, as usual. I am informed that the quantity of work to be given out during the next three weeks will be even greater than during the last fortnight. This applies not only to railway wagons, carriages, &c., but to steel rails, springs, axles, and nearly every description of rolling stock and permanent way.

There is little said now about the proposed removal of the business of Messrs. Wilson, Cammell, and Co., of Dronfield Steel Works, to the coast. I have been in the Dronfield district a good deal recently. From what I saw there seems little prospect of the company being able to carry out any such intention for many months to come. There is abundance of work; prices are undoubtedly improving, and the prospects are brighter than they have been during the whole of the year. There is little doubt the manufacture of steel rails and other heavy material must eventually go to the sea-side; but so long as the tendency of prices is upward, and work is plentiful, the companies will not precipitate their departure. Rails are now making from £6 5s. to £6 7s. 6d. and £6 10s. per ton. Special sections are higher. Owing to the pressure of orders prices are still stiffening. One Sheffield firm has orders on hand sufficient to keep it going till the end of 1882.

The improvement in the iron and coal trades of South Yorkshire continues. I do not hear of a single colliery in the district where full time is not being worked. The reports from the ironworks at Thorncliffe, Milton, Elsecar, and Penistone. Heavy castings for gas and waterworks are being turned out in great quantities at all the local foundries.

The surprise of the week has been the failure to launch Messrs. Newton, Chambers, and Co., of the Thorncliffe and Chapeltown Ironworks and Collieries, as a limited liability company, with £650,000 capital in £20 shares, £14 to be called up. The amount applied for was less than one-half of the number of shares—26,500—offered to the public. Under these circumstances the directors issued a circular, stating that they did not feel justified in proceeding to an allotment. They announce that the vendors will now take £320,000 of the share capital, and it is intended to raise £160,000 by mortgage debentures of £50 each, bearing interest at 6 per cent. per annum, and redeemable at three, five, or seven years at the option of the holders. These debentures will be a first charge on the property of the company.

The Rotherwood Iron and Steel Company, near Woodhouse, has commenced operations. It has laid down a special plant for the manufacture of hoop iron, to which it will devote great attention.

At No. 4 Renishaw Park Colliery—Messrs. J. and G. Wells, Limited—the colliers have struck work, because, as they say, the employers have taken from their total weight of coal a larger quantity of "dirt" than has hitherto been the case.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Entering upon the season, when business, so far as new transactions of any importance are concerned, is usually narrowed down to as limited a compass as possible, it is only natural that a dull tone should characterise the iron market to some extent, and as regards pig iron the market during the past week has been pretty near as dull as it could possibly be. Consumers, who are mostly well bought for the present, seem to have made up their minds to wait the turn of the year before giving out further orders, and makers who, at least for the remainder of the year, have sufficient iron to deliver under contract to take away all their output, are not disposed to force business, either by concessions in price or long forward deliveries.

Lancashire makers report a few inquiries, but very little actual business doing, although they would now be open to book up to the end of March at present rates, which for delivery equal to Manchester remain at 48s. for No. 4 forge, and 49s. for No. 3 foundry, less 2½ per cent.

Outside brands, so far as makers are concerned, are generally unaltered in price, and in Lincolnshire iron, for delivery well over the first half of next year, business is reported at prices equal to 48s. 6d. and 49s. 6d., less 2½ per cent., for forge and foundry qualities, delivered into the Manchester district. Middlesbrough is nominally quoted at 49s. 10d. net cash, but no business is being done. There are a few low-priced parcels of outside iron offering, but these have come into the market under special circumstances, a portion being bankrupt stock which mortgagees are selling.

In the finished iron trade, although there is not actually any great weight of new business coming in at present, the demand is very fair for the time of the year, and makers are in some cases so full of work that they cannot entertain the inquiries which are being made. There is an expectation in some quarters of a very considerable American demand before long, and makers are extremely cautious about selling forward. There is some underselling on the part of dealers, but makers' prices remain firm at £6 10s. to £6 15s. for bars, £7 to £7 10s. for hoops, and £8 10s. to £8 15s. for sheets, delivered into the Manchester district.

The shops both in the engineering and tool making trades in this immediate neighbourhood continue generally pretty busy, and judging from the numerous inquiries from outsiders, which are at present being made for smiths and pattern makers, it is evident that there is an increased amount of activity generally throughout Lancashire.

From inquiries made amongst some of the large cotton machinists, I find that although there is not the same improvement which is noticeable in other branches of the engineering trades, still there are more orders coming in. A few mills are being erected in the district, at Stockport, Staleybridge, and one or two other places, but it is not so much in the home trade as in export work that increased activity is being experienced, and this export work, I may add, includes a good deal of machinery which is being sent away to India.

Manufacturers of rolled and rivetted girders and of heavy castings generally for constructive work are in many cases very full of orders, some works having recently been kept going night and day on the completion of contracts. The work in hand includes considerable contracts for new places of business and public buildings at present being erected in this district, together with some tolerably large orders for railway work. One feature in this branch of trade which is somewhat surprising is the large quantity of foreign rolled girders of certain sections which still come into this district, and it certainly seems strange that English manufacturers do not themselves lay down the requisite plant which would enable to produce this class of work successfully at home. As it is, however, certain sections can only be got from foreign houses, and the only reasonable explanation I have heard is that these particular sections are such "lean" work at the prices at which they can be bought, that English manufacturers with the shortest hours of labour in this country could not undertake to produce them at a profit.

As I mentioned last week, there is a considerable inquiry for pipe castings. The Manchester Corporation have sent out specifications for about 3500 tons of 36in. pipes, and inquiries of smaller dimensions are being made by other local authorities throughout the district. The average prices quoted for the ordinary lined or coated 6in. pipes delivered equal to Manchester are about £4 17s. 6d. to £5 per ton.

The adjourned annual meeting of the Manchester and Salford Trades Council was held last week, and the secretary, Mr. Peter Shorrocks, presented a report, which showed a decrease both in the funds of the Council and in the number of members, but the hope was expressed that the efforts which were being made to improve the position of the association would be successful. The report touched upon the inspection of factories and workshops, with regard to which efforts would still be made to obtain an increase in the number of inspectors, and upon the Employers' Liability Act, with regard to which the Council were not yet in a position to express a final opinion, but it was strongly urged that during the next session of Parliament something should be done to prevent employers contracting themselves out of the Act. The programme to be arranged for the Trades Congress in Manchester next year was introduced, but the further consideration of the matter was adjourned. Mr. Peter Shorrocks was elected president of the Council for the ensuing year.

The demand for coal, particularly the better sorts for house-fire purposes, has been quiet during the past week, owing to the exceptionally mild weather, and at some of the pits stocks are accumulating. The common classes of round coal for iron making, and burgy and good slack for engine purposes, are, however, in fair demand. Prices are generally being maintained, colliery proprietors preferring for the present to put down into stock rather than give way upon late rates. Best coal at the pit mouth averages about 10s.; seconds, 8s. to 8s. 6d.; common coal, 6s. 6d. to 7s.; good burgy, 5s.; and slack, 3s. to 4s. per ton, according to quality.

The shipping trade has been dull, with a tendency to give way in prices, good steam coal being delivered at the Mersey ports at from 8s. to 8s. 6d. per ton.

The annual meeting of the South Lancashire and Cheshire Coalowners' Association was held in Manchester last week, and Mr. W. Hewlett, of the Wigan Iron and Coal Company, was elected president for the ensuing year.

The Manchester Coal Exchange has proved very successful since its establishment in its present quarters nearly two years ago. At a meeting of the committee held on Tuesday, the secretary—Mr. Hodson—presented a statement showing that there are now 402 subscribers, that the income for the past year had been about £220, the expenditure about £140, and that the balance now in hand, including the amount carried over from last year, was about £122. It was resolved to make some concessions in the prices charged to colliery proprietors and other trading firms for tickets, the charge for one ticket being still fixed at a guinea, but every additional ticket taken by the same firm being reduced to 10s. 6d. per annum. A sub-committee was also appointed to consider and report upon the advisability of incorporating the Coal Exchange.

Barrow.—The hematite pig iron trade is very steadily employed, although the actual business which has been transacted of late is not as great as that which characterised the market a month or two ago. Makers are heavily sold forward, and are reticent about the acceptance of contracts which they cannot fulfil for some months to come. The foreign inquiry is still maintained. The prices remain steady at 63s. for No. 1 Bessemer, and 60s. 6d. for No. 3 forge quality. Stocks are smaller than they have been, although the winter season has caused a partial suspension of shipments. In the steel trade the mills are fully employed, and the orders in hand are of a considerable magnitude. Of rails there is an especially large output, and merchants' qualities find a good market.

No change can be noted in the active state of the iron shipbuilding trade. Engineers, both in the marine and general deparments, are well up for orders. Iron ore is in full request, and the mines are busily employed. Coal and coke in full demand at steady prices.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

But little business was done at the Cleveland iron market held at Middlesbrough on Tuesday last, notwithstanding that the attendance was at least as good as usual. The prices of pig iron were about the same as the week previous, No. 3 g.m.b. being quoted at 41s. 9d. f.o.b., and No. 4 forge at 40s. 9d. For delivery over the next three months 3d. per ton more was asked in either case.

The shipments of iron last week were about equal to the average for the time of the year. During the present month about 40,000 tons have been shipped, and it is expected that the total for the month will be above the average, if only favourable weather should continue.

Messrs. Connal's warrant stores continue to give out more iron than they take in. The reduction during the week has amounted to 744 tons, leaving the stock 178,464 tons. The demand for warrants continues small, the present price being about 1½d. per ton above that of makers' iron.

In the finished iron trade prices remain unaltered, plates being still quoted at £6 10s., angles at £5 17s. 6d., and bars at £6. Shipbuilders at all the north-eastern ports are exceedingly busy, and consuming large quantities of materials. There is, however, a general belief among them that prices will be easier in the winter, and consequently they are avoiding making fresh contracts except at a considerable reduction in price. They believe that the increased competition which will ensue when the West Hartlepool and Walker Works are restarted will modify prices in their favour, and they also contend that when winter weather fairly sets in, and their yards are more or less laid off, the pressure of the manufacturers for fresh orders will give consumers control of the market, as they had during the spring of the present year. On the other hand the new works above referred to cannot be in operation before about March. In the meantime the very high rate of freight is stimulating the demand for ships, and consequently for shipbuilding materials, very considerably.

The coal trade is partaking of the general improvement noticeable throughout the country. House coals have gone up 1s. per ton, and coals for iron manufacturing purposes are from 3d. to 6d. per ton dearer than they were.

The West Hartlepool Rolling Mill Company has engaged the services of Mr. T. Lewis as their general manager. Mr. Lewis has for many years occupied a similar position at the Bowesfield Ironworks, Stockton-on-Tees, and has the reputation of being one of the ablest managers in the district. The works he is about to take charge of will eventually be much larger than those which have lately been the field of his labours. In addition to the pull-over mill which has been there for years, a new reversing mill has been ordered of Messrs. Taylor and Farley, of West Bromwich, and this new mill will no doubt be up to date in every respect. It is understood that Mr. T. Lewis's place at Bowesfield will be filled by promoting one of the foremen at present employed there.

A meeting of the ironmasters having works in the district known as the Marshes, was held on Tuesday at Middlesbrough, to consider the advisability of forming a company for the supply of electric lights on the Brush system to their several works. It was estimated by Mr. Hammond, who attended as representative of the Brush Light Company, that the total cost of the necessary plant would amount to £10,000. This would comprise four engines, four dynamo-electric machines, and 160 lights. Only 120 lights, however, driven by three engines and three dynamos, would be in regular work, the remainder being kept spare. The cost for maintenance of each light of 2000 candles would come to £22. The conclusion arrived at was that it would not be wise to do away with gas altogether at present, but still to retain it in the offices, cabins, and other similar places. It was thought, however, that the lighting up of large areas about the works and of important places, such as the shearing, marking, and inspecting floors of plate mills, might be advantageously lighted by electricity. No final conclusion was, however, come to, the ironmasters preferring to await the further development of lighting by electricity before committing themselves to a joint scheme or any other. It appeared that at present the electric lights would be likely to cost more than is now being paid for gas, and it was not clear that there would be any corresponding advantage.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The firmness that characterised the Glasgow iron market last week gave way a little on Friday, but the prices rallied again on Monday, and during the present week the fluctuations have not been large. The tone of the market, on the whole, continues steady, and indicative of good business being done. Last week's transactions were largely speculative, but this week there has been a better demand for makers' iron, the prices of which are a shade firmer. The market is well sustained by the reports which come from all quarters as to the gradual improvement of the manufacturers' iron, engineering, and ironfounding trades. The past week's shipments have been very satisfactory, amounting to 12,890 tons, as compared with 10,550 in the corresponding week last year. The exports to date, however, are still upwards of 80,000 tons behind those of the same period of 1880. There is no doubt, however, that while the aggregate shipments abroad do not come up to those of last year, the consumption of pig iron at home has been considerably larger, and the wants of home consumers are still upon a satisfactory scale. Notwithstanding the high freights which are being charged, the consignments of pig iron to America and the Continent are very good for the season. Stocks are not accumulating so rapidly as of late in the public stores. Messrs. Connal and Co. have received several hundred tons less than last week, and the aggregate reserve in their hands now amounts to 614,000 tons. The stock on makers' hands is estimated at upwards of 330,000 tons, so that despite the blowing out of the furnaces, the pig iron on hand is not far short of one year's supply. While the stocks are thus very large they have a beneficial effect in steadying the market, and preventing those sudden upward speculative movements in prices which have occasionally done so much to unsettle the public confidence.

Business was done in the warrant market on Friday morning at from 51s. 3½d. to 50s. 11d. cash, and 51s. 7d. to 51s. 3d. one month, the afternoon quotations being 50s. 10½d. to 50s. 7½d. cash. On Monday the market was stronger, with business at 50s. 9½d. in the forenoon, to 51s. 1½d. cash and 51s. 4d. one month in the afternoon. The tone of the market was quieter on Tuesday, when transactions were effected from 51s. 2d. to 51s. 10d. cash, and 51s. 6d. to 51s. 1½d. one month. On Wednesday the market improved to 51s. 4½d. cash, on the report that the coalmasters were to reduce the miners' wages. Business was done to-day—Thursday—between 51s. 5d. eight days, and 51s. 1½d. cash.

Makers' iron, for which, as is stated above, there has been an improved demand, is firmer all round, and most of the special brands have advanced about 6d. per ton. The quotations are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 59s.; No. 3, 52s.; Coltness, 59s. 6d. and 52s. 6d.; Langloan, 61s. and 52s. 6d.; Summerlee, 59s. and 51s.; Calder, 59s. and 52s.; Carnbroe, 52s. 6d. and 50s.; Clyde, 51s. 6d. and 48s.; Monkland, 51s. and 48s.; Quarter, ditto ditto; Govan at Broomielaw, 51s. and 48s.; Shotts at Leith, 60s. and 52s. 6d.; Carron at Grangemouth, 53s. 6d. (specially selected, 56s.) and 52s. 6d.; Kinneil at Bo'ness, 50s. and 48s. 6d.; Glengarnock at Ardrossan, 52s. 6d. and 50s.; Eglinton, 51s. 6d. and 47s. 6d.; Dalmellington, ditto ditto.

The manufactured iron trade continues in a very satisfactory state. Prices of malleable iron are well maintained. Ironfounders are busy; cast iron pipe-makers have of late been receiving fresh orders; locomotive engineers have also closed additional contracts with both home and foreign railways; makers of machinery are well employed, and while the shipbuilders are very busy, there is no lack of specifications for new vessels yet to be fixed. In short almost every branch of the iron and cognate trades is active.

The coal trade is not quite so active in the shipping department as it was a week or two ago, still there is a very good business doing at former prices. The coasting trade has been fair, and the shipments from Ayrshire and from the Firth of Forth have been very satisfactory, the small decline to which reference has been made arising chiefly in connection with foreign consignments from the harbour of Glasgow. The question of the miners' wages is still partially unsettled. The advance of 6d. per day has been obtained in the districts of Hamilton, Motherwell, Baillieston, and Slamannan, but the masters are to withdraw it, and it has been refused in the Glasgow district and also in Fife and Clackmannanshire and in Ayrshire. No organised movement has yet taken place among the miners of the Lothians and Stirlingshire. A private conference of delegates representing the different quarters of Scotland was held in Glasgow this week, with the object of devising means to render the advance general. So far the leaders of the men have been acting with caution. The Union funds are too low, and the season rather far advanced for a strike, and I am assured by the principal iron and coal masters that they are resolved not to advance the wages at present, the prices received for iron and coal not being sufficiently good to warrant an increase.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Another good week's work has been done both in the iron and steel and coal trades. The general improvement shown by the export of 1000 tons of steel more last month than the corresponding month of last year tells its tale concerning the Welsh works, which have helped considerably towards this result.

Makers' books retain also good orders, and as prices show a tendency towards improvement, there is a probability that the benefits enjoyed by the colliers in their late advance may also soon be shared by the ironworkers. There is, however, this to be considered, that coal has been going up steadily for some time, but it is only lately that the prices in the steelworks have begun to "stiffen." The changing condition of things in the iron world is well shown by the fact that for every ton of iron now made there are eight tons of steel.

Messrs. Davy of Sheffield, have the order for supplying the machinery at the new wire works at Merthyr, and the projectors say that they are bent upon having one of the best, if not the best wire mill in the world.

The centralisation of the coal trade by lessening the area of produce and diminishing the number of smaller collieries is a fact gradually forced upon one's attention in the Welsh district. This week and next no less than three large quantities of colliery plant will be dispersed, the first at Tyn Filkins, near Tredegar Junction; the second at Hendredenny Colliery, Caerphilly; and the third at Birch Rock Colliery, Pontardulais. Casual readers at a distance of local announcements would augur a bad condition of trade from this, but the coal trade was never in sounder or more hopeful form and if prices have shown a tendency to droop, it is only in the case of second-class coals. The large coalowners maintain their prices, and most are well sold, some few even a twelvemonth in advance. The tendency of this will be to push up prices, and such I confidently expect. The united exports of coal from the Welsh ports last week amounted to a little under 140,000 tons.

A satisfactory trial of the patented invention of Messrs. Lewis and Kirkhouse for watering the roads in collieries, thus lessening the ranges of explosions, took place last week at Treherbert, and was voted by skilled lookers on to be eminently satisfactory.

I have also to place on record a capital trial with the electric light in collieries. This took place last Thursday at the Maerdy colliery, under the direction of the able manager, Mr. W. Thomas.

Near this colliery a meeting of colliers, some 800 in number, was held on Monday, ostensibly to begin the agitation for the amalgamation of the sliding scales to which I referred last week. In the beginning of the meeting a vote of thanks to Lord Aberdare for his services before the Home Secretary, in connection with blasting in collieries, was carried unanimously. I may add that general satisfaction has been expressed in Wales that the rumoured disuse of blasting in collieries turned out a scare. Mr. Morgan, one of the miners' representatives, gave some useful statistics to the meeting concerning past strikes. That of 1879, when 10,000 colliers were on strike, entailed a loss of a million of money. That of 1875 cost the country 11 millions. A good deal of discussion ensued with regard to the sliding scales, some arguing stoutly for a minimum, but all contending that one scale in use both by house-coal and steam-coal men, and applicable to all the country, should be well reasoned out and established. Motions to take initiative steps were then carried, and the meeting dispersed. One commendable feature of the meeting was the temperate manner of the men, and if this be continued it will show that the past has taught a good lesson. Considering the excellent tone of trade, I should strongly counsel the men to leave the question with their representatives. Mass meetings are unnecessary, and many of the collieries, notably Ferndale, kept aloof and remained working.

The report of the Nantyglo and Blaina Company shows a profit on the year of £6194, but no dividend can be realised until the losses of past years are made up.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

8th November, 1881.

4874. Ploughs, F. Wolff.—(*J. L. Jensen, Copenhagen.*)
4875. Supplying Feed Water, J. Adams, Watford.
4876. Clearing Places of Gas, W. Teague, Illogan.
4877. Pickling Steel Plates, &c., T. H. Cobley, Dunstable, and C. Monckton, Harefield.
4878. Rendering Structures Proof against Strain, J. P. Bayly, London.
4879. Tap Hole Fittings, J. W. Kenyon, Manchester.
4880. Portable Forges, G. H. Pym, Nottingham.
4881. Testing Purity of Breath, A. C. Henderson.—(*A. F. L. Plague, France.*)
4882. Timepieces, W. Thompson.—(*A. Lemoine. France.*)
4883. Winding Clocks, M. Bauer.—(*C. A. Mayrhofer and W. Otto, Paris.*)
4884. Transmitting Motion, D. Young.—(*E. Brosser, Paris.*)
4885. Protecting Electric Lighting Wires, W. C. Johnson and S. E. Phillips, Charlton.
4886. Umbrellas, F. Wolff.—(*A. Malmros, Sweden.*)
4887. Aerial Navigation, E. Edwards.—(*J. C. R. de Souza, Paris.*)
4888. Sulphuric Acid, T. Richters, Germany.
4889. Getting Marls, &c., J. Mills, Hanley, and T. D. Brown, Salop.
4890. Filter Presses, A. G. Salamon, London.
4891. Preparing Grain, J. Fordred, London.
4892. Invalid Chairs, A. M. T. Amherst, Brandon.
4893. Locks, R. H. Clive, Birmingham.
4894. Knitting Machines, W. Harrison, Manchester.
4895. Advertising, F. W. Hembry, London.
4896. Photographic Emulsions, J. Plener, London.
4897. Ageing Padded Textile Materials, W. R. Lake.—(*P. St. A. Basquin, France.*)
4898. Slide Valves, A. M. Clark.—(*W. B. Turman, Waldron, U.S.*)

9th November, 1881.

4899. Colouring Matters, J. Imray.—(*H. Koechlin, Germany.*)
4900. Excavating, J. W. H. James, London.
4901. Velocipedes, R. E. Phillips, London.
4902. Bridges, &c., J. F. Smith, Leicester.
4903. Boots and Shoes, H. Dickson, Leicester.
4904. Consuming Smoke, E. P. Alexander.—(*J. Elliott, Montreal, Quebec.*)
4905. Transmission of Sounds, W. C. Barney, London.
4906. Mules, &c., J. Chisholm and J. Clegg, Oldham.
4907. Water-gas, P. Jensen.—(*European Water-gas Company, Stockholm, Sweden.*)
4908. Weaving Carpets, J. S. and S. Smith, Glasgow.
4909. Drawing-off Liquids, J. Webster, Solihull.
4910. Preserving Eggs, J. Stead.—(*K. H. Loomis, U.S.*)
4911. Carding Engines, W. T. Cheetham.—(*J. Konshin and W. Charnock, Serpokoff, Russia.*)
4912. Torpedoes, S. Pitt.—(*W. H. Mallory, U.S.*)
4913. Steering Vessels, S. Pitt.—(*W. H. Mallory, U.S.*)
4914. Moulding Metallic Bodies, S. Pitt.—(*W. H. Mallory, U.S.*)
4915. Farinaceous Food, E. Edwards.—(*F. Maire, Lyons, France.*)
4916. Breech-loading Fire-arms, J. Lang, London.
4917. Bicycles, &c., L. E. Broadbent, London.
4918. Raising Sunken Vessels, J. Standfield and J. L. Clark, Westminster-chambers, London.
4919. Neckties, C. B. Ketley, Smethwick.
4920. Lifeboats, J. Baharie & W. Adamson, Sunderland.
4921. Raising Water, W. Tasker, Andover.
4922. Furnaces, A. M. Clark.—(*J. Garnier, Paris.*)

10th November, 1881.

4923. Hoists, J. Gordon, Glasgow.
4924. Simultaneous Impressions, J. A. Máquez, Peru.
4925. Raising Stamp Heads, S. Jellyman, Cannock.
4926. Digging Machinery, T. C. Darby, Chelmsford.
4927. Artificial Stone, E. de Pass.—(*R. H. Stone, Victoria.*)
4928. Stoves, J. Thompson & C. Morris, Birmingham.
4929. Stoves, H. J. Haddan.—(*J. Schneur, Paris.*)
4930. Multiplying Drawings, R. Kimm, Dalry, N.B.
4931. Flanging Edges of Boiler and other Plates, J. Lyall, Govan, N.B.
4932. Tramway Engines, T. Hunt, Fairfield.
4933. Optical Illusions, W. W. Baggally, London.
4934. Tune-playing Tops, M. A. Wier, London.
3935. Filtering Apparatus, F. Wirth.—(*G. Baier, Ulm, Germany.*)
4936. Separating Glycerine, &c., W. R. Lake.—(*M. C. A. Ruffin, Paris.*)
4937. Spring Hinges, F. R. Baker, Birmingham.

11th November, 1881.

4938. Stopping Tram Cars, C. E. Davison, London.
4939. Producing Light, A. F. St. George, London.
4940. Musical Instruments, F. Pool, London.
4941. Ventilating, W. Cunningham, Dundee.
4942. Electric Currents, S. Pitt.—(*L. Gaulard and J. D. Gibbs, Paris.*)
4943. Preventing Escape of Steam, G. Tall, Brixton.
4944. Mixture Yarns, W. Blackburn, Cleckheaton.
4945. Handbrakes, W. R. Lake.—(*O. Bergstrom, Sweden.*)
4946. Slipping Apparatus, C. F. C. Morris and F. H. Bennett, London.
4947. Electro-plating, F. Wirth.—(*A. Classen, Germany.*)
4948. Electric Lamps, G. G. André, Dorking.
4949. Water Cisterns, W. F. Padwick, Redhill.
4950. Baskets, &c., H. S. Bale, London.

12th November, 1881.

4951. Washing Machines, A. Fortune, Keighley.
4952. Packing Cases, G. Robson, Liverpool.
4953. Ventilators, H. W. Yates, Brighton.
4954. Self-acting Mules, A. Metcalf, Preston.
4955. Gas, B. Russ, London.
4956. Velocipedes, R. H. Lea and G. Singer, Coventry.
4957. Ships' Pump Valves, J. Gwynne, London.
4958. Receiving Apparatus, W. M. Lindsay, Dublin.
4959. Conveying Grain, J. Higginbottom and O. Stuart, Liverpool.
4960. Cleaning Carpets, C. D. Abel.—(*J. Zacherl, Vienna.*)
4961. Nailing Boxes, F. W. Blood, Liverpool.
4962. Illustrating Objects, E. Sykes and O. G. Abbott, Huddersfield.
4963. Bakers' Ovens, J. L. Hancock, London.
4964. Friction Coupling, W. J. Fraser, London.
4965. Binders, G. Hayes, London.
4966. Electrical Signalling, W. R. Lake.—(*J. B. Johnson, Boston, U.S.*)
4967. Camera Obscuras, A. Pumphrey, Birmingham.
4968. Trunks, W. B. Worger & E. M. Richford, London.
4969. Syruping Ginger Beer, J. Murrell, Ipswich.
4970. Photographic Cameras, A. M. Clark.—(*E. Enjalbert, Montpellier, France.*)
4971. Gas Stoves, C. W. Torr, Birmingham.

14th November, 1881.

4972. Metallic Fasteners, W. F. Long.—(*G. W. McGill, New York, U.S.*)
4973. Testing Wine, H. J. Haddan.—(*A. C. Woschnagg, Vienna.*)
4974. Rifle Shooting, A. H. Atkinson, Worcester.
4975. Steam Engines, J. Shanks & J. Lyon, Arbroath.
4976. Churns, F. Levavasseur, Paris.
4977. Steering Apparatus, G. Knowling, London.
4978. Securing Boots, J. O. Spong, London.
4979. Compositor's Rules, J. C. Mewburn.—(*L. K. Johnson, Brooklyn, U.S.*)
4980. Embroidering Machines, A. M. Clark.—(*Ferry and Millet, Lunéville, France.*)
4981. Hoppers, &c., J. Higginbottom and O. Stuart, Liverpool.
4982. Marking Key Grooves, J. Roemmelle, Glasgow.
4983. Fire-arms, F. Wirth.—(*N. Jaberg, Germany.*)
4984. Carpets, J. J. Delmar, London.
4985. Teeth Brushes, E. Pierrepont, London.
4986. Pickers, E. Hallass, Huddersfield.

Inventions Protected for Six Months on deposit of Complete Specifications.

4887. Aerial Navigation, E. Edwards, Southampton-buildings, London.—A communication from J. C. R. de Souza, Paris.—*5th November*, 1881.
4888. Sulphuric Acid, T. Richters, Breslau, Germany.—*8th November*, 1881.
4910. Preserving Eggs, T. Stead, Strand, London.—A communication from K. H. Loomis, New York, U.S.—*9th November*, 1881.
4912. Torpedoes, S. Pitt, Sutton.—A communication from W. H. Mallory, Bridgeport, U.S.—*9th November*, 1881.
4913. Steering Vessels, S. Pitt, Sutton.—A communication from W. H. Mallory, Bridgeport, U.S.—*9th November*, 1881.
4914. Moulded Metallic Bodies, S. Pitt, Sutton.—A communication from W. H. Mallory, Bridgeport, U.S.—*9th November*, 1881.
4946. Uncoupling, C. F. C. Morris and F. H. Bennett, Blackfriars-road, London.—*11th November*, 1881.

Patents on which the Stamp Duty of £50 has been paid.

4513. Marine Steam Boilers, T. Archer, jun., Gateshead.—*7th November*, 1878.
4543. Purifying Feed-water, W. R. Lake, London.—*8th November*, 1878.
4864. Saddle Bar, J. A. Barnsby, Walsall.—*29th November*, 1878.
4527. Raising Sunken Vessels, J. L. Clark and J. Standfield, Victoria-street, and F. J. Bolton, Grosvenor-gardens, London.—*8th November*, 1878.
4534. Forging Screws, A. N. Porteous, Edinburgh.—*8th November*, 1878.
4556. Frames, T. H. Rushton and J. Albinson, Bolton.—*9th November*, 1878.
4594. Sewing Machines, W. Fairweather, Manchester.—*13th November*, 1878.
4655. Treating Animal Substances, E. M. Nelson, Dowgate-hill, and J. R. Johnson, Red Lion-square, London.—*16th November*, 1878.
4676. Centrifugal Machines, C. D. Abel, London.—*18th November*, 1878.
4728. Hydrants, &c., J. H. Greathead, Westminster, and M. D. Martindale, Anerley.—*21st November*, 1878.
4549. Treating Sulphides, J. Hallway, Jeffrey's-square, London.—*9th November*, 1878.
4582. Steam Hammers, S. Massey, Openshaw.—*12th November*, 1878.
4770. Cases, &c., J. Henderson, Peckham.—*23rd November*, 1878.
5042. Ships, &c., J. Long, Brighton.—*9th December*, 1878.
4590. Duplex Telegraphy, J. Muirhead, jun., Westminster.—*12th November*, 1878.
4606. Dry-copying Process, J. G. Wilson, London.—*13th November*, 1878.
4683. Sheaves or Pulleys, W. R. Lake, London.—*18th November*, 1878.
4807. Treating Foecal Matters, &c., Baron de Podewils, Munich.—*26th November*, 1878.
4838. Working Valves, J. Tangye, Illogan.—*27th November*, 1878.
5306. Developing Magnetism, T. A. Edison, Menlo Park, U.S.—*28th December*, 1878.
21. Breech-loading Ordnance, A. Longsdon, London.—*2nd January*, 1879.
4577. Paper Pulp, G. H. Mallary, Bernard-street London.—*12th November*, 1878.
4581. Separating Apparatus, T. G. Webb, Manchester.—*12th November*, 1878.
4585. Illuminating Gas, H. J. Haddan, Strand, London.—*12th November*, 1878.
4604. Tubes, H. Whitaker, Manchester.—*13th November*, 1878.
4618. Wind Instruments, D. J. Blaikley, Canonbury.—*14th November*, 1878.
4636. Capsuling Bottles, E. Belmer, Islington, London.—*15th November*, 1878.
4658. Brick, &c., E. Edmonds, Fleet-street, London.—*16th November*, 1878.
4726. Colouring Matters, J. P. Griess, Burton-on-Trent.—*20th November*, 1878.
4765. Cutting out Soles of Boots, J. Silman, Birmingham.—*22nd November*, 1878.

Patents on which the Stamp Duty of £100 has been paid.

3852. Making Cigarettes, A. M. Clark, London.—*7th November*, 1874.
3988. Gas Purifiers, W. T. Walker, Highgate.—*20th November*, 1874.
4142. Skates, J. L. Plimpton, Bedford-place, London.—*2nd December*, 1874.
3917. Pumps, F. P. Preston, J. T. Prestige, E. J. Preston, and J. Fowler, Deptford.—*13th November*, 1874.
3934. Blasting Powder, J. W. Gray, London.—*14th November*, 1874.
3930. Sugar, W. Garton, Southampton.—*17th November*, 1874.
3992. Ventilators, &c., W. Batten, Aston.—*24th November*, 1874.
3909. Treating Starch, C. O'Sullivan, Burton-on-Trent, and W. G. Valentine, South Kensington.—*12th November*, 1874.
4020. Metallic Tubes, A. Clifford, Birmingham.—*23rd November*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 2nd December, 1881.

2458. Displaying Advertisements, H. H. Banyard, London.—Com. from J. I. Czettel.—*4th June*, 1881.
2898. Extinguishing Fires, F. Grinnel, Providence, U.S.—*2nd July*, 1881.
2927. Propelling Road Vehicles, J. Simmons, Brixton, London.—*5th July*, 1881.
2934. Knife Cleaners, W. Scott, Haverstock-hill, London.—*5th July*, 1881.
2945. Decorating Doors, &c., F. D. Harding, Hampstead Heath.—*5th July*, 1881.
2946. Caloric, &c., Engines, L. Wolff, Magdeburg.—*5th July*, 1881.
2951. Trousers, A. W. Adams, Southampton.—*6th July*, 1881.
2968. Vehicles, R. Brabyn, St. Wenn, Bodmin.—*7th July*, 1881.
2970. Nails, H. Booth, Bilston.—*7th July*, 1881.
2974. Storing, &c., Fruit, G. A. Cochrane, Liverpool.—*7th July*, 1881.
2986. Telephonic Signalling, J. Imray, London.—A communication from C. Ader.—*7th July*, 1881.
2994. Preserving Articles of Food, F. Pool, Stoke Newington.—*7th July*, 1881.
3001. Anchors, H. Terrell, Regent's Park, London.—Com. from S. Chapleau & A. Smith.—*8th July*, 1881.
3003. Taps, G. Furness and J. Robertshaw, Manchester.—*8th July*, 1881.
3004. Steam-pressure Gauges, G. Furness and J. Robertshaw, Manchester.—*8th July*, 1881.
3006. Condensing Pumps, J. McEwen and S. Spencer, Manchester.—*8th July*, 1881.
3008. Dredging Machines, W. R. Lake, London.—A communication from J. Menge.—*8th July*, 1881.
3010. Signalling Code, H Gardner, London.—A communication from E. Roe.—*8th July*, 1881.
3014. Photographic Cameras, G. Smith, Southampton-buildings, London.—*8th July*, 1881.
3015. Electric-lighting Apparatus, W. R. Lake, London.—Com. from J. J. C. Greb.—*8th July*, 1881.
3018. Spinning Machine Rollers, H. J. Haddan, Kensington.—A communication from J. B. William.—*9th July*, 1881.
3022. Wagon Wheels, W. F. Lotz, London.—A communication from A. Wilké.—*9th July*, 1881.
3025. Roasting Tobacco, C. H. Andrew, Stockport.—*9th July*, 1881.
3027. Fire-arms, T. Woodward and T. Woodward, jun., Birmingham.—*9th July*, 1881.
3039. Playing Pianos, &c., H. E. Newton, London.—A communication from C. Gavioli.—*11th July*, 1881.
3042. Band Saw Machines, A. Dodman, King's Lynn, and N. G. Kimberley, London.—*12th July*, 1881.
3054. Brooms and Brushes, A. Denjoy, Auch, France.—*12th July*, 1881.
3055. Disinfecting Apparatus, C. M. Scott, Dalkey, Dublin.—*12th July*, 1881.
3078. Cakes, &c., W. R. Lake, London.—A communication from J. H. Mitchell.—*14th July*, 1881.
3094. Propelling Ships, H. J. Allison, London.—A communication from T. G. Widmer.—*15th July*, 1881.
3118. Lamps, C. Saunderson, Kilburn.—*18th July*, 1881.
3135. Screw Propellers, W. Morrison and C. Norfolk, Kingston-upon-Hull.—*19th July*, 1881.
3254. Cables, H. H. Lake, London.—A communication from D. Brooks, jun.—*26th July*, 1881.
3336. Producing Metals, W. L. Wise, London.—Com. from L. and T. Chevanne.—*2nd August*, 1881.
3376. Artificial Ivory, F. W. Cottrell, Calthorpe-street, London.—*4th August*, 1881.
3390. Permanent Way, P. J. Neate, Belsize Park, London.—*4th August*, 1881.
3567. Tunnelling Apparatus, A. L. Blackman, Nashville, U.S.—*16th August*, 1881.
3875. Starting Engines, A. B. Brown, Edinburgh.—*7th September*, 1881.
3897. Motive Power Engines, H. G. Hosmer, London.—*8th September*, 1881.
3944. Telephones, W. E. Irish, Sunderland.—*12th September*, 1881.
4191. Gas Cooking Stoves, G. J. Cox, Maidstone.—*29th September*, 1881.
4247. Coupling Railway Wagons, J. Jackson, Kirkintilloch, and T. Ballantyne, Uddingston, N.B.—*1st October*, 1881.
4265. Rotary Valves, P. G. B. Westmacott, Newcastle-upon-Tyne.—*1st October*, 1881.
4437. Hats, W. R. Lake, London.—A communication from W. A. Baglin and G. Yule.—*11th October*, 1881.
4451. Discharging Torpedoes under Water, P. Brotherhood, London.—*12th October*, 1881.
4563. Holders, &c., H. J. Haddan, Kensington.—Com. from W. H. Miles, jun.—*19th October*, 1881.

Last day for filing opposition, 6th December, 1881.

2841. Plain Repps, J. Horrocks, Bolton.—*29th June*, 1881.
3024. Grinders, R. R. Gubbins, Park-road, New Cross.—*9th July*, 1881.
3028. Axles, H. H. Lake, London.—A communication from A. Cohen.—*9th July*, 1881.
3034. Movable Windows, &c., R. Laws, Hackney.—*11th July*, 1881.
3038. Fire-lighters, J. F. Wiles, Old Charlton.—*11th July*, 1881.
3044. Printing on Envelopes, W. McKenzie, Monkston.—Com. from S. A. Grant.—*12th July*, 1881.
3045. Shuttles, J. Broadhead, Huddersfield.—*12th July*, 1881.
3051. Effecting Motion to Bodies, G. Wilson, Parliament-street, London.—*12th July*, 1881.
3053. Battery Telephones, L. Jacobson, Berlin.—*12th July*, 1881.
3066. Spinning Cotton, H. Robinson, Bolton.—*13th July*, 1881.
3068. Flexible Strips, R. Auerbach, Old Broad-street, London.—*13th July*, 1881.
3079. Open Firegrates, J. Cornforth and E. T. Burton, Birmingham.—*14th July*, 1881.
3090. Ladies' Saddles, W. F. D. Schreiber, Roundwood.—*15th July*, 1881.
3121. Range Finder, G. W. Hart, Portsea.—*18th July*, 1881.
3181. Water-tube Boilers, F. C. Glaser, Berlin.—Com. from H. Heine.—*21st July*, 1881.
3188. Malleable Bronze, H. H. Lake, London.—A communication from L. Létrange.—*21st July*, 1881.
3195. Sleepers, H. L. Bucknall, Westminster.—*22nd July*, 1881.
3211. Obtaining Zinc from its Ore, H. H. Lake, London.—Com. from L. Létrange.—*22nd July*, 1881.
3247. Electric Clocks, F. T. Reid, Exeter, and J. U. Valentine, Teignmouth.—*25th July*, 1881.
3309. Lasting Uppers of Boots, H. H. Lake, London.—Com. from G. W. Copeland.—*28th July*, 1881.
3513. Steam Engines, M. Lowe, Scholes, Wigan.—*12th August*, 1881.
3654. Fire-arms, P. Mauser, Wurttemburg.—*22nd August*, 1881.
3662. Controlling Feed-water, M. Benson, London.—Com. from S. C. Salisbury.—*23rd August*, 1881.
3700. Exhibiting Advertisements, J. Cooper, Nottingham.—*25th August*, 1881.
3720. Stoppering Bottles, W. R. Lake, London.—Com. from P. J. Carmien.—*25th August*, 1881.
3766. Preventing the Waste of Water, W. H. Cutler and J. Chapman, Eton.—*30th August*, 1881.
3813. Joints, M. Benson, London.—A communication from A. H. Fanchers.—*2nd September*, 1881.
3954. Couplings, A. Thomson, Southampton.—*13th September*, 1881.
3959. Refining Starch Sugar, P. Jensen, London.—A com. from F. Soxhlet.—*13th September*, 1881.
4039. Corsets, H. E. Newton, London.—A communication from M. Cohn.—*19th September*, 1881.
4072. Coloured Sized Yarns, F. A. Gatty, Accrington.—*21st September*, 1881.
4086. Gas Engines, J. Atkinson, Finsbury Park, London.—*22nd September*, 1881.
4092. Binding Corn Crops, J. Howard and E. T. Bousfield, Bedford.—*22nd September*, 1881.
4156. Floating Batteries, A. Longsdon, London.—A com. from A. Krupp.—*27th September*, 1881.
4170. Corking Machines, C. Farrow, London.—*27th September*, 1881.
4174. Electric Lamps, E. G. Brewer, London.—A com. from T. A. Edison.—*27th September*, 1881.
4178. Superheating Steam, C. D. Abel, London.—A com. from A. Estrade.—*28th September*, 1881.
4188. Sun Blinds, G. Hatton, Southport.—*29th September*, 1881.
4194. Intermitting Audible Signals, F. W. Durham, New Barnet.—*29th September*, 1881.
4240. Corrugated Plates, R. Armitage and T. Gillott, Leeds.—*30th September*, 1881.
4313. Surveying, G. H. Stephens and H. Wilmer, London.—*4th October*, 1881.
4455. Secondary Batteries, J. W. Swan, Newcastle-on-Tyne.—*13th October*, 1881.
4509. Sheaf-binding, J. Hornsby, J. Innocent, and G. T. Rutter, Grantham.—*15th October*, 1881.
4535. Distilling Apparatus, C. Paulmann, London.—*18th October*, 1881.
4553. Using Secondary Batteries, P. Jensen, London.—A com. from T. A. Edison.—*18th October*, 1881.
4597. Safety Envelopes, W. W. de la Rue, London.—*20th October*, 1881.
4599. Food for Horses, &c., J. H. Cox, Matlock.—*20th October*, 1881.
4619. Filter-presses, E. A. Pontifex and R. Gunning, Shoe-lane, London.—*21st October*, 1881.
4779. Augers, P. A. Gladwin, Boston, U.S.—*1st November*, 1861.
4913. Torpedoes, S. Pitt, Sutton.—A communication from W. H. Mallory.—*9th November*, 1881.
4913. Steering Vessels, S. Pitt, Sutton.—A communication from W. H. Mallory.—*9th November*, 1881.
4914. Moulded Metallic Bodies, S. Pitt, Sutton.—Com. from W. H. Mallory.—*9th November*, 1881.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 11th November*, 1881.)

1957. Sulphuric Acid, W. Weldon, Burstow.—*5th May*, 1881.
2061. Producing Animal Charcoal, D. A. Fyfe, Barnes.—*12th May*, 1881.
2069. Expansion Gear, C. Pieper, Berlin.—*12th May*, 1881.
2070. Stoppering Bottles, J. J. Broadbridge, Manchester.—*12th May*, 1881.
2084. Capstans, B. C. Scott, Chester-terrace, London.—*13th May*, 1881.
2087. High-pressure Regulating Taps, G. Osborne, Brighton.—*13th May*, 1881.
2088. Conveying Intelligence, J. M. B. Baker, Southampton-buildings, London.—*13th May*, 1881.
2095. Spinning Fibres, S. Tweedale, Accrington.—*13th May*, 1881.
2096. Supplying Gum, &c., to Paper, J. J. Allen, Halifax.—*13th May*, 1881.
2102. Tin and Terne Plates, D. Leyshon, Penclawdd.—*13th May*, 1881.
2103. Printing Ink, C. T. Bastand, Camberwell.—*13th May*, 1881.
2108. Cotton Pile Plushes, W. Irlam, Eccles.—*14th May*, 1881.
2109. Controlling the Speed of Steam Engines, H. Lindley, Salford.—*14th May*, 1881.
2111. Clipping Machines, W. W. Urquhart and J. Lindsay, Dundee.—*14th May*, 1881.
2118. Mandrel, C. Croissant and P. P. Huré, Paris.—*14th May*, 1881.
2121. Screw Propellers, W. R. Lake, Southampton-buildings, London.—*14th May*, 1881.
2122. Gas Motor Engines, J. Dougill, Manchester.—*16th May*, 1881.
2125. Propelling Vessels, A. Figge, London.—*16th May*, 1881.
2132. Portable Crane, J. Hurst, Brighton.—*16th May*, 1881.
2144. Blasting Charges, W. E. Gedge, Wellington-street, London.—*17th May*, 1881.
2145. Wax Thread Sewing Machines, W. R. Lake, London.—*17th May*, 1881.
2149. Fireplaces, T. F. Shillington, Belfast.—*17th May*, 1881.
2166. Spring Mattresses, G. D. Peters, Moorfields, London.—*18th May*, 1881.
2177. Sock Suspender Clasps, E. Blinkhorn and F. A. C. Grœbert, London.—*18th May*, 1881.
2214. Umbrella Furniture, W. G. Denham and F. A. Ellis, London.—*20th May*, 1881.
2255. Rackets, &c., G. Hookham, Birmingham.—*24th May*, 1881.
2252. Fog Horn, H. J. Haddan, Strand, London.—*24th May*, 1881.
2291. Propulsion, &c., of Vessels, J. Neil and J. L. Corbett, Glasgow.—*25th May*, 1881.
2294. Regulating the Supply of Gas, A. Pope, Gotha Ironworks, Slough.—*25th May*, 1881.
2314. Preserving Butter, G. M. Allender, Bayswater, London.—*26th May*, 1881.
2324. Boxes, &c., for Biscuits, W. I. Palmer, Reading.—*26th May*, 1881.
2334. Furnaces, A. M. Clark, Chancery-lane, London.—*27th May*, 1881.
2342. Brick-making Machines, F. Firth, J. Firth, and E. Firth, Dewsbury.—*27th May*, 1881.
2416. Magneto-electric Machine, F. Wolff, Copenhagen, Denmark.—*1st June*, 1881.
2422. Fluid Meter, W. R. Lake, London.—*1st June*, 1881.
2658. Saving Life at Sea, A. D. Roth, Blackheath.—*17th June*, 1881.
2874. Centrifugal Extracting Machines, F. Wolff, Copenhagen, London.—*1st July*, 1881.
2961. Gas Motor Engines, C. G. Beechey, Liverpool.—*6th July*, 1881.
3007. Binding Books, H. G. Thompson, New Haven, U.S.—*8th July*, 1881.
3037. Securing the Joints of Earthenware Piping, J. Gooddy, Wombwell.—*11th July*, 1881.
3041. Making Tubing, &c., A. L. Murphy, Philadelphia, U.S.—*11th July*, 1881.
3050. Furnaces, J. A. King and J. Little, Dublin.—*12th July*, 1881.
3139. Lamps, &c., W. R. Lake, Southampton-buildings, London.—*19th July*, 1881.

(*List of Letters Patent which passed the Great Seal on the 15th November*, 1881.)

2123. Belts and Straps, D. Williams, Portmadoc.—*16th May*, 1881.
2131. Petroleum Stoves, F. H. F. Engel, Hamburg.—*16th May*, 1881.
2137. Stands for Lasts, J. Southwood, Leeds.—*17th May*, 1881.
2146. Wax-thread Sewing Machines, W. R. Lake, London.—*17th May*, 1881.
2171. Extracting Metals from Ores, R. Stone, King William-street, London.—*18th May*, 1881.
2176. Extracting Glycerine, W. R. Lake, London.—*18th May*, 1881.
2208. Ironing, W. H. Davey, London, and H. Fabian, Erith.—*20th May*, 1881.
2209. Gunpowder Flasks, F. W. Ticehurst, Birmingham.—*20th May*, 1881.
2216. Sewing Machine, J. Imray, Southampton-buildings, London.—*20th May*, 1881.
2221. Dressing Fabrics, J. W. Bannister and W. Bywater, Leeds.—*21st May*, 1881.
2222. Applying Springs to Doors, A. McMillan, Thornliebank.—*21st May*, 1881.
2223. Steam Generators, N. G. Kimberley, London.—*21st May*, 1881.
2230. Air Compressors, H. Fletcher, Bolton-le-Moors.—*21st May*, 1881.
2231. Washing Glasses, T. Wood, Newton Heath.—*21st May*, 1881.
2265. Telephone Transmitting Apparatus, J. T. Gent and H. G. Ellery, Leicester.—*24th May*, 1881.
2275. Reaping Machines, A. C. Bamlett, Thirsk.—*24th May*, 1881.
2319. Ploughs, S. Pitt, Sutton.—*26th May*, 1881.
2327. Swimming, J. Overton, Coventry.—*27th May*, 1881.
2337. Graters, L. Field, Birmingham.—*27th May*, 1881.
2344. Gas Regulators, W. Carter, Oldham.—*27th May*, 1881.
2369. Stopping Motion for Looms, W. Walker, Radcliffe Bridge.
2389. Device for Boots to Prevent Slipping, W. R. Lake, London.—*31st May*, 1881.
2405. Folding Arm Chair, W. H. Beck, London.—*31st May*, 1881.
2437. Metallic Circuits, E. Edmonds, Fleet-street, London.—*2nd June*, 1881.
2442. Taps, J. L. Corbett and W. Lochhead, Glasgow.—*3rd June*, 1881.
2481. Spinning, W. R. Lake, Southampton-buildings, London.—*7th June*, 1881.
2579. Moulds, A. M. Clark, Chancery-lane, London.—*14th June*, 1881.
2815. Coating Bags, A. M. Clark, Chancery-lane, London.—*27th June*, 1881.
2912. Vertical Steam Boilers, G. Kingdon, Kingswear.—*4th July*, 1881.
3173. Raising Beer, P. J. Catterall and E. Birch, Manchester.—*21st July*, 1881.
3329. Ploughs, J. Cooke, Lindum Works, Lincoln.—*1st August*, 1881.
3406. Foot Skates, J. F. Walters, Bayswater, London.—*6th August*, 1881.

3807. DRYING RICE, A. W. Gillman and S. Spencer, London.—1st *September*, 1881.

List of Specifications published during the week ending November 12th, 1881.

2993, 1s. 2d.; 82, 2d.; 1365, 2d.; 1452, 6d.; 1464, 2d.; 1478, 2d.; 1489, 8d.; 1492, 8d.; 1496, 10d.; 1497, 6d.; 1504, 2d.; 1513, 6d.; 1621, 6d.; 1522, 6d.; 1530, 6d.; 1534, 6d.; 1543, 6d.; 1544, 8d.; 1547, 8d.; 1555, 6d.; 1560, 6d.; 1563, 6d.; 1467, 6d.; 1565, 2d.; 1566, 2d.; 1567, 2d.; 1568, 2d.; 1569, 2d.; 1570, 8d.; 1571, 2d.; 1572, 2d.; 1573, 2d.; 1575, 6d.; 1576, 6d.; 1577, 2d.; 1578, 2d.; 1579, 2d.; 1580, 6d.; 1581, 4d.; 1582, 2d.; 1593, 1s.; 1584, 4d.; 1585, 8d.; 1587, 1s.; 1589, 2d.; 1590, 4d.; 1591, 6d.; 1592, 2d.; 1593, 4d.; 1594, 2d.; 1595, 6d.; 1596, 6d.; 1597, 6d.; 1598, 4d.; 1600, 6d.; 1601, 6d.; 1602, 6d.; 1603, 6d.; 1605, 4d.; 1607, 2d.; 1608, 6d.; 1613, 8d.; 1614, 6d.; 1615, 10d.; 1616, 4d.; 1617, 6d.; 1618, 6d.; 1619, 6d.; 1620, 6d.; 1621, 2d.; 1622, 2d.; 1623, 2d.; 1624, 6d.; 1625, 6d.; 1626, 6d.; 1627, 2d.; 1430, 4d.; 1631, 2d.; 1632, 2d.; 1635, 6d.; 1636, 6d., 1637, 2d.; 1638, 2d.; 1640, 2d.; 1641, 8d.; 1642, 2d.; 1643, 6d.; 1645, 2d.; 1646, 6d.; 1647, 6d.; 1648, 2d.; 1650, 8d.; 1654, 6d.; 1656, 2d.; 1659, 6d.; 1660, 6d.; 1661, 6d.; 1662, 6d.; 1663, 6d.; 1664, 2d.; 1665, 6d.; 1666, 2d.; 1667, 2d.; 1670, 6d.; 1673, 2d.; 1674, 2d.; 1675, 4d.; 1676, 6d.; 1677, 6d.; 1678, 6d; 1679, 6d; 1684, 2d.; 1698, 6d.; 1735, 4d.; 1797, 6d.; 1961, 10d.; 2081, 6d.; 3011, 6d.; 3263, 4d; 3421, 1s. 2d.; 3477, 1s.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

82. PRODUCING REVOLVING MOTION AND MOTIVE POWER, *W. Jones.—7th January*, 1881.—(*Not proceeded.*) 2*d*.

This relates to a wheel with a number of weighted levers hinged to its circumference, and caused to stand out during one part of the revolution of the wheel, and to lie down during the other portion.

1365. LOOMS, *E. Smethurst.—28th March*, 1881.—(*Void.*) 2*d*.

This relates to improvements on patent No 1027, A.D. 1880, for looms for weaving "loongees," or similar fabrics, and more particularly to the part of the loom employed for weaving straight coloured stripes or borders along the selvages of the piece.

1452. MONEY TILLS, *T. E. Boyce.—2nd April*, 1881. 6*d*.

The coins are dropped through slots in the top of the case and fall into spaces on a travelling band, the slots being covered by slides which have to be moved (and so ring a bell and advance the band one step), before a coin can be introduced. From the band, the coins fall into a pivotted shoot, which can be set so as to deliver into any one of a series of receptacles, thereby the money taken in a given period can be ascertained.

1464. PRESERVING ANIMAL AND VEGETABLE SUBSTANCES AND LIQUIDS, *H. A. Bonneville.—4th April*, 1881.—(*A communication from A. Robert.*)—(*Void.*) 6*d*.

This relates to apparatus to preserve alimentary and fermentescible products by securing them against fermentation due to the germs of fermentation in the air, and for rapidly improving liquids by keeping them in constant contact with the oxygen of pure air.

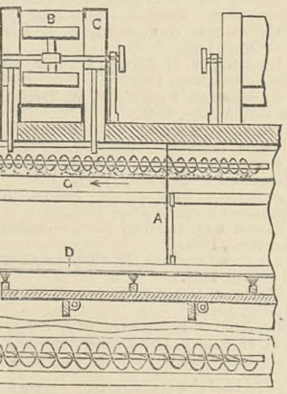
1478. TREATING WOVEN FABRICS, *W. Mather.—5th April*, 1881.—(*Void.*) 2*d*.

This relates to the treatment of woven fabrics in the operations of dyeing, bleaching, and washing, and consists in delivering the fabric in regular plait into a semicircular annular compartment having the entrance side carried up to a higher level than the delivery side. Such compartment is fixed in a tank with a space around it, and a stream of liquor flows in at the outlet side, and escapes through apertures in the upper side of the casing at the lowest part of the semicircle.

1489. MACHINERY FOR PURIFICATION OF MIDDLINGS IN MANUFACTURE OF FLOUR, &c., *A. Crabtree and J. Jackson.—5th April*, 1881. 8*d*.

This consists, First, in constructing an air passage on each side of the fan, such air passages to extend entirely across the machine. The machine is divided into separate compartments by means of partitions A, and each compartment is provided with a fan B, revolving within a casing C, which extends across the machine, so as to draw the dust equally from the surface of the vibrating tray D. Around the shaft of the fan, at each end, is formed a trough or hollow receptacle E, which reaches up to about the centre of the

1489

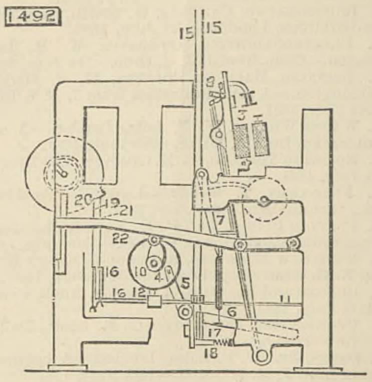


shaft, but may be adjusted according to requirement. The air has consequently to rise above the edges of this trough before it can enter the fan, and by this arrangement any light granules or middlings which may have been carried to the fan along with the refuse have an opportunity of becoming separated from the current and falling into the trough, and thence through the pipe F into a revolving worm G, which conveys them to a suitable receptacle; Secondly, in securing the sections of sieve to the vibrating frame by means of thumb screws or bolts which pass through the edges of the sieve into nuts formed in the cross bars of the frame.

1492. LOOMS, *H. A. Foster.—5th April*, 1881. 8*d*.

This relates to looms employed for weaving figures or designs on the surface of the fabric after the manner of embroidering, and it consists, First, of means for levelling the warp. A rack carries the shuttles and is provided with a projecting safety guard 3, which when the rack is lowered puts down any ends of warp improperly shedded, or which should not have been raised. The rack is raised and lowered by cam 4, operating levers 5 and 6, and connecting rod 7, so as to impart a partial rotation to cross shaft 8 connected to the rack. The shuttles are worked by a scroll 10, operating lever 11 by means of pin 12. The picking motion for the ordinary shuttle and for the embroidering shuttles is controlled from the jacquard by levers and clutch boxes, so that the ordinary shuttle is out of action during the operation of the embroidering shuttles. The cords 15 from the jacquard are connected to levers 16, with links 17 connected to double lever 18, thus insuring the catch 19 being in

1492

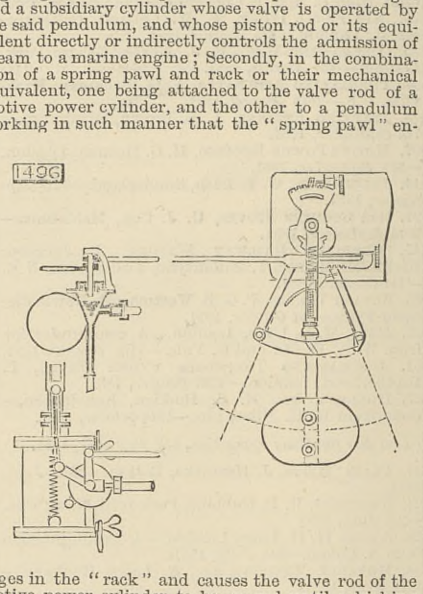


connection with lever 21, only when lever 20 is clear of catch 22, and *vice versâ*.

1496. APPARATUS FOR PREVENTING "RACING" IN MARINE ENGINES, *T. Mudd.—6th April*, 1881. 10*d*.

This consists, First, in the combination in a marine engine governor of a pendulum or pendulous weight and a subsidiary cylinder whose valve is operated by the said pendulum, and whose piston rod or its equivalent directly or indirectly controls the admission of steam to a marine engine; Secondly, in the combination of a spring pawl and rack or their mechanical equivalent, one being attached to the valve rod of a motive power cylinder, and the other to a pendulum working in such manner that the "spring pawl" en-

1496



gages in the "rack" and causes the valve rod of the motive power cylinder to be moved until a kicking gear is put in action by one of the moving pieces, which gear throws the pawl or its equivalent out of gear and allows the valve rod to run back to its original position by the force of a spring weight, steam acting against a piston on the rod, or a mechanical equivalent of these. The drawing shows one modification.

1497. VARNISHING, SIZING, OR GUMMING SHEETS OF PAPER, &c., *W. and S. Rawcliffe.—6th April*, 1881. 6*d*.

A large revolving cylinder has round its periphery blocks of nearly the same size as the sheet to be varnished, which are attached to the blocks by cramping pieces worked by a cam so as to grip and release the paper at the required times. Below the cylinder is an elastic roller which runs in the varnish contained in a tank below.

1504. WORKING AND SPLITTING WOOD, *J. Hardinge.—6th April*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to machinery to be used for mortising, mitreing, and tenoning wood at an angle, splitting fire or other wood, and with which may be combined arrangements for boring, grooving, sawing, lath punching, and other purposes.

1513. VESSELS TO CARRY GRAIN IN BULK, *J. Taylor.—6th April*, 1881. 6*d*.

The object is to prevent shifting and facilitate discharge of cargo. The vessel is divided longitudinally by two bulkheads of about the same contents. To carry grain in the space between the upper deck and the deck below it is sub divided by bulkheads. To facilitate loading, long narrow hatchways run almost the entire length of the holds when only grain is carried, but if cattle are to be carried below the upper deck, then narrow feeders are provided, which run through the spaces between the decks. Tubes extend from the bottoms of the lower holds to a suitable height, and are large enough to allow grain elevators to work therein.

1521. SHUTTLES FOR WEAVING, *J. Lomax and R. Dawson.—7th April*, 1881. 6*d*.

This relates, First, to the tip, and consists in making its stem hollow with a cutting edge, so as to facilitate its entrance to the block. It relates, Secondly, to the shuttle peg, which is forged with a flat portion, afterwards twisted to form a screw, so that the cop may be firmly held therein.

1522. TRIMMING THE SOLES OF BOOTS OR SHOES, *W. R. Lake.—7th April*, 1881.—(*A communication from D. C. Knowlton.*) 6*d*.

This relates to machinery for trimming soles, and consists of a knife moved over the edge of the sole by a steady motion imparted by power, while the shoe is held on a jack until the knife approaches the curves of the toe, and while trimming around the curves of the toe the shoe is swung half round, and at the same time moved bodily in the direction in which the knife is moving.

1530. CEMENT, &c., *J. C. J. Smith.—7th April*, 1881. 6*d*.

This relates to the drying and burning of the slip or slurry, and consists in placing in the drying chamber baffle-plates, so arranged as to compel the heated gases from a charged kiln to traverse the drying chamber in close contact with the surface of the slip or slurry, which is afterwards burnt in the kiln.

1534. MONEY TILLS WITH APPLIANCES FOR CHECKING RECEIPTS OF CASH, *F. Hawkins.—7th April*, 1881. 6*d*.

This consists mainly of an apparatus in which are slots through which coin is allowed to fall, and in falling comes in contact with studs adjusted to the weight of such coin, so as to shift their position and establish an electrical connection through an armature and coil with a bell or other indicator, the coin then passing into a drawer. The latter on being drawn out establishes communication with a sound-producing apparatus.

1543. IMPROVEMENTS IN ELECTRIC LAMPS, *G. St. George Lane-Fox.—8th April*, 1881. 6*d*.

In this improvement the platinum wires are fused into English lead glass, the upper ends being in tubes containing mercury, into which also are led the conducting wires. The lower end of the platinum wire is cemented into the carbon block by means of Indian or Chinese ink. The ends of the carbon filament are also similarly cemented in the block. Cotton wool is put over the mercury, and plaster of Paris over the wool.

1544. DRYING COFFEE, *J. Walter.—8th April*, 1881.—(*A communication from F. C. Da Cunha and Co.*) 8*d*.

This relates to means for drying coffee as picked from the plant, and consists in subjecting the berry to the influence of heat in a vessel, in which a partial vacuum is maintained, so that the juices are forced out and evaporated, the parchment skin on the berry being also cracked and loosened.

1547. ARTIFICIAL BUTTER, *E. G. Brewer.—8th April*, 1881.—(*A communication from L. Q. Bruin.*) 8*d*.

The fat of beef, pork, or even veal is reduced to a kind of paste by means of rotating knives, and is then melted, submitted to pressure, and some white vegetable oil and colour being added, is finally acted upon in a churn.

1555. PREPARING BITUMINOUS SUBSTANCES, *J. G. Tongue.—9th April*, 1881. -(*A communication from H. Randhahn.*) 6*d*.

This relates to processes for rendering bituminous substances hard enough to enable them to be used for hydraulic engineering, paving roads, &c., and it consists in heating the bituminous substance, and adding finely crushed carbon or ground coke, the whole being well stirred and worked about with a shovel. By exposing the materials to a gradually increasing heat and at the same time continuing the working about with the shovel, the mass may be still further hardened.

1560. DISTRIBUTING LIQUID IN THE FORM OF SPRAY, *W. Wells.—9th April*, 1881. 6*d*.

This relates to a spray diffuser intended more particularly for horticultural purposes for distributing liquids inimical to insect life, and it consists of a pair of pointed handles, one holding an elastic air bulb, and the other a glass bulb containing the liquid to be diffused. From each a tube leads to a nozzle, and when the handles are forced together air issues from the elastic bulb and causes the liquid in the other bulb to be exhausted and ejected through the nozzle in the form of spray.

1563. VELOCIPEDES, &c., *J. C. Garrood.—11th April*, 1881.—(*Not proceeded with.*) 6*d*.

This relates, First, to fitting velocipedes with hand levers to be worked in connection with the cranks, so as to assist in propelling the vehicle; and Secondly, to a form of safety velocipede for the use of elderly or nervous riders.

1564. TREATING AND PURIFYING SEWAGE, &c., *R. Weld and H. Ledger.—11th April*, 1881. 6*d*.

The sewage to be purified is first placed in a mixing chamber, where agitators cause it to become thoroughly mixed with a solution of aluminoferric cake and soap water. The mixture then passes up and down through a series of compartments formed by partitions fixed alternately to top and bottom of the tank, leaving the solid particles behind, and flowing out into a trough, where it may be still further treated with a solution of aluminoferric cake, and a requisite with a small quantity of ammonia. The liquid then passes through a filter.

1565. TOBACCO PIPES, *J. Trieb.—11th April*, 1881.—(*A communication from S. Notton.*)—(*Not proceeded with.*) 2*d*.

This relates to a reservoir to collect the juice and moisture from tobacco, and which can be detached, so as to empty the contents.

1566. CLIPS FOR SECURING SLATES OR TILES ON ROOFS, *H. J. Allison.—11th April*, 1881.—(*A communication from J. J. B. Celier.*)—(*Not proceeded with.*) 2*d*.

The clip consists of two parallel branches of unequal length which clasp the purlin. At the top of the longer branch a space is arranged to permit the placing of the slates in position, and which may be removed by sliding them upwards and taking them out of a hook formed at the bottom of the longer branch.

1567. REGULATING APPARATUS FOR AIR REFRIGERATING MACHINES, *T. B. Lightfoot.—11th April*, 1881.—(*Void.*) 2*d*.

This relates to means for rendering automatic the regulation of the expansion of air refrigerated by compressing it, cooling it, and then permitting it to expand while performing work, and it consists in the use of a thermometric instrument which acts upon the slide of the working cylinder so as to govern the cut-off of the air.

1568. PRODUCTION OF A BEVERAGE RESEMBLING COFFEE, *G. W. Kincaid.—11th April*, 1881.—(*Not proceeded with.*) 2*d*.

The malt is roasted, then ground and mixed with coffee or chicory, the mixture being used to produce a beverage.

1569. FITTING SHIFTING BOARDS IN SHIPS OR VESSELS FOR CARRYING GRAIN CARGOES IN BULK, *M. Dring and J. Pattison.—11th April*, 1881.—(*Not proceeded with.*) 2*d*.

Shifting boards are fitted so as to divide the space between decks, and in the bottom hold into longitudinal compartments when required to convey grain in bulk, but which can be turned back out of the way when not in use.

1570. TREATING HORSE AND MARKET REFUSE AND SEWAGE MATTER, AND RENDERING THE SAME AVAILABLE FOR MANURE, *R. Pease and T. Lupton.—11th April*. 1881. 8*d*.

Privies are formed with a screen acting in conjunction with the ordinary ash-pit, so that the fine ashes pass to the privy. To sift, assort, and screen ash-pits, street and market refuse, and sweepings, a rotating perforated cylinder is employed, through which the finer portions pass, while the larger portions are discharged at one end of the cylinder. Refuse vegetable matter is acted upon by cutters, and when mixed with the ashes from the screening cylinder can be used as manure. A furnace is described for burning sweepings and refuse and decomposing noxious gases arising from decayed matter, the heat from such furnace being utilised to heat water and raise steam.

1571. CARDING ENGINES, *W. H. Oates, W. Jameson, and B. Leonard.—11th April*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to an appliance to be used in conjunction with the feed and "licker" or "taker-in" roller, whereby the fibre being fed to the machine is freed from husk, grit, and dust, and it consists of a comb forming a grating extending across the machine between the feed and "licker-in" rollers.

1572. COMBINED COMB AND HAIR BRUSH.—11*th April*, 1881.—(*A communication from J. Coutris.*—(*Void.*) 2*d*.

This consists of a comb and brush, and an enclosing sheet of metal to hold the two together.

1573. DISENGAGING OR SLIPPING CONTRIVANCE, *B. J. Grimes.—11th April*, 1881.—(*Not proceeded with.*) 2*d*.

An enclosing frame piece is pivotted at one end, the upper end of the pivotted side taking into a recess in the shoulder of the "slip link," and by an arrangement of surrounding collar piece and a spring catch the "slip link" when locked will bear the load or pull put on it, whilst when the catch is unlocked the collar piece is raised to allow the unlocking the "slip link."

1576. INDICATING APPARATUS FOR DOOR OF WATER-CLOSETS, &c., *W. E. Gedge.—11th April*, 1881.—(*A communication from J. Francois.*) 6*d*.

This relates to an indicator attached to the slide-bolt of the door of the water-closet, and which is visible from the outside so as to indicate whether the place is occupied or empty.

1577. IMPROVEMENTS IN ELECTRIC TELEGRAPHS, &c., *J. Hopkinson and A. Muirhead.—11th April*, 1881. 2*d*.

This invention relates to the use of dynamo-electric machines for producing currents for telegraph purposes, combined with secondary batteries.

1575. RAILWAY BRAKES, *G. W. von Nawrocki.—11th April*, 1881.—(*A communication from G. H. Lippmann.*) 6*d*.

This relates to a railway brake consisting of wedge wheels A fixed on shafts B, which may also be braked, and which by rods D are suspended from the under

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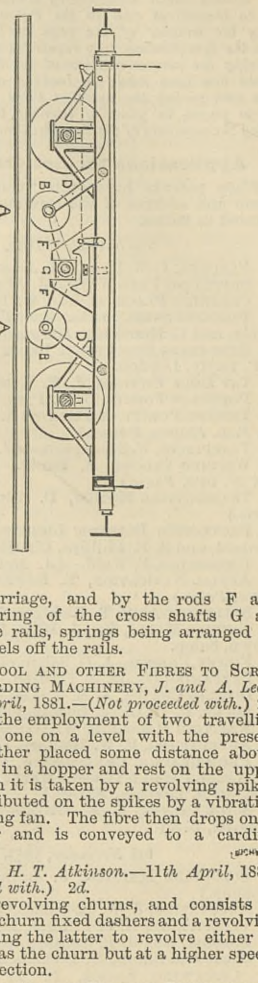


framing of the carriage, and by the rods F and through the lowering of the cross shafts G are pressed against the rails, springs being arranged to lift the wedge wheels off the rails.

1578. FEEDING WOOL AND OTHER FIBRES TO SCRIBBLING AND CARDING MACHINERY, *J. and A. Leadbeater.—11th April*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in the employment of two travelling sheets or creepers, one on a level with the present creeper, and the other placed some distance above. The fibre is placed in a hopper and rest on the upper creeper, from which it is taken by a revolving spiked roller, and is distributed on the spikes by a vibrating comb and a revolving fan. The fibre then drops on to the lower creeper and is conveyed to a carding machine.

1579. CHURNS, *W. H. T. Atkinson.—11th April*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to revolving churns, and consists in placing within the churn fixed dashers and a revolving beater, and in causing the latter to revolve either in the same direction as the churn but at a higher speed, or in a different direction.

1580. WETTING THE GUMMED FLAP OF ENVELOPES, *F. H. F. Engel.—11th April*, 1881.—(*A communication from B. Amsberg.*) 6*d*.

The apparatus consists of a square box containing a vessel of water from which two wicks lead to the cover plate of the box and are placed in open channels or gutters, placed at an angle to each other, so as to fit the shape of the gummed flap of the envelope. The gutters are adjustable so as to suit different envelopes. Behind and parallel with each gutter two or more arms are passed through the cover plate, and their bottom ends are fastened to plates inside the box and acted upon by springs, while their upper ends project beyond the wicks and serve as a guide to secure an exact position of the flap when placed on the wicks.

1581. THRASHING MACHINES, *R. Creed.—11th April*, 1881. 4*d*.

The object is the more regular and efficient feeding of thrashers. The head of the sheaf is cut off before thrashing by means of a rapidly-revolving disc of steel, the sheaf being fed up to such disc without being opened, and the head or corn end of the sheet as it is cut off drops into the feed mouth of the thrashing machine.

1582. SWIFTS OR APPARATUS FOR HOLDING YARN OR THREAD WHILST BEING UNWOUND, *W. Graham.—11th April*, 1881.—(*Void.*) 2*d*.

The swift has three radiating arms on each of which a sliding piece is mounted adjustably to suit the size of the hank to be unwound, and each sliding piece is furnished with a spring to hold it in any required position. On each sliding piece is mounted an arm at right angles to the plane of the radiating arms, and this second set of arms can be locked in position when in use, and when not in use they can be folded upon the radiating arms, which can also fold up so that they are parallel to the axis on which they revolve.

1583. SEWING MACHINES, *J. H. Johnson.—12th April*, 1881.—(*A communication from C. H. Wilcox and J. E. A. Gibbs.*) 1*s*.

This relates to machines which produce a lock stitch by means of a rotary hook carrying the loop of an upper thread around the mass of the lower thread contained in a stationary or comparatively stationary bobbin case, and completes each stitch separately by means of an independent take up; and the object is to increase the regularity and rapidity of the movement and the efficiency in the production of stitches with precision and certainty, and with little friction or strain upon the thread, except that resulting from the tension.

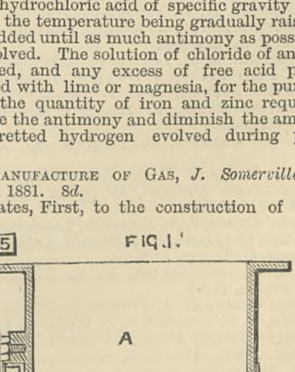
1584. TREATING ORES AND SUBSTANCES CONTAINING ANTIMONY, *J. Hargreaves and T. Robinson.—12th April*, 1881. 4*d*.

This relates more especially to the treatment of antimonious ores and substances containing sulphur, and contaminated with lead and arsenic, or mixed with a large amount of gangue, and the main objects are to obtain economically and quickly metallic antimony relatively free from admixture of contamination, to eliminate the sulphur in an available condition, to recover and re-use hydrochloric acid employed in the treatment, and to provide suitable apparatus. The ores are subjected in a finely-divided state to the action of hydrochloric acid of specific gravity not less than 1·06, the temperature being gradually raised and the ores added until as much antimony as possible has been dissolved. The solution of chloride of antimony is decanted, and any excess of free acid partially neutralised with lime or magnesia, for the purpose of reducing the quantity of iron and zinc required to precipitate the antimony and diminish the amount of antimonuretted hydrogen evolved during precipitation.

1585. MANUFACTURE OF GAS, *J. Somerville.—12th April*, 1881. 8*d*.

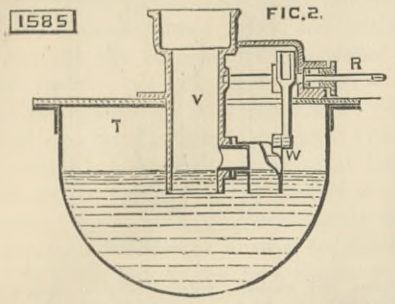
This relates, First, to the construction of mouth

1585 FIG.1.



piece and lids of retorts so as to insure a sound gas-tight joint; and Secondly, to apparatus for relieving the retorts from the pressure of gas, such apparatus being operated upon simultaneously with the opening or closing of the retort lids. Fig. 1 shows a mouthpiece embodying this invention. The mouthpiece A has a conical interior circumference, the lid C being formed to fit the same. On the lid is a circular projection E, against which bears the cross bar F hinged at one end, and the other having a stud J over which the handle K with an inclined plane is brought to bear, the handle being attached to an excentric screw

1585 FIG. 2.



bolt M. Fig. 2 shows the arrangement for the relieving the retorts from pressure of gas, and it consists of a chain attached at one end to the handle K of the retort lid, and at the other to rod R passing through a stuffing box on the hydraulic main T. On the spindle is a lever which causes the elbow W on the lower part of the dip pipe V to partially revolve and be sealed when the retort is open. A weight effects the unsealing when the retort is closed.

1587. Mineral Oil and Ammonia, &c., *W. Young.*—12*th April*, 1881. 1s.

This consists, First, in effecting the destructive distillation of shale or similar substances at two temperatures, namely, first at a low temperature, for the production of mineral oil, and secondly, at a considerably higher temperature, for the production of ammonia; Secondly, in subjecting oils containing impurities to the action of caustic soda, lime, or soda-lime while the oils are in a hot, vaporous state; Thirdly, in the process and apparatus for subjecting the oils to the action of acids and alkalies so that the pure acids and alkalies are used to treat comparatively pure oil, and that as they become more and more saturated with impurities they are successively applied to act upon more impure oil; Fourthly, in the separation of ammonia from ammoniacal liquor by causing steam which has been used to eliminate the ammonia from the liquor, and to convey it to the saturating vessel to be used over again; and Fifthly, in treating ammoniacal liquor for obtaining ammonia for use in the purification of coal-gas.

1589. Purifying and Sifting Grain, *H. J. Haddan.*—12*th April*, 1881.—(*A communication from F. Dronet.*)—(*Not proceeded with.*) 2d.

The apparatus contains three sieves, forming a three-storeyed box, one side of which is open for escape of refuse.

1590. Pipe Joints, *T. Lloyd.*—12*th April*, 1881. 4d.

This relates to a joint for sheet metal pipes, and consists in forming round one end of each length an annular recess, into which the plain end of the next length of pipe is introduced.

1591. Laminated Springs for Locomotive Engines, *J. W. Spencer.*—12*th April*, 1881. 6d.

The object is to produce springs of decreased weight for a given amount of elasticity, or of increased strength with a given amount of weight, and it consists in forming springs from one or more plates having a form in transverse section similar to a corrugated plate, in which the intersecting plane is at right angles to the corrugations.

1592. Indicators for Steam Engines, *A. Budenberg.*—12*th April*, 1881.—(*A communication from C. Budenberg and B. A. Schaefer.*)—(*Not proceeded with.*) 2d.

This relates to the production of diagrams to show in one figure the work done in a double stroke, and it consists in the use of two pistons, cylinders, and springs, the piston rod being secured to both pistons, and carrying both springs, while each cylinder has a separate steam inlet, which are connected to opposite ends of the engine cylinder.

1593. Injectors, *A. Budenberg.*—12*th April*, 1881.—(*A communication from C. F. Budenberg and B. A. Schaeffer.*) 4d.

The water inlet of the injector is divided for the whole or part of its length by one or more partitions. Within the condensation chamber of the injector one or more additional nozzles are inserted in such a

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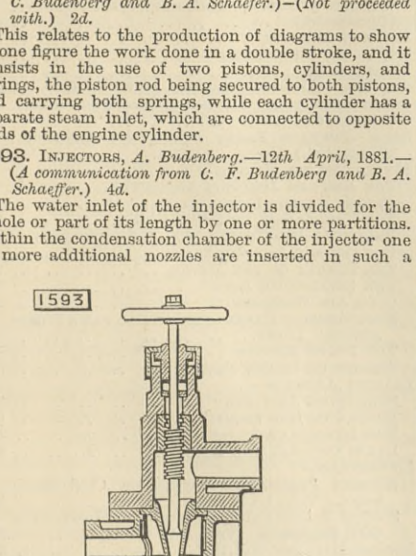


manner that this condensation chamber is divided by the flanges of the nozzles into as many smaller chambers as there are passages in the water inlet.

1594. Bicycles, &c., *R. O. Rowland.*—12*th April*, 1881.—(*Not proceeded with.*) 2d.

The crank is replaced by a spur pinion gearing with an internal wheel revolving on an axis secured to the fork, so that it can be raised and lowered. On the wheels are the treadles.

1595. Portable or Movable Railways, &c., *E. Leahy.*—12*th April*, 1881. 6d.

This consists of a flexible revolving annular steel rail, guided over rollers and passing under the wheels of the vehicle, which are grooved and run on the rail.

1596. Improvements in Electric Lamps, *A. W. L. Reddie.*—12*th April*, 1881.—(*A communication from H. Sedlaczek and F. Wiknlill.*) 6d.

This invention relates to improvements in the regulation of the carbons in those lamps where the electrode holders are supported in fluid contained in closed vessels communicating with each other at their lower parts. The mechanism of the lamp is so arranged that the variation in the velocity of the generator due to the increased or diminished resistance in the circuit, is utilised to effect, through a centrifugal governor, the self-regulation of the carbons. A method of regulation by means of a spiral spring and an electro-magnet is described, this being intended for use on shipboard or for locomotives, where heavy shocks are likely to derange the carbons. In this arrangement the armature lever is mounted on a vertical axis, the armature being secured to its shorter end, the longer being attached to the regulating mechanism and spiral spring. It is claimed for this system that the carbons are fed forward only to the exact extent that they are consumed.

1597. Gas Burners, &c., *H. H. Doty.*—12*th April*, 1881. 6d.

This relates to argand burners, and also to duplex and triplex burners, the object being the more complete combustion of gas. Within the circular burner a rod is carried upwards, and on it are placed two or more discs, one above the other and of increasing diameters. They are slotted or perforated radially from the centre. The chimney to be used with such burner has a bulb form at the part surrounding the discs.

1598. Horseshoes, *G. W. von Nawrocki.*—12*th April*, 1881.—(*A communication from A. Finze.*) 4d.

This consists of roughing studs capable of being applied without taking off the shoe, and consisting of chisel-headed screws, which will not work loose.

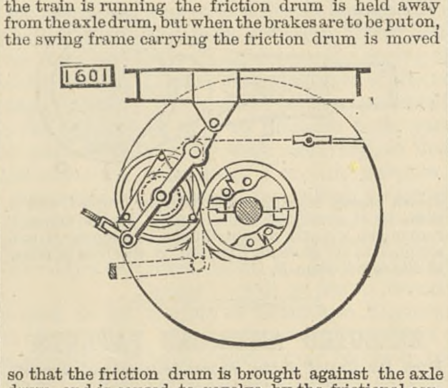
1600. Tanning, &c., *C. Michel, jun., C. Kollen, and G. Hertzog.*—12*th April*, 1881. 6d.

The hides or skins are subjected to agitation within a revolving drum in the presence of tanning liquid, which is made to circulate through the drum, so that its strength and quantity can be made to suit the different stages of the process.

1601. Railway Brakes, *C. Fairholme.*—12*th April*, 1881.—(*A communication from W. Bandel.*) 6d.

In this apparatus a drum is fixed on one of the running axles of a brake carriage, and near it is suspended a swing frame carrying another or friction drum, on the axis of which there is a barrel having a chain extending from it to the brake levers. While the train is running the friction drum is held away from the axle drum, but when the brakes are to be put on, the swing frame carrying the friction drum is moved

1601



so that the friction drum is brought against the axle drum, and is caused to revolve by the frictional contact therewith. The chain is thus wound up, pulling the brake lever and putting on the brakes. The drawing shows a side view of the arrangement of friction drum gear.

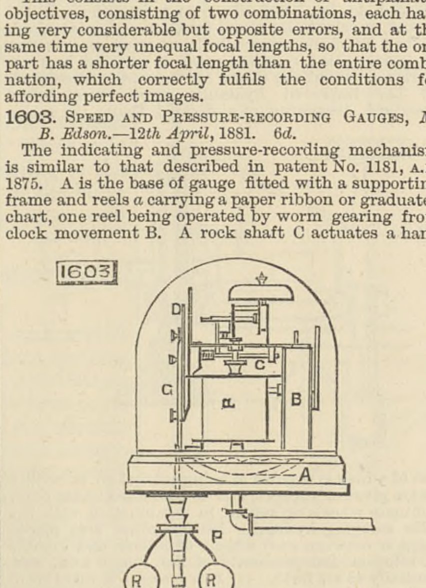
1602. Photographic Objective, *H. A. Steinheil.*—12*th April*, 1881. 6d.

This consists in the construction of antiplanatic objectives, consisting of two combinations, each having very considerable but opposite errors, and at the same time very unequal focal lengths, so that the one part has a shorter focal length than the entire combination, which correctly fulfils the conditions for affording perfect images.

1603. Speed and Pressure-recording Gauges, *M. B. Edson.*—12*th April*, 1881. 6d.

The indicating and pressure-recording mechanism is similar to that described in patent No. 1181, A.D. 1875. A is the base of gauge fitted with a supporting frame and reels *a* carrying a paper ribbon or graduated chart, one reel being operated by worm gearing from clock movement B. A rock shaft C actuates a hand

1603



D by a toothed segment, and carries an arm that gives motion to pencil-holder G connected to a centrifugal apparatus driven by the engine, and consisting of balls R connected to spring arms P and to the movable washer sliding in a central pillar.

1605. Extracting the Oxides and Carbonates of Zinc and Copper from Ores, *A. M. Clark.*—12*th April*, 1881.—(*A communication from L. L. C. Krafft and J. E. Schischkar.*) 4d.

The ore reduced to powder is treated by a solution of caustic ammonia, which dissolves the carbonates and the oxides of copper and of zinc.

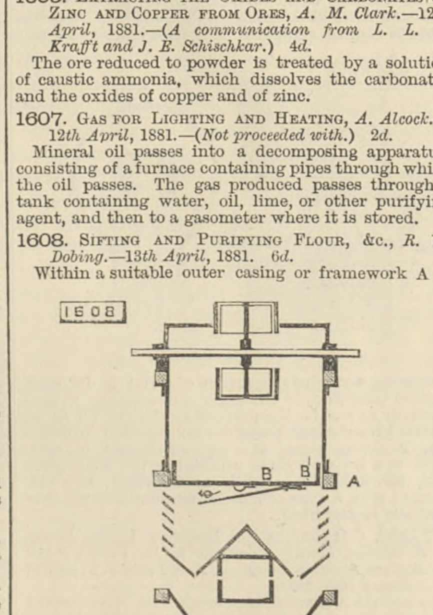
1607. Gas for Lighting and Heating, *A. Alcock.*—12*th April*, 1881.—(*Not proceeded with.*) 2d.

Mineral oil passes into a decomposing apparatus, consisting of a furnace containing pipes through which the oil passes. The gas produced passes through a tank containing water, oil, lime, or other purifying agent, and then to a gasometer where it is stored.

1608. Sifting and Purifying Flour, &c., *R. W. Dobing.*—13*th April*, 1881. 6d.

Within a suitable outer casing or framework A of

1608



the apparatus is applied a sieve or riddle B provided with a suitable silk straining surface B[1]. This sieve or riddle is supported with capability of being vibrated to and fro, so as to assist the passage therethrough of the finer particles of flour or other matters. This vibratory motion of the sieve or riddle is also aided by a tapping motion, given to it by means of springs on the underside of the sieve or riddle, being acted on by short arms or projections from an axis or shaft beneath or otherwise, by which arms or projections in the revolution of their axis or shaft those springs are compressed and then released, by which means the sieve in the rebound of these springs is shaken, so as to prevent the meshes of the silk from becoming blocked or stopped up, and the passage of the finer flour or matter under operation is facilitated.

1613. Improved Electrical Signalling and Telltale Apparatus for Watchmen, *W. R. Lake.*—13*th April*, 1881.—(*A communication from I. T. Campbell.*) 8d.

The objects of this invention are to cause an alarm at any desired place in case of failure of a watchman to perform his duty; to obtain a record of such failure and the time thereof; to permit the watchman to send signals independently of the ordinary working of the apparatus; to permit any one to discern between regular and unusual signals; to prevent the apparatus being tampered with; to automatically set the apparatus when the watchman goes off duty, whereby the negligence alarm is rendered inoperative, while the fire alarm may be sounded. The inventor makes use of a transmitter of peculiar construction operated by a suitable motor, which is locked against movement by the armature of an electro-magnet. This magnet is in circuit with the distant signal and recording apparatus, and through its transmitting arm with the finger levers for use by the watchman; these latter are arranged as required, and each one is separately connected with the insulated circuit-closing points of the transmitter. The transmitting arm is arranged to be moved over the insulated points in proper order and in succession as the circuit is closed, the motor is released by the action of the magnet. Clockwork drives a cylinder carrying the record sheet, and the recording pencil is operated by the armature of an electro-magnet in circuit with the transmitter, so that when the circuit is closed the pencil is brought into contact with the paper. The arrangements for carrying out the other objects of the invention are also described and illustrated

1614. Roller Mills for Grinding Corn, &c., *W. L. Wise.*—13*th April*, 1881.—(*A communication from Messrs. Seck Brothers.*) 6d.

This relates to mills in which two rollers are used revolving in opposite directions, and it consists in driving the rollers by an endless chain, means being provided for simultaneously slackening such chain, and moving the one roller from the other. It also consists in arranging vibrating or reciprocating fingers in the hopper above the rollers, so as to prevent obstruction in the hopper.

1615. Sewing Machines, *J. G. Wilson.*—13*th April*, 1881.—(*A communication from A. M. Leslie and the Teller Manufacturing Company.*) 10d.

This relates to a novel rotary shuttle sewing machine, and its main object is to embody the rotary shuttle principle in a sewing machine, having in a superior degree the qualities of noiselessness, light running or freedom from excessive friction, and perfection of stitch, with convenience of manipulation, so as to be easily adjusted or controlled; uniformity of action, so as to work substantially the same at high and low speeds; and simplicity of construction, so as to be readily manufactured and kept in repair.

1616. Sash Bars, *F. A. Lawrance.*—13*th April*, 1881. 4d.

The object is to secure panes of glass in sash bars without the use of putty or other cement, and it consists in holding them between two pieces of metal, one fitting over the other.

1617. Sewing Machines, *F. Heyrick and F. Quensteit.*—13*th April*, 1881.—(*A communication from the Actiengesellschaft, vorm. Frister and Rossmann.*) 6d.

This relates to a device for automatically disengaging the bobbin when it is reeled, and in an arrangement of "Carter's valve" and guide frame for facilitating the introduction of the thread.

1618. Latches and Locks, *G. E. Wilson.*—13*th April*, 1881. 6d.

This relates to a latch to be opened by pushing the knob inwards on one side, and pushing it outwards on the other, and also to means for preventing the bolt projecting after being withdrawn, and to retain it until the door is closed. A projecting piece on the knob spindle engages a cam on the bolt, so as to force it inwards, the return movement being effected by a spring, but in order to retain it in its withdrawn position a side spring stop arrangement drops into a recess in the bolt, and is fitted with a projecting piece, which on the door being closed is pushed inwards and relieves the bolt.

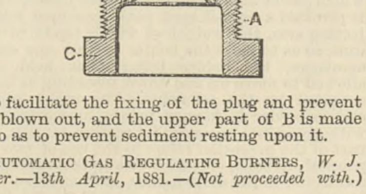
1619. Gas Lamps, &c., *W. J. Brewer.*—13*th April*, 1881. 6d.

This relates to improvements on patent No. 2617, A.D. 1880, and consists in the use of additional reflectors beneath the truncated cone, near the apex of which the light burns, the object being to more effectually diffuse the rays of light. The reflectors are protected from injury by heat of the lamp, by fitting over their faces a sheet of glass, leaving a space between the two through which air can circulate.

1620. Fusible Plugs for Steam Generators, *H. Adams.*—13*th April*, 1881. 6d.

The drawing shows a plug suitable for screwing into the crown of a fire-box from the interior. It consists of two parts, A and B, the former screwing into the fire-box, and the latter being held in position by the fusible metal D. The part A has a hexagonal

1620



head C to facilitate the fixing of the plug and prevent it being blown out, and the upper part of B is made conical, so as to prevent sediment resting upon it.

1621. Automatic Gas Regulating Burners, *W. J. Brewer.*—13*th April*, 1881.—(*Not proceeded with.*) 2d.

The orifice of the burner is in the form of two slits at right angles to one another, and the supply of gas is regulated by causing it to act on a piston valve which regulates the size of the passage to the burner.

1622. Fastening for Articles of Jewellery and Dress, *J. Doodey.*—15*th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to a fastener made in two parts, one having a tongue to enter a box, where it is secured by means of detents taking into recesses.

1623. Compounds to be Used as Cement, for Casting in Moulds, &c., *J. d'Arcy.*—13*th April*, 1881. 2d.

This consists in a mixture of slag and sulphur.

1625. Metal Pipes or Tubes, *S. Fox.*—13*th April*, 1881. 6d.

A metallic plate having been bent to the form of a tube, is enclosed in a covering of refractory material, and heated in a furnace until it is in a molten state, after which it is allowed to cool, by which means the edges of the plate will be joined without requiring to be welded.

1626. Umbrellas and Sunshades, *W. R. Seaton.*—13*th April*, 1881. 6d.

This relates to studs, clips, or eyelets for fastening the front ends of the covers to the front ends of the ribs.

1627. Carpets and Rugs, *G. O. C. Holloway.*—13*th April*, 1881. 2d.

This relates to the manufacture of carpets and rugs, with patterns upon them, from horsehair or other hair, either alone or combined with yarns of worsted, cotton, or jute.

1630. Treatment of Ores, &c., *J. H. Johnson.*—13*th April*, 1881.—(*A communication from N. E. Reynier.*)—(*Not proceeded with.*) 4d.

This relates to an improved electro-chemical treatment of ores with a view to the economical production of electricity.

1631. Railways, *A. J. Acaster.*—14*th April*, 1881.—(*Not proceeded with.*) 2d.

This consists in the use of three or more wedges on each side of the rail, the centre wedge being formed so that the face of the wedge next to the web of the rail is slightly broader than the face on the side farthest from the web of the rail.

1632. Apparatus for Trawling, *J. W. de Caux.*—14*th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to improvements on patent No. 3438, A.D. 1879, and consists in the use of beams made in two pieces scarfed together, and the net is supported by a rope passed around the beam, and secured with other parts of the net by sliding bolts at each end of the beam.

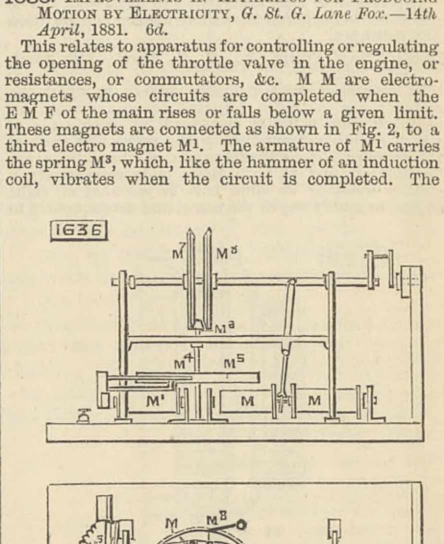
1635. Receptacles for Thread, &c., *J. Darling.*—14*th April*, 1881. 6d.

The thread or string passes from the inside of the box between a fixed blade and the outside of such boxes, so that when pressure is applied the string is severed, the end being retained between the blade and box.

1636. Improvements in Apparatus for Producing Motion by Electricity, *G. St. G. Lane Fox.*—14*th April*, 1881. 6d.

This relates to apparatus for controlling or regulating the opening of the throttle valve in the engine, or resistances, or commutators, &c. M M are electro-magnets whose circuits are completed when the E M F of the main rises or falls below a given limit. These magnets are connected as shown in Fig. 2, to a third electro magnet M[1]. The armature of M[1] carries the spring M[2], which, like the hammer of an induction coil, vibrates when the circuit is completed. The

1636



armature also carries a pawl M[4] to act on wheel M[5]. The rotation of the wheel may be transmitted to the point to be controlled in various ways. The one shown is by a bevel pinion M[6] on shaft of wheel M[5], and two bevels M[7] M[8] on shaft M[9], connected with part to be controlled. The other armature, acted upon by one or other of the magnets M M, causes one or other of wheels M[7] or M[8] to gear with pinion.

1637. Colouring Matters for Colouring Cotton, &c., *T. Holliday.*—14*th April*, 1881. 2d.

The coal-tar colour known as saffranire is treated with nitrous acid and the product combined with alpha or beta naphthol.

1638. Producing Azo Colours on Cotton, &c., *T. Holliday.*—14*th April*, 1881.—(*Not proceeded with.*) 2d.

The fibre is oiled by any suitable process and the colours made by the combination of diazo or diazo azo compounds with the naphthols, or other phenolic bodies are then formed on such fibre.

1640. Bottles, *H. J. Haddan.*—14*th April*, 1881.—(*A communication from Boucher Aîné.*)—(*Not proceeded with.*) 2d.

This consists chiefly of a rotary mould, serving to make and finish bottles of various shapes by means of a pedal, which allows the mould to be connected or disconnected or closed by means of a single pedal.

1641. Liquid Meter, *J. H. Blum.*—14*th April*, 1881. 8d.

The object is to measure and keep a record of the quantity of liquid withdrawn from any vessel, and it consists of a cock A divided into two compartments and a given capacity by a partition C, so that by turning the cock each time it is required to withdraw the

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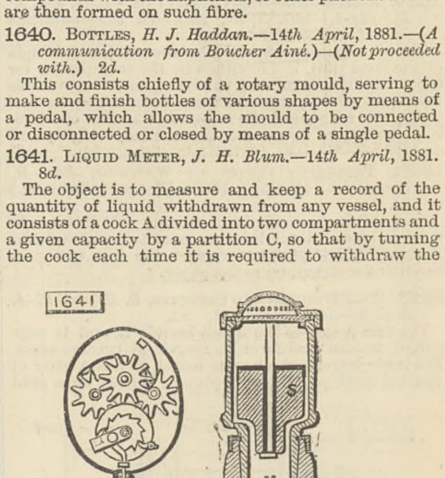

given quantity, a projection thereon is caused to act on a rod connected with suitable counting mechanism. The chambers, as the cock is revolved, are alternately caused to communicate with the delivery tube M and the discharge N. S is a float, which regulates the supply of air, and is especially designed for use with liquids which volatilise easily.

1642. Manufacture of Certain Kinds of Chain, &c., *E. Wilkins.*—14*th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to chains called ball chain and head chain, and consists in forming the balls hollow and with two opposite holes in the line of their axes, by which they are connected together by links, each consisting of a tube forked at each end, where a short cross-bar is secured.

1643. STEELYARDS FOR WEIGHING MACHINES, *O. Jones.—14th April*, 1881. 6d.

This relates to weighing machines intended to give indications in several distinct standards of weight, and it consists of a revolving bar prolonged beyond the fulcrum knife edges in both directions, and fitted with a sliding weight on each side. This bar bears on it the different scales required.

1645. SUPPORTS OR BREAST SHIELDS FOR CORSETS, &c., *C. H. Bradley.—14th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to the formation of the supports on blocks of the required form on layers of fabric coated with a solution of india-rubber, together with cork or felt, and a solution of gum.

1646. SANITARY APPLIANCES FOR BUILDINGS, &c., *H. P. Holt.—14th April*, 1881. 6d.

This relates to means for preventing sewer gases entering buildings, for flushing the trap and ventilating or carrying off noxious vapours. It is preferred to have a single connection only with the sewer, which should be fixed at the ground level, and the connection from the building flows into it through metal pipes arranged to deliver above the level of the trap. The gases are trapped in two places, the first trap forming a grease box, and the second, connected to the sewer, consists of an inverted box with its edges dipping into a cavity over which it is fixed. A cistern and ball cock are used to flush the closet basin and trap, a syphon being taken over the top of the cistern in the usual manner.

1647. PENCIL-HOLDERS, *P. Lawrence.—14th April*, 1881.—(*A communication from J. Reckendorfer.*) 6d.

This consists in the combination of a pair of scissors with a tubular case having one end adapted to receive a pencil or pen, the scissors being capable of sliding within the tube when not in use.

1648. PACKAGES FOR CARRYING OR SHIPPING PAINT, *R. R. Gray.—14th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to a package that will pack well, that is not likely to leak, and that when opened can be used as a paint pot.

1650. STEAM PUMPS, &c., *T. H. Ward.—14th April*, 1881. 8d.

In the case of single cylinder engines, in which one cylinder has the valve actuated by one piston, an ordinary slide valve is employed, at both ends of which a slide bolt extends to the respective ends of the cylinder. The extreme ends of these bolts are bevelled off, and at both these ends respectively a smaller shooting or slide bolt is situated at right angles, or nearly so, to the same, and consequently to

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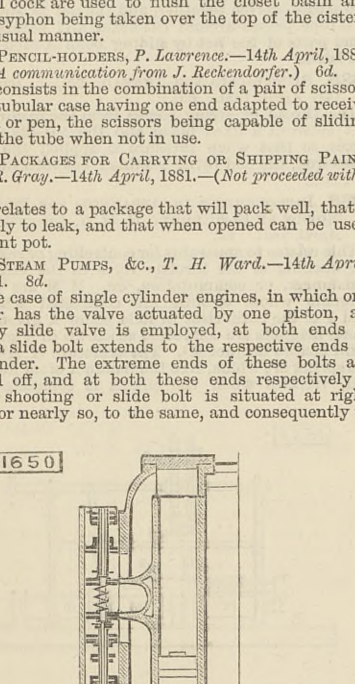

the piston path, the said shooting or sliding bolts having corresponding bevels at both ends. Each shooting bolt has a slot, hole, or recess, into which a pin enters for the purpose of preventing the bolt from dropping out altogether. Another part of the invention relates to improvements in the piston stuffing-box, where the two cylinder covers face each other, and where the glands serve as fulcra for the tightening appliances. Another part relates to improvements in valves and valve-boxes in connection with the water cylinder.

1654. ASCERTAINING THE CAPACITY OF CASKS, &c., *A. M. Clark.—14th April*, 1881.—(*A communication from T. Sourke.*) 6d.

The apparatus consists of a balance on the principle of the steel yard, but modified by the substitution for the counterpoise or weight scale pan of a suitable vessel, so as to permit the employment in lieu of weights of a liquid of the same kind as that of which it is desired to determine the volume, weight, and density.

1656. PRODUCING COPIES OF WRITINGS, &c., *D. Gestetner.—14th April*, 1881.—(*Not proceeded with.*) 2d.

A stencil is obtained of the writing and laid on to an even layer of thick ink; on paper being placed over the stencil and pressure applied the ink will pass through the stencil on to the paper.

1659. MAST WINCHES AND CAPSTANS, *E. E. and F. A. Bentall.—14th April*, 1881. 6d.

The axle A carries the winch barrels B, and is supported in the middle of its length by bracket arms. The inner larger end of each barrel B has a ring of nternal teeth gearing with pinions D loose on a stud

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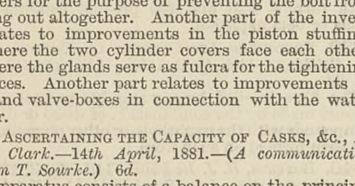

pin carried by an arm keyed to axle A. Loosely mounted on the axle is also a sleeve E carrying a pinion at one end in gear with pinion D and forming the axle on which the barrel is loosely mounted. The end of sleeve E is connected to the handle F. Outside the barrel is a ratchet wheel with which gears a retaining pawl.

1661. VELOCIPEDES, *W. Hillman.—14th April*, 1881. 6d.

This consists in the combination with the two parts of driving shaft extending through tubes, of a novel apparatus comprising a case enclosing diagonal shafts geared together and connected by universal joints with the inner ends of the two parts of the driving shaft. On the tube through which the driving shaft passes is fixed a chain wheel operated from the pedal shaft. The object of the arrangement is to regulate the power of the driving shaft to suit the variation of speed of the two wheels thereon when turning round or deviating from a straight line.

1660. BOILER FURNACES, *A. W. L. Reddie.—14th April*, 1881.—(*A communication from W. Duryea.*) 6d.

This consists essentially in the combination with the furnace of a hanging bridge of brick F—or it may be a water leg—projecting below the top of the furnace and near the end at which the products of combustion escape from the furnace, and a pipe or pipes for

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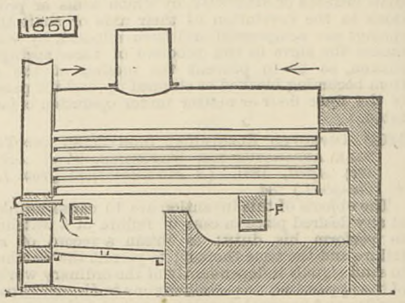

injecting steam into the said furnace. The injected steam is retained for a time within the furnace by the hanging bridge over the fire, and becomes highly heated and thoroughly mixed with the gaseous products of the fuel, producing very perfect combustion.

1662. CRATE FOR PACKING AND CARRYING BANANAS, &c., *J. Pullen.—14th April*, 1881. 6d.

This relates to a crate formed so as to support the fruit by their stems.

1663. SEWING MACHINES, *L. Silverman and J. R. Cumming.—14th April*, 1881. 6d.

This relates, First, to the use of a second needle attached to and operated by the needle bar, so as to be adjusted to work at any required distance from the ordinary needle, the shuttle and shuttle carrier looper or other parts for locking the thread being in like manner adjustable; and Secondly, to means for dispensing with the shuttle spool or bobbin for carrying the under thread in lockstitch machines, and employing an ordinary wooden reel or spool of thread as it comes from the manufacturers.

1664. TRICYCLES, &c., *W. H. Bliss.—14th April*, 1881.—(*Not proceeded with.*) 2d.

The driving apparatus is similar to a ratchet drill, wheels being fixed on the driving axle and treadles fitted to the ratchet lever. The invention further relates to fitting tricycles with side wheels just clear of the ground, so as to enable it to stand upright; to fitting governing springs to the back wheel, the axle of which is curved. The saddle spring is formed with a segment, with which gears a pinion, so as to adjust the saddle to incline of the road and for turning.

1665. COMBINED AIR AND GAS BURNERS, *J. Lewis.—14th April*, 1881. 6d.

According to one arrangement an argand burner is used, and a current of air is injected by a pipe into the centre of the flame in a similar manner to a Bunsen burner. On the end of the burner is mounted a cage of platinum wire gauze, into which the gas flame projects, and on becoming heated effects a more perfect combustion.

1666. DOUBLE SPRING SADDLE BAR, *F. Dovey.—14th April*, 1881.—(*Not proceeded with.*) 2d.

This consists in making the saddle bar in two main pieces, one the saddle bar, and the other a piece rivetted to the saddle tree to receive the bar.

1667. FASTENING BOXES ON ARMS OF CARRIAGE AXLES, *J. E. H. Colclough.—16th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to means for retaining the box in any required position and lateral oscillation prevented. The collet and nut are combined, and lateral grooves formed in the thread, and also in the thread at end of axle arm, a lateral key being inserted into the grooves.

1670. IMPROVEMENTS IN ELECTRIC LAMPS, *G. S. Grimston.—16th April*, 1881. 6d.

The invention relates to the regulation of the carbons by the differential action of two solenoids, and is an improvement on patents granted to C. W. Siemens, Nos. 4949, 1878, and 2652, 1879. Instead of regulating the feed of the upper carbon by mechanism the soft iron core, which is acted upon by the two solenoids

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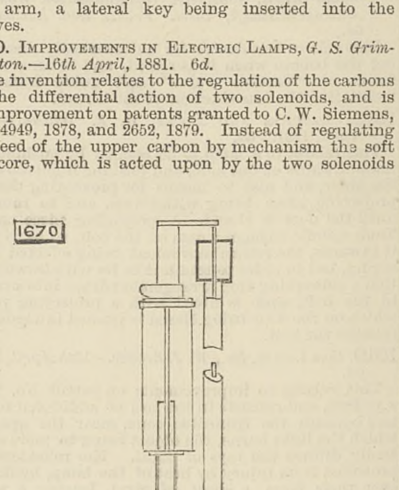

above referred to, carries an arm, through apertures in which passes the carbon holder—see figure. To the arm is pivotted a cam-shaped piece provided with a projecting arm, the weight of which tends to turn the cam, so as to press the holder against one side of the apertures, the holder being thus held and only allowed to move up and down according as the core is actuated by the solenoids. The upper end of the carbon holder is formed into a tube, which is filled with glycerine, to render its motion smooth. Another part of the invention refers to the use of two or more pairs of carbons, of which the upper carbons are all connected to the same holder, so that when one pair is partly consumed the current will on the descent of the holder be transferred to another pair.

1673. VENTILATING TUNNELS, MINES, &c., *A. J. Goulstone.—16th April*, 1881.—(*Not proceeded with.*) 2d.

This consists in constructing a shaft through the arch of the tunnel, and inserting an iron tube therein. A gas pipe extends up such tube, and carries off the noxious gases, which are consumed above.

1674. GUN CARRIAGES, *J. Vavaseur.—16th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to gun carriages which are mounted on slides, and consists, First, in an arrangement of rollers on which the carriage runs during recoil and running out; and Secondly, in an improved elevating gear for the gun.

1675. TREATMENT OF MAIZE FOR BEVERAGES, *A. W. Elliot.—16th April*, 1881.—(*Partly a communication from C. Van Outrive.*) 4d.

The object is to prepare a substitute for coffee, and it consists in roasting maize in a revolving cylinder, and then cooling it in other rocking cylinders, after which it is ground and used to prepare a beverage.

1677. COKE OVENS, *J. Hunter.—16th April*, 1881. 6d.

The object is to increase the production of coke, and it consists in forming an opening at top of oven through which the coal is loaded; the sides and ends of the oven are straight. There is a door at front of the full width of the oven, and the top is arched. There are flues on the top clear of the opening and under the bottom of the oven; through these flues the heated gases pass into a flue at the back, and thence into a chimney.

1678. REMOVING VEGETABLE FIBRE FROM WOOLLEN FABRICS, *J. H. Riley.—16th April*, 1881. 6d.

The fabric is passed in a flat state through a decomposing tank, and between or over a number of rollers, and then passes through a squeezer or mangle in line with the tank so as to expel the moisture, after which it is passed round drying cylinders or through a tentering machine.

1684. CARBURETTING AND REGULATING GAS, *H. Weston.—16th April*, 1881.—(*Not proceeded with.*) 2d.

This consists in increasing the illuminating power of gas by causing it to pass through a hydrocarbon liquid.

1698. OBTAINING MOTIVE POWER, *G. W. von Nawrocki.—19th April*, 1881.—(*A communication from R. Schultz.*) 6d.

Tanks containing water are exposed to the solar rays, and connected with an apparatus for evaporating sulphurous acid, so that the heated water causes the sulphurous acid to evaporate. The evaporator is connected with an engine, and a condenser is employed.

1735. COUPLING APPARATUS, *J. M. Head.—22nd April*, 1881.—(*A communication from J. C. Davidson.*) 4d.

This relates to means for actuating the stem fitted with right and left-handed screws at opposite ends, and by means of which the adjoining carriages are

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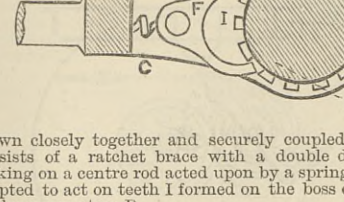

drawn closely together and securely coupled, and it consists of a ratchet brace with a double driver F rocking on a centre rod acted upon by a spring G, and adapted to act on teeth I formed on the boss or collar of the screw stem D.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

247,054. HYDRAULIC CRANE, *Jean Hartmann, Mont St. Martin, Meurthe et Moselle, France, assignor to Sidney Gilchrist Thomas, London, England.—Filed May 21st*, 1881.

Claim.—(1) In a hydraulic crane, a two-part beam having one portion or arm arranged to rotate about a centre pivot and its other arm carrying the ladle and adapted to be lifted above and rotated upon the former, substantially as and for the purpose described. (2) In a hydraulic crane, a ladle carrying arm having an independent rotation upon a rotating beam or carrier, substantially as and for the purpose described. (3) The improved hydraulic crane hereinbefore described, consisting of a divided beam, the major

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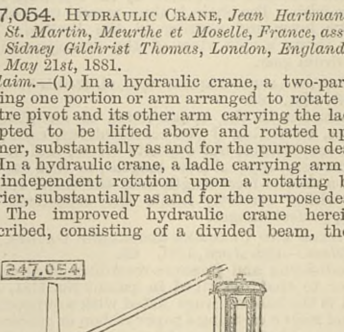

arm of which is capable of being rotated on or with a centre pivot or support, and is sustained at its outer end upon wheels or rollers, in combination with the ladle carrying hydraulic lifting minor arm placed above or between such wheels or rollers, and capable of rotation independently of the major arm, substantially as set forth. (4) In a crane, a divided beam having one arm arranged to be rotated on or with a central pivot or support, and mounted at its outer end upon wheels or rollers, and carrying a motor for the other arm, combined with such other arm, which carries the burden, and is adapted to rotate about and be lifted by such motor, substantially as described.

247,084. INCANDESCENT ELECTRIC LAMP, *Hiram S. Maxim, Brooklyn, assignor to the United States Electric Lighting Company, New York, N.Y.—Filed April 25th*, 1881.

Claim.—(1) The method of sealing wires in glass, which consists in surrounding them previously to inclosing them in the glass with a mass of metallo-vitreous cement composed of several layers, each one

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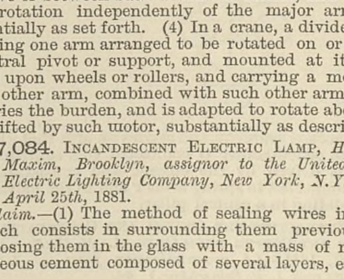

containing a greater proportion of metal in its composition than that of the layer surrounding it, substantially as and for the purpose set forth. (2) In an electric incandescent lamp, the combination, with the glass inclosing globe, of a ground stopper B, composed of a body of glass, containing the conductors C C', threaded or grooved, as described, and surrounded with a mass of metallo-vitreous cement, substantially as described.

247,086. CHANDELIER FOR ELECTRIC LAMPS, *Hiram S. Maxim, Brooklyn, assignor to the United States Electric Lighting Company, New York, N.Y.—Filed January 15th*, 1881.

Claim.—(1) A chandelier or bracket for incandescent lamps the two sides of which are insulated from each other and each connected, respectively with one terminal of a line wire and the contact strip of an incandescent lamp, whereby the circuit may be completed through the lamp and the sides of the bracket frame, substantially as set forth. (2) The chandelier or bracket for electric lamps, consisting of the conducting bars C and D, insulated from each other and having terminal plates C^1 D^1 C^{11} D^{11}, insulated and secured in proper position by means of clamping

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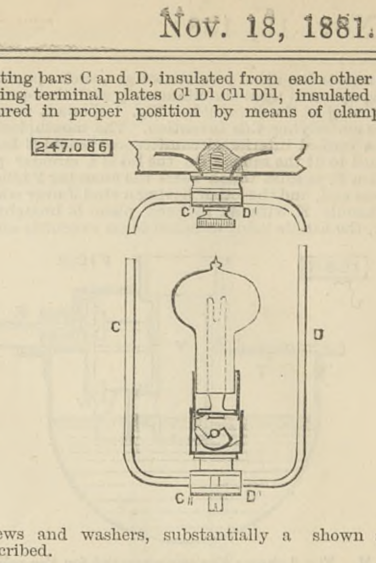

screws and washers, substantially a shown and described.

247,106. REMOVABLE WOODEN TREAD FOR STONE STEPS, *Henry T. Pratt, New York, assignor to Charles E. Pratt, Flatbush, N.Y.—Filed January 31st*, 1881.

Brief.—The hand rail is mounted on baluster studs made in two pieces united by a sleeve. A tension rod is hooked over the lowest step, passes through the sleeves, and is secured at its upper end to a bracket by a nut. Dowels resting in grooves on the under side of the treads project beneath the treads and also against the risers of the stone steps. *Claim.*

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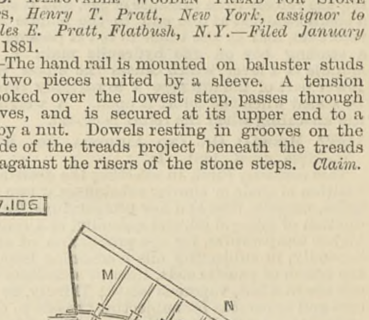

—(1) The combination, with the removable wooden treads for stone steps, of the tension rod E, a hook at one end to engage the bottom stone step, a tightening nut at the upper end, and baluster studs upon the respective treads, against which the tension rod act to keep the treads in place, as set forth. (2) The slotted sleeves K, baluster studs H, tension rod E, hand rail N, rail studs M, and removable treads, substantially as set forth. (3) The removable wooden treads for stone steps, having dowels that run across such treads and project at one side below the treads and at the back end behind the back edge of the treads, for the purposes and as set forth.

CONTENTS.

THE ENGINEER, November 18th, 1881.