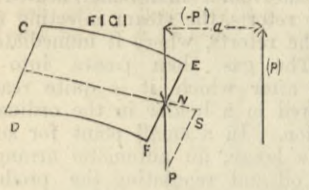
AN ELEMENTARY THEORY OF ARCHED GIRDERS.

By HERR ROBERT TOTTH, Reschitza.

IN a recent article on the Reschitza Works, reference was made to my graphic method of treating the stresses in an arched girder. My object is to show that by only supposing a previous knowledge of the elements of geometry, and the chief elements of the theory of elasticity, it is not very difficult to determine all the forces acting upon elastic arched girders.

FIG 1



In Fig. 1, C D E F represents a small longitudinal element of the arch, and P a force acting on the right side of this element. The action of P on this element can be decomposed as follows:—

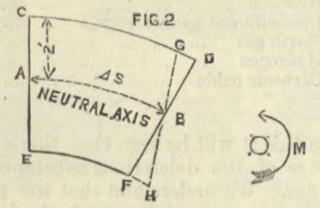
(a) The action of the bending moment P a = M.

(b) The pressure—or tension—of the component N, working at right angles upon the section E F on its centre of gravity.

(c) That of the force S applied to the section itself.

All these influences will now be dealt with separately, beginning with that of the bending moment P a = M.

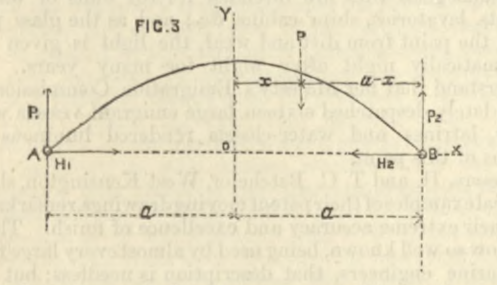
FIG. 2



Supposing the moment M to act on the element as shown in Fig. 2, the section F D will keep in the position G H by this influence, and the rate of compression λ = G D is found by the well known formula to be (I.) $\lambda = \frac{\Delta s \,.\, \rho}{E}$; ρ being the pressure per unit of area in the curve C D, and E the modulus of elasticity of the material. And after the general formula of bending: (II.) $M = \frac{J}{i}\,\rho$, where J is the moment of inertia of the section under consideration with regard to the horizontal axis through its centre of gravity. By the aid of I. and II. we conclude that $\lambda = \frac{i}{J} \cdot \frac{M}{E}\,\Delta s$, or for the very small angle made by the sections F D and G H. (III.) $\Delta\alpha = \frac{\lambda}{i} = \frac{M\,\Delta s}{E J}$.

Before proceeding further we will consider, first, the two following cases:—α, A single force P acting vertically upon the arch on any part of it. This force produces the vertical reactions P_1 and P_2 in A and B and the horizontal thrusts H_1 and H_2, as shown in Fig. 3. By the first principle of statics we find in the case of equilibrium—

FIG. 3



(1) $P(a-x)+2a\,P_1 = o$; $P(a+x)+2\,P_2\,a = o$

or better

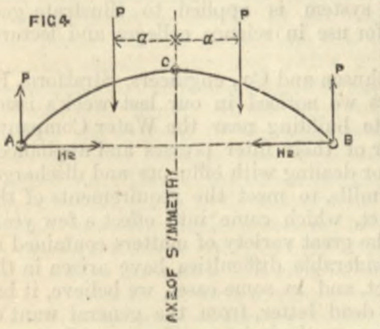
$$P(a-x) + 2a\,P_1 = o; \; P_1 + P_2 = P$$

being the English style of thing from which we obtain the values of P_1 and P_2. As regards the horizontal components of P H_1 and H_2—supposing them to be working at the same level—we only know that—

$$(2)\; H_1 + H_2 = o, \text{ or } H_1 = -H_2 = H.$$

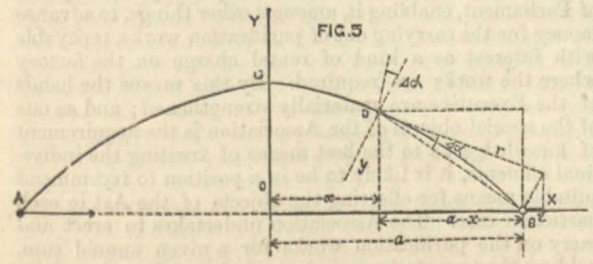
(β) Two equal vertical forces applied symmetrically on the arch. We have seen in α that a single force P produces the two horizontal thrusts H_1 H, so it may therefore be concluded that in the present case the horizontal reactions produced by the two symmetrical forces P_1 P_1 must be equal to 2 H, and also that the point C in Fig. 4 does not make any movement in a horizontal direction, and may therefore be regarded as a fixed point with respect to this direction.

FIG. 4



Taking now the springing line A B for the axis of abscissæ, and o Y the line of symmetry for the axis of the ordinates, we will endeavour to determine the elongation of a equal to Δx produced by the action of two symmetrical forces, as indicated by Fig. 4. Supposing, for a moment, the point D fixed, we get Δx as follows:—At point D the section of the arch turns at the rate $\Delta\alpha$ by the influence of M, the bending moment of all forces applied on the right side of D. All points connected with D describe the same angle, as B for instance, and we have—

FIG. 5



$$\Delta\,\Delta x : y = r\,\Delta\alpha : r \text{ or } \Delta\,\Delta x_a = y\,\Delta\alpha = y \,.\, \frac{\Delta s\,M}{E J} \quad \text{(IV.)}$$

and by adding all the $\Delta\,\Delta x$ determined for every section between B and C, we obtain the whole elongation of (a) = ($\Delta_1\,x_a$) to be

$$\Delta_1\,x_a = \sum_o^a \frac{y\,M}{E J}\,\frac{\Delta s}{\Delta x}\,.\,\Delta x \quad \text{(V.)}$$

Influence of the force N.—The elongation produced by the force N is given by—

$$\Delta_2\,x_a = -\sum_o^a \frac{1}{FE}\,\Delta x\,N, \quad \text{(VI.)}$$

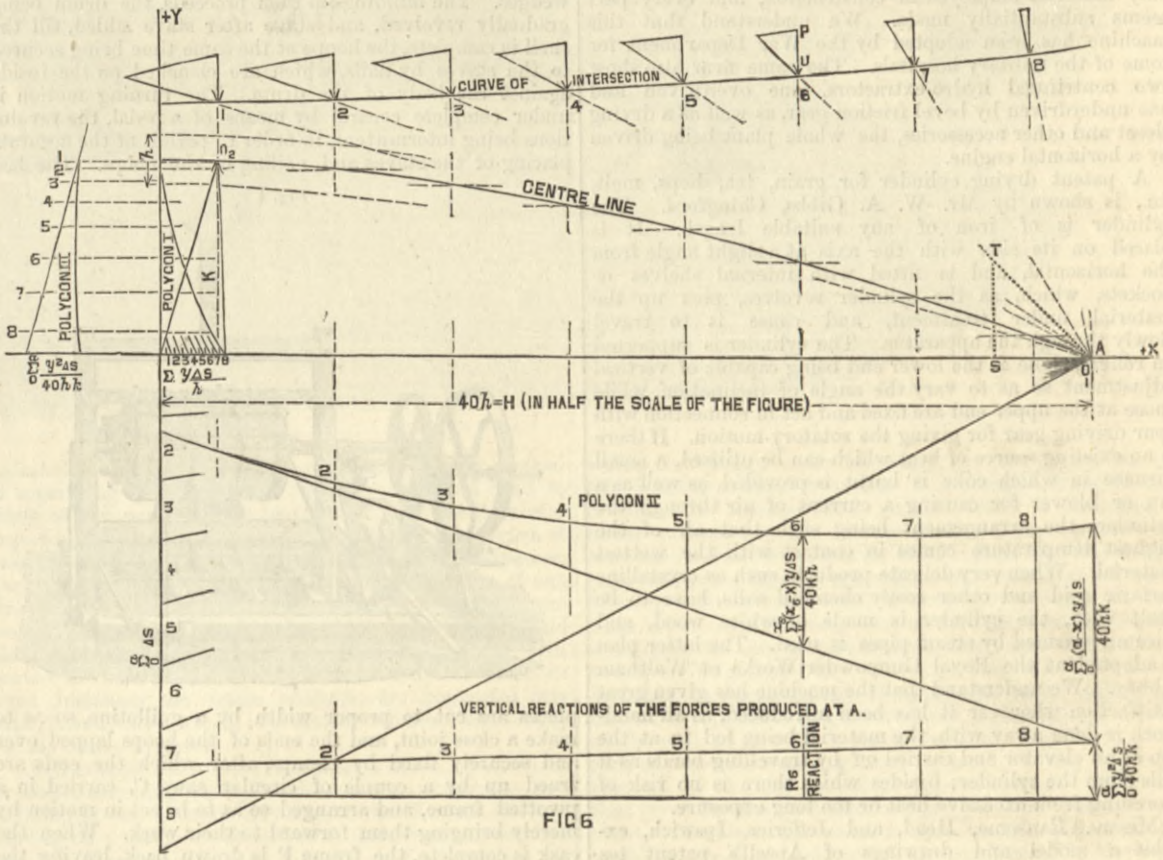
where F is the area of the respective sections of the arch. Regarding now especially the case indicated—sub. (β)—we find—

$$M = P\,(a-x) - Q\,y \text{ and } N = P\,\frac{\Delta y}{\Delta s} + Q\,\frac{\Delta x}{\Delta s},$$

and the whole elongation of a produced by these two influences—

$$\Delta a = \Delta_1\,x_a + \Delta_2\,x_a = \sum_o^{x_1}\Big[P\,(a-x) - P\,(x_1 - x) - Q\,y\Big]\frac{y\,\Delta s}{E J} + \sum_{x_1}^{a}\Big[P\,(a-x) - Q\,y\Big]\frac{y\,\Delta s}{E J} - \sum_{x_1}^{a}\frac{P}{FE}\,\frac{\Delta y\,\Delta s}{\Delta s} - \sum_o^a \frac{Q}{FE}\,\frac{\Delta x\,\Delta s}{\Delta s},$$

FIG 6



x_1 representing the abscissa of any particular force; or—

$$\Delta a = P\sum_o^a (a-x)\,\frac{y\,\Delta s}{E J} - P\sum_o^{x_1}(x_1 - x)\,\frac{y\,\Delta s}{E J} - Q\Big[\sum_o^a \frac{y_2\,\Delta s}{E J} + \sum_o^a \frac{\Delta x\,\Delta s}{\Delta s\,F\,E}\Big] - P\sum_{x_1}\frac{\Delta y\,\Delta s}{\Delta s\,F\,E}.$$

The ends of the arch A and B, being fixed points, we conclude that—

$\Delta a = o$ and Q =

$$\frac{P\Big[\sum_o^a (a-x)\frac{y\,\Delta s}{J} - \sum_o^{x_1}(x_1 - x)\frac{y\,\Delta s}{J}\Big] - P\sum_{x_1}^{a}\frac{\Delta y\,\Delta s}{\Delta s\,F}}{\sum_o^a \frac{\Delta x\,\Delta s}{\Delta s}\,\frac{1}{F} + \sum_o^a \frac{y_2\,\Delta s}{J}}$$

We will now take into consideration the case when F—the section of the arch—is constant, that is, of the same shape for the whole of the arch. Ignoring the web of the girder, we find $J = h^2\,F$, h being the theoretical depth of the arch, and obtain—

$$Q = \frac{P\Big[\sum_o^a (a-x)\,\frac{y\,\Delta s}{h^2\,F} - \sum_o^{x_1}(x_1 - x)\,\frac{y\,\Delta s}{h^2\,F}\Big] - P\sum_{x_1}^{a}\frac{\Delta y\,\Delta s}{\Delta s\,F}}{\sum_o^a \frac{\Delta x}{\Delta s}\,\frac{\Delta s}{F} + \sum_o^a \frac{y^2\,\Delta s}{h^2\,F}}.$$

We will now divide both numerator and denominator by the same value—for instance, $40\,k$, where $k > 1$. By this operation the last member of the numerator and the first of the denominator become very small, and may therefore be neglected. We therefore conclude that—

$$Q = \frac{P\Big[\sum_o^a (a-x)\,\frac{y\,\Delta s}{40\,h\,k} - \sum_o^{x_1}\frac{(x_1 - x)\,y\,\Delta s}{40\,h\,k}}{\sum_o^a \frac{y^2\,\Delta s}{40\,h\,k}},$$

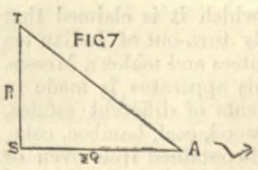
and this value of Q we shall endeavour to represent graphically. Diagram (6) shows an arch of 40 m. span. The height of its neutral axis above the springing line is taken to be 4 m. in the middle of the arch, the constant depth of the girder itself being 1 m. In this figure only the neutral axis of the arch is marked, while the depth of the girder is but indicated in the neighbourhood of the axis of symmetry Y. One half of the arch is then divided into eight equal parts along the springing line a, and on the middle of these parts the forces P are supposed to act. All the elements Δs, from one to eight, are then put in a row on a vertical line, which operation is denoted by $\sum_o^a \Delta s$ in the diagram. On the upper end of this row we mark in a horizontal direction the length $H = 40\,h$, and regard this latter as the pole distance of the vertical and horizontal forces Δs. By the aid of this polygon we trace, first, the funicular polygon I in such a manner that the sides of the latter form right angles with the sides of the above-mentioned polygon of forces, so that, for instance, the side between the forces 1 and 2 of the funicular polygon is at right angles to O (1, 2) in the polygon of forces. It is to be observed that all forces of the funicular polygon I are acting horizontally. By considering the respective similar triangles of the polygon of forces and funicular polygon I, we see that the first and last side of the latter cuts off the value $\sum_o^a \frac{y\,\Delta s}{40\,h}$ upon the springing line a. These segments, which are respectively marked $1^1, 2^1, 3^1 \ldots 8^1$, are again regarded as forces, and O_2 and K kept as pole and pole distance of this second polygon of forces, and in this manner are traced the funicular polygons II. and III. In III. the forces act horizontally, and the sides are parallel to the radii of its funicular polygon, while in II. the forces act vertically, and the sides of funicular polygon are perpendicular to those of the polygon of forces O_2.

We conclude by diagram 6 that polygon III. cuts off upon the springing line a the value $\sum_o^a \frac{y^2\,\Delta s}{40\,h\,k}$, and that on each force P we have cut off the value of $\sum_o^x \frac{(a-x)\,y\,\Delta s}{40\,h\,k}$ by polygon II., and consequently on the vertical line through A the sum $\sum_o^a \frac{(a-x)\,y\,\Delta s}{40\,h\,k}$; and supposing for a moment $P = \sum_o^a \frac{y^2\,\Delta s}{40\,h\,k}$, we get:

$$Q = \sum_o^a \frac{(a-x)\,y\,\Delta s}{40\,h\,k} - \sum_o^x \frac{(a-x)\,y\,\Delta s}{40\,h\,k},$$

or double the value of the horizontal thrusts if only one force P is acting on the arch, as shown in α; therefore, taking $AS = \frac{1}{2}Q$, and ST = P_1, the vertical reaction of P in A, we find A T to be one of the required components of P. We need now only connect the point of intersection U—Fig. 6—of A T with P, with the other abutment of the arch, and get the two directions into which the force P is to be decomposed. In diagram 6 these points are determined for every force P, and joined by a curve—the curve of intersection.

FIG 7



R. T.

DISTRIBUTION OF ELECTRICITY.—In the article descriptive of Mr. Beeman's system of distribution, the words quoted from Prof. Forbes were incorrectly given, as, in line 48, the words "care of the Board of Trade," should have been "ban of the Board of Trade." "Distant addition," in the last paragraph, should have been "distinct addition."

MACHINERY AND MECHANICAL APPLIANCES AT THE INTERNATIONAL HEALTH EXHIBITION.

No. V.

Messrs. Colman and Sons, Norwich, exhibit a complete plant of machinery for the production of mustard. The process is a very simple one, and will be readily understood. The seed is passed through a pair of small horizontal rollers in order to crack the shell, and is then stamped to a fine powder in iron mortars, the beaters being lifted by wipers on a revolving shaft, which allow them to fall when they have reached the top of the stroke. When sufficiently crushed the beaters are thrown out of gear and the mustard removed to the sifting machines, which consist of rectangular wooden trays suspended by wires at each corner, and vibrated rapidly backwards and forwards by machinery below. Each of the trays contains four fine sieves which separate the shell from the good mustard, the latter being collected in hoppers below, and stored or packed for delivery, while the former is pressed and made into cakes for feeding cattle. A very noticeable feature at this stand is the ornamental framework of columns and other castings by Messrs. Barnard, Bishop, and Barnard, Norwich, which is a beautiful specimen of the work for which this firm is so well known.

Messrs. Clements, Jeakes, and Co., London, occupy a handsome house erected by the Willesden Patent Waterproof Paper and Canvas Company on the Terrace outside the Western Gallery, where they exhibit two Clements' patent dash wheel washing machines, one of 6ft. and one of 4ft. diameter. As the name almost implies, these machines run for a certain number of revolutions in one direction, and then by an ingeniously arranged gear are reversed, and run for an equal period of time in the opposite direction, the clothes being thoroughly washed and prevented from being rolled or balled together. Galvanised iron is the only material employed in construction, and every part seems substantially made. We understand that this machine has been adopted by the War Department for some of the military hospitals. The same firm also show two centrifugal hydro-extractors, one overdriven and one underdriven by bevel friction gear, as well as a drying closet and other accessories, the whole plant being driven by a horizontal engine.

A patent drying cylinder for grain, tea, hops, malt, &c., is shown by Mr. W. A. Gibbs, Chingford. The cylinder is of iron of any suitable length. It is placed on its side with the axis at a slight angle from the horizontal, and is fitted with internal shelves or pockets, which, as the cylinder revolves, pick up the material under treatment, and cause it to travel slowly through the apparatus. The cylinder is supported on rollers, those at the lower end being capable of vertical adjustment so as to vary the angle of inclination, while those at the upper end are fixed and act in connection with spur driving gear for giving the rotatory motion. If there is no existing source of heat which can be utilised, a small furnace in which coke is burnt is provided, as well as a fan or blower for causing a current of air through the cylinder, the arrangement being such that air of the highest temperature comes in contact with the wettest material. When very delicate products, such as crystalline tartaric acid and other costly chemical salts, have to be dealt with, the cylinder is made of white wood, and pure air warmed by steam pipes is used. The latter plan is adopted at the Royal Gunpowder Works at Waltham Abbey. We understand that the machine has given great satisfaction wherever it has been introduced, as all handwork is done away with, the material being fed in at the top of an elevator and carried off by travelling bands as it falls from the cylinder; besides which there is no risk of scorching from excessive heat or too long exposure.

Messrs. Ransome, Head, and Jefferies, Ipswich, exhibit a model and drawings of Ansell's patent tea sorting and winnowing machine. The leaf is fed into the hopper on the top and delivered on to a double sieve, which separates the Pekoe and the broken Pekoe. The leaf remaining then falls over the end to the third sieve, being winnowed as it passes from one to the other. Here the Souchong is taken out, and a fourth and fifth sieve further separate any Pekoe that may have remained after the previous siftings. The machine occupies a space of about 21ft. by 5ft., and is very simple in its working, the tea being merely thrown into the hopper and the different qualities being delivered quite separate from each other. When the tea only requires fanning, a light corrugated tray is added to the end of the first sieve, so as to bring the leaves evenly under the influence of the blast.

Messrs. Marshall, Sons, and Co., Gainsborough, show photographs of Jackson's patent tea machinery, of which they are the sole makers. Among them we may mention the "Invincible" tea mill for equalising dried tea leaf by reducing it to a size suited for the market, in which a perforated steel plate is reciprocated backwards and forwards below a number of stationary bars, the tea-leaves being clipped or broken against the edges of the perforations. There is also a continuous tea-sifting and sorting machine of simple construction.

The "Sirocco" tea drier, in which it is claimed that about one-third of the total yearly turn-out of Indian tea is dried, is exhibited by the patentees and makers, Messrs. Davidson and Co., Belfast. This apparatus is made in various sizes to suit the requirements of different estates, and is constructed for burning wood, coal, bamboo, coke, or grass fuel. It consists of a self-contained iron oven or drying box surmounting a furnace which is made either of metal or brickwork, according to the nature of the fuel to be used. Trays for the tea are placed in the upper part of the drying box, arranged so that they can be pushed in and pulled out from the outside like ordinary drawers, and around these trays pure air heated to a suitable temperature is caused to circulate by means of connections with the furnace chimney. According to Mr. Davidson, "Sirrocooed" teas are well-known in the home market for their good keeping qualities and excellent flavour, and he claims that these are produced by the chemical action of the pure hot air, a temperature of about 260 deg. Fah. being the best for the purpose. This degree of heat should be maintained, and about 6 lb. to 7 lb. of tea should be spread on each tray and be exposed for about four or five minutes in the lowest and hottest place, which means that in order to properly develope the requisite flavour a tray should occupy altogether some sixteen to twenty minutes in passing through the apparatus from the top to the bottom, although to some extent the time required depends on the condition of the tea when it is put in for the roasting process.

A new method of dry cask making by machinery is exhibited by the London Guelph Patent Cask Company, Great Tower-street, E.C. Fig. 1 is a general view of the machine, which consists of a drum E, fixed to a horizontal shaft, and capable of being revolved by gearing actuated by hand or other power. The shell of the drum is of sheet iron, the joint being left open about $\frac{1}{2}$in., and a simple arrangement of levers is provided inside by means of which the joint may be closed and the diameter of the drum slightly reduced thereby. The casks are cylindrical, and are made of two layers of staves, each about $\frac{1}{4}$in. or $\frac{3}{16}$in. thick, which are wound on to the drum, and bound round with wood hoops, one layer of staves breaking joint with the other, as shown in Fig. 2. The staves or slabs are inserted between the drum E and the pressure roller D, which is grooved at the places where the hoops are to be fixed. A small portion of a turn is then given to the drum, and after the first stave has been moved round a few inches, a second one is placed above it, so as to break or lap the joint, and the hoops are placed in position and secured to the drum by clamps with sliding wedges. The building-up then proceeds, the drum being gradually revolved, and stave after stave added, till the shell is complete, the hoops at the same time being secured to the staves by nails, which are clenched on the inside against the body of the drum. The turning motion is under complete control by means of a pedal, the revolutions being intermittent, in order to permit of the accurate placing of the staves and nailing of the hoops. The last

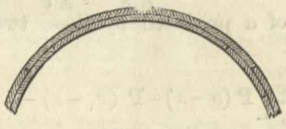
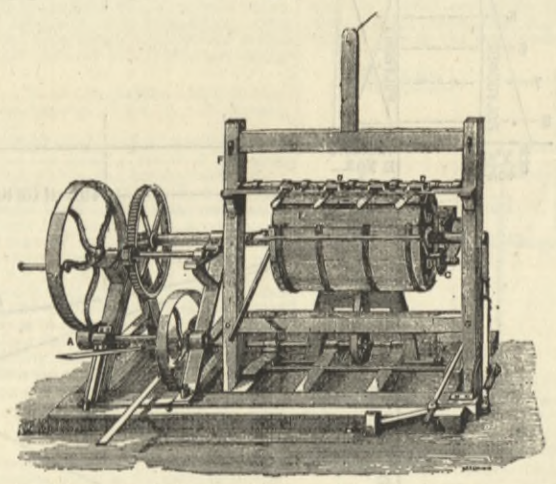


Fig. 2

Fig. 1



pieces are cut to proper width by a guillotine, so as to make a close joint, and the ends of the hoops lapped over and securely fixed by clamps, after which the ends are trued up by a couple of circular saws C, carried in a pivotted frame, and arranged so as to be set in motion by merely bringing them forward to their work. When the cask is complete, the frame F is drawn back, leaving the drum shaft entirely supported by the iron framework at the side, and on contracting the drum by the lever arrangement previously referred to, the cask can be drawn away from the outer end. The heads are then fixed, being supported by hoops nailed to the inside, and retained by the ordinary Dutch hoop on the outside. The average time occupied in making a cask is stated to be not more than three minutes, and the cost about 80 per cent. of that of hand-made goods; but in reference to this latter point it must be borne in mind that the Guelph cask is a much stronger and more accurate job, and will last a much longer time than the ordinary casks, besides which the joints of the staves are so accurately made that no internal lining is required. For different sizes of casks different drums are used, but the pressure roller with its collars is adjustable so as to suit any diameter and length that can be dealt with by the machine. The casks manufactured at the Exhibition are supplied to Messrs. Peek, Frean, and Co., Bermondsey, for packing biscuits, and we understand that the system, though comparatively new, is being taken up extensively both in this country and abroad. Each machine requires the attendance of one lad and one boy, who, it is stated, can turn out about a couple of hundred casks in an ordinary working day.

The machinery at this stand is driven by one of Barker's patent universal gas engines, which were fully described in The Engineer of 13th October, 1882. Since this date the design has been somewhat modified and improved, and some alterations have been effected in the details, which have rendered the working steadier as well as more noiseless. We understand that these engines are being largely used up to a power of about 2 horses, the cost of gas being about $1\frac{1}{2}$d. per horse-power per hour.

The Machinery and Hardware Company, Queen Victoria-street, E.C., occupies a building outside the Western Gallery, and shows a great number of specialities in engines, boilers, lathes, and other tools and engineers' fittings. It also exhibits Roger's patent Koh-i-noor gas apparatus, by which it is claimed that pure gas of about 60-candle power can be produced at a cost of about 7s. per 1000 cubic feet, which is equivalent to about 1s. 9d. per 1000ft. for gas of the ordinary illuminating power supplied by the companies. The gas is produced by the distillation of hydrocarbon oil in a red-hot retort. The plant consists of an oil tank placed near the retort bench, having pipes and regulating cocks leading to glass bulbs, through which the oil passes, the object being to exclude air from the retorts during manufacture. From these bulbs pipes communicate with small gun-metal injectors, where the oil comes in contact with steam from a small boiler, heated by the waste gases from the retorts, the steam injecting the oil into the centre of the retorts, where it immediately becomes volatilised. The gas then passes into a cooler, and is washed, after which it is quite ready for use, and can be stored in a holder in the ordinary way, without deterioration. In a small plant for supplying gas to a single house, an automatic arrangement for admitting the oil and regulating the production of gas by the rise and fall of the holder may be applied in order to avoid the constant supervision by the attendant, which in such a case would be both inconvenient and expensive. It is stated that the quality of the gas does not deteriorate by storage for any reasonable time, and that distribution may be effected through any ordinary length of pipes, but as the illuminating power is four times that of coal gas, four times that amount of light can be obtained from any given size of main. The following is an analysis of the Koh-i-noor gas:—

Sulphuretted hydrogen	0·00
Carbonic acid	0·00
Oxygen	0·73
Nitrogen	5·06
Luminiferous hydrocarbon	16·19
Marsh gas	46·10
Hydrogen	31·51
Carbonic oxide	0·41
	100·0

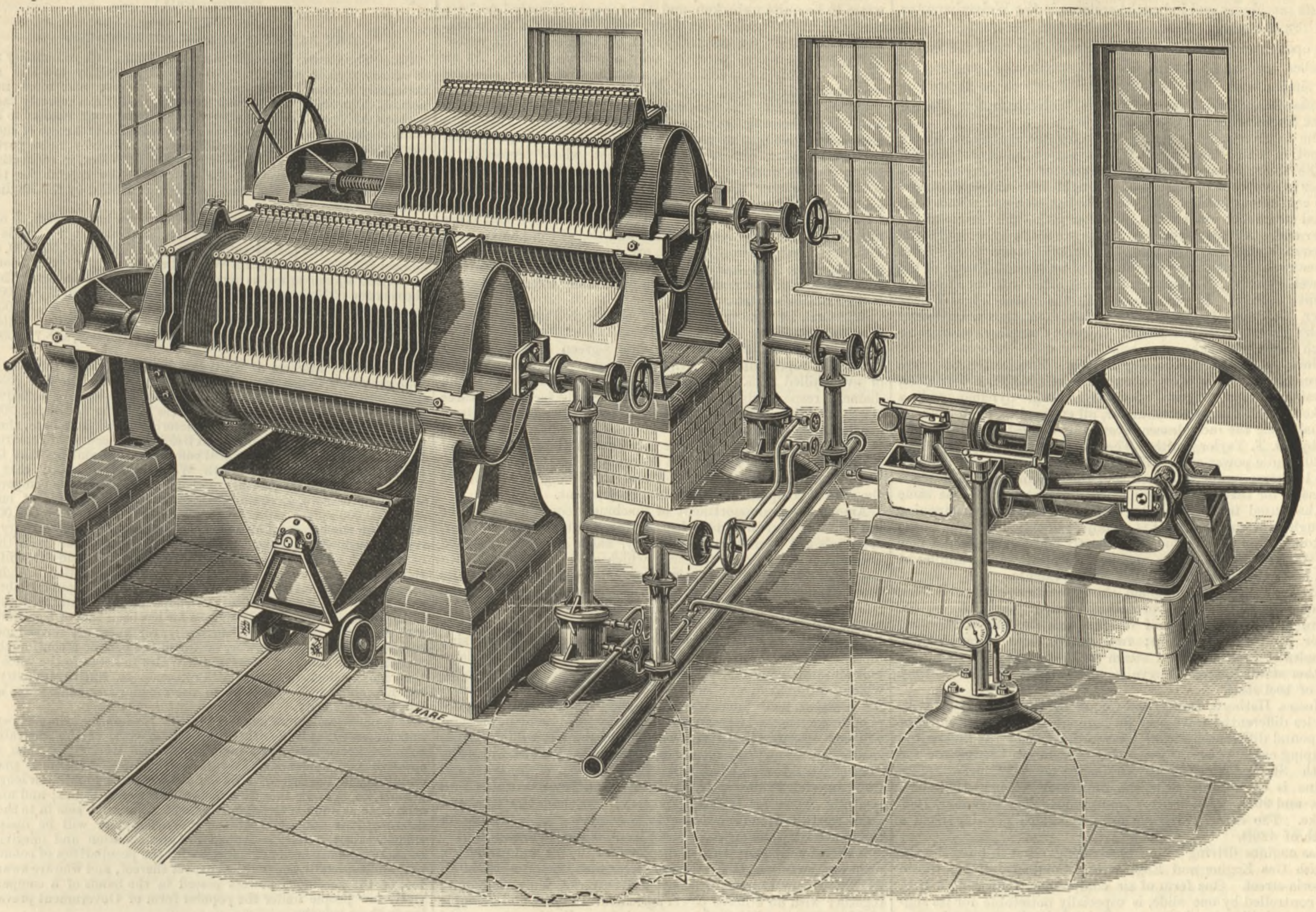
From this it will be seen that there is almost a complete absence of the deleterious substances generally found in coal gas. We understand that the process has been well tested over several years, both in private houses and factories, with most satisfactory results, and it would seem that the use of steam in the manner we have described has entirely overcome all difficulty from fouling of the retorts by the deposit of carbon, which was frequently experienced in previous oil gas apparatus. Retorts which have been in active use for upwards of twelve months have been examined and found to be quite clean, and so far as could be seen, still good for several years' service. The apparatus is stated to occupy about one-fourth the space, and to cost about one-fourth as much as ordinary coal gas plant.

The Pioneer Paint Company, London, has a very good exhibit of Balmain's luminous paint in a couple of rooms built off the Water Company's Pavilion. In one of these a number of notices for use at night time or in the dark, such as "danger," "firecock," "fireman," are shown, while the other is entirely walled and roofed with glass panels covered on the back with the luminous paint, the light emitted being quite sufficient to enable the features of persons within the room to be distinguished. These luminous glass tiles are intended for the walls of water-closets, lavatories, ships' cabins, &c.; and as the glass protects the paint from dirt and wear, the light is given out automatically night after night for many years. We understand that her Majesty's Emigration Commissioners have lately despatched sixteen large emigrant vessels with their latrines and water-closets rendered luminous by means of this paint.

Messrs. H. and T. C. Batchelor, West Kensington, show several examples of their patent moving drawings, remarkable for their extreme accuracy and excellence of finish. These are now so well known, being used by almost every large firm of marine engineers, that description is needless; but we might point out, what perhaps is not altogether appreciated, that the mechanical portion which gives the movements to the various parts is not a mere toy gear, but is truely and properly constructed, so that if necessary it may be continuously worked. In proof of this, one of the drawings shown has been regularly in use since the year 1879, and all the movements seem to be quite as accurate as those in the more recent examples exhibited alongside. Judging from the number of firms using Messrs. Batchelor's descriptive drawings, it is evident that they are in considerable demand, and certainly it would be difficult to imagine anything more perfect both as regards the finish of the drawings themselves and the movements of the various parts. The same system is applied to illustrate geometrical motions for use in science colleges and lecture-rooms.

Messrs. S. H. Johnson and Co., engineers, Stratford, E., whose water filters we noticed in our last week's issue, exhibit in a separate building near the Water Company's Pavilion a number of their filter presses and appliances, specially adapted for dealing with effluents and discharges from factories and mills, to meet the requirements of the Rivers Pollution Act, which came into effect a few years since. Owing to the great variety of matters contained in these effluents, considerable difficulties have arisen in the working of the Act, and in some cases, we believe, it has been practically a dead letter, from the general want of knowledge of proper methods for purification. In consequence of these difficulties an association has been formed, called the Manufacturers' and Mill-owners' Mutual Aid Association, which is endowed with special powers by Act of Parliament, enabling it, amongst other things, to advance money for the carrying out of purification works, repayable with interest as a kind of rental charge on the factory where the works are required. By this means the hands of the Executive are materially strengthened; and as one of the special objects of the Association is the acquirement of knowledge as to the best means of treating the individual effluents, it is likely to be in a position to recommend suitable means for effecting the objects of the Act in each particular case. The Association undertakes to erect and carry on the purification works for a given annual sum, holding the manufacturer indemnified and harmless from the consequences of the Act. It does not confine its operations to any particular process of purification, but possesses

JOHNSON'S FILTER PRESSES WITH PNEUMATIC PRESSURE APPARATUS.



facilities for dealing with every kind of pollution, and is moreover prepared to adopt any plan by which it can obtain the inspector's certificate under the Rivers Pollution Prevention Act of 1876, upon which certificate an order will be granted by the Enclosure Commissioners, making the sum advanced by the Association for the requisite works, a statutory charge upon the premises, if so desired. It would appear, however, that hitherto it has been found that of all the appliances and methods for separating the liquid from the solid matters, whether it is in the case of effluents from tanneries and other manufactories, or the ochreous and muddy sludges taken from the settling tanks in mines, some of which contain from 90 to 95 per cent. of water, the filter-press is the best and the most economical, and it is to this particular process that Messrs. Johnson's exhibits chiefly relate. A filter press consists of a number of narrow cells of cast iron shown in Figs. 3 and 4, held together in a suitable frame, the interior frames being provided with drainage surfaces communicating with outlets at the bottom, and covered with a filtering medium, which is generally cloth or paper. The interior of the cells so built up are in direct communication with each other, or with a common channel for the introduction of the matter to be filtered, and as the only exit is through the cloth or paper, the solid portion is kept back while the liquid passes through and escapes by the drainage surfaces to the outlets. The cells are subjected to pressure, which increases as the operation goes, on from the growing resistance offered by the increasing deposit of solid matter on the cloths; and it is therefore necessary that they should be provided with a jointing strip around the outside, and be pressed together sufficiently to prevent any escape of liquid. In ordinary working both sides of the cell are exposed to the same pressure, but in some cases the feed passages become choked, and destroy the equilibrium. This, in the earlier machines, gave rise to considerable annoyance, as the diaphragms being thin, readily collapsed at even moderate pressures; but recently all trouble on this head has been obviated by introducing the three projections near the centre, as shown in the cuts, which bear upon each other and form a series of stays from one end of the cells to the other, supporting the plates until the obstruction is forced away. We give an illustration above showing the arrangement of a pair of filter presses with pneumatic pressure apparatus, which has been successfully applied for dealing with sludge containing a large amount of fibrous matter and rubbish, which could not be conveniently treated with by pumps in the ordinary way. The sludge is allowed to gravitate into wrought iron receivers placed below the floor, and of sufficient size to receive one charge. From these vessels it is forced into the presses by means of air compressed to from 100 lb. to 120 lb. per square inch, the air being supplied by the horizontal pump shown in the engraving. The press is thus almost instantaneously filled, and the whole operation is completed in about an hour, the result being a hard-pressed cake containing about 45 per cent. of water, which can be easily handled and disposed of as required. The same arrangement is in use for dealing with sewage sludge, and the advantages of the compressed air system over the ordinary pumps, as well as the ready and cleanly method of separating the liquid, will probably commend itself to many of our readers. We understand that from careful experiments on a large scale, extending over a period of two years, the cost of filtration, including all expenses, has been found to be not more than about 6d. per ton of wet sludge. A number of specimens of waste liquors from factories with the residual matters pressed into cakes, and also of the purified effluents, are exhibited. These will prove of interest to many, all the more so since in some instances the waste products are converted into materials of value, which, it is stated, will more than repay for the outlay incurred.

Another application of the filter press is in the Porter-Clark process of softening water, which is shown in operation in a building in the grounds adjacent to the Western Gallery. Having on a previous occasion fully described this process, and the apparatus in which it is carried out, we do not propose again to enter into its details, but we may perhaps just briefly state that the chief object is to precipitate the bi-carbonates of lime and magnesia held in solution by the water, and so get rid of what is known as

Fig 3

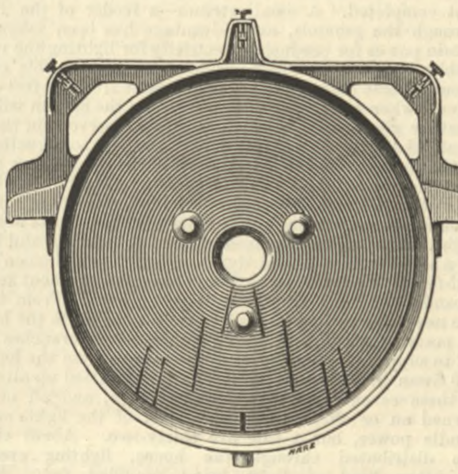


Fig 4

the temporary hardness. To accomplish this, strong lime water is introduced in a clear state to the water to be softened, the quantity being regulated according to the amount of bi-carbonates in solution. The immediate effect of this is that a proportion of the carbonic acid of the latter combines with the invisible lime of the clear lime water, forming a chalky precipitate, while the loss of this proportion of carbonic acid also reduces the invisible bi-carbonates into visible carbonates. The precipitates thus formed are in the state of an impalpable powder, and in the original Clark process many hours were required for their subsidence in large settling tanks, which had to be in duplicate in order to permit of continuous working. By Mr. Porter's process, however, this is obviated by the use of filter presses, through which the chalky water is passed, the precipitate being left behind, while, by means of a special arrangement of cells, the softened and purified water is discharged under pressure to the service tanks. Large quantities can thus be dealt with, within small space, and in many cases no pumping is required, as the resistance of the filtering medium being small, the ordinary pressure in the main is but little reduced. One of the apparatus exhibited is designed for use in private mansions, and will soften and filter 750 gallons a day. In such a case, where it would probably be inconvenient to apply the usual agitating machinery, special arrangements have been made by which all the milk of lime for a day's working is made at one time in a special vessel agitated by hand, on the evening previous to the day on which it is to be used. Time is thus given for the particles of lime to settle during the night. The clear lime water is introduced into the mixing vessel by means of a charge of air compressed in the top of a receiver, by the action of water from the main, the air being admitted to the milk of lime vessel through a suitable regulating valve. A very small filter suffices for removing the precipitate, and the clear, softened water can either be used at once, or stored in the usual way. The advantages which would accrue to the community at large from the general adoption of some cheap method of reducing the hardness of water are too well known to need much comment from us. In the districts supplied by the London water companies alone the saving in fuel and soap for washing purposes would be enormous, without taking account of the convenience and indirect benefits both in domestic and manufacturing operations. Much of this was fully entered into in a report of the Rivers Pollution Committee on the domestic water supply of Great Britain in 1874, from which a great amount of useful information can be obtained.

SANITARY INSTITUTE OF GREAT BRITAIN.—At an examination, held June 5th and 6th, twenty-three candidates presented themselves. The Institute's certificate of competency to discharge the duties of local surveyors was awarded to W. H. Radford, J. B. Wilson, C. Gilby, W. Tattersall; and to discharge the duties of Inspectors of Nuisances, R. Gibbs, G. W. Joblings, Kenneth Cameron, T. S. Ainge, T. Turner, R. Jeffery, J. Parkes, J. Mallinson, W. A. Shadrake, W. C. Beck, T. Haslam, F. T. Poulson, J. Whyte, A. Suctliffe, C. J. Easton.

SOCIETY OF ENGINEERS.—At a meeting of the Society of Engineers, held on Monday, the 9th day of June, 1884, at the Westminster Town Hall, Mr. Arthur Rigg, president, in the chair, a paper was read by Mr. J. C. Fell, on "Soft v. Hard Water for Manufacturing Purposes." The author commenced by giving the chemical distinctions between hard and soft water, and the practical distinction between temporary and permanent hardness, and explained what salts held in solution constituted the hardness. The author then proceeded to point out the loss of economy resulting from the use of too hard water in steam boilers, and in the bleaching and brewing trades, and its injurious effect upon animal and vegetable life. The evils of hard water having been described, the author gave the various softening processes in use, and their comparative advantages, instancing Professor Clarke's chemical process and Mr. Porter's improvements thereupon, Mr. Maignen's anti-calcaire process, and Mr. Field's Electrical Scale Preventer. The paper was elucidated by a series of experiments.

ENGINEERING AT THE STAFFORDSHIRE EXHIBITION.

THE machinery and industrial sections in the Wolverhampton and Staffordshire Industrial and Art Exhibition, which was opened on May 30th, and will remain open until the end of October, are well filled with excellent specimens of engineering and similar work. The buildings are shortly to be lighted up on the incandescent system by the Wolverhampton Electric Light Engineering and Storage Company.

The boiler selected to supply steam for driving the machinery in motion is the Babcock and Wilcox patent, made at Glasgow by the Singer Sewing Machine Manufacturing Company. The boiler is composed of a series of wrought iron tubes, expanded into continuous headers, and connected at each end with a horizontal steam and water drum, together with a mud drum at the lower end. All the connecting joints are made by wrought iron tubes expanded into bore-holes. It supplies steam to a 10-horse power variable expansion engine made by Messrs. Evans, of the Culwell Foundry, Wolverhampton, and fitted with the Pickering yatent governor. In connection with the Babcock and Wilcox boiler, Mr. Jonah Davies, of Wolverhampton, shows, on behalf of the Patent Exhaust Steam Injector Company, an injector which works with exhaust steam.

The stand of Messrs. Crossley Brothers, Manchester, who were pepresented by their Wolverhampton agent, Mr. H. P. Lavender, contains a small "Otto," a Parker-Elwell dynamo, and a Parker-Elwell Planté accumulator, all engaged in exhibiting on a small scale the incandescent system of domestic electric lighting by Mr. T. Taylor Smith. The dynamo drives twelve lamps of 20-candle power each. The Otto is of ½-horse power nominal and 1·9-horse power indicated, and the dynamo has been made specially for that size of engine. The arrangement is the same as that used to light up by several of the Swan companies. Though on a small scale, it is an object of much interest to the visitors at night. The firm will shortly add to the stand a new self-starter 8-horse power engine, indicating 14·7, running at 160, and embracing all the latest improvements.

Messrs. Tangye, Birmingham, show steam engines and boilers, gas engines, and a variety of patent pumps, jacks, blocks, &c. There are steam pumps of various sizes capable of throwing water up to 7330 gallons; ram pumps, and boiler feeders. Samples of their powerful steam jacks are also on view. At another stand Messrs. Tangye have examples of steel castings and of tool steel.

Messrs. Hathorn, Davey, and Co., of the Sun Foundry, Leeds, besides differential valve gear for pumping engines and model of compound differential engine, show a drawing of the differential pumping engine which is now being erected at Bradley for the South Staffordshire Mines Drainage Commissioners. This engine is on a large scale, the dimensions being:—Cylinders, 52in. and 90in.; 10ft. stroke; ram pumps, 27in. diameter, 10ft. stroke. The capacity is four million gallons per day from a depth of 420ft.

Gas engines driving a line of shafting are exhibited by the British Gas Engine and Engineering Company, of 11, Queen Victoria-street. One form of air compressor, indicating 3-H.P. and controlled by one slide, is especially noticeable for its simplicity, and likewise for economical lubricating arrangements. The company is putting down an Atkinson compressor, making one working stroke every revolution.

Askham Bros. and Wilson, of the Yorkshire Steel and Engineering Works, and Crucible Steel Foundry, Sheffield, have on view three sizes of Lucop and Cook's patent centrifugal pulveriser for treating various substances. They invite tests from visitors. All of these, so far, especially one with phosphates, have been eminently satisfactory. The firm also shows its new registered tramway wheel, which is an improvement on the old pattern, inasmuch as, instead of six plain arms, it has five lighter arms forked, making ten supports to the tire. Care has been taken not to increase the weight. These wheels have already, we understand, found much favour with tramway users in many parts of the country.

Messrs. Pullan, Tuke, and Co., engineers and millwrights, of the Cambrian Works, Leeds, show a specimen of Titley's brick and tile press. By one turn of the wheel or lever, it gives a traverse of 5½in., and puts on a pressure as high as 30 tons. It is fitted with double-action steel screw and phosphor bronze nuts. The capacity is not less than 3000 bricks per ten hours. Messrs. W. Allday and Sons, Branston-street Works, Birmingham, exhibit, for the first time, a new blowing fan on a French patent, of which the firm has as yet made only a few for England. The inside is one steel disc divided in the centre, with paddles on both the sides acting independently. The centre forms also an air accumulator, which gives a very large volume of blast. They show, likewise for the first time, an exhaust fan on the same principle as the preceding. An idea of the power can be obtained from the fact that by their use 10 tons of corn may be lifted per hour 100ft. high. This new fan, both in the blowing and exhaust types, is used largely on the Continent. At Turin, Berlin, and Brussels they may be seen at work, and a large carriage proprietary in Paris have adopted them throughout their premises. The new type will take hot blast as easily as cold, without special arrangement. Allday's improved exhaust fan is shown exhausting 2000 cubic feet per minute. Of their improved silent blowing fan, made in sizes to blow from one to 150 fires, a specimen was shown capable of blowing for fifty-two smiths' fires, and of melting 7½ tons of metal per hour. The Duplex fans are also exhibited.

As usual, several novelties are shown by Messrs. Joseph Evans and Sons, engineers, of the Culwell Foundry, Wolverhampton. As perhaps the largest pump makers in the kingdom, they are, of course, strong in this particular class of exhibit. There is a double ram pump with 14in. cylinder, 10in. ram, and 11in. stroke, and pumping 11,900 gallons per hour. The crank, crank pin, crank shaft, and excentrics, are all in one forging. The "kite" is inverted, so that the momentum of the fly-wheel is communicated to the ram direct. There is also a portable Cornish steam pump and boiler—Tonkin's patent—specially made for the water department of the Birmingham Corporation for low lifts in emptying mains, water pipes, &c. By the motion of a lever, one can either exhaust into the chimney or into the suction pipe, thus at once avoiding an escape of exhaust steam in the chimney and producing a vacuum to assist the pump. In the suction pipe is an enlarged chamber filled with a grill to keep out stones. It can be immediately cleared out by sliding open a door underneath. The Premier air pump and compressor is convertible by a quarter turn of a lever on the same principle as that in the Birmingham specialty. The firm shows also an improved hydraulic press pump, and yet working up to 5000 lb. the square inch. The cylinder is 6in., with 6in. stroke, and ⅝in. ram. Phosphor bronze is used for the pump barrel and valve chambers.

A novelty in the shape of a contractor's pump, with telescopic tubular legs, by which the pump can be raised from 3ft. to 5ft. 6in., is shown among a large collection by Messrs. Lee, Howl, Ward, and Howl, engineers, of Tipton. Among other pumps is one for hand or power, worked by a double set of valves and plunger. A personal test showed the column of water to be quite unbroken, and the capacity is stated to be a throw of 10,000 gallons an hour, 80ft. high, for a 2½ pump. Among the drills, for which the firm lay themselves out extensively, is a new one, patented only a few weeks ago. At an expense of only a few shillings, an action is obtained identical with the costly cam self-feed motion.

Messrs. T. Perry and Son, engineers, Bilston, show a powerful guillotine shearing machine for sheet metal. They also show a fine specimen of chilled roll, 21in. by 48in., with ground surface for zinc, copper, or other sheet, whose perfection of polish is quite worth the glass and wood case placed around it. A 26in. diameter mill pinion with helical teeth, and other specimens of ironworks' engineering, are also shown.

A collection of chilled iron wheels, for tramways and other purposes, are sent by Messrs. Miller and Co., of the London-road Foundry, Leeds. Many of them are in section, to show depth of chill. The firm had a similar display at the Philadelphia Exhibition, and as a result, have shipped many thousand tons to United States' centres.

What can be done in the way of chilled roll manufacture in South Staffordshire is conspicuously shown also at the stand of Messrs. Charles Akrill and Co., Gold's-green Foundry, Westbromwich, represented by Mr. Geo. Wright. They have a stand of five chilled rolls of 12½in., 18½in., 21½in., 24½in., and 31in. diameter respectively, the corresponding lengths for the last three being 3ft. 8in., 4ft., and 9ft. 4in. The largest has just been produced for an Austrian mill. It weighs 13 tons. The chill is 1in. deep all over, and the work may be said to be a triumph of casting, since it was turned out on the first trial without a flaw. The difference between this roll and those ranged above it for the sake of comparison was strikingly apparent.

Among a varied assortment of machinery connected with the nut and bolt and tube manufacture, Mr. Samuel Platt, engineer, of King's-hill Foundry, Wednesbury, has a specially designed noiseless bolt-screwing machine which deserves to be known outside the local nut and bolt centres, to which at present its use is chiefly confined. It is a three-pulley machine, driven by two bands, one straight and one crossed, and is reversed by raising the lower end of a cross lever. The reversing gear is kept in its place by a ball on the hanging lever. The reversing motion is accomplished without strain or noise. It manipulates bolt and nut together. Another machine by the same exhibitor which has found favour in New Zealand and New South Wales for artesian well purposes is a specially designed improved revolving cutter, which can be worked by hand or by power, and will cut off any sized tube from ⅛in. to 4in. It will also treat small round iron, brass, or copper. The weight is 1 cwt. 3qr. 18in.

Among a selection of mills shown by Messrs. W. M. Ward and Co., Limerick Foundry, Great Bridge, is a large crushing mill specially made for bull-dog, pottery, ores, and the like, and quite worthy of the reputation it is acquiring at ironworks in the South Staffordshire and other iron-making centres.

A direct-acting centrifugal machine for drying and extracting purposes, largely used for foreign sugar manufactories, is shown by Mr. Henry Denton, St. Peter's Ironworks, Wolverhampton, together with an 8-horse power agricultural engine, and a sample of his patent steel chain harrows. A fine collection of wrought iron tubes and fittings of all descriptions is shown by the Mayor of the Borough, Mr. Wm. John Brotherton, of the Imperial Tube Works.

Prominent among the iron manufacturing houses who show are the Earl of Dudley, Messrs. Stephen Thompson and Co., and Messrs. Hatton, Sons, and Co., all of whom have excellent exhibits, as also have certain other certain iron-making firms likewise represented.

IN 1874 New South Wales exported 67,053½ cwt. of tallow, valued at £104,151; ten years later, in 1883, the quantity had risen to 220,363 cwt., valued at £358,914; thereby indirectly furnishing a striking proof of the rapid development of the pastoral industry in that colony.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending June 7th, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 21,207; mercantile marine, Indian section, and other collections, 9856. On Wednesday, Thursday, and Friday, free, from 10 a.m. to 6 p.m., Museum, 7159; mercantile marine, Indian section, and other collections, 3970. Total, 42,192. Average of corresponding week in former years, 53,036. Total from the opening of the Museum, 21,110,441.

ELECTRIC LIGHTING AT LINDEN PARK.—An interesting installation of the electric light has just been completed at Linden Park, near Hawick, the residence of Mr. Walter Laing. Linden Park is about two miles from Hawick, and the house is a new one only just completed. A small stream—a feeder of the Teviot—runs through the grounds, and advantage has been taken of this to obtain power for producing electricity for lighting the mansion and stables. A turbine wheel has been erected capable of giving off about 8-horse power, and requiring about 270 cubic feet of water per minute when working at full power. As the stream will not in dry weather give nearly so much as this, a reservoir, in the shape of a small lake of about an acre in extent, has been constructed in the bed of the rivulet. In the driest weather the stream may be depended upon to give at least 80 cubic feet per minute, and this being stored up in the reservoir during the day time, more than sufficient force is obtained for working the turbine when the lights are required at night. The turbine is fixed in a small building, and is connected by a short belt with the dynamo, which is a Siemen's compound self-regulating machine, capable of regulating about seventy Swan incandescent lamps of 16-candle power each. From the dynamo, the necessary conducting wires are carried up to the house, partly on posts overhead and partly underground, branches being taken off to supply the stables and the avenue from the lodge. About 100 Swan incandescent lamps have been fitted up altogether, and of these seventy can be worked at once, and all or any can be turned on or off at pleasure. Most of the lights are about 16-candle power, but a few are thirty-two. About eighty lights are distributed through the house, lighting every portion, no other kind of light being provided for. Seven lights are taken up in lighting the stables, and twelve outside. These latter are all controlled by one switch near the hall door, and can either be lighted or extinguished instantly. The distance of the turbine and dynamo from the house is about 350 yards, and from the house to the lodge about 4000 yards, so that a circuit approaching a mile in extent has to be traversed by the electric current, which goes to the farthest lamp. For stopping the turbine at night when the lights are no longer required, a simple electrical arrangement has been designed, by means of which the sluice valve can be closed from the house without going down to the turbine house. This is done by merely touching a handle, and so admits of the lights being burned late, and put out at any time without the necessity of keeping any one in attendance to turn off the water when done with. Mr. Laing is to be congratulated upon being the first in this district to show such a complete adaptation of the electric light for domestic purposes, and the abundanee of water power at disposal in the neighbourhood will no doubt induce many others to follow his example. The whole of the electrical portion of the work was entrusted to and successfully carried out by Messrs. J. Edmundson and Co., Westminster.—*Hawick Express.*

LETTERS TO THE EDITOR.

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

THE RAILWAYS OF NEW SOUTH WALES.

SIR,—The Australian colonies are developing into nationality at so sturdy a pace, and their growth and prosperity are still so materially identical with many of the largest and most important interests of the mother country, that it can scarcely fail, perhaps, to prove acceptable to very many of your readers to be made acquainted with some of the more prominent features of such development, and of the direction assumed thereby, more particularly in the premier colony of New South Wales, in connection with the public works—*i.e.*, the railways—the capital for the construction whereof has been hitherto furnished by the English money market.

In claiming for New South Wales the premier position, I am justified by such statistics as these, viz., that although Victoria—the offshoot of the parent colony—has a population of 890,000, as against 798,000 in New South Wales, the area of the latter colony is 311,000 square miles, as against Victoria's 88,000 miles. That the revenue of New South Wales for 1882 amounted to £7,410,000, or some £9 per head of the population; for Victoria, £5,592,000, or £6 per head. Value of imports in New South Wales, £21,000,000; exports, £16,700,000. Victoria, imports, £18,750,000; exports, £16,100,000.

The railway systems of these two leading colonies compare as follows:—New South Wales had, at the end of the year 1882, some 1313 miles open for traffic, 504 miles in course of construction, and trial surveys were in progress for some additional 2500 miles of light and other lines. In Victoria, at the same date, there were 1355 miles opened, and about 340 miles in course of construction. I will close this statistical comparison by stating that the total public debt of New South Wales is £18,700,000; that of Victoria, £22,000,000—neither of them large amounts as compared with that of New Zealand—£30,000,000—with an area of only some 100,000 square miles, and a population—white— of 508,000. And when the increased area of the New South Wales territory is remembered, viz., 311,000 square miles—or nearly four times that of Victoria, and over three times that of New Zealand—it will, I think, be easily understood that its financial condition is highly satisfactory, especially, too, bearing in mind that its public debt is thoroughly well "secured" in the shape of its profitably-worked railways, and that its fiscal policy so far has been that of free-trade. The words "so far" are used advisedly, for there are surface indications that there is a growing desire on the part of a considerable section of the people of New South Wales to listen to the voice of that most delusive charmer, "Protection to Native Industry;" but happily, those who hold to the broader free-trade views are still in the majority.

It is doubtless known to most of your readers that the railways, in common with all the other large public works of the Australian colonies, are constructed, maintained, and worked by their respective Governments. Private enterprise — with one small exception, in the case of a line of railway some 45 miles in length —finds no field in this direction in New South Wales; and until such time as a much stronger stream of population sets in to these colonies, it is unlikely that the present system will be discontinued. But herein is ground for apprehension and misgiving to those who are well acquainted with the peculiarities of colonial life, and especially the political aspect thereof, and who are aware, too, of the enormous powers placed in the hands of a comparatively few people under the popular form of Government prevailing in these colonies.

The columns of your paper being scarcely, perhaps, the fitting place for political disquisitions, I will endeavour concisely to indicate the nature of the danger I refer to. In England or in America, even, a company seeking to obtain the sanction of Parliament for a proposed new line of railway would doubtless, in the first instance, be impelled thereto by the apparent or real necessity for such a line; and before a board of directors would venture to propound such a line, it would assuredly satisfy itself of the probability of the lines proving remunerative, and the Legislature would also have to be satisfied that the proposed railway was in sympathy or union with the wishes and requirements of the inhabitants of the district affected thereby. In the case of such a proposal, the question of remunerativeness would, of course, never be lost sight of. Now, on the other hand, under the peculiar conditions prevailing under the form of popular government in the colonies, it happens pretty frequently—and there is unhealthy evidence that it is likely to happen yet more frequently unless popular attention and disapproval should fortunately be aroused and step in presently to avert or arrest the practice—that in New South Wales, lines of railway are proposed by a few deeply-interested political and other individuals, quite irrespective and anticipative of any general public necessity, and also quite without reference to the consideration of such proposed lines ever paying interest on the capital borrowed for their construction; such interest being, of course, in the case of these loan-made railways the mere equivalent of the dividends earned by railway companies.

Some of your readers may be disposed, from their knowledge of our railway operations here, and from the reports which are annually put forward as to the receipts obtained and interest declared to be earned upon capital expended, to question the correctness of the above proposition, and refer to the fact that on our lines now opened the declared interest upon such capital account is stated to be some 5·14 per cent.—*vide* report for 1882 by Commissioner for New South Wales' railways—and that the average interest payable on our lines for these railway works is only some 4·26 per cent., or a net profit of 0·88 per cent. It is not without regret I here state that this is indeed a more roseate statement than is warranted by absolutely faithful and accurate analysis and investigation of our railway vote accounts; and as this is a matter which, indirectly at any rate, concerns English capitalists, and is also illustrative of some rather strange departures from ordinary commercial practices, and certainly a very new feature in the keeping of debit and credit accounts, I will presently describe the matter more fully, in order that your readers may understand the reasons which influence me in stating that many of our railways are originated and sanctioned under quite abnormal conditions, and that the method adopted for the purpose of endeavouring to prove that our railways are paying good interest for their cost is scarcely less abnormal, and, in fact, rather startling.

It may be that, as Antipodean subjects of the Empire, we can scarcely avoid reversing many of the practices which obtain in England; assuredly we do reverse very many of them, and it is quite worth our while inquiring whether we gain or lose thereby; and as there is nothing like letting in the strong currents of a broad public opinion in order to scatter and dispel errors of judgment, or of worse evils in connection with all matters of common public interest, I will endeavour to indicate some of those abnormal conditions I have referred to as surrounding our railway affairs here at this time. Straws are accepted even by very learned and cautious people as indicating which way the wind blows, or the direction of the current on whose surface they float; and in describing some straws which are being propelled hither and thither in our midst, I think they will be found to possess some little interest for your readers. I referred to the policy of this colony as being emphatically that of enlightened free-trade, but that the spirit of protection is also abroad among us. Now, the straws show that this spirit, or its embodiment, appears to have decided upon adopting some rather curious and, as they appear to many persons here, not very commendable or reputable means for effecting its objects, or some of them.

We all know, of course, that even in Conservative England all sorts of clever tactics have been and are resorted to, whether to drive an electioneering rival out of a contest or to beat him therein; and in the ordinary struggles for supremacy in commercial life there, as elsewhere, smartness and expertness are in common enough requisition "on 'Change" and off it; and if only successful, very little hostile or severe criticism is displayed against those who employ these refinements of our century in their transactions with their fellow men; and in this respect there is very little shortcoming on the part of your antipodean brothers. Australians are to the full as keenly imbued with this necessity of the time as could be desired.

But the particular development or phase of this smartness to which exception has, as I have said, been somewhat taken, is this, that the New South Wales Protection to Native Industry party having become desirous and determined to secure to themselves the profits and advantages which in their opinion are now improperly diverted to English manufacturers of railway structures, permanent way materials, &c., have recently, and as a preliminary step to inaugurating and bringing to success their desires and the fiscal policy of their party, endeavoured—so the straws indicate—to disparage the quality and workmanship of large numbers of the railway structures furnished to this colony during the past quarter of a century by various English manufacturers.

To enable your readers to understand the serious aspect assumed by this quasi-political proceeding, let me state at once that a Royal Commission has just been appointed by the Government of this colony of New South Wales "to inquire into and report upon the quality and workmanship" of a large number of our iron railway bridges. That with the exception of one gentleman—a visitor to the colony, and a partner in an Irish firm of founders and bridge makers—this Commission consists of local professional and mechanical engineers only; and that whilst these bridges have been supplied by such firms as Peto, Brassey and Betts, Thames Iron Company, Handyside, De Bergue and Co., Park Gate Company, Cochrane and Co., McLellan, and others, and that all the bridges have been subjected to the inspection and approval, before being shipped from England, of the consulting engineer, that neither that gentleman nor any of the firms named above have been invited to nor will be represented at such commission of inquiry. I should also state that this commission has its immediate origin in the very serious and conflicting disorganisation prevailing in the railway department of this colony, a condition of affairs which may perhaps be safely affirmed to have been mainly induced in this wise:—

Firstly, the programme or platform adopted by the Protection to Native Industry party, anxious as aforesaid to clear the field of the English manufacturers as far as possible, and also, when that is not completely possible, to at least put an end to the present system of inspection and importation, with a view to substituting in its place local middlemen as importers, and local inspection for their importations.

Secondly, the conflicting and absurd position of affairs in our railway management, whereby the works of railway construction on being completed pass out of the hands and control of the engineer-in-chief, into those of a non-professional commissioner and of a staff of professional officers, called the "Existing Lines Branch," appointed by and responsible only to the commissioner, and completely uncontrolled by and independent of the engineer-in-chief.

Your professional readers will readily understand what a fruitful opportunity for conflicting management and for turmoil and trouble such an *olla podrida* as that furnishes. Some of the results thereof are already developed, and I may mention that the two sub-departments above described are locally known now as the Montagues and Capulets; and amongst the subject matters to be investigated by this Royal Commission are some very extraordinary proceedings initiated or authorised by the commissioner in respect to the railway bridges. For instance, it is now well known here that the fine Penrith Bridge on the Nepean River—plate girder, 186ft. spans, double way—and a dozen or two other iron lattice girder bridges of 150ft. span, &c.—and many of which have stood years of heavy traffic without the smallest sign of defect or weakness—have been "examined" during the past eighteen months by directions of the Existing Lines engineer and the commissioners' authority; and without any intimation having been previously made to the engineer-in-chief, those bridges were pronounced defective in design, of bad material, bad workmanship, and unsound in condition, and were forthwith "repaired." The "examination" was made, so it is alleged here, by a blacksmith, who used a 4 lb. flogging hammer to test the rivets with; the "repairs" consisting of cutting out and renewing tens of thousands of rivets, and, it is also alleged, quite improperly and unnecessarily.

The commission, in fact, then will start upon its inquiry with the most valuable and essential part of the evidence destroyed or unavailable, owing to the peculiar tactics adopted by one branch of the railway department in its antagonism to the other branch.

In my next letter I will give a few more particulars of this somewhat peculiar incident of politico-professional life in this colony. N. S. W.

Sydney, April, 1884.

THE FUTURE MARINE ENGINE.

Sir,—I have read with much interest the letter of Mr. Houghton, in your issue of 23rd May, and should like to give my opinion on the subject. To follow his letter: "There can be no doubt as to the economy of the present marine engine as compared with its predecessor. But the steam engine of the present day is practically as Watt left it, its improvement is due solely to more perfect manufacture, in fact to the substitution of tools for hand labour."

Now as to the motors of the future. Are we to have electricity, the all-powerful Vril of the "coming race"? Manna would be the more appropriate term to apply to this force. As applied to propulsion of boats, it is a moot question as to whether, weight for weight, a reservoir of compressed air with its motor would not be as efficient as a reservoir of electricity with its motor. The time of recharging the former would be but a tithe that of the latter. I hope the day is far distant when ships will carry 3150 tons of secondary batteries, and 500 tons of propelling and auxiliary motors. Fancy the continued distraction of the chief engineer when he finds his charge in a chronic state of fused shunts, short circuit, making earth, and generally behaving in the many erratic ways in which electricity on shipboard seems to delight. Fancy the joy of the owners whose ships might be lying in mid-Atlantic with batteries run down, maybe from the rats gnawing the insulation. Or the pleasure of the crew of an Alabama chasing a rich prize when suddenly the propeller stops, and the chief engineer reports "an earth somewhere." Such case would be of constant occurrence until long harassing experience had produced perfection.

Of the forces capable of utilisation, wind and coal seem to be the most accessible. Doubtless there is a wide field for inventors in the former direction, as, for instance, there is no reason why each house should not have its windmill constantly storing electricity for lighting purposes. Coal is at present used in steam and gas engines. In steam engines a very small percentage of the available power of the coal is obtained. We throw lumps of coal on the fire, and they are consumed in fewer minutes than nature took years to form them, grain by grain. Of 100 tons of coal put into the furnaces, but about 7 tons are utilised on the pistons, the remainder being wasted. Even the treadmill would be abolished if the efforts of ninety-three prisoners in each hundred were wasted.

In the most economical gas engine quoted by Mr. Houghton, 1 indicated-horse power was produced by 1·2 lb., or an energy of 12·3 foot-tons per lb. Now there is and has been for a long time in use a gas engine which, though crude, has produced far better results than the above. In official reports I find that in five English guns the average energy per lb. of powder is 63 foot-tons, the maximum 70 foot-tons, the minimum 57 foot-tons. In ten French guns the average is 69 foot-tons—the maximum 75 foot-tons, the minimum 54 foot-tons. In twenty-one German guns, the average is 85 foot-tons—the maximum 258 foot-tons, the minimum 59 foot-tons. In thirteen Austrian guns the average is 76—maximum 90, and minimum 63 foot-tons. In seven Italian guns the average is 67 foot-tons—the maximum 82, and minimum 54. In six Armstrong guns the average is 57 foot-tons—the maximum 59, the minimum 55. In six Russian guns the average is 72·6 foot-tons—the maximum 83, the minimum 66. In five American guns the average is 81 foot-tons—the maximum 93, minimum 69 foot-tons.

In a steam engine using 2 lb. of coal per indicated horse-power, the energy per lb. is 7·3 foot-tons on the piston. Of these 7·3 foot-tons, but 3 foot-tons are utilised in propelling the ship. I have called the gun a crude gas engine, for while we have actual, not indicated, work of from 54 to 258 foot-tons per lb. of combustible, there is a large portion of its power wasted, seeing that at the time of the shot leaving the muzzle, the gun is filled by gas of very high pressure, capable of utilisation under other circumstances.

Like Mr. Houghton, I should like to prophecy. The future power motor will be a gas engine. The fuel used will be coal, finely powdered, intimately, mechanically mixed with chemicals and made into suitable form for handling. This mechanical mixture will, like gunpowder, contain within itself the same ingredients as the gas it produces. There will be a generator, consisting of one or a series of vessels, into which, by suitable apparatus, the prepared coal will be periodically or continuously inserted. The gas from the generator will perform work in a motor by change of volume under free expansion. Instead of all the horrible paraphernalia of secondary batteries and accessories as above, the fuel, generator, and motor for the Oregon will not weigh more than 1000 tons, as compared with 4200 tons of steam machinery and fuel. Lastly, the future power motor will be far simpler and less liable to accident than the steam engine of the present day. Engineer.

Mediterranean Squadron.

A DISPUTED POINT IN NAVAL SCIENCE—A LETTER OF RECLAMATION.

Sir,—Mr. Robert Mansel having circulated among his friends and my own a pamphlet having the above title, and involving points of discussion between him and myself, I shall be greatly obliged if you will kindly give publicity to the accompanying two letters which I have written him concerning this pamphlet.

Wm. Denny.

Leven Shipyard, Dumbarton, June 9th.

Leven Shipyard, Dumbarton, 14th May, 1884.

R. Mansel, Esq.,
Messrs. Aitken and Mansel,
Whiteinch, Glasgow.

My Dear Sir,—I yesterday received from you printed copy of a letter addressed by you to the President and Council of the Institution of Engineers and Shipbuilders in Scotland, regarding some remarks I made on a paper of Mr. Froude's before the Institution of Naval Architects in April, 1876. I have only as yet had time to glance through your letter, and will require, before writing you more fully, to refresh my memory as to the various points you raise in it.

Even, however, from a short perusal of your letter, I gather that you consider my remarks to have been made in some underhand way, and, as it were, behind your back. To this I feel compelled at once to demur. What I said was said publicly, and before a public Institution. Indeed, as the Institution of Naval Architects is exclusively devoted to naval architecture and marine engineering, and, I believe, the only Institution in this country exclusively devoted to these subjects, it never occurred to me that its proceedings would be unknown to a professional man of your high standing.

Whatever points there may be for discussion between us, I hope you will understand that your failure to hear of my remarks made in 1876 is not a matter for which I am prepared to accept any blame.

If you will kindly forward me one or two more copies of your letter I shall be much obliged.

Yours very truly,
(Signed) Wm. Denny.

Leven Shipyard, Dumbarton, 9th June, 1884.

R. Mansel, Esq.,
Messrs. Aitken and Mansel,
Whiteinch, by Glasgow.

My Dear Sir,—Since writing you on the 14th ult., I have been looking through my papers referring to the period dealt with in your "Letter of Reclamation," and I have also been considering how I should reply to your remarks. I have decided to do so in the following way:—From the considerable extent to which, I am informed, you have circulated this letter, I infer it is your desire that the utmost publicity should be given to my answers to it, and at the same time an easy opportunity afforded our professional friends in the Institution, to which you have addressed your letter, of joining in any discussion which may ensue. I shall therefore prepare a paper dealing with all the points you have raised, and read it before the first meeting of the Institution in the coming session.

Meanwhile, in order to inform both your friends and my own of my purpose, I am sending copies of this and my previous letter to the *Glasgow Herald*, The Engineer, and *Engineering*.

(Signed) Wm. Denny.

THE PRESENT PROSPECTS OF YOUNG ENGINEERS.

Sir,—As one of those referred to by your correspondent, Mr. Audain, in his letter published by you last week, permit me to say that I can, unfortunately from experience, thoroughly endorse all that gentleman says. The position of those who, like myself, find themselves called upon to get a living as draughtsmen or assistants, unless they happen to possess capital or influence, is indeed anything but encouraging; and I cannot but think must tend, in some degree, to bring discredit upon a great profession. Parents that belong to the station of life mentioned by your correspondent apprentice their sons to the profession in the belief that if they serve their time creditably they have no difficulty at the completion of their time in obtaining good and even lucrative employment without the expenditure of any further money; and they think, naturally enough, that a profession which costs so much to qualify for should yield a fair return. How gradually they learn the mistake they have made, I can personally vouch for; and I have met many who, had they known these facts earlier, would far rather have seen their sons in some honest trade than in a profession which has little more than its title to recommend it, at least to its young members. Apologising for trespassing thus far on your space, I will now, Sir, conclude. I think Mr. Audain deserves the thanks of all the young members of the profession for bringing publicly forward this—to them—all-important question, and should he be the means of bettering their position by any advantages that may spring from his suggestions, he would certainly deserve to be regarded as a great benefactor to a very large number of deserving but unfortunate young men. I enclose my card, but not for publication. Draughtsman.

London, June 5th.

Sir,—In reply to a letter published in your paper of May 30th, permit me to say a few words. Your correspondent considers that the prospects of young engineers are not satisfactory. At the present time every prospect is held out to young engineers. Large engineering colleges have been opened. Night classes for practical as well as theoretical work are available. Sir Joseph Whitworth also holds out his scholarships to deserving pupils. Great engineering works are projected, while others are on their way to completion, thus giving the student every facility for seeing practical work. It is quite possible for any pupil to advance himself in a drawing office if he will work, but the idea is to get a smattering of drawing office work and then to consider yourself a civil engineer. Your correspondent is under the impression that the engineering profession is learnt without hard practical work. Has he been in the shops? also does he know the difficulty in learning every branch of one of the most difficult professions? He also speaks of the way our firms employ Germans; what is the reason? Simply this, they are good mathematicians, good mechanics, and in every way qualified to fill the important post of engineer. And until our young engineers can see their way to work harder and understand the practical as well as theoretical part of the work, our profession as engineers will certainly fail, and we shall still be overrun by foreign competition. Let the writer think again before he puts upon paper statements slightly coloured; and also let him look around and see what some of our young engineers really are doing; he will not then think it is impossible for thoroughly good men to get on. James Jones, Jun., C.E.

26, Budge-row, Cannon-street, June 9th.

TELPHERAGE.

Sir,—With reference to your article on the above subject, will you kindly allow me to state in your paper that in addition to the parts described before the Society of Arts, I employ when necessary the following devices:—(1) A centrifugal brake, which prevents the train from running away down hill; this brake was in action on the model shown; (2) a governor, by which the current is cut off when a limit in speed is reached; (3) a block system, by which trains are kept at any desired distance from each other.

Permit me, however, to remark that even if none of these devices were employed, the slight fall in the electro-motive force at the far end of a line would be unimportant. I mentioned this fall in my paper, and stated the amount of the fall in a given case, but I neglected to point out that even if trains ran slower at one part of the line than at another, no one train would overtake another so long as all behaved alike.

We are now, after nearly two years of hard work, ready to put up lines at our own risk for any one who may require them, and we will work the lines at our own expense for a limited time. Experience will soon show to what extent the difficulties of the problem have been overcome. Fleeming Jenkin.

Offices of the Telpherage Company,
53, Old Broad-street, E.C., June 9th.

Sir,—I shall be obliged to Professor Jenkin for a statement of the probable cost of a line to carry 10 tons an hour over a distance of about 1¼ mile through a rocky and wooded district. Viator.

Travellers' Club, Pall Mall, June 11th.

FOUNDATIONS IN QUICKSAND.

Sir,—With reference to the inquiries of your correspondent "S. S.," who appears to be embarrassed by having to encounter a running sand foundation, allow me to suggest that the difficulty of such a foundation may be surmounted by the means proposed by Mr. John Bourne for establishing foundations upon quicksand—first turning it into rock by the injection of an agglutinating fluid. Many rocks are formed in nature by this process, and it is quite possible thus to make a great bed of concrete *in situ*, by the aid of sulphate of iron or lime-water, or, still better, by both. T. P. Hosegood.

Muswell Hill, June 10th.

CLOONACANNANA BRIDGE.

Sir,—In The Engineer of the 6th inst., I see that you have given a copy of the principal portions of my design for an iron bridge over the river Moy, at Cloonacannana, in the county of Mayo, and Mr. Edward Elwes is given as the name of the engineer. I hope you will kindly allow me to say that the design is by

Castlebar, Co. Mayo, Edward Glover, M.A., B.E.
June 7th. County Surveyor.

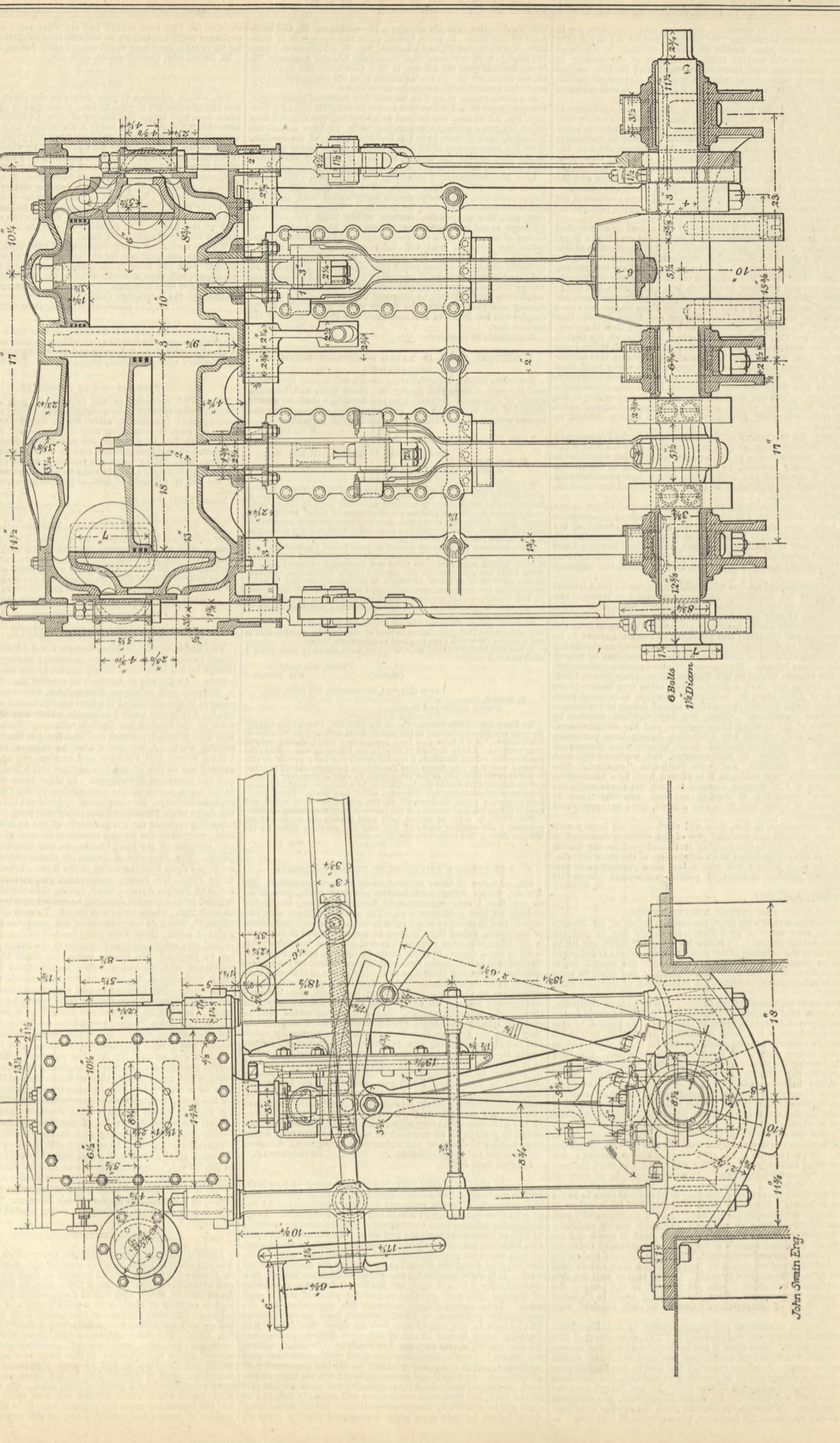
DEATH OF MR. BRAGGE.

The death of Mr. William Bragge, F.S.A., F.R.G.S., removes a well-known figure in the past industrial history of Sheffield, though he has been more widely known in the world of applied science. At the age of fourteen he entered the office of Mr. C. A. Capper, civil engineer, Birmingham, who was at the time engaged in the cutting of the then famous tunnel of Kilsby, near Rugby, a mile and a-third in length, which was the first great work of the kind on the English railways. Young Mr. Bragge was thus afforded unusual facilities for learning railway engineering work. A few years later he engaged himself at the Vulcan Works and Foundry, and on attaining his majority he entered the service of the Birmingham and Gloucester Railway, and was located at Bromsgrove. In after years he was engaged in the management of the construction of the Chester and Birkenhead Railways. He also planned and laid out the railways about the docks when Birkenhead was rising into note. He was superintending engineer for the gas works at Rio de Janeiro, where he also constructed the famous mountain railway at Rio, the first and steepest of its kind, leading to the Emperor's mountain palace. The Emperor of Brazil, for these and other services, conferred upon him the Order of the Rose. Leaving Rio for the River Plate, Mr. Bragge constructed gas, railway, and waterworks at Buenos Ayres. Here, finding that the land frequently suffered from excessive drought, he caused numbers of wells to be sunk 20ft., where water was found. To each well was a small windmill, which at every stroke of the pump brought up about a pint of water; these mills being erected in enormous numbers, proved very effectual in the irrigation of the country. On returning to England, Mr. Bragge settled in Sheffield, and became associated with Sir John Brown at the Atlas Works, where, along with Mr. J. W. Ellis, he was afterwards admitted into partnership. Mr. Bragge's special department was to encourage the development of the foreign trade, which he did most effectually. In 1872 he resigned his position as a managing director at the Atlas Works, proceeding to Paris, where he had the concession of the disposal of the sewage and drainage. The scheme was to take the sewage seven miles from Paris, and convert it to dry manure for farming purposes. The speculation proved unfortunate, and was the beginning of a series of untoward events which unfavourably affected the fortunes of Mr. Bragge, who once more removed to Birmingham, where he formed a company for the production of machine-made watches, under the title of the English Watch Company. At Sheffield he became Master-Cutler, was a leading member of the Literary and Philosophical Society, and took a leading part in the establishment of the Weston Museum, which he enriched with many valuable articles. He was a great collector of pipes, being himself fondly attached to the "weed." His collection was sold in February of 1882, but the whole of the prehistoric pipes of Mexico and the United States are, together with the pipes of uncivilised nations, preserved in the collection in the British Museum. The pipes were humorously described by *Punch* in verses headed "The Pipes of all People."

Launch of the French Cruiser Sfax.—This cruiser, which was laid down at Brest eighteen months ago, was launched there on Monday. The Sfax, which is built of steel with twin screws and watertight compartments, is 290ft. long, by 50ft. in beam, and draws 23ft. of water, with a total displacement of 4500 tons. The hull is entirely of steel, with a wood facing and a sheathing of copper. The vital portions of the vessel, such as the engines, boilers, and magazine, are protected by a deck with iron plates 2in. thick. The Sfax carries six 6in. guns, ten 5in. guns on hydraulic carriages, and several revolving guns. Her two screws derive their motive power from two separate engines which can develope at full pressure 7500-horse power. The maximum speed is estimated to be 16¾ knots, and the Sfax will carry enough coal for a cruise of 6200 miles. She has cost so far £153,000, of which about £80,000 has been spent upon the hull, and the remainder upon the engines, &c. If to this is added the expense of arming and equipping her, she will cost about £200,000.

ENGINES FOR TORPEDO BOATS FOR THE RUSSIAN GOVERNMENT

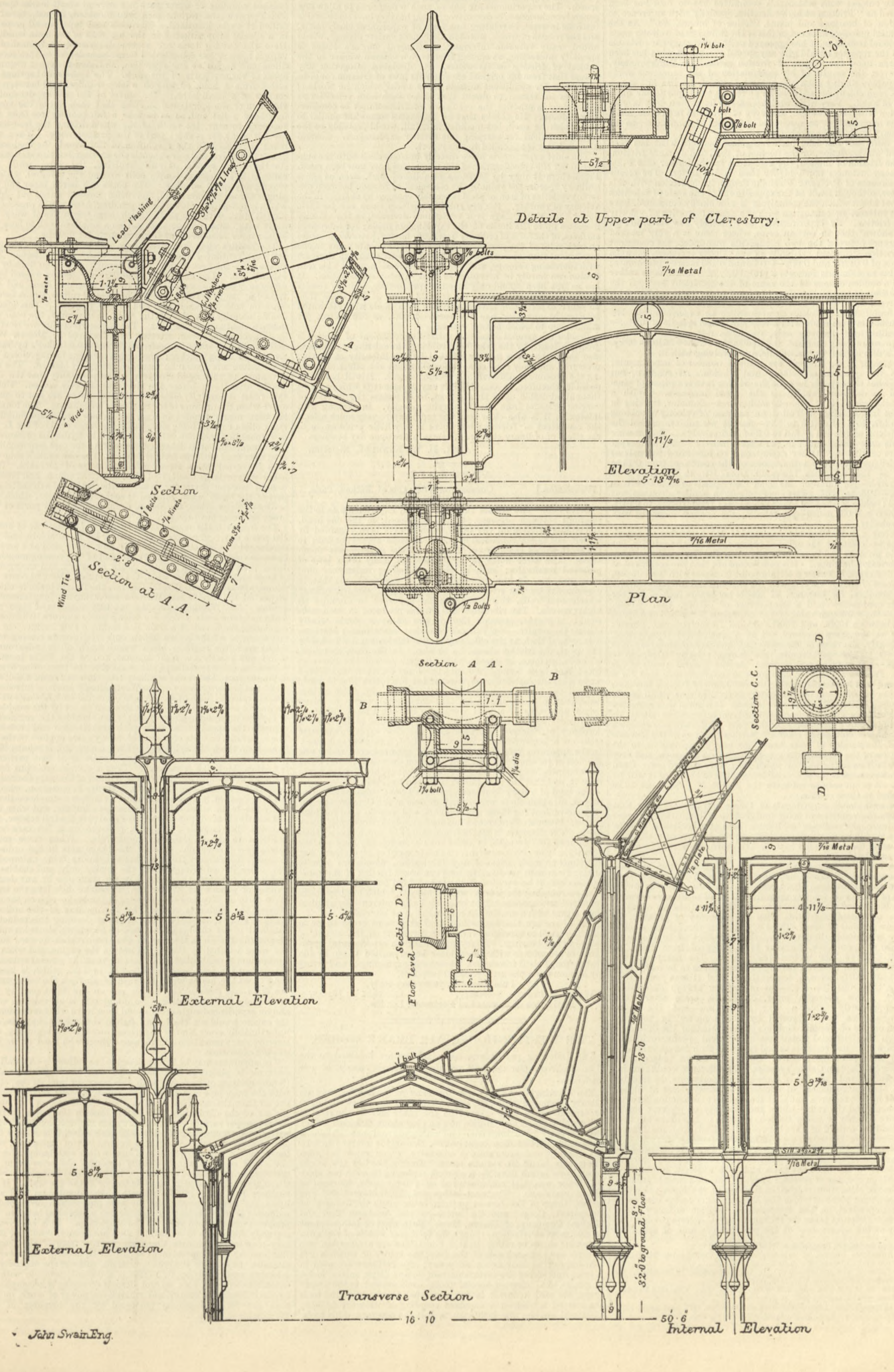
(For description see page 453.)



ALBERT EXHIBITION PALACE.—DETAILS OF IRONWORK.

MESSRS. BELL, MILLER AND BELL, WESTMINSTER, ENGINEERS

(*For description see page* 449.)



FRICTION AT HIGH VELOCITIES.

The following is the first report to the Council of the Institution of Mechanical Engineers, of the Committee on Friction at High Velocities. The committee consisted of the following members:—Mr. E. A. Cowper, Capt. Douglas Galton, C.B., Hon. D.C.L., F.R.S., Dr. John Hopkinson, F.R.S., Prof. H. C. Fleeming Jenkin, F.R.S., John Ramsbottom, Esq., Lord Rayleigh, F.R.S., Prof. A. B. W. Kennedy (reporter).

The subject with which this committee has to deal has been defined as "Friction at high velocities, specially with reference to friction of bearings and pivots, friction of brakes, &c." As the essential question involved in this is the influence of velocity upon frictional resistance, it has appeared neither necessary nor advisable that the reporter should give any special account of what has been written upon the subject of friction generally. Unfortunately, however, the results of his examination of the numerous works and papers bearing upon the subject to which he has had access have been chiefly negative, so far as relates to the particular question in hand. Very little work appears to have been done in connection with this question; and even of what has been done much seems inapplicable—on account of difference of conditions—to the ordinary work of the mechanical engineer.

A difference has long been recognised between what has been called static friction, or the friction of rest, and dynamic friction, or the friction of motion, the coefficient in the former case being in many instances much higher than in the latter. The recent experiments of Professor Fleeming Jenkin in connection with this matter, although made at the opposite end of the scale of velocities to that about which the committee is now chiefly concerned, have great interest in connection with the general question of velocity and friction. By experimenting at extremely low velocities, he has shown* that in certain cases, where there is a very marked difference between the two coefficients mentioned, the coefficient of friction decreases gradually as the velocity increases, between speeds of 0·012ft. and 0·6ft.—0·0036 and 0·183 metre—per minute; and his experiments indicate a probability of a continuous rather than a sudden change in the value of the coefficient between the conditions of rest and motion. In cases where there is little or no difference between the coefficient of rest and motion, no difference was found at the velocities between which he experimented. His experiments were made with a very small steel spindle of 0·1in.—$2\frac{1}{2}$ millimetres—diameter only, resting in rectangular V notches, the pressure being constant, and due to the weight—86 lb. = 39 kg.—of a disc carried by the spindle, and revolving with it.

Professor A. S. Kimball has made a number of experiments† upon the question of velocity and friction. At common, but somewhat slow speeds he finds the friction between pieces of pinewood to decrease rapidly as the speed increases. With a wrought iron shaft of 1in.—25 millimetres—diameter, working in a cast iron bearing, well oiled, an increase of velocity of rubbing from 6ft. to 110ft.—1·8 to 33·5—metres per minute caused the coefficient of friction to fall to 0·3 of its first value. The pressure in this case was about 67 lb. per square inch—4·7 kilogrammes per square centimetre. Other experiments on lubricated journals at smaller pressures gave a diminution of the coefficient from 0·15 to 0·05 as the velocities increased from 1ft. to 100ft.—0·3 to 30 metres—per minute. At such slow speeds as from 0·59ft. to 2·2ft.—0·18 to 0·67 metre—per minute a similar decrease was found; while at the still lower velocities of from 0·002ft. to 0·01ft.—0·0006 to 0·003 metre—per minute, the friction increased with the velocity.

Professor R. H. Thurston has carried out a number of experiments to determine the effect of changes, not only in velocity, but also in pressure and in temperature, upon the frictional resistance in lubricated bearings.‡ His conclusions are that the coefficient at first decreases, but after a certain point increases with the velocity, the point of change varying with the pressure and the temperature. At a pressure, for instance, of 100 lb. per square inch—7 kg. per square centimetre—and a temperature of 150 deg. Fah.—65 deg. Cent.—the minimum value of the coefficient is reached at a speed lying between 100ft. and 250ft.—30 and 75 metres—per minute; while at the same pressure, but at a much lower temperature, apparently, the value of the coefficient increases continuously from 30ft.—9 metres—per minute, the lowest velocity tried, up to 1200ft.—360 metres—per minute. As the general result of his work, Professor Thurston has come to the conclusion that for a cool and well lubricated bearing the coefficient of friction increases with the velocity, and approximately as its fifth root, at all speeds exceeding 100ft.—30 metres—per minute. It is much to be regretted that Professor Thurston has published no information about his very important experiments in this part of the subject, except a few tables of epitomised results. Neither the sizes of the journals tested, the number of tests made, nor any particulars as to the variation of the experiments among themselves are given, and very few details as to the way in which they were carried out. Until this information is made accessible—as it is to be hoped it will be made—it is not easy to estimate the degree of importance to be attached to these results.

The well-known experiments of Poirée and Bochet§ show that between the velocities of 900ft. and 3600ft.—270 and 1080 metres—per minute, the coefficient of friction both of wheels and of shoe brakes skidding on rails diminished very much—approximately—in the former case—from 0·2 to 0·13. The surfaces were, of course, quite unlubricated.

The recent experiments of Captain Douglas Galton and Mr. Westinghouse, described by Captain Galton in his papers read before the Institution,‖ afford very valuable information as to the effect of change of velocity upon the frictional resistances between brake blocks and wheels, and also as to the simultaneous variation of the coefficient of friction with the intensity of pressure, or pressure per unit of area. These experiments throughout showed a very remarkable diminution of the coefficient of friction with increase of speed over the very large range of from 400ft. to 5300ft.—120 to 1600 metres—per minute. The nature of the appliances used, however, permitted observations to be made only for about thirty seconds consecutively; and it was found that during this time the coefficient of friction always diminished rapidly. This decrease must, of course, cease after some time—apparently after a very short time—and the question arises, as was suggested by the reporter in the discussion on one of Captain Galton's papers, whether the difference between the frictional resistances at different speeds would still remain when these resistances had taken up their lowest values, or would then have disappeared. So far as can be judged from plotting out Captain Galton's results,¶ the difference would remain. From working out a number of these brake experiments, the reporter found that the coefficient of friction was sensibly less at higher than at lower pressures, and that the coefficient of friction between the wheels and the rails—where the intensity of pressure might easily be seventy or eighty times as great as on the brake blocks—was less than a third of that between the wheels and the brakes. From Professor Thurston's experiments with journals there appears the notable result that, while this is substantially corroborated for ordinary velocities and loads, there comes always a point—varying irregularly in the different cases and with different lubricants—after which increase of pressure increases the coefficient of friction, this change being more marked in the case of the lower velocities. The particular point at which this change occurs seems also to be partly dependent on the temperature. Within ordinary limits Professor Thurston takes the friction to vary—*cæteris paribus*—inversely as the square root of the pressure per unit of area; but this conclusion is very far from representing the average results of those sets of experiments which he has selected for publication.

No very large number of answers have been received to the inquiries sent out upon this subject. Of those which have come in, the most interesting are (1) a letter from Mr. Pearce, of Cyfarthfa, and (2) a letter from General Morin. The former gives particulars of indicator tests of a rolling mill engine running empty at different speeds, from which it appears that proportionately a much smaller power was required to drive the engine at a high than at a low speed. The experiments are not of such a nature as to allow any general conclusions to be drawn from them; but they have considerable intrinsic interest, as relating to a form of experiment easily made, and the results of which, noted in a sufficient variety of cases, would afford really valuable information. General Morin's letter is specially interesting, as coming from such a veteran worker in the subject of friction as its writer. He disclaims altogether any notion that from his original experiments laws of friction could be laid down for conditions outside those under which he worked; and sees no reason to doubt that under such high velocities as often occur in practice the coefficient of friction may be considerably reduced. He thinks that an apparatus somewhat similar to that which he used, but modified in detail, would probably be the most convenient for carrying out further experiments. General Morin's letter is appended to this report.

The chief experiments made directly in connection with the subject under the consideration of the committee have now been cited. From them it may be taken as established that, even at quite ordinary speeds, the value of the coefficient of friction between different varieties of iron or steel is sensibly changed by changes in the velocity of rubbing. For dry rubbing surfaces there can be little doubt that this change is a continuous decrease, as the velocity increases up to the limits of the experiments made; for lubricated surfaces, of the form of ordinary bearings—having, however, pressure on both sides of the journal—Thurston's experiments point to the conclusion that at some point the coefficient ceases to decrease with increasing velocity, and begins to increase again. This conclusion can hardly be accepted as final without confirmation. It has as yet been found only by one experimenter, and his results are in many points anything but regular. But at the same time no other experiments have apparently been made with lubricated bearings at anything like the speed—1200ft. or 360 metres per minute—up to which he has worked.

Besides the general conclusions that the coefficient of friction is greatly affected by the velocity of rubbing, the existing experiments also show that it is greatly affected by the intensity of bearing pressure; and they raise some probability that the effect of altering the pressure is different at different speeds. It will hardly be possible, therefore, in carrying out any experiments which may be thought advisable upon this subject, to dissociate the question of varying pressure from that of varying velocity. In working with lubricants it is also clear that the temperature very much affects the coefficient of friction; but there is very little evidence as to the effect of ordinary changes of temperature upon dry bearings.

Alex. B. W. Kennedy, Reporter.

APPENDIX.

[*Translation.*] Conservatoire des Arts et Métiers, Paris, 15th March, 1879.

Dear Sir,—The results furnished by my experiments as to the relations between pressure, surface, and speed, on the one hand, and sliding friction on the other, have always been regarded by myself, not as mathematical laws, but as close approximations to the truth within the limits of the data of the experiments themselves. The same holds, in my opinion, for many other laws of practical mechanics: such as those of rolling resistance, fluid resistance, &c. It has, therefore, been no surprise to me that, in experiments on the resistance to the sliding of skidded railway wheels over rails, this resistance has appeared to diminish at higher speeds. The vibrations and strains produced in such cases would, moreover, occasion disturbances such as would wholly change the results. For journals revolving in stationary bearings, it is natural that, as the efficiency of the lubrication is affected by the speed, the friction should be so also. In the case, therefore, of loads, surfaces, or speeds, which largely exceed the limits of those that have formed the subject of my own investigations, I agree with the Institution of Mechanical Engineers that it would be well for further experiments to be tried. But after mature consideration I am of opinion that the question might be solved by an apparatus of a kind similar to the one I made use of, as described—page 13, *et seq.*—in the paper published in 1838 by the Academy of Science: provided that the new experiments were tried on a larger scale in regard to weight, diameter, and speed. In the apparatus referred to, the rotary dynamometer, which was the first of its kind, was mounted direct on the axle that was being experimented upon. It would be better that it should be separate from it, and that the axle should be driven by a belt.

The kind of rotary dynamometer that I have subsequently employed, of which there are several models in the Conservatoire, is very convenient for these experiments, and can be used for high speeds. It would afford greater facility for applying sufficiently heavy loads. The diameter of the bearings should be much greater than is required for strength, in order that a sufficiently high surface velocity may be obtained with a moderate speed of revolution. For experiments made without any lubrication, anomalous results arising from wear produced by long-continued friction of the same surfaces might be avoided, if instead of fixed bearings an annular bush surrounding the journal were employed, which by some easily contrived arrangement might be shifted circumferentially at pleasure, either with a continuous movement or at intervals.

The above are the suggestions that at present occur to me to offer in regard to arranging further experiments on the friction of axles in their bearings. If any scheme for an experimental apparatus in accordance with these ideas be submitted to me by the Institution, I shall have much pleasure in examining it and giving my opinion upon the arrangements proposed.

I am, dear Sir, yours very truly,
General A. Morin.

Walter R. Browne, Secretary,
Institution of Mechanical Engineers, London.

* Royal Society, "Proceedings," 1877, p. 93.
† "American Journal of Science," 1876 and 1878; also Thurston's "Friction and Lubrication," p. 182, *et seq.*
‡ "Friction and Lubrication," p. 185. American Association for Advancement of Science, Aug. 1878, p. 61.
§ Mem. de la Soc. des Ing. Civ. 1852, p. 110, &c. Compt s Rendus, xlvi., 1858, p. 802, and li., 1860, p. 974.
‖ See "Proceedings" Inst. M.E., June and October, 1878, and April, 1879.
¶ "Proceedings" Inst. M.E., April, 1879, Pl. 23, Fig. 14.

THE WESTINGHOUSE AIR BRAKE WORKS.

The following particulars, for which we are indebted to the U.S. *Railroad Gazette*, will no doubt interest many of our readers:—

The Westinghouse brake was for many years manufactured on Liberty Avenue, Pittsburgh, but a few years since new and most convenient works were erected on the other side of the river in Allegenhy city. These works now employ about 600 men; they have recently been improved and enlarged, and now exhibit a remarkably perfect shop organisation, thoroughly adapted to turn out cheaply and accurately a specialty which must be interchangeable in all its various parts. During the last few weeks several new lathes have been started, replacing those in use since the brake was first manufactured on a large scale, fourteen or fifteen years ago. The new lathes are chiefly turret and Fox lathes, those of the former pattern being made by Bullard, of Bridgeport, Conn., and the latter by the American Tool and Machine Company, of Boston, Mass. Both class of lathes appear to give great satisfaction, though the feed gear wheels of Bullard's lathes appear to be rather light. The lathes are arranged in two or three rows on each side of the shop, the centre of which is left free and can be used as an alley way. No callipers are used in turning and boring the various parts of pumps, triple valves, locks, couplings, &c. Sets of special tools, each ground to the proper shape, are used in turret lathes, and when the fresh ground tools are started a trial on a standard coupling or other article being machined enables the latheman to test the accuracy of his tools, and a micrometer scale in connection with his slide-rest feed-screw gives him the exact amount of feed necessary. It is evident that this point once properly determined, the cutting tools will turn out accurate and interchangeable work every time, unless the tools become blunt or loose in the tool-holder. Neither can occur without detection. Piece-work offers no inducement to work with tools which cannot cut perfectly, and any slackness about tool-holder or rest should be instantly detected. Each piece of work is stamped by each man handling it, and thus a finished coupling or other part has several small marks upon it which enable the various men who moulded, turned, bored or milled it to be identified. The tools and taps are all prepared in a special shop situated in the top floor of the main building. Here the cutting tools are accurately ground and finished to various more or less complicated forms and adapted to turn several fillets and angles at one operation, and give the exact distances apart of various parts of the work. The brass spiral springs are coiled from a hank of wire on a long mandrel held between the centres of a small lathe. The travel of the carriage determines the pitch of the spiral, and in order that each end of the spring may have a flat end, so as to take a fair bearing free from any tendency to cant, the teeth of the wheel driving the feed-screw are cut away for a short part of the circumference. When this point is reached in the revolution of the wheel, the feed-screw ceases to revolve, and consequently the carriage remains stationary. As the lathe spindle is still revolving, the wire, while the carriage is stationary, simply coils around the mandrel, without making any spiral advance. The cocks are bored taper and the plug is turned to correspond, and when finished stands out $\frac{1}{32}$in., which is left as an allowance for grinding, after which process the plug is flush with the shell. Such large quantities of work are dealt with, that a lathe once set on a standard cock to bore the proper taper remains set at the same angle for months.

The smith's shop is entirely new, and is the neatest, cleanest and best ventilated smith's shop the writer ever entered. The smoke from the fires is drawn off through sheet-iron flues by an exhaust fan. The ends of the small reservoirs are welded by a machine which passes the edges of the reservoir shell and the turned-up flange between a couple of grooved rollers, which form a bend on both the shell and end of the reservoir. This gives a double security, as, should the weld be imperfect, the bead will insure a tight and secure joint. The engine reservoirs are rivetted by a direct-acting steam rivetter, manufactured by Messrs. Wm. Sellers and Co., which is preferred to the same maker's hydraulic rivetter as being quicker; the steam machine having closed the rivet before the hydraulic machine has fairly started. The disadvantage of very rapid rivetters is the possibility that the dies can be withdrawn before the rivet has properly cooled. Unless this point is carefully attended to, the plates are apt to spring apart when the pressure of the rivetter is withdrawn. The foundry has been nearly doubled in size, and is now an L-shape building, two Colliau cupolas being situated at the inner angle of the L. A new moulding machine, which is worked by hydraulic pressure, is just completed, and is intended for making the cast iron auxiliary reservoirs used with the freight brakes. The old smith's shop has been converted into a store for finished parts of the brake. It is fitted with a large number of bins, each 3ft. square and labelled to hold just one particular detail of the brake. Each individual part of the brake when finished is sent into this store, which can be drawn upon when the pump, couplings, or other parts of the brake are being put together.

The freight brake is now being turned out at the rate of nearly 100 sets a day. A set for a car weighs 480 lb. complete, and the regular price is 40 dols., though it is now being sold at a smaller figure to roads adopting it before the end of the coming month of June. Considering the accurate work necessary, and the amount of brass and india-rubber used, the full price, about $8\frac{1}{3}$ cents per pound, appears very moderate. So far, the freight brake is chiefly in use on the Pacific and Western roads having long mountain grades. Mr. Westinghouse has recently introduced two new features in the brake which are calculated to improve its action in regulating the speed of a train descending a long incline. In the endeavour to set the brakes lightly on a freight train coming down a long grade the engineer often wastes much air in endeavouring to let out exactly the right amount, and as the brake must be released in order to recharge the reservoirs, the train often attains an undue speed before the auxiliary reservoirs are again filled with air of the proper pressure. Mr. Westinghouse has now introduced a small valve which may be put into operation on a few cars at the summit of a long grade. This valve can be set by the conductor or brakesman walking along the train, and enables the engineer to regulate the speed of his train with greater ease and certainty. The apparatus consists of a sort of safety valve applied to the exhaust from the brake cylinder. When connected, it retains 10 lb. per square inch pressure in the brake cylinder of that particular car, when the brake is released. Thus a certain retarding force, the amount of which depends on the number of these appliances put in operation at the top of the grade, is always in operation, whether the brake generally is released or not. It is then a simple matter to apply the brake when the speed increases unduly, and when it is sufficiently checked, put the engineer's valve to the full release, and recharge the reservoirs; the 10 lb. pressure on a few cars being sufficient to steady the train meanwhile. When these safety valves are thrown out of use, the brake acts in the ordinary manner, the exhaust from the brake cylinder being unimpeded. The other device is applied to the engine only, and enables an engineman to reduce the pressure in the train pipe by any desired number of pounds per square inch, no matter how long the train. With forty or fifty cars the pressure in the brake pipe on the cars nearest the engine is reduced by the opening of the ordinary engineer's valve, say 20 lb. The engineer deeming this reduction sufficient to set the brakes as hard as he wishes, shuts his valve. Meanwhile the air in the rear of the train rushes forward to fill the space vacated by the air let out on the engine, and when an equilibrium is established it is possible that the general reduction throughout the train may be only 2 lb. or 3 lb., which is insufficient to set the brake, while the rush of air from the back part of the train has released the brakes set on the front part by the momentary 20 lb. reduction. No doubt this is an extreme case, and an experienced engineman would soon learn what reduction on the engine would set the brakes lightly throughout the train, but unfortunately every kind of experience must have a beginning, and improvements must be made to assist those who need or are just gaining experience.

The apparatus may be briefly described as follows:—A small air reservoir is placed on the train pipe near the engineer's valve. Communicating on one side with this reservoir, and on the other with the train pipe is a diaphragm, which moves a valve releasing the air from the train pipe, when the air pressure on the upper surface of the diaphragm falls below that on the lower surface. As the upper surface of the diaphragm is in direct communication with the small reservoir and the engineer's valve, it is evident that the pressure is under the direct control of the engineman, who, having only a definite quantity of air to deal with independent of the length of the train, can easily diminish the pressure in the reservoir by any desired amount. This reduction being effected by the engineer, the valve in turn lets the air out of the train. If the engineer has made a 15 lb. reduction, the diaphragm will keep lifted, and release the air from the train pipe until a corresponding reduction is effected, and an equilibrium established between the pressures on the two sides of the diaghragm. This contrivance certainly appears to be a distinct step in advance, rendering it an easy matter to graduate the brake on the train of any length. But one further improvement seems to be needed, the power to diminish the force of the brake when on, without the necessity of releasing and resetting it. This is a difficult problem with an automatic brake, but we do not despair of seeing it accomplished by the indomitable energy and marvellous power of work, no less than the fertile ingenuity possessed by the inventor of the Westinghouse brake.

RAILWAY MATTERS.

The whole extent—75 miles—of the Coude d'Eu Railway, in the province of Parahyba, Brazil, constructed by Messrs. Wilson, Sons, and Co., was successfully opened for traffic on 4th inst., this being before contract time.

About 94 per cent. of the double mileage of the railways in England and Wales is now worked on the absolute block system, and the greater portion of the single lines is under the same control, in addition to the train-staff system. In Scotland, the double mileage worked by the absolute block is 90 per cent. of the whole, and in Ireland, 22 per cent.

It is now some twelve years ago that Messrs. Merryweather and Sons, of London, constructed their first steam tramway engine for the late Mr. Grantham. Since the failures of that time the economy and practical value of steam on tramways have been gradually proved in several parts of the world. The measure of success now obtained may be gathered from the fact that Messrs. Merryweather have received an order for fifteen of their tramway locomotives for use on the North London tramways. This tramway company has waited until experience has improved tramway engines sufficiently to add economy to the advantage they offer as to haulage power.

Proposing the construction of a railway in Soudan, General M. C. Meigs, U.S.A., writes to the *New York Tribune*—"From a newspaper letter of March 15th I extract the following:—'In May, 1880, the work of the Mexican Central Railway was begun. In twenty-six working days 73 miles of track were laid. On March 8th, 1884, the railroad, 1225 miles long, was completed, and at the rate of nearly nine-tenths of a mile for every day.' From May 8th, 1880, to May 8th, 1884, there were 1460 days, in which 1225 miles of railroad were graded and built, and not a narrow gauge." General Meigs naïvely asks: "If a private stock company can do this, why cannot the British Government do better?" If the question had been in the reverse order it would not have given proof of want of experience between what can be done in a given time, and at a given cost, by a Government and a private company that has to make a profit.

The American Consul—Mr. Lyell T. Adams—at Geneva, writing on the subject of international railway communication, states that any account of the commercial position of Switzerland at present would be incomplete without some reference to the great change impending on the completion of the new lines of international communication, whose effect will be to make her a commercial, as she already is the geographical and hydrographical, centre of the Continent. Nothing has isolated her hitherto but the altitude above the sea-level now overcome by the Brenner Railway, and the tunnels of the Mont Cenis, the St. Gothard, and the Arlberg, recently opened. By these routes the extremities of Europe are brought into direct relations, the meeting point of all lying upon Swiss territory, with the exception of the Mont Cenis. This line crosses Upper Savoy, which by the treaty of 1815 forms part of the Swiss neutral territory to be occupied in war by the armies of the Confederation. One of its main feeders is the West Swiss Railway from Berne to Geneva, and much of its traffic is likely to be diverted by the projected tunnel under the Simplon. What effect, adds Mr. Adams, this reconstruction of the European railway system will have on the fortunes of Switzerland it is as yet too early to conjecture.

A report recently issued by the High Commissioner for Canada furnishes some instructive statistics relating to the progress of Canadian railway enterprise. At the close of 1882-83 Canada had altogether 8805½ miles of railway under traffic, of which 1275 miles were added during the year. When the schemes at present afloat are completed, she expects to have a total mileage of 11,400 miles. The paid-up capital increased 19 per cent. during the year, from 415,611,810 dols. to 494,271,264 dols.—about £90,000,000. The share and bonded liability of Canadian railways is about 32·253 dols. per mile, the total capital liability for shares and bonds being approximately about 341,074,466 dols. The gross revenue for the year amounted to 33,244,585 dols.—an increase of 4,216,796 dols., or 14½ per cent. The net earnings were 8,552,918 dols.—an increase of 1,915,837 dols. or 28¾ per cent. The dividend yield averaged 2½ per cent., contrasting rather unfavourably with the 4½ per cent. yielded by our railways, though, compared with the profit earnings on American roads, where the ordinary stock seldom reaps any benefit, it represents a high and steady state of prosperity. All the lines show an increase in passengers carried, except the Grand Trunk, which figures with a decrease of 436,842 passengers. In tonnage also it shows a decrease of 813,856 tons. As regards accidents, 169 persons were killed and 550 injured during the year, being a large increase in both instances.

The construction of the Corinth Canal seems to have tended to increased activity in railway construction in Greece. A railway is being constructed in the Peleponnesus starting from the Piræus, which is the port of Athens. The station at Athens is about 1500ft. in length and 130ft. in width, being near the Academy of Plato. The Kepissos is crossed by a bridge 90ft. in length, and the railway then traverses the north-western plain of Athens to Kameteron; following in a northerly direction the base of the Parnes mountain, subsequently penetrating through the narrow pass of Phylæ, and proceeding through the villages of Charia to Eleusis. The further portion of the railway from Eleusis to Megara was expected to be opened about the present time. The portion of the line from Megara to the Isthmus of Corinth presents the difficulty of a track overhanging the sea at a height of about 190ft. for a distance of nearly six miles, this romantic locality being known as the Scirronic Rocks. The completion of this portion of the line will hardly be possible before a late period of the autumn. At Corinth the line divides the southern portion terminating at the cities of Argos and Nauplia. The western line follows the coast of the Gulf of Corinth and goes through Ægium—Vostizza—to Patras. From that point it extends along the western coast of the Peloponnesus through Achaia, Gastuni and Kalakolon to Pyrgos in the vicinity of Olympia. The whole district traversed by the railway is thickly populated and in a good state of cultivation, the gain to local commerce being enhanced by the fact that there are scarcely any practicable harbours at that part of the coast.

Included in a volume of British Embassy and Legation reports is a "Memorandum on Railways in Russia," which contains some interesting information. It is stated that the great defect of the present system is the want of efficient control over railway construction and administration in regard both to State and private lines. The Russian Treasury makes advances and loans for definite or indefinite periods, but has no power to control the application of the money. As a case in point, it may be mentioned that the so-called coal railway in Donetz district cost the Treasury during the past year the sum of £70,000, in addition to payments on account of guarantees on shares and obligations. The average expense for construction of Russian railways has been about £7000 per verst—two-thirds of a mile. A military railway recently constructed from Jabinska to Pinsk cost about £3300 per verst, while the last railway constructed in Finland—from Tamerfars to Wasa—cost only £2200 per verst. There are in Russia fifty-three railways, of which only eight pay dividends. Amongst reasons given in explanation of the failures of Russian railways are the following: —The subordination of commercial to strategical reasons in construction; the absence of branch lines, and even in many districts of roads connected with main lines; the enormous expense of renewal of materials necessitated by action of climate, by inferior quality of articles originally supplied, and by substitution of steel for iron rails; the unnecessary luxury of carriage fittings, decorations, &c., and the number of non-paying passengers; and above all, the absence of State control or of immediate supervision. At the present time several new lines of railway, amounting altogether to about 1500 miles, are in course of construction in Russia, chiefly short connecting lines, and along the frontier; and it is expected that the cost of construction will be more carefully watched.

NOTES AND MEMORANDA.

The rainfall at Greenwich in 1883 was 21·9in., being about 3in. below the average.

The total area at the present time under pastoral lease in New South Wales is 125,880,398 acres, producing an annual rental to the Government of £255,889, making the average rental of each block £1 6s. 0¼d.

No failure in the automatic drop of the Greenwich time ball has occurred during the year 1883. The ball was not raised on two days on account of the violence of the wind, and on four other days during the repair of the machinery.

During the year 1883 Osler's anemometer at Greenwich showed an excess of sixteen revolutions of the vane in the positive direction N. E. S. W. N., if all the turnings are counted, or of nineteen revolutions in the positive direction if the turnings which are evidently accidental are excluded.

The export of coal from Newcastle in New South Wales during 1883 amounted to 1,359,505 tons; in 1874 the quantity was 724,204 tons, since which time there has been a steady annual increase, except in 1880, when, in consequence of a labour dispute, the quantity sank to 673,393 tons.

There are various kinds of wattle, the bark of which is suitable for tanning purposes, found in New South Wales. Among these is the green wattle, the timber of which being light, tough, and strong, is used for making staves. The silver wattle is a wood of the same character, while that of the golden green wattle is largely used for axe handles.

The number of hours of bright sunshine recorded by Campbell's sunshine instrument at Greenwich during 1883 was 1241, which is about thirty hours above the average of the six preceding years. The aggregate number of hours during which the sun was above the horizon was 4454, so that the mean proportion of sunshine for the year was 0·280, constant sunshine being represented by 1.

The mean daily motion of the air at Greenwich in 1883 was 291 miles, being 12 miles greater than the average. The greatest daily motion was 842 miles, on December 12th, and the least 62 miles, on December 26th. The pressures exceeding 20 lb. in 1883 were 28·0 lb. on January 27th, 28·5 lb. on February 2nd, 24·4 lb. on March 6th, 20·5 lb. on October 17th, and 26·5 lb. on December 12th.

A contributor to the *American Machinist* gives the following as the standard for shrinkage used in a foundry in Philadelphia, in which he is engaged:—For loam castings, $\frac{1}{12}$in. per foot; for green sand castings, $\frac{1}{16}$in. per foot; for dry sand castings, $\frac{1}{16}$in. per foot; for brass casings, $\frac{3}{16}$in. per foot; for copper castings, $\frac{3}{16}$in. per foot; for bismuth castings, $\frac{5}{32}$in. per foot; for tin castings, $\frac{1}{4}$in. per foot; for zinc castings, $\frac{5}{16}$in. per foot; for lead castings, $\frac{5}{16}$in. per foot.

What the *Colonies and India* calls a kind of natural cement has been found on the bank of the Bow River, a few miles west of Calgary, in the Canadian North-west. It is the same kind of material as that which was found near Morley last autumn, and which is also plentiful in Florida, where it is said to be superior to stone for building purposes. It has been used almost entirely in building the town and fort of St. Augustine in that State, where it is called coquina.

Six Staffordshire blue bricks, made by Mr. Joseph Hamblet with his improved machinery, were tested at Kirkaldy's on the 4th inst., and resulted in their averaging a crushing strength of 1064 tons to the square foot. This exceeds the crushing resistance generally given of granites, but the mean results of experiments with Aberdeen granite, which is considered the hardest and strongest kind, Mallet found the crushing resistance on cubes about 1·5in. square to equal 22,681 lb. per square inch, or about 1440 tons per foot.

The recently published volume of Joule's scientific papers contains a long description of the apparatus finally used in determining the mechanical equivalent of heat, and particulars of the results of numerous experiments. The final conclusion of the author is:—"The equivalent at the sea level and the latitude of Greenwich will therefore be 773·492 foot-pounds, defining the unit of heat to be that which a pound of water, weighed by brass weights when the barometer stands at 30in., receives in passing from 60 deg. to 61 deg. Fah., with water weighed in vacuo, the equivalent is finally reduced to 772·55 foot pounds."

It is said that an aniline ink can be made, which will resist bleaching powder, by dissolving 12 grains of nigrosine, brand noir perfectionnè, and 12 grains of aluminium acetate in 1 ounce of water. Labels or any fabric to be marked must be free from all starch and dressing, and time allowed for the ink to be absorbed. Another aniline ink, which must be sent out in two bottles, and mixed when required for use, is made as follows:—Crystallised copper chloride, 8·52; sodium chloride, 10·65; ammonium chloride, 5·35; water, 60. Solution 2: Aniline hydrochlorate, 20; distilled water, 30; gum water—1 in 2—20; glycerine, 10. Four parts of No. 2 and one part of No. 1 yield a greenish fluid, which can be used, but will not keep more than a few days. This is said to be the composition of jetoline.

After various delays, the arrangement for sending a current to Deal, and receiving a return signal through the chronopher of the Post-office telegraphs, was brought into operation on February 29th, and has worked well since. The change necessitated some slight alteration in the Greenwich arrangements in order to receive the Westminster signal through the same wire which is now used for the Deal current and its return signal. There were in 1883 sixteen cases of failure in the dropping of the Deal time ball owing to interruption of the telegraphic connections, twelve under the old system, and four since the new arrangement with the Post-office. On nineteen days the current was weak and required the assistance of the attendant to release the trigger, and on nine days the violence of the wind made it imprudent to raise the ball.

The total number of bushels of wheat grown in New South Wales in 1883-4 is 15,449,143 against 8,735,440 for 1883, the increase being no less than 6,763,703 bushels. The whole yield is far in advance of that of any previous year, the nearest approach to it being in 1881, which was 5,771,674 bushels behind the present year's yield. The average for wheat is 14·09 bushels per acre, the highest for the previous nine years being in 1876, when it was 15·49 bushels. The increase in oats, as compared with previous years, was 289,271 bushels; in barley, 301,689 bushels; in peas and beans, 103,621 bushels; in potatoes, 31,519 tons; in hay, 106,807 tons; in grass and clover seeds, 12,872 cwt.; in hops, 6526 cwt.; in tobacco, 4261 cwt. The average of oats was 25·12, as against 26·17; the average return of potatoes per acre was 4·01 tons, as against 3·78 tons; and of hay, 1·43 tons, as against 1·06.

Herr Nettekoven has reported finding deposits of gypsum at Luebtheen in the principality of Mecklenburg-Schwerin. In 1878 a deep bore hole passing through 327·14 metres of sand, gypsum, anhydrite, and marl, reached salt nearly 150 metres thick. The upper part of it contained potash salts, and the lower carried from 9·96 to 19·46 grammes of potassa per litre. Since then the Government put down a number of holes, and in one of them, under the village of Probst-Jesar, the drill penetrated into 900 metres, or nearly 3000ft. of salt without passing through the deposit, the total depth of the hole being 1207 metres, or 3960ft. This stimulated private enterprise, and in September, 1882, work was begun on drilling at Luebtheen. At a depth of 252·70 metres, potash salt was struck, and it was only at a depth of 328·97ft. that salt was reached. The average of the cores obtained in this section showed 13·42 per cent. of potassium chloride and 18·9 per cent. of chloride of magnesium, while the average of the cores from a depth of from 297 to a depth of 329 metres, or a thickness of 32 metres, or 105ft., was 15·02 per cent. of potassium chloride, the highest single analysis being 22·4 per cent.

MISCELLANEA.

An excavator of 300-horse power, intended for the piercing of the Isthmus of Corinth, has been shipped at Marseilles for Kalamaki.

The International Railway Sleeping-car Company is organising what is called "a lightning express," to run between St. Petersburg, Berne, and Lisbon, on the model of the one between Paris and Constantinople.

As most engineers are smokers, we may warn them that, before they step ashore at Boulogne-sur-mer, they must throw their matches overboard, or expect to be fined a franc a match for smuggling such things ashore.

A concession granted for laying a cable from Portugal to America, *viâ* the Azores, has been transferred to a joint-stock enterprise, entitled the American, British, and Continental Cable Company, which, by Royal Order, has its legal status recognised in Portugal.

A Dover correspondent of the *Times* says it is stated on good authority that the Government, in view of the three large harbour works about to be commenced there, have decided to make Dover a naval station, and that the harbour is likely to be completed at an earlier date than was originally contemplated.

In a New South Wales gully or creek called the Waterfall Creek running into the Cadiangullong Creek, and at the extremity of a mountain spur known as the Rocky Ridge, there is, it is stated, an immense mass of oxydulous iron—hæmatite—forming in one solid mass a precipitous waterfall of about 60ft. in height; in this mass of iron, especially in the joints, there are brilliant crystals of iron pyrites, with a small quantity of yellow copper ore and traces of blue and green carbonate of copper. Here also is found iron sulphate, from the decomposition of the pyrites.

A Committee has been formed for the purpose of holding in Cape Town, in September next, an exhibition of South African arts, manufactures, minerals, and industrial products. It is to open on the 9th September and remain during the month. The determination to hold the exhibition results from a wide-spread conviction amongst colonial manufacturers that much of the preference for imported articles of a certain class is due to imperfect knowledge of the actual stage of development to which colonial industry in some important branches has already attained.

The Executive Council of the International Health Exhibition have determined to hold an International Conference on Education in connection with the Education Division of the exhibition; they have appointed a Committee of Management, who have drawn up a programme. For convenience of discussion, all papers to be read will be printed beforehand, and they will subsequently be published by the Executive Council. Persons desirous of attending the conference are invited to send in their names to Mr. R. Cowper, secretary to the Committee of Management, International Health Exhibition, South Kensington.

Messrs. Joseph Wright and Co., Tipton, Staffordshire, who are the makers of the chains for mining and crane work of the brand, A1 Special Best Best, J. W. and Co., recently had a sample of their 1⅜in. A1 quality, for London Docks, tested to destruction at Lloyd's Proving House, showing a breaking strength of 67½ tons, equal to about 200 per cent. over Admiralty proof, which, we think, has never been excelled, or ever equalled, on this size. The iron from which this result was obtained is made specially for Messrs. Wright for this brand of chain, and none but picked workmen are employed in its manufacture.

At a meeting held in Berlin on 24th ult. of representatives of the iron and shipbuilding trades, shipowners, classification and insurance associations, &c., resolutions were adopted to the effect that iron for shipbuilding purposes should be subject to a careful preliminary examination as to its quality, the results of such examinations to be embodied in certificates. These tests would apply to breaking strength, extension and flexure, and the principle was acknowledged that when iron of superior quality is used a corresponding reduction in the thickness of the metal should be allowed. A commission was appointed to investigate the matter and report upon it.

Trial trips of two steel screw ferry boats, Volta and Victor, built by Messrs. Edwards and Symes, of London, for the Portsmouth Steam Launch and Towing Company, recently took place from London to Portsmouth, the run being completed in twenty-seven hours, on but 20 cwt. of coal for the whole distance of 200 miles, and in Stokes Bay a mean speed of nearly nine knots per hour was obtained. The dimensions are:—54ft. long over all, 15ft. beam, and are constructed so as to give a draught of water 8in. forward and 3ft. 9in. aft. They are fitted by the builders with compound surface condensing engines and steel boilers, and carry a Board of Trade certificate for over 100 passengers.

Hitherto the principal supply of malachite, which is largely used in Europe for mantelpieces, pedestals, and similar decorative purposes, has been obtained from Russia, but it is, we are told, equally rich and abundant in New South Wales, where its colour ranges from pale emerald to deep green, the various layers often possessing different shades of colour, and forming a most beautiful and valuable stone for ornamental and inlaying purposes. Crystals are occasionally met with, and sometimes of large size; those from the Cobar Mines are particularly beautiful. The silky lustre is often very remarkable, the capillary crystals being sometimes several inches long, and compacted together into fibrous bundles. It is found in most of the upper workings of New South Wales copper mines, as in the Bathurst district, with chlorite, vitreous, yellow, and other copper ores.

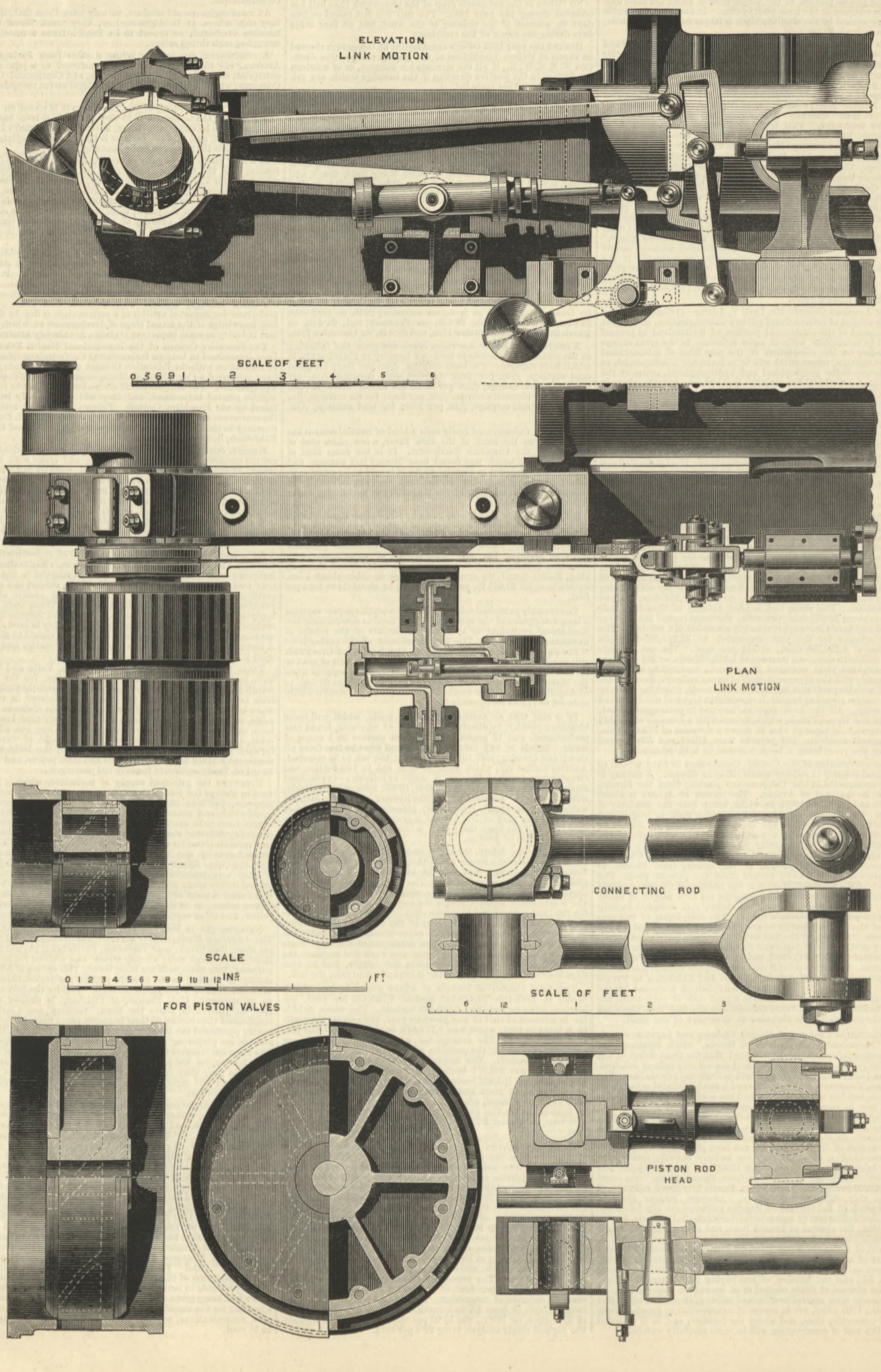
Natural gas is being more than ever utilised in the States. The *American Manufacturer* says:—"The development of natural gas along Bull Creek, near Tarentum, Pa., is being pushed rapidly. Besides the large wells already struck and utilised for industrial purposes, four more wells are being bored. This section of Allegheny county is proving to be a more prolific gas region than either Westmoreland or Washington counties. Besides the four new rigs up on the creek, C. L. Flaccus, of Pittsburg, is drilling another near his glassworks above the town. Godfrey and Clark have commenced the erection of their immense paper mills at Tarentum, having purchased one of the wells for 6000 dols. Richards, Hartley, and Co. are preparing to build their glassworks at the same place. The Emerson Natural Gas Company has been organised at Hamilton, Ontario, for the purpose of utilising the flow of gas from the gas wells near that city. The company will attempt to use the gas for fuel and light purposes, and proposes to lay pipes to and through Hamilton."

The third annual meeting of the British Association of Inspectors of Weights and Measures will be held in Glasgow on Tuesday and Wednesday, 24th and 25th June inst. Among the resolutions to be submitted are:—"That the members of the British Association of Inspectors of Weights and Measures, in annual meeting assembled, respectfully submit to the Board of Trade that they do not consider it at all necessary, and certainly not desirable, that a new standard weight of 112 lb. should be legalised, and for the following reasons, viz.:—That it is so near in size to the cental or 100 lb. weight, and in consequence liable to be used fraudulently; that anyone requiring such a large weight could use the already legalised cental; that if a concession is to be made to one business, can the Board of Trade consistently refuse to grant a special weight to any other business? that the concession asked for by the ironmasters, if granted, will destroy the main principle of the Weights and Measures Act, 1878, as therein expressed, which is uniformity." And "That this meeting begs most respectfully to call the attention of the Board of Trade to the continued use of the old troy weights in some districts and in Government offices—the latter fact being given as a reason by a magistrate who dismissed a summons for the use of such—and the stamping of new weights of such denominations, which is clearly illegal." Several papers are to be read.

COMPOUND REVERSING ROLLING MILL ENGINES.—DETAILS.

MESSRS. TANNETT, WALKER AND CO., LEEDS, ENGINEERS.

(*For description see page 453.*)



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BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

TO CORRESPONDENTS.

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

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

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

C. C. C.—*The* Times of India. *Inquire of Messrs. F. L. May and Co.,* 159, *Piccadilly.*

X. Y. Z.—(1) *We do not know. Write to the Great Seal Patent-office.* (2) *Not of necessity.* (3) *Yes.*

C. H.—*You have quite missed the point at issue in your criticism on Dowson's gas. No one proposes that the gas shall be burned to make steam, and as regards the dimensions of the apparatus, you seem to have forgotten that steam boilers are needed with steam engines.*

P. P. C.—*The experiments of the gentleman to whom you refer were absolute failures, nearly resulting in loss of life. He died without accomplishing anything about fifteen years ago. We do not suppose that the French Minister of Marine took any action in the matter.*

W. LEITH.—*Neglecting the effect of the tangential resultant of the elastic pressure put upon the ball by the flexible discs, the pressure on the shoe ring will be* $W R N^2 \times 0.00034$, W *being weight of the ball,* R *radius in feet, and* N *number of revolutions per minute. Supposing the ball to be cast iron, you have* $760 \times 3 \times 90000 \times .00034 = 69768$ *lb.*

T. W.—*There does not appear to be anything in the arrangement you describe to make it preferable to any of those now in use, and it could in no way take the place of any of the continuous brakes now before the public. It would, moreover, cost more than the simpler arrangements generally adopted, and even if it had any points of merit, you could not get it taken up until after experimental trial, and only with great difficulty, supposing perfect success achieved.*

FOIL CUTTING MACHINE.

(*To the Editor of The Engineer.*)

SIR,—I want to cut metallic foil accurately into strips of varying widths, and should be much obliged if any of your correspondents could tell me where I could procure a machine to do this. K. H.

June 10th.

BRYAN, CORCORAN AND CO.

(*To the Editor of The Engineer.*)

SIR,—I observe in your issue of the 6th inst. an advertisement of the sale of the effects of a wire-weaving, mill-furnishing, &c., business, therein stated to be the property of a firm styling itself "Bryan, Corcoran, and Co." As I am the only person of the name of Bryan Corcoran carrying on such business in London, and as this advertisement has led several of my customers to inquire the reason of my retiring from business, I trust that by granting me the favour of inserting this letter you will enable me to notify that I have no intention of retiring from the business which I have for many years carried on at this address besides my other places. BRYAN CORCORAN.

31, Mark-lane, London, June 10th.

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MEETINGS NEXT WEEK.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, June 18th, at 7 p.m., the following papers will be read:—"The Equinoctial Gales—Do They Occur in the British Isles?" by Mr. Robert H. Scott, M.A., F.R.S., President. "On the Physical Significance of Concave and Convex Barographic and Thermographic Traces," by the Hon. Ralph Abercromby, F.R. Met. Soc. "Maritime Losses and Casualties for 1883, Considered in Connection with the Weather," by Mr. Charles Harding, F.R. Met. Soc. "The Helm Wind," by the Rev. Joseph Brunskill, F.R. Met. Soc. "Climate of the Delta of Egypt in 1798-1802 during the French and British Campaigns," by Mr. W. T. Black, F.R. Met. Soc., Surgeon-Major. The commemoration dinner will take place at the Holborn Restaurant, High Holborn, on Tuesday, June 17th, at 6.30 p.m.

CHEMICAL SOCIETY.—Thursday, June 19th, at 8 p.m.: "On the Magnetic Rotation of Chemical Bodies in Relation to their Composition and Constitution," by Dr. Perkin, F.R.S. "On the Effect of High Temperatures on Petroleum Hydrocarbons," by Drs. Armstrong and Miller. "On Nitrification," Part III., by Mr. R. Warrington.

THE ENGINEER.

JUNE 13, 1884.

LONDON WATER SUPPLY.

THE water supply of London is again the subject of discussion, not only from a financial and economic point of view, but from that of quantity and quality. To a considerable extent the question is being forced into discussion as an agitation by people who have special views to advocate. Within a few months a crop of pamphlets has appeared, and with a collection of these before us it would be possible to be very much amused by the equal urgency of the views expressed in each, though none are quite the same, were it not for the way in which some of the advocates of new schemes adopt as facts the contradictory conclusions which have been published by enthusiasts or by pessimist sanitarians. "Adam Gladstone" crushes the history of the London water supply from the creation of man to 1884 into an amusing pamphlet of but sixteen pages, published by no one, and arriving at the conclusion that the water supply of London is likely to be better managed by the water companies than by a Metropolitan Board of Works; though with a really municipal body, in whose hands the supply might be placed, he thinks it would pay Londoners in the end to expend about thirty millions sterling in the purchase of the existing works. Mr. Francis R. Conder has written a report published, for the water companies generally, by Messrs. Spon, in which it is clearly shown that these companies have been and continue to be the greatest benefactors of the London people, and that as angels they ought not to be interfered with by the fiends who would do anything towards preventing the companies from increasing the fabulous profits already made, it is said, at least by some of them. After reading some of these pamphlets, one cannot help feeling that the people of London ought to be thankful that the companies supply them with any water at all; and that it is the basest ingratitude which makes them complain of the price they have to pay for that which is supplied them. A really useful little book on the past, present, and future of London water supply, by Mr. G. Phillips Bevan, has been published by Mr. Stanford. Mr. Bevan is a member of the Statistical Society, and presumably revels in the labyrinths of figures relating to water companies, water rates, profits, working expenses, and so on, with as much pleasure as he would in any others. He refers to the apathy of the average Londoner as to the water supply, and seems to be of the opinion that it is urgently necessary that something should be done. This something seems to be the acquisition of "the very best supply that can be got." The numerous facts and figures given by Mr. Bevan tend more to excite feelings of resentment against the charges made by the companies than anything else; and no facts are given to show that the present water supply is not, as to quality, as good as can be wished for, nor is it shown that in respect of quantity there is any danger. Yet "the very best that can be got" refers to quality, for Mr. Bevan, having imbibed the previous sewage contamination ideas, goes the length of saying that "broadly speaking, it is almost an impossibility to get any pure water from the Thames basin," and later on he shows his alarm as to quantity. Like a good many others who have not considered the question in all its bearings, he has failed to see that the limit to deep well supply would be reached in a comparatively short time, if the 60 per cent. of all the water supplied to London were no longer taken from the Thames and Lee, but from deep wells dotted round London; that there is a limit to the rate at which water can percolate through chalk, and that even if unlimited chalk water could be got, people would not wish for it; and lastly that, as judged by Mr. Bevan, the chalk water may be no better than the river water. The presence of nitrates seems to alarm Mr. Bevan, and he likes deep well chalk waters because they are "free from nitrates." It is rather unfortunate, however, that the fact seems to be that the Kent deep well water contains of nitrogen, as nitrites and nitrates, much more than any of the river waters, and always does.

As to the quantity question, the following may be considered a sufficient answer to any alarmist cry. "Although as far back as 1824 the insufficiency of the London water supply was an acknowledged fact, and was then sought to be remedied, nothing has been done beyond increasing the capabilities of the existing sources." This is from Mr. Bevan's book. The "nothing" seems to have been a something very considerable, for the supply has increased from 44 millions of gallons in 1850 to 140 millions in 1884, and a larger proportion of all existing houses is supplied. Mr. Bevan does, however, think it is due to the companies to acknowledge that they have done their best to keep pace with the demand. Now, as the dry season flow over Teddington weir is 400 millions of gallons per day, there is just a little room left for London to grow in its water requirements, and that "we are confronted with the same difficulty as was the last generation" does not seem to make our case desperate; for as that generation certainly got out of the difficulty by doing "nothing beyond increasing the capabilities of the existing sources," we may hope to do, at least, as well.

That we shall have to legislate to prevent the companies from continuing exorbitant charges is clear; and we may have to enforce increase in the supply in some places and to improve and augment the means of filtration; but that any radical alteration in the sources or means of supply is wanted seems to be no more true than that it was necessary in order to bring the gas companies to reason that an entirely new set of gasworks should be built. When, however, we see that while the average increase in the net profits made by the companies has increased nearly 80 per cent. between 1871 and 1882, and the net water rate by nearly 62 per cent., while the increase in the working expenses has only been 40 per cent., it may be seen that it is high time to call for regulation, especially in some cases, as, for instance, in that of the Lambeth Company, which has increased its net water rate by 91 per cent., its profits by 120 per cent., its working expenses having increased but 62 per cent.; and the Kent company, whose working expenses have increased but 30 per cent., while its rate has increased 77 per cent., and profits no less than 111 per cent. No wonder the income from a New River Company's share has reached no less than £2600, though in 1862, when that Company's property was even then a gold mine, the one share income was but £876. The Grand Junction Company has only increased its supply by from about 11,000,000 to about 12,000,000 gallons in the period referred to, so that the enormous increase in profits looks too much like an unearned increment on the sale of a necessary like water, for people to put up with a 56 per cent. increase in the rate in the same period.

From time to time proposals have been made to bring water to London from Wales, and from Cumberland and elsewhere, but all have fallen through, for Londoners naturally refuse to believe in the inferiority of the Thames supply, when the improvements which have been made since the 1871 Waterworks Act have brought the quality of the water up to that of the Loch Katrine supply, and while the London death rate remains amongst the lowest of all large towns. Recently a scheme for the supply of water to London, partly from the streams and springs of the chalk, greensand, and oolitic formations, and partly from the elevated hill districts of Radnorshire has been published by Mr. R. Hassard and Mr. A. W. N. Tyrrell, MM.I.C.E. This scheme looks to the time when London shall require 200 million gallons per day, and afterwards 330 million gallons; and the estimate for a supply of 220 million gallons by the well supply from chalk, greensand, and oolitic districts, including the 15 million gallons already supplied from the New River Company's chalk springs and the Kent Company's wells, is £10,789,825. The estimated cost of the works to get 330 millions is £20,500,000, when it becomes necessary to resort to the hill districts of Radnorshire. This latter supply would come from a number of small rivers, and it is not so easy to see that the objections which are urged against surface waters from agricultural districts cannot also be brought against those of Radnorshire, although the analyses given compare very well with the waters of the Thames. The authors of the scheme regard the waters of the Thames at the parts where the London supply is derived as "so hopelessly contaminated by sewage and other contaminations as to be quite unfit for domestic use;" but as this opinion is not generally held, and as the practical results do not support it, the new scheme must be looked upon as having quantity for its reason for existence. It yet remains to be proved that it is necessary to go from the Thames basin for all that is required if the Rivers Pollution Acts are strictly carried out.

TWIN SCREW ENGINES.

UNLESS some very excellent reason can be urged against the more extended adoption of twin screws, the system ought to be more freely employed than it is. Day after day we hear of the fractures of the cranks or screw shafts of ocean steamers; in fact, hardly a week passes without the occurrence of a casualty of this kind, and in nine cases out of ten large passenger steamers are the victims. This follows almost as a matter of course—the larger a shaft the more difficult is it to make it sound, and the more likely is it that it will get out of line. Then in full-powered steamers the strains are no doubt greater than they are in steamers of moderate speed. The engines are driven harder in all sorts of weather; and the shocks and strains to which the metal is exposed are augmented. Setting on one side the risk incurred when a shaft breaks, which is fortunately not very great, we have the cost, which is very heavy, to consider. The breakage of a shaft may represent in one way or another a dead loss of thousands of pounds, which falls, it is to be presumed, not on the owners but on the underwriters. Salvage often amounts to a very large sum. In one recent case £3000 expenses were incurred in this way alone by the failure of a screw shaft. If twin screws were used, the saving to underwriters would be very large—so large that they could take reduced premiums; and in this way the shipowner would be benefitted. We have already dealt very fully with the questions raised by the breakage of crank and propeller shafts, and we shall not go over the ground again. It is a noteworthy fact, however, that in no single instance have we heard any argument or objection urged against the use of some device which would ensure flexibility in the shaft, and so eliminate one of the most prominent causes of failure. No one has said that, of the numerous schemes before the public, any or all are bad. There is nothing but an obstinate prejudice, so far as we can see, standing in the way, and preventing the use on board ship of devices which might secure practical immunity from casualty. We recognise the existence of this inertia, and urge shipowners if they are obstinately bent on trying to get by brute force what would much better be obtained by skill and ingenuity, to try another alternative, and consider whether they would not on the whole be very much the gainers by using twin screws. That twin screws cannot be made to succeed mechanically is too obviously untrue to require more than a passing mention. In the Navy they enjoy high favour. For telegraph ships and for tugs they are much liked. It has been shown over and over again that they adapt themselves easily to the lowest, and it is unquestionable that they are admirably suitable for the transmission of the very highest powers. It is to the last degree unlikely that both engines in a twin-screw ship will break down at the same time; and the element of safety thus introduced into steam navigation is really of the greatest importance.

What, then, can be urged against them? When the City of Rome was laid down, the propriety of giving her twin screws was keenly discussed. It was considered by some engineers to be very doubtful if a single screw could use up without enormous slip the 10,000 horse-power which her engines were intended to develope. Finally, a single screw was adopted, and it was proved then, and has been proved again since, by the Oregon, that screws of less than 30ft. in diameter may be trusted to deal with over 10,000-horse power. The great objection urged against the adoption of twin screws in the case of the City of Rome was that much risk of breaking them would be incurred whenever the ship went into or out of dock. It is not, we think, quite easy to prove that any extra risk of the sort would be incurred; but we know that a fear of this kind has done more perhaps than anything else to retard or prevent the adoption of a system which has a very great deal to recommend it. There are, however, a good many twin-screw steamers afloat, and statistics showing how often and how much their propellers have suffered from the causes indicated would prove extremely interesting and valuable. In the absence of such figures, it is difficult to avoid the conclusion that the docking difficulty, as we may call it, is more or less imaginary—one of those difficulties, in fact, which grows smaller the nearer we approach them, until they vanish altogether as soon as an attempt is made to touch them.

The most tangible objection to the twin-screw system must be sought inside, not outside the ship. It is urged that two engines are heavier and more costly than one; that they take up more room, and require a larger outlay for attendance, repairs, and lubrication. However true this may be when we have comparatively small powers to deal with, it is difficult to see that there is much in the argument when we come to great powers. Two engines intended to develope 4000-horse power each ought not to cost more than one engine of 8000-horse power; indeed, it is questionable if they would cost so much. The large engine must have three cylinders, three frames, and three cranks. It would be impossible to make a double-cylinder engine of the power. The low-pressure cylinders can hardly be less than 84in. in diameter, and one cylinder to take their place would need to be 120in. Cylinders of this size have been put to work at sea, and are at work now; but the experience acquired with them has been unsatisfactory, and the power developed by engines with such cylinders has never, we believe, exceeded 5000 horses. Be this as it may, it is certain that 120in. cylinders are not now made, and thus, as we have said, for very large powers at least three cylinders must be used. With twin screws only four cylinders would be needed. For the sake of illustration, we may assume that a given engine has three cylinders, one of 60in. and the other two of 80in. diameter. Assuming the piston speed to remain the same, two cylinders of 43in. and two of 80in. would develope the same power. Thus, other things remaining the same, we should have two engines with 43in. cylinders instead of one with a 60in. cylinder. We do not say that these are the proper proportions to be adopted, but the figures we give will suffice to illustrate our meaning. It would be possible, and, indeed, desirable, to modify the strokes and the piston speeds, and thus still further to reduce the comparative cost and weight of the twin-screw engines. Furthermore, the crank shafts could be greatly reduced in dimensions, weight, and proportionate first cost. We believe that if proper estimates were got out by competent and experienced men, it would be found that the difficulty as to cost would vanish like the rest into thin air. As regards the engine-room staffs, oil, &c., the advantage would be on the side of the single screw; when heavy repairs had to be made, the advantage would lie with the twin screw. The paramount objection seems to be, after all, that twin-screw engines would take up more room than the single engine. This, we think, must be conceded. The question remains, How much more? This can only be answered when all the facts of any particular case are before us, and even though it is granted that in the matter of space occupied the twin screw is at a decided disadvantage, it remains to be seen whether the extra space taken up could be utilised in any other way.

Nothing, we may say in conclusion, is more wanted than definite information concerning the relative cost, weight, space, economy of fuel, and power of twin and single screw engines; and we commend the subject to our readers as one admirably adapted for a paper to be read before the Institution of Mechanical Engineers or Naval Architects.

WATER-TUBE BOILERS.

The water-tube boiler is probably very nearly, if not quite, as old as any other in use; but it has never enjoyed much popularity, at least in this country. In the United States the Babcock and Wilcox, and in France the Belleville boiler, have been diligently pushed, with the result that a goodly number of both have been put to work. In this country at the present moment it may be said that there is only one form of water-tube boiler—namely, Root's—in use. The exceptions are very few indeed, certain Howard boilers in use in Barrow-in-Furness being the most noteworthy. The advocates of the water-tube boiler attribute its neglect to prejudice; but prejudice has very little to do with the progress of engineering matters. It may delay, it does not absolutely stop. In selecting a boiler the steam user is usually anxious to get the best thing that can be had of its kind, and if it could only be proved conclusively that the water tube boiler was the best it would be used. But this is exactly what cannot be proved; and there are certain well understood and grave objections to all water-tube boilers which have done more than anything else to prevent their extended adoption. As time rolls on we see types of mechanism rise and fall in favour. That which was once little known and despised becomes fashionable; while things which once stood high in the opinion of the world die out and are lost to sight. The water-tube boiler a few years ago made a great sensation. It was tried on a colossal scale in the s.s. Montana. The ship only made one experimental trip with it; her boilers, at all events, were an utter failure. The Howard boiler was much talked of, and the patent rights were bought for a large sum by a limited company in the North. A few boilers are made now, but they are very few. The only type which has made any mark is, as we have said, Root's; it lived while its rivals died. Just now attention is once more being turned to the subject. The Babcock and Wilcox boiler is being pushed in this country; and those who can read the signs of the times know that a good deal will be said in the immediate future concerning water-tube boilers. They have been out of favour for a time; they are coming to the top again. This is the reason why we say anything about them.

It is claimed for the water-tube boiler that it is cheaper, safer, and more economical than the Lancashire, Cornish, locomotive, or marine boiler. We may for the moment concede all this for the sake of argument, and proceed to ask, How much? How much cheaper? How much safer? How much more economical is it than, let us say, a first-rate locomotive or Lancashire boiler? To these questions we have never yet seen anything like a definite and complete answer. We do not now speak of any particular boiler, but only of the type—only, in short, of boilers in which the water and steam are inside a considerable number of comparatively small tubes or pipes. So far as we are aware, there is not the smallest reason to think that such boilers are more economical as a class than Lancashire boilers as a class. If the contrary is the case, the facts have never reached us. Particular boilers of the Lancashire type have been beaten by particular boilers of the tubulous type, and *vice versâ*. This proves nothing. Taken as classes or types, we suppose there is very little to choose between Lancashire, locomotive, or water-tube boiler in the matter of economy of fuel. As regards cost it is not easy to arrive at facts. As far as we know, the difference, if any, is small. The water-tube boiler cannot be sold and, erected, and put to work, at a much less price than its rivals. Concerning safety we speak with considerable hesitation. There have not been any factories destroyed by tubulous boilers. This much we concede at once. But there have been several bad accidents with them, and not a few lives have been lost. Not many accidents and not many lives lost in the abstract, but a fair proportion, if we bear in mind that the number of water-tube boilers at present at work is very small. Thus, then, it seems to be clear that the tubulous boiler is in no good sense pre-eminent. It cannot give its rivals a thorough beating. It may be a very excellent type of generator, but it is not prominently the best type, and this has retarded its adoption.

So far we have said nothing concerning its demerits. It is necessary to refer here to only two. These are its tendency to prime and its tendency to boil dry when pushed. No doubt we shall receive a number of letters from various makers asserting that their boilers, although tubulous, never prime and never boil dry. That exceptional boilers possess these merits we shall not pretend to dispute; but this does not affect the fact that this type of boiler has a reputation for priming and boiling dry. This is not disputed by the advocates of this class of steam generators; on the contrary, each inventor insists on it, pointing out that all other water-tube boilers, save that particular one in which he is interested, are primers. As we have said before, we are not now concerning ourselves with any particular make of boiler, but only with the class as a whole, and we repeat that it is generally admitted that it primes. This is a very bad fault; and there seems to be only one way in which it can be got over, namely, that pointed out by Dr. Ernest Alban, of Mecklenburgh, nearly forty years ago. It consists in letting the boiler prime as much as it likes, and catching the steam and water in receivers, where separation takes place, the water returning to the boiler and the steam to the engine. All modern successful tubulous boilers are fitted with receivers, sometimes two or even three being attached to each boiler. We do not know that there is anything objectionable in this, but it sometimes happens that space can only be found with considerable difficulty for the tubes of considerable dimensions which constitute the receivers and separators; and it is doubtful at the best of times if boilers of this class supply steam as dry as that which may be had from more commonplace generators. As to boiling dry, that will not take place unless the fires are pushed. It will not perhaps take place in some water-tube boilers at all. As a general rule, however, the water-tube boiler does not lend itself kindly to being forced, and the larger it is for a given power the more satisfactory will be found its performance.

We have certainly no desire to do the tubulous boiler any injustice. We have written concerning it according to our lights, and we shall go so far as to add that in our opinion most steam users will endorse all that we have written. We have, so to speak, endeavoured to formulate popular opinion on this subject. We are quite open to conviction; we are willing, indeed, to admit that the tubulous boiler is as good as any other, but we are not disposed to go further. It would, however, interest us, and no doubt many of our readers, very much if some one—an authority—well skilled in steam boilers would set forth in our correspondence columns the merits of the water-tube boiler. Let us, as we have begun, keep clear of special boilers, and deal with the type as a whole. Such an end would, perhaps, be best attained if our correspondents would each write about someone else's boiler. Thus the representatives of Messrs. Babcock and Wilcox might take the Root boiler, and show that it is really better than any Cornish or Lancashire boiler; the representatives of the Root boiler might in turn show the good points of the Babcock and Wilcox boiler, and so on. We have no doubt that in this way a considerable amount of useful information might be obtained. The whole subject would be brought before the steam user with some semblance at least of novelty, and we should have a statement of recent experiences which could hardly fail to be at once interesting and instructive.

THE 112 LB. STANDARD WEIGHT.

The British Association of Inspectors of Weights and Measure which was formed in Manchester about three years ago is taking up the question of the proposed new standard weight of 112 lb., and at the annual meeting which is to be held in Glasgow during the present month a resolution is to be submitted which closely affects the interests of ironmasters with regard to this matter. The resolution to be proposed is to the following effect:—"That the members of the British Association of Inspectors of Weights and Measures respectfully submit to the Board of Trade that they do not consider it at all necessary that a new standard weight of 112 lb. should be legalised, and for the following reasons:—That it is so near the size of the cental or 100 lb. weight, and in consequence liable to be used fraudulently; that anyone requiring such a large weight could use the already legalised cental; that if a concession is to be made to one business, can the Board of Trade consistently refuse to grant a special weight to any other business; that the concession asked for by the ironmasters, if granted, will destroy the main principle of the Weights and Measures Acts, 1878, as therein expressed, which is uniformity." Another question of considerable importance that is also being brought forward specially for consideration is with regard to the weights and scales used for Government purposes, and resolutions are to be submitted in which the opinion is expressed that it is not only desirable, but absolutely necessary, for the protection of the public, that duly authorised inspectors of weights and measures should be empowered to enter any place where weights and scales are kept and used by employés of the Post-office, and that the attention of the Board of Trade should also be called to the continued use of the old troy weights in some districts and in Government offices, and that the stamping of new weights of such denomination is clearly illegal.

PUBLIC WORKS IN NEW SOUTH WALES.

We have from time to time given our views on the management of public works in the Colonies, and especially those in Australia. We now draw the attention of our readers to the first of a series of letters which appears in our columns this week from a correspondent in New South Wales, specially qualified for the task he has set himself of informing his countrymen in England of the last phases in Colonial mismanagement, to which we have so often had to take exception. New South Wales owes much of her prosperity to the sensible way in which she has kept clear of the errors of her neighbour Victoria. A most interesting account of the progress of these two Colonies is to be found in Mr. Richard Tangye's new book of travels, which we recommend to our readers, and of which we may have more to say on a future occasion. It appears that the manufacturers in Sydney who desire to adopt the protectionist laws of Victoria have adopted the indirect and unfair method of discrediting the quality of engineering material imported from England. The means by which this is attempted will be found in the letters from our correspondent "N. S. W.," to which we have above referred. It may be natural and excusable for Colonial manufacturers who aim at making rails and bridges to claim prohibitory customs' duties, but to decry, as a means to their own benefit, the quality of the goods manufactured by the leading firms in England, and to praise by inference the work of their own hands in the Colony, is going further than might be expected. Meanwhile, our manufacturers at home are busier than ever on Australian orders, and those who are responsible in New South Wales for the proper disposition of the public money have as yet prevented in the interests of the community that misappropriation of the funds entrusted to them which would be the immediate result if the intrigues now in progress were to succeed.

LITERATURE.

British Mining: A Treatise on the Metalliferous Mines of the United Kingdom. By Robert Hunt, F.R.S.; 8vo., pp. 994. London: Crosby Lockwood and Co. 1884.

The author of this large volume has, as those of our readers who are interested in metal mining well know, been occupied for nearly forty years in the collection and reduction of the terms of the produce of the mineral workings in the United Kingdom. Before the year 1845 no attempt at the collection of mineral statistics, from the country as a whole, had been made, and it is practically to Mr. Hunt's exertions alone that the system that prevailed up to the year 1881 of publishing returns obtained by the voluntary co-operation of the mineowners was elaborated. Latterly, however, new ideas have prevailed, the voluntary system has been given up, and the plan of compulsory returns under the provision of the Mines' Regulation Acts has been adopted instead. This has necessitated the transfer of the work to the Home-office, the old Mining Record-office being abolished. With the termination of the activity of a very useful branch of the public service, which has in its time served as a model for similar establishments in foreign countries, and which was always honorably distinguished by being the earliest in the field with its work, while most foreign Governments were two years or more in arrear with the returns, the author has done good service by the publication of this present work, which in some way represents that done as a whole by his office during its continuance. In view of the very large amount of information contained, it will not be possible to give more than a general idea of the contents of the volume. These are comprised under four following heads, namely: (1) Historical sketch. (2) The formation of mineral deposits. (3) Practical mining. (4) The future of British mining.

The first, or historical section, includes notices of all the prominent mines at work before the end of the eighteenth century, commencing with the tin streamers of Cornwall, who in pre-Christian times traded with the Phœnician merchants at St. Michael's Mount, or wherever else the Iktis of Diodorus may have been. Then follow notices of the different Roman lead mines in the Mendips, Shropshire, Derbyshire, and elsewhere, and the copper mines of Pary's Mountain, Anglesea. The introduction of German miners into England in the reign of Elizabeth in 1570-80, marks the commencement of copper mining on the great scale, and what manner of men these were is amusingly set forth in the narrative of the doings of Ulrick Frone at Perran Sands in Cornwall, and Daniel Hochstätter in Cumberland, as collected by the late Colonel Grant Francis from documents in the Record-office and elsewhere, which the author has laid under contribution with due acknowledgment. These foreigners are also credited with the introduction of the divining rod into Cornwall. The next great events in our mining history are the successful working of the Cardiganshire mines in the beginning of the seventeenth century by Sir Hugh Middleton, and their less successful continuance by the Company of Mine Adventurers, which lingered on till the middle of the eighteenth century. The last of the great historical mining companies, the London Lead Company, formed by the Society of Friends in the reign of William and Mary—1690—and still at work, at one time carried on mines on both sides of the Pennine chain in the Northern counties, but at present its operations are confined to the valleys of the Tees and Wear in Durham.

The second book on the formation of mineral deposits is divided into four chapters, treating respectively of (1) The Rocks of Mining Districts and the Distribution of Metalliferous Deposits; (2) Mechanics of Mineral Veins, Faults, Cross Courses, &c.; (3) The Laws relating to

Mineral Deposits; (4) Remarkable Phenomena observed in Ore Deposits. Under the first of these different heads are included notices of the more important districts; and under the last of these of the most remarkable mines in Cornwall and elsewhere, the latter being illustrated with plans and views in considerable number. Among these the plans and sections of the Parys and Mona mines in Anglesea may be noticed as especially interesting.

Book third, or that on practical mining, contains notices of the leading improvements into the working of mines of late years, and more particularly of boring machinery, which is treated in very full detail, and is perhaps the best compendium of information upon this important subject that has as yet appeared. The subject of dressing a mechanical preparation is also very fully treated, the newer forms of machines for dressing fine stuff and slimes, upon which the successful handling of the masses of poor stuff produced in most large mines at the present so much depends, receiving especially full and careful notice. A table on page 91, defining in few words the functions of each of the different kinds of crushing, sizing, and separating machines, will be found to be extremely useful as an *aide memoire* in planning dressing floors. In the fourth and final book, the future prospects of British mining are discussed somewhat hopefully, the author arriving at the conclusion that there is little chance of the Cornish supply of tin ore giving out within depths that are still quite attainable, though there is less promise for the future of lead and copper mining. In these the question of foreign supply is largely involved, and especially in the case of lead no great improvement can be expected so long as the enormous production of Spain, Germany, and the United States is maintained. The author concludes with a few wholesome remarks on the necessity of economy and honesty in all departments of British mining if foreign competition is to be successfully met.

The statistical matter contained in the text is supplemented by a copious appendix, and there is also a glossary of the principal terms used in the different mining districts of the United Kingdom.

From the above brief notice of the contents of the volume it will be readily understood that it is not a systematic treatise upon mining, either in form, or technically, or from a historical point of view, but is rather to be regarded as supplementary to such treatises; as containing a mass of information not elsewhere available, and as such, of the greatest value to those who may be interested in our great mineral industries.

The volume is very handsomely got up, both as regards printing and illustrations; but it is decidedly unwieldy. It is to be hoped that the *edition de luxe* mania is not going to take hold upon our scientific works as it has done in general literature. For all practical purposes it would have been better to have divided the work into two volumes, a course that will probably be followed by most of its readers when rebinding it.

THE EXTENSION OF INDIAN RAILWAYS.

WHEN Parliament resumed its labours after the Easter recess, Committees on both public and private Bills and questions developed a surprising degree of energy, as though the work entrusted to them was a real pleasure. That members of Parliament generally are gratified at being told off for this kind of duty it is not easy to imagine, but it is one of the conditions of a seat in the House, and it must be admitted that hon. members discharge the task as a rule with creditable zeal and efficiency. The gentlemen who move for Select Committees, and the promoters of private undertakings are, of course, delighted to obtain these Committees, but the pleasure is generally limited to them, and the other members have to go through the labours allotted to them with as much grace and attention as they can muster. Occasionally a question comes up for the consideration of a Select Committee, in which a large number of gentlemen are interested, and this is especially the case with regard to Indian subjects. On both sides of the House there are gentlemen who have either spent many years in India in an official capacity, or have made Indian affairs a special object of study at home; and to these a large and an elaborate inquiry affecting our Eastern Empire appears to be a great source of satisfaction. Each hon. member, of course, considers himself an expert, *facile princeps*, and a place on a strong Parliamentary Committee gives him great opportunities of displaying his knowledge and opinions. Such a Committee is that appointed several weeks ago to consider the knotty question of developing the railway system in India, on the motion of Mr. Slagg, one of the members for Manchester, largely interested as a merchant in the commercial condition of India. Of the early proceedings of this Committee, which numbers nineteen members, we have already given some account, and we may now return to the subject.

Under the chairmanship of Mr. Baxter, this Committee have held two or three further sittings since Easter, at which various kinds of evidence has been taken. In the course of the further investigation Mr. Bullen Smith, speaking largely for the East Indian Association, recommended that £10,000,000 annually should be spent in the construction of additional railroads, under the guarantee system; but he prudently added that as India itself could not bear this burden, the money should be raised in England. Mr. Lord, a Manchester merchant, who twenty years ago was engaged in business in Bombay, and while President of the Chamber of Commerce of that city—as he has since been of the Manchester Chamber—traced the improvement in the quality of Indian cotton largely to the railway facilities for the cotton trade, and the stimulus given by the railroad system to the cultivation of cotton. From this he argued that a further development of the railroad system would produce like results in regard to other valuable commodities, especially wheat and other grains. He advocated the broad gauge principle for the main lines, and said he was so satisfied that the Indian railways would in the end pay, that he would prefer to see them owned by the State—with a view of course to the profits of the future going to the State—instead of to private owners. At the same time he admitted that there were certain objections to a State ownership of the railways, one of which was that if the Government strove to construct new railways too rapidly and with borrowed money, the railways would suffer in the event of a war or of financial deficits. On these grounds he rather abandoned the notion of State-made railways; but still he urged that the Government should assist private enterprise in that direction, seeing that the probable dividends would not sufficiently tempt English capitalists. Therefore he thought, with Mr. Bullen Smith, that the Government might appropriate £10,000,000 a year for this purpose, but proposed that one-fourth of that sum should be raised in India. Mr. J. K. Bythell, a Bombay and Manchester merchant, stated that no less than five millions yearly had been spent on Indian railways between 1860 and 1884. For the greater part of that time the annual deficit had been two millions, but that had now been charged to an annual surplus, and therefore he contended that the Government might and ought to spend at least four millions a year more than the average of recent years upon railway extensions, and urged the Committee to recommend that policy. On purely financial points, Mr. Hardy, secretary to the Bank of Bengal, was examined. He gave it as his opinion that the two-and-a-half millions which the previous witness had said should be raised in India were more than could be borrowed in that country with advantage, seing that about one of the two-and-a-half millions which was borrowed in India was absorbed in India itself. He was, however, disposed to leave it to the Government of India to borrow in both countries as they should think desirable, and he stated that there was a strong public feeling in India in favour of a further and a larger development of the railways. This opinion, however, he admitted was European; but then he rightly pointed out that the natives as a rule took no interest in the subject, and certainly did not subscribe the capital.

One of the most valuable witnesses yet examined was Major Conway Gordon, Accountant-General of the Public Works Department in India, who gave evidence on three main points, viz., the rate of expenditure on railways proposed by the Government of India, the class of works proposed by the Government, and the alternations proposed by the Government with regard to borrowing for public works. On the first point he stated that the Government contemplated spending during the next five years, directly or indirectly, through companies, £33,462,000, leaving private persons to spend £24,288,000, making £50,000,000 altogether. Of the £33,462,000, £28,262,000 would be for new railways, and the remainder for improvements and extensions of existing lines. Also of that total sum, £17,822,000 would be spent by the Government directly, the balance through private agencies. He mentioned that the charge to the public for public works was gradually decreasing, and the Government of India had good reason to anticipate that before very long they would be able to do all the work without any such charge on the public, except in regard to the loss by exchange, by means of railway, irrigation, or other works. Of the £17,822,000 to be spent by the State directly, £11,000,000 would go to constructing 1647 miles, £2,899,000 on 499 miles, and £48,000 on one mile to be constructed. To this would be added £700,000 for working expenses and surplus stores, £1,500,000 additional outlay on existing lines, and a like sum on the East India Railway for improvements and extensions. With respect to the second point, viz., the class of works proposed, he said it was proposed that the restrictions imposed by the existing regulations should be removed, and the Government of India be left to carry on their work on the principle of the sum borrowed being always governed by the possibility of good works being carried out without involving further burdens upon the people; and on the third point he stated that the view of the Government was that the annual loan of £1,800,000 should be increased by £350,000. Mr. R. W. Crawford, chairman of the East India Railway, was also examined. He entered into a lengthy statement as to rates and conditions of existing lines in India, and expressed the view that there was no real demand for new railways, and that probably not one person in a hundred had taken part in the supposed agitation for a further extension of the system.

The Committee do not seem to have been able to get along far without the assistance of Major Gordon Conway, Deputy Controller of the Public Works Department of India, for once more at the sitting following those above noticed he was called into the chair as a witness. He then gave further particulars as to the probable cost of the railways which the Government of India contemplated being made, and other details bearing on the same project. Speaking upon the railways which had already been constructed, he mentioned that the only one that was not likely to pay was the Raipur-Vizagapatam line. The policy and first aim of the Government, he explained, was to make lines to protect the country from famine, and of course such protective lines were most required by the least populated and least productive districts. He expressed the view that some of the railways now being made were likely to prove remunerative, and that even in parts of the country not likely to pay, the people would not sell their surplus produce in prosperous years and leave themselves without in famine or bad years. But even if that were likely to be done, if railways were made to a sufficient extent supplies could always be obtained, because famine never prevailed over the whole country at the same time. Upon the question of roads *versus* railways, he advised the construction of railways, on account of the expensiveness of making roads in some districts, and also because the extension of the railway system would promote the prosperity of the country generally, increasing the production, and proportionately raising the prices. After giving the Committee an idea of the amount of land still awaiting cultivation and development by the help of railways, Major Conway mentioned that between Moollan and Lahore there was land waiting for the plough like an American prairie, but that a canal would be necessary to irrigate that land. A company which Messrs. Hoare, Millan, and Co. were to promote was to have the right, if formed, of purchasing the Chattingur State Railway at cost price, and to change it from the metre gauge to the broad gauge. The Government of India would pay a dividend of 4 per cent. on the cost of the standard gauge line up to a limit of five crores of rupees, the guarantee to be limited to seven years. They would also have to supply the land, but they would have the right to purchase the railway on certain favourable conditions, and at the same time they would have control over the rates. The completion of this scheme had, however, been suspended until this Committee had concluded their inquiry and reported.

On Tuesday last the Committee met again, and on that occasion they took a different class of evidence. Mr. Kendel, consulting engineer to the Secretary of State for India, instructed the Committee on the traffic, capacity, and construction of various Indian railways, referring specially in regard to the latter point to the adoption of the narrow gauge. The cost of the narrow gauge, he explained, was only £4500 a mile, as against £6000 a mile for the broad gauge, and he further assured the Committee that the cost of working was also in favour of the narrow gauge even where there were heavier gradients, higher charges for coal, &c. In the same spirit he combatted the view that there was inconvenience in a break of gauge. At the same time he discouraged a too rapid construction of railways in India because of the difficulty of obtaining properly qualified engineers, though apart from that consideration, he was anxious to see a large development of lines, more especially as he believed they would prove a valuable source of revenue in due time.

THE ALBERT EXHIBITION PALACE.

ON page 443 we give illustrations of the ironwork of these buildings, which explain themselves. In our last impression, page 432, we described the building at some length, and we referred to the exceptionally fine organ, which will no doubt constitute one of its principal attractions. We now add the following particulars concerning this instrument taken from a printed description of it:—

It has long been known to the musical world as perhaps the most perfect organ extant, both for musical tone, balance of power, and constructive art; indeed, with the exception of the great organ at Haarlem, there is no instrument that can compare with it for beauty of effect, and the Holmes organ exceeds even the latter instrument in size, power, and sweetness. It may be here mentioned that the late Chevalier Lemmens was for more than two years an almost daily student at this instrument, avowing that it was the only organ in the metropolis worthy of being studied and performed upon, and when it is considered that it embraces thousands of combinations, each one capable of producing the most varied and pleasing effects, the resources at the command of the player are endless and worthy of special study, such as the late Chevalier Lemmens bestowed upon it. The foundations for the organ are complete, and the re-erection will be commenced without delay and will likely be completed within six weeks. This great organ stands 50ft. high, exhibiting a bold and imposing front, of the 32ft. metal double diapason pipes massed in three towers, with a succession of large scale pedal pipes on each side, and double tiers of 8ft. work on each side the central tower, the entire front being over 30ft. in width, and the organ itself from the console 30ft. in depth. In addition to the height of the case work an additional 13ft. has to be added for the wind arrangements, bringing up the total height of the instrument from the foundation to 63ft. The organ has four manuals of the usual five octave compass, with a pedal board of $2\frac{1}{2}$ octaves. It consists, however, of six distinct organs and not five, the highest keyboard serving for an "Echo" organ as well as for a "Solo" organ, the "Echo" being placed at some distance from the great organ, and controlled by electric action. The number of speaking stops is as follows:—Pedal organ, 11, including metal double open diapason, and contra bombarde, each of 32ft. speaking length; great organ, 14 stops; choir organ, 12 stops; small organ, 16 stops; solo organ, 5 stops; echo organ, 6 stops; and there is a carillon of 61 bells—five octaves—making a grand total of 65 sounding stops, every stop extending throughout the entire five octaves on the keyboards, in addition to which there are thirty combination accessory movements, bringing up the entire total to ninety-five mechanical registers distributed between the hands and feet that control the tone colour of the instrument. The number of pipes at the performer's command is over 4200, the wind to fill them being supplied by a steam engine of 11-horse power. Every approved modern invention is applied to this gigantic instrument, which forms one of the most perfect examples of the organ builder's art. The following detailed description of the instrument may be read with interest by the general public, who so far have not had the opportunity of hearing it in Mr. Holmes' private concert-room at the Hall, Primrose Hill. The great organ is controlled by the lowest keyboard, the choir by the second keyboard, the swell by the third, the solo by the fourth keyboard, and the echo organ by the fourth. The necessary changes of tone are effected by means of eight combination pedals, and a series of eight small pistons placed between the keyboards, both of a new construction. The soundboards receive the wind at various pressures from fifteen separate reservoirs, which derive their supply from the main bellows, placed in the basement. The regulation of the wind supply is automatic. The keyboards are detached from the organ itself, and reversed in position, so that the player faces the audience, and is enabled to hear the various effects of tone produced without difficulty. Every stop extends throughout the entire manual compass, and the keyboards are constructed so that a passage of organ music can be readily played on two adjoining rows of keys by the same hand. The various stop handles are within convenient reach of either hand, and do not ascend beyond the level of the fourth keyboard. Vacuum pneumatic instantaneous drawstop action is applied to the whole of the registers of the several organs. Vacuum pneumatic touch is applied to the great, swell, and pedal claviers. The couplers and other accessory appliances are acted upon by a system of pedals; and a tremulant, also brought into operation by means of a pedal, can be applied to any of the reed stops in the swell and solo organs. The *vox humana* stop in the organ is one of the finest in Europe. The instrument contains two stops of 32ft., ten stops of 16ft., thirty-three stops of 8ft., twelve stops of 4ft., one stop of 3ft., four stops of 2ft. speaking length, three compound or mixture stops, and seventeen reed stops. The largest pipe in the organ is to be found in the central tower, and is in metal, 38ft. high and 20in. in diameter; vibrating thirty-three times in a second, and sounding the lowest C of the musical gamut; the weight of this pipe is about one ton. The organ is to be erected at the end of the Connaught Hall at the Albert Exhibition Palace, and will present a commanding appearance. The instrument was inaugurated in January, 1876, by a series of recitals, Mr. W. T. Best, the designer of the instrument, presiding on the opening night; M. Guilmant, the well-known organist of La Trinité, Paris, presiding at the second recital; and the celebrated Belgian organist, M. Lemmens, occupying the instrument at the third recital.

It may interest the musician to note the relative sizes and magnitudes of the Holmes organ, and the two most celebrated and best known of the European organs—namely, the great organ of the Cathedral Church of St. Bavon, Haarlem, and the great organ of St. Nicholas, Freiburg, Switzerland.

The Haarlem organ was built by Christian Müller, of Amsterdam, and was commenced in 1735, and finished in 1738, occupying nearly $3\frac{1}{2}$ years in construction. It contains sixty sounding stops, all being through stops, except the cornet and hautboy in the great organ. The 32ft. metal pedal pipe in the front tower is 39ft. long and 15in. in diameter. There are two stops of 32ft. speaking length on the pedals. The organ has no composition pedals or other mechanical appliances, except two couplers and a tremulant. It stands 90ft. high, 50ft. broad, and 14ft. deep.

The Freiburg organ, built by Aloise Mooser, of Freiburg, was commenced in 1827, and finished in 1834, occupying nearly eight years in construction. It contains sixty-one sounding stops, all being through stops. The organ has no stop of 32ft. speaking length upon the pedals, and has no composition pedals or other mechanical accessory movements.

The Holmes organ, built by Bryceson Brothers, of London, was commenced in 1872, and finished in 1875, occupying over three years in construction. It contains sixty-five sounding stops, all of which are through stops of five octaves, and a carillon of sixty-one metal bells. The organ has nine couplers and twenty-one mechanical combination and accessory movements. The echo organ is erected as an independent organ at a distance of 100ft.

WILLAN'S ELECTRICAL GOVERNOR.

Fig

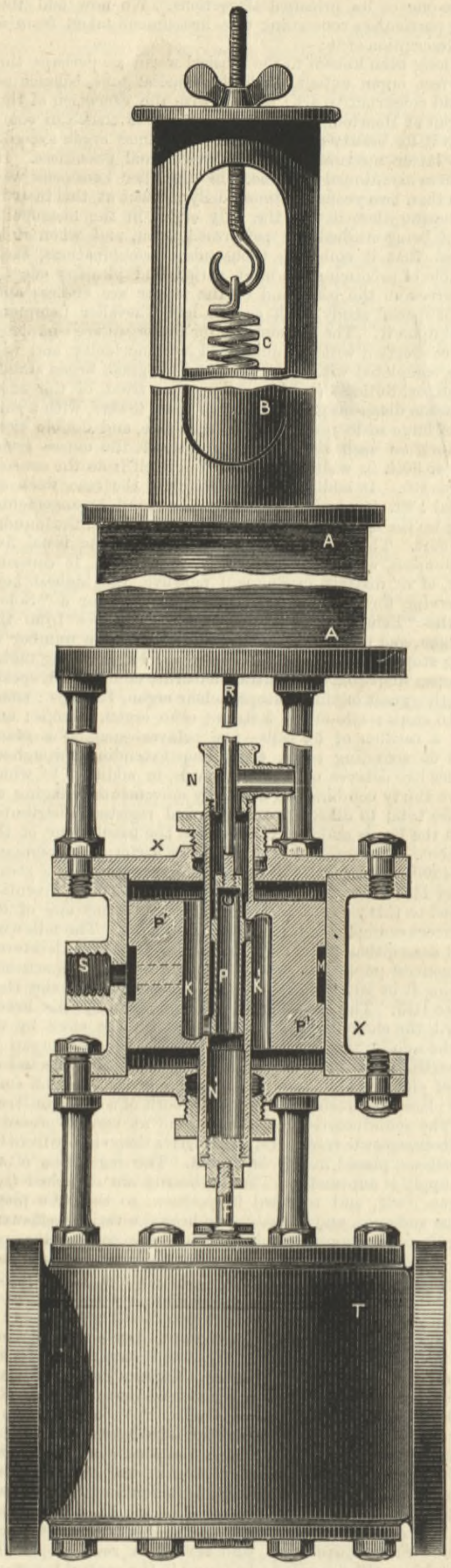
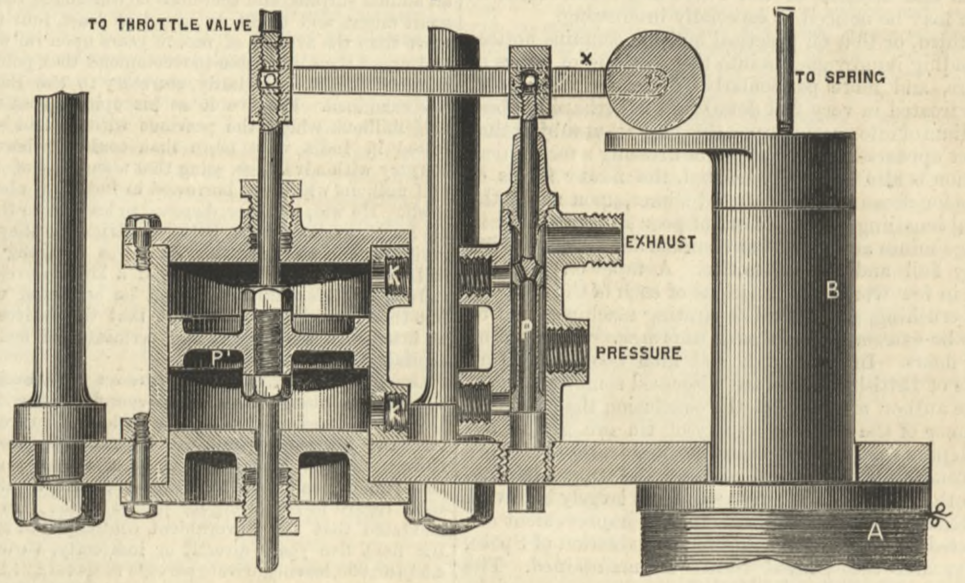


Fig. 3

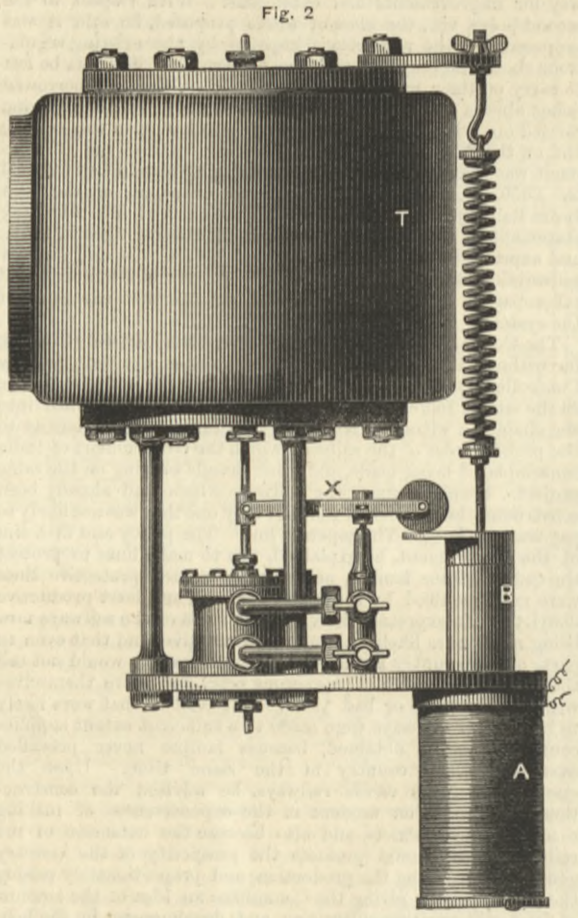


THE engravings given above illustrate a form of electrical governor for controlling the speed of engines driving dynamo-electric generators, invented by Mr. P. W. Willans, of Thames Ditton, and applied by Mr. R. E. Crompton at the Victoria electric lighting installation and elsewhere. The governor consists essentially of a solenoid and core, by the action of which the movements of a small valve, which controls the stroke of a hydraulic piston, connected to a piston throttle valve, are determined. The solenoid thus has but little to do, although it controls a large steam valve. In following the description, it must be borne in mind that the function of this governor, unlike that of all others, is to vary the speed of the engine, not to keep it constant.

In our engravings, Fig. 1 shows the standard form of the governor, and Fig. 2 a special form as adapted to the engines at Victoria. In Fig. 1 A A are the coils of the solenoid, and B is an iron core suspended inside it by a spring, so adjusted that when the desired strength of current is passing through the coils, the core shall occupy a position in which a small movement one way or the other shall not materially affect the strength of the pull upon it. The solenoid, it will be understood, is pulling against the spring, so that if from any cause, such as a reduction in the number of lamps, the current becomes stronger, the core will be drawn downwards; if, on the other hand, the current is weakened, the spring will overcome the pull of the solenoid, and will raise the core. The latter is connected by the rod R with a small double piston valve P, which works inside the main hydraulic piston P^1 as the latter works inside the cylinder X. The hollow piston-rods N and N^1—connected with P^1—pass through the ends of the cylinder X, and N^1 is connected by the rod F with the throttle valve, or, if so desired, with the expansion gear of the engine, as for example with the quadrant of the ordinary link motion. The piston P^1 has an annular space round it M, into which water or other fluid pressure is admitted by the pipe S. By a passage therefrom, shown in dotted lines, the annular space M communicates with the annular space between the two pistons which form the piston valve P. A passage K leads from the lower piston of the piston valve P to the upper end of the cylinder. A similar passage K^1 leads from the upper piston of the piston valve P to the lower end of the cylinder.

In the position shown the current is supposed to be constant and the mechanism is at rest. If now the current is increased, the piston valve P is lowered by the lowering of the core B, and pressure is admitted to the top of the piston P^1 by the passage K, which is uncovered by the upper piston of the piston valve, and at the same time the space below P^1 is opened to the exhaust by the passage K^1 and the hollow rod N^1. This causes the piston P^1 to descend, and as it descends it closes the throttle valve by means of the rod F, and reduces the speed of the engine and dynamo, which in turn weakens the current and so stops the downward motion of the core B and the piston valve P. The latter coming to rest is immediately overtaken by P^1, and the passages K and K^1, being brought opposite to the now stationary piston valve, are closed, and the motion of P^1, owing to

Fig. 2



the inelastic fluid employed, is also immediately arrested. If the current is weakened the reverse action takes place. The sequence of the various actions described is extremely rapid, and consequently the piston P^1 follows so closely upon the piston valve P that the stopping or slowing of the latter produces an instant effect upon the motion of P, and "hunting" is entirely prevented. P^1 cannot go too far and overdo its part.

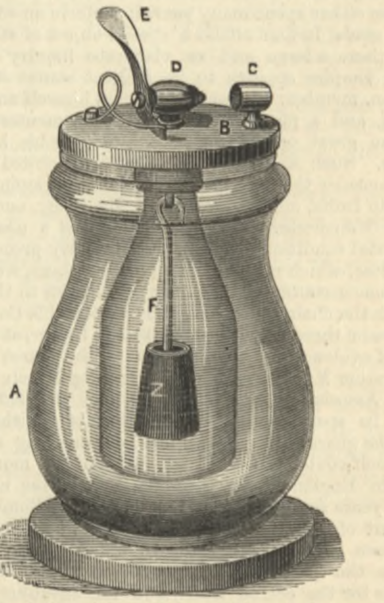
Another way of attaining the same result is to connect the piston working the throttle valve, the core of the solenoid, and the piston valve to different points in a bar. Fig. 2 shows an arrangement of this kind. In this and Fig. 3 A are the coils of the solenoid, B the iron core sheathed with brass and carrying an ear upon which rolls a roller on the bar X. To this bar is connected the piston valve P. X is jointed at another point to the rod which connects the piston P^1 to the throttle valve in a cylinder T. When the spring overpowers the current and the piston valve P is raised, water or other fluid pressure is admitted by the passage K to the upper side of the piston P^1, and the throttle valve is opened. When the current overpowers the spring and the valve P is lowered, the fluid pressure passes in like manner by the passage K^1, to the underside of piston P^1, and the throttle valve T closes. As the piston P^1 rises it raises the bar X with it, and consequently the piston valve P, until the latter has again closed the passages K and K^1 leading to the cylinder in which the piston P^1 works, when the mechanism is at rest. This is analogous to the "overtaking motion" in Fig. 1, and both are related to the so-called hunting gear or "differential action" applied in steam steering gears and elsewhere. But it is impossible not to be struck with the beauty of the present application, which gives to such a weak and sensitive instrument as the solenoid the most absolute control over the powerful governing agency of hydraulic pressure.

The governor has already been applied in several installations beside that at Victoria, and governors are in hand for upwards of a dozen others. The advantage of a system of regulation which permits both engine and dynamo to run slowly when little work has to be done, and fast only when the work increases, is obvious enough, for although self-regulating machines have been brought of late to a high degree of perfection, it cannot be contended that the maintenance of a constant high speed is so good a thing in itself, however necessary it might appear so long as the only known means of automatically regulating an engine involved running it at an invariable speed. But the advantages of the new system are not limited to reduction in wear and tear of engine and dynamo, and therefore in the expenses of working. It is urged that the first cost of the installation is reduced by the substitution of a plain shunt-wound machine for the more costly self-regulating type, and it is claimed, further, that the results are considerably more perfect. The variation in electro-motive force is, we are told, certainly less than 3 per cent., and, as a rule, less than 1 per cent., even under tests of much more severe character, as regards variation in the number of lights, than any installation is likely to be exposed to in practice. We understand that a later patent of Mr. Willans covers a great number of variations in the form of the governor described above, and provides also for those cases where water pressure cannot be applied with convenience. We shall probably illustrate some of these forms upon another occasion.

The governor is manufactured by Messrs. Willans and Robinson, of Thames Ditton, Surrey, by whom the well-known Willans' engine is also made.

HYDROGEN LAMP.

THE hydrogen lamp which we illustrate by the accompanying engraving is a recent application in a very convenient form, by Messrs. Newton and Co., Fleet-street, London, of the fact that a stream of pure hydrogen striking on spongy platinum makes the platinum red hot—so hot, in fact, that the platinum in its turn ignites the gas; and we refer to it here, not only as a very clean and convenient source of occasional light, but because the arrangement comprises an ingenious idea, which should be applicable electrically. The lamp consists of an outer jar A, containing slightly acidulated water, and hanging from the brass top B is a bell-shaped glass jar F, without any bottom, and closed at the top by a stop-cock D. A small nozzle is attached to the stop-cock, and opposite it is fixed a brass cap C, containing a piece of spongy platinum. Inside the glass bell is a wire, on which is hung a piece of zinc Z. The glass vessel A is



filled to a depth of 4in. with a mixture of 1 part of pure sulphuric acid to 14 parts of water. When the brass top is put in its place with the bell glass hanging in the acid, the bell glass being closed at the top, will, of course, be full of air. By means of the lever handle E of the stop-cock the air is let out and the acid rises and covers the zinc, producing immediately bubbles of hydrogen gas.

The gas so produced in the bell glass forces out the acidulated water, which will accordingly rise to a greater height in the outer vessel. The gas in the bell is therefore kept under a constant pressure of about 4in. of water, while the zinc hangs free from the acid, thus stopping all action until the lamp is used. When a light is required the handle is pressed down, the gas in a stream is projected on the platinum, and becomes ignited. The flame may be used to light paper, candles, cigars, &c., and being automatic in the production of hydrogen, and in stopping the action of the acid on the zinc, the lamp lasts a long time without any attention. The method by which the oxidised material is automatically removed from the acid ought to be applicable in other ways, and no doubt will find its use in secondary batteries with hollow electrodes.

PUNCHING AND SHEARING MACHINE.

MESSRS. DAVIS AND PRIMROSE, LEITH, ENGINEERS.

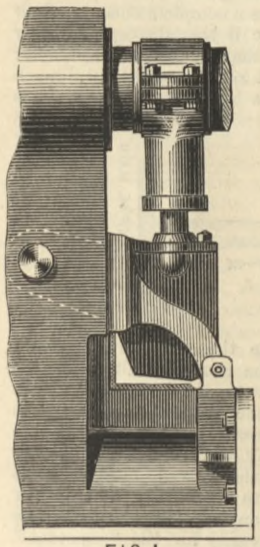


FIG. 1

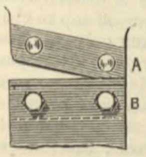


FIG. 2

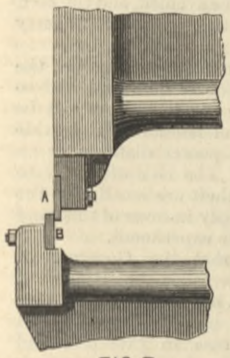


FIG. 3

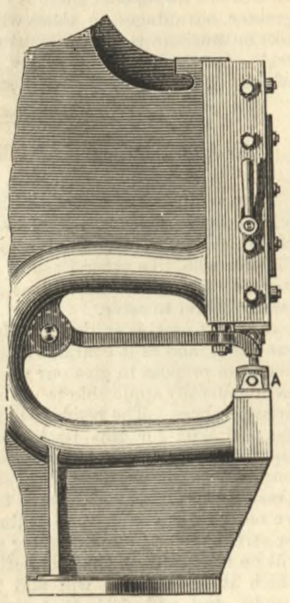
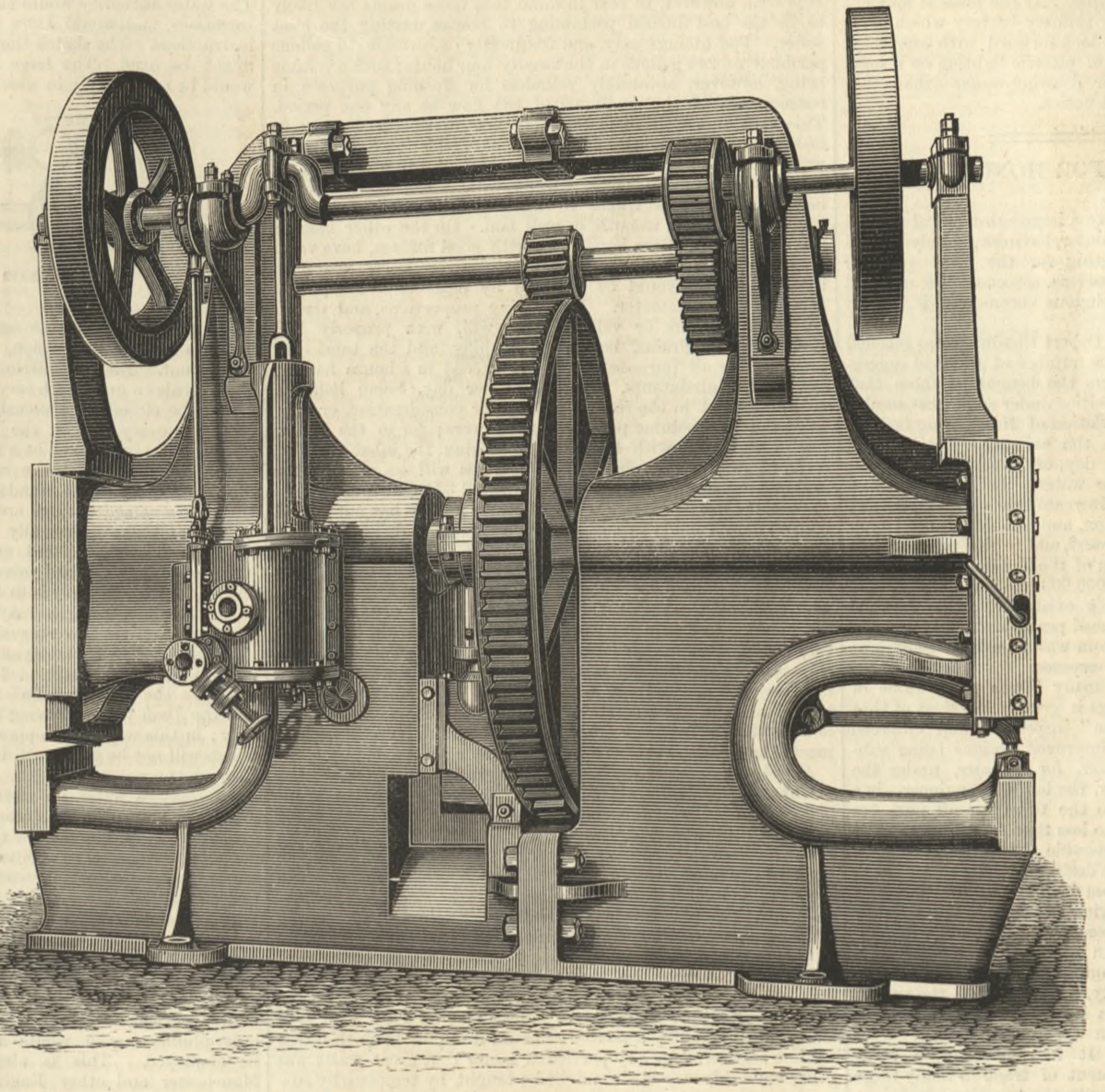


FIG. 4



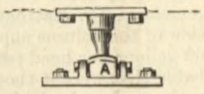


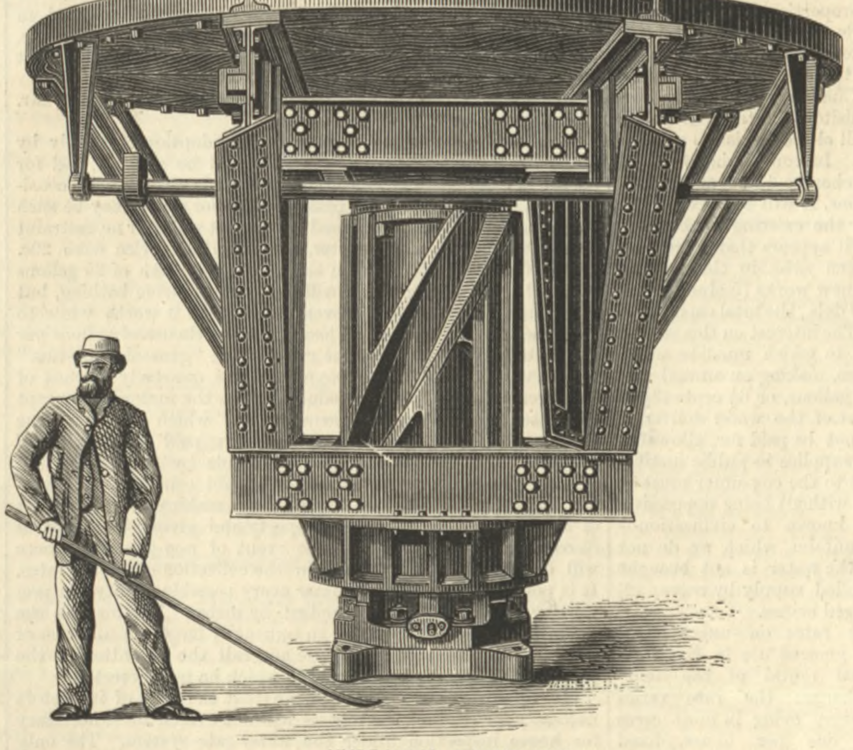
FIG. 5

WE illustrate by the accompanying engraving a large punching and shearing machine by Messrs. Davis and Primrose, Leith. The machine is for punching and shearing iron plates up to 1¼in. thick and cutting angle irons up to 6in. by 6in. The frame is cast in two parts, viz., the punching half and the shearing half, with an angle iron cutter cast on it. The depths of the gaps are such that holes can be punched at 30in. from the edge of a plate, and that plates 60in. broad may be cut up the centre line. The angle iron cutter is shown in detail in Fig. 1; Figs. 2 & 3 are enlarged views of the shears, while Figs. 4 & 5 are details of the punching gear. The angle iron cutter is worked from an excentric forged on the main shaft, the strap and rod from this excentric actuate a vibrating lever that has one end pivotted in the frame, the other end of this lever having the shear blade attached to it. By this arrangement the angle irons are cut on the flat **L**, instead of in the more common way **V**. The former arrangement is much preferable for many obvious and practical reasons. The illustration shows the back of the angle iron cutter, that is, the operator would be at the other side of the machine, and the cuttings off the bars would fall at the side shown. There are stop motions to the angle iron cutter and the punching slides, to enable the workmen to adjust the plate accurately before cutting or punching.

The steam engine attached to the frame has a cylinder 10in. bore, 12in. stroke, bored out guide bars, and slipper guides on the crosshead. The crank shaft is made from round iron bent to shape, and is supported in four gun metal bearings; it carries the driving pinion and two heavy fly-wheels. The second shaft runs in two gun metal bearings, and carries first spur wheel and shrouded driving pinion for main wheel. The main spur wheel is 6ft. diameter at the pitch circle and 2½in. pitch, the teeth being shrouded to the pitch line; this wheel is keyed on the main shaft which is supported in three bearings, and has at each extremity a crank or excentric pin for actuating the punching and shearing slides. The total weight of the machine is 16 tons 11 cwt. Many have been supplied to large boiler works and shipbuilders in this country and abroad. One has just been despatched to Australia.

HYDRAULIC TURNTABLE, MILLWALL DOCKS.

WE illustrate a type of hydraulic turntable specially designed by Mr. F. E. Duckham, M.I.C.E., for lifting grain trucks in the Millwall Docks and turning them simultaneously on to lines at right angles to the lower lines of rails. In these docks, the grain on being discharged from the ships is stored until required in travelling bins or covered railway trucks. The chief advantage of this system is due to the fact that small quantities can be delivered with the utmost promptitude into carts, barges, or railway trucks in the case of consignments for the country, at any part of the dock premises that may be most convenient. Portions of the dock quay could not be utilised for delivery to barges until the construction of these turntables, owing to their position and elevation as compared with contiguous lines of rails. The tables are 12ft. diameter, and in addition to raising a full truck-load of grain, are sufficiently strong to allow engines to run over them at full speed when fixed for the lower line of rails. It will be seen that a double worm or thread is cast on the lifting cylinder, having a pitch of 14ft. A drum forming part of the moving portion is turned to fit the cylinder, and is provided with internal steel rollers working in the grooves previously referred to on the cylinder. When the hydraulic pressure is admitted to the cylinder the upward motion of the ram will be combined with the rotary motion required by the friction of the rollers against the grooves. Separate turning cylinders are not therefore necessary. The whole of the machinery was designed and constructed by the East Ferry-road Engineering Works Company, Limited, Millwall, E., under the superintendence of the managing director, Mr. C. R. Parkes, A.M.I.C.E. We believe that a few years ago a somewhat similar turning arrangement was used in a lift constructed by Sir W. G. Armstrong and Co., but in this case the spiral guides were placed at the outside of the turntable instead of being cast on the lifting cylinder.



HYDRAULIC TURNTABLE.

THE LALANDE-CHAPERON "DOMESTIC PRIMARY BATTERY."

AN installation of incandescence lamps worked by this battery has for some time past been open to inspection at the offices of Mr. H. A. Fergusson, 31, Lombard-street. The battery in question was characterised by Sir W. Thomson, in a letter which appeared in *The Electrician* of January 26th of the present year, as superior to every other kind of voltaic element in its very remarkable capacity for giving very strong and steady currents from plates of moderate area. In support of this statement, Sir William mentions that a cell in his possession, "of quite moderate dimensions," gave a current of 100 ampères. A cell with opposed surfaces of two square feet in area will in fact give on short circuit a current of from 75 to 100 ampères. When it is stated in addition that the battery can be constructed to work for a period of one month, or even longer, without attention, it is evident that it possesses a special claim to notice amongst the numerous batteries that have recently been brought before the public.

The Lalande-Chaperon battery is essentially constituted of a zinc positive element, an electrolyte of caustic alkali in aqueous solution, and a negative element of iron in contact with oxide of copper, preferably in the form of copper "scale" as a depolariser. When the circuit of the battery is closed the electrolyte yields oxygen to the zinc, dissolving the oxide of zinc which is thus formed, whilst the equivalent of hydrogen passes to the negative surface, where it recombines with oxygen supplied to it by the copper scale, which thus becomes reduced to metallic copper. The internal resistance of the cell with opposed surfaces of two square feet is, we understand, no greater than 0·04 ohm. On the other hand, the working electro-motive force of the cell is decidedly low, being about 0·9 volt. This, it should be observed, is a very serious objection, the weight of zinc consumed in doing a given quantity of work being inversely as the electromotive force. In the present battery the theoretical consumption of zinc corresponding to the horse-power hour—that is, to 746 watts (volt-ampères), or to 373 candles, with the best incandescent lamps at present obtainable—is 2¼ lb. Taking the price of zinc as only £18 per ton, the cost of the zinc theoretically corresponding to the horse-power hour would be 4½d. Practically, even supposing the waste of metal by "local action" to be *nil*, the consumption of zinc in obtaining an effective horse-power hour would be sensibly greater than 2¼ lb. According to the prospectus which has been issued in relation to this battery, the consumption of zinc requisite for the performance of a given quantity of work would, however, be a matter of no moment. It is, in fact, stated that "the value of the material produced in the combination of the two elements used, yields a greater return than the original separate cost, and simultaneously gives off the electricity, which therefore costs nothing." Whilst admitting that this statement may possibly be to some extent justified by the proceeds derived from the sale of a limited quantity of the products obtained from the battery residues, we are sorry to be obliged to characterise it, nevertheless, as "too good to be true." It would, in fact, be easy to show that these products, whether in the shape of oxide, carbonate, oxy-chloride, or any other possible compound of zinc, could, if a sufficient market existed, be manufactured much more cheaply than by the solution of metallic zinc in caustic alkali.

The demand for a domestic primary battery which would render small installations possible without the necessity for prime motors and dynamo machines is, however, not absolutely dependent upon economical considerations. We believe there are many persons who, if they could obtain a steady and not too inconvenient source of electrical supply at a small first cost, would not look very closely at the comparative expense of a means of illumination which might contribute very materially to personal comfort and well-being. Of course, other things being equal, the most economical primary battery will have the best chance of a permanent success in solving the problem of small installations of electric lighting. At the present moment we are not aware that there is any primary battery which offers greater advantages to those who look forward with something like enthusiasm to the enjoyment of electric lighting on a small scale—in their studies, offices, or drawing-rooms—than that which is the subject of the present notice.

WATER ORDINANCE FOR HONG KONG.

No. I.

THE conditions of water supply to a large sub-tropical seaport lying only 20 deg. north of the Equator, having a densely-packed yet migratory population, consisting for the most part of Chinese who, like other Eastern nations, associate the use and storage of water with various religious ceremonies, is not an easy problem to solve.

A report on this subject by Mr. Osbert Chadwick has reached our hands, and as it contains a large number of practical suggestions, we propose to give our readers the benefit of those that seem generally applicable to other cities under somewhat similar circumstances. The resident population of Hong Kong in 1881 was 131,570; for this population the existing works afford a supply of only 500,000 gallons per day, or somewhat less than four gallons per head of drinkable water. There are certain streams and nullas which serve to increase this supply, but they are more or less subject to pollution, and should be used only for street watering and flushing sewers, and to this purpose they will be relegated on the completion of the Tytam tunnel works, which it is expected will add 2,000,000 gallons daily to the supply, and will, with that already existing, provide for the present population 19 gallons per head per day, a volume which, if properly utilised and guarded from waste through inefficient fittings, ought to be ample for all purposes.

Experience has shown that in many towns the volume of water wasted through faulty fittings is greatly in excess of that used. A rigorous "house-to-house" inspection and enforced removal of bad fittings (new and improved designs being substituted), has resulted—as in Dover, for instance, under the management of Mr. Matthew Curry, the borough engineer—in a reduction of the volume supplied to the town for all purposes from 60 gallons per head per day to less than 30 gallons, and it is probable that were it thought desirable this volume could be still further reduced. This is most desirable where water has to be raised by steam power either from deep wells or from streams, for in the former case the limit of yield of water in the well may be reached, and in either case unnecessary cost in pumping will be incurred if waste takes place. In localities which admit of a gravitation supply the gathering ground or impounding reservoir may be limited in area and capacity, in which case the supply will be limited also; consequently a reduction in the waste of water frequently means more than a pecuniary saving. This point is frequently overlooked. It has, however, a most important bearing on the development of trade in many large towns, and is intimately connected with the question of efficient protection from fire by mains fully charged. In cases where water requires filtration it may affect the quality of the supply, for in many towns the filter beds are and must be limited in area. If, then, from inordinate consumption or waste of water, these filter beds are pressed to pass more water per square foot than, say, 50 gallons in twenty-four hours, there is great risk of improper filtration.

In Hong Kong, as at present supplied with water, the rate charged is 2 per cent. on the assessed value of a tenement, made regardless of whether there be baths, water-closets, urinals, or gardens, a householder having the right to use or waste as much water as he can get from the pipes. It is seen that if this is allowed to continue and grow, and if inhabitants are allowed to use and waste water absolutely without control, the supply, even when enlarged to the utmost extent possible, will not suffice for this and the ordinary wants of the community. The only practical way of checking wanton extravagance in connection with water is to make the payment more or less proportional to the volume used by each consumer; in other words, to impose such rates as will secure to all sufficient for daily domestic wants, extra payment being demanded for purposes of trade and luxury. In the report under notice, we think Mr. Chadwick has shown how this may be done without undue inquisitorial interference with that free use, not abuse, of water by all classes which is so especially desirable in tropical climates. In considering the best method of fixing fairly the scale of charges to be adopted in Hong Kong for water per 1000 gallons, it will be necessary to estimate the total capital invested in the existing works up to the present time. From reliable data it appears that something over 400,000 dols. (£83,332) have been sunk in the existing works in Hong Kong, and that the new works (including the Tytam tunnel) are estimated at 500,000 dols., the total capital will be nearly 1,000,000 dols. (£208,330). The interest on this will be 50,000 dols. annually, at 5 per cent., to which must be added 10,000 dols. a year for working expenses, making an annual cost of 164·40 dols. per day for $2\frac{1}{2}$ million gallons, or $6\frac{1}{2}$ cents ($3\frac{1}{2}$d.) per 1000 gallons, as the net prime cost of the water delivered. As, however, the whole volume will not be paid for, allowance being made for losses from leakage, supplies to public institutions, and for fire extinction, the price to the consumer must be higher than this, which it well can be without being oppressive. The three systems of water supply known to civilisation—besides the use of stand pipes and fountains, which we do not propose here to discuss, as by them the water is not brought into the dwellings—are: (1) Uncontrolled supply by rates; (2) supply by meter; (3) supply by a gauged orifice.

Supply by Rates.—The charge by rates on uncontrolled supply is the system at present in general use in England; the rates are based on the annual rental of the tenement, with a certain minimum charge; the rate varies between 5 and 8 per cent., extra charges being in most cases made for all water-closets beyond one per house, fixed baths, gardens and greenhouses, horses and carriages, trades of every kind. In some cases penalties are arranged for with the intent of preventing waste from various causes, but cannot easily be enforced. For example, the Reading Local Board, in whose hands is vested the water supply of that town, have a special charge for the use of a flexible tube for watering gardens, and the following regulations regarding its use—it being obvious that such regulations are certain to be ignored:—(1) A competent person must be in charge of the tube; (2) it must not be allowed to lie on the ground. In such parts of Germany as the system of uncontrolled supply exists in, the charge is usually made in accordance with the number of rooms in use in each house; the houses, as usual on the Continent, being let in flats.

Meter supply.—This system, from a purely commercial point of view, is the most equitable arrangement, the consumer paying for the exact volume he uses or wastes. In its simpler form it is open to objection on sanitary grounds; for in the interests of health and cleanliness, as well as for flushing drains, it is desirable that a certain minimum volume of water should be used. It is well, however, to bear in mind that those drains are likely to be the best flushed pertaining to houses wasting the least water. Bad fittings may, and frequently do, dribble 10 gallons per hour, or 240 gallons in the twenty-four hours; such a volume being, however, absolutely valueless for flushing purposes in consequence of the smallness of the flow at any one period. This sort of condition is probably not an uncommon one in many towns. In houses fitted with old-fashioned "pan" or—water seal—closets, having absurdly small down pipes—$\frac{3}{4}$in. or $\frac{5}{8}$in. diameter—such pipes, except with abnormal pressures, being entirely inadequate to flush properly any drain, no matter how small, smooth, or well laid. On the other hand, a well-arranged modern house will, with good fittings, have valve closets holding up perhaps two gallons or more water in the pan, which would be supplied by pipes of not less than $1\frac{1}{4}$in. or $1\frac{1}{2}$in. diameter. With these proportions, and waste-preventer cisterns or valves, there will, with properly laid stoneware pipe drains, be perfect flushing, and the total consumption for all purposes need not exceed in a house having, say, seven inhabitants, 120 gallons per day, being half the volume wasted in the former case under consideration, or one-third the total volume passing to the sewers; for in the former case of the house with bad fittings—taking the inhabitants as seven in number—a volume of 120 gallons will be required for use, making in all with the volume wasted 360 gallons.

That the use of meters for a domestic supply has not gained ground more rapidly in this country is probably due to the fact that here people for the most part live in separate houses, and not in flats to the extent which prevails on the Continent, thus requiring a meter for about every five or seven inhabitants, whilst on the Continent there are frequently forty persons in one house. In Berlin the average is even greater, one house containing sometimes twelve families. A cheap and at the same time reliable and durable meter would do much towards rendering this system of supply more common. Mr. Chadwick, after taking all the circumstances of the case into consideration, decides that a "meter system," with a minimum charge, best meets the requirements of the case of Hong Kong.

Supply by gauged orifice.—This system, apart from the mechanical difficulties attendant on the alteration in the available area of the orifice, either by accidental obstruction or intentional enlargement, has the further disadvantage that as the water flows continuously in a very small stream, a cistern must be provided to store it for use, and by this alone a fertile source of pollution is at once opened.

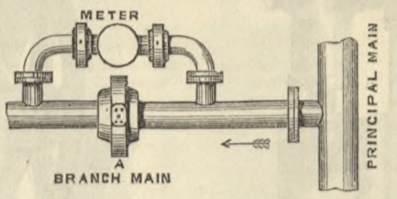
In concluding his remarks on the best system for the supply of Hong Kong, Mr. Chadwick recommends that supply by meter only be adopted throughout. But if that system in its entirety be thought too expensive, then the following modification of it may be adopted for poorer parts of the town, where common taps for the supply of groups of houses may be fixed, such taps being commanded by a meter. Should it appear from the large volume registered by any particular meter that great waste was going on, a salutary lesson might be taught by temporarily suspending the supply. The alternative system of rating proposed by Mr. Chadwick is much as follows:—(*a*) The existing general water rate should be reduced to 1 per cent. on the assessed rental instead of 2 per cent. as at present. (*b*) Extra rates should be payable by owners of premises where water is used for purposes of trade or for purposes other than domestic supply, as hereinafter defined, such as gardens, fountains, baths—and water-closets in excess of one per house—or in such cases a supply may be given by meter. The general water rate is levied on account of the general advantages derived from the waterworks—as, for example, protection from fire. It further entitles the occupiers of premises to a limited supply of water for strictly domestic purposes, as drinking, cooking, and washing. Such a supply would be given by a single tap, to be provided by the owner. In accordance with the regulations, extra rates would be levied for more elaborate services. In such cases the rates may be assessed at a lump sum, according to a fixed tariff, or a meter may be used, and the volume actually consumed paid for quarterly. Extra rates without control may be collected in advance, so that there is little chance of making bad debts. Meter rates, however, cannot be collected in advance, so that with them there is a chance of making bad debts.

In concluding his remarks on this subject of water rates, Mr. Chadwick says:—

"In short, I strongly recommend the adoption of supply by meter in all cases where extra rates would be payable, and for all the larger houses of Europeans and Chinese. A little consideration will show that the price charged for water may be such that, though bringing in a good revenue, it will offer no restraint on the reasonable use of water. Suppose the price were 20c. per 1000 gallons—10d.—then the price of a bath of 25 gallons would be $\frac{1}{4}$d., a sum which will deter no one from bathing, but one which will give a good revenue and make it worth while to shut the taps to prevent the loss of several thousand gallons per day to be paid for at the same rate." The "general water rate" will serve as the minimum payment; the quarterly amount of the "general rate" will be deducted from the meter bill, except the latter be less than the "general rate," which will then alone be charged. At present the rates are paid by owners of property, but are summarily recoverable by them from the tenant. This favourable condition should continue, and with the addition of a few regulations making the payment of water rates a claim on the property and giving the right of discontinuing the supply in the event of non-payment, there will be little, if any, difficulty in the collection of meter rates. It is politic to give the consumer every possible facility for preventing waste even when supplied by meter. To this end the meter inspector, if he notices an unusually large consumption of water, should inspect the service and call the attention of the consumer to any source of leakage which he may detect."

Mr. Chadwick goes on to observe that the staff of inspectors necessary for reading the meters will not exceed those necessary for house inspection under the water-rate system. The only extra labour will be in the book-keeping, which will necessarily be somewhat more complicated. The existing water ordinance merely provides for raising a loan for the construction of works, it does not provide powers for charging extra for water for trade purposes or for making regulations against waste. From the above it is evident that a new ordinance is a necessity, and that if possible the whole of the laws relating to water supply of Hong Kong should be consolidated in one enactment. The Kowloon Peninsula requires a water supply, which fact should be borne in mind in forming a new Act.

Mr. Chadwick next gives some suggestions for the improvement of the intermittent system, pending the completion of the new works in about three years' time (1887). To arrange for a division of the network of pipes into zones of approximate equal level, seems to be of the first importance in this way each district may be served successively, as in those parts of London which are still under the intermittent system. It would be well to have a meter on the branch pipe with which each district is served—we think a self-registering meter would give the best results, showing the consumption during each hour of the day. The water authority would then have a complete check on their turncocks, and would know at once if they disregarded their instructions. The sketch shows the manner in which the meter might be fixed. The large cock A on the principal branch would be opened only in case of fire. Whilst these operations



are in progress the home services in the same streets should undergo a rigid inspection, and the necessary alterations be carried out. The chief fittings to be provided will be:—(*a*) A stop ferrule to unite each service to the main, enabling any service to be closed permanently if necessary. The stop ferrule should in every case be the property of the water authority; (*b*) A service cock, fixed as a rule in the pathway near the front of the house, enabling the service to be readily shut off for repairs and to prevent inundation if anything goes wrong. The two above-named fittings are a necessity for the "constant" service and are universally insisted on. The following are requisite for intermittent supply: (*c*) A cistern containing a day's supply; (*d*) A ball valve; (*e*) Draw-off tap to cistern. As the intermittent supply is to be temporary only, the use of cheap substitutes for cisterns may be tolerated. It appears to be advisable that the Government—which is the present, and will be the future water authority, and as such is responsible for the present and future state of the water supply—should provide and give the "stop ferrule" in the mains, the "service cock" and the "ball valve," leaving the consumer to find the cistern only; in this way much opposition will be avoided, and the cost, which will not be great, will be paid by the owners of property through the water rates.

A supply of water, no matter how limited, would prove the greatest boon to the inhabitants of the poorer quarters; and so great may be expected to be the gain to the town, that if it be thought inadvisable to arbitrarily compel landlords to provide services as described, it would in the poorer districts be an economy to the town to do it gratis. The risk of injury to fittings from wantonness or motives of theft are small, and the inconvenience attending cessation of supply in cases of this kind would soon check the desire to repeat the experiment.

Mr. Chadwick goes on to advise that the Government, as the Water Authority, should undertake the laying of house services, or if this be thought out of its sphere, that only plumbers who would receive an official licence should be employed. This is already the case in Liverpool and Manchester and other English towns, and is a great check on bad work. The licences are given to all plumbers who give satisfactory proof of their ability to do the work. The licensee enters into formal agreement:—(1) In all things to conform to regulations and to use materials and fittings of approved pattern and quality. (2) To report in detail all new services or additions and alterations to existing services which he may execute. (3) To report any cases of waste or abuse of water or other irregularity which may come under his notice. (4) The licensee makes a substantial money deposit as a guarantee of his conforming to the terms of his agreement, which is to be summarily forfeited in case of contravention. In no case must any person except a Government servant be allowed to tap mains or shut off water. Especial vigilance must be used to prevent the connection of unauthorised services during the continuance of the intermittent supply. All ball valves must be inspected and stamped with the Government stamp before being issued, and it would appear very desirable if the Government of Hong Kong would import a stock of good pipes and fittings and sell them at cost price to the licensed plumbers. In this way the adoption of the best modern fittings might be secured, and the system of grooved joints without solder might be largely adopted, greatly reducing the risk of fire in any town, for it is to be feared that plumbers' stoves have much to answer for in this respect.

ELECTRIC LIGHTING AT COLCHESTER.

ON Wednesday the directors of the South-Eastern Electric Lighting Company and a number of others interested in the lighting of towns by electricity, paid a visit of inspection to the installation of what is called the B.T.K. system of electric lighting at Colchester. The visitors assembled in the Town Hall, where the system was described, and a number of the manufactures of the company exhibited. A paper was also read, descriptive of the works at Colchester, from which we take the following:—

"One of the aims of the system which we have commenced to instal in the town of Colchester is decentralisation, as far as regards the station from which the supply of electricity is given, and the other is to make the supply independent of the moving machinery, so as to avoid the liability to sudden stoppages from any cause. A cursory examination of the problem of electric lighting direct from the dynamo machine will show that the maintenance of a standard electro-motive force or pressure, with an allowance of, say 5 or 6 per cent. variation when large currents, such as would be required for, say, 600 or 700 incandescent lamps, are driven along even moderate lengths of conducting cable, would entail the use of perfectly compounded dynamo machines, very costly conductors, and engines fitted with almost absolutely accurate or perfect governing gear, such as have not yet been invented.

"On the B. T. K. system, the distinctive features are the use of secondary batteries or accumulators placed in favourable positions for reducing the length and dimensions of conducting cables. Dynamo machines capable of generating electric currents of any high electro-motive force or pressure so as to charge a large number of these secondary batteries at one time, although situated at a long distance from the dynamo or generating station. Rocking switches, which break the charging circuit when the operation of charging is completed, and which shunt the stored current on to the mains and service wires for the supply to consumers, and which at the same time convert the high electro-motive force which existed during the charging procees to the standard electro-motive force required by the lamps in use. For this purpose there are alternate sets of batteries and rocking switches, so that while one set of batteries is being charged, the other set is in supply, and by the time the maximum current is required, say, in the evening, both sets of batteries will have been fully charged, and will therefore have been cut out of the charging circuit, and will be connected to the supply mains. The engine for driving the dynamo machines, built by Messrs. Davey, Paxman, and Co. is of 25-horse power nominal, semi-portable type, is capable of exerting 90-horse power, when working at 133 revolutions per minute. It is connected by belting from the fly-wheel, which is 7ft. in diameter, to a 4ft. 6in. pulley on the countershaft, and from pulleys of 5ft. diameter on the countershaft, by belting, to two No. 8 Brush dynamo machines. The machines at present in use give a current of 9·5 to 10 ampères at an electro-motive force of about 1800 volts, when rotated at a speed of 700 to 750 revolutions per minute. They are connected together in what is known as parallel arc, or for quantity—thus acting as one machine, and giving a current up to nearly 20 ampères. Some little difficulty was at first experienced in arranging the two machines for running together, so that each produced its quantum of the work, and so balanced the work of the other. The machines being originally constructed for arc lighting, also required some modification to convert them to their present purpose, and they are therefore separately excited by means of a small Victoria dynamo, which passes a current of about 10 ampères round the field magnet coils of each, and so excites the magnetic field in which the armature rotates. This Victoria dynamo machine gives an electro-motive force of 150 volts, when working through an external resistance of 7·5 ohm. This method of excitation of the magnetism allows of great adjustment of the strength of the magnetic field, so that the power expended in charging less than the maximum number of cells is nearly proportional to the number in charge at any time. The adjustment of the strength of the magnetic field of the large machines to the requirements of the circuit is accomplished by means of an automatic regulator, which limits the supply of current to the field magnet coils in the large machines. It consists of two electro-magnets, the armatures of which actuate contact-breaking apparatus in connection with a small electric motor, and which cause the armature of a motor to rotate in either direction, according to the manner in which the connection is made with the source of supply. The rotation of the armature of this motor then actuates a sliding contact, which increases or decreases the resistance in the field magnet circuit of the Victoria machine. The charging current is passed through the coils of the electro-magnets of the regulator, and fluctuations in the current have their effect on the armatures, causing them to be attracted or released according as the current is above or below the normal amount. When, in consequence of an excess in the charging current, one of the armatures is attracted to its electro-magnet, connections are made to the motor in such manner as to cause its armature to rotate and so actuate the sliding contact and add resistance in the field magnet circuit of the Victoria machine. This decreases the electro-motive force generated and thus lowers the current in the field magnet coils of the large machines until the strength of the charging current is again brought to its normal.

"The generation of currents of high electro-motive force by means of the Brush dynamo machine presents some difficulties when it is necessary that the maximum electro-motive force should be available at any instant. This arises from the fact that the current generated by these machines is not absolutely continuous, but is a series of waves or pulsations caused by the commutation of the current in which the circuit is broken three times in each revolution of the armature. As a result of this peculiarity it is impossible to run the machine in open circuit when separately excited, and to obviate this difficulty a switch and resistance was constructed. The switch is mounted on a board carrying three current meters. One of these shows the amount of current circulating in the coils of the field magnets of the large machines, another shows the current passing in the resistance coils, and the last shows the current passing in the charging circuit. The first position of the switch carries the current generated by the large dynamos through the resistance coils, and the amount of resistance in ohms being multiplied by the reading of the current meter gives the value of the electro-motive force generated in volts, and on this reaching its maximum the switch is moved to the second position and the current then passes into the charging circuit. The resistance coils also serve to load the engine up to the amount of work required from it, and thus prevents the pull up and consequent strain which would take place, when from running almost light a load of 80-horse power were suddenly put upon it. One of the clauses of the licence prohibits the introduction of electro-motive force of more than 200 volts into the houses of consumers, and although 2000 or 3000 volts may be used for the purpose of charging, this apparatus limits the force in the supply mains to the standard pressure required by the lamps in use, which in the case of Colchester is 60 volts. With the rocking switch the accidental presence of high electro-motive force in houses is an impossibility, as at the instant of breaking the circuit either of charge or supply both circuits will be interrupted for a moment. The rocking switch consists of two rows of eighteen iron cups containing mercury, mounted at opposite ends of an insulating base. In the centre of this base a cradle is fixed, in which the rocking bar carrying the contact pieces is suspended by steel centres. Sixteen of the cups at one end of the base are connected alternately with the positive and negative poles of the cascades of batteries; the two remaining cups at this end being connected respectively to the positive and negative poles of the charging main. Connections are made on the under side of the base from the sixteen alternate positive and negative cups to sixteen of the cups at the other end of the base, so as to make eight cups on one side positive and the remaining eight negative. A pair of large cups, one at each side, carry the whole of the current to the positive and negative supply mains. The contact pieces carried by the rocking bar are in the form of prongs, which dip into the mercury cups. On the charging side they are in detached pairs mounted on an ebonite bar so as to connect the positive end of one cascade of batteries to the negative end of the next cascade and so on. On the supply side the contact prongs are mounted on two copper bars connecting all the positive ends of the cascades to one bar and terminal mercury cup, and all the negative ends to the other bar and cup, and from these terminal cups to the supply mains as before explained. The rocking switches are actuated by automatic means, which throw the batteries out of the charging circuit, when the charging process is completed or so near completion that free hydrogen is rapidly evolved from the positive electrodes, and this operation is carried out by means of the master cell. This master cell is one of the ordinary battery cells, as described in THE ENGINEER, 22nd February, 1884

"It is on this ground of economy in cables that one of the claims of the B. T. K. system for economy rests. If it had been decided to light this district of Colchester on what is known as the parallel system, direct from the dynamo machine, we should have been compelled to spend a very large sum of money in cables, and this I hope to prove by the following simple calculation :—

"We will divide our consideration of the cables necessary for the direct parallel system into two parts—(1) The cable for carrying the whole current from the generating station to the supply mains in Head-street and High-street; (2) The supply mains in Head-street and High-street. We will suppose that the supply is to be equally distributed along the whole area, and on both sides of the road. (1) The cables for carrying the whole current. This would be in, say, three branches from the station in Culver-street: one branch would go to Head-street and the two others to High-street, in the most favourable positions. The average length of each branch, lead and return, will be about 333 yards.

"Now, as the total current required would be about 2000 ampères, we have to transmit along each branch 666 ampères, a maximum of 2 per cent. fall in the electro-motive force is the utmost allowable in this part of the circuit, and on a 60-volt circuit this would amount to 1·2 volts." The resistance of the largest cable we use is about $\frac{1}{7}$ or ·145 ohm per 1000 yards, and if we used this size for our three branches, we should have a resistance in each of, say, $\frac{1}{20}$, or nearly ·048 ohm.

"But to pass 666 ampères through such a conductor as this would be impracticable on account of heating, besides which it would take an electro-motive force equal to $666 \times {\cdot}05$ or 33·3 volts. Our allowance for fall being limited to 1·25 volts, we should have to use a cable the copper conductor of which would equal the sectional area of twenty-seven cables such as the largest we use, and the weight of the cable would be about 25 tons. This would cost at least £3000 or £4000. (2) The mains for supply in High-street and Head-street. The total length required would be about 5000 yards, which would be divided or may be considered as divided into twelve branches of equal length, each branch being about 416 yards in length and supplying a maximum current of 166 ampères with an allowance for variation in electro-motive force of, say, $2\frac{1}{2}$ per cent. The resistance of 416 yards of this 19 No. 12 B.W.G. cable will be about ·06, and to calculate the fall in electro-motive force when using this cable we must multiply 166 by ·06, giving 9·96 volts. But as the current is supposed to be equally distributed this amount will be divided by 2, and we should have a maximum fall of about 5 volts instead of 1·25. From this it will be seen that a cable would have to be used which would equal in sectional area $\frac{5}{1{\cdot}25}$ or four of these 19 No. ·12 B.W.G. cables. Now, as this size costs about £200 per 1000 yards, it is fair to assume that a cable four times the weight would cost at least three times as much, or about £750 per 1000 yards, and as the total length is about 5000 yards, the cost will be about £3800, and making in all a grand total for the cable of £7000 or £8000. The whole for the supply of 2000 incandescent lamps, on the B.T.K. system, has cost about £1200. The cables as laid for the B.T.K. system are in twenty-one parallels, each distinct from the other and branching from six battery stations. This division enables us to avoid the use of distributing boxes and also to test any length independently of the rest. They are laid in a brick trench built directly under the pavement, and having wells at distances of 50ft. apart to allow of drainage. The internal dimensions of the trench are 9in. by $7\frac{1}{2}$in., which is ample space for three or four times the number of cables laid.

"The lamps manufactured by the Consolidated Company are being used in the water pavilion at the Health Exhibition, where Messrs. Opperman are running them in parallel series with an electro-motive force of 200 volts. They find that to obtain equal light in all the lamps, they have to be run according to the following proportions :—Woodhouse and Rawson, 22 lamps; Consolidated, 20 lamps; Swan, 15 lamps; Gatehouse, 14 lamps. That is to say, the same energy which gives 300 candles in the Swan gives 400 candles in the Consolidated Company's lamps, while the high candle power suited for street lighting is still more economical. The 140-candle power lamps exhibited take 60 volts, and about 4 ampéres, or 434 candles to the horse-power."

The charge for lighting at Colchester is one half-penny per lamp per hour. The visitors after the reading of this paper inspected the generating station, some of the shops fitted with the light, and the secondary battery stations. They subsequently lunched at the Red Lion Hotel, where the dining hall was lighted by lamps supplied from the secondary batteries.

TORPEDO BOATS FOR THE RUSSIAN GOVERNMENT.

ON page 442 will be found a sectional elevation fully dimensioned of the engines of the boat illustrated in our last impression. The engraving explains itself.

Mr. Baird, of 13, Berkely-square, requests us to "make known his protest against the use of his name in connection with the published matter, which is done without his knowledge or authority."

Mr. Baird's connection with the works has, we believe, ceased for some time.

He also calls our attention to the title "Baird and Co.," as being erroneous. The firm has been, however, constantly spoken of in this country under that title, although the works were carried on, as is well known, by the widow Baird.

COMPOUND ROLLING MILL ENGINE.

OF the engine which we illustrated on pages 406 and 426, made by Messrs. Tannett, Walker, and Co., of Leeds, for the new plate-rolling mill of the Butterley Iron Company at Codnor Park, we give some further details. In another impression we shall give a description of these and of the rolling mill.

SOCIETY OF ARTS.—The Albert Medal of the Society of Arts—instituted in 1862 as a memorial of the Prince Consort, and given annually "for distinguished merit in promoting arts, manufactures, or commerce"—has been awarded by the Council of the Society, with the approval of the Prince of Wales, the president, to Captain James Buchanan Eads, of the United States.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—William Snell, assistant engineer, to the Valiant; James Lane, John G. L. Baker, John L. Michell, Frederick W. Parkes, George L. Bench, George S. Cornish, John Anderson, and James Fairbrother, engineers, to the Valorous, additional.

THE PANAMA RAILROAD.—According to the *Panama Star and Herald*, the report of the Panama Railroad Company for the year 1883 shows a remarkable increase in the tonnage carried, 215,725 having crossed the road in 1883, against 161,744 tons in 1879. The increase in passenger traffic is more remarkable, 303,979 persons, having been transported in 1883, against only 23,729 in 1879; 22,808 tons more were carried during the past year than in 1882, which with the figures previously quoted, serves to show how suddenly the demand for increased conveniences has been made upon the road. The total earnings of the line for the year were 2,811,983·92 dols., and the expenditure 1,660,192·26 dols., leaving 1,151,791·67 as the net earnings. The total operating expenses on the Isthmus were 1,002,456·22 dols. in 1883 against 730,764·42 dols. in 1882, showing an increase in operating expenses of 271,691·80 dols.

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

(*From our own Correspondent.*)

ON 'Change in Wolverhampton yesterday, and in Birmingham to-day—Thursday—ironmasters reported that the works were all on again, but only in a quiet manner, since the orders that have arrived during the holidays have not been numerous. To provide employment for the mills, specifications were again eagerly hunted up under old contracts. Purchasers mostly declined, however, to give them out freely.

Makers of best—thin—sheets for working up and stamping purposes are exceptional, in that they keep busy upon orders for colonial and other export consumption, and likewise for home use. This branch is indeed the best off at the present time of any of the departments of the Staffordshire iron trade, alike as to the work doing and the prices realised. Messrs. E. P. and W. Baldwin quoted their list to merchants as :—Severn singles at works, £11; Baldwin Wilden, B., £12; B. B., £13; B. B. B., £14; charcoal, £16 10s.; best charcoal, £19 10s.; and extra best charcoal, £21 10s. John Knight and Co., Kidderminster, quoted working-up sheets—singles—£7 10s.; doubles, £11; and lattens, £12 10s. Stamping sheets, either of steel or iron, to 24 b.g., were £13, and lattens, £14. Charcoal sheets the firm quoted : Singles, £19 10s.; doubles, £21; and lattens, £22 10s.

The production of soft steel sheets for stamping purposes is steadily increasing, thanks to a regular growth in the demand. The application of the Clapp and Griffith's patent to this branch is answering very satisfactorily. Messrs. Hatton, Sons, and Co., of Bilston, are now turning out some 200 tons of sheets upon this principle weekly.

Makers of ordinary merchant and galvanising sheets spoke to-day of continued indisposition by home consumers to buy in large lots. On export account fair orders are coming forward, but they have to be accepted at very low rates. Merchant singles were sold at £7 to £7 5s. per ton; galvanising doubles, £7 10s. to £7 15s.; and lattens, £8 10s. to £8 15s.

The plate mills are poorly employed, and competition from outside districts is unabated. The constructive engineers are securing most of their supplies of plates, angles, and smaller sections from the North of England, and other centres which are more favourably situated than Staffordshire. Some engineers are buying from Middlesbrough at as much as 20s. per ton below native prices. In boiler-plates, Staffordshire occupies a better position than for other descriptions.

Monmoor best boiler plates to 5 cwt. each were quoted £9; double best, £10; treble best, to 4 cwt., £12; special qualities, to 3 cwt., for flanging, &c., £15 10s.; charcoals, £17 10s. Monmoor sheets, of 20 w.g., were £8 10s.; best, £9 10s.; double best, £10 10s.; and charcoal, £17. A second quality, denominated the Wright brand, could be had alike as to plates and sheets at 10s. per ton under the quotations named.

Marked bars remained at £8 2s. 6d. to £7 10s. and £7, medium bars were £6 15s. to £6 10s., and common ranged down to £6 and £5 17s. 6d. Hoops varied from £6 to £6 5s. and £6 10s., according to description. Gas strip was in some instances as low as £5 12s. 6d. for small sizes, but the more general quotation was £6 to £6 2s. 6d.

This week the Staffordshire Steel and Ingot Iron Company has started a portion of its new plant at Bilston. So far matters have proceeded very satisfactorily, but some little while longer must be allowed before the works are in full operation.

The native pig trade does not give indications of revival, and some makers are seriously talking of blowing out furnaces. The number now in blast is put down at thirty-seven. Vendors of foreign pigs are making a few sales, but they are not up to the average, and deliveries under contracts taken some time ago are unusually restricted. Prices are easy upon the basis of 42s. 6d. for Northamptons delivered at consumers' works, 43s. for Derbyshires, 44s. for Wigan pigs, and about 46s. for Lincolnshires. South Wales scrap iron, composed mainly of sheet shearings, is very quiet at 50s. delivered, which is a reduction upon the prices that ruled at the close of last year of 10s. per ton.

Strong dissatisfaction with the award of the arbitrator to the Coal Trade Wages' Board is being expressed by the colliers. No sooner was it known that wages would be reduced from 3s 8d. to 3s. 4d. per shift than the Tipton miners had a meeting. The gathering protested against the award as "unjust," and pledged themselves to "play" if another meeting of the Board to consider the question was not called. Similar action has been taken by the men at Pensett, Oldbury, and the other districts. Therefore 16,000 colliers threaten a strike. Probably, however, the desired meeting will be held, although the masters strongly protest against the unfairness of the men's action.

The heavy ironfoundry and engineering orders now on the books are neither large nor numerous. Yet they include some fair pieces of railway work for home, and roofing work for Norway and Sweden. The Colonies, India, and South America are quiet.

Local pipefounders note with satisfaction that 3000 tons of cast iron pipes, varying from 2in. to 10in. diameter, are required by the Hawarden and District Waterworks' Company.

Hardware orders of most value are on merchant account for export, the colonial and South American market figuring most conspicuously. Purchasers are still content with meeting early necessities, declining to stock, notwithstanding that it may be reasonably considered that prices have now touched bottom. An increase in colonial orders is hoped for by certain manufacturers, who instructed their representatives at the close of the Calcutta Exhibition to take on their samples to the colonies.

The Wolverhampton Corporation desire to increase their regular supply of water. They have this week determined to invite tenders for the supply and erection of a powerful new engine at their station at Tettenhall. This will pump water from the artesian well at Cosford, several miles distant, in addition to the existing engines which are now drawing supplies from the same source. The capacity of the new engine is to be equal to 2,000,000 gallons per day, and with one or two new boilers, buildings, connections with reservoirs, &c., it is estimated that the expenditure will be £6500.

The Birmingham Trades' Council have determined to memorialise the House of Commons in favour of the Railway Regulation Acts Amendment Bill, as introduced by Mr. Chamberlain. They have adopted this course because they believe that if it came into operation "many of the accidents which now occur would be averted by the adoption of continuous brakes, the absolute block system, the interlocking of points and signals, and the making known of the excessive number of hours many men engaged in the working of the traffic are kept on duty."

Unusual engineering difficulties have had to be overcome in the new line of railway belonging to the London and North-Western Company, now under completion, eight and a-half miles long, from Sutton Coldfield to Lichfield. At one point most expensive works have been necessary owing to a tributary of the Tame, known as the Black Brook. In some spots the peat has been dug out to the depth of 6ft., and dry material substituted in order to obtain foundations for embankments. A very large number of flood arches have also been constructed, the set at one station comprising thirteen and forming quite a viaduct. The bridges too over this portion of the line have been built of unusual strength, some of them containing over 2000ft. of brickwork. There are several steep hills on the route, so that the embankments and cuttings are numerous, and there is one tunnel 170 yards long, constructed partly by tunnelling and partly on the cut-and-cover system. The retaining walls at one end are over 9ft. thick and 34ft. high. The principal cutting is one mile seven chains in length, and with 40ft. as the greatest depth. From it have been taken about 400,000 cubic yards of earth, or about 600,000 tons, of which 120,000 cubic yards, or 180,000 tons, have been used for one of the embankments. The line is double throughout, with sidings at all the stations. Of these several new intermediate ones are building, and the existing ones at either terminus are being re-constructed. The permanent way will be of the best character. The rails, a considerable portion of which are laid, are of steel 84 lb. to the yard, with improved chairs weighing 45 lb. each, secured to transverse sleepers by iron spikes and galvanised iron bolts.

Messrs. Joseph Wright and Co. report favourably as to the demand for their well-known Martin's anchors, as supplied to the British and all foreign Governments. Their contracts include one for ten Martin's for the Brazilian Government, one for six for torpedo boats. They are also making the Martin's anchors which will be used in the forthcoming Arctic Expedition to be despatched by the United States Government.

The works at Shrewsbury in connection with the forthcoming visit of the "Royal" are in a satisfactorily forward state. The Town Council have this week decided to ask the War-office to throw a pontoon bridge across the Severn near the present English bridge, at a cost not exceeding £200, consequent upon the present bridge being too narrow to carry all the traffic.

The regret felt in engineering circles at the death of Mr. William Bragge on the 6th inst. is deeper in the Birmingham district than elsewhere, since Birmingham was his birth-place, in Birmingham he resided a considerable part of his lifetime, and at Birmingham he died. At the same time Mr. Bragge was well-known in Sheffield, in London. in most European capitals, especially in business circles in Russia and Austria, and also in Brazil and other parts of South America. The son of a Birmingham jeweller, he was born in 1823, studied mechanics and mathematics, theoretical and practical, became at the age of twenty-two a railway surveyor, went out to conduct railway and gas engineering work in South America for Messrs. Belhouse and Co., of Manchester, and at the age of thirty-five became a partner in the then young firm of John Brown and Co., of Sheffield. Here he ran the "big errands" of the firm—as he termed them—all over Europe, largely promoting business when the helical railway buffer spring, and afterwards the rolling of armour-plates and steel rails was begun by them. His connection with the firm lasted until 1872, in which year he resigned the position of managing director. After this the Société des Anglais retained his services in a monster and unsuccessful sewerage scheme for Paris. The last eight years of his life were spent in Birmingham, devoted chiefly to literary leisure, but saddened by failing eyesight, deepening at last almost into blindness.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business in this district during the past week has not quite settled down after the holidays, but the general quietude which was previously noticeable is still apparent throughout all branches of both the iron and the coal trades, and there is a continued absence of any prospect of improvement, which has a tendency to check buying beyond mere hand-to-mouth requirements. In the iron trade there is a general belief that at least during the present year low prices will have to rule, and that this is not only the opinion of buyers, but also of sellers, is indicated by the fact that iron is offered for long forward delivery on the basis of the present low rates. In the coal trade a similarly despondent tone prevails, but the uncertainty as to possible disputes with the men with regard to wages' questions has a tendency to check colliery proprietors in entering into any very long forward contracts, and in some cases there is a disposition to accumulate coal in stock, which would seem to indicate an expectation of possible disturbance in the near future.

The Manchester iron market on Tuesday brought together a tolerably good attendance after the suspension of business for the holidays, but there was very little inquiry stirring, and the actual business doing was so small as scarcely to afford any real test of values, The general tone of the market, however, was weak, the only exception being in North-country iron, for which makers are very firm, the slight improvement which has been reported in Scotch warrants during the last few days being only regarded as temporary and not really affecting this market to any material extent. For Lancashire pig iron quotations remain at 43s. 6d. for forge and 44s. for foundry less 2½ per cent. delivered equal to Manchester, and although orders are not to be got at these figures, local makers do not at present show any disposition to give way. At about 1s. under these figures orders might be booked, but these are apparently being allowed to pass into the hands of district makers who are offering Lincolnshire iron for delivery equal to Manchester; at about 42s. 6d. to 43s. less 2½ for forge and foundry qualities, and Derbyshire iron can now be bought at low prices, good brands being obtainable at about 6d. to 1s. per ton above the minimum quotations for Lincolnshire. Middlesbrough iron is firm at about 44s. 6d. net cash as the minimum for anything like good foundry brands delivered equal to Manchester, but forge qualities could be bought at about 1s. to 1s. 6d. per ton under this figure.

For hematites there is still only a very slow demand, and for good foundry brands delivered into this district 55s. to 55s. 6d. remains about the average price.

In the finished iron trade, business continues very quiet. The shipping season is bringing forward a little extra inquiry, but the weight of actual business doing is only small, and generally the condition of the manufactured iron trade is without improvement. Nominally £5 15s. remains the price for bar iron delivered into this district, and the leading makers of Lancashire and North Staffordshire brands are not disposed to accept orders at under this figure; but there are sellers at less, with some local brands to be bought at about £5 12s. 6d., and generally prices are weak.

In the engineering trades, one or two special branches, as previously reported, continue tolerably well supplied with orders; but the weight of new work coming forward generally is decreasing, and some of the large local firms are discharging men.

I understand that an attempt is being made to resuscitate the Gidlow Iron and Coal-works at Wigan, which have been practically closed for several years past. At one time these works were valued at something like £100,000, but recently they have been offered for sale at about one-tenth of this figure, and now an attempt is being made to re-start them by the promotion of a company with a nominal capital of £50,000.

It has been frequently pointed out that in the event of a general spread of electric lighting, seriously affecting the demand for coal used in the manufacture of gas for illuminating purposes, there would still be a large field open in the manufacture of what are now termed the residual products, which are so essential in the production of dyes. That this is a branch of manufacture which, apart from any vicissitudes that may attend the demand for gas, will in itself become a large consumer of coal, there is little doubt, and as an illustration of what is already being done in this direction, I may mention that in the Dukinfield district, near Manchester, where a bastard cannel is got, which as a purely gas coal has comparatively little value, but which possesses rich properties for the manufacture of dyes, it is in contemplation to build works in the immediate neighbourhood of the pits, with the view of using this coal simply for the manufacture of dyes. Already it is being largely used at dye works in the Manchester district, and considerable quantities of the Black Mine and the Peacock Mine got in the Dukinfield district are also being used solely in the manufacture of dyes.

In the coal trade, although it is only in a few exceptional cases that there has been any actually announced reduction in quoted prices this month, there is a downward tendency, and at the pit mouth prices for anything like quantities average about 8s. 6d. to 9s. for best coals, 6s. 6d. to 7s. for seconds, 5s. to 5s. 6d. for common, 4s. 6d. for burgy, and 3s. 6d. to 4s. for good slack.

Barrow.—I have to report a much better state of affairs in the hematite pig iron trade of this district. Of late some extensive contracts have been received by makers. Home consumers are still very cautious in placing out orders, but on foreign account an appreciable improvement has occurred in the number and extent of the contracts booked. Russian buyers are busy, and the shipments to this country are greater than they have been for a long time. Makers are very firm in their prices, and are unwilling to accept orders at prices lower than those now ruling. No. 1 Bessemer samples are quoted at about 48s. per ton net at works; No. 2, 47s. 6d.; and No. 3, 47s. per ton. The weight of metal now stored at warehouses is considerable, as the furnaces for some time have been producing for stock. Steelmakers are better employed, aud the business received of late, I hear, is sufficient to keep them well employed for some three months. Rails are in better request, but prices are unchanged, remaining at 90s. per ton net at works, prompt delivery. Shipbuilders are very quiet, and few inquiries are being made. Engineers and boiler-makers quiet. Iron ore in better demand at about 8s. 6d. per ton net at mines. Stocks are heavy. Coal and coke easier. Shipping better employed.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

There is a very unsatisfactory return of railway traffic for the last few weeks, thus confirming the falling-off in trade, as shown by the limited tonnage of goods forwarded by the carrying companies. The decrease on the March quarter was heavy, and during April and May the decrease was still more marked. An unfortunate yet significant feature of the traffic returns is that the decrease is most serious on the lines which serve the iron and hardware districts. It is in such trades as those of Sheffield and district that the depression is chiefly felt.

Long-continued drought has been followed by refreshing rain, and the farmers are not without hope of another good harvest. This would have a great and beneficial influence on the home markets. In the rural districts the demand for articles of social industry has been dull for years, and it is impossible to go through the Midlands, particularly where the villages are dependent upon agriculture, without seeing that merchants have literally all but exhausted their stocks, and keep simply ordering from hand-to-mouth as customers require. There is no speculation, and no encouragement to it. A further fruitful harvest would do much to restore confidence in agricultural quarters, and thus in turn benefit Sheffield industries.

The Miners' Permanent Relief Fund, a most important institution, is about to undergo a change of great consequence, if the members approve. At present members pay 3d. per week, which contributions are supplemented by whatever sums can be got, to cover the benefits claimed on account of mining accidents. It is now intended to pay annuities to aged and infirm miners, for which an extra subscription will be required. The Miners' Permanent Relief Fund was started in 1877, and at that time the Northumberland and Durham Society, whose rules the Society at Barnsley —showing no great wisdom in their choice—adopted, had 65,000 members, with a capital of £47,000, and a revenue at the rate of £40,000 per annum. Meetings are now being held in various parts of the district to carry out the new scheme, which is practically one of self-insurance and provision for old age.

Sheffield is now committed to an extensive scheme of sewage works, for which the Sewage and Rivers' Committee of the Corporation have already accepted tenders. The borough authorities contemplate a complete system of drainage, the sewage to be taken down to Blackburn Meadows, there to be purified, and the effluent to pass away into the river. The cost of the entire scheme is estimated at £150,000. Fifteen firms sent in offers for the work, their tenders being as follows:—Messrs. W. Bissett and Son, Sheffield, £23,960; Messrs. Longden and Son, Sheffield, £24,506; Mr. John Scott, Rotherham, £24,600; Messrs. Tomlinson and Sons, Sheffield, £24,700; Messrs. Brier, Sons, and Wilson, Dewsbury, £24,950; Messrs. S. Pearson and Sons, Bradford, £25,758; Messrs. Armitage and Hodgson, Leeds, £26,250; Mr. George Carr, £27,300; Messrs. Thomas Obank and Son, Idle, £27,800; Mr. S. Warburton, Manchester, £27,931; Mr. A. J. Ripley, Rotherham, £28,075; Mr. James Fidler, Eckington, £30,450; Mr. H. Brumley, Sheffield, £32,196; Mr. J. Cowan Smith, Rotherham, £32,242; Mr. Charles Green, Rotherham, £42,541. The lowest tender is that of Messrs. Bissett—which has been accepted—and the highest that of Mr. Green, there being a difference of £18,546 between the two. The contractors are bound to have the main buildings completed by the 1st of January next, and the whole of the works at Blackburn are to be finished by the 1st of January, 1886.

The Town-Clerk of Sheffield is about to advertise for tenders for the carrying out of the first section of the main drainage scheme, which will be a much larger and more expensive undertaking than that of the purification works.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The attendance at the Cleveland iron market held at Middlesbrough on Tuesday last was not large, but a slighty improved tone was noticeable, and somewhat more business was transacted. Foundry iron for prompt delivery was in demand, some of the merchants being anxious to cover their contracts with consumers. The prices obtained by makers for No. 3 g.m.b. ranged from 37s. to 37s. 6d. per ton, and no sales were made at less than 37s. Notwithstanding the slackness in finished iron, forge iron is very scarce, and as merchants hold little or none, makers are able to obtain 35s. 6d. per ton without difficulty.

Shipments are not so good this month as they were in May, only 17,927 tons having been sent away up to Monday night, against 21,669 tons in the first nine days of last month.

There is nothing new to be said with regard to the manufactured iron trade. Inquiries are scarce, and orders still more so. Prices remain unaltered, and are as follows:—Ship plates, £5 to £5 2s. 6d. per ton; angles, £4 15s. to £4 17s. 6d.; and common bars, £5 2s. 6d. to £5 5s. All free on rails at makers' works, cash 10th less 2½ per cent.

The stock of Cleveland iron in Messrs. Connal's store at Middlesbrough on Monday last was 58,587 tons, being a reduction of 20 tons for the week. Their stock at Glasgow on the same day was 590,494 tons.

The Cleveland ironmasters' returns for May were issued on the 4th inst., and appear highly satisfactory from a producer's point of view. There were 100 furnaces at work during the month, sixty-seven producing Cleveland, and the remainder hematite, spiegel, and basic iron. The total quantity of pig iron of all kinds made amounts to 210,992 tons, or an increase of 6671 tons as compared with April. The sum of the stocks in the whole district were 266,152 tons, being a reduction of 17,281 tons for the month.

Messrs. W. Whitwell and Co., of Stockton-on-Tees, have commenced the manufacture of hoops in iron and steel at their Westbourne works.

It is said that the Stanners' Close Steel Company, of Wolsingham, has booked an order for £30,000 worth of steel castings for the Belgian Government. This firm recently made extensive additions to their works, and the above order comes in most opportunely, and will keep them fully employed for some time.

A representative meeting of shipbuilders from the Tyne, Tees, Wear, and the Hartlepools was held at Sunderland on the 6th inst. It was decided to give notice to operatives at the shipyards of a reduction of wages ranging as high as 10 per cent., according to the conditions of the occupation. The reductions will take effect from July 10th.

The value of goods exported from Middlesbrough last month—exclusive of coal and coke—was £263,433, being an increase of £66,473 over May, 1883.

A meeting of the North of England Board of Arbitration was held at Darlington on Monday last, to consider the notice given by the employers of a reduction of 1s. per ton in puddling and 10 per cent. on all other forge and mill wages. An animated discussion took place, and ultimately the following resolution was unanimously agreed to, viz.:—"The employers accept the offer of the operatives, which is as follows:—'That from June 28th to September 27th, 1884, there shall be a reduction of 3d. per ton on puddling and 2½ per cent. in all other forge and mill wages.' It is understood that this arrangement is not to affirm any relationship between realised selling prices and the rate of wages now proposed. That during the currency of this arrangement the Standing Committee shall endeavour to agree upon a sliding scale to be recommended for the adoption of the Board. This resolution is passed subject to confirmation by the subscribers to the Board." The question as to rollers wages was referred to Mr. Dale, the standing referee. It is to be noted that the operative delegates did not actually offer to accept the above 2½ per cent. reduction, but only to recommend their constituents to accept it. Should this recommendation not be adopted the old position will be reverted to, and an arbitration will take place on the employers' original claim. On the other hand, should the 2½ per cent. reduction be established, which is nearly certain, the wages will once again be adjusted to 1s. 6d. above shillings for pounds of realised price for finished iron, as last ascertained by Mr. Waterhouse.

The tendency as to a diminished production of finished iron is still manifest in the Cleveland district. The output during March and April was only 75,044 tons, as compared with 90,616 for January and February. This is a serious falling off, but it is probable that May and June will show still smaller figures.

The West Hartlepool Works are now entirely closed, the current contracts of Messrs. Gray and Gladstone having been undertaken by the West Stockton Iron Company. The Stockton Malleable Iron Company has at work this week only one angle mill; Messrs. Bolckow, Vaughan, and Co.'s Witton Park Works are standing still; and the number of firms who continue in full operation has become very small indeed. A large number of ironworkers are idle, and want and suffering, especially among the aged and the infirm, the women and children, is becoming daily more severe and more widespread.

Meanwhile there is before us the, at first, surprising and apparently inconsistent fact, that the exports of pig iron have been so far this year considerably in excess of those of the corresponding portion of last year. What does this mean? Pig iron is a raw material for all those branches of the iron trade which disburse large amounts of money in wages, and therefore maintain large populations. To export pig iron largely, and but little manufactured iron, castings, machinery, bridge work, railway material, and ships, means that the raw pig iron is being converted into those higher products founded upon it elsewhere rather than here. It means that the concomitant wages are going into the pockets of foreign artisans, rather than into those of British workmen. No wonder there are so many of the latter idle and in distress, and that still the exodus of raw material continues to increase. The Amalgamated Society of Engineers, with their Sunderland strike hands still on their books, might do worse than ponder these things; and so might all that swarm of human locusts, whether of the operative or super-operative class, who in recent years have somehow or other managed so largely to encumber the higher branches of the iron trade, and to get more than a fair day's pay for less than a fair day's work, and sometimes for no necessary work at all. The one thing now needful to aim at is to keep at home, as far as possible, our raw materials, and send abroad our highly-finished products; and the most feasible and perhaps only way to do this, is to cheapen cost to the utmost, and in every way. Drones, at all events, can no longer be permitted in our hives of industry, or there will soon be no working bees at all.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The warrant market, which declined to 40s. 10d. last week, manifested rather more strength in the early part of the present week, in consequence mainly of the Board of Trade returns having shown the exports of pigs for May to be considerably larger than had been anticipated. In consequence there was a great upward turn in the market; but after a series of covering operations on the part of the bears, the market soon relapsed. Better reports are to hand from some quarters abroad as to the demand for Scotch pigs, and the shipments are, on the whole, fairly satisfactory; but the market is in a backward state notwithstanding. The stock of pigs in Messrs. Connal and Co.'s stores is about 500 tons less than it was a week ago.

Business was done in the warrant market on Friday at 41s. 1d. per ton for cash. On Monday the prices ranged from 40s. 11½d. to 41s. 1d.; while on Tuesday quotations advanced to 41s. 3d., subsequently receding to 41s. 1d. Business was done on Wednesday from 41s. 0½d. to 41s. 2d. cash. To-day—Thursday—the market was firmer, with quotations up to 41s. 4½d. cash, and 41s. 6½d. one month.

The values of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 3d.; No. 3, 50s.; Coltness, 56s. 6d. to 50s.; Langloan, 52s. 6d. and 51s.; Summerlee, 51s. and 46s. 6d.; Calder, 51s. 9d. and 46s. 6d.; Carnbroe, 50s. 6d. and 46s. 9d.; Clyde, 47s. 6d. and 45s.; Monkland, 43s. 3d. and 40s. 3d.; Quarter, 42s. and 40s. 3d.; Govan, at Broomielaw, 42s. 6d. and 40s. 3d.; Shotts, at Leith, 51s. 6d. and 51s.; Carron, at Grangemouth, 48s. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 44s. and 43s. 6d.; Glengarnock, at Ardrossan, 50s. 6d. and 44s.; Eglinton, 44s. 6d. and 41s.; Dalmellington, 47s. and 42s. 6d.

There is still a good demand here for Cleveland pig iron, the arrivals of which are about 8000 tons larger than at this date last year.

The inquiry for malleable iron goods continues very slow, and the probability is that additional numbers of workmen will have to be discharged. The exports of manufactured iron and steel goods from Glasgow in the past three weeks embraced £123,000 worth of machinery, £14,000 steel manufactures, £115,000 iron goods, and £9620 sewing machines. The prospects of the shipbuilding industry not being in the least degree improved, the different branches of the iron and steel trades dependent upon it show no improvement. There are thousands of workmen in the Clyde ports unable to get the least measure of employment, and it is feared that they will not be able to hold out much longer without public aid.

Coalmasters state this week that they are receiving fair orders for shipment at Glasgow, and that, notwithstanding the restriction of labour on the part of the miners, they are enabled to implement all demands. At many of the collieries the men are working only six hours a day; but labour is so plentiful, through the slackness in other departments of industry, that there is a probability of the number of colliers being largely increased. Among the shipments of coals in the past week from Glasgow were 3200 tons for Canada, 1790 for Portland, 1400 for Odessa, 1530 for Newfairwater, 765 for Cronstadt, 710 for Bombay, 660 for Odessa, 600 for Stockholm, 810 for Rouen, and 512 for Demerara. The values of coals at the port of Glasgow and at the Lanarkshire collieries are without quotable change. The week's exports of coal at Grangemouth were 7172 tons, and in consequence of the large supply of available shipping, freights were somewhat reduced. At Greenock 3493 tons of coals were despatched.

A serious dispute has occurred between the miners of Fife and Clackmannan and their employers. The men had been persuaded by their leaders that it was reasonable to expect an advance of 15 per cent. on their present wages. The employers, on the other hand, cannot see their way to grant the concession in the present condition of trade. Upon this the colliers resolved to restrict their labour to four days of eight hours a week. Some days ago the masters posted a notice to the effect that the men would not be allowed to descend the pits unless they undertook to work not less than eleven days a fortnight. This the men declined to do, and the consequence was that several thousands of them were locked out. On behalf of the workmen a request was made that a conference of representatives of both sides should meet to discuss the matters in dispute; but the masters decline to confer unless the men go back to work on the old terms and regulations.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

A slight lifting of the cloud has been noticed of late in connection with our steel industries, and judging from the cautious inquiries being made for large quantities, it would not surprise one to have another "boom" from America. It would be premature to express oneself more decidedly at present, but this I can state, that agents are watching the signs with great carefulness. It is full time that some movement occurred. The capacity of the works in Wales is very much greater than present requirements, and here is Cyfarthfa coming upon the scene with the best appliances that skill can produce and money obtain, and will be aided by a water-power of extreme cheapness, as noticed by me last week.

The question under discussion in iron circles is, How will this affect trade? Cyfarthfa used to be busy when other works were idle, from its unexampled sources of trade. Will this again occur? For the encouragement of the firm of brothers who have invested over a quarter of a million, it is to be hoped so.

In wire, tin plates, steel plates, trade is tolerably good, and a good American and China business is being done in best steel plates. A large consignment—over 3000 tons—left for New York a few days ago. Some departments of the workers are under notice.

The coal trade of the ports continues to show some degree of slackness. For instance, Cardiff shows a decrease of 50,000 tons in the exports of the last two weeks; Newport, too, is quiet, and Swansea is about the only port indicating some approach to past figures. This quiet tone may be but the reaction from the excessive vigour which prevailed in the week before the holidays, and it may be something more! I am not a pessimist, but with a very long experience in the coal trade of Wales, never expect that we shall always have a "rush" to contend with. And for the general good it would be better that we had not. It would be better to see less eagerness in getting rid of the best coals in the world, and better for the future most certainly if they were more sparingly worked, and the less valuable brought more to the front.

I commend the evidence of Mr. W. T. Lewis before the Barry Dock Bill Committee as the clearest exposition that can be given of the present state and future probabilities of the coal trade of South Wales. It is very able. There is no special pleading about it, but it has all the irresistible eloquence of facts and figures. "In two years," Mr. Lewis states, "the Severn tunnel will be finished, and a large quantity of coal that now goes to Cardiff for shipment will go by this route, and also by the Pontypridd and Caerphilly." His description of existing means of railway service and shipment, of places in progress, and of future capacity, was very lucid, and evidently told; and nothing could be more broad and philosophic than his conclusions.

Like him, I have contended that the history of one coal valley is that of another. Aberdare Valley began its coal era forty years ago, and, whatever specialists may say, the local opinion is that Aberdare has had its day. Rhondda has now its day, and following Rhondda Valley we shall have the Sirhowy Valley, Monmouthshire, which will feed Newport, and the London and North-Western and Great Western Railways.

Injunctions are flying about obstructively. I hear of one threatened upon the Pontypridd and Caerphilly Railway, on account of neglecting to construct a bridge, and this has had the effect of preventing the opening of the railway, so I imagine, and it is difficult to see any other cause. Another injunction is in action at the docks, Newport. The election of the Harbour Commissioners at this port took place last week, when all the old members were returned.

Arrangements are being made for a summer meeting, at Cardiff, of the Mechanical Engineers' Institution. The guarantee fund has come up £740, being £40 more than was asked for. Mr. Riches is the hon. sec., and has an influential committee.

The local association of enginemen and stokers met at Aberdare on Monday, under the presidency of Mr. Isaac Evans. There was an animated meeting, and various subjects of interest were discussed, principally the hours of labour and wages. With regard to the hours, a resolution was passed advocating eight hours only, and this it was decided to submit to the Sliding Scale Committee of the Employers' Association. In case of the Wamllwyd dispute the meeting judiciously counselled the men to withdraw their notice, and promised an investigation.

Patent fuel is in good demand, and prices are firm.

Iron ore still depressed.

The Rhondda miners' delegate meeting was held on Monday, when it was stated that the Gelli and Tynybedw dispute had been settled, the employers having paid the men the whole of the money which had been kept back.

It was resolved at the close of the meeting to urge upon all collieries a fortnightly settlement.

The imports and exports of New South Wales have nearly doubled within ten years, namely, from 1873 to 1883. In the former year the imports were £10,471,483, and the exports £12,345,603. In 1883 the imports were £20,980,157, and the exports £19,886,018. This rapid rate of increase is being maintained during the present year.

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 the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

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

3rd June, 1884.

8513. Tobacco-pipes, H. Woodward, Shepherd's-bush.
8514. Ring Spinning, T. Thorp, Whitefield, and B. Cooper, Manchester.
8515. Printing and Perforating, &c., Machine, G. W. Castle, sen., Basted.
8516. Cutting and Elevating Ensilage, W. C. Toone, Warminster.
8517. Rims of Wheels, E. Barnes and H. W. James, Birmingham.
8518. Velocipedes, W. E. Heys.—(*F. Rackles, Kaiserslautern, Germany.*)
8519. Stoppering, &c., Bottles, A. H. Cochrane, Dublin.
8520. Feed Apparatus for Roller Mills, &c., T. N. Robinson, Rochdale.
8521. Regulating the Passage of Air in Middlings Purifiers, T. N. Robinson, Rochdale.
8522. Portland Cement, W. Smith, Dublin.
8523. Igniting Apparatus for Gas Engines, H. G. Hellier, London.
8524. Telephonic Transmitting Instruments, S. P. Thompson and P. Jolin, Bristol.
8525. Cleaning Cast Iron Water Pipes, N. J. Ginman, Bradford.
8526. Locks, W. H. S. Aubin, Bloxwich.
8527. Jibbing Casks by Self-action, J. Carter and J. Tozer, Exmouth.
8528. Insulators for Electric Wires, E. L. Sheldon, London.
8529. Cart Locker, J. Hetherington, Boreland.
8530. Patterns for Casting Metallic Lasts, W. P. Thompson.—(*G. A. Reynolds, Utica, U.S.*)
8531. Bushed Flyers, J. H. Boyd and J. Press, Antrim.
8532. Presses for Moulding Glass Insulators, L. B. Gray and J. Ham, Boston, U.S.
8533. Screw Propellers for Vessels, E. S. Hawley, Buffalo, U.S.
8534. Ferrule for Umbrellas, &c., J. Andrews, Hampstead.
8535. Tobacco, &c., Box, J. Andrews, Hampstead.
8536. Auxiliary Handle for Velocipedes, F. W. Jones, Exeter.
8537. Boots, &c., E. Pittam, Northampton.
8538. Compound for Photographic Purposes, J. J. D. Hutinet, Paris.
8539. Telephones, J. T. Lister, Cleveland, U.S.
8540. Holder for Tennis or other Bats, T. Brookes, Birmingham.
8541. Telegraphic, &c., Apparatus, D. Sinclair and J. L. Corbett, Glasgow.
8542. Mechanical Retorts, J. M. Bennett, Glasgow.
8543. Mountain Sandal, B. J. B. Mills.—(*N. Vértesy, Marmaros-Sziget, Hungary.*)
8544. Nut-locks, E. C. Smith, Brooklyn, U.S.
8545. Sewing Machines, S. Pitt.—(*W. S. North, Chicago, U.S.*)
8546. Advertising, R. C. Annand, South Shields.
8547. Stockings and Socks, J. H. Cooper and W. J. Ford, Leicestershire.
8548. Life-saving Apparatus, H. H. Lake.—(*E. B. Lake, New Jersey, U.S.*)
8549. Ball and other Valves or Cocks, H. F. Hill, Nottingham.
8550. Magazine Guns, A. J. Boult.—(*C. B. Scott, U.S.*)
8551. Tube Beader, C. Wicksteed, Kettering.
8552. Rotary Fluid Pressure Motor, &c., B. Todd, London.
8553. Ink Pots or Holders, A. Kempson, Tunbridge Wells.
8554. Electric Arc Lamps, A. M. Clark.—(*Wirth and Company and S. Schuckert, Germany.*)
8555. Dynamo Electric Generators, A. M. Clark.—(*Wirth and Company and S. Schuckert, Germany.*)

4th June, 1884.

8556. Power Mortising Machine, G. Lowry.—(*W. W. Green, Chicago.*)
8557. Self-acting Mules, J. Macqueen, Bury.
8558. Lamps, I. Marcuson, Birmingham.
8559. Flour Screens, T. N. Robinson, Rochdale.
8560. Spinning Fibrous Materials, J. W. Shepherd, W. Ayrton, and C. Siddall, Manchester.
8561. Grinding Minerals, W. A. Vérel and P. Stewart, Glasgow.
8562. Obtaining Copper, &c., from Copper Matte, W. A. Vérel and P. Stewart, Glasgow.
8563. Applying Hydraulics to Velocipedes, &c., W. Phillips, Southampton, and G. H. Street, Richmond.
8564. Automatic Musical Instrument, M. A. Weir, Upper Norwood.
8565. Gas Engines, J. E. Rogers, Smethwick.
8566. Mechanically Shifting Photographic Scenery, G. W. Morgan, Aberdeen.
8567. Inhalers, A. M. Vereker, Dublin.
8568. Rendering India-rubber Tubing Gas-proof, T. Fletcher, Warrington.
8569. Applying Driving Gear to Velocipedes, F. C. Wrighte, Birmingham.
8570. Knitting Machines, W. Rothwell, Bolton.
8571. Weaving Reversible Pile Fabrics, A. Rothwell, Bury.
8572. Compass Course Indicator, T. Purdy, Liverpool.
8573. Electrical Batteries, J. C. Mewburn.—(*C. B. de Montaud, Paris.*)
8574. Boots and Shoes, J. Scouse, Northampton.
8575. Steam Valve, W. T. Stewart, Cork.
8576. Carriage for Grass-cutting Shears, A. Brown, Ealing.
8577. Adjustable Anti-dip Pipes used in Manufacturing Gas, J. Cort, London.
8578. Moulding and Casting Steel, J. Fox and S. Whiteley, Leeds.
8579. Gas Motor Engines, J. Shaw, Leeds.
8580. Glass Lamp Holder for Incandescent Electric Lamps, M. Sugar, London.
8581. Electrical Switch, M. Sugar, London.
8582. Ascertaining the Safety as to Stability of a Vessel, P. P. S. y Chico, London.
8583. Treatment and Production of Iron, S. R. Smith, London.
8584. Closing and Fastening Retort Lids, &c., J. Methven, London.
8585. Metallic Flanges, W. H. Beck.—(*La Société Olry et Granddemange, Paris.*)
8586. Compound Motors, M. F. D. Cavalerie, Paris.
8587. Automatic Governing of Steamship Engines, J. G. Sanderson, London.
8588. Candlesticks, B. Willcox, London.
8589. Cup-leathers for Pistons, &c., R. R. Gubbins, London.
8590. Bronzing Machines, G. W. Seitz, Germany.
8591. Breech-loading Sporting Guns, E. Bled and E. Richoux, Paris.
8592. Safety Apparatus for Cages, A. J. Boult.—(*P. F. Laarman, Amsterdam.*)
8593. Pivot Safety Saddle Bar, N. Buxton, London.
8594. Controlling Supply of Water, A. M. Clark.—(*T. P. Ford and J. Cruikshank, New York.*)
8595. Oat Cake for Horses, H. J. Haddan.—(*F. Meyer, Austria.*)
8596. Cloth-pressing Machines, R. Patrick, jun., Canada.
8597. New Toy, G. Martin, Southsea.
8598. Sheathing Cakes of Lubricating Compound, A. M. Clark.—(*D. D. Wass, New York.*)—*3rd April*, 1884.
8599. Self-regulating Electro Motors, W. M. Mordey and C. Watson, Putney.

5th June, 1884.

8600. Adjustments for Fanlights, R. McTaggart, Shawlands.
8601. Insulator for improving Tone of Pianofortes, E. Trow, Birmingham.
8602. Folding Easels or Stands, C. A. Jones, Hatherley Court.
8603. Spinning, &c., Fibres, C. W. Lyons and W. Fearn, Rochester.
8604. High-pressure Ball Valve Cock, J. Friend, Exeter.
8605. Benzol, H. Kenyon, Manchester.
8606. Winding Machinery, J. B., C. H., and W. Whiteley, Lockwood.
8607. Machinery for Combing Wool, W. Terry and J. Scott, Bradford.
8608. Glove Stretcher, &c., W. P. Thompson.—(*A Traver, New York.*)
8609. Smelting Ores, E. V. Bibby, Garston.
8610. Furnaces for Treating Copper Regulus, E. V. Bibby, Garston.
8611. Cartridge Holders, N. T. B. Carlin, St. Louis.
8612. Making Steel, W. Beardmore and J. MacC. Cherrie, Glasgow.
8613. Making Bricks, &c., G. Sewell and W. H. Sissons, Barton-on-Humber.
8614. File Wheel, E. de Pass.—(*La Société Veuve A. Miroude et Compagnie, Paris.*)
8615. Oil Lamps, &c., W. Daniell, Linslade.
8616. Cooling Air in Mines, &c., E. Capitaine.—(*F. Poetsch, Aschersleben, Germany.*)
8617. Production of Carbonic Acid, &c., E. Capitaine.—(*H. Herbertz, Barmen, Germany.*)
8618. Tempering Steel Wire, J. Thornton and H. Ellison, Cleckheaton.
8619. Lawn Tennis, &c, Balls, W. E. Bussey, Peckham.
8620. Guns and Ordnance, A. L. S. Leighs, London.
8621. Umbrella, &c., Handle, L. J. Murray, Birmingham.
8622. Penholders, W. H. Ellison, London.
8623. Hydraulic Lifts, J. J. Miller, Hammersmith.
8624. Beating Carpets, &c., S. Simmons, London.
8625. Treating Cocoa, W. L. Wise.—(*P. Lobeck, Dresden.*)
8626. Constructing Hats, &c., G. F. Powell, Bath.
8627. Educational Slates, &c., E. G. Peyton, Notting Hill.
8628. Raising, &c., Chimneys of Engines, J. T. Smith, Peakirk.
8629. Drain Traps, O. Elphick, London.
8630. Treating Vegetable Fibre, J. Smith, Jersey.
8631. Window Sashes to Lessen the Risk of Life, G. Calvert, Glasgow.
8632. Striking Bags, H. J. Haddan.—(*A. Rumsey, Cleveland, U.S.*)
8633. Flower Stands, H. J. Haddan.—(*Knauth and Co., Saxony.*)
8634. Hot-air Valves, H. J. Haddan.—(*F. Bargers, Germany.*)
8635. Coupling for Railway Vehicles, H. H. Lake.—(*Messrs. Wirth and Co., and A. Staubitz, Germany.*)
8636. Looms for making Pile Fabrics, W. R. Lake.—(*J. Sené, Paris.*)
8637. Otto Gas Motor Engines, &c., F. W. Crossley, Openshaw.
8638. Attaching Labels to Goods, &c., R. H. Hughes, London.
8639. Couplings for Railway Wagons, J. B. Hannay, Lochlong, and J. Cowan, Glasgow.
8640. Boiler for Generating Steam, S. Lloyd, London.
8641. Treatment of Ground Coffee, T. A. Brown, Upper Norwood.
8642. Crimpled Fabric, A. M. Clark.—(*P. and C. Depoully, and La Société C. Garnier and F. Voland, Paris.*)
8643. Coating Photographic Plates, B. J. Edwards, London.

6th June, 1883.

8644. Automatic Cooking Apparatus, G. H. Wiscom, Newport.
8645. Crow-bars, J. Heap, Ashton-under-Lyne.
8646. Cutting Holes in Metal, W. Heap, Ashton-under-Lyne.
8647. Self-acting Mules, W. T. Watts, Stalybridge.
8648. Revolving Cutter Block, &c., W. Andrew, Oldham.
8649. Conveying Yarns to be Dried, &c., R. H. Reade, W. Kennedy, and J. Mallon, Belfast.
8650. Fire-grates, J. Donald, Glasgow.
8651. Roll-chronometer Escapement, E. Capitaine.—(*A. E. Müller, Germany.*)
8652. Water Filters, W. E. Rushworth and S. Jackson, Bradford.
8653. Automatic Suction Apparatus, W. Reed, Deptford.
8654. Transmitting Electro-motive Power, C. P. Elieson, Leytonstone.
8655. Divesting Roots of their Detrimental Parts, J. W. Duncan, London.
8656. Frames for Exhibiting Signs, J. A. Causton, London, and C. Shether, Buxton.
8657. Barbed Fencing, H. Smith, Dudley.
8658. Baking Powder, &c., A. McDonald, Langside.
8659. Tramways, J. Richardson, London.
8660. Oil Press, A. J. Boult.—(*J. P. F. Cartier, Chevaline, France.*)
8661. Composition for Removing Incrustation from Boilers, E. Morris, Wigan.
8662. Treating Phosphates of Lime, P. de Wilde, Brusssls.
8663. Producing Gas from Hydro-carbons, J. F. G. Kromschröder, London.
8664. Electric Arc Lamps, W. B. Brain, London.
8665. Power Engines, J. Q. Dunstan, Falmouth.
8666. Drying Apparatus, L. Hagen, Magdeburg.
8667. Spurs, &c., P. Jensen.—(*W. Schulze, Brederlow, Germany.*)
8668. Filters, J. W. Sawyer, London.
8669. Filters, J. W. Sawyer, London.
8670. Surface Thermometers, J. Mayer, London.
8671. Electric Alarm Clock, H. J. Haddan.—(*V. Gallet, Brest.*)
8672. Looms, H. J. Haddan.—(*A. Dubouis, E. Lager, and C. Chassignol, Belmont, France.*)
8673. Sewing Machines, W. R. Lake.—(*A. A. Fisher and A. Hart, Brooklyn, U.S.*)
8674. Screens for Sifting, Riddling, &c., J. Tushaw, London.
8675. Slating Iron Roofs, W. Middleton, London.
8676. Steam Generators, P. M. Justice.—(*O. Lillienthal, Germany.*)
8677. Car Axle Lubricators, S. A. Flower and P. Ross, New Jersey.
8678. Numbering, &c., Tickets, Cheques, &c., J. M. Black, London.
8679. Treating Oxides of Iron, J. Mason, near Witney.
8680. Sulphate of Ammonia, &c., R. R. Kelly and A. C. L. Wiegel, London.
8681. Furnaces for Steam Generators, O. Imray.—(*J. Ferrando, Italy.*)

7th June, 1884.

8682. Tricycles, J. A. Leeming, Bradford.
8683. Materials for Covering Floors, W. T. Symons, Winsford.
8684. Pressing and Baling Hay, &c., J. H. Dickinson, Ormskirk, and J. W. Dickinson, Southport.
8685. Mechanical Mute Tailpieces for Violins, T. Parker, Pudsey.
8686. Invert Sugar for Brewing, &c. F. W. Tomson, Burton-on-Trent.
8687. Erection of Cheap Silos, R. H. Murray, Copcut.
8688. Shower-bath Roses, T. W. Twyford, Hanley.
8689. Calculating, &c., Apparatuses, J. J. Raggett, Aston.
8690. Washing Machines, J. Summerscales, Keighley.
8691. End-grain Wood-carpet, Veneer, &c., H. C. Webb, Worcester.
8692. Buttons and their Attachments, J. Booth, Birmingham.
8693. Seats of Couches, &c., R. L. Hickes, London.
8694. Paper Pulp, W. H. Richardson, Jarrow-on-Tyne, and W. Bertram, Edinburgh.
8695. Controlling the Supply and Exit of Water to Washbasins, &c., W. Baker, Brockley.
8696. Water Bottle and Surcingle, H. S. Russell.—(*F. A. Fortescue, Egypt.*)
8697. Lead Pencils, H. J. Allison.—(*M. S. Shipley and E. Tyrrell, Cincinnati, U.S.*)
8698. Frames for Tricycles, W. E. Hurrell, London, and W. Spence, Surbiton.
8699. Steam Boilers, J. C. Jopling, Sunderland.
8700. Cutting Hair, W. Bown, Birmingham, and G. Capewell, Aston.
8701. Generating Caloric in Boiler, &c., Furnaces, S. R. Smyth, Clapham.
8702. Electro-chemical Extraction of Salts, E. Edwards.—(*A. N. Champy, fils, and L. P. Champy, Antwerp.*)
8703. Carrying a Child's Seat on a Tricycle, A. H. Cartmale and W. Day, London.
8704. Microphones, A. J. Boult.—(*K. S. Dembinski, Brussels.*)
8705. Turning Watch Cases, &c., A. M. Clark.—(*La Société Dubail, Monnin, Frossard, and Co., Paris.*)
8706. Measuring and Recording Distances, F. Wright, Forest Gate.
8707. Electrical Lamp Supports, &c., T. T. Smith, London.
8708. Garden Engines, E. Newton, Hitchin.
8709. Skein or Hank Holders and Winder, J. Lewis, Langley.
8710. Measuring Liquids, &c., R. Fraser and W. Clark, Plumstead.
8711. Propelling Vehicles and Boats, W. Astrop, London.
8712. Lids for Sheet-metal Kegs, &c., J. McQueen, Glasgow.
8713. Lawn Tennis Bats, C. Malings, Woolwich.
8714. Spring Motors for Velocipedes, H. Horscroft, Maidstone.
8715. Frames of Portable Tents, &c., E. L. Berthon, Romsey.
8716. Bicycle, &c., Wheels, E. Nunan, London.
8717. Alcohol, Yeast, and Vinegar, C. R. Bonne, Manchester.
8718. Taking up Slack in Wires, J. Coleman and I. Henson, Derby.
8719. Closing Bottles with Screw Stoppers, S. E. K. Capps, London.
8720. Sliding Seats for Boats, J. H. Clasper, Putney.
8721. Photographic Cameras, W. S. Atwood, Southgate, and S. B. Goslin, London.
8722. Mechanism for Winding-up Clocks, &c., H. H. Lake.—(*F. Fitt, Switzerland.*)
8723. Breech-loading Fire-arms, H. Studer, Paris.
8724. Chronographic Mechanism for Watches, H. H. Lake.—(*F. Fitt, Switzerland.*)
8725. Extension Levers, D. Buckley, Boston, U.S.
8726. Martini Rifles, &c., J. Hämmerli and J. Hausch, Lenzburg.
8727. Apparatus to be Used in Looms for Weaving, W. Mould and H. Barton, Preston.

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8728. Safety Screw Rowing Boat, L. C. Pfund, Carlisle.
8729. Electric Singeing Apparatus, J. C. Eaton, Ancaster.
8730. Steering Tricycles, &c., I. Briggs and F. Holloway, Birmingham.
8731. Portland, &c., Cement, J. Roberton, Glasgow.
8732. Nest Telephones, S. P. Thompson, Bristol.
8733. Feeding Wool, &c., to Carding Machines, J. Taylor, Barkisland.
8734. Adjustable Boot-jack, A. Weck, Tammerthal.
8735. Slate, &c., Cleaner, J. Vickers, Leeds.
8736. Automatic-acting Condensed Water Outlet, A. H. Kuhlmann.—(*W. Kuhlmann, Germany.*)
8737. Cornice Pole Rings, W. A. Rees, London.
8738. Locking Nuts on Bolts, F. Reeves, London.
8739. Preventing Collisions on Railways, E. G. Matthewson, Upper Norwood.
8740. Washers and Nuts for Fastening Fish-plate T. B. Matthews, Sheffield.
8741. Lamps, A. J. Boult.—(*M. Matthews, Toronto.*)
8742. Mixing Liquids with Dry, &c., Materials, C. Vinkeles-Houssart, London.
8743. Inking Pad for Rubber Stamps, &c., H. Savage, London.
8744. Colouring Matters for Dyeing and Printing, C. D. Abel.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
8745. Softening Water, P. A. Maignen, London.
8746. Refining Coloured Raw Sugar, C. Steffen, Vienna.
8747. Moulds for Decorative Slabs, &c., A. McLean, London.
8748. Compressing Peat, A. McLean. London.
8749. Door Springs, J. Adams, London.
8750. High-speed Steam Engines, G. Anslow and H. A. Bayley, Coalbrookdale.
8751. Telpher Locomotive, F. Jenkin, Edinburgh.
8752. Self-igniting Match-boxes, &c., A. Berkeley, London.
8753. Spring Motor, H. J. Haddan.—(*A. Marquis, Paris.*)
8754. Latch-needle Knitting Machines, J. W. Watts, Countesthorpe.
8755. Gas Furnaces, T. E. Edwards, Birkenhead, J. W. C. Holmes, Huddersfield, and B. Midgley, Milnsbridge.
8756. Willowing Wool, W. R. Lake.—(*C. Obozinski and A. Darolles, Belgium.*)
8757. Steam Boiler Furnaces, H. H. Lake.—(*Messrs. Schultz, Mnaudt, and Co., Prussia.*)
8758. Opening, &c., Fanlights, J. T. Pennycook, London.
8759. Sofa Beds, W. R. Lake.—(*B. Kreth, Hungary.*)
8760. Casks or Barrels, A. Dunbar, Liverpool.
8761. Rackets, A. E. Trimmings and C. G. Knighton, London.
8762. Twist Lace Machinery, H. B. Payne, Nottingham.
8763. Filling, &c., Self-closing Stoppered Bottles, W. Wingfield and J. F. Hemmings, St. Leonards-on-Sea.

ABSTRACTS OF SPECIFICATIONS.

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

4984. Checking, Counting, or Indicating Apparatus for Tram-cars, &c., *R. W. Vining, Liverpool.*—*19th October*, 1883. 8*d.*

Consists in making the arms of a turnstile adjustable in position in their relation to the central axis besides the mere rotary movement, in such manner that the arms shall fold up or pack into a smaller space when behind the centre, a cam or its equivalent giving the direction and rigidity, or the two arms are arranged opposite each other in one piece, or to work together, and by means of a cam the ends of that piece are caused as they come into useful position to project, and the ends at the back of the central axis to be close to that centre.

5024. Printing Telegraphs, &c., *H. J. Allison, London.*—*23rd October*, 1883.—(*A communication from S. D. Field, New York, U.S.*) 8*d.*

This invention relates to that class of printing telegraphs in which two type wheels, whose step-by-step movement is electro-magnetically controlled, are used, It consists more particularly in determining which of the two type wheels shall be printed from; to controlling the "unison" in printing telegraphs; to preventing any false impression on the record from the wheel not desired to be printed from; to preventing any blurring of the record from accidental contact of the paper slip with either wheel: to a transmitter, and to the arrangements of the circuits.

5030. Substitute for Animal Wool, *J. F. Phillips, London.—23rd October*, 1883.—*(A communication from J. L. Allagnou, Paris.)—(Not proceeded with.)* 2*d*.

The object is to manufacture a new industrial product from the vegetable fibres found in peat mosses.

5036. Ignition of Inflammable Substances and Gases by Electrical Discharges, *O. E. Woodhouse, F. L. Rawson, and A. R. Molison, London.—23rd October*, 1883. 6*d*.

This relates to the combination of an electrical inductive machine (patent No. 1295, of 1883) with a frame and handle provided with insulated wires and a sparking tip. In a "Voss" or "Varley" machine the commutators are made of insulating material suitably coated with tin foil, the brushes being made of twisted loops of wire. The armature is driven by clock-work.

5039. Obtaining Vegetable Hydrocarbons from Coal Gas, &c., *E. Drew, London.—23rd October*, 1883.—*(Void.)* 2*d*.

Relates to the general arrangement of the series of vessels.

5041. Sewing or Stitching Holes, *W. R. Lake, London.—23rd October*, 1883.—*(A communication from C. M. Banks and St. J. W. Mintzer, Philadelphia.)* 8*d*.

Comprises improvement in the means for effecting a reciprocating motion of the needle; and in devices for effecting the feed of the cloth in the line of the edge of the button-hole.

5067. Manufacture of Sheet Metal Cans, *W. R. Lake, London.—24th October*, 1883.—*(A communication from E. Norton and J. G. Hodgson, Chicago.)* 6*d*.

Relates principally to the combination with a revolving can holder or chuck of a rocking or swivelling tool holder, provided with a seaming tool reciprocating thereon, and means for operating the said tool holder and seaming tool.

5068. Name-plate for Plants, &c., *A. Still, Liverpool.—24th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to a rod of stout wire flattened out at top, or having a name-plate attached to it, and having a broad short-pointed plate soldered to it at bottom.

5069. Secondary Batteries, *J. S. Sellon, London.—24th October*, 1883. 6*d*.

The upper portion or rim of the corrugated plate is an addition of plain thin lead, either cast on or attached to the thicker plate. In cases where the plates are packed one within the other, as in conical plates, the upper thin portion is coated with insulating material.

5070. Obtaining Sulphur from Sulphuretted Hydrogen, *C. F. Claus, London.—25th October*, 1883. 4*d*.

Consists in the production of sulphur from sulphide of hydrogen; the passing of a mixture of air and sulphide of hydroegn in equivalent quantities, either through a layer of oxide of iron, which has been mixed with lime, alumina, magnesia, or similarly acting substance or substances, or through a layer of oxide of copper, oxide of manganese, or other pyrophoric or contact substance or substances, which will decompose sulphide of hydrogen at the ordinary atmospheric temperature or at an elevated temperature.

5072. Insulators for Electrical Purposes, *E. Roe, London.—25th October*, 1883. 4*d*.

The insulators are made of metal, the gases being expelled from the pores, and these fitted with rustless oxide by the "Bower-Barff" process.

5073. Preparing Fish for Cure, *J. Ross, jun., Muchalls, N.B.—25th October*, 1883.—*(Not proceeded with.)* 2*d*.

The fish having had the gut and head removed, are fixed on an endless travelling band, and strong jets of water are caused to play upon them to remove the blood.

5075. Valve Gear for Steam Engines, &c., *A. Paul, Dumbarton.—25th October*, 1883. 1*s*. 4*d*.

Relates to valve gear for steam engines, and for steam hoisting, hauling, winding, steering, and other apparatus having two or more cylinders, which act on separate cranks, and consisting of a single shifting excentric, arranged to act directly or through a rocking shaft or lever on the valve of one of the cylinders, and combined with one or more rocking shafts and suitably disposed levers for acting on the valve or valves of the other cylinder or cylinders.

5081. Switch Apparatus for Connecting and Disconnecting Electrical Lines for Telegraphic or Telephonic Communication, *J. Imray, London.—25th October*, 1883.—*(A communication from T. A. Connolly, Columbia, U.S.)—(Not proceeded with.)* 2*d*.

The connections are made by mechanically driven carriers running on a series of horizontal bars.

5082. Dynamo-electric or Electro-dynamic Machines, *R. E. Dunston, A. Pfannkuche, and J. Fairlie, London.—25th October*, 1883. 4*d*.

The core of the annular armature is made by winding hoop iron in convolutions, together with a strip of interposed insulating material.

5085. Gas Motor Engines, *C. A. Bullock, London.—25th October*, 1883. 6*d*.

Relates to the construction of the cylinders and the arrangement of the valves and springs.

5086. Valves for Steam Engines, &c., *T. Lewis, Cardiff.—25th October*, 1883.—*(A communication from P. H. Stangaard, Germany.)* 4*d*.

Relates to the employment of layers of canvas, cotton duck, or other like fabric in the shape of the required valve.

5089. Apparatus for Propelling Boats, *L. Bellefonds, London.—26th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to an arrangement of gearing for driving screw propellers or paddles by the feet.

5091. Apparatus for Use in Trawling, *H. Brooks, 26th October*, 1883.—*(Not proceeded with.)* 2*d*.

The trawl heads are formed of iron or steel of double flanged or other suitable section, or partly of such flanged form of section and partly such as the sole portion, of plain rectangular section.

5093. Moulding or Pressing Screw Forms in Plastic Material, *D. Rylands, Barnsley.—26th October*, 1883.—*(A communication from H. Brooke, New York.)* 6*d*.

Relates to an appliance for moulding or pressing screw forms or threads in plastic material consisting of a screw die, which at the same time that it is pressed forward into the plastic material, has a backward or withdrawing rotary motion imparted to it.

5094. Melting Furnaces, &c., *D. Rylands, Barnsley.—26th October*, 1883.—*(A communication from R. Good, New York.)* 6*d*.

Relates partly to an improvement in producers for making gas for glass melting and other purposes, and consists of the application of a blast pipe to an ordinary Siemens producer from a fan or blower, which blast pipe operates through a hole in the brickwork, under the centre of the producer grate bars.

5095. Appliances for Heaving up Slips, *T. Summers and A. J. Day, Southampton.—26th October*, 1883.—*(Not proceeded with.)* 2*d*.

The cradle and vessel are supported by rollers which carry their weight, but to which they are not bolted, the case of the wheels of the ordinary slipways.

5096. Manufacturing Unalterable Cartridges, *L. G. Bachman, Brussels.—26th October*, 1883.—*(Not proceeded with.)* 2*d*.

Consists in constructing the cases of vegetable parchment.

5097. Ashpans, &c., *G. Asher, Balsall Heath.—26th October*, 1883. 6*d*.

Relates to a combined dust receptacle, cinder sifter, and trivet or rest.

5098. Carrying or Supporting Knapsacks, *J. C. Mewburn, London.—27th October*, 1883.—*(A communication from A. Mendel, Dresden.)* 6*d*.

The object is to provide means by which the load or weight of the knapsack, generally carried on the back, is removed from the shoulders and distributed over a larger area of the body.

5099. Treating Residual Matters from Town Refuse in the Manufacture of Bricks, &c., *T. Whittaker, Accrington.—27th October*, 1883. 4*d*.

Relates to the treatment of the refuse and mixing with clay.

5100. Apparatus for Generating and Condensing Steam, *H. J. Haddan, London.—27th October*, 1883.—*(A communication from A. Goupil, Chauvigny, France.)—(Not proceeded with.)* 2*d*.

Relates to steam generators using petroleum or other hydro-carbon oils, and to condensers; the object being to reduce the weight of apparatus for a given power of engine.

5103. Electric Gas-lighters, *T. and J. Taylor, Oldham.—27th October*, 1883. 6*d*.

So as to ensure that a single spark shall light the gas, the lighter is provided with a swinging "concentrator," formed as a cone, and so hung that the apex of the cone shall coincide with the point where the spark is produced.

5104. Metallic Compound for Ramming or Tamping Gunpowder in Coal Mines, &c., *H. Lawrence and J. L. Ryott, Durham.—27th October*, 1883.

The compound consists of $76\frac{4}{11}$ parts of copper; $14\frac{2}{7}$, lead; $4\frac{1}{2}\frac{1}{7}$, antimony; $4\frac{1}{2}\frac{1}{7}$ bismuth. The materials are melted and thoroughly incorporated together, and are then cast and worked in the ordinary way into the articles required for different purposes.

5105. Variable Expansion Gear for Steam Engines, *J. T. Marshall, Gainsborough.—27th October*, 1883.—*(Not proceeded with.)* 2*d*.

The expansion gear is automatic, the "cut off" being controlled directly by the governor without the intervention of slot link, expansion excentric, or gear wheels.

5106. Reservoir Penholders, *T. A. Hearson, London.—27th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to the construction of a reservoir penholder for supplying ink to a nibbed pen.

5111. Magnetic Garments, *G. Carron, London.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

This relates to the construction of the magnets, and to the method in which they are used in the manufacture of various garments.

5114. Keys for Locks, *J. Legget, Edinburgh.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

The projecting part of the key is made movable, so that it can be rotated axially, and therefore in being so rotated its rotation cannot affect the rotation of the key in the lock, and thus prevent the unlocking of the lock by tongs or other instrument.

5115. Rims for the Wheels of Velocipedes, &c., *A. B. Woakes, London.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to means for attaching the rubber tires to the rim.

5116. Forming Cylindrical and Similar Shells of Steel, &c., *A. H. Maclean, Glasgow.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to the employment of a rotating casing for casting the shells.

5118. Trouser Suspenders, &c., *J. B. Fournier and J. B. Thoully, St. Chamond.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

The object is to suspend various articles of dress, such as trousers, coats, cloaks, and so forth, without folding, and so prevent creasing the garments.

5120. Manufacture of Blue Colouring Matter or Dye Stuff, *F. Wirth, Frankfort.—29th October*, 1883.—*(A communication from E. Oehler, Offenbach.)—(Not proceeded with.)* 2*d*.

The object is the production of a blue colouring matter by the treatment of tetramethyldianidodiphenylenamin—that is, the leucobase of the dimethyl-phenylengreen or its homologues—in an acid solution, with sulphuretted hydrogen and chloride of iron, or any other oxidising agent.

5121. Mincing Machines, *T. Williams, jun., London.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to the arrangement of a threaded archimedian propeller, and the arrangement of the claws or knives.

5122. Couplings for Railway Trucks, &c., *I. Davies, Manchester.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

Consists of a special attachment to the ordinary chain or other coupling, whereby the operation may be performed without the operator going between the vehicles for that purpose.

5123. Ships' Berths, *C. J. Fox, Birkenhead.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to a metallic framework and the formation of the berths or bunks of wire rope or its equivalent.

5124. Thrust Bearings for the Shafts of Screw Propellers, *G. Davies, Manchester.—29th October*, 1883.—*(A communication from F. Jackson, San Francisco.)* 6*d*.

The inventor claims the construction of thrust bearings wherein the thrust is not borne by metallic surfaces revolving in contact, but by hydraulic means—that is, by a surface of compressed water, oil, or other liquid.

5125. Extraction of the Precious Metals from their Ores, &c., *A. P. Price, London.—29th October*, 1883. 4*d*.

Consists in effecting the precipitation and separation of the precious metals, viz., of gold or of silver, or of gold and silver, from solutions resulting from the treatment of ores or of metallurgical products by the employment when in a fine state of division of zinc or of other metal or metals other than copper, which are capable of precipitating either gold or silver, the same being brought into contact with the solution, and maintained in contact therewith by means of agitation.

5126. Clarification of Beer, *H. H. Lake, London.—29th October*, 1883.—*(A communication from Dr. H. Kunheim, Berlin, and Dr. W. Raydt, Hanover.)* 4*d*.

Consists in introducing into the vats carbonic acid gas produced by the expansion of liquid carbonic acid.

5127. Electrical Generators and Motors, *T. J. Handford, London.—29th October*, 1883.—*(A communication from T. A. Edison, Menlo Park, New Jersey, U.S.)* 6*d*.

To obviate the sparking of the commutator in generators having continuously wound armatures connected at intervals to the commutator slips, the electro-motive force of the coils as they are short-circuited at the commutator is opposed by a counter electromotive force. This is produced by making the connections between the armature and the commutator slip by a conductor connected to, and preferably smaller in section than, its coil, and carried back one or[1] more times around the armature before being connected to the slip.

5128. Fastenings for Lacing Boots and Shoes, *J. Paton, Johnstone, Renfrew.—29th October*, 1883.—*(Not proceeded with.)* 2*d*.

The fastenings consist of circular or oval eyes or loops of metal wire or other material fitted to the leather.

5129. Apparatus for Producing Steam or Vapour, *J. Millen, London.—29th October*, 1883. 6*d*.

Relates to a hot-air and vapour producing apparatus consisting essentially of the following parts, viz., an inner closed vessel or boiler to be charged with water and to be heated so that vapour or steam is produced from the water, an outer enclosing mantle open below for the heat from the source of heat having a jacket, means for regulating the inlet of air to the jacket and a pipe from the steam or vapour in the boiler, which pipe may be used as a jet pipe for drawing in the air through the jacket and for carrying it off in a heated state commingled with the vapour or steam. Other improvements are described.

5132. Dynamo-electric Machines, *S. Z. de Ferranti, London.—29th October*, 1883. 6*d*.

The coils of the field magnets are wound parallel to the axis of the armature, and pass alternately over and under it, or on one side and the other. The pole pieces, each wound with its own coil, may be set in inclined positions, so as to form an undulating ring-like structure.

5133. Marine Engines, *J. Hargreaves, Widnes.—30th October*, 1883. 6*d*.

The inventor uses a prime mover, say a steam, caloric, gas, or thermo-dynamic engine, to force water or other fluid at high-pressure into an air or other suitable accumulator. The water or other fluid is afterwards employed to actuate a reversible hydraulic motor coupled or geared to the propeller or its shaft.

5134. Clearing Roads, Railways, &c., from Snow, *J. Forster, St. Helens, Lancaster.—30th October*, 1883. 6*d*.

Consists in a machine drawn along by horses, or steam or other motive power, and clearing away the snow by means of a revolving digger passing the snow into a heater forming a part of the machine, and thus melting it.

5137. Combined Boiler and Steam Vacuum Pumps, &c., *H. J. Allison, London.—30th October*, 1883.—*(A communication from C. L. Riker, Brooklyn.)* 6*d*.

Relates to the method of exhausting the steam from the working chamber of a steam vacuum pump, which consists in applying to the steam in the working chamber the pressure of a column of water contained in a separate chamber at a higher level by means of the open connection of said higher water chamber with the lower portion of the working chamber, and in providing for the steam subjected to the said pressure an exhaust vent, so soon as it has forced the water out from the working chamber to a given level by means of a water trapped tube connecting the upper part of said chamber with a separate condensing chamber, and which is automatically unsealed by the depression of the water therein to said level.

5139. Ships' Bows, *H. J. Haddan, London.—30th October*, 1883.—*(A communication from J. B. B. Vautré, Toulouse.)—(Not proceeded with.)* 2*d*.

Relates to movable bows for navigable vessels.

5143. Fixing Handles and Legs to Cast Metal Utensils, *E. Green, Deepfields.—30th October*, 1883.—*(Not proceeded with.)* 2*d*.

The object is to secure tubular and other wrought metal handles and legs to cast metal utensils.

5145. Bottle Stopper, *M. Haymans, London.—30th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to the employment of a cap.

5149. Flattening, Crushing, or Reducing Beans, Peas, &c., *J. A. Fawcett, Wakefield.—30th October*, 1883.—*(Not proceeded with.)* 2*d*.

Relates to machinery in which vibrating crushing jaws are employed.

5150. Needle and Apparatus for Sewing Shoes, &c., *L. A. Groth, London.—30th October*, 1883.—*(A communication from F. Schumacher, Stuttgart.)—(Not proceeded with.)* 2*d*.

Consists in the combination of a hooked-shape needle and bolt or bar, the said needle and bolt or bar being fastened by means of adjustable screws in the socket or sockets of a holder provided with a suitable handle.

5179. Hydraulic Lifts and Accumulators, *J. S. Stevens and C. J. Major, London.—31st October*, 1883. 8*d*.

Consists partly in the combination in a hydraulic lift of a lifting ram, balancing ram, and driving ram, differing in sectional area from the balancing ram—each ram with its cylinder—and a heavy compensating chain or a weight and pulley with variable radius.

5274. Shirts for Tropical Climates, &c., *A. B. Rodyk, London.—7th November*, 1883.—*(A communication from W. R. Grey, Singapore.)* 2*d*.

The shirt is open straight down for the whole of its length, either before or behind, and is buttoned and secured by an elastic band round the bottom.

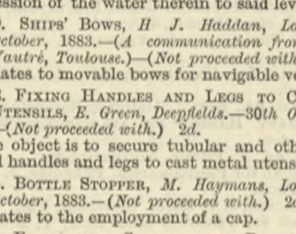
SELECTED AMERICAN PATENTS.

Frome United States' Patent Office Official Gazette.

297,991. Step for Bicycles, *George F. Harwood, Wocester, Mass.—Filed February 25th*, 1884.

Claim.—(1) In a step for bicycles and other velocipedes, the combination, with the band H, bolt D, and nut *d*, of the step A, the back plate A^1 thereof being provided with the slot B, extending from a point near the lower end of said back plate to the surface of the step, substantially as and for the purpose set forth. (2) In a step for bicycles and other velocipedes, the combination, with the band H, bolt D, and nut *d*, of

297,991

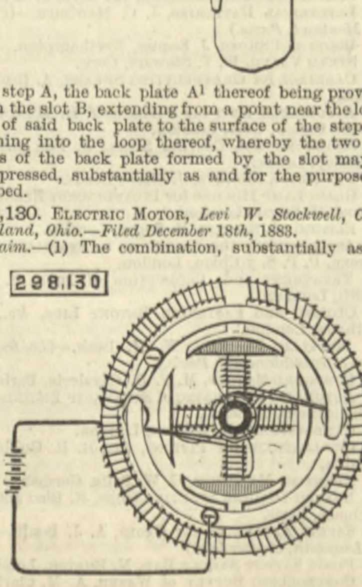


the step A, the back plate A^1 thereof being provided with the slot B, extending from a point near the lower end of said back plate to the surface of the step and opening into the loop thereof, whereby the two portions of the back plate formed by the slot may be compressed, substantially as and for the purpose described.

298,130. Electric Motor, *Levi W. Stockwell, Cleveland, Ohio.—Filed December 18th*, 1883.

Claim.—(1) The combination, substantially as set

298,130

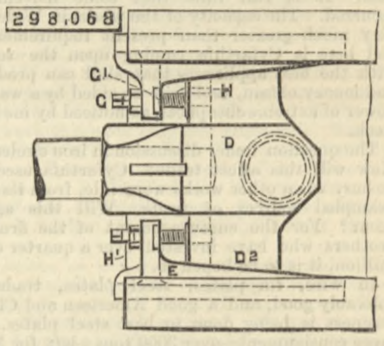


forth, of the armature spindle, the armature magnets arranged thereon transversely to each other, an independent coil on each half of each armature, the terminals of which coil are connected with adjoining commutator plates, as shown, the commutator ring, and brushes arranged to give an extended or double contact on each side of the ring, for the purpose set forth. (2) The combination, substantially as set forth, of the field-magnet poles, having a uniform polarity on each side of the armature spindle, the armature spindle, the armature magnets arranged thereon transversely to each other and in different vertical planes, the commutator plates, the brushes arranged to give an extended or double contact on each side of the ring, and an independent coil on each half of the armature, the terminals of which coil are connected to adjoining commutator plates, as set forth. (3) The combination, substantially as set forth, of the field-magnet poles, the armature, the commutator ring, and the commutator brushes arranged in pairs—one pair on each side of the ring—the brushes in each pair being arranged one above the other, as described.

298,068. Crosshead, *George H. Corliss, Providence, R.I.—Filed February 4th*, 1884.

Claim.—(1) The combination, with the crosshead D, having inclined faces D^2, of gibs E, having inclined faces E^2, and two or more independent adjusting bolts G G^1 and H H^1, exerting forces in opposite directions, all arranged for joint operation, to move and to resist the movement of the gibs relatively to the cross-

298,068

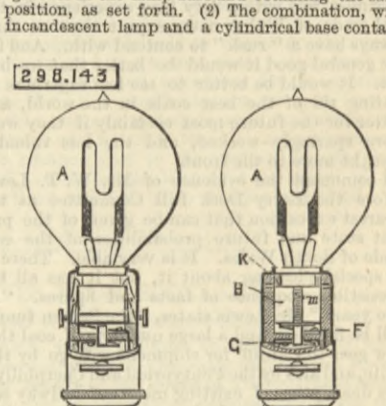


head, substantially as herein specified. (2) The combination, of a crosshead D, having inclined faces D^2, with adjustable gibs E, having inclined faces E^2, and adapted to be operated in the direction of their length relatively to the crosshead by means of one or more adjusting bolts, substantially as herein described.

298,143. Socket for Incandescent Lamps, *Edward Weston, Newark, N.J.—Filed October 4th*, 1883.

Claim.—(1) The combination, with an incandescent lamp and a cylindrical base containing a groove or grooves, as described, of a socket or holder having projections or their equivalents therein for entering the grooves in the lamp base and retaining the same in position, as set forth. (2) The combination, with an incandescent lamp and a cylindrical base contain-

298.143



ing a groove or grooves, of a socket or holder, projections therein or their equivalents, for entering the grooves in the lamp base, and spring contact plates forming a seat for the lamp, as herein set forth. (3) The combination, with an incandescent lamp A, and base B, containing grooves *m m*, of a socket or holder, projection K, and spring contacts F G, all as described.

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