REACTION WHEELS AND TURBINES.

By William Donaldson, M.I.C.E.

The principle of action of the reaction wheel is totally distinct from that of the turbine. The name "Reaction Wheel" has probably been given to it by the inventor because the energy imparted to the water by the action of rotation causes, by reaction, an increase in the pressure at the orifice of discharge.

The machine consists of one part only—viz., a revolving receiver provided with radial arms, at the extremities of which there are placed simple orifices, or special nozzles, which have their axes horizontal and at right angles to the radial arms. The reaction wheel is actuated solely by the difference between the pressures due to the discharge through the orifice and the maximum pressure at the extremity of the revolving arm acting upon an area equal to that of the orifice of discharge. The reaction wheel, therefore, is simply a water-pressure engine in which there are no valves or pistons, and therefore one in which the machine friction is reduced to that of two bearings.

The pressure of the water in the receiver has its maximum and the relative velocity its minimum value, and, *vice versâ*, at the orifice of discharge the pressure has its minimum and the relative velocity of discharge its maximum value. The absolute velocity gradually increases from zero until it acquires the velocity of rotation of the extremity of the arm of the wheel, and then suddenly, at the orifice of discharge, attains its final minimum value, which is equal to the difference between the final relative velocity and the absolute velocity of the orifice.

A turbine wheel consists of two parts, a guide blade chamber and a revolving wheel. The water issues from the guide blade chamber with its maximum and leaves the wheel with its minimum absolute velocity. In outward flow turbines and in inward flow also, which are constructed in such a way that the pressure, leaving friction out of consideration in the wheel, is constant, the relative velocity of the water may either increase or decrease as the water passes through the wheel. If the tangential velocity of the wheel, in the case of outward flow turbines at its outer periphery and in the case of inward flow at its inner periphery, is not greater than the initial tangential relative velocity of the water, the final relative velocity will be less than the initial, and *vice versâ*, if the tangential velocity of the respective peripheries is greater, the final relative velocity of the water will also be greater than the initial relative velocity.

It is utterly impossible that statical pressure can exert any appreciable effect on producing motion in a turbine, because the area against which the fluid presses on the front face of a wheel vane cannot be greater than the corresponding area against which it presses at the back. Throughout the greater part of the length of the vane the pressures at the back and front of the vane are equal, and it is only for a short length of vane near the outer and inner periphery of the wheel that the pressures on the back and front are not equal to each other. In the case of turbines which are designed in such a way that the pressure of the water when it enters the wheel is greater than that with which it leaves the wheel, whether intentionally, as in the case of Professor Thomson's vortex turbine, or unintentionally through the ignorance of the designer, this pressure must have a retarding effect on the motion at the beginning of the stroke and an accelerating

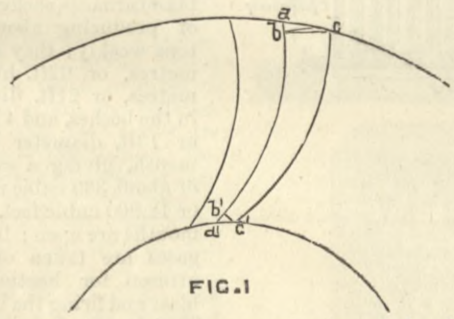


FIG. 1

effect towards the end. An examination of the diagram Fig. 1 shows this clearly. The diagram shows a section through three consecutive vanes of an inward flow turbine wheel, of which the top and bottom plates are parallel to each other. $c\,b$, $c^1\,b^1$ are perpendiculars from the inner and outer extremities of the third upon the middle vane $a\,b\,b^1\,a^1$. If equal and opposite velocities are imparted to the water and to the wheel, so as to bring the latter to rest, the action of the water relatively to the wheel will be the same as if the wheel were revolving with the assigned angular velocity. The jet will now be flowing through the guide blade passages with a steady motion, and the relations of the heads due to velocity and statical pressure will be in accordance with Bernouilli's theorem. The sum, therefore, of these heads, leaving friction out of consideration, will be the same at every section, and the greater, therefore, the height due to the velocity, the less will be the height due to the pressure. At the receiving side the pressure on the back of the arm for the length $a\,b$ is constant, and equal to the maximum initial pressure, whilst the pressure on the front of the vane diminishes from the point a to the point b owing to the increase in the velocity of flow. At the discharging side the pressure at the back of the vane is constant for the length $a^1\,b^1$, and is equal to the tail water pressure, whilst on the face of the vane the pressure increases from a^1 to b^1 owing to the diminution of the relative velocity. Whether the retarding effect of the pressure on the receiving side is greater than, equal to, or less than, the accelerating effect at the discharging side, depends entirely on the shape of the vanes, but it is quite impossible that there should be any appreciable difference between the two. Clearly then the whole of the work in a turbine is produced by the impulsive action of the fluid against the vanes, and the sections of the guide blade and vane passages ought to be so designed that the water ceases to be under any other pressure than that due to the tail water the instant it leaves the guide blade chamber.

The vane itself ought to be so designed that as little as possible of the energy of the current is lost in altering the temperature of the water and the turbine. The water should strike the vane without shock, and should leave it without tangential absolute velocity. The best turbine is simply a perfect Poncelet wheel. I have discussed this question at great length in my work on water-wheels, and am confident that the arguments therein stated in favour of my views are unanswerable.

The effective duty obtainable from a turbine must be very much less than the tangential energy of the water when it leaves the guide blades. Impact and friction cause change of temperature and consequent loss of total efficiency, and from the total efficiency there have to be deducted the work done in overcoming friction of bearings and resistance of the air or of the water, according as the turbine is working in the air or is submerged in the tail water. If α therefore be the angle at which the guide blades cut the tangent to the wheel periphery, the coefficient of efficiency must be much less than $\cos.^2\,\alpha$. In very few turbines is this angle less than 20 deg., for which $\cos.^2\,\alpha = {\cdot}89$. If $\alpha = 10$ deg., $\cos.^2\,\alpha = {\cdot}97$. The smaller the value of α the greater will be the difficulty in constructing a theoretically perfect turbine, and therefore the greater the liability to loss of total efficiency. This loss of total efficiency, and therefore the sum of the losses due to friction of bearings and resistance of the atmosphere or tail water, cannot be ascertained experimentally. It has, however, been ascertained that nearly 25 per cent. more duty can be got out of a turbine working in the air than out of a turbine working in the water. If, therefore, we deduct this difference from the value of $\cos.^2\alpha$, we shall obtain a limiting value of the coefficient of efficiency, which we know a turbine with its wheel working submerged can never reach. For the reason already stated, 20 deg. may be looked upon as practically the minimum value of α, so that deducting ·25 from ·89, the value of $\cos.^2$ 20 deg., we get ·64 as the limiting value. From this have to be deducted the loss due to working in the air, since 25 per cent. is the difference only between working in the air and working submerged and the loss in total efficiency. It is clear, then, that the net efficiency of a turbine working submerged must be less than 50 per cent. of the net initial energy of the water, and of a turbine working in the air less than 70 per cent. The great difference between duty of a turbine working with its wheel drowned and in the air is due not only to the greater frictional resistance of the water, but to the creation of eddies in the wheel passages owing to their being filled with water under the pressure due to the head of tail water.

The theoretical efficiency of the reaction wheel admits of easy calculation if we take into account only the net head due to maximum pressure at the extremities of the arms, and leave out of consideration all losses due to friction and eddies in the water before it reaches the orifice of discharge. The rotation of the wheel will produce an angular velocity in the water which will be equal to that of the machine itself at every point, both in the receiver and in the arms, so that the water will enter the arms from the receiver under exactly the same conditions as if the wheel were at rest. The net pressure due to the fall will be increased by the head due to the centrifugal force, and the work done in producing this head will in part be given back by increasing the total work done by the water.

Let Q = cubic feet of water discharged per second.
W = weight of a cubic foot of water.
R = radial distance in feet of the centre of the orifice of discharge from the axis of the wheel.
ρ = ditto ditto of any other point.
ω = angular velocity of rotation per second.
a = area of orifice.
H = height due to maximum pressure in radial arm arising from gross fall.

In passing from the centre to the end of the radial arm each particle of water acquires the angular velocity ω R, and, therefore, acquires the kinetic energy $\frac{\omega^2\,R^2}{2\,g}$, or the whole work done per second in producing the angular velocity of rotation will be equal to $\frac{W\,Q\,\omega^2\,R^2}{2\,g}$.

The centrifugal force exerted by a lamina of thickness $\delta\rho$ and area, equal to one square foot at the distance ρ from the centre would be equal to $\frac{W\,\omega^2\,\rho\,\delta\,\rho}{g}$, and the total centrifugal force opposite the centre of the orifice of discharge being equal to the sum of the forces exerted by all the lamina, would be equal to $\frac{W\,\omega^2\,\rho^2}{2\,g}$ per square foot, or the height due to pressure would be equal to $\frac{\omega^2\,\rho^2}{2\,g}$. The potential energy therefore acquired by the water in a second being equal to $\frac{W\,Q\,\omega^2\,\rho^2}{2\,g}$ is exactly equal to the work done in imparting to it the tangential energy. The total height due to pressure at the extremity of the radial arm is $H + \frac{\omega^2\,R^2}{2\,g}$.

There are three cases to investigate:—

I.—Straight arm with simple orifice of discharge at side.
II.—Straight arm with especial nozzle designed to make loss of head due to discharge a minimum by making area of orifice coincide with area of *venâ contractâ*.
III.—Curved arm with special nozzle.

Case I.—*Simple Orifice.*

If we, as a first step, leave out of consideration the cause and effect of the angular momentum imparted to the water, the work done per second will be equal to

$$W\,c_2\,H\,.\,a\,.\,\omega\,R = \frac{W\,Q\,c_1\,H\,\omega\,R}{c_2\,\sqrt{2\,g\,H}}$$

since $Q = c_2\,.\,a\,.\,\sqrt{2\,g\,H}$, where $(1 - c_1)\,H$ is the head lost in resistance at the orifice, and c_2 the coefficient of discharge. We can only determine the value of c_1 by actual experiments with orifices of different shapes. With the orifice described in Case II., we should have $c_1 = c_2$ and the work done equal to $\frac{W\,Q\,H\,\omega\,R}{\sqrt{2\,g\,H}}$. The maximum value of ω R cannot exceed the velocity of the water in the *venâ contractâ*, which we may take to be equal to $\cdot 9\,\sqrt{2 g H}$, and should not be less than $c_2\,\sqrt{2\,g\,H}$. Assuming ·62 for the value of c_2, the total efficiency of the machine would be equal to from 60 per cent. to 90 per cent. of the gross power.

When we take account of the cause and effect of the angular momentum of the water, the total work done per second is equal to

$$W\,c_1\left(H + \frac{\omega^2\,R^2}{2\,g}\right).\,a\,.\,\omega\,R = \frac{W\,Q\,c_1\,\omega\,R\,\sqrt{2 g H + \omega^2\,R^2}}{2\,g\,c_2}$$

$$\text{sin. } Q = c_2\,a\,\sqrt{2\,g\,H + \omega^2\,R^2}.$$

In order to arrive at the net effective work done by the water exclusive of the work done in producing the angular velocity of the water, it will be necessary to deduct from the above the value of the latter, or $\frac{W\,Q\,\omega^2\,R^2}{2\,g}$, and we have for the value of the net total effective work done, the expression

$$\frac{W\,Q\,c_1\,\omega\,R\,\sqrt{2\,g\,H + \omega^2\,R^2}}{2\,c_2\,g} - \frac{W\,Q\,\omega^2\,R^2}{2\,g}$$

which reduces to

$$W\,Q\,H\left\{c_3\,K\,\sqrt{1 + K^2} - K^2\right\}$$

if we put $\omega\,R = K$ and $c_3 = \frac{c_1}{c_2}$.

It has been ascertained by experiment that the efficiency of a machine provided with the nozzle described in Case II. is greater than that of a machine with a simple orifice, therefore c_1 must be less than c_2. It must be greater than the value given by the equation $c_3\,K\,\sqrt{1+K^2} - K^2 = 0$ from which we get $c_1 = \frac{c_2\,K}{\sqrt{1+K^2}}$

The limiting values of K will be given by the equations

$$\omega\,R = K\,\sqrt{2\,g\,H} = \cdot 9\,\sqrt{2 g\,H\,(1+K^2)}\,.\quad .\quad (1)$$

$$\omega\,R = K\,\sqrt{2\,g\,H} = \cdot 62\,\sqrt{2 g\,H\,(1+K^2)}\,.\quad .\quad (2)$$

From (1) we get $K = 2\,c_1 \nless \cdot 55$
From (2) we get $K = \cdot 62\,c_1 \nless \cdot 2.$

It is clear, therefore, that with a simple orifice the velocity of the orifice can never be equal to $2\,\sqrt{2\,g\,H}$. If $\omega\,R = \sqrt{2\,g\,H}$, or $K = 1$, we have $c_1 \nless \cdot 44$, which corresponds with a loss due to obstruction at orifice equal to 56 per cent. of the whole head. That is clearly in excess of what the actual loss can be. Therefore in the case of a simple orifice the velocity may be equal to $\sqrt{2\,g\,H}$. It is impossible to calculate the theoretical total efficiency without a knowledge of the value of c_1.

Case II.

When nozzle is so designed that the area of the orifice corresponds with that of the *venâ contractâ*, the loss of head due to friction of discharge is exactly counterbalanced by an increase in the area of discharge, so that we have for the total efficiency the expression—

$$W\,Q\,H\,(K\sqrt{1 + K^2} - K^2)$$

since $c_1 = c_2$.

When $K = 2$, the coefficient of efficiency is therefore equal to ·45, and when $K = {\cdot}62$, the coefficient is equal to ·34. This difference of 11 per cent. would probably be much more than counterbalanced by the increase of the work done in overcoming friction and atmospheric resistance, the former of which would be equal to $2 \div 62 = 3{\cdot}2$ times, and the latter to $(3{\cdot}2)^2 = 10{\cdot}3$ times the value of these items in the case of $K = {\cdot}62$. If $K = 1$, the coefficient of efficiency is equal to ·4.

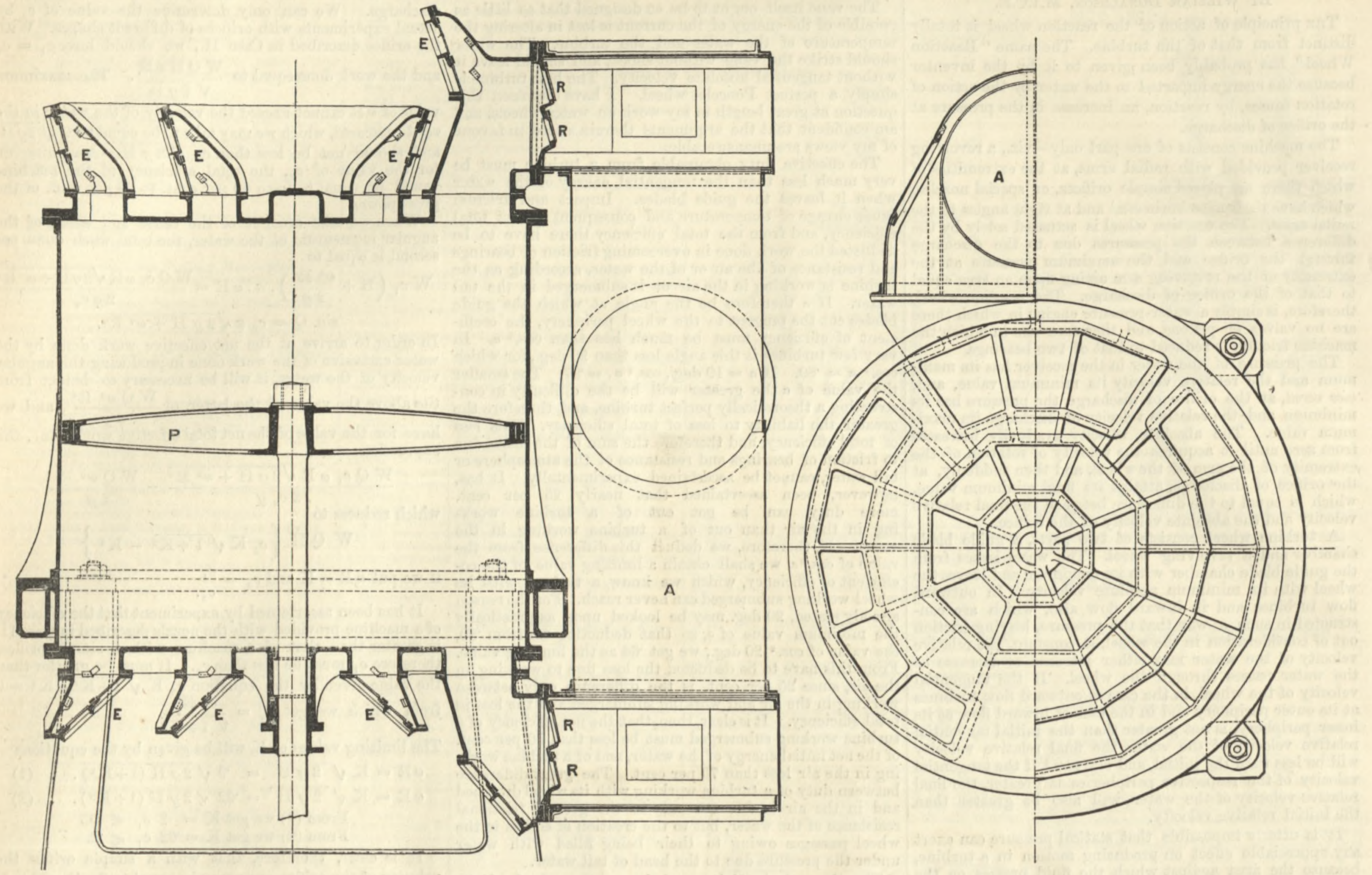
Case III.—*Curved Arm.*

Since the curvature of the arm cannot add anything to the effective moving force acting on the arm, there can be no advantage in adopting a curved arm beyond that of diminishing the resistance of the air on the back of the arm. With a straight arm and a nozzle at right angles to the arm the greater part of the velocity of approach would be destroyed by impact and eddies, but if the arm is curved the loss of velocity of approach will be due to friction only. When, therefore, the head due to pressure is very small, and the height due to velocity of approach very great, the velocity of the orifice may be greater than it could be if the final relative velocity of flow were due only to the sum of the pressure heads, but there will be no increase in the total effective work of the machine, because the moving force being proportional directly to the area of the orifice,, and the area of the orifice being inversely proportional to the velocity of flow, the product of the moving force multiplied by the velocity will be constant, so long as the pressure is constant, whatever may be the value of the velocity.

Flow of Water in Pipes.—In the article on this subject in our last impression, and in Hagen's formula, the denomination should have been $d^{1\cdot 25}$ instead of $d^{1\cdot 23}$.

Letts's Diaries.—A selection of these well-got-up specialities of Messrs. Letts, Son, and Co. has reached us, including large and small diaries, with more or less of the guide, directory, and statistic information which it has become customary to print with good diaries. The high character of Messrs. Letts and Co.'s publications is marked in the fine diary of a day on a page, No. 1, a quarto diary on fine paper, and suitable for a Boswell. A very good selection accompanies the little diary No. 26, with a week on an opening or on every two pages; a very useful little diary. One of the most generally useful is the No. 11 octavo diary, a week on an opening. No. 24 is a very handy pocket diary. Diaries No. 35 and No. 36, the former having a week on an opening, and the latter two weeks on an opening, are small scribbling diaries.

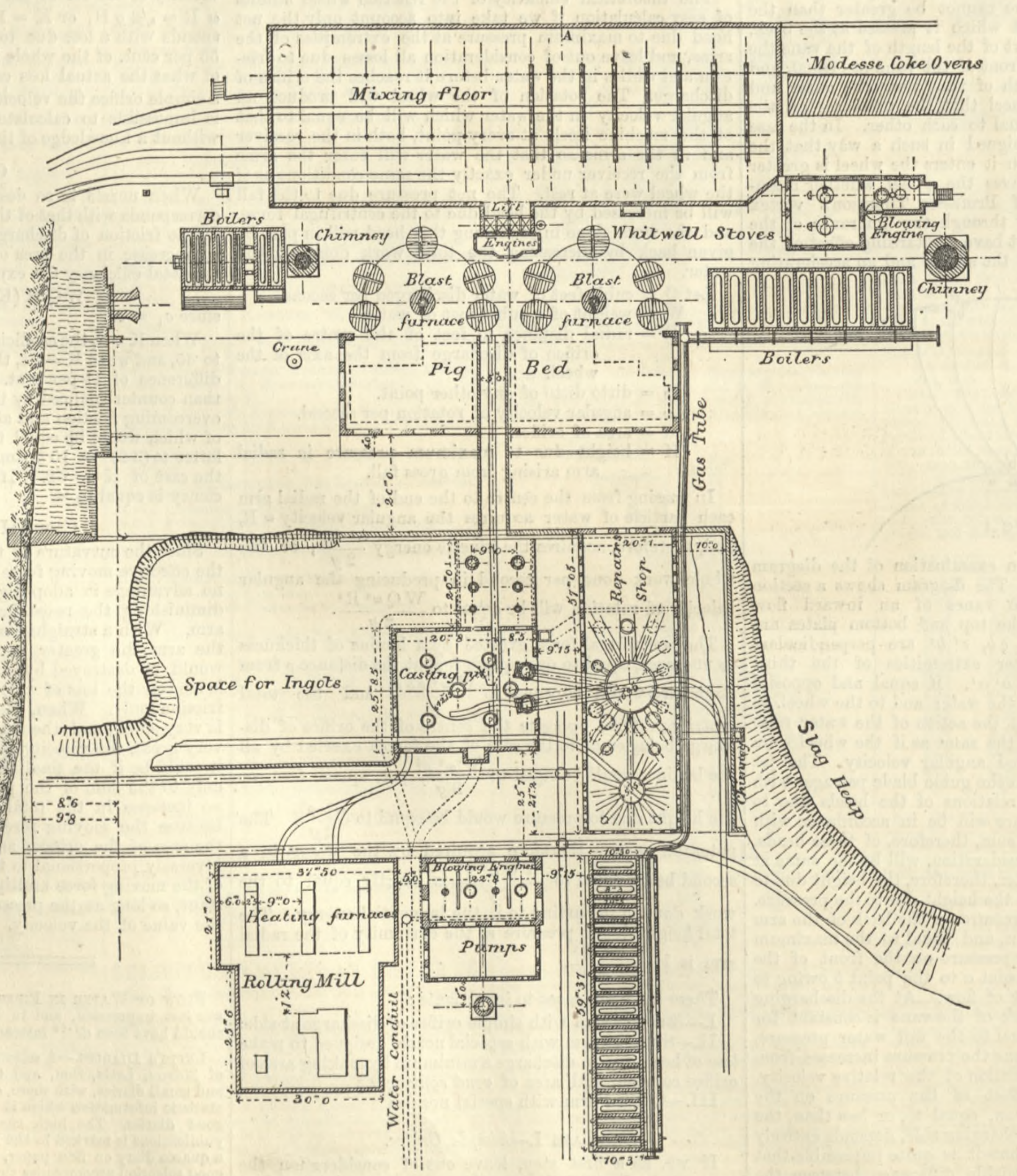
THE MEUSE BLOWING ENGINE, ATHUS WORKS.—DETAILS.



THE ATHUS IRON AND STEEL WORKS.

No. II.*

Ironworks.—A noticeable feature in the Athus Ironworks, personally managed by Baron Fernand d'Huart, is the great neatness and cleanliness which prevail, so different from what is generally observable at ironworks in England. This is secured, in a great measure, by the admirable charging arrangements. The ore is brought from Petingen or Petange, in the Grand Duchy of Luxemburg, a distance of about three miles, to the furnaces at Athus, in Belgium, where it is tipped from the Prince Henri Railway wagons on to the covered mixing floor, the large lumps being broken up by hand with a *masse*, or two-handled sledge hammer. Annexed is a general plan of the iron and steel works, only a small portion of the latter not having yet been carried out. The nature of the ground, as shown by the section, permits of the steel works casting floor being arranged at a level of 9·8 metres, or 32ft. below that of the blast furnace hearths, thus greatly facilitating operations. Adjoining the mixing floor are fifty coke ovens on the Modesse system, which does not greatly differ from that of Coppée; but they are not used now, as it is found cheaper to bring coke from Charleroi or Westphalia. An ingenious appliance has been devised for ascertaining the quantity of water contained in the coke delivered. Inside a stove, fired by the blast-furnace gases, is a truck capable of holding a hectolitre or 2¾ bushels of coke, which is weighed by a steel-yard outside the stove, both before and after the process of roasting, the difference, of course, giving the percentage of water. The ironworks are lighted by twenty Jablochkoff electric lamps, each holding eight candles, which are switched into circuit in turn. The current is supplied by a Gramme dynamo; and there is also a Jaspar lamp, maintained by a separate machine. Both dynamos are driven by a 40-horse steam belted, inverted cylinder engine, made by Hanrez et Cie., of Monceau-sur-Sambre, and fitted with Mayer variable expansion gear, and also with a Buss governor, which latter has an oil moderator for rendering its action less spasmodic. There are two blast furnaces, each capable of producing about 700 tons weekly; they are 19 metres, or 62ft. high, 6½ metres, or 21ft. diameter in the boshes, and 4 metres or 13ft. diameter at the mouth, giving a capacity of about 360 cubic metres, or 12,960 cubic feet. The mouths are open; but the gases are taken off and utilised for heating the blast and firing the boilers. The furnaces were first blown in at the beginning of 1872. No. 1 remained in blast until the beginning of October, 1884, when it was repaired for blowing in again on the 1st of January of this year, while No. 2 has not ceased to work since its first blowing in. The charge is raised in barrows by two pairs of vertical lifts, each pair being worked separately with a steel rope by a Hanrez horizontal engine, the cylinder of which is 35 centimetres, or 13¾in. diameter, and 1 metre, or 3ft. 3⅜in. stroke; but one man is sufficient to drive both engines. Each blast furnace has four tuyeres, the blast being heated in five Whitwell stoves—one kept in reserve—to each furnace. The diameter of the stoves is 6·72 metres, or 22ft.; and the original height of 8·9 metres, or 29ft., is being increased, in one stove after another, to 20 metres, or 65ft., with an increase of temperature from 600 deg. Centigrade, or 1112 deg. Fahrenheit, to 650 deg. Centigrade, or 1200 deg. Fahrenheit. Two stoves are already heightened; and

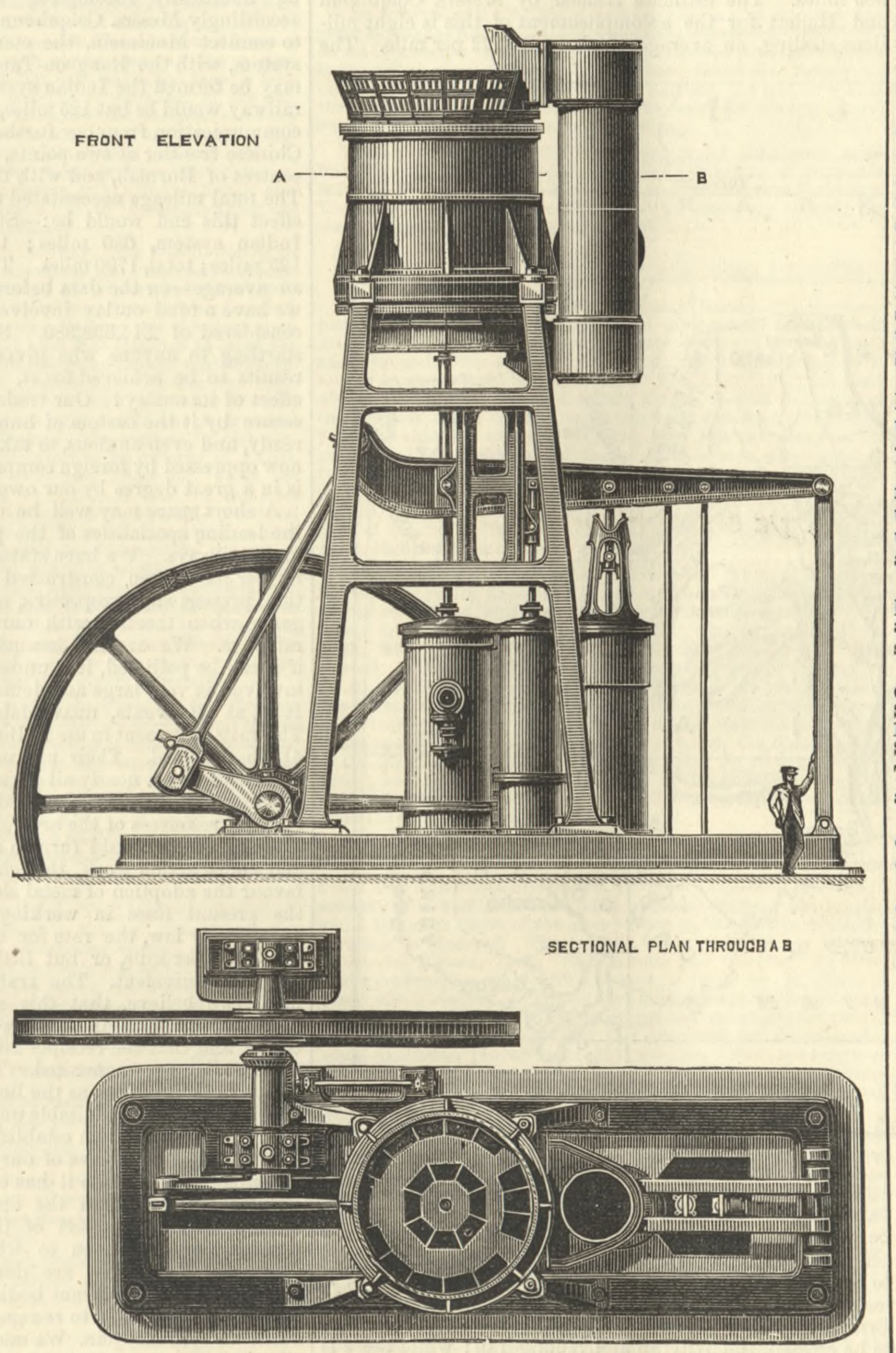


GENERAL PLAN OF WORKS.

* Continued from page 241, vol. lix

preparations are being made for carrying up the third. Besides firing the stoves, the gases raise steam in seventeen boilers, each of 60 square metres, or 646 square feet heating surface, for the ironworks, and as yet only six out of the twelve boilers, each of 100 square metres, or 1076 square feet, heating surface, for the steel works.

There are three 300-horse blowing engines for the blast furnaces, one being kept in reserve. Two are of the Cockerill Company's last design but one, a development of the engine illustrated in connection with the Reschitza iron and steel works in Hungary.* While the same general arrangement is preserved, and also the principle of all the strains neutralising one another, so that the foundation has only to carry the dead weight, many improvements have been made in detail. The four hollow circular cast iron tubes, which form the frame, are splayed out in the direction of the thrust, so as to give greater stability. As in the primitive engine, the air cylinders are on the top; and the connecting rods, from the crosshead, work on to the crank pins of the fly-wheels, which are arranged outside the frame, while a beam from the crosshead works the pump rods. With steam at 60 lb. or 67 lb. per square inch, the engines make from nine to eleven revolutions a minute. They were put down with the furnaces and started at the beginning of 1872, and have worked almost constantly, with but slight repairs, up to the present time. The third blowing engine, of the vertical compound, or rather Woolf type, was constructed about four years ago at the Ateliers de la Meuse, near Liége, under the superintendence of M. A. Stévart. The frame consists of four square, hollow, cast iron columns, splayed out and bolted to the cast iron bed-plate, which is also hollow. This arrangement, besides the fact that the bed-plate is not divided to make room for the fly-wheel, gives great solidity to the engine. The inverted blowing cylinder, 3 metres, or 9ft. 10in., in diameter, is mounted on a circular architrave. The piston, which is very light—see vertical section, page 22—is hollow, being made of plate iron, fitted to a cast iron boss and ring. It is worked direct, with a stroke of 2·45 metres = 8ft., by the piston and rod of the large cylinder 1·2 metre = 4ft. in diameter, placed below. The small cylinder, 85 centimetres = 2ft. 10in. in diameter, works on to a horsehead beam, one end of which actuates the connecting-rod, crank, and fly-wheel, while the other is articulated to a carrier. Next to the small cylinder is the air pump, and between that and the carrier are seen—in the general elevation—the rods of the cold water pump and of that for circulating the water in the tuyeres. The radius of the crank is 1·5 metre = 5ft., and the diameter of the fly-wheel 8 metres = 26ft. 3in. The volume of air delivered at each double stroke is $34\frac{1}{2}$ cubic metres, or 1215 cubic feet, while at twelve revolutions a minute the volume is 415 cubic metres, or 14,661 cubic feet a minute. The speed of the engine may, however, be varied between six and sixteen revolutions a minute. In designing the inlet valves, marked E E in the vertical section of blowing cylinder, and shown also in the half plans of top and bottom covers, the object has been to afford passages of as large sectional area as possible for the entering air. The covers are, therefore, extended beyond the circumference of the cylinder, so that the total sectional area of the inlet valves is about 50 per cent. of that of the cylinder. With each side of the polygonal cover corresponds a chamber containing two flap valves, which are of light plate iron on cast iron seats, provided with stops for limiting the lift. The delivery valves, marked R R in the section, allow the air to pass into the collector at the side of the cylinder, and thence, by a central air tube, to the blast furnaces. The total sectional area of the delivery valves is about 12 per cent. of that of the cylinder.



BLOWING ENGINE MADE AT THE ATELIERS DE LA MEUSE.

When in full blast, the two furnaces keep employed about 160 hands, and produce about 160 tons of pig iron in the twenty-four hours. Last year, with a consumption of 205,000 tons of oolitic limonite, or ferruginous schorl, from the Grand Duchy of Luxemburg, 450 tons of manganiferous iron ore from Nassau, and 77,000 tons of coke, there were produced 43,000 tons of forge pig, 9800 tons of foundry pig, and 9900 tons of special basic pig for the Thomas-Gilchrist process, making a total of 62,700 tons of pig iron. This, however, is not the maximum production.

It might be expected that, with the keen competition now going on between the different countries, ironmasters should be reticent as to the composition of their blast furnace charges; but the withholding of the constituent parts of an excellent product was scarcely to be anticipated, unless, indeed, it was feared that the knowledge might prove an incentive to others to go and do likewise. It is known, however, that the mixture of ore in the charge contains over 40 per cent. of metallic iron. Such a proportion of calcareous ore is mixed with the silicious, both being about equal as regards the content of iron, as to require no addition of limestone as a flux. Moreover, the iron is so intimately combined with the lime as to render its reduction easy, rapid, and economical.

Nearly the whole quantity of coke named above—that is to say, 64,000 tons of it—was obtained from the Charleroi basin of Belgium, and the remainder, or 13,000 tons, from the Ruhr district of Germany. Although the greater distance of the latter makes it more expensive for a given weight, it is really not less economical in the end, containing, as it does, from 5 to 7 per cent. only of ash, while the Belgian product, made from unwashed coal, contains as much as from 12 to 15 per cent. of incombustible matter. The consequence is, that from one to one and a-half hundredweight more of the Belgian coke is required for the production of a ton of pig iron. On the other hand, however, the longer railway journey in open wagons renders the Ruhr coke liable to absorb more water than the Belgian.

As the Athus works are well situated for receiving their ore supplies, so also are they under favourable conditions for the transport of their products, being connected by a siding with the Arlon and Longwy branch of the Belgian State Railway, which has now absorbed the Grand Luxemburg line, originally made, and for a long time worked, by an English company, Mr. T. Kitson being locomotive superintendent.

The pig iron, being made from the same ore, does not greatly differ from other Luxemburg pig; and the following table may be regarded as giving an approximate average analysis of the white forge pig with its accompanying slag:—

Forge pig.		Slag.	
Iron	94·97	Silicon	42·49
Manganese	·22	Alumina	16·02
Silicon	·91	Protoxide of iron ...	2·87
Phosphorus	1·82	„ manganese	·89
Sulphur	0·08	Lime	34·39
Carbon	2·00	Magnesia	2·31
		Sulphur	0·41
	100·00	Phosphorus	0·9

The following are the results of analyses made last year of the several classes of foundry pig produced under similar conditions:—

Foundry Pig.

Number.	I.	II.	III.	IV.	V.	VI.	VII.
Total carbon ..	3·359	3·277	3·061	2·964	2·918	2·874	2·845
Free carbon ..	2·983	2·887	2·664	2·621	2·587	2·554	2·528
C'mbin'd carbon	0·376	0·390	0·397	0·343	0·331	0·320	0·317
Silicon	2·060	1·711	1·704	1·584	1·511	1·440	1·434
Sulphur	trace	0·005	trace	0·0082	0·0091	0·010	0·0184
Phosphorus ..	1·923	1·738	1·764	1·814	1·8256	1·825	1·841
Manganese ..	0·440	0·434	0·360	0·381	0·424	0·374	0·288
Iron (by difference)	92·218	92·835	93·111	93·2488	93·3123	93·477	93·5736
Totals ..	100·000	100·000	100·000	100·0000	100·0000	100·000	100·0000

On account of the high proportion of phosphorus—about 2 per cent.—contained in pig produced from the oolitic iron ore of Luxemburg, the Thomas-Gilchrist process was heartily welcomed both in the Grand Duchy and in Belgian Luxemburg, the Athus works being among the first to produce basic pig iron. In making this special pig, for subsequent treatment in the basic converter, about 8 per cent. of manganiferous iron ore, containing on an average 20 per cent. of manganese, are added to the blast furnace charge; and the resulting pig contains, roughly, 1·5 per cent. of manganese, 2 per cent. of phosphorus, 0·085 of sulphur, and 0·75 of silicon; but still higher percentages of sulphur, and especially of phosphorus, are admissible for the Thomas-Gilchrist process. It is hoped that the slag of basic pig will not long remain a waste substance, but that the rich phosphates it contains may be turned to account as manure. The great difficulty has been to render them soluble; and we hope there is no indiscretion in stating that Mr. Gilchrist is actively pursuing, with every prospect of success, the experiments in this direction begun by his late regretted partner, Mr. Sydney Thomas.

Since the above was in type, we have been favoured by Baron Fernand D'Huart with the following particulars of the working and products of the Athus furnaces. Taking $4\frac{1}{2}$ tons as the unit of coke per charge for comparison, $13\frac{1}{4}$ tons of ore are charged into the furnace for grey forge pig, and nearly $13\frac{3}{4}$ tons for white forge pig; while, for the same weight of coke, from $12\frac{1}{4}$ to 13 tons of ore are used to produce foundry pig, according to the No. required, and nearly $13\frac{1}{4}$ tons for special basic pig.

To produce grey forge pig, the ore is mixed in the proportion of 25 per cent. calcareous, 40 per cent. grey mine, and 35 per cent. friable; and the following are the constituents of the product:—

Grey forge pig.		Corresponding slag.	
Carbon	3·19	Silica	36·5
Silicon	0·7	Lime	39·25
Phosphorus	1·7	Alumina	17·8
Sulphur	0·08	Oxide of iron	1·35

The difference in the pig giving the iron, and the sulphur and phosphoric acid in the slag not being taken.

White forge pig, made with a mixture of 19 per cent. of calcareous ore, 61 per cent. of grey rock, and 20 per cent. of friable ore, gives the following analysis:—

White forge pig.		Corresponding slag.	
Carbon	2 97	Silica	38·1
Silicon	0·24	Lime and magnesia ...	39·25
Phosphorus	1·61	Alumina	18·6
Sulphur	0·19	Oxide of iron	2·1

Foundry pig, for which the charge consists of 30 per cent. calcareous, 33 per cent. grey rock, and 37 per cent. yellow friable ore, gives the following:—

Foundry pig No. 3.		Corresponding slag.	
Carbon	3·42	Silica	33 25
Silicon	1·95	Lime	47·1
Phosphorus	1·61	Magnesia	1·32
Sulphur	0·25	Alumina	16·32
		Oxide of iron	1·01
		Sulphur and phosphoric acid	1·02

For the Thomas pig the charge consists of 28 per cent. of calcareous ore, 10 per cent. of red mine, 20 per cent. of grey rock, 37 per cent. of yellow friable ore, and 5 per cent. of manganiferous iron ore, the result being as follows:—

Thomas pig.		Slag.	
Carbon	3·08	Silica	35·08
Silicon	0·67	Lime	45·19
Phosphorus	1·75	Magnesia	1·15
Sulphur	0·05	Oxide of iron	1·47
Manganese	1·85	Oxide of manganese ...	3·07

The difference in the analysis of the pig gives, of course, the iron.

As a rule one furnace produces forge pig, including Thomas pig, and the other foundry pig; and lately one furnace has made as much as 90 tons of foundry pig in the twenty-four hours. With both furnaces, however, on forge pig, as at the present time, they have together turned out as much as 250 tons in the twenty-four hours.

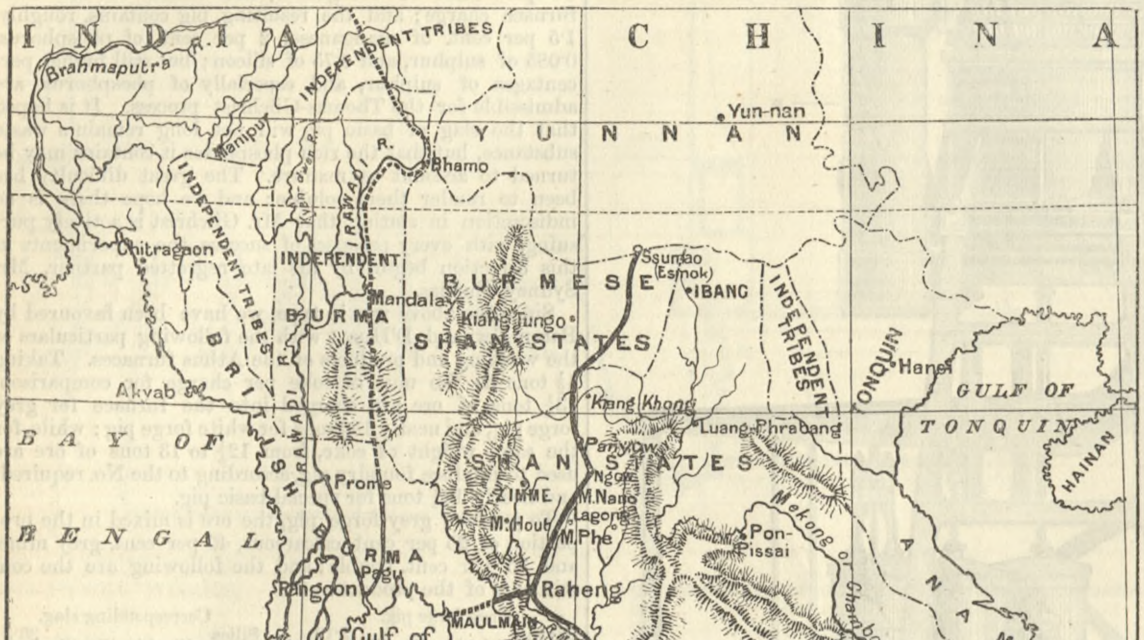
The general agent for the Athus pig, which has now made for itself a name in Belgium, is M. Alexandre Résimont, whose father is foundry manager at the famous Seraing works, having just accomplished his fifty years of service with the Société John Cockerill.

* See THE ENGINEER of 1st and 29th February, 1884, vol. lvii., pp. 85, 92, and 166.

PROPOSED RAILWAYS IN BURMAH AND SIAM.

THE complete annexation of the newly-acquired territory in Upper Burmah by the Indian Government has done much to remove the scheme of railway communication with the Chinese frontier propounded by Messrs. Colquhoun and Hallett from the region of speculativeness, and to bring it within the scope of early practical realisation. We may therefore expect soon to hear of action in a matter which will possess a very important bearing towards many of our leading English industries. We agree with the terms in which the *Times*, in its earliest notice of the subject, referred to it. It constitutes, as that journal observed, essentially a "working man's question;" and, pressed as are all branches of English trade at the present time, we cannot but feel glad that for some of them at least there is a prospect of very considerable relief. Indeed, we need scarcely limit our congratulations. The opening of trade routes to tap some of the wealthiest provinces of China will not be confined in its beneficial effects to any particular branch of industry. These must ramify throughout the whole of our industrial classes; and although we, in this journal, must confine ourselves principally to the scheme as it embraces the construction of railways, we are certain that all must share our view as to the widespread benefits which must accrue from it to each and all of our workers.

We propose in this article briefly to summarise the scheme for the development of railways which is designed to procure the attainment of such a desirable object, premising that we are indebted to the courtesy of Messrs. Colquhoun and Hallett for the particulars which will enable us to do so from a professional point of view. Those who have merely read the outlines given by the gentlemen above named in their public addresses, will hardly have realised the labour, the care, and minuteness with which their observations have been made, or of the mass of figures which the reduction of these has entailed; but they may nevertheless rest assured upon our statement, that their completeness has left nothing to be desired upon



PROPOSED RAILWAYS IN BURMAH.

which correct conclusions may be arrived at. Before proceeding to deal with the scheme formulated, we may with advantage refer to what has already been accomplished as to railway communication in what has hitherto constituted British Burmah. From the capital of that territory, Rangoon, two lines are now open and working in a northerly direction; the one communicating with Prome, and the other with Taungoo. Each of these lines is severally 162 miles in length, and the latter was only completed during the course of last year. They are of metre gauge throughout; the Prome line having cost—after iron and masonry had been substituted for the timber bridges at first erected—£8700 per mile, and that to Taungoo, £7400 per mile. The first named line, opened in 1877, pays 6 per cent. upon its capital outlay, while the second is expected to pay even a better return. We need not further pursue our reference to the railways at present working, save to notice a peculiarity of their traffic, which is of highly favourable augury for the future of the addition to them in contemplation. That peculiarity is to be found in the element of third-class passenger traffic. Whereas on our Indian lines generally this yields but one-third of the total receipts, on the Burmese lines it has hitherto reached two-thirds, giving proof of Mr. Colquhoun's statement that the Burmese are essentially a trading people, moving freely about in their conduct of trading transactions.

We now proceed to the proposals submitted for future operations. We understand that no definite promise has been made by the authorities of the adjoining country of Siam, but that they have stated that their interests will lie in the construction of railways in their country if they can rely upon being brought into communication with Moulmein—one of the centres of British commerce in that part of the world. Now Bankok, the capital of Siam, has 500,000 inhabitants, and Moulmein and its district have 300,000. The traffic between two such centres must necessarily be large, and the expressed wish of the Siamese to practically join them may be accepted as sincere. To effect this, a line to Raheng, 275 miles in length, must be made from Bankok, and entirely through Siamese territory. Raheng is 160 miles in an easterly direction from Moulmein, 80 miles of which are within British territory, and the remaining 80 within the Siamese possessions. A railway 435 miles in length would therefore unite the two places named, and its construction would constitute the first link in the complete system contemplated. No commencement has as yet been made in this direction. Assuming this link to be achieved, it is proposed then to carry the Siamese railway northwards from Raheng above-named to the extreme limit of Siamese territory at Kiang Hsen—or Kiang Khong, as marked upon our maps. This would be reached by an extension of 300 miles, and further work would be within the Shan states of Upper Burmah. To reach the Chinese frontier at Sstmao (Esmok), 250 additional miles would have to be traversed, and with them would be attained the full completion of the route between Moulmein and Bankok to the Chinese frontier. The total mileage to effect this would be as under:—Bankok to Raheng, 275 miles (Siamese territory); Moulmein to junction at Raheng, 160 miles (half British, half Siamese territory); Raheng to Kiang Hsen, 300 miles (Siamese territory); Kiang Hsen to Chinese frontier, 250 miles (Upper Shan States); total, 985 miles. The estimate framed by Messrs. Colquhoun and Hallett for the accomplishment of this is eight millions sterling, an average of about £8122 per mile. The 160 miles between Rangoon and Taungoo, above referred to, cost £7400 per mile, and, the features of the country to be passed assimilating, it may be held that that estimate can be accepted as sufficient. As to the special obstacles to be overcome on this section of the general system, it may be observed that on the line from Moulmein to the British boundary towards Raheng there are two big rivers to be crossed, the Alteran and Houngdran; while there is a pass 1600ft. above sea level near the frontier, though the boundary line itself has an altitude of only 640ft. After passing the latter there is another pass of 2280ft., while Raheng, the junction, is only 300ft. Between Raheng and Bankok the country is almost entirely plain. This, however, is subject to inundation, and the embankments would average 9ft. in height. From the junction—Raheng—northwards to the Chinese frontier there is a height at Lakong of 763ft., after which there is a gradual rise to 1564ft., and a gradual descent therefrom to 1347ft. These form the only formidable difficulties to be found throughout the route to the Chinese frontier, and we think we may say that there is nothing in them to daunt our engineers, accustomed as they are to deal with far greater altitudes.

Having thus brought our readers to one of the points at which the coveted trade with the vast Chinese Empire is to be tapped, we may well pause before proceeding further with our main subject to give a few figures of population which will indicate the value of that trade. In immediate proximity to the termini of the proposed lines on the Chinese frontier are the provinces of Yunnan, with 5 millions of people; S'ochan, with 21 millions; Kweichtan, with 5 millions; and Kwangsi, with 7 millions. We cannot guarantee the exact correctness of the spelling of these Chinese words. What we have stated reveals the importance of the markets the proposals we have discussed are destined to open to British trade, and we may now proceed to the consideration of what may be termed the subsidiary proposals made by the explorers.

These, as secondary, perhaps, in importance to those above discussed, we may deal with in a more cursory manner than was due to the prominence claimed by that dealt with. We have already stated that a railway is working between Rangoon and Taungoo. It is proposed to extend this northwards to Mandalay, the recently acquired capital of native Burmah. The distance would be 230 miles. Carrying a line thence to Bhamo would entail a further 200 miles, and from Bhamo, to effect a junction with our existing Indian railway system, would require an additional 250 miles. Tabulating these distances, we have, in order to join the present Indian and Burmese systems, to construct railways as follows:—Taungoo to Mandalay, 230 miles; Mandalay to Bhamo, 200 miles—touches Chinese frontier at this point, from Bhamo to junction, 250 miles; total, 680 miles. All this work, or very nearly all of it, would be within what is by the recent proclamation constituted British territory. From Mandalay an alternative route is suggested for this junction with the Indian lines passing more to the westward, and up the valley of the Khyendwin river. Its length would be practically the same as the route *viâ* Bhamo above given; but the value of tapping the present caravan traffic through the latter town, situated as it is on the Chinese frontier, would doubtless insure this alternative being set aside in favour of the Bhamo route.

We have yet another section of our subject to treat of. The two main schemes we have already dealt with would be manifestly incomplete without their union, and accordingly Messrs. Colquhoun and Hallett propose a line to connect Moulmein, the starting point of the Siamese system, with the Rangoon-Taungoo line, the base of what may be termed the Indian system. The length of such a railway would be but 125 miles, and it would effect through communication from our furthermost Indian cities to the Chinese frontier at two points, to the principal commercial centres of Burmah, and with the capital of Siam, Bankok. The total mileage necessitated therefore by the proposals to effect this end would be:—Siamese system, 985 miles; Indian system, 680 miles; to unite the two systems, 125 miles; total, 1790 miles. Taking this mileage as to cost an average—on the data before given—of £8122 per mile, we have a total outlay involved in the several proposals considered of £14,538,380. Such a sum need not seem startling to anyone who gives due consideration to the results to be achieved for it. Who can predict the full effect of its outlay! Our trade, now so languishing, would secure by it the custom of hundreds of millions of people ready, and even anxious, to take the produce of our labour, now oppressed by foreign competition, fostered as the latter is in a great degree by our own trade principles.

A short space may well be devoted to a brief sketch of the leading specialities of the present and proposed Burmese railways. We have stated the gauge on which the former have been constructed to be the metre. Its adoption, present and prospective, must necessitate a break of gauge when meeting with our present Indian system of railways. We are not insensible to this drawback; but, if it can be palliated, it is under circumstances such as are involved in very large and detached sections of the Empire. It is, at all events, unavoidable, and must be accepted. The rails at present in use in Burmah are of steel, and weigh 41¼ lb. per yard. Their use would be maintained on all extensions. On nearly all portions of the routes to be traversed vast teak forests, which constitute one of the greatest resources of the several countries, are to be found. They of course would furnish ample material for sleepers and construction work, though we believe the engineers favour the adoption of metal sleepers. The traffic rates on the present lines in working in British Burmah are exceedingly low, the rate for third-class passengers being but 3 pie per mile, or but little more than a farthing of English equivalent. The traffic manager of these lines holds, we believe, that this rate might be considerably increased without injuriously affecting the amount of traffic, and that the receipts might thereby be readily, and without danger, augmented. This is, however, a question which does not press, as the lines pay well at present rates, and it is always unadvisable under such conditions to hurry towards a change from established custom.

We cannot take leave of our interesting subject without noticing the comments it has evoked by our Chambers of Commerce throughout the kingdom. These have been unanimously in support of the proposals made by the enterprising gentlemen to whose self-imposed and self-denying labours they are due. Among the resolutions passed by these important bodies are many which call upon our Government fitly to recognise those labours. In such a call we cordially join. We understand that not only have all the necessary journeys and surveys been undertaken and made without remuneration or recoupment of expenses, but that, in order to keep themselves free of any imputation of personal motive in their advocacy, Messrs. Colquhoun and Hallett have declined many offers made to them to become financially associated with proposals for the realisation of their work.

THE GROWTH OF TRAMWAYS.—From a Parliamentary return just issued, it appears that in the past year no less than a capital sum of £14,051,546 was authorised to be raised for the construction of tramways in England and Wales, over £9,000,000 having been actually paid up, and something more than that was expended. In 1876 the amount raised was only £2,667,300, £1,254,277 being paid up, and £1,314,070 being expended. In 1885 there were 658 miles of line open, as against only 94 miles nine years ago, while the passengers carried were in 1885 283,320, and in 1876 only 756. These figures furnish a very striking illustration of the growth of tramways, and the Bills prepared for the next session promise yet further extensions, especially in the metropolis. Developments on a less scale have taken place in other parts of the United Kingdom in the same period. In Scotland, £1,157,074 were authorised in 1876, and £1,555,041 in 1885, the traffic increasing from 47,680,256 passengers, to 61,438,106. In Ireland the sums authorised in the respective years were £640,000 and £1,527,166, and the passengers carried numbered respectively 8,878,859 and 19,943,445. In connection with this system of conveyance the suggestion is made that existing Acts should be so amended and new Acts so framed as to compel tramway companies to place the construction of proposed lines open to public tender, and to render void all contracts in which the contractor has a deciding vote. The main reason for this suggestion is that there are many tramways in the country which were constructed at the instigation of contractors for their own benefit, which can scarcely make traffic enough to exist, far less pay the unlucky investors.

RAILWAY MATTERS.

THE passenger traffic on the Belfast Central Railway has been discontinued.

THE traffic returns of the Trans-Caspian Railway show a total for the year 1885 up to December 1st of 5,141,701 roubles, or an increase upon 1884 of 1,062,861 roubles.

THE total length of European railways at the end of 1884 is given as 189,334 kilometres, or 118,208 miles, being an increase at the rate of 3·46 per cent. on the length at the end of 1883, which was 182,000 kilometres or 113,000 miles.

THE Belfast Harbour Commissioners have, it is said, decided to lay down two additional lines of rail along the whole course of the harbour, which will enable each of the railway companies to deal with traffic direct to and from the steamers.

THE best plant at present known for consolidating by the interlacing of its roots the loose soil of a newly made embankment is, according to M. Cambier—of the French Railway Service—the double poppy. While the usual grasses and clovers need several months for the development of their comparatively feeble roots, the double poppy germinates in a few days, and in two weeks grows enough to give some protection to the slope, while at the end of three or four months the roots, which are 10in. or 12in. long, are found to have interlaced so as to retain the earth far more firmly than those of any grass or grain. Though the plant is an annual, *Nature* says, it sows itself after the first year, and with a little care the bank is always in good condition.

THE method of placing electric lamps in front of locomotives to illuminate the line has been tried on many lines, but apparently has not found much favour. Recent experience in Russia appears to show that financial considerations are not alone unfavourable to the system. On the railway between St. Petersburg and Moscow several locomotives were fitted with electric lamps. For a time they gave great satisfaction, lighting the way more than a kilometre in front. But the servants began to complain of the contrast between the lighted and the unlighted surfaces painfully affecting the eyes; and doctors ere long reported that there had been several cases of grave injury to the eyes in this way. Hence the lamps were abandoned. The directors have not, however, given up the idea of better illumination of the line, and they now contemplate placing electric lamps so as to illuminate about one kilometre on either side of the station.

THE Whitby and Scarborough Railway, from which, during its construction great things were expected, has been very unlucky, and is now in a poor way. Although its primary and main object was to improve the communications between the two towns named, by competing with the North-Eastern Railway, the directors eventually entered into an agreement with that company to work the new line. Owing to financial difficulties, and under that arrangement, the line was opened six months ago. During the Scarborough season, and, indeed, all through the summer and autumn, there is usually a considerable traffic, but it is found that although the new line shortened the journey in distance, and in time, only 92,000 people, yielding an income of £4700, were carried over it between July and December, while the goods conveyed only amounted to 1800 tons, and the minerals to 1500 tons, the respective profits being £296 and £126. The total profit is thus a trifle over £5000 for six months' working—a very lamentable result. This trifling yield is attributed to the action of the North-Eastern Company, which, it is alleged, instead of giving the new railway a fair chance, according to the undertaking, maintained prohibitive charges, and so restricted the service on the new line that people chose rather to go to and between Scarborough and Whitby, and other places in that neighbourhood, by the old—North-Eastern—though more circuitous route. This is, of course, a serious indictment, but it is widely believed in.

A TEST, the results only of which are given by the *Railway Review* of America, to determine the relative condensation between steam surfaces protected by non-conducting jacket and similar surfaces uncovered, both being exposed to the atmosphere under the same conditions of ordinary temperature, are given as follows:—Two wrought iron tanks, 6ft. diameter by 12ft. high, placed in the same room, were used for rendering lard. The lower ends were protected from radiation by resting on solid foundations, while the sides and top were exposed to the atmosphere, giving a surface of 225 square feet for radiation. A constant steam pressure of 35 lb. was maintained in both of them, and the water of condensation was drawn off at intervals and weighed. No. 1 tank was uncovered, with the rough black iron exposed to the air. No. 2 tank was thoroughly protected by a coat of asbestos cement, enclosing air spaces, over the sides and top. The result was as follows:—No. 1 tank condensed 146 lb. of steam per hour; No. 2 tank condensed 54 lb. of steam per hour, giving a difference of 92 lb. of steam at a pressure of 35 lb. per hour. Now, 92 lb. of steam represent, at the rate of $7\frac{1}{2}$ lb. to 1 lb. of coal, the combustion of $12\frac{1}{4}$ lb. of coal per hour—or 254 lb. per day of twenty-four hours; $\frac{254}{2000} \times 3$dols. per ton equals 38c. per day saved on each tank. The cost of 225 square feet of covering at, say, 20c. per foot in place = 45 dols., and $\frac{4500}{38} = 118$ days—or the whole cost of the covering saved in four months. In the establishment cited sixteen of the tanks were used, so that by having them all covered, after the first four months $16 \times 38 = 6$ dols. per day was saved in the coal pile for every day they were actually in use.

SIR BERNHARD SAMUELSON has compiled a report on the charges for transport of goods on Continental railways. The report is concerned chiefly with the railways of Northern Germany, Belgium, and Holland, these being the countries in which Sir B. Samuelson finds the conditions of traffic least unlike those of this country. In Northern Germany most of the railways were originally constructed by private companies, but have now either been purchased by the State or are administered under State control. Not more than 2368 kilos. of German railways are in the hands of private companies out of a total mileage of 35,823 kilos. The change of ownership and management from private to public hands is stated in the report to have come fully up to expectations, and has produced decided economy in the cost of working the traffic, greater uniformity in rates, and increased accommodation to the public, and these advantages have, Sir B. Samuelson declares, after full inquiry, been secured without any drawbacks. He finds producers and consumers alike well satisfied with the results. In Belgium, 4319 kilos. of line were opened for traffic at the end of 1883, of which 3063 kilos. were in the hands of the State, and 1256 were worked by private companies. How far the transfer to the State has been beneficial is less clear in the case of the Belgian than of the North German lines. On the State lines the percentage of expenses to receipts is just under 60 per cent. On the private lines it amounts to about $54\frac{1}{2}$ per cent. On both classes of line the rates of transport are moderate; but it is not clear that this advantage has not been obtained at the cost of the State, although a report submitted to the Belgian Chambers in 1884 shows a clear total profit of £3,900,000, after deduction of all charges on revenue and on capital account. On the Dutch lines the financial benefit of State interference is more doubtful still. These lines, 2118 kilos. in length, are partly the property of the State and partly of private companies, but they are all administered by private companies, the State receiving, in return for its capital outlay, on the average of the last five years, the rate of 1·18 per cent., while private proprietors were receiving dividends varying from 4·56 per cent. to upwards of 7 per cent. The charges for transport on the Dutch lines are made on a haphazard system, closely resembling our own. For the whole of Germany there has been a general tariff in force since 1877. It was framed as a compromise between two distinct systems—that by which charges for transport were made chiefly according to the value of the goods conveyed, and that by which values were almost wholly disregarded, and charges were proportioned to the mileage traversed and to the space occupied by the goods.

NOTES AND MEMORANDA.

IN Greater London 3853 births and 2593 deaths were registered last week, corresponding to annual rates of 38·5 and 26·0 per 1000 of the population.

IN the course of some recent remarks, Sir James Anderson said the Eastern Telegraph Company had sent messages to America in 4 min., to Australia in 10 min., and had once got a reply from India in 5 min.

THE deaths registered during the week ending January 2nd in twenty-eight great towns of England and Wales corresponded to an annual rate of 25·5 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of the year. The five healthiest places were Hull, Brighton, Sheffield, Sunderland, and Derby.

THE number of applications for patents during the year which expired yesterday amounted to 16,101, being 1009 below the recorded applications in 1884. It was not expected that the figures would have been so high, the abnormal increase in 1884, when no less than 17,110 patents were applied for, having been due to the stimulus of the simplified procedure and low fees of Mr. Chamberlain's Act.

IN London, last week, 2996 births and 2071 deaths were registered. The births were 757, and the deaths 195, above the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 18·8, 22·0, and 18·0 in the three preceding weeks, rose last week to 26·5; much, however, of this apparent rise was simply due to deferred registration from the previous week.

THE *Journal of the Society of Arts* describes a plan for rendering paper as tough as wood or leather, which has been recently introduced on the Continent; it consists in mixing chloride of zinc with the pulp in the course of manufacture. It has been found that the greater the degree of concentration of the zinc solution, the greater will be the toughness of the paper. It can be used for making boxes, combs, for roofing, and even in bootmaking.

AT a recent meeting of the Paris Academy of Sciences a paper was read on the determination of the differences of longitude between Paris, Milan, and Nice, by MM. F. Perrier and L. Bassot. The values obtained for the differences of longitude between the observatories of these places is found to be:—

Milan—Paris..	× 27m. 25·315s.		$\Delta = 0{\cdot}01$s.
Paris—Nice	− 19m. 51·513s.	27m. 25·325s.	
Nice—Milan..	− 7m. 33·812s.		

THE highest chimney yet built in the world has recently been completed at the Mechernich Lead Works in Germany. The whole height of the structure is approximately 440ft., 11ft. of which is under ground. The subterranean portion is of block-stone, 37ft. square in plan, all the rest is of brick. The plinth, or lower part of the chimney above ground, is 34ft. square, so that the height of the shaft is nearly thirteen times the lower diameter. For about 34ft. the chimney continues square; then becomes octagonal in plan for a little distance, and finally changes to a circular form, retaining this shape to the top. The exterior diameter of the shaft at the top is about $11\frac{1}{2}$ft. The flue is $11\frac{1}{2}$ft. in diameter at the bottom, and 10ft. at the top. Until the completion of this chimney, that of the St. Rollox Chemical Works near Glasgow, which is 434ft. high, was the tallest in the world.

THE prevailing direction of the winds on the shores of the Black Sea and the Sea of Azov has been recently studied in great detail, and in connection with the recent progress of meteorology with regard to wind generally, by M. Spindler, who has published his work, with maps, in the Russian *Maritime Review—Marskay Sbornik*. Four maps show the prevailing direction of the wind at 7 a.m. and at 1 p.m. during the four seasons of the year. During the winter a notable difference between the prevailing direction at these two hours of the day is seen only on the eastern shore; while in the spring and summer nearly everywhere on the Russian coast of the Black Sea these two directions differ by 90 deg., and at some places they are quite opposite to one another, thus showing that the predominating influence of the currents of air depends upon the different heating of land and sea.

IN his investigations of the changes of level of inland lakes—known as *seiches*—Professor Forel has arrived at the simple formula $t = l \sqrt{g h}$ for those movements, in which t expresses the time in seconds, of a half oscillation of a uninodal *seiche*, l the length, and h the mean depth of the cross-section of the lake in which the variation is observed. The formula holds good for the lakes of Neuchatel, Brienz, Thun, Wallenstadt, and Geneva. An interesting confirmation of it, *Nature* says, is found by M. Forel in observations made by Mr. Russel with a limnograph on Lake George in New South Wales. This instrument had recorded thirty-three very regular *seiches* on the lake this year, and the duration of a whole oscillation proved to be 131 minutes. Now the length of the lake being 28,962 metres, the above formula gives for the mean depth, 5·536 metres, or 18·1ft. Mr. Russel states that the mean depth is between 15ft. and 20ft.

THE average heat value of well purified coal-gas at constant volume has been recently determined by M. Witz—*Ann. de Chim. et de Phys.*—as about 5200 calories per cubic metre at 0 deg. and 760 mm. when the water formed is fully condensed. This value, got from a great variety of experiments with gas from different works, appears to make the generally accepted figure of 6000 calories about 15 per cent. too high, and the calculation of gas motors is here concerned. The heat value of the gas from one and the same works varied in the course of a year from 4719 to 5425 calories, which was more than the variation between different works. The influence of temperature and external pressure was not perceptible. The operations for purifying gas diminish the heat effect sometimes as much as 5 per cent. The gas of the last hour of distillation is—contrary to the usual view—less, *Nature* says, rich than that of the first hour. Dilution with oxygen lessens the heat value; but in dilution with air, curiously, no such effect was observed; the heat of combustion was the same with six or with ten volumes of air.

AT a recent meeting of the Geological Society, seven deep borings in the eastern part of Kent were described by W. Whitaker, B.A., all of them reaching to the gault. The chief one is at Chatham Dockyard, where, after passing through the whole thickness of the chalk, the gault was found to be 193ft. thick, whilst the lower greensand was only 41ft., and was underlain by Oxford clay, a formation not before known in Kent. These parts involve the thinning of the lower greensand from 200ft. at the outcrop a few miles to the south, and the entire loss of the whole of the Wealden series, which, further south, exists in great force, the Weald clay being 600ft. thick, or perhaps more, and the Hastings beds 700ft. or more. Still further south, in the central part of the Wealden district, there are outcrops of the Purbeck beds, whilst the sub-Wealden boring continues the series downwards. We have thus an addition to the beds wanting at Chatham of some 400ft. of Purbeck and Portlandian, of over 1100ft. of Kimeridgian, and of nearly 500ft. of Corallian, &c. In a section of 32 miles, therefore—the distance between the sub-Wealden and the Chatham borings—we have a thinning of beds to the extent of over 3400ft., or at the average rate of about 100ft. in a mile. This northerly thinning agrees with the facts that have been brought before us from other deep borings in and near London; but the Chatham boring is the first in the London basin in which a Middle Jurassic formation has been found. The teaching of the deep borings, as a whole, is that north of the Thames older rocks rise up beneath the cretaceous beds, whilst on the south, newer rocks come in between the two. The question of the finding of the coal-measures beneath parts of the London basin seems, he thinks, to admit of a hopeful answer, whilst the lesson of the deep borings as regards water-supply is that there is small chance of getting water from the lower greensand at great depths underground.

MISCELLANEA.

WHAT is probably the largest Government order ever secured in Wolverhampton is now under execution at the engineering works of Messrs. Bayliss, Jones, and Bayliss, in that town. It is work for the Indian Telegraph Department, and is valued in round figures at something like £50,000.

AS a part of their lock and key business with registered names of purchasers, Messrs. Hobbs, Hart, and Co. some time since commenced the manufacture of key labels with registered numbers, and stamped on each an offer of reward to any finder. It was through one of these and a telegram to Hobbs and Co. that the body found near Brighton last week was identified.

WE hear that the evening lectures at Exeter Hall by Mr. Gribble, on "Science of Construction," have been so well received that the committee have arranged with him for the delivery of two courses, advanced and elementary, on Mondays and Thursdays, from 7.30 to 3.30 p.m. The subject for the opening lecture on the 11th inst. is stated to be "The Cannon-street Station Roof."

REPORTS reached London on Tuesday that a severe shock of earthquake was felt on Monday morning, at 20 minutes past 10 o'clock, all along the route between Dartmouth and Kingsbridge, as well as at other places lying more inland. It appears to have been most severe at Torcross. At Stoneham, Chillington, and Frogmore it was also experienced. We should like to know whether this shock was felt in any of the Devon or Cornwall mines.

THE Manchester Corporation have taken advantage of the excessively low prices ruling in the market to place out large contracts for cast iron pipes in connection with the Thirlmere Waterworks scheme, and at the meeting of the Waterworks Committee held last Thursday contracts were granted to Messrs. McFarlane and Co., of Glasgow, to the extent of £110,000, and to the Stavely Iron Company, Glasgow, to the extent of £120,000. As, however, the deliveries under these contracts are extended over a very long period, it is scarcely likely that they will have any appreciable effect upon the market.

A SERIES of interesting experiments in blasting were made in North Staffordshire mines towards the close of last week with a new water cartridge, the invention of Mr. Miles Settle, managing partner of the Madeley Coal and Iron Company, who have extensive collieries at Leycett, near Newcastle-under-Lyne. In Mr. Settle's invention the case containing the explosive is completely surrounded by water, in lieu of having the water at one end or but partly around it, and the especial advantage claimed is that a complete extinction of the flame follows immediately upon the firing of the charge. The experiments were very successful.

MESSRS. JOHN CROWLEY & CO., of Meadow Hall Ironworks, who are largely engaged in the production of agricultural specialities, have been looking about for fresh markets. Our Birmingham correspondent says that from a leading firm of merchants at St. John's, New Brunswick, the answer they got was that the freight of English goods, with the 35 duty added, made them 100 per cent. more than the first cost. This had greatly hindered business with England in the past, and would continue a serious factor in the future. It would be a wonder if it were otherwise. How can British producers fight against disadvantages like these with any hope of permanent success?

ON Saturday evening, December 19th, the foremen of the Spittlegate Ironworks, of Messrs. R. Hornsby and Sons, met for the purpose of presenting Mr. Vincent Rhodes, M.I.M.E., late manager of works, who has resigned, with a testimonial in the shape of a handsome timepiece, with inscription on a gold plate, and an illuminated address. After a suitable reply from Mr. Rhodes, in which he gave an account of his career from the time of his taking the position of manager of works to his retirement, he exhorted the foremen to adhere to the principle of assisting each other to promote the welfare of the company, and that he would look back with pleasure upon their hearty co-operation. Mr. Rhodes is about to leave for Australia, where he takes the management of a large establishment.

Le Yacht of December 19th gives a capital summary of the effects of the firing from the Hercules at Portsmouth against the Moncrieff gun. It remarks that the quick-firing and machine guns firing at about 1300 yards range for ten minutes made sufficiently close shooting and such hits that it could scarcely be decided whether the gun would have been disabled or not by them. The shrapnel had fired at about 3000 yards with less effect, and the common shell with still less. None of the dummy detachment were struck. The results were considered strongly in favour of the Moncrieff system. There is an account of the operations of the French fleet in the capture of the Pescadores Islands. The geographical position of the Pescadores is declared to be admirable, better, in fact, than that of Hong Kong, and the port of Makung, and well suited to the requirements of the French Fleet in the Chinese waters.

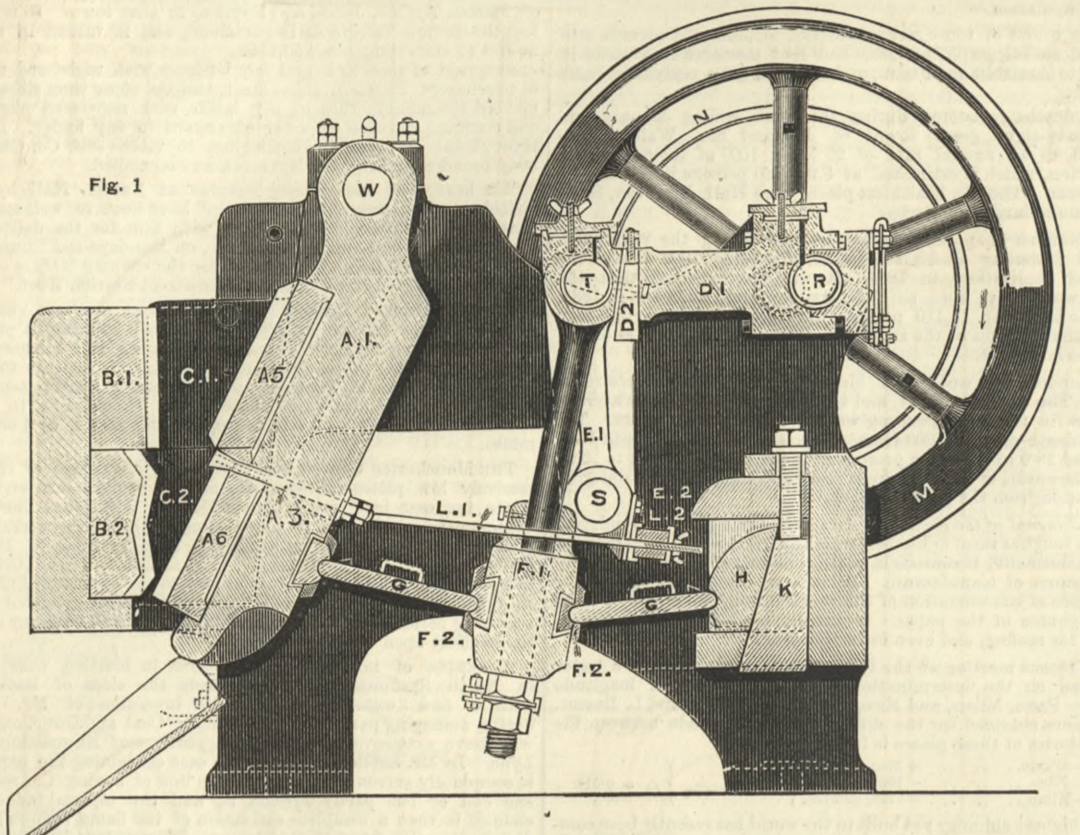
AT a meeting of the South Staffordshire Mines' Drainage Commissioners in Wolverhampton on Wednesday, Mr. Walter Williams, the chairman, reviewed operations of the Commission during the past year, and made important announcements. He stated that so successful had been the policy of the Commissioners in draining the underground water by the driving of levels at a heavy cost, that whereas two years ago fifteen pumping engines were employed the number had now been reduced to five, and that there was a prospect of a still further reduction. The value of the surface works was shown in the circumstance that whereas at the earlier period 14,000,000 gallons of water were pumped daily, it was now only necessary to raise 10,000,000 gallons. He anticipated an early increase in the quantity of minerals raised since collieries once submerged in the Bilston and other districts would be shortly again available for operations.

THE lead industry in the North of England is probably the only one of the mineral industries in which any improvement has been noticeable over a large part of the year 1885. In 1884 and 1885 there was a very considerable reduction in the production of British lead. There was also a considerable decrease in the imports of lead from Spain because of the cholera outbreak; and there has been concurrently an increase in the export of lead, especially in China. One of the largest of the lead mining companies in the North of England sold lead, at the worst period of 1885, as low as £10 5s. 8d. per ton in March last; but before the end of July—its financial year then ending—it made sales at £12s. 4s. 10d., and this advance in price has since continued. Some of the largest producers of lead have closed their mines altogether for a time. Some attempt has been made, but with only partial success, to obtain a reduction of the royalty dues.

THE members of the Tees Conservancy Commission have had an animated debate, and find themselves equally divided in opinion upon a certain important point. It appears that before the Commission was established the lands bordering on the river were protected from flooding at the various places by embankments. The Commissioners, acting under their powers, have since made better embankments on the outer or river side of the old ones. In so doing they have always considered they had no responsibility as regards the old ones, which, being superseded, might safely be abandoned, and the site of them used as part of the reclaimed land. A short time since a riparian owner or occupier, who suffered damage by the non-maintenance of an old embankment, brought an action against the Commissioners, and obtained a verdict and substantial damages. The Commissioners, in view of this decision, propose to include in a new Act, for which they are applying to Parliament, clauses relieving them from this liability for the future. Half the Commissioners at the recent meeting supported the retention of these clauses; the other half thought it improper to seek relief from liabilities which had been decided to be rightfully theirs by a court of law. The votes being even, it was finally decided, by the casting vote of the chairman—Sir J. W. Pease, M.P.—that the clauses alluded to should be retained.

BAXTER'S STONE BREAKER.

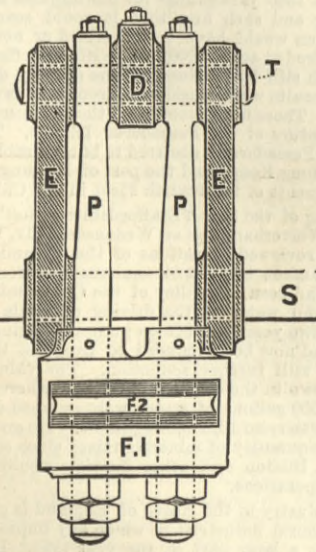
Fig. 1



BAXTER'S STONE BREAKER.

The stone breaker illustrated by the engravings below is made by Messrs. W. H. Baxter and Co., of Albion-street, Leeds, and is called by them the Knapping-Motion Stone Breaker. It is a strong, powerful machine, and we are informed that in July last at the Royal Agricultural Show it broke over two tons of stone to one by some other machines, the machine being a 16 by 9, driven by a 6-horse power engine, whilst a competing machine was a 15 by 8. It broke at the rate of over ten tons an hour. At the Inventions Exhibition Messrs. Baxter refused a gold medal because their machine was the only one which was practically tested before two juries out of the three who visited the stand, while the machine to which was awarded the gold medal had not broken a single stone at the Exhibition; whereas Messrs. Baxter's 16 by 9 machine broke 5 cwt. of Mountsorrel granite in 1 min. 45 secs. for one jury, and 1 min. 40 secs. for the second jury. After their refusal to accept the silver medal and a statement of the facts, the juggling at South Kensington could not disprove that it was expedient and necessary to give Messrs. Baxter and Co. a gold medal. The following is the result of a test of a 16 by 9 patent Knapping-Motion Stone Breaker at work in Stirlingshire, November 6th, 1885:—7 tons 2 cwt. broken to 2¼in. ring in 23 min., 5 tons 16 cwt. broken to 2¼in. ring in

Fig. 2

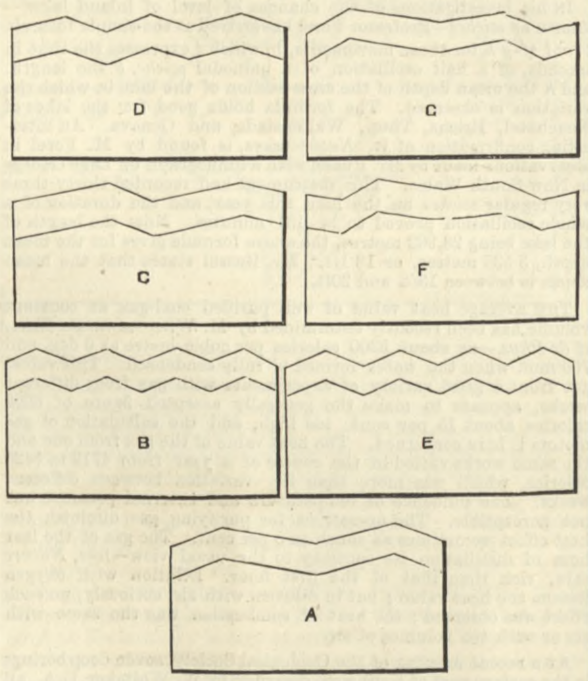


20 min.; 5 tons 15 cwt. broken to 2¼in. ring in 18 min., or 18 tons 13 cwt. broken to 2¼in. ring in 61 min. The specified quantity for this size machine is eight tons per hour.

The object of Messrs. Baxter's design is to get a sudden movement of the jaw at the latter part of its breaking stroke, and this is done by the arrangement called a knapping motion, stone being more easily broken by a movement that strikes and cracks the stone than by one which is slower and crushes locally. It is contended by the makers that the jaws worked by a knapping motion, give a result which approximates to that of hand-breaking. In our engravings, which give a longitudinal and transverse view of the machine, and views of the cubing jaws, and from Fig. 1 it will be seen that the movable jaw A swings upon the shaft W, actuated by the toggle arrangement, consisting of the plates G G and the block F. A feature in the machine is that the jaw is closed by the lifting the block F, which is done by half the revolution of an excentric placed on R. The block F has a compound motion. In closing the jaws or "knapping," it is simultaneously lifted and rocked, its upper part towards the right. This motion is obtained in the following way:—The block F is suspended from the shaft T by the two rods P. The shaft T is carried at the top of the nearly vertical radial levers E, which are capable of rocking in bearings of the shaft S. The shaft T is also connected by the rod D to the crank shaft R, carrying the fly-wheels, and driven by a belt in the usual way. As the crank shaft revolves, the shaft T is pulled to and fro, the radial levers working to allow of the movement. When the latter are in the dotted position, the shaft T is slightly lower than at the other end of the stroke, consequently, when T is pulled to the right, the block F is lifted, thereby working the toggle closing the jaws. At the same time the block F has a slight rocking motion, due to the movement of the suspending rod P from left to right. It would be difficult with a drawing only to trace out the consequence of this compound motion of the block F, but, as seen in an actual machine, its effect is to close the jaws with a jerk, imitating a blow somewhat nearly by applicable mechanical means, and to open them with equal rapidity. Instead of half a revolution being required to give the blow, as in most arrangements, in the Baxter it is given in one quarter of a revolution, the jaws remaining steady for the next half revolution, the backward motion being acccomplished by the remaining quarter.

That the sudden closure of the jaws is an advantage will be well understood after a little consideration. The material is more evenly cubed, there is less waste from dust and chippings, and less power is required to drive the machine. The material falls away with greater readiness, and is therefore not broken more than is necessary. The engravings of Figs. 3 show various forms of jaws. The forms A B C D E F and G are designed to suit the different kinds of rock, and are to be used in place of jaw B 2, as shown on circular. This jaw is not reversible, and therefore when the bottom points are worn off it has to be thrown away. A is a similar jaw, but is made reversable, and therefore lasts twice as long. This jaw is suitable for the

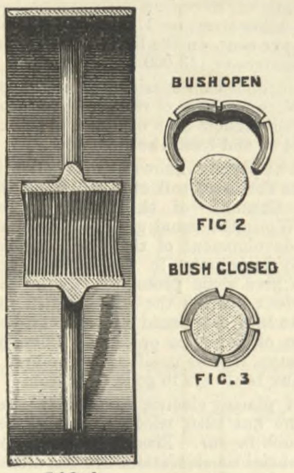
Figs. 3



hardest material. Jaw B is most suitable for the toughest materials. Jaws B and E form one jaw as B 1 and B 2, Fig. 1. These are only recommended when the material is both hard and tough. Jaw G is most suitable for a hard limestone, and jaw B for a softer stone. Jaw F is most suitable for a slatey kind of rock, with a movable jaw made to work so as to prevent the long pieces from passing out of the machine unbroken. This jaw is reversable for this purpose. Jaw G is a jaw half like jaw A and half like jaw F, and can be used either way.

SMITH'S INTERCHANGEABLE PULLEYS.

The cast iron pulley illustrated by the accompanying engravings has been brought out to meet the want for a pulley which can be kept in stock and made to fit any size shaft from 1¼in. to 3in. diameter by inserting a bush fitted as explained below:—Fig. 1 represents a section of pulley. The hole in all the pulleys is bored slightly taper, and screwed to one uniform size and gauge; this admits a taper bush screwed upon the outside and bored to fit any size shafting from 1¼in. to 3in. diameter. Thus it will be seen that each pulley will do for any size shafting by using a bush of the required bore. Fig. 2 represents a bush open ready to be placed on shafting. The bushes are in four pieces, held together by connecting material, and can be put anywhere on shafting without the use of tools or skilled workmen. Fig. 3 represents a bush closed in position on a shaft before the pulley is screwed on. The bush being in four pieces, conical and screwed upon the outside, it firmly grips the shaft when the pulley is screwed on. Fig. 4 represents a pulley and bush on a shaft ready for fixing. The pulley has simply to be screwed upon the bush, which can be done in less than one minute, and is then ready for work, the bush gripping the shaft; so that to



fix the pulley it is only necessary to place the bush on the right way for the pull on the belt to run the pulley on the bush. The shafting may vary, say, $\frac{1}{32}$ over or under the standard size.

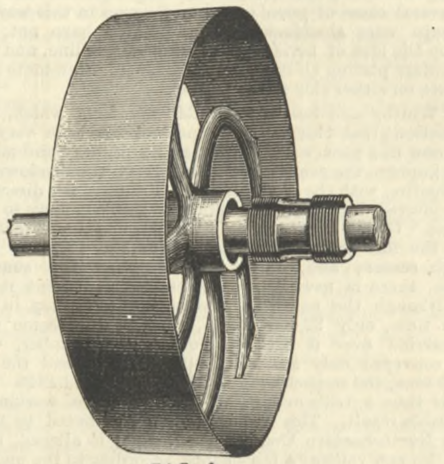


FIG. 4

The pulley makes a given stock virtually much larger than on any other system, and offers many advantages. It is made by Messrs. Smith and Grace, Thrapston.

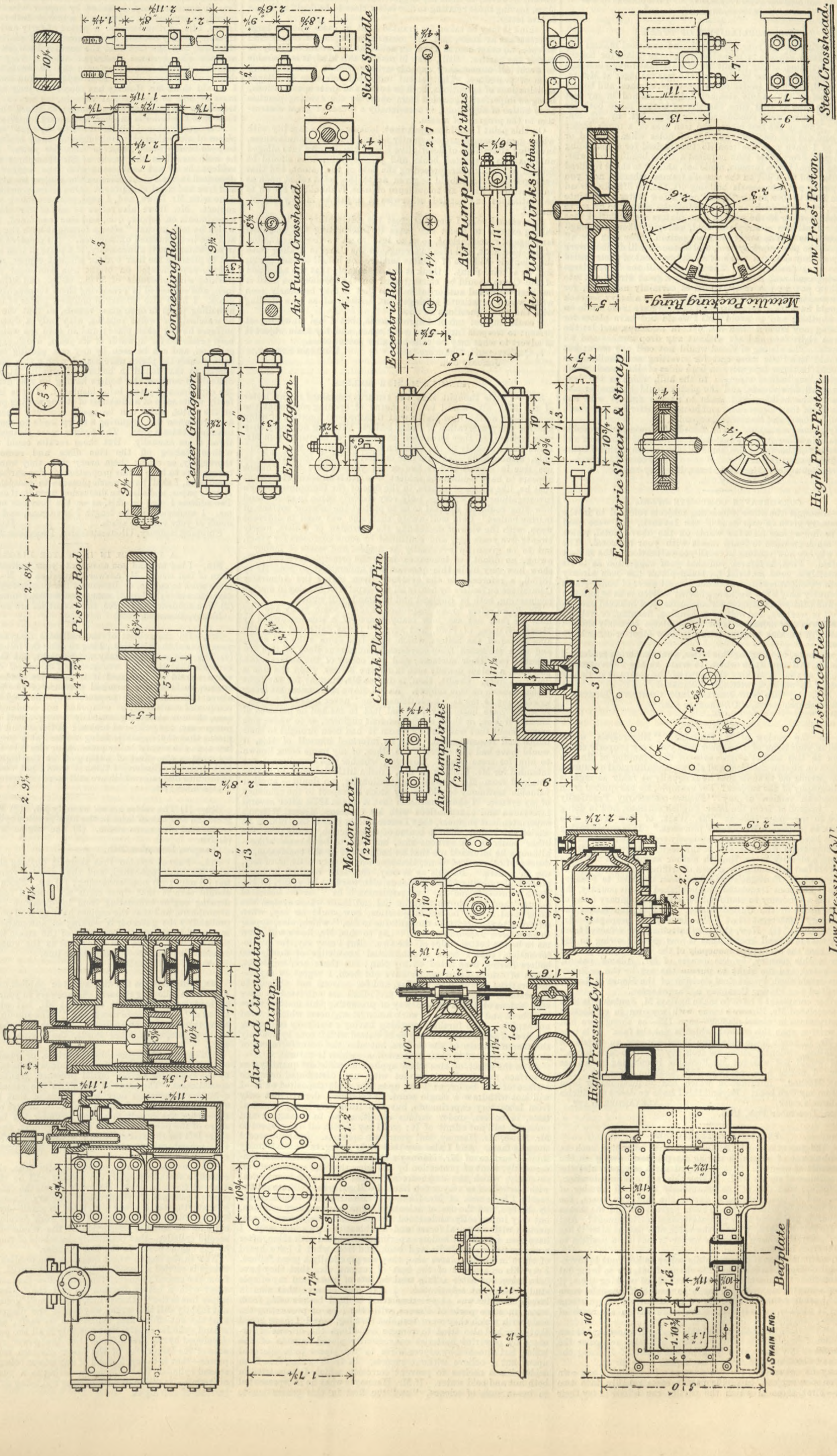
Engineers in the Field.—Sir Charles Warren, talking about Volunteers and engineering, is the right man in the right place. He understands both subjects, and is an authority on them. And, speaking the other day at Sheffield, he testified both to the value of Volunteers in the field and to the ease and success with which they could be made useful. He told his hearers how, in South Africa, he got together 2000 men in two or three weeks. He had a company of mounted engineers, another of technical engineers, and a third of pioneers. Many of those in the second company came direct from labouring at their trades; yet in a few weeks they were quite accomplished at the work of sinking for water, building forts, and so forth. Sir Charles is convinced of the great utility of engineers, both in offensive and in defensive warfare, and he regrets that, in his opinion, the existing regulations are inadequate in this respect. They refer entirely, he says, to times of peace, and contain nothing relating to duties on active service. Something more should be required of them than at present. Instructions are given as to the mode in which a bridge should be built; but "something far beyond that is necessary, and that is to fix upon the particular part of the country where a bridge would be required in case of defensive operations." Again, there is ample information as to boring for water; but of much greater importance is it to know where water is to be found. These are matters in which experience is necessary, and in which, when competent, engineers can obviously be of very great service to an attacking or defending force. In all regular warfare, Sir Charles considers mounted engineers should go forward at the head of the column, to be ready for any emergency. These considerations will commend themselves to all practical minds, and will, no doubt, have their effect in quarters where lies the power of putting them to the test. In making them Sir Charles has deserved well of all who are interested in our military efficiency.—*Globe.*

The Report of the Secretary of the United States Navy.—This report deals in all the first part of it with questions of organisation; then follows the discussion of the appropriation. The paragraph which is most striking is that dealing with the question of the strength and efficiency of the United States fleet. On this we read as follows:—"At the present moment we have nothing which deserves to be called a navy. There is no navy in the world that is not in advance of us with regard to ships and guns. We have no navy either of offence or defence; and again, it is questionable whether we have a single naval vessel finished and afloat at the present time that could be trusted to encounter the ships of any important Power—a single vessel that has either the necessary armour for protection, speed for escape, or weapons for defence. This is no secret. This country can afford to have, and it cannot afford to lack, a naval force at least so formidable that its dealing with foreign Powers will not be influenced at any time, nor even be suspected of being influenced, by a consciousness of weakness on the sea." This is plain spoken, manly, patriotic language. The way in which the construction of the navy is dealt with in England and France is explained. The way in which private enterprise is called in to help national establishments is especially discussed, as, for example, in marine engines, armour guns, projectiles, explosives, torpedoes, search lights, steering gear, wire cordage, &c. The inventive power of the States has been discouraged at home, while utilised abroad, as exemplified in the case of Hotchkiss and Ericsson. Then, again, the want of scientific advice is complained of. A system of organisation is recommended on which the secretary should have an assistant, and under the secretary should be three branches, viz., the departments of finance, construction, and personnel, with their various subdivisions. An example of the want of harmony in the present system is given in the mistakes made in the Omaha, which was found eventually to have had her space so appropriated as only to have room for four days' coal. Without wishing to ask for a great naval force, adequate provision should be demanded to secure right and justice, and for this both increased expenditure and reform in organisation are necessary in the judgment of William C. Whitney, Secretary of the Navy.

VERTICAL TANDEM COMPOUND SURFACE CONDENSING ENGINE.—DETAILS.

MESSRS. WORTH, MACKENZIE, AND CO., STOCKTON-ON-TEES, ENGINEERS.

(For description see page 34.)



LETTERS TO THE EDITOR.

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

THE PECULIARITIES OF STEEL.

SIR,—Having read in your paper that iron and steel makers are going to a great expense in manufacturing large plates for boilers and vessel building, kindly permit me to state that forty years ago I was an apprentice under my father, who was manager at Messrs. Pimms, Hull, and built twelve screw steamers, engines, and boilers complete before the paddle steamer Leipzic, named in my last letter to you, and at that time the size of plates made both for boilers and ships were considered very large—8ft. by 2ft. 9in. breadth. Now, in the first place, the iron was of a much better quality, and did not crack at the edge of holes when punched or sheared, as I have seen the iron do that is used for shipbuilding now. Again, every plate that required a little bending or twisting had to be put into a furnace, made hot, and set to shape required in a cradle, and then put on the vessel's frames, whereas now you can see plates put into vessels building 4ft. 6in. to 5ft. 6in. broad and from 12ft. to 20ft. in length, and only a few plates are put into a furnace, viz., boss, tuck, and garboard strake plates, to be set to shape when hot, for at the present time platers are so skilled that they can roll all the other plates cold, and give them the longitudinal curve as well as a curve in cross section. The men are all working on the piece-work system, and of course will do their work as cheap as they can, and make as much profit out of their skilled labour as they possibly can. Thereby you will see by the large plates being used and rolled cold there is a great strain put into them when put on the vessel, which is certainly not right, for when a vessel is heavily loaded and labouring in a heavy sea each plate should have its equal stress, and not one have more strain on it than another; and to avoid that I would not have plates for shipbuilding any broader than 3ft. 6in. in midships, and let the shears run right fore and aft without any drop strakes and all triple butts. The plating of vessel would not cost any more; but there would be a little more cost for rivetting and caulking, as there would be three laps more on both sides of the vessel, which would give longitudinal strength to the hull, which is the desideratum in all iron vessels, and the plates would be smaller and cost less to the builder, and made to fit the frames with less strain on them than larger ones, and be much better for the vessel, steamship owners, and insurance companies, &c.

Kindly excuse me asking if the Board of Trade prefers double butt straps in boiler furnaces instead of welding, if the seams and rivets are out of the way of fire, same as is shown on enclosed lithograph of my patent furnace. JOHN HARRISON.

5, Cavendish-square, Margaret-street, Beverley-road, Hull, January 4th.

CORNGREAVES COMPOSITE STEEL.

SIR,—Amongst the other interesting subjects referred to in the able summary given in your issue of the 1st inst., you were good enough to find a place for a few words on the above metal, which we are much gratified to learn meets with your approval. The reasons why we now venture to recall your attention to the subject are twofold. First, to inform you that your suggestion as to its being possibly a good material for boiler-plates has been already tried with excellent results, one of the largest users of boiler-plates in the country only a few weeks ago having written to us as follows:

"We find that your Corngreaves composite steel behaved exceedingly well in working, and neither in bending, flanging, or welding did we observe any defect or fault. The plates certainly showed the quality in working usually found in Low Moor or other high-class iron."

And, secondly, by inserting this letter, your numerous readers, if so inclined, will now know where to write to the "Corngreaves Company," as you, by sinking the name of the company in that of the place of its works, unwittingly designated

THE NEW BRITISH IRON COMPANY, Limited.

60, Gracechurch-street, E.C., January 6th.

ELECTROLYSIS.

SIR,—In the review of M. Fontaine's "Electrolysis, which appeared in your issue of December 4th, you very properly called attention to this author's ignorance of the standing of English authorities on electro-chemical and electro-metallurgical questions. Will you permit me to show that he is equally at fault as regards the bibliography of the subject? For example, he has quoted from the American version of my "Electro-metallurgy Practically Treated," instead of from the later English editions, and in doing so refers to me—page 103—as "Mr. Watt, of New York, who undertook to propagate Mr. Adams' processes." It is surely vexing enough to have one's book unceremoniously reproduced in America, to the commercial disadvantage of the legitimate work, without having one's identity as an English author sacrificed at the same time. This last evil would have been of trifling consequence if the publication of M. Fontaine's book had been confined to France; but since it has been translated and published in this country, the blunder has a tendency to confound me with an imaginary being of the same name in the United States. M. Fontaine makes the extraordinary statement that I "undertook to propagate Mr. Adams' processes" (?) Now, this is so extremely far removed from the fact, that it is well known that it was greatly owing to my exertions that the attempted monopoly of the whole nickel-plating industry in this country, by the owners of Mr. Adams' patent, was frustrated, and the right to pursue the art by the ordinary processes established, by the final decision of the House of Lords, in the suit of the Plating Company *v.* Farquharson.

A further complaint I have to make against M. Fontaine is that he has associated Mr. Elmore's name with my own in connection with instructions in nickel-plating—page 129—as though we had jointly written upon this subject, which is not the fact. It is true that in Mr. Elmore's trade catalogue there appears an article on nickel-plating, evidently concocted from my "Electro-metallurgy," but this would not warrant M. Fontaine in coupling our names together. I notice also, at page 115, that he gives, as "Mr. Elmore's Method," information which has unquestionably been taken from my own book. Beyond this I have no desire to criticise M. Fontaine's work. ALEXANDER WATT.

London, December 28th, 1885.

TRIAL OF PATENT CASES.

SIR,—The recent case of Otto *v.* Steel that attracted such an unusual amount of attention during its progress, owing to the great conflict of scientific effort displayed in it, suggests also the great costliness of such a trial. Taking this fact into consideration, in conjunction with that of the enormously increased number of patents, and of poor patentees, during the last two years, the question naturally arises, how are such persons to find the means of adequately protecting their patents against infringement? And it may further be asked, What is the value of a patent after it has become generally known that its owner is not in a position to defend it from invasion?

Now, assuming that it is good public policy to hold out to inventors of all classes inducements in the shape of patents to bring out new inventions and communicate the methods of working them, it becomes a matter of great importance to devise, if possible, some mode of lessening the cost of trials or investigations of questions relating to patents, so as to bring them more within the reach of patentees generally.

Any one acquainted with cases of this kind will know that it is a very difficult problem to solve, but they will also recognise the importance of any arrangements having the effect of limiting the questions to be tried, and making the inquiry more direct.

It may be convenient, for the purpose of explaining my own views on the subject, to divide patent cases roughly into two classes—First, those in which the parties can afford to try their cases in a court of law; and secondly, those in which it would be impossible for the parties to bear the expense of such an ordeal. I intend, however, to limit my suggestions at present to the former class, leaving those relating to the latter class to be dealt with in a future letter.

I think it may be taken for granted that in cases wherein large interests are at stske, and the means are ample for attack and defence, no other course than an action at law would be likely to satisfy the parties. Still, even in cases of this kind, it is desirable to avoid all unnecessary expense arising from a circumlocutory form of procedure. The present unlimited reference to alleged anticipations of inventions, both in books and prior specifications, being so imperfectly guarded from abuse by the existing practice as to notice of objections, is occasionally a source of great obstruction to the progress of a case.

On this point I would suggest that, looking to the rapidity with which great changes are constantly taking place in manufactures, involving alterations of descriptive terms, the inquiry into alleged anticipations by printed books and prior specifications should be limited to twenty years preceding the date of the patent, and that very specific notice should be given as to the point relied upon as an objection. Then as to evidence of user, it should be shown to be continuous and settled, otherwise it might be merely experimental.

As a second point I would suggest the advisability of the court calling experts to assist the judge in interpreting the technical language of specifications, so as to lead to an earlier construction of the document, and also to strengthen the Court in dealing with the scientific evidence of opinion tendered on behalf of each party; and, as a third point, I think it but reasonable that the attention of the Court should be concentrated on the specification until it has been construed authoritatively, so that it may be clearly seen what would constitute infringement, instead of as now dealing with the whole questions at once.

I could suggest minor improvements, but I am unwilling at present to trespass further on your space, and my main object is to advert to what may be called smaller patent cases.

8, Quality-court, Chancery-lane, January 5th. WILLIAM SPENCE.

ZINC IN MARINE BOILERS.

SIR,—I little thought that the remarks contained in my letter of the 27th ult. would be the means of opening somewhat the controversy on the now pretty well thrashed-out question of using zinc for the preservation of steam boilers; but I am not sorry they were written, as they have been the means of eliciting from Mr. Rowe that his study of the question is limited to "a year or two" only, although he states further on that he "had the privilege to use zinc in marine boilers five or six years before Mr. Phillips appears to have studied the subject"—which is an acknowledgment that he, like scores of others, in the face of Sir Humphrey Davy's investigations and writings, only very recently came to understand how zinc could be applied so as to protect the interior surface of marine boilers. I am well aware that zinc was used in different ways, with the view of decreasing the corrosion of boilers, nearly twenty-five years ago, and continued by some engineers for years, but to be given up eventually as useless and waste of money—owing, no doubt, to ignorance as to the principle involved. To show how very little this question was understood so recently as 1875-6, a reference to the evidence given before the Admiralty Committee on Boilers by nearly all the experts of the day in marine engineering, both in England and Scotland, will suffice.

Mr. Rowe refers to an inspection made "some years ago" by him—he does not say how many years—of a steamer owned by Messrs. Wilson, of Hull, and says: "I was delighted with the appearance of the boilers, which were free from adherent scale, and were protected from corrosion by numerous slabs of zinc distributed over their surfaces; and the colour of the boilers was a pale buff, a colour usually seen in marine boilers when the zinc is doing its duty. Credit, then, is due to Mr. Hannay for the light he has thrown on this subject. As Mr. Rowe commences his letter by referring to me as "a gentleman" he "never heard of before," it would have been only fair and just to me had he inquired of Messrs. Wilson, or their superintendent engineer, as to whose zinc arrangement that was, and by whom it had been brought to their notice and recommended. Had he informed himself of this, it would have had this effect, if no other, of my name being known to him for some years. However, whether the compliment was intended for Mr. Hannay or not, I feel a little flattered in having obtained from Mr. Rowe—unintentionally, no doubt—another valuable testimony to add to my stock in respect to the efficiency of my system. I should mention that it was in 1878, after several interviews and consultations with Mr. Cameron, Messrs. Wilson's superintendent engineer, that I succeeded in persuading him to fit one of two boilers, then in course of construction, on my plan, the other boiler to be without zinc, but both to be treated alike—although he informed me that he had arrived at the conclusion, as dozens of others had done, that zinc was of very little, if of any, use in boilers. Be this as it may, the trial resulted in many other boilers being fitted very soon afterwards. Now, Sir, as Mr. Rowe represents me as "a gentleman" he "never heard of before," and has shown that he did not know whose system was being used in the boilers in question, how could he say, when referring to the credit he thought due to me, "which, alas, appear to have been unremunerative"? As to this, Mr. Rowe will allow me to be the better judge of the two. But I may say, for his information, that I have a substantial knowledge of nearly 600 boilers having been fitted on my plan; but there are, no doubt, scores of others fitted which have not been, I regret to say, remunerative; at any rate this far, and for reasons not difficult to understand. And although old prejudices are admitted to have been serious obstacles in the way of promoting this matter, there have been and are others at work amongst engineers which I need not explain. And further, anything having a tendency to prolong the lives of boilers is not likely to be viewed with favour by not only the manufacturers of the boilers, but also the manufacturers of the materials used in their construction—which is natural.

As to the effect of zinc when applied in sufficient quantity—as to surface, and in direct contact with, and distributed over, the surface of the boiler, as I do, upon the scale deposited on it—I will not withdraw a single word. Experience, derived not only from laboratory experiments, but also from very many practical tests, in boilers, under various conditions as to treatment and pressure, will not admit of it; and I say it with all due respect to Mr. Rowe, Mr. Hannay, and your own opinions. I cannot accept them as facts. And I also say that it is owing to the extremely limited surface of Mr. Hannay's zinc spheres or balls, and, consequently, want of protection by the iron, that the scale comes off so easily, which the engineers and those who know how to deal with the boilers so very much like. I will go further. From all the results I have seen of Mr. Hannay's "Electrogem"—which name, by-the-bye, and the use of scientific terms now so very common, but very imperfectly understood by mechanical engineers, in connection with electrical forces and combinations, go a long way. I have seen a good few boilers experimentally fitted with them, after a voyage or two to India and back, and from what I have heard of them in various places also, they are practically a great failure. I say this on account of the best of reasons, viz., that they have been taken out after a fair trial in lots of cases, and my simple stud attachment substituted. I may here observe that zinc in large quantities was at one time tried in land boilers using fresh water in some parts of France, with the idea of preventing the scale with which they were troubled forming. And I have heard that they had also tried to remove scale from the crowns of furnaces by powerful batteries conveniently placed outside of the boiler, but attached by copper wires to the places to be operated upon, but I believe without success. In fresh water, free from acids, zinc is useless to prevent corrosion, which I have tried in both hot and cold water. If Mr. Hannay is what he is represented to be—a man of science, "and the first in this generation to scientifically investigate the subject and explain it thoroughly," in the opinion of Mr. Rowe—it seems strange, if not absurd, that he should apply an exposed surface due to *two* balls of zinc 6in. or 7in. in diameter only, attached by copper wires at two or four points, to prevent the oxidation of a marine boiler of the type now in use, 14ft. in diameter, for a period of forty and forty-five days' steaming, to say nothing of the necessity of scaling the oxide off the balls, and the fact that the contact between the copper bar and the zinc becomes destroyed after a very short time, on account of oxide forming between the two metals, the result, no doubt, of the inequality of their expansion and contraction, which I should think Mr. Hannay has found out long ago. To make a mass of zinc to last several voyages, so as to give but little trouble to the engineer, is one thing; to afford the necessary protection to the boiler is another, and a very important one.

It is equally absurd for Mr. Rowe to say that "one or two small pieces of zinc soldered in the bilges of these crafts—launches and torpedo boats—would preserve them for years." Mr. Rowe may be well versed in the works of Sir Humphrey Davy, but it is evident he is not conversant with the works—specifications—deposited in the Patent-office on the subject he urges on engineers and iron and steel shipowners. One more point and I shall have done with Mr. Rowe, and, I hope, with troubling you, Sir, on this subject. Mr. Rowe also refers to one of Sir Humphrey Davy's experiments on copper, iron, and zinc combined, in sea water, of which he tells us that "after a fortnight both the polish of copper and the iron remained unimpaired." To preserve a plate of copper in sea water zinc is unnecessary, if a plate of iron is attached to it; but to preserve the iron with or without copper, zinc is necessary. I have experimented on bright iron and steel plates in boilers working with pressures of 30 lb., 60 lb., and 80lb. to the square inch, and succeeded in preserving them thoroughly for nearly two years. I have also preserved polished plates of iron in sea water at boiling point in open glass vessels, so that the operation could be watched, for twelve months, with only a discoloration of the surfaces having taken place; and in cold sea water the polish has been preserved for upwards of six years, which experiment is still going on, and can be seen by any one wishing to do so. In the former cases the plates were coated with a thin scale nearly white, similar to that found in boilers effectually fitted with zinc, and difficult to remove, the boilers having no zinc fitted in them and the experimental plates being insulated. In the latter case, a perfectly white scale of a thickness of strong writing paper is deposited on the plates, which can be easily removed when wet, but hard and firm when dry, requiring a sharp knife to remove it on being examined twice a year. The former were cleaned and examined three times annually. But these results could not be obtained without taking off the zinc discs and removing the oxide thoroughly, or renew them every time they were examined, and taking care to have a fair proportion of zinc surface attached. In conclusion, I shall have much pleasure in accepting a copy of Mr. Rowe's paper, and also the discussion upon it, if convenient to him. The address I give on this, as on the previous occasion, will find me. I apologise for the length I have gone, and for taking up so much of your valuable space. DAVID PHILLIPS.

Chipping Sodbury, Gloucestershire, December 22nd.

A PROBLEM IN INDICATOR DIAGRAMS.

SIR,—I beg to hand you answers to your indicator diagram problem of last week. My answer to question (1) No. (2) Either add more work to engine, or disconnect low-pressure cylinder, or reduce diameters of cylinders if compound working must be continued. (3) Non-condensing. (4) No, the excentrics are not wrongly set.

Batley, December 26th. S. H. A.

SIR,—On the subject of the indicator diagrams submitted in your issue of the 25th inst., I beg to offer the following answers:—(1) The valves may or may not be right, but the cards offer no evidence that they are wrong. (2) The cut-off of the expansion valve should be increased if it is a non-condensing compound engine, to bring the terminal pressure of low-pressure cylinder above the atmospheric pressure. (3) The engine may be either compound condensing, or compound non-condensing; in the first case, there is something seriously wrong about condenser or air-pump—say, the pump-rod broken; in the second case, it probably means that the engine is being worked at a pressure very much less than the normal boiler pressure, or else it is an experiment to see what is the effect of cutting-off at the highest grade in the high-pressure cylinder. I think it would not cost much difficulty to produce diagrams which are still more mysterious.

December 27th. MULCIBER.

SIR,—(1) The valves are *not* wrongly set. (2) Reduce the initial pressure, and cut-off later in the high-pressure cylinder, or *load* the engine and give more steam. (3) The engine is *non*-condensing. (4) No. V.

Glasgow, December 28th.

SIR,—I am of opinion that there is nothing the matter at all with the cards published, and thus answer your questions:—(1) no; (2) none; (3) non-condensing; (4) no. From my experience I should take it that these cards are from a compound non-condensing engine exhausting from low-pressure cylinder direct to atmosphere, and that the engines have no load on them, and in all probability the governor is working an automatic cut-off slide, as instanced by the quick depression of the steam line. In the low-pressure card, I read the thick line as the steam line, and the exhaust line that above atmospheric line. W. P.

London, December 28th.

SIR,—Referring to the diagrams you publish on page 503, I will hazard the following remarks and answers to your questions. The engine is not a condensing engine at all, but what is sometimes called a "high-pressure compound." The amount of power that is being taken out of the engine is very small compared with the size of the engine, or in other words, the engine is too large for its work.

In a compound engine—double, triple, or quadruple—the point of cut-off in the first cylinder determines the total power given out by the engine for a given initial pressure, granting exceptions for special cases. The point of cut-off in the remaining cylinder or cylinders determines only what share of that total power each cylinder shall have. Leaving the cut-off in first cylinder constant, the earlier the cut-off in second cylinder the larger will be the share of the power developed in that cylinder, and the smaller the share left for the first cylinder; because the earlier the cut-off in the second cylinder the higher the back pressure in the first cylinder.

The converse of this is, of course, also true, viz., the later the cut-off in second cylinder, the greater will be the first cylinder's share of the total work. So much is this the case, that with ordinary proportions of cylinders and ordinary pressures it is possible to make the total power developed so small—by early cut-off in first cylinder—and the share of that work developed in the second cylinder so small a proportion of the whole—by late cut-off in second cylinder—that practically the whole of the power developed by the engine occurs in the first cylinder.

Now in the engine whose diagrams you publish this condition of things is carried a considerable step further still. In the diagram from the second cylinder, the line below the atmospheric line is what with a better diagram we call the "steam line," and the upper line is the "exhaust line," the pencil going what one might not inaptly call the wrong way round the diagram. This means that the cut-off in first cylinder is so early, and the cut-off in second cylinder so late, that not only is all the power of the engine developed by the first cylinder, but the power represented by the area of the larger lobe of the lower diagram represents negative power—that is to say, instead of any power being developed by the second cylinder, that cylinder is acting as a pump—a rather bad air pump—its piston and connecting rod being driven by the shaft, instead of driving it.

The air-pump action of the second cylinder has the effect of producing a partial vacuum in the first cylinder; but at what a cost is this vacuum obtained? The first cylinder is expending 20·6-horse power in driving the second piston and the remaining 27-horse power is going to drive the shaft and overcome internal friction.

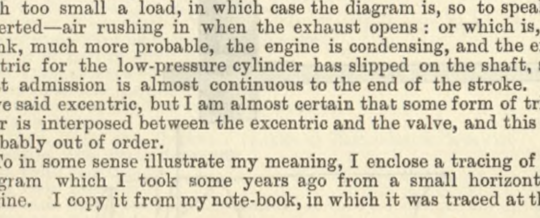
The excentric driving the valve of the second cylinder requires shifting very much further in advance of the crank, and the valve requires "piecing," to give much more lap, so as to effect earlier cut-off; or what would be better if no more than 27-horse power is required, a separate cut-off valve on the second cylinder, as by this means the "port opening" would not suffer so much.

The size of the engine is, however, so much too large for the power required, that good diagrams will probably be impossible with so high an initial pressure; and as in other cases where it is necessary to seek the least of two evils, the best results under the circumstances might be obtained by resorting to the objectionable plan of placing a stop valve in the main steam pipe near the engine, and there wire-drawing the steam to such a pressure as would necessitate the cut-off in first cylinder being very late; that in the second cylinder could then be arranged to take place at such a period as would divide the power equally between the two without what may be called over-expansion. OBSCURITY.

Hartlepool, December 28th.

SIR,—The worst of such diagram puzzles as that which you have given is, that it may have more meanings than one. For example: The low-pressure diagram may have been turned upside down for the purpose of making a puzzle; or it may be a non-condensing engine with too small a load, in which case the diagram is, so to speak, inverted—air rushing in when the exhaust opens: or which is, I think, much more probable, the engine is condensing, and the excentric for the low-pressure cylinder has slipped on the shaft, so that admission is almost continuous to the end of the stroke. I have said excentric, but I am almost certain that some form of trip gear is interposed between the excentric and the valve, and this is probably out of order.

To in some sense illustrate my meaning, I enclose a tracing of a diagram which I took some years ago from a small horizontal engine. I copy it from my note-book, in which it was traced at the



time. The engine was working much worse than this diagram accounted for at first sight, and it was some little time before I could persuade the works manager that the excentric had slipped round on the shaft. A is really the exhaust line and B the admission line. J. D.

London, December 30th.

SIR,—After having derived considerable amusement from the examination of your Christmas conundrum, published in your issue of the 25th inst., I beg to submit the following replies:—From the data you give—viz., the indicated horse-power and mean pressures—of the two diagrams, it is easy to find the ratio of the cylinders, and also the vertical scales of the cards. Then, using these particulars, it is found that more than twice as much steam is shown by the low-pressure diagram as is shown in the high-pressure diagram, so that the two cards do not follow the action of the same steam, but the low-pressure diagram shows the action of the steam that has passed through the other end of the high-pressure cylinder to that from which the high-pressure diagram has been taken.

The cut-off in the high-pressure diagram is at about one-sixteenth of the stroke, and I calculate that the cut-off at the other end of the high-pressure cylinder is at about one-fifth of the stroke, while to get an equal distribution of the steam the cut-off at each end of the high-pressure cylinder should be at rather more than one-eighth of the stroke. But with even this correction to the points of cut-off, it will be found, if allowance is made for clearances, that the steam will have expanded to atmospheric pressure by the time it leaves the high-pressure cylinder, so that without a condenser it would be useless passing the steam into the low-pressure cylinder—the work shown in the low-pressure diagram you publish being, I believe, only work wasted by the low-pressure cylinder in a kind of useless pumping against the atmosphere, the useful work indicated by the two published diagrams being the difference of the two horse-powers there stated, or 27-horse power. Should, therefore, less than 200-horse power be required from the engine, it would appear to be advantageous to entirely disconnect the low-pressure cylinder, and work the engine as a simple one, after having altered the length of the valve rod so as to obtain an equal distribution of the steam at the two ends of the high-pressure cylinder. As, however, the engine was probably built to give off much more than this horse-power, while it clearly has not a condenser, it follows that the cut-off in the high-pressure cylinder should be so arranged that the terminal pressure in the low-pressure cylinder shall not fall below that necessary to overcome the friction of the whole engine—say 5 lb. above atmosphere—which result, I consider, cannot be obtained with an earlier cut-off in the high-pressure cylinder than ·8 of the stroke under full steam.

Assuming that the steam and exhaust valves are worked by separate excentrics, my answers to your four questions will accordingly be as follows:—(1) The high-pressure steam and low-pressure exhaust valves are wrongly set. (2) The high-pressure valve-rod should be lengthened or shortened, so as to obtain an equal cut-off at each end of the cylinder. The alteration cannot be determined, as it is not stated from which end of the cylinder the card has been taken. The low-pressure valve should have more exhaust lap, so as to give more compression or cushioning. The high-pressure cushioning will, I think, be sufficient with the higher back pressure—possibly too great. (3) Non-condensing. (4) The high-pressure admission excentric is wrongly set. It should be altered so as to have less angular advance, and therefore give a later cut-off. The low-pressure exhaust excentric will require more angular advance, so as to prevent the exhaust lap added causing a too late release.

London, December 30th. W. J. LAST.

SIR,—The engines are running very light, and giving out but a small portion of the work they were designed for. The low-pressure engine is a drag on the high-pressure one to the full extent of the work represented by the low-pressure diagram, minus the small loop at the cushioning or right-hand corner, and the total amount of useful work given out by the engines is about 26 indicated horse-power.

When running with a full load on—as, no doubt, the engines were designed to be generally doing—the steam would be carried to about three-fourths of the stroke in the high-pressure cylinder before cutting-off for expansion. There appears to be little or no time for release at the end of the stroke in the high-pressure cylinder, which perhaps is the only fault in the valves. When doing full work the exhaust line of the high pressure cylinder would be considerably higher than the atmospheric line, as also would be the admission and expansion lines of the low-pressure cylinder. Whenever the exhaust line of the high-pressure cylinder and the steam line of the low-pressure cylinder fall below the atmospheric line, there is a great waste of power, and when the full load is reduced, instead of cutting off early or throttling the steam in the high-pressure cylinder, the pressure should be greatly reduced, so as to still retain a late cut-off. There are cases where this would not be always practicable or advisable—*e.g.*, in the case of a compound locomotive engine running at a slow speed and without any load on, which would only be for a short time, and economy for that time would not be a desideratum. The easiest way of working in such a case would be that depicted in the diagrams.

The questions that accompany the diagrams may be answered thus:—(1) The valves of the engines are not set wrongly; (2) the only alterations to produce a different result would be to reduce the pressure of steam considerably, and have a much later cut-off in the high-pressure cylinder; (3) the engine is not a condensing one, but exhausts into the atmosphere; (4) the excentrics or their equivalent are not wrongly set, and therefore no alterations need be made. WILLIAM LEWIS.

Prince's-square, Bayswater,
December 31st.

SIR,—In answer to your queries of last issue regarding the above, I venture to give you the following opinion:—

(1) Are the valves of this engine set wrong?

Ans.: Only in reference to the low-pressure, the excentric having slipped round the crank shaft to a position almost opposite to what was intended.

(2) What alterations should be made, &c.?

Ans.: Simply readjust the low-pressure excentric.

(3) Is the engine condensing or not?

Ans.: Condensing.

(4) Are the excentrics or their equivalent wrongly set, or not?

Ans.: Only with regard to the low-pressure cylinder as before-named. W. WALKER.

Smethwick, January 1st.

ELECTRIC TRAMWAYS.

SIR,—As it is stated in your article on the Blackpool electric tramways, in last week's ENGINEER, that since the opening of the Portrush electric tramway over two years ago, "No other works of a similar character have been constructed," I think it is only due to Dr. E. Hopkinson, who carried out all the electric arrangements on this line, to inform you that it has been open for some months, and is working very satisfactorily. The following brief particulars of the line will be sufficient to show that in this part of the kingdom, at all events, we are not so far behind our neighbours.

The length of line open is over three miles; the gauge for passenger cars is 3ft.; for the goods wagons, which have flangeless wheels, and run on rails ⅜in. lower than the car rails, 3ft. 4¼in.; the steepest gradients 1 in 50 and 1 in 51, continuous for five furlongs; but there is a rising gradient throughout from Newry to Bessbrook, the total rise being 180ft.; the sharpest curve is 150ft. radius, except at the termini, where the cars, which are double bogie, run round a semicircle of 56ft. 6in. radius; and the maximum speed authorised is fifteen miles an hour.

The line is altogether on private ground, except for a length of about fifty yards, where it crosses a public road obliquely, and where Dr. John Hopkinson's patent overhead conductor is applied. The conductor, a channel iron—section ⎍—is on the same level as the rails and rests in wood blocks attached to the cross sleepers in the centre of the truck. There are two dynamos, in duplicate, constructed by Messrs. Mather and Platt, of Manchester, of the Edison-Hopkinson type, only one of which is used at a time, and is sufficient for working the traffic, driven by a McAdam's turbine, for which there is a constant supply of water. The dynamo house is on the side of the line about two miles from the Newry end of the line. In a front compartment of each of the two cars at present in use there is a dynamo of the same type as the generators, and there is a collector both in front and rear of the cars, in order to span the breaks at farm crossings and sidings, where the current is continued by means of an underground cable. A gross load of 30 tons can be taken up the line with a working pressure of 250 volts, the maximum pressure allowed by the Board of Trade being 300 volts. The goods traffic of the Bessbrook Spinning Company alone is about 28,000 tons annually, and the wagons are run off the line at the termini and drawn by horses along the roads to the ships' side or railway station, &c., in Newry and through the factory and works in Bessbrook. Owing to the large passenger traffic it has become necessary to order an additional car already.

J. L. D.

Bessbrook and Newry Tramways, Engineer's Office,
Newry, January 4th.

HIGH-SPEED ENGINES AT THE INVENTIONS EXHIBITION.

SIR,—While agreeing with you that many high-speed engines at the late Exhibition did "more harm than good" to the reputation of "this type of motor," we think we are justified in protesting that this is not a fair summing up of the result of the Exhibition as a whole. For the first time it was there publicly shown that compound engines, working economically, could be run at high speed night after night—they might have been run all dight and all day too—without any kind of hitch or trouble; indeed, with less trouble than an ordinary double-acting engine gives. Surely the establishment of this fact was of more importance than the proof of the already patent truth, no doubt given at the same time, that some high-speed engines had been designed without knowledge. The question of interest to the public was whether good high-speed engines could be made, and the public has shown its appreciation of the answer then plainly given in the affirmative. No one doubted that bad engines could be made—that is done even for low speeds—and the plentiful proof offered at the Exhibition was interesting rather to the makers than to the public. Surely what the Exhibition did was to definitely establish the reputation of the high-speed engine as a type, not to injure it. If you do not take this view, then the refusal to give names is a little hard upon some who, as you would no doubt be the first to allow, can only be named as exceptions to your condemnation.

We would not, however, address you on this ground, but for the remark that "although a considerable measure of success has been attained by some engineers, these very gentlemen prove by taking out fresh patents that they are not quite satisfied with what they have accomplished."

We are not so presumptuous as to suppose that in these words the writer had only or mainly in view the Willans patent. But it is tolerably well known that Mr. Willans last year brought out a new engine—the subject of more than one patent—and we ask leave to say a few words upon this. The original—three-tandem—compound engine, which had long before proved its value for marine use, passed out of the experimental stage as a high-speed land engine about two years ago. There has been practically no alteration in it since, and we still make it largely, and hope to continue to do so, believing it to be the best engine for very many purposes. In everything except the system of steam distribution—such as the "constant thrust" on all bearings, the self-lubrication, and the independent air cushion to absorb the momentum of the moving parts—it is reproduced in the new engine.

With regard to the steam distribution, in the three-tandem engine that is accomplished by means which, though of great simplicity, are yet good enough to bring the steam consumption down to 30 lb. per indicated horse power per hour, or less in the larger engines, non-condensing. As high-speed engines go, this will explain a good deal of the success of the Willans engine. Nor need such an engine fear to come out very badly in competition with other small engines of ordinary types, especially if actual power at the pulley or coupling is made the basis of comparison, as it practically is in electric lighting, and in other cases where the choice lies between a high-speed engine and direct driving, and a low speed engine and belts. But it has never been pretended that the extreme simplicity of the valve action—this is a fair claim, for in one sense there are no valves at all—is not bought at some cost in other ways. The cut-off is fixed in both high and low-pressure cylinders at about three-quarter stroke, and this is not consistent with obtaining the very highest economical results. Mr. Willans has therefore designed the new "central valve" engine, in which every refinement of valve action, including variable cut-off, can be and is embodied, though the method is only one degree less simple than that of the old type. One of these engines, running at nearly 400 revolutions and non-condensing, has lately been proved by an independent authority, whose name everyone would accept as a guarantee, to use but 22·5 lb. of water per indicated horse-power per hour, and this under circumstances which leave little doubt that the figures might be brought below 20 lb. The experiments were not made at our works or for us, but for the purchasers of the engine, so we are not in a position to send you the details; but the fact is of interest, as showing that Mr. Willans has succeeded in the attempt to combine the practical advantages and convenience of quick-running engines with the economy of the highest class of valve gears. It will thus be seen that the recent engine is a wholly new one, and that its design is not in the nature of an "improvement" upon the three-tandem engine, which we still regard as in every way suitable for the great majority of uses to which it has hitherto been applied. WILLANS AND ROBINSON.

Thames Ditton, January 6th.

TRADES UNIONS AND PIECE-WORK.

SIR,—Your correspondents on this subject seem to know very little about it. "London Master" need have no trouble to get his men to work piece if he goes the right way about it, and displays a little of that tact you so ably describe in this week's article. Piece-work resolutions, like Acts of Parliament, can have a coach and six driven through them with a good coachman.

I think it is admitted that contract engineering shops, mills, mines, steel works, and the like, are the life and soul of the trade of Great Britain. When these places have no work, or are short of orders, railway traffic falls off, so many hundred men are discharged at Crewe, Swindon, Wolverton, and similar places, and those kept on put on short time—that is, when the producer falls off in his output, the non-producer soon finds out that he is something like the fly on the wheel. Now how can masters or firms make up their estimates and compete in the market for engines, machines, or anything else, unless they know what it will cost to make them? Again, how can they know that cost unless they have a proper system of piece-work in their establishments?

"A. C." writes so much twaddle when he says day-work jobs are best, piece-work injures the trade, and so on. No doubt when "A. C." orders a suit of clothes he lets the tailor do them day-work, and charge what he likes. No doubt he orders his boots of the best quality, and never hints at what the cost has to be when he gives the order. Perhaps "A. C." has a weakness to know even the cost of repairing his boots before he has them mended. Many Trade Unionists don't care for piece-work themselves, but make everybody work piece-work for them, yet their clothes, and boots, and other jobs or articles they have had done for a fixed price give them every satisfaction.

After many years' experience I have come to the conclusion that the piece-work system is the best all round, and the piece-work man knows if he does his work indifferently he has to make it good at his own cost. Mechanics are as honest as other people, and it is very rare an attempt is made to scamp work. Piece-work is best for the customer, as he gets the best article at the lowest cost; it is best for the man, as the smarter he is the more money he makes; it is best for the master, as the more economical and quicker he can execute orders, the more work he can get; it is best for Great Britain, as the best articles at the lowest price find the readiest sale in the world's market.

I have as good non-society as society men working for me. Non-society men can decide for themselves on trade matters as they crop up, but society men have to consult the oracle. Trade Unions are very good for the benefits they bestow in sickness, out of work, and the like; but as regards wages and trade interests they are paradoxical. For instance, a marine engine fitter on the Thames must have about 36s. per week, the same man on the Clyde would have about 24s. per week; yet the London master must compete with the Clyde master. A locomotive fitter at Manchester must have about 34s. per week, the same man in Glasgow would have about 26s. and no overtime circular; yet the Manchester master must compete with the Glasgow master.

Cannot "A. C." and his brother members perceive how gradually, but surely, the engineering business is going from the South and Midland Counties, where wages are high and Trade Unions strong, to the North, where wages are low and Unionism weak and Liberalism rampant. Not much Russian serf about Glasgow. As this is a levelling up age, the sooner the leaders of Unions tackle this subject the better, and equalise the wages more fairly, so that masters and districts shall be more equally handicapped in the race for trade, unless masters and Unionists all go North bag and baggage.

I could write a good deal on this subject, but will not trouble you with any more this time; but in all cases give the devil his due. BRITISHER.

Eccles, near Manchester, December 26th.

DR. LODGE'S MECHANICS.

SIR,—The only point in Mr. Donaldson's letter which needs an answer is that concerning my statement that the definition "capacity for motion" should be substituted for the word "inertia." I have said that capacity for motion is the reciprocal of the definition of momentum, viz., quantity of motion. Mr. Donaldson has apparently failed to catch the sense in which I use the word "reciprocal." According to the theory of polars, every proposition becomes, as it were, double—that is to say, it leads immediately to another, called its reciprocal. This is the sense in which I have used the word. Φ. Π.

London, January 4th.

THE ROYAL AGRICULTURAL SOCIETY.

SIR,—I am much pleased with your article in THE ENGINEER of the 25th ult. I quite agree with you that the Royal Agricultural Society are not giving equal privilege to the exhibitors of stock and implements, giving a decided privilege to stock. A little inaccuracy appears in your reference to the proceedings of the Royal Agricultural trials, or rather to the original inventor of the sheaf-binding reaper. A string binder was patented April 12th, 1872, by a young engineer then residing at Bedford. I have questioned McCormick's people, and do not find they had a patent until 1874. Now this is two years afterwards, and although the 1872 patent was not produced as a marketable machine, I presume it to be the original patent, and Messrs. J. and F. Howard have never dropped the thread of the original invention. PROGRESS.

January 4th.

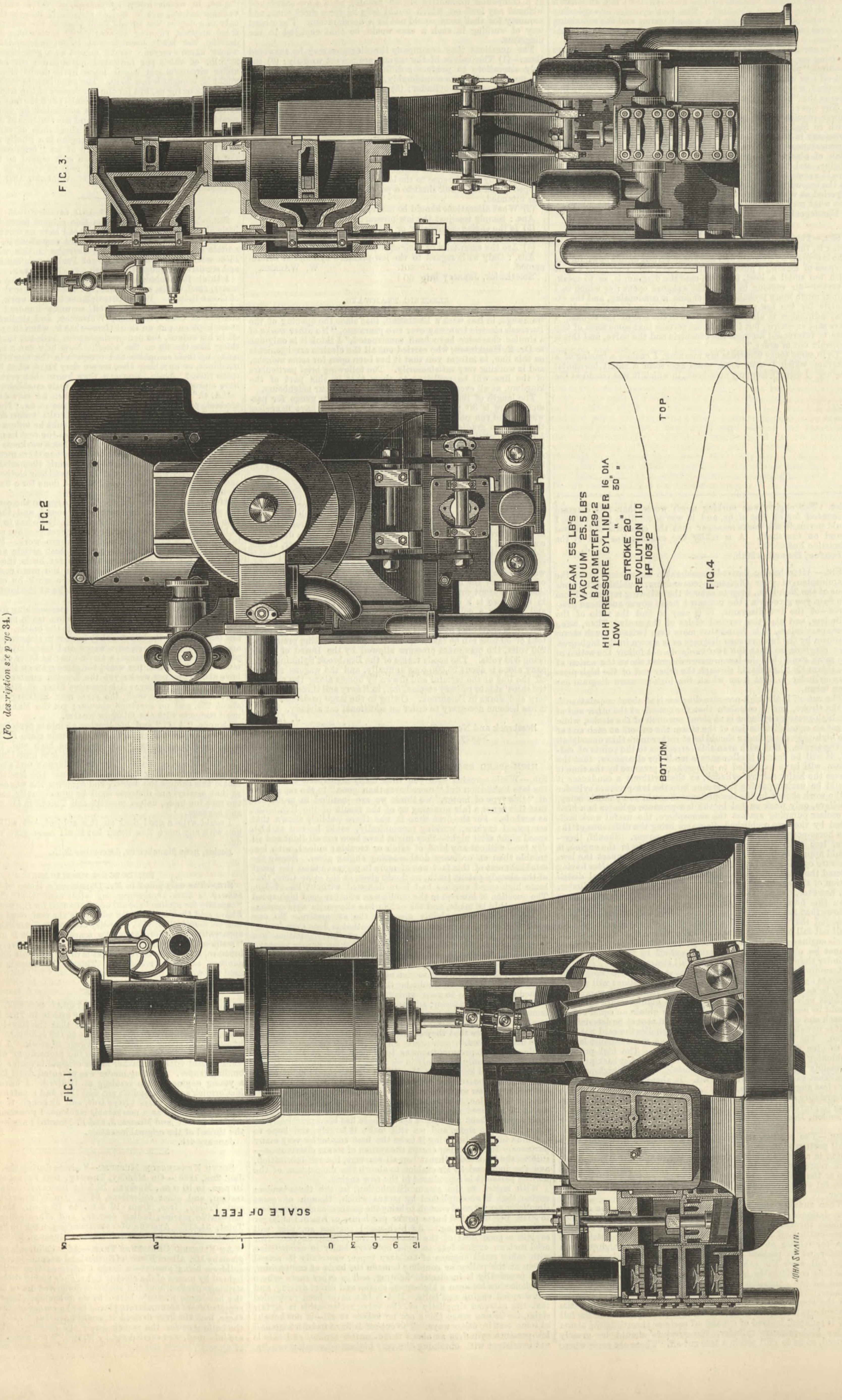
SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Jan. 2nd, 1886:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 16,584; mercantile marine, Indian section, and other collections, 6458. On Wednesday, Thursday, and Friday, free, from 10 a.m. to 10 p.m., Museum, 7719; mercantile marine, Indian section, and other collections, 3656. Total, 34,417. Average of corresponding week in former years, 31,126. Total from the opening of the Museum, 24,548,411.

AN ELECTRIC CHRISTMAS TREE.—At a children's evening party given by Mr. Albert Kisch, of Sutherland-avenue—nearly a hundred children being present—a large Christmas tree was successfully lighted by means of the electric light, thus giving the whole a most striking effect without the slightest danger of fire or destruction to the handsome presents borne by its branches. The current was supplied from accumulators placed in the corner of the room, and these, had the host desired it, could have been used for lighting the ball-room for the remainder of the evening. The work, we are informed, was carried out by Messrs. Woodhouse and Rawson, of Queen Victoria-street.

VERTICAL TANDEM COMPOUND SURFACE CONDENSING ENGINE.

MESSRS. WORTH, MACKENZIE, AND CO., STOCKTON-ON-TEES, ENGINEERS.

(For description see page 34.)



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THE ENGINEER, January 8th, 1886.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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*** *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.*

J. S.—*The pressure of steam varies inversely as the space occupied. That is to say, steam which occupies a cubic foot at* 100 *lb. will have a pressure of* 50 *lb. when it occupies two cubic feet, and so on.*

W. N. (West-terrace, Adelaide).—*As you extend your researches and your reading you will see that you are wrong. Why, for example, should the attraction of a man for the atmosphere be less at the top of a high mountain than it is at the bottom?*

PATENTEE.—*The fact is perfectly well known. The law is very sound. Why should you have a right to put the word patent on an article which is not patented? You do not seem to understand what provisional protection is. Consult some good works on patents and patent law.*

HOMER.—*You are quite mistaken if you imagine that an American patent gives you an indefeasible title. The American examination is of very little value, old things being re-patented daily. The nominal cost of an American patent is small. You will find the real cost of a valid patent for a valuable invention very heavy.*

MESSENGER'S VERTICAL STEAM BOILERS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me who is the maker of Messenger's vertical steam boilers, with bent copper tubes in fire-box?

Birmingham, December 28th. G. P.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Tuesday, Jan. 12th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion, "Gas Producers," by Mr. Fred. Jno. Rowan. Friday, Jan. 15th, at 7.30 p.m.: Students' meeting. Paper to be read and discussed, "Graphic Method of Determining the Flow of Water in Pipes," by Rudolph E. von Lengerke, Stud. Inst. C.E. Dr. Pole, F.R.SS. L. and E., hon. secretary, in the chair.

LIVERPOOL ENGINEERING SOCIETY, Royal Institution, Colquitt-street, Liverpool.—Wednesday, Jan. 13th, at 8 p.m.: Paper "On a Strange Failure of Steel Boilers," by Mr. Arthur J. Maginnis, M. Inst. N.A.

CHESTERFIELD AND MIDLAND COUNTIES INSTITUTION OF ENGINEERS, Stephenson Memorial Hall, Chesterfield.—The next general meeting will be held on Saturday, Jan. 9th, at 2.45 p.m. The following papers will be open for discussion:—Mr. Arnold Lupton's paper, "Mining in North America;" Mr. James Stevens' paper, "The Kaiping Coal Mines, China," Mr. A. H. Maurice's paper, "Maurice's Firedamp Indicator;" Mr. F. T. Mott's paper, "The Geological History of Charnwood Forest;" Mr. P. M. Chester's paper, "The Locked Coil Wire Rope;" Mr. J. C. Jefferson's paper, "The Application of Meinicke's System of Balance Ropes to Winding Flat Ropes;" Mr. J. C. Jefferson's paper, "Davis's Self-timing Indicator."

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Wednesday, Jan. 13th, at 8 p.m.: Sixth ordinary meeting. "Museums for Trade Patterns," by Mr. William H. Ablett. Mr. Owen Roberts, M.A., F.S.A., will preside.

THE ENGINEER.

JANUARY 8, 1886.

LIQUID FUEL.

WE had occasion last week to mention an experiment which has been tried recently on the Thames with petroleum as a steamship fuel. For some time back experiments have been made with the same object at Portsmouth Dockyard. A method of burning creosote, patented by Colonel Sadler, is being tested there. It seems that the boiler used will evaporate 10 lb. of water per pound of coal burned. With creosote as fuel the ratio becomes one to 13, the pressure being 60 lb. Many attempts have been made during the last twenty years to use mineral oils as fuel, but none of them have resulted in commercial success. Mr. Aydon was the first engineer who succeeded in this country in burning liquid fuel in a steam boiler. He effected his object by injecting the fuel in the form of spray by the aid of a jet of steam; and nothing to rival this system has ever been discovered. In South Russia and on the Caspian liquid fuel is used to a considerable extent to generate steam, but even there what we must term the Aydon system has been adopted. Petroleum in all its varied forms is too well known to render it necessary that we should say much about it here. An average sample contains—carbon, 85 per cent.; hydrogen, 13 per cent.; and oxygen, 2 per cent. Its calorific value is very high because of the large quantity of hydrogen. Petroleum oils are of almost endless composition, and are obtained by distillation from petroleum or crude rock oil, as it is sometimes called. Petroleum will evaporate theoretically about 18 lb. of water per pound of oil. Petroleum oil is of higher value, as it will evaporate as much as 25 lb. of water per pound. Its calorific value may be taken as two and a-half times that of coal, while the value of the crude oil is a little less than twice that of coal. In practice, however, no such results have ever been obtained; and because attention is being once more directed to the subject, and hopes may be formed which cannot be realised, it is well that we should say something of the practical difficulties which stand in the way.

In order to give liquid fuel every advantage, we shall take the value of coal in the following comparison at 9s. 4d. a ton, that is 0·05d. per pound. The lowest price at which "dead oil," creosote, or any other form of liquid fuel can be had is 1d. a gallon, and at this the supply is very limited. The specific gravity may be taken at not far from ·9, so that a gallon of it would weigh about 9 lb., but with coal at 0·05d. per pound we get 20 lb. for 1d., so that again giving petroleum all the advantage of even numbers in lieu of fractions, it is just twice as dear as coal. To be burned, therefore, with equal economy, it must be twice as efficient; but a practical evaporation of 20 lb. of water per pound of petroleum has never been got. Indeed, this ratio is beyond the theoretical powers of the crude oil. It may, therefore, be taken as granted that liquid fuel has no claim to be a cheap fuel. At the price of even 3d. a gallon it could not be used at all for making steam, provided coal was accessible. Before proceeding to consider any other aspect of the matter, it is well to finish with the question of relative economy. Petroleum is a very difficult thing to burn to advantage, because of the enormous quantity of smoke which it produces. The smoke itself does not necessarily represent much loss of fuel, but the deposited soot does, because it coats the heating surfaces with an admirable non-conductor; and there is a strong tendency to the production of what is known as greasy soot, which clings and sticks, and can only be got rid of with much trouble. To prevent smoke, the oil must be burned with a large supply of air in a brick-lined chamber, which will prevent the rapid cooling of the gas and partial extinction of the flame. This entails a very important modification in the structure of a boiler, for reasons which will be apparent hereafter. The only possible place where liquid fuel may be used with advantage by English engineers is at sea; but any attempt to use it in the existing boilers practically deprives them of the heating surface of the furnaces, because these must be lined with firebrick if combustion is to be complete. The bulk of the work will be transferred to the combustion chamber and tubes, and this would entail a high chimney temperature, and consequent waste, if the combustion chamber temperature was raised above what it now is when coal is burned. It appears certain that the total efficiency of a marine boiler burning liquid fuel instead of coal must be lowered. This is a simple deduction from theoretical considerations, but it has hitherto been borne out in practice, for the Himalaya, the steamer which recently made a run to Leith with liquid fuel, could not keep steam to anything near the proper pressure, and the experiments made at Portsmouth have so far ended in the same way. We do not say that a special boiler may not be devised to get over the difficulty, but in any case it must be, we believe, much larger than the existing type.

A serious objection to the use of liquid fuel is that a very considerable quantity of steam is required to blow the fuel into the furnace. This steam acts on the fuel precisely as it would on water in an injector. It is condensed, and enters the furnace as so much water, which has to be all re-evaporated. It is true that it gives up its heat in the first instance to the fuel, but it makes no return whatever for the second evaporation, which is dead loss. If the steam were not made the second time, its use for blowing in the fuel might in one sense be neglected, but with re-evaporation it stands for so much waste of heat. The quantity used has never been ascertained with any precision, but it is of importance. It renders the use of the supplementary feed necessary to keep up the level of the water in the boilers, and this entails constant risk of incrustation. Indeed, when the voyages are long and the pressures high, it would be impossible to work at all in this way, and steam would have to be furnished by a supplementary boiler working with salt water at a low pressure; or else special distilling apparatus must be provided to furnish fresh water to the main boilers. We have here a second and very serious obstacle to the use of liquid fuel at sea.

The great merit which is claimed for liquid fuel is, that owing to its superior efficiency, either a much smaller quantity of it than of coal may be carried, or that a given weight of it will take a ship much further than would a similar quantity of coal. It is for this reason that it is being tried in the Navy. We shall grant, for sake of argument, that liquid fuel may be carried with as much safety as coal. Bulk for bulk, however, it will occupy about as much space. If, however, it can be shown that a ton of liquid fuel will do as much as a ton and a-half of coal, then space may be saved or the duration of cruises prolonged. It may also be urged, and with justice, that the number of hands required in the stokehole will be largely reduced. Such points as these are well worth consideration in the Navy, and we are glad to see that an experiment is being tried with liquid fuel. In the mercantile marine petroleum has no chance whatever, the price must always prove fatal to its success. In the Navy, price is a secondary consideration, and as fuel for war ships it may yet be adopted. But it must not be forgotten that even a small shell exploded in a mineral oil tank would produce the most appalling results.

The principal point to be decided is, however, the possibility of burning the oil to advantage at sea. This has yet to be proved. Until this is done it may be mere waste of paper to point out objections to the use of a comparatively volatile, inflammable fluid as a fuel. The next point to be decided is the possibility of getting it at a sufficiently low price. Experiences on the Caspian are valueless, because liquid fuel can be had there for next to nothing. In this country Mr. Aydon was very successful in burning "dead oil" at Messrs. Field's candle factory, Lambeth, to begin with. The oil could be had for a penny a gallon. This was only because there was no known use for the refuse left in the still after the illuminating oils, such as "paraffine," had been obtained. Mr. Aydon, however, used a good deal of dead oil; the supply diminished, and the price rose. It remains to be seen whether mineral oil could be had in sufficiently large quantities in this country to render its use possible even in the British Navy in time of peace.

THE UNITED STATES NAVY.

THE report of Mr. William C. Whitney, Secretary of the United States Navy, to the President, and dated November 30th, 1885, lies before us. It has only just been made public. It contains much that provides interest for Englishmen, especially at the moment when our own Admiralty is being reorganised. We have frequently criticised and commented in no unfriendly spirit on the United States system of naval administration, and it is not without permissible pleasure that we find Mr. Whitney endorsing all that we have said. The United States have no navy in the proper sense of the word; and Mr. Whitney says very plainly that it is impossible that it should have one under the existing system. There is no official in Government pay competent to design either a war ship, or her engines, or her armament; and it appears further that the private firms able to undertake such work can hardly be said to have any existence. The demands of our own Navy have produced our great marine engineering firms. They have stimulated progress, and supplied that attraction for capital, without which it would never have been invested in the plant and appliances—and we may add men—which have given English engineers a well deserved reputation for producing the best marine engines in the world. Mr. Whitney makes the startling statement that since 1868 the United States have spent 75,000,000 dols., or over £15,000,000 sterling on the construction, repair, equipment, and ordnance of vessels, "which sum, with a very slight exception, has been substantially thrown away." Thus, in seventeen years £15,000,000 have been wasted, or in round numbers, £882,000 a year. With all our vast expenditure and our waste, it is certain that we have not thrown away money in this way. Mr. Whitney gives examples of how the money has gone. "The Omaha has been rebuilt within the last four years at a cost of 572,000 dols." For this outlay of £114,400, the United States have obtained "a repaired wooden vessel, with boilers, machinery, and guns, all of which would at the time have been sold for what they would have brought by any other nation on earth. In the event of a war she can neither fight nor run away from any cruiser built contemporaneously by any other nation. Her rebuilding cost the full price of a modern steel ship of her size and all modern characteristics."

The first conclusion at which our readers will arrive will be, no doubt, that such extravagance means a colossal job. There is reason to think, however, that such a surmise would not represent all the truth, or even great part of it, and we desire to draw particular attention to the explanation supplied by Mr. Whitney. The lesson it affords is impressive, and our own Government will find a warning in it which may well be taken to heart by the nation. That the rebuilding of the Omaha was a mistake is admitted; but no one was responsible for the mistake. "The Chief Constructor will deny responsibility except for the survey; the Chief Engineer the same; and the Secretary of the Navy, if he should be able to recall the circumstances, would doubtless remember that he was advised that she needed general repairs and rebuilding, and gave the orders in probable ignorance of the result of his decision." There is, in point of fact, no responsible head competent to pronounce a valuable opinion as to what ought and what ought not to be done. Whether this is the result of a republican feeling which holds that no one has a right to exercise sway over another; or the result of the system of turning everyone out of office at the end of each four years; or a consequence of mutual distrust, we cannot pretend to say. The effect of the policy is ludicrous in the eyes of the rest of the world. It cannot fail to strike right thinking Americans as deplorable. There are four bureaus as they are called, one for engineering, one for construction—that is, shipbuilding—one for equipment, and one for ordnance. "At present," says Mr. Whitney, "the four heads of these bureaus, instead of co-operating, work independently of each other, and not always in harmony in producing their respective parts of a completed ship. After the Omaha had been commissioned and was ready for sea, it appeared that the several bureaus working independently upon her, had between them so completely appropriated her space that they had left her coal-room for not more than four days' steaming at her full capacity. Each bureau, too, finds it necessary to maintain its separate shops in the several navy-yards, each with a separate organisation of foremen, quartermen, leading men, &c., so that shops doing precisely the same class of work—carpenters' shops and machine shops, for instance—are commonly duplicated, and sometimes triplicated, in the same navy-yard, with a corresponding multiplicity of foremen and organisation expenses—a state of things which, under the present organisation of the Department, it is almost impossible to correct"

It is by no means easy to understand how the existing system has grown up. The defects of that system, if stated by anyone but the Secretary of the Navy in an official report, would be regarded as incredible. We could easily understand the United States resolving not to have a navy, and adopting a policy which would have the merit of consistency. What we cannot comprehend is that the nation should spend very large sums and manifest a determination to have a navy, which, if small, would be efficient, and at the same time take trouble to prevent the attainment of the apparently sought for end. There are two ways in which a nation can obtain a navy. It can buy one or build one. If the latter course is adopted, men having the requisite attainments must either be sought for or reared. Our Government adopts both methods. It buys ships and it builds them. It buys all its machinery; and it succeeds in obtaining men with the requisite talent and skill, partly by offering sufficient pecuniary inducements to attract what is wanted, and partly by training up men for the post they will have to fill. We are, to a large extent, enabled to get on in this way, because we are a nation of shipbuilders. Every private yard in the kingdom is training men. We have no difficulty in buying steam engines, because we have fostered private engineering works; and these works have been able to carry on during the intervals when they were not employed by the Government, in fitting merchant ships with machinery. In the United States there are no great shipbuilding yards; no great firms of vast experience in marine engine work. Consequently the American Government has difficulties to contend against that we have not. But two courses were open to it as well as to us. It might buy a navy by ordering men-of-war in this country, just as Brazil, for example, has done; or it might build a navy; but possessing no indigenous skill and talent sufficient for this latter purpose, the United States must either import what they lacked or rear it; that is to say, train young men in proper schools for the intended purpose. But the United States have declined to buy ships, with the result that, if they went to war to-morrow with a second-rate Power like Brazil, they would be brought to their knees in a fortnight. The Brazilian Navy could simply make havoc of the United States seaboard. There is absolutely nothing to save New York from bombardment by such a ship as the Richuaelo, save such doubtful protection as hastily laid submarine mines might afford. As to what is done in the way of rearing talent and skill, this is what Mr. Whitney says:—"In broad contrast with the policy of both the great naval Powers here indicated—England and France—the only step we have taken for many years to meet the constantly changing exigencies of the service has been to discontinue the special education of engineers. The separate engineer class at the Naval Academy was abolished in 1882, and the man who now graduates from the Naval Academy into the engineer corps will have had no experience in the dockyard, no familiarity with construction, except such elementary knowledge as he may have acquired in common with a line officer at the Academy. Even his sea service has been in a sailing vessel, where he has been taught the seamanship of a past generation, and he may have never seen a modern engine in his life. Upon graduation, instead of being sent where practical experience in his branch of work can be acquired —to a marine-engine establishment or a shipyard—he is sent to sea; and it is from this class that designers—who are expected not only to utilise all the latest improvements of other naval Powers, but to add to and perfect them—are supposed to be selected. One exception should be noted to this: By the courtesy of the Governments of England and France we are permitted to maintain two students at the Royal Naval College at Greenwich, and two at the French Naval College at Cherbourg. This privilege will doubtless prove an important advantage to us in process of time, though somewhat slowly; and our students are still without the dockyard experience which theirs enjoy. In other words, we have travelled in one direction in this regard, and other people in another. They imagine that to keep up with one branch of scientific human industry at the present time is sufficient for one man, and that it is necessary to educate to it, and to furnish adequate rewards within the line in which talent and science are desired. The result of this is seen in the fact that while they have been steadily advancing in the arts of naval construction and equipment until there is scarcely a feature of the vessels they are now constructing, or a weapon which figures at all conspicuously among the destructive powers of their armament, which is not comparatively a novelty, we stand but little in advance, of our position as it was twenty years ago."

Further on he says:—"With us the head of the Bureau of Steam Engineering, upon whom we depend for designs, is selected from a corps which is at present given by the Government only an elementary training in the science of engineering. He is at once loaded down with the distracting executive work of construction. Having the charge of a multitude of shops in the various navy yards, he must look after a great variety of contracts, purchases, and so on. In addition to all this, for which of itself few men are equal, he is expected to design the most complicated machinery and give his country the benefit of the daily improvements in his art. It is needless to say that to such a task no man is equal."

We have always held that the Government of this country would best study the interests of the nation by giving as much employment as possible to private yards. It is certain that ships built there ought to be as good as those built in Government dockyards, and it is not clear that they ought to be more costly; even if they were, the money would not be thrown away. Mr. Whitney's utterances on this subject are extremely impressive: "The policy of enlisting private enterprise in the work tends to the creation and development of important branches of industry within the country. The resources of our country, its ingenuity and enterprise in any line of human endeavour, when called out, are unexcelled by any nation or people on earth. If the 75,000,000 dols. spent since 1868 by our Government had been used to stimulate competition among our people in the production of modern ships of war, it is quite fair to assume that the activities and agencies at the disposal of the Government would have been by this time entirely adequate to its needs. It has been wasted by Government agencies upon worthless things. The invention of the country has been discouraged. The Hotchkiss gun, now commanding the widest attention, the manufacture of which is becoming an important industry in France, was the product of American invention, which, when ignored and rejected by Government agencies here, found elsewhere its field of development. Ericsson, whose name will always be one of the great ones of our time in history, works now, at the age of eighty three, without encouragement or notice, at the great problems of naval warfare, and is receiving more attention and greater encouragement from other Governments than from our own. Examples might easily be multiplied. Suffice it to say our Government has placed itself in no relation to the inventive genius of the country, and is without the rich fruits which such a course would bring to it." In another place he says:—"Indeed, it is to private enterprise that the art of naval warfare is indebted for most of its improvements. It is difficult to name a single component part of a first-class vessel of war to which private enterprise has not made quite the most important contributions. The iron or steel used for her hull and for her armour; her power and the engines by which it is controlled and directed; her revolving turrets; her guns; her projectiles; her explosives; her torpedoes; her search lights; her steering gear; her wire cordage, are almost exclusively the invention of private individuals, and are manufactured and supplied by industrial agencies operated mainly by private capital."

We have not space to quote further from a report, the sound common sense of which recommends it at once to the dispassionate reader. We shall probably have something more to say concerning it. The worst of the matter is that much to nearly the same effect has already been said by former secretaries, and that no substantial improvement has ensued. Possibly it will always be so. There is reason to believe, however, that the present United States Government has realised more fully than its predecessors that native American talent cannot give the country ships of war. The experiment has been tried and failed lamentably. Advantage has been taken of Sir N. Barnaby's visit to the United States in search of health to obtain the advice of the talented ex-chief constructor of the British Navy. No doubt he will have left his mark on whatever he has touched.

THE PURIFICATION OF WATER BY MEANS OF IRON.

It may be in the recollection of our readers that towards the end of last summer a paragraph appeared in the columns of the *Times*, stating that the quality of the water supplied to the city of Antwerp was not altogether satisfactory. The complaint was no doubt fostered to a considerable extent by the numerous exhibitors of filters at the International Exhibition, but there was undoubtedly some ground of objection, for though the water was as clear and brilliant as usual, it had a faint marshy taste and smell. The cholera at the time was raging in Spain, and grave fears were entertained of its being imported into the ports of Eastern Europe, consequently the town council of Antwerp could not altogether disregard the expressions of public opinion which found their way into the local papers, and accordingly appointed a Commission of five chemists, under the presidency of M. Augenot, to inquire into the whole question of the water supply. Although the Commission was only appointed on the 22nd of August, a very complete report was presented on the 30th of November; that report is now before us. It deals with the choice of a source of supply; with the quality of the waters of the Nethe; with the process of purification adopted, and finally, with the quality of the water supplied during the exceptional drought of last summer.

The conclusions arrived at are, that during the months of August and September the water supplied, though not as good as it might be, could not be considered as unwholesome or in the least dangerous to the public health. The cause of the temporary condition of the water was an abnormal demand created by the exceptionally dry weather, joined to an exceedingly bad condition of the river produced by the same cause; and they add, that all doubts about the efficiency of the system of purification adopted must disappear before the researches of the Commission, which have confirmed in a remarkable manner the conclusions arrived at by the English scientific men respecting the purifying properties of iron, and that it will be only necessary for the Waterworks Company to extend its works upon the present system to be able to furnish at all times a water absolutely free from all suspicion. The nature of the works at Antwerp and of the process carried out will be found fully set forth in papers by Mr. W. Anderson and Mr. G. H. Ogston in volume lxxxi. of the "Proceedings" of the Institution of Civil Engineers; and we would wish to draw especial attention to the paper by Mr. Ogston, which gives a table of the analyses of ten different samples of water, showing in a striking manner the beneficial action of iron, and detailing some experiments which go far to establish its claims as an efficient destroyer of many forms of microscopic organic life. The Antwerp Commission confirm these results to a great extent, and announce that they propose to carry their experiments still further.

Year by year as the hot weather comes on the newspapers in this country are flooded by correspondence relating to the condition of some of the sources of the metropolitan water supplies. Indignation meetings are called, the strongest language is used, it is pointed out how the inhabitants are obliged to fly from the banks of the beautiful but fœtid rivers they dwell on, how property is destroyed, and how, should cholera invade us, half at least of London is doomed to destruction. A few days of cool weather set in, the smell disappears, and the whole matter is laid on the shelf and forgotten. The authorities, such as the Conservators of the Thames and Lea, the water companies, and the official water exmainers, know by experience that they have merely to leave matters alone, and the outcry will inevitably still itself.

Before the discovery of the process which has achieved such wonders at Antwerp, it was easy enough to issue injunctions to restrain towns from polluting the rivers with their sewage, but it was impossible to give effect to the legal thunderbolts, because there was practically no remedy for the evil. The various precipitation processes, though they made a great improvement in the sewage discharged, did not destroy the dissolved organic matter; yet it is the organic matter in that form which is the source of the offensive condition of the water in hot weather. Now, however, matters are in a different condition. Anyone who has seen the Nethe in hot weather, and the potable water produced from it, needs hardly any other evidence as to what may be done with the effluents from our precipitation works and sewage farms. Among the analyses given by Mr. Ogston is one of the effluent of Hertford, one of the principal contaminators of the Lea. We find there that the albumenoid ammonia is reduced from ·33 to ·08 in a million parts, or to one-fourth, by treatment with iron; and there can be no doubt that if the whole of the effluent were so treated that all nuisance from the Hertford town sewage would disappear. Those who have seen the Antwerp apparatus, or read Mr. Anderson's description of it, and his statement as to the expenditure on the works, will see that the cost of absolutely purifying the effluent waters of the towns which now pollute so many sources of our water supply is moderate, and certainly insignificant in comparison with the advantages to be gained. If the dwellers on the banks of the suburban rivers are in earnest about the alleged intolerable state they are reduced to in hot weather, we would remind them that now is the time to make preparations for avoiding a repetition of what must be called a disgraceful and dangerous state of things—dangerous in ordinary times, but much more so now that the advent of cholera next summer is by no means improbable. At any rate, no time should be lost in making experiments on a large scale, so as to demonstrate whether the benefits enjoyed in Antwerp could not also be conferred on London.

ELECTRICITY IN 1885.

The electrical work of the year has been uneventful. Progress has undoubtedly been made, but more in the direction of perfection of details than in any great application of principles. Taking the various applications more in the order of their prominence before the general public than in that of their intrinsic value, we may notice that the more recent designs of dynamos by all the principal makers tend to a similarity to that of Gramme. No great advance has been made, no great advance is likely to be made, in adding to the efficiency of the machines of the best makers. Selection has now to be made as much for mechanical construction as electrical efficiency, and it is as well to utter a word of warning in this direction to possible users. Any society having the power and the influence to do for dynamos what the Royal Agricultural Society did in years gone by for portable engines would, by making a good use of that power, be conferring a lasting benefit upon the world. The authorities at the South Kensington Exhibition have had great opportunities, and have systematically neglected them—though, paradoxical as it may seem, South Kensington has done more than any other place or exhibition to favour electric lighting. We take credit for having, early in 1881, foreshadowed the direction in which improvements in dynamos should be sought—and so far the suggestions then made have been followed. Just as is the case with steam engines, dynamos are now designed for the work they are required to do; and it is not expected that a machine is to be equally effective for arc lighting, for incandescent lighting, and for electro-chemical purposes. We might perhaps except from the general type of dynamo that exhibited by Professor Forbes at Kensington and fully described in our article thereon. This machine is specially adapted for electro-depositing purposes, and will no doubt be largely adopted for such work. Those young students who, looking around in the busy world seeking for an opening in which to make a name and obtain fame and money, may perhaps like to know that in the opinion of those best fitted to judge there is an immense field in electro-chemistry and electro-metallurgy almost untouched, promising greater fame and more money to the patient worker than any other field of science.

Speaking of dynamos naturally leads to speaking of lamps. Here again the principal work has, so far as arc lamps are concerned, been simplification of details to obtain a greater steadiness of light. The weak point in arc lighting is found in the carbons. The scientific chemist has not yet had his attention concentrated upon the subject or perhaps he might help his more rule-of-thumb neighbour. Some progress has been made, but much remains to be done before perfection is reached. With regard to incandescent lamps, greater attention is paid to the manufacture and in the obtaining of a homogeneous filament, so that under normal conditions the life of the lamp is being increased. Incandescent lamps should be sold for half-a-crown guaranteed to have a life for 2000 hours when run with a current not varying more than 2·5 per cent. from a given normal. The use of secondary batteries is greatly increasing, and from opinions expressed, with more satisfactory results than at any previous time. Finality here, however, is in the dim and distant future, and there are opportunities in this direction for all the skill and talent available.

The actual installation work of the year has been principally in the direction of ship lighting. Large orders have been placed by the Government, chiefly under three firms—the Brush Company, Crompton Company, and Messrs. Siemens Brothers. The engines of Willans and Robinson, and of Brotherhood, have been more largely used in these installations than any other. Of course, in ship lighting the electric light has every advantage, and Government experts have satisfied themselves that in addition to its other obvious advantages, it is economical. No very extraordinary installations have been made inland excepting that at South Kensington—for we cannot as yet say the Paddington installation is complete or out of the hands of the contractors. When the lighting at South Kensington is considered, it must be taken to have absolutely proved the suitability of the electric light for various purposes—for lighting interiors and exteriors, for luxury and for business.

From lighting we pass to telegraphy, and in this direction also the year has been uneventful. The telegraph system of England compares very favourably with that of any other State. More work is done with less friction. That branch of telegraphy termed telephony is very much as it was twelve months ago. London has no system, and when subscribers complain they are told to blackguard the Post-office authorities and Parliament. The right people to blame are the mismanagers of the company having the virtual monopoly. The methods are unbusinesslike, the work unworkmanlike, the system unsystematic, and the results altogether bad. London wants the telephone at a small rental in every house, the wires underground and in a safe position, the connections properly made, and certainty of action of the instruments insured when required for use. An old saying tells us that two kinds of payment are bad. One of these is payment in advance. There are exceptions to every rule. But we doubt if paying £20 a year in advance for the use of the telephone is admittedly an exception, especially when from some cause or other we find the instrument, the line, or something out of order when required for use. The National Company in its operations has not followed the example of the London Company. Hence many large towns possess greater telephonic advantages than the capital.

Good work has been done in submarine telegraphy during the year by joining up various business centres to the trunk routes, and great progress has been made in carrying out the West African cable system, which, when completed, will give an alternative cable route to the Cape. The first portion of this system has been successfully carried out by the Silvertown Company; the remaining connections, we believe, will be carried out by the Telegraph Construction and Maintenance Company. But the construction and laying of cables is now becoming so familiar that they cease to be wonderful. One feat in cable work during the year is unique. The new direct Spanish cable broke in more than two thousand fathoms of water. The cable was grappled for and spliced in three days by the Eastern Telegraph Company's new ship Electra, Captain Pattison. Although the multitude believe that electricians can tell to an inch the position of a fault in a cable, those acquainted with the subject know better, and therefore when a captain is told that a fault is in such a position, he knows it is there—within a few hundred yards or a mile or so; and in such cases as this he has to pick up a 1½in. rope lying somewhere about upon the bottom at a distance below him of, say, 13,000ft., and bring the piece of rope wherein lies the fault up to his deck. We consider the work mentioned the best ever done in cable operations since cables were invented.

It is customary in this summary of the year's work to indicate specific directions in which improvement is required; but at the present moment any attempt of this kind must be necessarily imperfect. The details of electrical apparatus are so numerous—and improvement is possible in almost every one—that we must content ourselves with the broader lines. In electric lighting, as in gas lighting, loss from leakage is an evil to be lessened as much as possible. The similarity holds good further, in that little has been done to avoid the loss, except to see that joints and materials are good and well made. Electrical work, perhaps, offers greater opportunities for prevention than the work connected with its rival. Other losses arise in electrical operations, some of which in lighting work are as yet ignored. Our knowledge of many things connected with magnetic phenomena is meagre, and experimental results would frequently aid the engineer in his designs. Professor Fleming, Professor Forbes, and Mr. Snell have in lectures or papers given a good deal of information about the distribution of electricity, but the practical grappling with the question is not yet accomplished. Edison has his system at work in New York; but that is known to be defective, and it has to be tried how near practice can come to theory. There is plenty of room for improvement in "motors." Reckenzaun's seems to meet with most favour, though Immisch's is supposed to be the coming motor, while the Elwell-Parker has been made successful upon the Southport tramway. An efficient motor would be a boon appreciated. Many ignorant inventors have been wasting time and money in ringing the chemical changes upon zinc, to obtain a primary battery comparable economically with the dynamo for electric light purposes. The idea is chimerical. If we are to have a primary battery for this purpose, zinc will not be burnt. A good primary battery, provided it could be obtained at a moderate cost, would be of great use in many cases where neither water nor steam were available for running a dynamo; but we do not expect to obtain a primary battery to compete with the dynamo under ordinary conditions.

REDUCTION OF WAGES IN THE ENGINEERING AND IRON TRADES.

A MOVEMENT for a general reduction in wages throughout the engineering and iron trades of the country has now taken definite shape in a circular which has been issued this week by the Iron Trades Employers' Association. The last reduction in wages was made during the extreme depression of trade in 1879, and continued in force until the year 1882, when the Amalgamated Society of Engineers, taking advantage of some apparent indications of improving trade, put forward a demand for an advance. This was taken into consideration by the Iron Trades Employers' Association, and ultimately in the Manchester district an advance of 2s. to workmen whose wages exceeded 26s. per week, and 1s. to workmen whose earnings were under this amount, was conceded. This advance was followed by a similar concession to the workmen in other districts throughout the country; but the improved prospects of trade upon which it was based have never been realised to any sufficient extent to justify the upward movement in wages which then took place; whilst for a very considerable period of late the position of employers has been no better, but in many instances even worse than in 1879, when the last reduction in wages had to be made. The present movement for returning to the 1879 rate of wages has, like the advance of 1882, been inaugurated in the Manchester district. During the last few weeks meetings of the members of the Iron Trades Employers' Association and of other employers in the iron trades of the district have been held at Manchester for considering the question of a reduction of wages, and on December 29th it was finally decided that notices should be sent out to the following effect:—"In consequence of the depressed state of trade and the high cost of production in this district, the wages of all workmen in these works will be reduced about 7½ per cent., or to the rates paid in the early part of 1879." This notice is dated January 9th, 1886, and is accompanied by an undertaking on the part of the members that it shall be posted at their respective works on or before that date, and that they will reduce the wages of their workpeople "to the same rates at least as were in force in 1879," and "that this reduction shall come into force within fourteen days of the above date." This may be taken as a practical inauguration of a reduction of wages throughout the country; in fact, the movement is already in progress in many of the chief engineering districts. In Liverpool and Birkenhead uniform notices were posted upon the last day of the old year, and the reductions will come into force on the 22nd inst. In Glasgow and on the Tyne, and Wear, and Barrow-on-Furness, notices for a reduction have been given, and in Belfast—the lowest rated engineering district in the kingdom—the men have accepted a reduction. Whether the action of the employers, which has become an imperative necessity under the present condition of trade, will be met with any serious opposition on the part of the trades' union societies' remains to be seen. The impoverished state of the societies funds would seem to preclude the possibility of any protracted strike, and prudence no doubt will strongly influence the men in accepting what they must recognise not only to be inevitable, but in the long run conducive to the best interest, both of the employers and themselves.

PATENT-OFFICE ADMINISTRATION.

OUR readers will be pleased to learn that the President of the Board of Trade has appointed Sir Farrer Herschell, the Earl of Crawford and Balcarres, and Baron Henry de Worms, M.P., to be a committee to inquire into the duties, organisation, and arrangements of the Patent-office under the Patents, Designs, and Trade Marks Act, 1883, and they will be further gratified when they observe that no permanent officials are appointed on this committee. Each member is thus perfectly free in action, and it may be hoped that the inquiry now to be made will be searching and complete. They have a delicate task before them in some respects, for although appointments to superior positions have been made without any regard to ability or fitness, it will, as usual, be difficult to obtain satisfactory information from subordinates. The necessary information for arriving at the cause of the disgraceful muddle which has been made of things under the new Act should not, however, be difficult of obtainment, and those responsible for it should not escape, be they who they may. The muddle, it may be noted, was not unforeseen, for Sir John Lubbock and Mr. Carbutt, M.P., both referred to it in their speeches on the second reading of the Bill. We must also observe that the statistics of the past year, apart from such matter as that referred to in our impression of the 11th ult., show how necessary is an investigation into the "duties, organisation, and arrangements of the Patent-office." Of the 17,000 patents applied for in 1884, about 7000 were dropped at the nine months. That is to say, 7000 patents were applied for, but before nine months had expired the applicants came to the conclusion their inventions were not worth another £3 fee, plus the expenses of an agent. As every application at present costs about £1 sterling for examining, book-keeping, &c., this 7000 dropped patents represents a considerable loss. Why these patents, or rather provisional protection, up to this stage should cost anything like 20s. it is impossible to tell. If the amount of work involved cost a business firm one-fifth of the money, they would soon be bankrupt; but private firms do not keep many clerks helping one another to do very little, or any men who have not some special qualifications for the work that has to be done. There are clerks in the Patent-office in one another's way, and with respect to the examinations, it must be said that as a large proportion of all the patents are for mechanical devices, men of diverse mechanical engineering experience, judgment and knowledge, combined with knowledge of the patent law, should be appointed to do this work, and a much smaller number than is now employed would be sufficient for the work.

STEEL PRODUCTION AT JARROW.

JARROW is notable as the place whence the impulse in shipbuilding in the north-east sprung, and the fact that the Palmer Shipbuilding Company has begun the production of steel plates must be looked upon as significant. There were reasons why that company should adhere as long as possible to iron—it has iron mines of its own in Cleveland, and it had its works at Jarrow fitted up for the production, cheaply and efficiently, of plate iron. But in the year 1885, before it was able to roll steel plates, it built six vessels of steel—a tolerably complete indication of the manner in which the tide was turning; and we may remark in passing that the yards on the Tyne which built, next to the Jarrow yard, the largest tonnage of vessels last year—those of Armstrong, Mitchell, and Co.—were still more marked in the use of the newer form of material, for every vessel launched by them was of steel. Of course on the Tyne there were other yards which built most or all of their tonnage of iron, but the tendency is unmistakeably towards the use of steel; and the Palmer Shipbuilding Company, seeing this, has now at work its steel plant, and is thus able to turn out vessels of whatever material the demand may set in for. It has built iron vessels almost exclusively for thirty years, and hence the significance of the recent addition. On and near the Tyne there are now complete or approaching completion three fine steel works, one of which is for the production of plates for sale, whilst the primary object of the other two is to produce plates for the shipbuilding yards to which they are attached. This does not define the extent of the steel plate production of the north-east, as the mills at Eston prove; but it does show that there will be a greater readiness to undertake the construction of steel vessels than there has been, because in the last year or two the northern ports in competing for orders for that class of vessel have had to do so under the disadvantage of not being producers of the metal largely, but of being purchasers from competing districts which could supply themselves and others. Whether or not the steel vessel may prove to be the best under all circumstances cannot be definitely said, but the tendency towards its use hitherto has been very decided, and the entrance of the great shipbuilding firms into the manufacture cannot but be looked upon as a proof of the growth of that tendency.

"A DANGER TO ENGLISH MANUFACTURERS."

THE *Times* has given English manufacturers, and Sheffield firms particularly, what the Yankees would term "a pretty considerable scare." In the industrial rivalry of recent years this country has been elbowed out of several foreign markets, and somewhat roughly jostled in her own. But she has borne her affliction meekly and alone in clinging to the doctrines laid down by Cobden many years ago. While resisting stubbornly the encroachments of competitors who were at one time consumers, England has turned a wistful eye to the East, looking for "fresh woods and pastures new" to conquer and possess. China was one of her brightest beacons. To the Celestial Empire our English manufacturers looked for the greatest of the great new markets. It was believed that the hour had struck when China was ready to admit the outer barbarian and his devices. Steel rail manufacturers looked forward to glorious times; engine-builders and the noble army of men who depend on railway appliances generally were certain of a splendid future in the Celestial Empire. All these hopes are dashed in the dust for the moment, by the article "A Danger to English Manufacturers" published by the *Times* on Saturday. The danger, as usual in these days, comes from Germany. A powerful German syndicate has been formed to offer the autocrats of the Flowery Land the enormous sum of £35,000,000 on terms so easy as to be barely more than sufficient to pay the expenses of raising the loans. All the syndicate require in exchange is the control of orders for war purposes, and for railway construction and maintenance. This, of course, would mean that not a ton would come to England. No Sheffield armour-plates, marine castings, gun forgings, steel rails, sleepers, wheels, axles, springs—none of the tools required in ship or fort construction, or in building railroads—would be ordered. Germany would establish a monopoly in the Chinese market, and, fixed there, would not only operate adversely against English interests in Siam and in the newly-acquired territory of Upper Burmah, but would make China pay enormously for their goods, and perhaps not less in the end than equal 100 per cent. for their loan.

THE COST OF STEAMSHIP INSURANCE.

THE attention of many holders of shares in steamships is being forcibly directed to the question of the increased cost of the insurance of steamships. At the present time the shareholders in these steamships are in a very large number of instances receiving no benefit whatever from their investments, whilst not a few steamers are actually working at a loss. In these circumstances, the shareholders very naturally scan the accounts presented to them closely; and many are astonished at the enormous sums which are paid for the insurance of the vessels and of the cargoes. In some instances, the calls made by the mutual insurance clubs of late have amounted to fully a fifth part of the earnings of the steamers over a considerable period, a proportion which may be said to be alarming in its amount, and to which the loss of dividend on the investment may be in very large degree ascribed. The cost of insurance seems to be growing, and it is probable that though the reforms in the method of assessing the cost on the different classes of vessels may vary the amounts, yet it is certain that there will have to be a very considerable reduction in the losses or in the amount insured on each vessel before the total sum paid is reduced, and that reduction is necessary before any real reduction of the sums paid by the mercantile fleet as a whole is obtainable. It is one of the most difficult questions of the day, how to bring this about; and it is one which will have to be faced, and will have to begin at the building of the ship and end at the working prior to loss; and even the working of the insurance clubs will have to be considered, for it is certain that there are some of the regulations for the carrying on of these clubs which need alteration. The mutual insurance clubs are the outgrowth of those in the past which insured the old sailing vessels, and it is certain that some of the conditions that then existed have passed away. We do not need to particularise some of the changes which might be made, but the cost of mutual marine insurance has become so great as to be almost monstrous in its proportions. It may be that it is not too high to protect underwriters, but the underwriters have not made this clear.

FRENCH ORDNANCE.

Le Yacht some time since had the following information:—"One of 42 c.m. guns intended for the Indomptable type has met with a serious accident in proof. The gun tube has burst in the chase, and it has been deemed necessary to shorten the piece and strengthen it by hooping from end to end. The steel came from St. Chamond, which establishment has not furnished the Navy with very good products when delivering armour plates. It is far from our intention to bring to light exaggerated criticism on matters relating to French industry, but there is a regular practice of the Minister of Marine of which we can hardly approve. With an excellent object, the Administration treats all manufacturing establishments on the same footing, giving them equal shares in contracts. One admirably furnished serves the State in a most satisfactory way, another less strong serves it in a worse way. The supplies are not of the same value; one knows it; one regrets it, but next day one acts in the same way. This we regard as unfortunate. Foreigners who order war material in France are more favoured. They have not to trouble themselves about rival industries nor about the pressing needs of this or that establishment. They apply to those who serve them best." The failure of so large a gun as 42 c.m.—16·5in.—even in proof, is serious; but with the introduction of powder developing so much more pressure towards the muzzle, such an accident as a rupture of the tube near the muzzle is not a matter that need cause much surprise, occurring in proof. We do not think that the bare fact as above stated is sufficient to condemn the steel from St. Chamond. Of course there may be more than we know. We fully concur in the regret that excellence in Government supplies should be made secondary to trade etiquette or to trade interest, except so far as is necessary to establish sources of supply to the country.

METROPOLITAN SEWAGE AND THE THAMES.

THE proposal made by Mr. J. Bailey Denton and Lieut.-Col. A. S. Jones to convey to and treat the sewage of London on Canvey Island is one that claims and deserves much more attention than it has yet received. Neither Mr. Bailey Denton nor Lieut.-Col. Jones now asks anything more than that the suitableness of Canvey Island should form the subject of official inquiry. The probable cost of conveying the sewage to the island is low enough to make the proposal important, and although few may see how a soil will afford material for sewage precipitation and at the same time do well for filtration, the statements of fact are such as to make it desirable in the public interest that the Canvey Island proposal should be thoroughly examined.

VERTICAL COMPOUND ENGINE.

THE vertical tandem compound surface condensing engine, illustrated on pages 27 and 30, was built by Messrs. Worth, Mackenzie, and Co., of Stockton-on-Tees. The engine is of substantial design, has a high-pressure cylinder 16in. diameter, mounted on a distance piece forming the top cover of the low-pressure cylinder, which is 30in. diameter, the stroke of both being 20in. There is one piston-rod common to both cylinders, of forged steel 3½in. diameter, for the low-pressure cylinder, and 2¼in. diameter for the high-pressure cylinder. This rod passes through an ingenious arrangement of gland, consisting of a deep gun-metal bush in the distance piece between the cylinders, and made tight by one gland which envelopes the outside of the bush.

As it is an essential feature in an engine of this type that the low-pressure piston shall very seldom require attention, and shall have no parts liable to get loose, it is cast in one piece 5in. deep, and has one cast iron ring 2½in. in depth sprung over the body. The piston is secured to the rod by cone and nut in the usual manner; and to prevent the nut working loose, an octagonal dovetailed recess 1in. deep is cast in the top of the piston; the space between the sides of this recess and the hexagon nut is filled in with patent metal, thus making it thoroughly secure. The piston of the high-pressure cylinder is 4in. in depth, and has two external rings of cast iron and one internal ring of steel. The low-pressure cylinder is carried on two massive cast iron standards. One of these is extended so as to form the surface condenser, which contains 224 Muntz metal tubes ⅝in. diameter. The tube and cover plates are of wrought iron, the tube joint being made with a round washer of pure india-rubber in a countersunk recess. To test the efficiency of this form of tube joint, Messrs. Worth, Mackenzie, and Co., tested the condenser of a pair of pumping engines made by them for the Stockton and Middlesbrough Corporations Water Board to a pressure of 120 lb. to the square inch, and every tube was absolutely tight at that pressure. The two standards are bolted to the planed face of a very strong bed-plate 12in. deep, which is also planed on the under surface to facilitate erection. There is one double-acting pump, which is used for air and circulating, the part below the piston being for the former and that above for the latter purpose. This pump is 10½in. diameter by 10¾in. stroke. The valve boxes and casings are of cast iron, the liner, valve seats, and guards being hard gun-metal; the bucket, which is 7in. deep, and the rod are also covered with gun-metal. This pump, and the cast iron tank forming the hot well, are bolted to a planed seat projecting from the bed-plate. The feed pump, which is 2in. diameter by 10¾in. stroke, is bolted to the planed top of the hot well. The pumps are driven by links and a pair of wrought iron levers from the engine crosshead, which is of cast steel, having bearing shoes 9in. broad by 13in. long. The crosshead is slotted out to receive a phosphor bronze bearing for the small end of the connecting-rod, this bearing being 3¼in. diameter by 7in. long. The motion bars are of hard cast iron, planed on both sides, and are bolted to the planed face of the cast iron standards; an oak liner is interposed between the condenser standard and the motion bar, to reduce the rate of transmission of heat to the bar and radiation therefrom. The connecting-rod is of wrought iron, 3½in. diameter at the smaller and 4¼in. diameter at the larger end, the crank pin bearing being of phosphor bronze 5in. diameter by 7in. long. The crank is of cast steel, the pin being cast solid with it, and is keyed to a crank shaft of forged steel, the bearings for which are of phosphor bronze 6in. diameter by 12½in. long. These bearings are very heavy, and are fitted in square bottomed seats, the main seat being cast solid with the bedplate. The excentric sheaves and straps are of cast iron 5in. broad, and the excentric rod has an adjustable bearing at the double eye end. The slide spindle is of forged steel, 2in. diameter for the low-pressure and 1½in. diameter for the high-pressure cylinder, and passes through a long brass bush between the cylinders, packed by a gland sliding on the outside of the bush in the same manner as the piston-rod. The travel of the valves is 5in., and the lap 1⅜in. at top and 1⅝in. at the bottom end, the lead being $\frac{1}{32}$in. and ⅛in. respectively. The fly-wheel is 7ft. 6in. in diameter, turned bright on the rim and edges, and weighs about 49 cwt.

The accompanying diagrams are from this engine. Compression at the bottom of the cylinders might usefully be much higher, and valve action might be rather quicker and more certain at the top. The influence of long port spaces, re-evaporation, and slow cut-off, is shown in the high-pressure diagram. The revolutions were 110; when these were taken the boiler steam was 55 lb., vacuum gauge 25·5in., and the horse-power indicated 103·2.

There was published in the correspondence column of our issue of June 5th last, the details of a trial of this engine, which gave the consumption of Lancashire duff coal as 2·32 lb. per indicated horse-power. The water used was not given, but this is enough to show that though the engine has few more working parts than the plainest high-pressure engine, it possesses the economical properties of the compound engine, for Lancashire duff is far from best coal, though a good Galloway boiler was used. The plain and strong construction of the engine and the massive proportions of the bearings tend to insure the minimum of cost for repairs and renewals.

THE Telephone Companies' books will soon show some of the results of a heavy snowstorm in London. Shareholders will get an uncomfortable awakening.

THE ROYAL INSTITUTION.

ON METEORITES.

ON Tuesday, December 29th last, Professor Dewar began a series of six Christmas lectures at the Royal Institution on "The Story of a Meteorite." He stated that records of the fall of meteorites extended to high antiquity, Biblical, Grecian, and Latin writers having noted their occurrence. He had been at some pains to get together a good variety of meteorites to exhibit to his hearers, for the objects being so rare, scientific men and others are exceedingly desirous to possess specimens, consequently any meteorites that fall are quickly brought up, and in most cases find their way into private collections. Professor Herschel, who had done much in this field of inquiry, had lent him specimens; so also had Professor Geikie. Mr. J. R. Gregory had lent him specimens from his collection, casts from those in the British Museum were on view, and one of the rarest gems before them had been lent by Mr. Warren De La Rue. It differed from all the others, and was so friable that it had to be kept under a glass case. Specimens of meteorites had also been lent by Professor Abel, Dr. Sorby, and Professor Bonny. The advent of a meteorite in daylight, he said, is sometimes accompanied by a cloud, and by a noise louder than thunder, followed by a sound like that of wild ducks rising from the water. Then comes a hole in the ground. The pieces on being immediately dug out are usually hot, but sometimes cold. In 1860 the fall of a meteorite was witnessed by many Europeans and others in India, and a report of the occurrence was drawn up and sent to the Governor of the Punjaub; the remarkable fact about this meteor was, that although at first it was warm, it quickly grew so cold that the holders had to drop it, because their fingers could not bear the low temperature. Meteorites are covered with a varnish-like glaze about as thick as writing paper, in which glaze are fused globules, proving the action of heat. Most meteorites are under 1 lb. in weight; indeed, a meteorite of 1 lb. weight is a comparatively large one, although in some few cases the weight of meteorites has been known to reach 3 or 4 tons. They can be divided into two great types—namely, the metallic type, rich in iron, and the stony type; there are also intermediate specimens, partly stony and partly metallic. All that can be observed in relation to their fall takes place in a very few seconds, their velocity being like that of what are popularly called "falling stars;" they move, in fact, at planetary velocities. Some idea of their speed can be gained from the following tables:—

Velocities.

Shot from 100-ton gun	½	mile per sec.	
Explosive wave, gaseous	$1\frac{7}{10}$	,,	,,
Gun-cotton	$2\frac{8}{10}$	,,	,,
Earth in orbit	18	,,	,,
Meteorites	36	,,	,,
Comets	45	,,	,,

Relative Velocities.

Falling body	32	feet per sec.	
Racehorse	50	,,	,,
Flight of pigeon	60	,,	,,
Fast train	90	,,	,,
Contraction of soap film	96	,,	,,
Impression along nerves	97	,,	,,
Ignition of gases	100	,,	,,
Sound	1,100	,,	,,
Air particles	1,500	,,	,,
Cannon ball	1,700	,,	,,
Gun-cotton	15,000	,,	,,
Earth in orbit	95,000	,,	,,
Light	1,100,000,000	,,	,,

Meteorites have not all the same velocity; some exceed 36 miles per second. A meteorite travelling at 50 miles per second may be visible for about nine seconds, its total path in that time being 450 miles, or about the distance from London to Edinburgh. The path of one which passed over the British Isles was discovered to be about 70 miles above the surface of the earth.

Bodies, said Professor Dewar, which move at high velocities acquire great rigidity. In illustration of this, he hung an endless chain B upon a wheel A, Fig. 1, and caused the chain to travel round the wheel at the rate of half a mile a minute, by driving the wheel with an electro-motor and dynamo machine. He pointed out that the chain had then the rigidity of a thick wire, and that if struck with a stick the loop would curve into forms which it would retain with some persistency, as if it were a continuous wire rather than a string of loose links. He next took a disc of common thin sheet india-rubber, and attached the centre of it to the electric engine shaft; when the latter was rotated rapidly, the sheet of india-rubber spread itself out until it had acquired a kind of "screw" form; it did not extend itself quite flat. At this velocity it had high rigidity, gave a roaring noise, and cut a sheet of paper near it into shreds. This roaring noise, he said, was related to the noise made by meteorites. To produce such a noise it is not necessary that a solid body should rupture the air; a series of induction sparks from an intervening electrical condenser ruptures the air, and produces a very disagreeable noise.

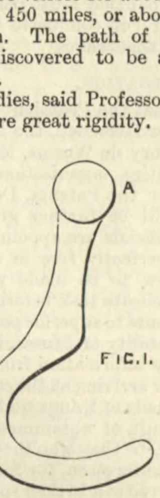


FIG. I.

Once upon a time it was believed that meteorites were due to inflammable gases rising in the air, until after a time they caught fire and produced "fire balls;" but later on other ideas came under consideration, including that of friction. The speaker here attached a smooth iron wheel to his electrical engine, and showed that at a high velocity of rotation it would cut red hot iron, as, he said, rails are cut at ironworks. He next used an emery wheel at high speed, and produced showers of sparks by pressing a piece of iron against it, the effects, he said, being remarkably like those produced by the fall of meteorites. He exhibited on the screen a magnified image of an instantaneous photograph of the shower of iron sparks, and pointed out how some of the iron particles were brighter at some parts of their path than at others. Some of the particles appeared also as if on the point of bursting. He collected some of these hot iron particles upon a glass plate, into the surface of which they fused themselves. Afterwards he dissolved out the particles with acid, and showed that they left little round holes in the glass, and that the particles themselves were round. The heat of the particles, he said, was partly due to friction and partly to combustion in the air. He also collected some of the sparks upon a glass plate with a horseshoe magnet behind it. The shape of the poles was visible where they burnt themselves into the glass, also some of the lines of magnetic force, as they have been called.

THE HEAT AND LIGHT OF METEORITES.

On Thursday, December 31st, at Professor Dewar's second lecture on "The Story of a Meteorite," he attached a thermo-electric couple, consisting of a slip of iron and a slip of copper, to the electrical engine; one slip was attached to the rotating shaft, and the other had rubbing contact with a fixed axis of the shaft; the thermal couple was fixed at right angles to the rotating shaft, and its head being outwards, rose in temperature as the pressure of the air before it increased with increased rapidity of rotation. The variations in temperature were read off by means of a reflecting galvanometer. In relation to the rigidity of soft substances at high velocities, he spoke of the rural pastime of firing a tallow candle from a gun through a door, and he illustrated it by firing some balls of paraffine wax, which, he said, were cleaner than tallow balls, through a deal board. He collected the pellets afterwards from a sand-bag at the back of the board; they had made clean-cut round holes in the wood. He also cut a plate of iron with a rapidly rotating disc of lead. Some lead, in a state of excessively fine division, was allowed to fall from the roof of the theatre, whence it descended in fiery streams, to illustrate heat from combustion in passing through the air, more than heat from friction. A piece of glass was made white-hot, and partly fused, against the rotating emery-wheel, as an example of heat from friction without combustion. That the sparks from iron were partly due to combustion he proved by covering the emery wheel with a glass case, filled with carbonic anhydride, when, upon application of the iron, not a spark was to be seen; a red glimmer was visible at the point of friction; with pure oxygen a brilliant shower of sparks was seen under otherwise like circumstances. The iron sparks in air, he pointed out, were so hot that he could light a gas jet with them at a distance of 2ft. or 3ft. from the wheel. He collected some of the particles on paper at that distance, and proved that many of them were small enough to float upon water; they varied in fact from $\frac{10}{1000}$in. to $\frac{1}{1000}$in. in diameter. He had, he said, the Newstead iron and nickel meteorite, belonging to himself, so he could do what he liked with it; he accordingly placed its edge against the rotating emery wheel, and but a dull red heat was produced, with a lesser amount of sparks than iron or steel would have given under like circumstances. He then put a piece of pure nickel against the revolving wheel, and it gave out less heat and light even than the meteorite, although nickel so resembles iron in some of its properties. Sir F. Abel had given him permission to do what he pleased with a polished plate from a large metallic meteorite. He accordingly etched it with weak acid, to show that some parts of its surface were more soluble than others, and that evidences of crystalline internal structure were thus brought to view. He exhibited upon the screen magnified images of the etched surfaces of meteorites. In relation to the travelling of flame, he said that flame might travel with great velocity without direct change of place of the substance burnt, as in the immense velocity with which the flame of ignited gun-cotton moved. He also, by experiment, proved that in a mixture of gas and air in a long thin tube, flame travels with a series of successive short jerks, and that the opening or the closing of the further end of the tube modifies those jerks.

THE COMPOSITION OF METEORITES.

At his third lecture on "The Story of a Meteorite," delivered on Saturday, January 2nd, Professor Dewar drew attention to the following tables of figures as to the composition of meteorites:—

Meteoric Stones.

	Silica.	Magnesia.	Iron protoxide.
Alais	31·22	22·21	29 03
Kold-Bokeveldt	30·80	22·20	29·94
Kaba	34·24	22·39	26·20
Orgreil	26·08	17·00	29·60
Chassigny..	35·30	31·76	26·70
Chateau Renard	38·13	17·67	29 44
Harrison City..	47·30	24·53	28·03
Concord	47·30	24·53	28·03
Danville	50·08	20·14	19·85
Searsmont	40·61	36·34	19·21

Meteoric Irons.

Iron	85·54
Nickel	8·55
Cobalt	0·61
Copper	0·03
Magnesia	2·04
Chromic oxide	0·21
Silica	3·02
Phosphorus	0·12

Alpianello Meteorite (proximate components).

Troilite (iron sulphide)	6·92	
Nickel iron..	2·11	Nickel .. 71·2 per cent.; Iron .. .. 28·8 ,,
Soluble silicate	50·86	
Insoluble silicate	40·11	

	Soluble silicate.	Insoluble silicate.
Silicic acid	35·12	12.56
Iron protoxide	51·43	13·40
Alumina	1·52	0·00
Chromium oxide	0·00	8·28
Lime	4·64	6·71
Magnesia	7 27	17·26

Professor Dewar exhibited magnified representations of Mr. Storey Maskelyne's thin sections of real meteorites, also photographs of sections, showing that stony meteorites consist generally of confused crystalline masses interspersed with jagged pieces of metallic iron, and that the iron sometimes runs between the other crystals in veins. He announced that Mr. J. R. Gregory, who possessed the Indian meteorite, of which he had spoken in an earlier lecture, had broken up some of it in order to give a small piece to the younger members of the auditory present at those Christmas lectures. On examining meteorites, he said, the resemblance they bore to the varieties of lava emitted by volcanoes was evident; there were also differences, in the matter of the large proportion of magnesia and metallic iron in meteorites. Olivine and the basalts present the same form of irregular internal crystallisation, but without the iron. Another difference is the thin varnish-like coating of meteorites; this cannot be produced artificially by throwing a piece of meteorite for a moment into the electric furnace, because the heat is neither sudden enough nor hot enough. He proved this by experiment, and the glaze went far too deep, whereas in meteorites it is but of about the thickness of writing paper. On taking the piece of meteorite out of the furnace, he remarked that burning gases were coming from it, a phenomenon that he had never seen before, and that there was a little crater on the fragment of meteorite whence the gases issued. A heat of about 3000 deg. would account for the thin varnish-like crust of meteorites. Iron, nickel, silicon, and oxygen are the more common of the constituents of meteorites; magnesium is somewhat plentiful in them; in all, twenty-two of the chemical elements have been found in them. Compounds of sulphur are always found in meteorites; such compounds yield most readily to acids when meteoric plates are etched, and a smell of sulphuretted hydrogen is then given off. The particles of iron can be separated from a crushed meteorite by means of a magnet, and what is left is simply a glass consisting of silicates like the masses of rock silicates common on this earth. The bases with which the silica is united are chiefly oxide of iron and oxide of magnesium, both in quantities not so relatively plentiful upon earth. He then spoke of the nickel-iron alloy of meteorites, and the general characters of alloys, illustrating his remark by the manufacture of aluminium bronze. He also spoke of phosphorus in meteorites, and the properties of phosphide of calcium. Next he pointed out that meteorites sometimes contained graphitic carbon; but no diamond had ever been found in them. If a diamond were to be so found, the temperature a meteorite had endured could be more exactly specified, because at a known temperature a diamond would be carbonised, and it would be possible to say that the temperature of the interior of the meteorite had not reached that of the electric crucible. He then explained to the listeners by experiment some of the properties of silica, and how it could be separated from the other constituents of meteorites by hydrofluoric acid. In reference to the Indian meteorite—which felt hot at first, but intensely cold afterwards—he said that he would exhibit an inverse but otherwise perfectly parallel experiment. One of the assistants then poured masses of white-hot molten glass, as big as apples, into cold water, and the instant they fell therein Professor Dewar picked them out while still white-hot with his bare fingers, and placed them on an iron plate on the table. He said that he seized them at the instant they were surface-cool; if he were to retain hold more than about a second, of course he should be burnt; conversely, a meteorite might be at first hot outside, but soon grow too cold to be held in the hand. Some meteorites, he said, are partly glassy and partly not so, just as in metallic slags. As to the relation between velocity in air, and temperature, a velocity of 145ft. per second gives an increase of 10 deg. temperature, and the rate continues as the square of the velocity. The surface of a body moving at the rate of thirty-nine miles per second would reach a temperature of 2,000,000 deg. A thin layer of meteorite at an elevation of 100 miles would, in its passage, reach the temperature of 3000 deg.

PRIVATE BILLS FOR NEXT SESSION.

THE official list of the Private Bills to be promoted in the forthcoming Session enables us now to gauge the prospects in this direction as nearly as can be done before Parliament meets. The first circumstance that attracts attention is that there is again a considerable falling off in the number and character of the measures proposed. Last year there were forty-seven fewer Bills brought forward than in the previous session, and the absence of high-class schemes was remarkable, the Ship Canal Bill being almost the only one involving any great issues. For the coming Session there are only 197 Bills, as against 247 last year, or a decrease of 51; and as far as at present can be seen, these 197 contain no really big scheme. This steady decline in the amount and nature of the Private Bill legislation is somewhat striking, but it is not so much to be wondered at when one considers the extent to which this description of legislation has been prosecuted for many years prior to last year. Enormous projects cannot be undertaken year after year without end; and besides this general consideration, the persistent depression of the last few years must be taken into account. That factor by itself would go far to explain the decrease in these projects for a while; but in the meantime many extensive schemes previously sanctioned are being worked out in all parts of the kingdom. These once completed, and a revival of trade realised, enterprising people will doubtless take fresh courage, and the Parliamentary Committees will again be heavily taxed. For this, lawyers, agents, and speculators must wait with such patience as they can muster, and meanwhile members will be glad to have their labours lightened, for few, if any of them, love the work of examining Private Bills.

The total of 197 Bills deposited this year is made up thus:—Railways, 80; tramways and subways, 20; canals, 2; water, gas, and lighting, 28; harbours, docks, and ports, 16; town improvements, markets, &c., 27; roads and bridges, 6; miscellaneous, 18. The largest decrease is in railway Bills, of which there were 119 last year—39 less than this year; and of tram and subways Bills there are 9 fewer. The difference in the other classes is not more than 2 in any case, while the water, gas, and lighting Bills again number 28. Of the total only 26 have reference to the Metropolis, 4 being Bills affecting railways in or starting from London, 6 having reference to metropolitan and suburban tramways, the remaining 16 being miscellaneous. To West London belongs this year the credit of introducing the only electric lighting Bill, and from this it appears that practically no new impetus is to be given to this mode of lighting so far as Parliament is concerned. The London and South-Western Railway Company has a general Bill containing, *inter alia*, provisions to which we recently referred respecting the proposed but now abandoned line round Wimbledon Common, and the line across the Thames at Putney. The South-Eastern Railway Company also promotes an additional powers Bill, while "various-powers" and other measures are advanced by the Brighton and South Coast, the London, Chatham, and Dover Railway Company, and the London, Tilbury, and Southend Railway Company. The Metropolitan Board of Works have introduced a very multifarious measure, giving them powers in almost every direction. Among other things they propose to erect a staircase from a point on the Victoria Embankment near the Metropolitan District Railway station, at Charing Cross, up to the foot-bridge leading from the bottom of Villiers-street to the Surrey side; other provisions in this Bill relate to the formation of new streets, the control of Dulwich Park, the purchase of land in various districts, the management of Deptford Creek Bridge, and so on. Water Bills are put forward affecting the East of London, Lambeth, and Southwark and Vauxhall, and among the other general schemes belonging to the metropolis is one which will be widely welcomed, viz., a Bill for purifying the river Lea. This measure is, of course, the outcome of the recent agitation over that malodorous stream, and well deserves speedy Parliamentary and Royal sanction. The several tramway Bills for London constitute the chief interest within the metropolitan area, but before dealing with them we may refer briefly to the South Kensington and Knightsbridge and Marble Arch Subways, and Knightsbridge Improvements Bill. By this Bill it is proposed to construct a subway from the junction of the Cromwell and Exhibiton roads to a point near All Saints-school, Knightsbridge-green; and another from the terminus under Hyde Park up to Oxford-street near Old Quebec-street. The Bill further contemplates the formation of two new streets near the Brompton-road and the Hyde Park barracks; and the widening of a number of roads and streets in the same extensive district of South Kensington and Knightsbridge.

As we have hinted, the tramways Bills are the most striking of the London schemes, showing as they do a yet further extension and development of this method of locomotion. These are the London Street Tramways Extension, North London, North Metropolitan Tramways (1 and 2), and Southwark and Deptford Tramways Bills. The proposals in the first-named Bill embrace new lines from the existing tramway in the Junction-road to Highgate Archway-road, and thence along that road and High North-road to Manor Farmhouse; from Kentish Town-road up Highgate-road to Woodsome-road and Swain's-lane; from High-street, Camden Town, up Chalk Farm-road to Haverstock-hill, through Hampstead, and on to and beyond Upper Avenue-road; from Hampstead-road corner into Tottenham Court-road as far as Goodge-street—a substantial encroachment upon ground hitherto jealously guarded from tramways; from King's Cross down Gray's Inn-road; and numerous ramifications in every promising direction, besides the doubling of many existing single lines. The North Metropolitan Tramways Company projects new lines in the neighbourhood of King's Cross-road, Farringdon-road, and Clerkenwell-road; and from these and other similar Bills it is evident that the tramway owners mean to gradually embrace within their octopus-like grasp every thoroughfare in London likely to prove remunerative; and they are likely to succeed, unless there is a vigorous revival of past efforts to exclude them from the most central and most crowded roads and streets. The river bridges are still free from tram lines, but each new advance towards the heart of the metropolis will be a menace to them. Among the general Bills referring to London and its outlying districts, are the Hampstead Heath Enlargement Bill, the Highgate and Kilburn Open Spaces Bill, the Horse Guards' Avenue Bill, the Metropolitan Markets Bill, a Bill relating to Charterhouse, and another affecting Lloyd's. The Greenwich and Millwall Subway scheme re-appears, and so does the Manchester Ship Canal, but only by a Bill to empower the company to pay dividend out of capital, and another authorising the Salford Corporation to invest £250,000 in the undertaking on behalf of the borough.

What may be called Navigation and Shipping Bills include the Argyll Ship Canal, the Barry Dock and Railways, the Bristol (Corporation) Dock, the Bute Docks Transfer, the Clyde Navigation, the East and West India Dock Company, the Gravesend and Northfleet Docks and Railways, the Felixstowe Railway and Dock, the Southampton Docks, and the Tyne Improvement Bills. The Channel Tunnel (experimental works) Bill stands by itself, but beyond the remarks we made upon it last week we need say nothing, except perhaps that despite its harmless appearance, the real purpose of this Bill is to push on the tunnel if possible, by inducing Parliament to practically rescind the resolution of the last Parliament under which the work has been suspended.

Glancing through the Bills hailing from the provinces, we find some of an unusual character that are worth notice. Two or three weeks ago we briefly described a measure for authorising the adoption of compressed air power in Leeds. Last year the Compressed Air Power Company obtained authority to introduce its system into Birmingham as a motive-power for manufacturers, small mechanical industries, electric lighting, &c., but so far as we know it has not exercised its rights. The company now comes to Parliament with a Bill which, among other things, will enable it to demonstrate the qualities of its system in Leeds, and empower the corporation to purchase its rights within twenty-one years. Another Bill of the same kind comes from Bradford, and a third from Nottingham, and a Bill is also presented by the Leeds Hydraulic Power Company. These proposals indicate the employment of an old motive-power for purposes too numerous to detail, and, supplementing gas engines and other apparatus for a like object, it is likely to prove of immense value for both large and small undertakings, that is, if when Parliament's sanction is obtained it is utilised. The applications for Provisional Orders this year number sixty-nine.

The dispute in the Salford Town Council—to which we referred last week—respecting the proposal to authorise the Corporation to invest a quarter of a million in the Ship Canal, has been settled, so far as the Council are concerned, in favour of the proposition. At the adjourned meeting one of the members lamented the strong personalities introduced on the previous occasion, but another member, so far from sharing in this sentiment, imitated the bad example complained of, and was twice rebuked from the mayoral chair. In the end the motion was agreed to by forty-three votes to eleven; and the next step to be taken is a poll of the ratepayers. It is difficult to believe that the town councillors know so little of their constituent's wishes as to render this process necessary, but only by this means could the hostile section of the Council be induced to accept the resolution.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE, CHANCERY DIVISION.

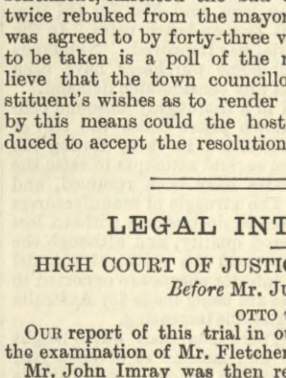
Before MR. JUSTICE PEARSON.

OTTO *v.* STEEL.

OUR report of this trial in our last impression terminated with the examination of Mr. Fletcher, from the British Museum.

Mr. John Imray was then re-called and his cross-examination resumed by Mr. MOULTON. Dr. Otto's patent No. 60, of 1881, was referred to. In it an arrangement similar to the spring piston employed in the experiment was described in order to enable a gas such as carbonic oxide to be advantageously used. The witness did not know of any engine that had been worked with carbonic oxide.

Mr. MOULTON then read the following passage from Dr. Otto's specification of 1877, No. 2177:—"A charge of explosive gaseous mixture—containing only such a proportion of air as is necessary to effect the combustion of the combustible gas—was admitted to the cylinder separate from a charge of air in such a manner that the explosive mixture existed in a more or less undiluted state in and near the inlet port, while forward of that point the explosive mixture became more and more diluted by admixture with the previously introduced air, so that on ignition the combustion of the charge took place rapidly at first and then proceeded more and more slowly as it extended forward." Further passages were also read showing, as Mr. ASTON put it, that Otto's idea was to use a kind of detonating charge to light the ordinary charge. It was also stated in this specification that the tapering form of cylinder end might be dispensed with, a long narrow chamber being formed instead.



Mr. Imray did not know it was a fact that a very large number of Otto engines are made with that shaped end. He believed some were made. Dr. Otto had tried various forms of the end of his cylinder, and has changed them from time to time. He believed his latest was a simple flat end with a hole in the middle. All these engines were called the Otto Silent Gas Engine. The witness agreed with Sir Frederick Bramwell that in regard to Wright's specification the pressure of 1 lb. or 2 lb. in the reservoirs would not be sufficient to make the engine work. But with a higher pressure it might possibly be made to work. He also agreed that Barnett's engine would not work as described. Assuming that the piston in the drawing is going downwards. The piston is not shown at the top, but suppose that for some reason or other it was going downward. As the piston is moving down, whatever there is underneath it, is escaping through *m*. Then when the piston has passed that hole the pumps begin to discharge—they are timed so as to discharge. Therefore, the gas and air coming from the pumps would come in above the piston while the piston is going down. As soon as the piston passed the middle hole, all the further supply of gas and air would be sent out through the middle hole.

Mr. MOULTON: I want you to be careful about this for your own sake, and because I want to do you justice. Assuming this engine is working for a moment—we will see whether it would go on working—what is the proper way of describing the cycle? Supposing it is descending, that means that there has been a combustion above it, does not it?

Witness: I assume it is going down for some reason. If you assume it was from combustion that the piston is going down, then when the piston passes the middle hole, the products of combustion above it, if there were any, would begin to escape, and then the pump at the same time forcing in air and gas would send out further quantity of the products of combustion if they were there; and then if all the products were sent out, the gas and air would then go out. The piston now being at the bottom of the stroke, you have got above it probably some gas and air if you have got them in. He thought most of the products of combustion would be sent out. He did not know what was to bring the piston up again. He saw no way that gas or air could get in under the piston.

Mr. MOULTON: If you say that looking at that engine you do not see how any gas and air, supposing this is beginning to descend and descends to its full stroke—if you tell me that you do not, after consideration, see how any gas and air would get in underneath, so that there would be a charge driving it out, I will leave it there; but I should like you to think over it, because I intend not only to prove it by witnesses, but I think I shall be able to show it must be so.—Witness: I see this, that as the piston comes down after it has passed the middle hole it would be compressing anything that is below it. Now, when the pump is at this time sending in gas and air with free access to the top, that valve at the bottom would inevitably be closed and not let any gas or air in. Therefore, when the piston got to the bottom, it could have no gas and air below it. —Q. I do not really see that. I see that it could not have drawn in any gas and air on the latter half of its stroke; but just as you have proved that it would be drawing gas and air in in the upper part of the cylinder, so it seems to me gas and air would have been driven in in the lower part of the cylinder.—A. Quite the reverse. It is drawn into the upper part because the piston is descending.

Some conversation then ensued between the learned judge and Mr. Moulton, the latter explaining his interpretation of the specification, and saying that when he called his witnesses he would show the exact proportions in which the combustible mixture would be admitted, both above and below the piston. He might tell his lordship—and he should show this more exactly—that two-thirds will come in during the descending stroke and one-third during the ascending stroke, but that there will be a charge at each end getting in properly; and he trusted to show, not only that the engine would work, but probably it was the forerunner of some of the best engines of the day.

Discussion then took place as to how far his Lordship should be guided by the decision in the Court of Appeal in regard to Barnett's specification, which was relied on in the Linford case. Mr. Imray disagreed with Mr. MOULTON'S explanation of Barnett's cycle. In the first place he did not know what could be either above or below the piston, because when the piston is at the top of its stroke there is no room, except a little clearance above it, so that there is no room for anything above it. There must be compression into almost no space at all. If you measure what is shown there and where the crank will go up to at the end of its stroke you will find the piston will touch the top as nearly as possible, which showed that the man did not intend at all to mean what Mr. MOULTON meant. The man evidently did not understand what he was about. He did not say that a competent mechanic would suppose there was to be no space into which the air was to be compressed, but the drawing shows it. In regard to Million's—Newton's, No. 1840, of 1861—specification, at page 10, under the head of "Third means of employing gases as motive agents," the motive cylinder is described as having a space at the end one-third, more or less, of the volume generated by the motive piston, which was similar to the arrangement in Otto. Supposing you allowed one-third at each end, and you let in a charge of compressed gas at two or three atmospheres, then there would be a quantity of residuum, and the charge would come in after that at a pressure of two or three atmospheres, and, therefore, would be diminishing the volume of what was in the space already in proportion to the pressure. Mr. Imray considered that in Newton's—Bischop's—specification, No. 1594 of 1872, every precaution was taken to mix the air and gas, because at every one of the six holes there was a deflector over it so as to spread the gas and air laterally. No deflector was mentioned, but it was shown very distinctly in the drawings. There was not a word said about deflectors. Bischop calls them valves, but these valves when they rise must operate as deflectors, and the mixture in his opinion would be very nearly homogeneous. If the valves did not act as deflectors you might then have a number of separate streams. There was no reason why such an engine would not work. It would not be economical because there is no provision for the heat of the combustion to be taken up except by the cylinder and piston themselves. The witness agreed with what Sir Frederick Bramwell said in regard to Lenoir's specification of 1860, viz., that if made according to the specification the charge would consist, first, of any residuum that there was in the clearance spaces, then a film of air, then the combustible charge, and then a considerable quantity of air. If it would ignite it did not make any material difference whether or not the air is up by the piston or between the charge and the end of the cylinder. He had never measured the Lenoir engine at South Kensington, but he should not imagine the clearance space was 20 per cent. of the total charge. Mr. MOULTON then submitted the publication of Beau de Rochas' work was proved and proposed to put it to Mr. Imray. Mr. ASTON, however, interposed, and submitted, on behalf of the plaintiff, that the publication had not been proved. He said, in order that a publication may anticipate a subsequent patent, it must be a publication of such a character as to make the contents of it part and parcel of the stock of public knowledge. He was not here to-day to say that if a book were placed in a public library to which the public had access, and which could be proved to be a work of reference in a library of reference, it would not go a very long way towards establishing publication—that the mere existence of a book of reference in a library, that is, a library of reference and accessible to the public attending and frequenting that library—would not go a long way towards proving publication; but where you have a library like the British Museum, a library where people have to go into a reading-room and arm themselves beforehand with a reference to the particular work, knowing that it is to be found in a particular work, and they ask a librarian to give them the particular work, that is not, as he submitted to his lordship, accessible to the public. Supposing that the book had been in such a foreign language as Chinese, and contained a description, if the person who had recourse to it knew Chinese it would be as much a publication, though in Chinese, as it would be if it were in English possibly. But here you have a reference to first of all a foreign work, and that foreign work is only referred to by name, and you have no proof that any person, notwithstanding there is a register of references, ever did refer to it; and if it had not been for this case arising when a special search was made for a particular thing which was known to exist in a particular work, you would not have had in all probability this disclosure of the contents of that book. Reference was made to the librarian, and then he, as he told us, looked out the work some few months ago, because *aliunde* the defendants in a patent action knew that in a particular book published by Lacroix there was this description. They then go, knowing that there is in that book that description, and obtain from the librarian by their guidance—not by the guidance of the catalogue, but by their own guidance and by the instructions which they gave the librarian—the book in question. Now up to that very moment it was nothing more or less than a sealed document. There is not the slightest proof that anyone of the public ever knew it. There is not the slightest proof that it might not remain, as it did remain from 1863 up to 1885, a buried document. The case of Plimpton *v.* Malcolmson was referred to at length by the learned counsel, who quoted the late Sir George Jessel's decision on a somewhat similar point.

Mr. JUSTICE PEARSON: Supposing an inventor unknown to fame in England publishes a volume here containing an accurate and sufficient description of a new invention. Supposing he puts that into print, and it is printed by two booksellers who take the responsibility of the venture in partnership together; and supposing when the question comes to be considered in Court as to whether or not that was publication it was proved to the Court that those booksellers had at the present time every single volume of that publication in stock. Is that a publication?

Mr. ASTON: Not if they have not sold any.

Mr. JUSTICE PEARSON: They were on sale.

Mr. ASTON: I know.

Mr. JUSTICE PEARSON: Lord Romilly's dictum is the other way.

Mr. ASTON: Let me put this, if I might venture to do so, with great respect to the Court. Lord Justice Fry thought you must go a little further than that, but I am going to answer your lordship by another supposition. Supposing it should turn out that the booksellers had the books packed up, and had never unpacked them, they are in stock in that sense, but they have never been unpacked.

Mr. JUSTICE PEARSON: Supposing they had been unpacked, and they had put some volumes on their counters, but at the time when the case came before the Court it was proved to demonstration that every single copy of the book was in the bookseller's possession, and they had never sold a single copy.

Mr. ASTON: Your lordship has put another element in, which, I must admit, is a formidable element—upon the counter.

Mr. JUSTICE PEARSON: Assuming that they put them there for sale, and had not sold them, and not a single copy was cut?

Mr. ASTON: Now your lordship is helping me.

Mr. JUSTICE PEARSON: I am not going to help you or fight against you; I am simply putting the answer to Lord Romilly's dictum in the most difficult way I can.

Mr. ASTON: I cannot help thinking that the Master of the Rolls goes on to answer that.

Mr. JUSTICE PEARSON: I am not at all sure I should answer t in Lord Romilly's way.

Mr. ASTON then further quoted from the late Master of the Rolls, and pointed out that although Beau de Rochas was in existence when Otto *v.* Linford was tried, no one knew about it. He then compared the analogy between the skate case and that at present being tried, and referred also to similar instances in a recent telephone case. In conclusion, Mr. Aston said that surely he was justified in saying that where the book is simply inert, containing information which possibly might go forth and be made part of the stock of public knowledge at some time or other, but as to which there is not a scintilla of evidence that ever it did, he was right in asking his lordship to infer from the facts as they stand, that the information rested in the printed matter in the sealed closed book, and never went beyond it, and, if it did not, the cases he had quoted were authorities to show there was no prior publication.

Mr. JUSTICE PEARSON: I do not think you can put your case so high as that. You can hardly say because no person has made use of knowledge which was accessible to the public, therefore it was not published.

Mr. MOULTON: If your lordship should be of opinion that this book, being duly catalogued and accessible to the public, and being in the British Museum, is not sufficient for publication, I shall ask your lordship to allow me to prove these facts, that in the well-known catalogues of French scientific literature this book was for ten years at least before the patent included, and its full title, directing all people who wanted to study this subject to it, was there printed at length. I shall probably be able to prove to your lordship not only that, but actually that in a catalogue commonly used in this country of French books, it appeared under the head of its subject.

Mr. JUSTICE PEARSON: Then I may as well say that at the present moment I am of opinion that if the matter stood where it stands at the present moment, upon the evidence before me I should not admit this book.

Beau de Rochas was therefore not admitted, but Mr. Moulton stated he would give further evidence in regard to it later on.

Mr. Imray was then further cross-examined by Mr. MOULTON as to the construction of the side igniting slide used in his experiments. It was almost exactly the same as the ordinary igniting slide, except that it moved vertically instead of horizontally. The result was that at the side the ignition was very irregular. Sometimes it ignited two or three times very well. Then it missed fire, and especially with small charges. It ignited two or three times very well, and then failed for many times.

Mr. Imray was then re-examined at considerable length by Mr. ASTON. The experiments were gone through again without, however, bringing out anything of much importance that had not been already brought out in the examination in chief. Indicator cards were also gone into, the witness pointing out that in those engines, such as the Lenoir, in which there is a uniformly dilute charge, the curve of expansion falls considerably below the adiabatic line, whereas in the Otto engine, when there is sustained combustion, it is at least as high and sometimes higher than the adiabatic. This was the result of keeping in the residuum. He did not think there was any way in which a similar result could have been obtained by uniformly diluted charge, if uniform dilution could have been secured. Conglet's, Barnett's, and some of the other specifications were then dealt with, but nothing additional was brought out. In reference to the 1877 patent of Messrs. Crossley, he said it is merely extending to a diluted combustible charge the same principle of arrangement as was applied in 1876 to the incombustible charge. The strong charge which is introduced is made to project its stream into the centre of a diluted charge. There was nothing which would controvert or contradict the statement he had made as to the advantage of the stratified or packed charge of 1876, because throughout this specification the diluted part of the charge is to be so diluted as to be not itself explosive. All his experiments showed that the Otto charge was a charge consisting of strata of different character, shading off into one another. He could not say that there is no line of demarcation between the one body and the other. Assuming that it be true that the gases when introduced into the cylinder behave in the manner suggested by Mr. Moulton, that would not make any difference in the answers which he had given with reference to there being volumes of different characters inside the cylinder. There would merely be a difference in position, not in character. There would be no intermingling of the gases so as to produce a homogeneous charge. He was quite convinced from the eudiometer experiments that that cannot be so.

This ended the case for the plaintiff.

(*To be continued.*)

THE ANGLO-ROMANO GAS COMPANY is following the example of the Imperial Continental Gas Association, and is establishing electric light plant for illuminating several public and private buildings in Rome, with a total of 12,000 incandescent lamps.

THE ENGINEERING TRADES IN 1885.

THE following is from Messrs. Matheson and Grant's half-yearly "Engineering Trades' Report":—

"Although the year opens with very doubtful prospects for engineers, there are signs of improvement, which may rapidly develope if peace be maintained and a stable Government assured. The falling off in values, and the general depression, which had grown from bad to worse during the year 1884, continued for the first half of 1885, and still exist; but during the autumn there have been several indications of a coming revival. Insufficient employment for professional engineers, low prices for all kinds of manufactures, and drooping wages, summarily describe the position of affairs during the last twelve months, and yet this has been associated with a fair amount of activity in some branches of the engineering trades. The establishment of new factories has reduced greatly the work available for each, while even this diminished share is of less account than formerly, by reason of the labour-saving processes which enable work to be finished quickly.

"*Iron.*—The past year has probably been the worst ever experienced so far as prices and profits are concerned, and about one-third of the furnaces in the United Kingdom are out of blast. Although some restraint has been exercised in the output, Scotch pig iron, which recovered slightly since July, is again lower than in January last, and pig iron at Middlesbrough, which a year ago was at 35s., has since fallen below 32s., a rate which allows of no real profit. The trade in rolled iron is in as bad or even a worse condition, and unless there be a further fall in the wages of the iron-workers more of the mills must stop or limit further their output. Unremunerative prices tend to a degradation of quality, and the reputation of the country suffers in some cases by the export of inferior iron.

"*Steel.*—Prices for rails have remained about the same during the year, namely £4 15s. to £5 per ton, but though makers in England and on the Continent have continued by mutual agreement to refrain from the extreme competition which has prevailed in other trades, the works have been only half employed, and if the large capital invested be considered as well as a provision for depreciated plant, scant profit has been made, and that only in the works most favourably situated. Production on a large scale is necessary to cheapness, but as too many works have been constructed on this principle, the output capacity of the country has become greater than the consumption is likely to reach for a long time to come. The slackness in the shipbuilding trades has caused a falling off in the demand for material; but it is significant to note that while in 1879 steel was substituted for iron only to the extent of 10 per cent., this proportion has grown every year since, till in 1885 48 per cent. of the tonnage launched on the Clyde was of steel. The use of the basic process for making steel from phosphoric ores does not appear to grow in this country; and while in Germany and France about 750,000 tons have been so made during the past year, in England the output has been only 145,000 tons. This is mainly due to the fact that in England the purer ores from the Barrow district and from Spain are cheaper than on the Continent, and that Bessemer steel, either by the acid or basic process—whose use is so advantageous for rails—does not, as at present made, command the complete confidence of engineers for structural purposes, steel made by the Siemens and kindred methods being preferred. But the modern inventions of steel-making are too recent to allow yet of any positive conclusions, and it can hardly be doubted that improvements in the basic process, and its successful application to open-hearth steel, will allow of the extended use of our native ores.

the other Indian lines only indirectly controlled by the Government. Several long-span bridges have been ordered, and there is more of such work to follow. In Australia the continued extension of railways causes a constant demand for bridgework: but there are attempts to manufacture in the colonies which can only succeed under protective tariffs, or other legislative interference. The work done in roofs and buildings has been below the average, but the railway station extensions are continually going on, and much more of them are needed and will follow, if improved trade and traffic receipts justify the expenditure.

"*Public works* at home are at present too few and limited in extent to afford sufficient employment for engineers, and, in regard to new undertakings, there are fewer Private Bills for the coming Session of Parliament even than last year, which showed a falling off from previous years. Foreign and colonial works afford the best prospects for the engineering trades. Countries unable to supply their own needs, and where no differential tariff laws handicap English manufacturers, are those which promise best for the future. The new Congo Railway will create a wide field for engineers; Northern Burmah, now open to British enterprise, is rich in produce and minerals, which need railways and machinery for their development; and China, forced to have railways as part of her scheme of military defence, will soon see the advantages of them for other purposes. In Brazil the difficulties, real or imaginary, which may arise from the emancipation of the slaves, are causing anxiety, and the Government has seen fit to cease for a time incurring the obligation of guarantees, which have in the recent depressed times proved so burdensome to the country. In the Argenttne Republic, over-speculation and reckless expenditure have caused a crisis and a great depreciation of the national currency, which will require time and great care on the part of the executive to set right. Existing railways whose rates are fixed in this currency are suffering severely; but works actually in progress, with large local outlay in wages of funds derived from Europe, benefit by the low rate of exchange. The colonies and India are looked upon as our best and safest markets, but neither the Parliament nor people of this country have any control over colonial public works, nor over the purchases arising out of them. This fact is not sufficiently held in view by those who propose as a counter stroke to the protectionist policy of foreign countries, a Zollverein or customs union of British people. Not only do the merchants in Australia and South Africa use freely their liberty to buy where they please, but the Colonial Governments having borrowed money in England for their railways, use the proceeds in buying the material in the United States, or from continental makers, instead of from England when any saving of price is apparent. A large order for bridgework has just been sent to Belgium by the Agent-General in London for New South Wales. In connection with the question of Continental competition, the great growth of Antwerp is of interest. Next to London and Liverpool it bids fair to be the greatest port in the world, and many of the principal lines of British steamers take goods on board there. The fact that the new subsidised German line to the East is to run from Antwerp confirms it as the great port for the trade of Northern and Central Europe.

"'*Fair-Trade*' as an improvement on the present unrestrained liberty of competition from abroad finds an increased number of advocates, and if a revival of trade is much longer postponed the new doctrine will almost certainly find powerful expression in Parliament. Those who seem able to measure the immediate benefits they may receive from a change appear less able to realise the drawbacks of which examples may be found near at hand. France, who since the war has become more and more exclusive, is not only suffering as keen a depression as in this

	Per ton.						
	January, 1881.	January, 1882.	January, 1883.	January, 1884.	January, 1885.	July, 1885.	January, 1886.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Steam coal, f.o.b. at Cardiff	0 9 6	0 10 9	0 11 0	0 12 0	0 10 9	0 10 3	0 9 6
West Hartley coal, f.o.b. at Newcastle	0 8 6	0 9 0	0 9 0	0 9 6	0 9 0	0 9 0	0 8 6
Pig iron at Glasgow, No. 3	2 12 6	2 11 0	2 9 0	2 3 6	2 2 6	2 1 0	2 1 0
Pig iron at Middlesbrough, No. 3	2 0 0	2 3 0	2 2 6	1 16 6	1 15 6	1 12 0	1 11 6
Iron ship plates at Middlesbrough	6 15 0	7 2 6	6 10 0	5 12 6	4 17 6	4 15 0	4 12 6
Iron bridge plates in South Yorkshire	7 5 0	7 15 0	8 0 0	7 5 0	6 10 0	6 0 0	5 17 6
Steel ship and bridge plates	12 0 0	10 10 0	10 0 0	8 10 0	7 0 0	7 2 6	6 17 6
Iron rails, f.o.b.	5 15 0	5 10 0	5 0 0	5 0 0	—	—	—
Steel rails, f.o.b.	6 10 0	6 10 0	5 5 0	4 10 0	5 0 0	5 0 0	5 0 0

"*Scrap iron* has fluctuated very little in price during the last half-year, about 43s. for heavy scrap iron, and 53s. for old iron double-head rails, being the present free-on-board rates. In the United States the price of old material has improved. Numerous inquiries have been sent here, and some purchases have been effected, but there are no signs yet of any considerable demand.

"*Galvanised Iron.*—This trade is in a thoroughly unsound condition, competition having forced down prices below the cost of production. Although spelter has advanced in value during the last few months, and there have been several attempts to raise the price of finished sheets, the old rates have been resumed, and makers are worse off than before. The struggle of manufacturers and dealers under these circumstances to do business without loss involves considerable risk of a lowered quality, and although the leading brands may be depended on and the principal colonial buyers can take care of themselves, inferior sheets are exported to India and elsewhere. Large purchases are being made for Australia and the use of galvanised iron in England is increasing.

"*Iron and steel shipbuilding.*—There has been but a slight recovery from the depression which had become so severe a year ago, and the statistics from the various shipbuilding districts appear the more gloomy from the contrast they present to the unprecedented output of 1883. Thus, on the Clyde, the vessels launched during 1885 amounted to 194,000 tons, and in 1884 to 297,000 tons, as against 420,000 tons in 1883; and even leaving the latter exceptional year out of the account, the average annual tonnage launched on the Clyde alone for the ten years ending 1882 was 242,000 tons. On the Tyne, 103,000 tons have been launched, as against 124,000 tons in 1884; on the Wear, the output in 1885 has been only 61,000 tons, as against 100,000 tons in 1884, and 212,000 tons in 1883. On the Tees the output of 1884 has been maintained; but there, as elsewhere, the prospects for the coming year are not good. It is, however, interesting and satisfactory to note that, in shipbuilding more than in any other trade, the supremacy of this country is upheld, and not only is there the advantage that British-owned ships outnumber those of all other countries, but that foreign nations come here when they require the best and swiftest vessels. Increased strength and carrying capacity are obtained by the use of steel, while power and economy in fuel are afforded by a higher pressure of steam and the use of triple-expansion engines. Working pressures of 150 lb. and 160 lb. are now quite common, and some of the leading builders have already made quadruple-expansion engines.

"*Bridges and structural ironwork.*—At the date of our July report bridge builders throughout the country were fairly well employed, but at very low prices. Now prices are lower than ever, the principal factories have gradually become less busy, and the work in progress as well as in view will not nearly satisfy the large and continually increasing producing capacity available. The principal events in connection with this branch of trade are the growing use of hydraulic rivetting and forging, the extended use of steel, and the larger proportion of long-span bridges than formerly. The facilities afforded in London by the mains of the Hydraulic Power Company now allow the use of portable rivetting machines in various parts of the metropolis for rivetting *in situ*, better work and the absence of noise being the advantages gained. The widening of Charing-cross railway bridge and the erecting of warehouse girders in the City are examples of such work now going on. For the India State railways there has been a continual export of bridgework, especially for the strategic lines in the north-west, and for

country, but the most protected trades feel it most; the working classes are suffering more than those here, and the country by her repeated deficits is approaching a financial catastrophe. In Germany the progress due to her national resources so long undeveloped is by 'fair-traders' supposed to arise from her protective tariff which is really impeding the national advancement; in Russia, trade has got worse as the tariff has increased, till at last, in despair, manufacturers call for a total prohibition of foreign machinery and materials. In the United States free trade within so vast a country has disguised the evils of protection against imports, which have rendered all but impossible any profit from exportation. In a small and exporting country like Great Britain such a system would be suicidal."

MATHESON AND GRANT.

ARTILLERY EXPERIMENTS IN ROUMANIA.—Some artillery experiments are being carried out at Bucharest, by a Roumanian Royal Commission, technically directed by the Belgian General Brialmont who has, however, met with a slight accident which has temporarily disabled him. Shots are fired at two revolving turrets, one of French and the other of German design and manufacture, by a 15½ c.m. De Bange and two 15 c.m. Krupp guns, from a distance of 1000 metres. The French turret, with 45 c.m. or nearly 18in. armour, while severely battered externally, appears not to have suffered internally, the rotating mechanism being intact, while the contrary is reported of the German turret, on which the projectiles have made little impression, but which was severely strained inside, even by its own fire. Conical shot were used, which, on a cylindrical turret, only do execution when striking radially, or nearly so, cylindrical shot, as recommended by Sir Wm. Whitworth, being used to pierce a cylindrical object when the line of fire is oblique to a radius.

CUTTING AND RE-SURFACING OUR WOOD PAVEMENT. — Some interesting experiments have been lately made with a view to cutting and re-surfacing our wood pavements that are already said to have become uneven through excessive wear or other causes. The machine is the invention of Mr. Arthur C. Bicknell, of the Sandycroft Foundry Company, Chester; in appearance it is not unlike an ordinary traction engine, propelling itself and carrying in front of it a large revolving horizontal head fitted with cutters and driven by friction gearing. The experiments have been carried out in Manchester; a number of old wooden blocks that had been taken up from a worn-out road, and were full of stones and grit, were obtained from the Improved Wood Pavement Company in London, and were relaid in concrete and fitted in with cement and sand, the usual method of making a road. A week was then allowed for the cement to thoroughly set before the cutting head was applied, the surface was then taken off, the cuts varying from ½in. to 3in. in depth; the deeper the cut the better the machine appeared to work, the cutters getting below the grit and stones on the surface. The speed at which the cutting head advanced was about 1ft. a minute. It is expected that further experiments will be made and that the machine will eventually come into general use, thus making locomotion more agreeable, prolonging the life of our roads and lessening the vexatious stoppage and delay to traffic that so frequently occurs when roads that are really only half worn out have to be taken up and entirely relaid.

THE INSTITUTION OF CIVIL ENGINEERS.

ON CONSTRUCTION IN EARTHQUAKE COUNTRIES.

At the seventh ordinary meeting, held on Tuesday, the 22nd of December, Sir Frederick J. Bramwell, F.R.S., President, in the chair, the paper read was "On Construction in Earthquake Countries," by Mr. John Milne, F.G.S., Professor of Mining and Geology, Imperial College of Engineering, Tokio, Japan.

The result of observations showed that there was at least one earthquake per day in Japan, including simple tremors. Buildings in that Empire were of three types: ordinary brick and mortar structures; light wood houses; and buildings strongly bound together with cement and iron rods, considered to be earthquake proof. The author had observed the effects of earthquakes upon buildings, and had instituted experiments to measure the relative motion in different parts of a building when shaken by an earthquake, as well as others to determine how far earthquake-motion might be cut off from buildings. Earthquakes which had produced effects on buildings in Japan, generally commenced with tremors of small amplitude and short period. They appeared to be surface waves and lasted ten or twelve seconds. These tremors were succeeded by the shock. If this had an amplitude of 25 millimetres, and a maximum acceleration of 500 or 600 millimetres per second, brick chimneys were in danger of being cracked. The amplitude and period of a shock were measured by diagrams taken by seismographs. From these quantities, on the assumption of simple harmonic motion, the maximum velocity, which determined the projecting power, and the maximum acceleration or intensity, might be calculated. The author then showed in what respect the methods pursued by him differed from those followed by the late Mr. Robert Mallet, M. Inst. C.E. The phenomenon terminated by a series of irregular vibrations resultant on the first shock, together with other shocks at intervals of a few seconds. The period of all the vibrations depended partly on the intensity of the disturbance, and partly on the nature of the ground. These concluding vibrations had periods of from 0·2 to 0·25 of a second. The author showed that there might be a disturbance of very large amplitude which would produce no destruction, and that at two neighbouring stations it was only the shocks which had similar directions. The motions were generally performed in ellipses, like the figure 8, spirals, and in a complexity of directions too intricate to define. The vertical component was relatively so small that it might usually be neglected. In the vicinity of an epicentrum there was without doubt much vertical motion. Of this, however, the author had no experience; but he concluded that the area of the anaseismic wave was relatively small, and that if the effects of the horizontal shock could be nullified, much destruction might be prevented. Experiments had shown that earthquake motion might be partially avoided, either by making a seismic survey of the area on which it was intended to build, and then selecting a site where the motion was comparatively small; or by adopting free foundations, or by using deep foundations. The author described a series of earthquake stations he had established on the premises of the Imperial College of Engineering, Tokio, which included an area of 10 acres. The differences in the amount of motion ta some of these stations showed that, in the same earthquake, buildings in certain positions would have been destroyed, while others on the same limited area would have been practically uninjured. The authorities in Tokio had since discussed the feasibility of making a seismic survey of the whole city, or at least of those portions where it was intended to erect large and important buildings. Some years ago the author made experiments to determine the difference in the range of motion on high ground as compared with that experienced on low ground. The result obtained in Tokio showed that there was least motion on the hills. This rule appeared to be reversed in Yokohama.

With respect to free foundations, the author had erected a building, 20ft. by 14ft., constructed of timber, with a shingle roof, plaster walls, and a ceiling of laths and paper. The building rested on 10in. shells, supported on cast iron plates with saucer-like edges fixed on the heads of piles. Above the shells, and attached to the building, were cast iron plates, slightly concave, but otherwise similar to those below. From the records of instruments placed in the building, it would appear that at the time of the earthquake there was a slow motion backwards and forwards, but that all the sudden motion or shock had been destroyed. Although this device somewhat mitigated the effects of earthquakes, the motion produced by walking, by the wind, and by other causes, resulted in effects much more serious than those due to ordinary earthquakes. To increase the rolling friction, the author next employed 8in. shot, and after that 1in. shot. The last attempt was to support the building at each of its six piers upon a handful of ¼in. cast iron shot resting on flat plates. By this means friction had been so much increased that the house stood solidly, and unless its free foundations were pointed out, the peculiarities of the building would not be noticed. Its movement at the time of an earthquake was very small. If still finer shot and in greater quantity could be employed, the resultant advantages might be increased. These experiments showed that light one-storied buildings, like bungalows, built of wood or iron, might be put up so that sudden horizontal motion of the ground could not be transmitted to them. Experiments with regard to deep foundations had been carried out in a pit 10ft. deep and 4ft. wide. At the bottom, where there was a natural hard earth, a seismograph proved that there the motion was always very small. The question of how to avoid destruction, due to the acquisition of momentum, was then discussed. It was pointed out that stresses and strains applied horizontally had chiefly to be dealt with, and not those due to gravity. This was illustrated by an ordinary masonry arch. For vertically-applied forces this was stable, whilst for horizontally-applied forces its stability solely depended upon the adhesion of the material which cemented it together. An examination of many brick arches which had been cracked by earthquakes showed, among other points, that if archways were indispensable, they should curve into their abutments, and not meet them at an angle. Another important rule was to avoid coupling together two portions of a structure which from their position were likely to have different vibrational periods. A remarkable example had been afforded in Yokohama after the earthquake of the 20th of February, 1880. A moderately high factory chimney was supposed to require support; it was therefore connected by an iron band to a neighbouring building. When the earthquake came, the band cut it in two. Chimneys of bungalows were liable to destruction due to difference in vibrational period. By themselves, either the chimneys or the roofs of the bungalows would have been secure, but when in contact they had been mutually destructive. If united, the various parts of a building, having different vibrational periods, should be connected by bonds so strong as to be constrained to move as a whole. Other observations indicated that in a severe earthquake the difference in phase of the portions of the building at the two sides of a crack sometimes reached two millimetres; from which it was deduced that portions of a building not likely to synchronise in their vibrational period ought either to be strongly tied together, or else, by joints intentionally left during its construction, be completely separated from each other. Finally, the author observed that in the construction of buildings in countries liable to earthquakes the most important principles to be followed were:—First, to provide against horizontally-applied stresses; secondly, to allow all parts of the building with different vibrational periods either to have freedom amongst themselves, or else to bind them securely together with long steel or iron tie-rods, especially at the floors and near corners; and, thirdly, to avoid heavy superstructures.

AN American paper says: "Small fly-wheels, cast hollow and loaded with lead, is a foreign notion that promises to become popular in this country."

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, December 26th.

TO-DAY'S advices from various manufacturing sections throughout the United states indicate a steady improvement in several cases, chiefly in iron and steel. Brokers to-day received urgent inquiry from buyers of old rails in the interior, but are unable to fill orders, as rails cannot be had. Old steel rails are in active demand, and tide water quotations are 15 dols. to 16 dols. 50 c. American Bessemer is steadily advancing, and English is held more firmly. The pig iron industry is steadily improving, both north and south, under the active demand, and local brokers are now negotiating for large deliveries during the first quarter of the year on a basis of 16 dols. to 17 dols, for standard forge and 17 dols. to 18 dols. 50 c. for two and one foundry irons. Buyers in Scotch report increased inquiry, and the American imitation of Scotch iron is in very active demand at 1 dol. per ton higher price. Tin is in active demand at 20·55; tin plates, 4·40; lake copper, 10·45; lead 4·65; spelter, 4·40. A general strengthening of prices is probable during January, owing to the course of consumers of iron, steel, and metals throughont the United States in departing from the hand-to-mouth policy of the past two years, and anticipating requirements one to two months. The bar, sheet, and plate mills will also resume full time January 1st. Angles and plates are selling at 2 cents; sheet iron, 3·5 to 4 cents; merchant bar, 1 dol. 50 c. to 1 dol. 80 c. Old rails are 20 dols. to 21 dols. nominally. Manufacturers of textile machinery report an influx of orders of all kinds for cotton, woollen, and silk mills. Three silk mills will be erected during the coming season. The industry is extending Westward, and Eastern Pennsylvania, the centre of the anthracite coal field, has been selected as the point for the establishment of new enterprises. The latest advices from the industrial centres in the South show that an improvement there is as general as here, and that crude iron has advanced 50 cents to 1 dol. per ton; that the cotton mills are full of orders, and that railway enterprises are being pushed forward under favourable weather. Large tracts of lumber land are offered for sale, and in view of the fact that railroads will penetrate these new regions, the properties offered are attracting the attention of capitalists.

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

(From our own Correspondent.)

ON 'Change in Wolverhampton yesterday, and in Birmingham this—Thursday—afternoon, interest was chiefly centred in the probable effect upon selling prices of iron of the reduction in ironworkers' wages. Merchants are already intimating that new orders must be subject to a drop of something like 2s. 6d. per ton. Makers will resist the demands as long as possible, and they declare that prices are already at such a point that there is no room for further ease. The lower wage rate only means a lessened cost of production of about 1s. 3d. upon bars, and possibly 2s., or slightly more, on the thin gauges of sheets.

Thin sheet makers report that orders at the moment are not so numerous as lately, but they are nevertheless well occupied. The Continental, United States, and Australian demand keeps up, upon the whole, well. Working-up sheets are quoted £10 to £11, and stamping sheets, £11 to £12.

Galvanisers are busy upon sheets, but a great proportion of the work is going to the colonies on consignment, and this keeps prices very low; 24 w.g., bundled, delivered Liverpool, are quoted £10 15s. to £11 of average quality. Some buyers are purchasing for much less.

Concerning prices, the basis of £7 10s. per ton for marked bars is still adhered to, but the actual sales effected at this figure, or even at £7, are very limited. Excellent bars are abundant at £6 10s. Unmarked iron is quoted from £6 5s. down to £5 5s. In hoops a fair amount of business is doing at £5 7s. 6d. to £5 10s. for common sorts. Gas tube strip has changed hands this week in considerable quantities at £5 2s. 6d. Galvanising sheets—singles—are £6 7s. 6d. and upwards, and merchant sheets £6 5s. and upwards. Galvanising doubles are £6 10s. to £6 15s., and latters £7 12s. 6d. to £7 15s. per ton.

The unmistakeable revival in the American iron and steel trades is exciting hope for the new year amongst watchful members of the Staffordshire iron trade. A sustained revival in the United States always, it is pointed out, reflects itself in an improved state of the English iron and steel trades. At the moment, however, new business is largely suspended until after the quarterly meetings of next week.

Much interest has been excited here by the success of Messrs. W. Briscoe and Sons, merchants, of Wolverhampton and London, in securing from the Government of Melbourne the contract for 40,000 tons of steel rails. It had been thought that the International Railmakers' Combination would have secured the work, but it is supposed that Messrs. Briscoe managed to underquote the Combination. Messrs. Briscoe are understood to be seeking German as well as English tenders. It is believed that the German mills will probably accept the lowest prices, and so get the bulk of the work, though some 2000 tons have already been placed with Messrs. Cammell and Co., Sheffield.

Mr. Alderman Avery, the president of the Iron Trade Wages Board, has awarded a reduction of 5 per cent. in the wages of millmen, and 6d. per ton in the wages of puddlers. The employers had asked for a reduction of 10 per cent. The award does not come into operation until the 16th inst., and is to remain in force for three months' certain. After that it may be terminated by either side on a month's notice. Puddlers' wages now become 6s. 9d. per ton.

Although Messrs. J. B. and S. Lees, West Bromwich, have been able to get men to operate their thin sheet mill at 10 per cent. reduction in the wages, yet the hands who have refused to accept the reduced scale continue to agitate against the step. A meeting of delegates from West Bromwich, Great Bridge, and Tipton districts has been held, and the meeting pledged itself to support the men who are out on strlke.

Numerous inquiries are still upon the market for pig iron to be delivered over the ensuing six and nine months. Heavy sales could be made if sellers were prepared to accept the prices offered. This is particularly the case as regards Midland brands of pigs; but principals step in and prohibit the acceptance of the business. They are holding for more money than buyers will at present give. Northampton pigs are quoted 38s. 6d. to 39s., delivered to consumers' works. The Wingeworth brand of pig is very firm at 39s. 6d., and orders at less have this week been refused; and other good Derbyshires are quoted at 40s. delivered. Lincolnshire pigs are 41s. to 41s. 6d.; the Thorncliffe—South Yorkshire—brand, 50s.; North Staffordshire, about 47s. easy; and hematites, 54s. as an average.

The outlook for constructive engineers in 1886 is not without features of encouragement. Engineers here are not disposed to believe that although the new large Chinese loan may be raised in Germany, yet that the contracts for the railways and other public works needed by the Chinese Government will be given exclusively to Germany. Local firms are hoping to by-and-bye get some of the work. The increased expenditure of the Indian Government, under the head of railways and some other works, is also a source of gratifying expectancy for the new year. Again, it cannot but be that if the promising Congo Railway scheme is carried through by Manchester, good orders in connection therewith will fall to Staffordshire and district firms.

An attempt will be made to secure for this district the contract for workshop machines which the Southern Mahratta Railway Company is about to give out. Some makers of steel buoys will also tender for the order for twenty-five spherical and twenty-one cylindrical buoys, to be made of best quality Siemens steel, which are needed by the Trinity House Corporation.

I have previously announced that Messrs. Simpson and Wood, engineers, James Bridge, are the contractors for the erection of the International Exhibition buildings, which are to be opened in May in Liverpool. The time allowed for the completion of the contract was so short that it would have been almost impossible for the ironwork to be made and erected in the time. Messrs. Simpson and Wood, therefore, have purchased the extensive building in which the Belgian Exhibition was held during last year at Antwerp. Hundreds of men have been employed in taking down that structure, and are now employed in re-erecting it upon a different plan in Liverpool. The Antwerp Exhibition covered something like ten or eleven acres, and the Liverpool Exhibition will cover a greater area, for an additional annexe is included in the design. There are more than 1500 tons of ironwork to be removed and re-erected, while of glass and zinc for the roofing there are some 200 tons to be used. The contract runs into many thousand pounds. All this ironwork is to be enclosed, not by brick, but by timber, of which some thousands of tons will be used.

Bridge builders learn without satisfaction that the Australians are becoming their own bridge builders. A good contract has just been received by a Wolverhampton merchant firm, who have a large Australian connection for bridge iron for one of the Australian colonies, and the colonists will themselves make the structure. The order has found its way from the merchants' hands to one of the North Staffordshire ironworks.

Iron pipe founders in Staffordshire are discussing this week the success of Messrs. McFarlane and Co., Glasgow, and the Staveley Iron Company, in having divided between them the contract for 50,000 tons of pipes given out by the Manchester Corporation. It is understood that the delivery is to extend over more than three years. The work is therefore deemed rather risky for the contractors. Nevertheless, pipe founders here admit that they would be glad of the opportunity for tendering for any other big job, should any such come out by any chance, even if the delivery was prolonged.

I have previously spoken of the sharp competition which hardware manufacturers are experiencing from Germany. That competition is increasing. Merchants here are now buying wire nails and iron wood screws of German make greatly under Messrs. Nettlefold's prices, and of a quality and finish which are perfect. South American merchants are also placing orders for axes and other edge tools with German makers at prices much below those which Birmingham and Wolverhampton edge tool manufacturers can accept. Manufacturers here are declaring that the only solution of the difficulty will be either imposition by Government of import duties or the working of longer hours by English workmen.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—During the past week business has scarcely settled down sufficiently after the holidays to afford any really trustworthy basis for an estimate of the actual condition of trade. There is, however, but too plainly evident an absence of any indication of improvement; there is still no weight of business coming forward or in prospect, and the tendency of prices is rather towards weakness than firmness. There is, in fact, nothing in the present outlook to encourage the hope that the new year is going to bring forward better trade than has been experienced during the year just closed. In the pig iron trade a depressing effect is produced by the heavy stocks held at Glasgow and Middlesbrough, which would seem to render the ruling of low prices almost inevitable for some time to come; hematites have sunk back into quietude under the advanced prices which makers have recently been asking; finished ironmakers have very little work before them, and to keep the forges running from hand-to-mouth are compelled to accept prices that are under cost, whilst buyers hold back in the expectation that the reduction in wages will result in some further concessions in their favour. The prospect in the engineering trades is very discouraging. With the resumption of work after the holidays numbers of men have been stopped, and many of the shops have had to be put on short time.

The Manchester iron market on Tuesday brought together a fairly good attendance, but business was extremely flat. For Lancashire pig iron makers were quoting their late rates of 39s. for forge and 39s. 6d. for foundry, less 2½, delivered equal to Manchester. One or two inquiries were reported, but any actual offers were at under the above quoted figures, and there is little doubt that the present condition of trade would induce makers to concede something on their list prices rather than allow business to pass. The only business reported in district iron was a moderately large sale of one of the better class brands at about late rates; in many cases sellers were without quotations, but judging from the excessively low prices at which second-rate brands could be bought, it is evident that makers will have some difficulty in maintaining the rates which were being quoted before the close of last year. North-country iron is decidedly easier, the best-named brands of foundry not being quoted at more than 41s. 4d. net cash, delivered equal to Manchester, whilst good ordinary brands could be got at considerably under this figure.

For good foundry hematites the average quoted prices for delivery into the Manchester district were about 53s. 6d. to 54s., less 2½; but buyers were not disposed to pay these figures, and in some instances sellers were prepared to take lower prices to secure orders.

In finished iron trade generally was reported as very quiet. Rather more inquiry seems to have come forward in one or two departments, chiefly in hoops for shipment to America, and some moderate sales have been made at low prices. In other departments, however, the tone is reported as quieter, if anything, and prices continue very low. For anything like forward delivery makers quote £5 5s. for bars equal to Manchester, but for prompt specification in quantity £5 2s. 6d. is being taken in most instances.

The most important matter of interest during the present week is the movement for a general reduction of wages in the engineering and iron trades of the district, and which is practically the prelude for similar general movement throughout the country that has been set on foot by the Iron Trades Employers' Association. In my "Notes" of last week I intimated that a general understanding had been arrived at amongst the employers in the various industrial centres that a general reduction in wages should be made. This has already been commenced in the leading shipbuilding districts; but as regards the general engineering and iron trades the first announced step in the direction of reducing wages has been taken in the Manchester district, which also took the lead in advancing wages in 1882, and in view of the importance which attaches to the action now being taken here, it will be as well if I quote in full the circular which has been sent out this week to the members of the Employers' Association:—

THE IRON TRADES EMPLOYERS' ASSOCIATION,
MANCHESTER. January 4th, 1886.

Re *Reduction of Wages in the Manchester District.*

Dear Sirs,—At the meeting of the members of this Association, and of other employers in the iron trades of this district, held in these offices on Tuesday last, December 29th, 1885, I was instructed by resolution to send to you, and to every member in the district, duplicate copies of the notice for the reduction of wages which had been agreed upon on the 22nd, and finally confirmed on the 29th ultimo.

Printed copies of the notice are enclosed herein, and in connection therewith, I have also to send you a copy of the undertaking, which was signed by the members present, and fixes the date for putting up the notice, and carrying it into effect. The document runs as follows, viz.:—

"We hereby undertake to put up a notice in our respective works on or before the 9th day of January next, that we will reduce the wages of our workpeople to the same rates at least as were in force in 1879 And we undertake that this reduction shall come into force within 14 days of the above date."

I shall be glad to send you additional copies of the printed notice if you require them, and will forward them upon receipt of a note from you to that effect.

Notices for reductions of wages have been posted in many of our chief engineering districts. In Belfast—the lowest rated engineering district in the kingdom—the men have at once accepted the reduction. In Liverpool and Birkenhead, uniform notices were posted up on the last day of the old year, and the reductions will come into force on the 22nd inst. In Glasgow and on the Tyne and Wear, and at Barrow-in-Furness, notices for reductions have been given, and the movement is evidently of a general character.

I shall be glad to hear that you have received the enclosures, and have dealt with them in the manner provided by the resolution.—I am, dear Sirs, yours truly,

E. Hutchings, Secretary.

The following is a copy of the notice referred to in the above circular:—

Notice to Workmen.—In consequence of the depressed state of trade and the high cost of production in this district, the wages of all workmen in these works will be reduced about 7½ per cent., or to the rate paid in the early part of 1879. This notice to take effect on the last pay day in the present month, January 9th, 1886.

This reduction in wages will not come upon the workmen by any means as a surprise; in fact, the course of action to be taken when the reduction should be put in force has of late been one of the most serious questions they have had in view. Nothing definite has of course yet been decided upon. Already an exceptionally large number of members are on the books of the trades' union societies for out-of-work support, the number being almost double as compared with this time last year, and this has necessarily entailed a serious drain upon the resources of the societies. It is therefore very questionable whether the societies are in a position to enter upon anything like a general strike, and, so far as I have been able to gather, the feeling is rather in favour of opposing the reduction by fighting one single firm that may be the best employed in the district. The societies assert that they are exceptionally strong in the best firms, and by fighting one firm, where they can do the most injury, it is evidently thought they may have some chance without incurring the large outlay which would be incurred by a general strike. Of course, if such a scheme were attempted, the employers would be able to meet it by a general lockout.

In the coal trade business has been very partially resumed during the past week. Many of the colliers had only on Wednesday got into full work after the holidays, and in the market there has been only a poor demand generally for either house-fire coals or fuel for iron making and steam purposes. The rates of last month remain the basis for quoted prices, but except that for house-fire coals prices are steady, the tone of the market is weak rather than firm, and inferior descriptions of slack are pressed for sale at extremely low figures.

Barrow.—The iron trade has opened in a fair position with the new year, and the probabilities are that the demand, which for the present is more active than it has been for some time past, will improve as the season advances, and that more business will be done with foreign and colonial consumers than has been the case during last year. The make is still comparatively small, and the furnaces are more than half of them out of blast. Stocks are not so large as they have been, and they are likely soon to be reduced, as steel makers who have enlarged order sheets to deal with are using more iron. Further orders are expected from America for rails, but the continental and colonial demand is very much restricted. Prices are steady at 45s. per ton for No. 1 Bessemer net at works, prompt delivery, 44s. 6d. Nos 2, 44s. No. 3, 43s. to 43s. 6d. No. 3 forge and foundry iron. Heavy sections of steel rails £4 15s. per ton net. Shipbuilders have not secured any new contracts, and very few are offering. Rumours are afloat that a considerable reduction will soon be brought about in working men's wages in this and other trades. The engineering trade is very quiet, both in the general and marine departments.

Considerable progress has been made of late in the construction of the high level bridge at Barrow. The Furness Railway Company has been engaged in doubling the width of that portion of the bridge which spans the docks and the railway, and it has added another hydraulic drawbridge in the centre across the entrance from the Devonshire to the Buccleuch Docks. The Corporation of the town have nearly completed the work of carrying the bridge from the railway into the main street of the town. Two lines of tramways will cross the bridge, and when completed this work will not only prove one of the most useful, but certainly one of the most imposing and attractive features in the town.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The Victorian steel rail contract continues to excite much interest. It was a surprise to find that it had been taken by Messrs. W. Briscoe and Sons, Australian merchants, of Wolverhampton and London. The expectation was that the steel rail ring would secure the work, and there is only one explanation of Messrs. Briscoe's success—that they underquoted the syndicate. The price is not known, and probably will not leak out for some time; but if the steel rail makers of South Wales, Sheffield, and Barrow are successful in tendering for such quantities as Messrs. Briscoe may offer, a pretty shrewd guess will be given of the price received by the contractors.

The "scare" of the week has been the publication in the *Times* of the formidable combination formed by Germany to establish a commercial monopoly in the Chinese Empire. The scheme has been, in vulgar parlance, "blown upon" so early that our authorities may have time to put the Chinese on their guard against the insidious purposes of the German Confederation; but if the three plenipotentiaries now on their way to China should be successful in their mission, all hopes of England having a share in the great business anticipated from the opening up of the Celestial Empire must be abandoned. It is remarkable how widely and effectively Germany is competing with England for the commerce not only of the new markets in the East, but of the old ones in the West. China is the latest example of the first, and each day furnishes fresh evidence of the second.

A Sheffield house of the highest standing in the cutlery world found their name stuck upon a sixpenny knife exposed for sale in a local ironmonger's window. The knife was not badly made, and being admirably finished, was a remarkably good sixpenny worth. It was ivory-handled, and two bladed. The principal of the firm whose name had been thus falsely used told me that the ivory scale could not be bought in the ordinary way of trading for less than 6½d., and yet the whole knife was offered retail at 6d. How was it done? The knife was a German production; but the Germans, clever as they are, do not make real ivory, and must buy it in competition with other firms at the ordinary market value.

The *Sheffield Daily Telegraph*, at the end of every year, makes a careful analysis of the condition of local limited companies in the district, or the shares of which are mainly held in the locality of Sheffield. The figures, as given this year, are so appalling that they have excited general surprise, and have been quoted on every side. The companies dealt with are mainly connected with coal, iron, steel, cutlery, ordnance, plated goods, edge tools, &c. The total called up value of forty-four companies is £11,822,630, and the present market value is £9,406,135, the net depreciation on the whole being, of course, the difference between these figures—£2,416,495. This is an enormous total, but great as it is, does not represent the entire loss sustained by investors under the Limited Liability Act in this district. Many companies, whose working record was very black, have disappeared altogether, engulfed in ruinous liquidation, and in other instances the shares which now are at a discount were purchased at long premiums. Of the whole forty-four companies, only nine showed an increase in value above the paid-up capital in 1885, the increase amounting to £1,410,007, while thirty-five companies showed a depreciation of no less than £3,826,502.

Work was fairly well resumed on Tuesday, after the holidays, and several good advices are already reported from the United States, Canada, India, and Australia. In several of the plated and edge-tool establishments there will be little done before February; but it is anticipated that spring will be busier than the opening months of last year, and energetic efforts are being made to retain the old markets and possess the new.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The tone of the Cleveland pig iron market has not improved during the last few days, the heavy increase of stocks both at Middlesbrough and at Glasgow having a very depressing effect. At the market held at Middlesbrough on Tuesday there were but few inquiries, and scarcely any sales. With the present unfavourable prospects before them buyers are unwilling to purchase except for the supply of their immediate needs, and they offer only 31s. 1½d. per ton for No. 3 g.m.b. Merchants, however, refuse to accept less than 31s. 3d., and makers quote 3d. to 6d. per ton more. The demand for forged iron has slightly improved now that some of the mills have resumed work, but not more than 30s. 6d. per ton is obtainable.

There are some buyers in the market who are willing to give 31s. 6d. per ton for warrants, but holders ask a shilling more. No business is done.

Large quantities of Cleveland pig iron are still being sent into Messrs. Connal's store. On Monday last their stock had risen to 144,391 tons, being an increase of 7559 tons during the week.

Certain of the rolling mills at Stockton, and those of Messrs. Dorman, Long, and Co., at Middlesbrough, resumed operations on Monday last, and continue working on the specifications which have accumulated during the holidays. There is, however, no improvement in the demand, and prices remain unaltered.

The Cleveland ironmasters' statistics for the month of December and for the whole of last year have just been issued. The make of pig iron of all kinds during December was 214,491 tons. The output during the year was 2,458,839 tons, being about 25,000 tons less than in 1884. The total stock of pig iron in the Cleveland district on December 31st was 517,488 tons, which represents an increase for the month of nearly 47,000 tons. At the end of 1884 the stock was only 338,689 tons, it has therefore risen 178,799 tons during twelve months.

The shipments of pig iron from the Tees during last month only amounted to 57,421 tons, of which more than half was sent to Scotland. The total quantity of pig iron shipped last year was 841,799 tons, or 85,057 tons less than during 1884. Of this Scotland took 358,452 tons; Germany, 119,398 tons; Holland, 75,016 tons; and France, 53,155 tons.

The average net selling price of Northumberland coal during the three months ending November 30th last was 4s. 9·36d. per ton. Under the provisions of the sliding scale in force in that county, the wages of the colliers will be reduced 1¼ per cent.

The vessels built in Tyneside shipyards last year amount to a total capacity of 25,057 tons, or 3854 tons less than during 1884. On the Wear forty-six vessels were built, amounting to 61,768 tons, as compared with seventy vessels, of 98,424 tons, during the previous twelvemonth.

Messrs. Bolckow, Vaughan, and Co. have decided to make certain alterations and extensions in their steel-making plant. Inasmuch as they have hitherto had only two Siemens furnaces, the produce of which in ingots could not exceed 300 tons per week, it was quite clear that they would be driven to put up more. Their plate and angle rolling machinery is equal to at least 1000 tons per week, and requires about 1400 tons of ingots to keep them in full operation. The recent decision of Lloyd's Committee excluding for the present all basic steel from being used in shipbuilding, has no doubt compelled the step in question, as the only alternative against allowing this part of their plant to remain idle. There is now considerable danger of steel-making by the Siemens process being overdone, even in the North of England, where hitherto manufacturers have been rather behindhand. Thus, in addition to the new plant about to be put down by Messrs. Bolckow, Vaughan, and Co., and the extensive plant of the Consett Iron Company, there are the steel works just completed by Palmer's Shipbuilding and Iron Company, at Jarrow, and also a somewhat smaller works in operation at Spennymoor. Besides these there are not less than three steel melting plants for the purpose of making castings, viz., that of Spencer and Sons, at Newburn, near Newcastle; that of the Wolsingham Steel Company, and that of Messrs. Butler Brothers, at Middlesbrough. There is scarcely sufficient work in ship and boiler building to employ fully all these places, but they are being put down, no doubt, more with regard to future than to present needs.

It is reported that arrangements are about to be made for the defence of the Tees and the shipping in the river, by forming a submarine depôt close to the mouth of the river. It does not yet appear, however, in what way this submarine chamber will be used.

The failure has been announced of Messrs. G. E. Casebourne and Co., iron merchants, West Hartlepool. A heavy bad debt which they have made with a large customer at Genoa is said to be the cause. Two or three Cleveland firms will suffer, but not to any very great extent. A vessel laden with over 1000 tons of section iron was just about to leave Middlesbrough on account of Messrs. G. E. Casebourne and Co., when she was stopped by the manufacturers. It is thought that there will be sufficient assets to pay a good dividend to all those who have unfortunately become involved. Messrs. Wigham, Richardson, and Co., of Low Walker, near Newcastle-on-Tyne, have received orders for five iron ships, which they will commence to build immediately. There seems to be a reaction at present at most of the Northern ship-owning ports in favour of iron as against steel. This is, perhaps, only the natural result of the troubles which have recently occurred with regard to the latter material. Although there is still a large number of vessels, especially steamers, laid up in port, there has been during the last two or three weeks a largely-increased inquiry for new ones. At some price new vessels, fitted with triple expansion engines and all latest improvements, will pay a dividend to their owners, even at the present low freights; and it is such minimum prices that are now being offered. Not much business has yet resulted, but several negotiations are in progress. Inasmuch as labour and material are both down to their lowest ebb, any shipbuilding carried on at present must prove in the future an excellent investment.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been comparatively little doing in the iron market this week, on account of the new year holidays. Many of the public works have been practically closed for a great part of the week, and so also have been the collieries. The pig iron market re-opened on Tuesday, but has been comparatively depressed. The shipments of pigs in the past week were small, amounting to 4955 tons, as compared with 4670 in the preceding week, and 5815 tons in the corresponding week of 1885. In the course of the week between 2000 and 3000 tons have been added to the stock in Messrs. Connal and Co.'s stores.

The warrant market closed on Thursday, with sellers at 41s. 1½d. cash. Business was done at the opening on Tuesday at 41s. 0½d. to 40s. 11d., again recovering to 41s. 0½d., but the tone was flat in the afternoon at 40s. 11d. cash. On Wednesday business was done at 40s. 9½d. to 40s. 3d. cash. To-day—Thursday—transactions took place at 40s. 1½d. to 40 4½d. cash, closing with buyers at 40s. 4d. cash.

The market values of makers' iron are as follow:—Summerlee, f.o.b. at Glasgow, per ton, No. 1, 51s. and No. 3, 44s. 6d.; Coltness, 49s. 9d. and 45s. 9d.; Calder, 50s. 6d. and 43s. 6d.; Langloan, 46s. 6d. and 44s. 6d.; Gartsherrie, 45s. 9d. and 43s.; Carnbroe, 45s. and 43s.; Clyde, 45s. and 42s.; G.M.B., 41s. 6d. and 39s.; Shotts, at Leith, 47s. and 46s.; Carron, at Grangemouth, 47s. and 46s.; Kinneil, at Bo'ness, 43s. and 42s. 6d.; Glengarnock, at Ardrossan, 46s. and 42s.; Eglinton, 41s. 6d. and 38s. 9d.; Dalmellington, 43s. 6d. and 40s. 6d.

The Scotch steelmakers held a meeting a few days ago to reconsider the question of prices and certain other matters connected with the trade. No changes were resolved upon, but it is probable that another meeting will take place at an early date. Only one of the Scotch companies lays itself out to manufacture steel rails, and it is not expected that much work of this description will come to Scotland at present. The quality of the Siemens steel which they make for shipbuilding and engineering has, however, been proved to be so universally excellent, that the Scotch makers are likely to maintain and extend the excellent position they occupy with respect to it.

The Committee of Selection of the Manchester Town Council have awarded a large portion of the Thirlmere cast iron pipe contract to Messrs. Macfarlane, Strang, and Co., of the Lochburn Ironworks, Glasgow. The firm has been engaged throughout the year with the Sydney pipe contract, which will be completed in the course of the next few months, and their success in obtaining the Manchester order, the money value of which is stated at £110,000, will enable them to keep their extensive works fully employed. It is understood that the greater proportion of the pig iron for casting the pipes will be imported from Middlesbrough.

The past week's shipments of manufactured iron and steel goods from the Clyde embraced a steamer in pieces, worth £7420, for Rangoon; machinery, £4800; sewing machines, £5000; steel goods, £4920; and general iron manufactures, £12,500.

The coal trade has been quiet in the past week, on account of the New Year holidays, and the shipments are therefore smaller than usual. The quantity despatched from Glasgow was 17,947 tons; Greenock, 1416 tons; Irvine, 1345; Ayr, 6417; Troon, 5837; Leith, 3126; and Grangemouth, 2920 tons.

In the West of Scotland the miners in some districts have been practically on strike since the beginning of December for an advance of 6d. a day. Some of the masters may possibly concede the demand for a little, but the state of the trade is not such as to warrant a general increase of wages.

The holidays have been prolonged in Fife and Clackmannan in consequence of the dulness of the coal trade. The shipping inquiry is at present backward, and prices are 6d. to 1s. a ton less than they were at this date last year, the minimum rates being 5s. 9d., 6s., and 6s. 3d. per ton f.o.b. at Burntisland.

The shipping trade of the Clyde in the past year gives an aggregate inward tonnage of 1,377,668 tons, being 117,422 tons over that of 1884, and 79,585 tons more than in 1883. The outward tonnage has been 1,672,414 tons, a decrease of 18,521 tons as compared with 1884.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

It is gratifying to be enabled to state that the two leading staple industries, iron and coal, are showing better form and tone with the New Year. Coal, perhaps more than iron and steel, is yielding more promising signs, and this extends alike to house coal and steam coal. In reference to steel, it is confidently predicted that large orders are forthcoming. One of 40,000 tons for the Victorian Government has already gone to the North, and I have heard that the Welsh ironmasters were asked to send in tenders for a portion of this, but that their figure was too high to leave sufficient margin for profit to the Wolverhampton merchant who obtained the Victorian order. I do not think our makers would refuse any reasonable offer unless they have good grounds for expecting substantial orders.

Stock is now held to a good round amount in several quarters, and if expedition is of importance large orders could easily be attended to with only the delay of conveyance to the seaboard.

If the expected trade does not come in, there will be a strong feeling in favour of check-mating Germany by putting import duties on their productions to us.

The Cardiff shipments of iron and steel last week amounted to 4600 tons. From Newport, Mon., there were some tolerable cargoes sent: 1900 tons to Bombay; 1055 tons to Rockhampton; 650 tons to Colombo; 250 tons to Paysanda; and to Colombo, 1823 sleepers. By rail also some consignments of rails and bars for home use.

The total coal exports from Cardiff last week were close upon 132,000 tons; from Newport, 31,700 tons; and 23,240 tons from Swansea for foreign destinations. It will be seen that quantities do not as yet vary much from those of the last quarter, but we are assured that the promise is better, and very likely the next totals we record will bear this out. Prices are firm for best qualities; seconds vary somewhat, according to the need of the buyer, 3d. and even 6d. per ton being added or subtracted according to bulk or pressure for shipment. Steamship owners are rather dolefully scanning their balance-sheets for the last year. If coalowners and ironmasters suffered, so most assuredly did steamship owners. The trial has been a severe one, and has told on the social life of the three leading ports—Cardiff, Newport, and Swansea.

Subscriptions are being solicited in aid of the Mardy explosion fund, and will, we hope, be forthcoming. Some years ago I advocated in these columns the necessity of making it legally compulsory upon landowners to contribute a fraction per ton out of their royalties towards miners' accidents. My contention was this: that owners of farms which were worth only £20 a year before the development of the coal beneath them, suddenly became enriched to the extent of several thousands sterling per annum, and it was a moral obligation upon these to contribute. Something like five years have passed, and "moral obligation" has brought little fruit. Men getting £20,000 a year from the Rhondda Valley do not give a pennypiece towards the fund, and in the event of an accident such as Mardy, dole out a £10 cheque only. This scandal is being strongly discussed, and I shall fully expect that Sir W. T. Lewis will move in the matter and endeavour to get it legally compulsory upon landlords to assist.

A very compact wire works, fitted with best and latest machinery, is in the market, and efforts are being made to float it. Railway and canal conveniences are good. Cwmtillery men numbering 1000, who left work at their collieries on account of a disagreement, are offering to go back on conditions which appear easy.

The Mardy pit is again at work. I am glad to hear that scientific opinion is against the theory of the explosion being due to the Comet light used by the masons in turning the arches. If this had been the case the arches would have been injured or affected. A "sudden blower and a defective gauze" is now stated as the likely cause, and the coal dust as extending the mischief.

The tin-plate trade has not shown any distinctive feature during the last week. Prices are still rather unsteady, and the "threepenny drop" in cokes, Bessemers and Siemens, promises to be a sixpenny one. Ordinary cokes were sold this week as low as 13s. 9d.

The tendency in the tin-plate trade at present is towards a systematic reduction of wages. The trade is fairly good, but characterised by spurts, and makers are less benefitted, on the whole, than workmen by this occasional improvement in price. It is contended that workmen are better paid, and out of all proportion, in this industry, than in iron and coal; so I expect as a variation to the stop week we shall have reduction. Yspitty Works have given notice of this.

A meeting of house colliers is announced for the 18th, to discuss certain action at certain collieries showing a tendency to infringe the spirit of the "sliding scale."

Patent fuel trade dull at Cardiff and Swansea.

The completion of the Rhondda and Swansea Bay line is beginning to be predicted. It is said that Cardiff firms will migrate to Swansea, but I doubt it; they may start branches.

NEW COMPANIES.

The following companies have just been registered:—

Buenos Ayres and Mercedes Railway Company, Limited.

This company was registered on the 30th ult. with a capital of £600,000, divided into 20,000 preference and 10,000 deferred shares of £20 each, to purchase from Juan Eduardo Clark, or Mateo Clark, or others, so much of certain concessions from the Minister of the Home Department of the Argentine Republic, for the construction of a projected system of railways from Buenos Ayres to the town of San Juan, through Rojas, Villa Mercedes, San Luiz la Pas and Mendoza, and also from Mendoza toward Chili, as relates to that portion of the said authorised railways which lies between Buenos Ayres and Mercedes. The subscribers are:—

	Shares.
J. C. Bunten, Glasgow, managing director of the Andersten Foundry Company, Limited	1
Henry Wallis Hunt, 26, Parliament-street, engineer	1
P. Riddoch, 93, Leadenhall-street, shipbroker ..	1
G. Earl Church, Dashwood House, contractor ..	1
E. M. Underdown, 3, King's Bench-walk, barrister	1
F. C. Norton, 2, New-square, Lincoln's-inn, barrister	1
E. G. Weaving, 24, Coleman-street, solicitor ..	1

The number of directors is not to be less than three nor more than seven; qualification, fifty shares; the first will be elected at a general meeting to be called for the purpose, the subscribers acting *ad interim*. The remuneration of the directors (other than the subscribers) will be a sum equal to £300 for each director.

Continental Etévé Engine Company, Limited.

This company proposes to acquire certain letters patent granted for the Etévé motor engine, power being also taken to carry on the business of mechanical and chemical engineers and electricians. It was registered on the 29th ult. with a capital of £450,000, in £1 shares, with the following as first subscribers:—

	Shares.
A. D. Moll, 15, New Broad-street, manager of a company	1000
E. J. Sheriff, 22, York-place, Portman-square, merchant	500
J. Lichfield, 61, Layspring-road, Leytonstone, merchant	300
J. Murphy, Wood-lane, Highgate, manufacturer	10
E. Fickling, Crouch-hill, merchant	20
R. Angus, 69, Holland-road, S.W.	300
J. J. R. Humes, C.E., 18, Lilford-road, Camberwell	200

The maximum number of directors is to be seven, and the minimum three; the subscribers are to appoint the first, and are to include in the number Mr. Albert Douglas Moll and M. Jean Andre de Braam, the latter of whom is to be appointed resident director at a salary of £300 per annum in addition to his remuneration as a director; directors' qualification, 500 shares; remuneration, £150 per annum for each director, with an additional £100 for the chairman. Within one month of allotment a workshop will be opened in Paris for the manufacture of engines, and a sum of £1000 will be set aside for carrying on the same. Mr. Eugene Etévé is to be manager at the works at a salary of £25 per month.

Congo Railway Syndicate, Limited.

This syndicate proposes to acquire from the King of the Belgians, or other competent authority, a concession of property, rights, and privileges in the Congo Free State, or any adjacent State or country, and to form a company for establishing direct and regular communication between the Lower and Upper Congo by the construction of a railway, with power to acquire and work light draught steamers on the river. It was registered on the 23rd ult. with a capital of £2000, in £5 shares. The subscribers are:—

	Shares.
*Lord Egerton of Tatton, Knutsford	10
*J. F. Hutton, M.P., 29, Dale-street, Manchester, merchant	10
*Jacob Bright, Alderley Edge, Sheffield	10
*H. M. Steinthal, 47, Lower Moseley-street, Manchester, merchant	10
*Henry Morton Stanley, 160, New Bond-street ..	10
*William Mackinnon, Clachan, Argyll, shipowner	10
W. Towers Smith, M.R.C.S., 36, Russell-road, Kensington	10
*Sir James Ferguson, Bart., M.P., Kilkerran, Argyll	10
*W. H. Houldsworth, M.P., Knutsford	10
Sir Henry E. Roscoe, M.P., Manchester	10
G. D. G. Taubmann, vice-chairman National African Company	10
J. H. Tritton, 54, Lombard-street, banker	10
S. L. Keymer, Parker-street, Manchester, merchant	10
C. Heywood, Claremont, Manchester	10
J. Jardine, Alderley Edge, spinner..	10
J. Lowcock, Broughton Park	10
R. Peacock, M.P., Gorton Hall, Lancashire	10
*D. Adamson, C.E., The Towers, Didsbury	10

The number of directors is not to be less than two nor more than twelve; the first are the subscribers denoted by an asterisk; qualification, £50 in shares or stock.

Grano-Metallic Paving Company, Limited.

Upon terms of an unregistered agreement of the 18th ult., this company proposes to purchase the interests of Messrs. Joseph Thompson and John Henry Bryant in certain patent rights, contracts, and other property relating to the manufacture and laying of pavement. It was incorporated on the 23rd ult. with a capital of £65,000, in £5 shares, 3000 of which are redeemable preference shares. The subscribers are:—

	Shares.
Frank Keed, Stock Exchange, dealer	1
W. E. Bryant, Stock Exchange, dealer	1
A. J. Sharpe, Manor House, Datchet, stock dealer	1
C. H. Wilkinson, 5, Whitehall-yard	1
E. J. Evans, Stock Exchange, dealer	1
A. Kennedy, 1, Clement's-inn, solicitor	1
Henry Johnson, 12, South-square, Gray's-inn ..	1

The number of directors is not to be less than three nor more than seven; qualification, forty shares. The first are Sir John Morris, General T. Addison, C.B., the Hon. Henry Roper Curzon, Messrs. W. Blewitt, J.P., Edwin Dixon, J.P., T. Saunders, J.P., and, upon completion of contract, J. H. Bryant. Remuneration, £100 per annum to each director.

Joseph Westwood and Co., Limited.

This is the conversion to a company of the business of engineer and contractor, bridge, girder, roof, and constructional ironwork manufacturer, carried on by Mr. Joseph Westwood at Napier-yard, Millwall. It was registered on the 30th ult. with a capital of £60,000, in £10 shares, with the following as first subscribers:—

	Shares.
*J. Jackson, Wilbury Rocks, Eastbourne	1
*Rev. J. Hawes, M.A., 1, Whitehall-gardens ..	1
T. B. Docura, Snaresbrook, Essex	1
C. Docura, Snaresbrook, Essex..	1
R. T. Reef, 26, Parliament-street, contractor ..	1
*C. J. Westwood, C.E., Snaresbrook	1
J. Toleman, Goswell-road, wall paper manufacturer	1

The number of directors is not to be less than three nor more than five; qualification, ten shares or equivalent stock; the first are the subscribers denoted by an asterisk, and Mr. Joseph Westwood; the company in general meeting will determine remuneration.

Production of Manganese in the United States.—The output of manganese ore in 1884 was about 10,000 long tons. The total value, at 12 dols. per ton at the mines, was 120,000 dols., or about the same as in 1883, the average price having declined 3 dols. per ton.

Ribble Navigation.—On the works now in progress for the construction of a forty-acre dock at Preston and the improvement of the navigation of the river Ribble, there are employed daily with the spade nearly 1000 men. Mr. Walker, of Westminster, entered into a contract with the Corporation of Preston at the beginning of the year 1885 for the building of the dock and the diversion of the river, &c., for a sum of £456,000. The borrowing powers of the corporation for these works, under the Preston Dock and Ribble Navigation Act, 1882, was £650,000. Up to the present time the corporation have paid to Mr. Walker £80,000, being, according to agreement, 90 per cent. of the work done. For land, compensation, surveys, and other charges, a sum of £140,000 has been paid; and for the deepening of the river near the estuary—a work not included in the contract—the corporation in September last resolved to purchase two dredgers at a cost of £38,300, twelve barges to cost £35,900, and two tugs at £4890 each—a total of £83,980 for appliances only for the performance of work outside the original contract. The aggregate amount of these various sums, with about £20,000 as the engineer's commission, shows that the corporation are already committed to an expenditure of £699,980, being £49,980 in excess of their borrowing powers. It will be readily understood, therefore, that there is much uneasiness in Preston among the ratepayers at the heavy drain that these works are likely to entail upon the resources of the town. The dredging operations, which will occupy five years, the provision of hydraulic machinery, and railways and roadways about the dock, have yet to be provided for, besides the payment of interest and repayment of loans. When it was agreed in public meeting of the ratepayers to apply for the Act, the *Times* says it was stated that the scheme would cost about half a million; but it was asserted as confidently by two or three gentlemen present that it would hardly be completed for less than a million.

Ventilation of Rooms.—In a letter to *Nature* on the ventilation of rooms, Mr. T. Fletcher says, the cause of the failure of the ceiling ventilators referred to by another correspondent, is a deficiency of fresh-air supply to the room. "An ordinary chimney with a fire will, if unchecked, draw an amount of cold air into the room which would make the temperature about the same as that of the outside air, and without enormous volumes of warmed air it is, I think, impossible to expect any service whatever from the system of ventilation from ceiling flues, as recommended by the writer of the article referred to. Since writing my first letter I have seen a regenerator lamp attached to one of these ceiling-flues, and the down draught was so strong and persistent as to reverse the natural current of the lamp, rendering its use impossible. The air inlet to my own rooms consists of a channel in the wall of every room opening into ten 1in. holes at the fireplace, but this, of course, is utterly inadequate to supply one-tenth of the air required by the flue, and the ventilator and the ventilating-shaft supplement this supply by working the wrong way." Another correspondent, Mr. W. Wilkinson, referring to a previous letter by Mr. Fletcher, says:—"A very common source of trouble with respect to ventilation is the absence of any arrangement for the supply of air to fires. So long as a fire draws on the general atmosphere of the room it is supposed to warm for its supply of oxygen, there must be the draughts so often complained of, and people are warm on the side next the fire and cold on the other. I should suppose that is what happens in Mr. Fletcher's case, described in his letter in *Nature*, pp. 153-4. If so, there is simply a sort of tug-of-war between the longer chimney-flue and the shorter ventilation flue, with the additional advantage on the side of the former that the volume of air ascending the chimney is necessarily much warmer than that which should ascend the ventilation flue. If, however, Mr. Fletcher will have a couple of holes bored in his floor, one on each side of the fireplace, so as to supply air directly to the fire, the pull of the fire on the air of the room will cease, the room will be warmer, and his ventilation flue should work satisfactorily. I warm thoroughly a room with considerably over 2000 square feet of floor area by means of three small stoves. When first used the stoves were inefficient, as there was a draught all round each towards it. A common rain-water pipe bend, inserted in the floor immediately in front of the aperture of each stove for admitting the air supply, stopped the draughts, and at least doubled the efficiency of the stoves as warmers. With the help of Tobin tubes there is now a gentle current of warmer air from each stove. The heated and vitiated air escapes through ventilators fixed in the ridge of the roof."

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

29th December, 1885.

15,951. Fluid Meters, H. J. Allison.—(*H. M. Bartlett and W. H. Brown, United States.*)
15,952. Spiral Spring Fastener for Gloves, &c., N. Arthur, Leith.
15,953. Making Size, A. Hieronimus, Glasgow.
15,954. Crushing Stone, &c., G. Lowry, near Leeds.
15,955. Candlestick and Case, H. Roberts, Clynnog.
15,956. Electric Batteries, W. S. Whittier, Bristol.
15,957. Water Taps, &c., J. Easby, Sheffield.
15,958. Shell for Dynamite Detonators, G. Bloem, London.
15,959. Separating Liquid from Solid Matters, Cordner, Allen, and Co.—(*P. Gaillet, France.*)
15,960. Scissors, St. J. V. Day.—(*F. Howell, New Zealand.*)
15,961. Combined Photograph Album and Show-case, T. A. Moryson, Glasgow.
15,962. Bottle Stoppers, J. Holmes, Keighley.
15,963. Expanding Frames, W. H. Coddington, Brighton.
15,964. Rafting Logs, &c., H. R. Robertson, Canada.
15,965. Packing of Sensitive Tissues for Photographic Purposes, W. H. Walker, London.
15,966. Mechanical Motors, J. Y. Johnson.—(*A. F. Martel, Canada.*)
15,967. Electric Transmitting Telephones, J. T. Dempster, London.
15,968. Frosting Gold, &c., J. Whitehouse, London.
15,969. Clips for Endless Rope Haulage, J. Archbold, London.
15,970. Urinal for Invalids, &c., W. F. Thorpe, London.
15,971. Injector for Surgical Purposes, A. E. A. Ruault, London.
15,972. Preventing Explosions of Steam Boilers, N. H. Humphrys, Westminster.
15,973. Regulating the Supply of Gas, G. W. Whitaker, London.
15,974. Self-acting Couplings, H. Taylor, London.
15,975. Drilling Tools, P. Nisbet, Glasgow.
15,976. Sketching or Drawing Frames, J. Sutherland, Glasgow.
15,977. Locomotive and other Boiler Furnaces, J. Richardson, London.
15,978. Perambulators, J. Simpson and S. T. Fawcett, London.
15,979. Turning the Leaves of Music, &c., O. Canler-Feys, London.
15,980. Slot Irons for Cable Railways, E. D. Dougherty, London.
15,981. Automatic Signalling Apparatus for Railways, H. J. Haddan.—(*H. Fénélon and E. Charpentier, France.*)
15,982. Rubbing Pine Needles, &c., A. M. Clark.—(*The Acme Manufacturing Company, United States.*)
15,983. Low-water Alarm for Steam Boilers, A. M. Clark.—(*E. Amouroux, France.*)
15,984. Medical Compound, A. M. Clark.—(*C. J. Ulrici, Canada.*)
15,985. Treatment of India-rubber Waste, A. W. G. Adey, London.
15,986. Control Apparatus for Gun Mountings, J. Vavasseur, London.
15,987. Pneumatic Cash Carriers, W. G. Davis and W. M. Hinman, London.
15,988. Extraction of Metals from their Ores, W. Elmore, A. S. Elmore, and H. Barrett, London.
15,989. Dress Steels or Stiffeners, W. Holmes, London.
15,990. Copying Machines, A. J. Boult.—(*J. F. Lash, Canada.*)
15,991. Fire-extinguishing Grenades, A. J. Boult.—(*J. Livingston, Ely, U.S.*)
15,992. Stop Mechanism, A. J. Boult.—(*Messrs. Acby and Landry, Germany.*)
15,993. Sales Books, J. R. Carter, London.
15,994. Variable Speed Gear, J. Braithwaite, London.
15,995. Transmission of Motive Power, W. R. Lake.—(*S. Fossati, Italy.*)
15,996. Books for Artificial Flies, W. R. Lake.—(*M. Bray, U.S.*)
15,997. Ornamentation of Varnished Surfaces, E. Laporte, London.
15,998. Perforation of Paper, W. R. Lake.—(*S. Wheeler, U.S.*)
15,999. Distributing Valves, A. J. Boult.—(*D. F. A. Decaix, France.*)
16,000. Securing Rails to Sleepers, J. and J. T. Gardner, London.

30th December, 1885.

16,001. Potato Cleaning Machines, H. Wild, Manchester.
16,002. Church Bells, A. W. L. Parkhouse, Brighton.
16,003. Automatic Stop Motion for Looms, E. Broome, Southport.
16,004. Propellers for Marine and Aerial Navigation, B. W. Maughan, and S. D. Waddy, London.
16,005. Compound Steam Engines, J. D. Gauldie, Glasgow.
16,006. Drums and Pulleys, J. Walker, Leeds.
16,007. Utilising Chemical Refuse, A. Whittle, Lancashire.
16,008. Yarn Winding Machinery, W. E. Heys.—(*F. Rosskothen, Russian Poland.*)
16,009. Measuring Electric Currents, R. D. Smillie, Dumbarton.
16,010. Musical Tops, M. Dannhorn, London.
16,011. Forming a Fluid-tight Connection by Stay Bolts employed in Boilers, G. Lohf and E. A. J. Müller, London.
16,012. Water closets, J. H. Kenyon and J. Conlong, London.
16,013. Motive Power Engines, T. McCarter and T. Cooper, London.
16,014. Centrifugal Machines, J. Laidlaw and A. J. Liversedge, Glasgow.
16,015. Heating Railway Carriages, &c., W. Foulis, Glasgow.
16,016. Steam Boilers or Evaporators, T. Hudson, Glasgow.
16,017. Velocipedes, H. and C. R. Morley, London.
16,018. Moustache-guards for Cups, &c., W. M. Andrew, London.
16,019. Wheels for Railway Vehicles, H. W. Fowler, London.
16,020. Fabrics for Waterproof Garments, W. Achnach, Glasgow.
16,021. Clip Holders for Photographs, &c., A. B. Lennox, Glasgow.
16,022. Drying Boots and Shoes, J. Barr, Glasgow.
16,023. Letter-copying Presses, A. C. Henderson.—(*A. C. Rolland and F. Lachnitt, France.*)
16,024. Travelling Rugs, H. H. Peach and R. Butland, Leicester.
16,025. Constructing Navigable Vessels for Conveying Sewage, &c., J. Casey and H. F. Swan, London.
16,026. Horseshoes, G. F. Redfern.—(*A. Delay, Belgium.*)
16,027. Wheels for Grinding or Polishing, F. Cooper and J. C. W. Stanley, London.
16,028. Opening and Closing the Doors of Hansom Cabs, R. A. Kemp, London.
16,029. Opening Points of Tram Rails, F. Pudney, London.
16,030. Vertical Steam Boilers, E. Edgar, London.
16,031. Voltaic Batteries, D. T. Piot, H. Charles, and A. Levy, London.
16,032. Signalling and Communicating Between the Passengers and Guard and Driver of a Railway Train, D. W. Ward, London.
16,033. Medical Soap and Tonic, J. L. Sabunjie, London.
16,034. Washing or Cleansing Clothes, S. Berry, London.
16,035. Crucibles, Retorts, &c., J. N. Longden, London.
16,036. Furnaces for Treatment of Ores, &c., J. N. Longden, London.
16,037. Condensation of Furnace Fumes, J. N. Longden, London.
16,038. Distributing Electric Currents, C. D. Abel.—(*Messrs. Siemens and Halske, Germany.*)
16,039. Cinder-sifter, E. Pritchard, London.
16,040. Low-water Alarms, O. Imray.—(*A. Kerr, R. Costigan, and W. Keys, Canada.*)
16,041. Cloth-pressing Machines, A. M. Clark.—(*E. Gessner, jun., Saxony.*)
16,042. Belt for Curing Rheumatism, &c., W. Thacker, London.
16,043. Sewing Machine Shuttles, &c., A. M. Clark.—(*The Deutsche Nähmaschinenfabrik vorm. Wertheim, Germany.*)
16,044. Saving Life and Property from Fire, B. G Boom, London.

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16,045. Securing Wedges in Railway Chairs, E. and J. M. Verity and B. Banks, London.
16,046. Safety Skirt for Ladies' Riding Habits, H. Nicoll, London.
16,047. Engraving and Filling in Letters on Brass, &c., J. Robson, Newcastle-on-Tyne.
16,048. Acme Window Stick, G. W. Bayley, Walsall.
16,049. Spinning and Twisting Flax, &c., A. Dobson, Belfast.
16,050. Igniting Inflammable Substances, R. R. Kelly, W. H. Akester, and P. Ward, London.
16,051. Salt Box, C. Godbolt, London.
16,052. Purifying Coal Gas, W. Young, Glasgow.
16,053. Sugar, J. Schwartz, jun., London.
16,054. Handcuffs, G. Glaister and H. Glendining, Carlisle.
16,055. Securing Papers, S. R. Vann, Newcastle-on-Tyne.
16,056. Handles for Parcels, J. Storer, Glasgow.
16,057. Bottles for Aerated Liquids, J. M. Day, Dublin.
16,058. Manufacturing Stockinette Cloth on Circular Knitting Machines, O. Lupton, Bradford.
16,059. Driving Belts, S. Turner, Manchester.
16,060. Purifying Sewage from Organic Matter, J. H. Kidd, Wrexham.
16,061. Sugar Tongs, C. Priestland and F. W. Green, sen., Aston.
16,062. Mechanical Figure, H. Gess, London.
16,063. Compensating Expansive Spiral Spring for Gun Barrels, &c., T. H. Heard, Sheffield.
16,064. Mechanical Musical Instruments, H. F. Hambruch, London.
16,065. Fire-bricks, &c., G. A. Bishop, Coatbridge.
16,066. Card Clothing, W. Walton, Manchester.
16,067. Steamers, &c., H. B. Barlow.—(*J. Scott, Bombay.*)
16,068. Unpasted Cigarette Tubes, W. H. Beck.—(*A. E. Decouflé, France.*)
16,069. False Grate for Fire-grates, J. Corry, Bradford.
16,070. Lawn Mowers, J. Shanks and J. G. Lyon, London.
16,071. Springs for Artificial Teeth, &c., J. D. Baddeley and W. Marrian, Birmingham.
16,072. Coupling for Boring Rods, &c., R. W. Taynton, London.
16,073. Locks for Carriage Doors, C. S. Snell, London.
16,074. Ice Apparatus, F Schmidt, London.
16,075. Frames for Pictures, &c., F. Servus, Liverpool.
16,076. Sanitary Pipes and Joints, B. Finch, Fulham.
16,077. Linings for Gloves, J. Whitby and W. Wilkinson, London.
16,078. Preventing Forgery, &c., D. C. Dallas, London.
16,079. Gas Heated Box Irons, A. P. Main, Glasgow.
16,080. Open Grates and Stoves, E. Johnson, West Cowes.
16,081. Producing Gas from Oils, &c., H. H. Blackmore, London.
16,082. Water Motors, &c., M. Westphal, London.
16,083. Chock Head or Gunwale Rowlock Plate, T. G. Tagg, London.
16,084. Linoleum, C. Wells, London.
16,085. Linoleum or Floorcloth, C. Wells, London.
16,086. Felts, W. B. Ritchie, London.
16,087. Date Calendars. G. A. Wilkins.—(*Thurber, Whyland and Co., United States.*)
16,088. Carpet Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
16,089. Voltaic Apparatus, R. H. Courtenay, London.
16,090. Floorcloth, &c., J. H. Hunt, London.
16,091. Transporting and Drying Cotton, E. Lamy, London.
16,092. Turning over the Leaves of Music, C. Wayte, London.
16,093. Gas Regulators, G. Porter, London.
16,094. Rudder Fittings, C. N. Nixon, London.
16,095. Regulating Steam Engines, &c., M. H. Robinson, London.
16,096. Terraces and Flat Roofs, H. J. Haddan.—(*J. Darnès, France.*)
16,097. Loading and Unloading Vehicles, W. R. Stegmann, London.
16,098. Decorated Glassware, M. R. von Spaün, London.
16,099. Mechanical Telephone, L. N. Loeb.—(*C. Loeb, United States.*)
16,100. Medicine Time Indicator, G. Bedford, London.
16,101. Slitting the Stalks of Plants yielding Textile Fibres, &c., W. A. Barlow.—(*L. G. de Landtsheer, France.*)

1st January, 1886.

1. Washing, &c., Machines, E. N. Kenworthy, Oldham.
2. Disc Mills or Disintegrators, J. H. Greenhill, Belfast.
3. Disinfecting, J. McN. Rimington.—(*C. T. Rimington, U.S.*)
4. Railway Wagon Couplings, P. H. Schirp, Germany.
5. Central Fire Breech Blocks, C. Stonehouse, Carlisle.
6. Sleeper Chairs and Fastenings, A. Murray, Glasgow.
7. Basket-making, J. J. Plater, Birmingham.
8. Bottles, &c., and Stoppers therefor, G. Quarrie, Liverpool.
9. Adjustable Head-rest, F. Proctor, Stevenage.
10. Drying Sewage, V. L. E. Miller, London.
11. Gas Engines, J. Y. Johnson.—(*E. Delamare-Deboutteville and L. P. C. Malandin, France.*)
12. Rotary Blowers, T. E. Mansfield, Bristol.
13. Advertising Goods, J. Smith, Stoke-upon-Trent.
14. Sheaf-binding, &c., Machines, J. Hornsby and J. Innocent, Grantham.
15. Turn-button for Doors, &c., M. H. Golightly, Birmingham.
16. Non-alcoholic, &c., Drinks, H. N. Eckel, London.
17. Loose, &c., Trays for Boxes, G. W. Vaughan, Wolverhampton.
18. Treatment of the Pile of Silk Plush, &c., Sir T. Salt, Bart., Sons, and Co., and T. Salt, London.
19. Prevention of Concussion in Pipes, W. Carr, London.
20. Plane Bits, W. F. Kellett, Canada.
21. Hand Embroidering Machines, C. W. Fields, Canada.
22. Suspension Lamp Fixtures, W. H. Babcock, Columbia, U.S.
23. Steering Fork for Velocipedes, H. J. Pausey and C. T. Crowden, London.
24. Fastening for Bracelets, &c., F. Fleuret, London.

25. CABLE for INDUCED CURRENTS, H. J. Haddan.—(*A. Arndt, Germany.*)
26. PUBLIC URINALS, A. E. Barker, London.
27. CUPOLA SMELTING FURNACES, F. A. Herbertz, London.
28. FOLDING TRICYCLE or VELOCIPEDE, J. Robson, London.
29. METALLIC PACKING for PISTONS, W. Filshie, Glasgow.
30. SHOVEL, RIDDLE, and SIEVE, E. Jones, Swansea.
31. UTILISATION of WASTE HEAT from KILNS, W. Joy, London.
32. STRETCHERS and RIBS for UMBRELLAS, &c., W. Corder, London.
33. TUBE BRUSHES, F. Perner, London.
34. SEWING and STITCHING, S. Keats, London.
35. PROPELLER for BOATS and SWIMMERS, J. Maplesden, London.
36. IRONING MACHINES, W. H. Davey, London.
37. CYCLOMETERS, G. P. B. Hoyt, London.
38. DYEING and PRINTING ANILINE BLACK, B. F. Cresson, London.
39. AUTOMATIC STARTING VALVE, T. W. Worsdell, London.
40. MECHANICAL TELEPHONE, W. McPherson, London.
41. SELF-ACTING SLIDE GEAR, O. Imray.—(*W. C. Loe, Holland.*)
42. VOLTA-INDUCTORS, C. D. Abel.—(*Messrs. Siemens and Halske, Germany.*)
43. COLOURING MATTERS, C. D. Abel.—(*C. Roth, Germany.*)
44. GOVERNORS, R. Matthews, London.
45. FORGINGS SCREWS by ROLLERS, C. Fairbairn and M. Wells, London.

2nd January, 1886.

46. CARBONIC ACID GAS, E. W. Parnell and J. Simpson, Liverpool.
47. CARBONATE of SODA, E. W. Parnell and J. Simpson, Liverpool.
48. BICARBONATE of SODA, C. Wigg, Liverpool.
49. FASTENING the ENDS of DRIVING BELTS, T. H. Smethurst, Manchester.
50. SELF-ACTING BRAKE for PERAMBULATORS, S. Keys and G. Edlington, Grantham.
51. SLIDE for EXPOSING SENSITIVE PLATES in a CAMERA, H. H. O'Farrell, London.
52. CASTORS for PIANOFORTES, J. Foster and H. Wingfield, Birmingham.
53. SPIRIT or LIQUOR FRAMES, W. H. Ireland, Birmingham.
54. LOWERING the UPPER HALVES of SLIDING WINDOW SASHES, W. Hilder, Portsmouth.
55. WOODEN SKATES, J. W. Vickers, Liverpool.
56. ELECTRIC GOVERNOR, G. E. Dorman, Stafford.
57. ATTACHING LAMPS to CARRIAGES, C. Bevan, H. Hallam, and C. Lowe, Birmingham.
58. FOLDING STEPS for CARRIAGES, C. Bevan, H. Hallam, C. Lowe, and A. Tonks, Birmingham.
59. LOADING and RECAPPING of CARTRIDGE CASES, W. Lightwood, Birmingham.
60. SELF-TIGHTENING RAILWAY CHAIRS, P. Cottell, Brighton.
61. CAR COUPLINGS, H. J. Haddan.—(*R. Powell, T. Mastin, and J. Mastin, United States.*)
62. CATCHING FISH, J. W. Hayward, Newfoundland.
63. SEPARATING AMMONIA CHLORIDE from LIQUORS, G. Jármay, London.
64. GRADING GRAIN, A. Stevenson, Liverpool.
65. OBTAINING AMMONIA from AMMONIUM CHLORIDE, L. Mond, London.
66. OBTAINING CHLORINE from AMMONIUM CHLORIDE, L. Mond, London.
67. SHEAVES or PULLEYS, G. D. Davis, London.
68. HOLDERS for SUPPORTING ELECTRIC LAMPS, A. Swan, London.
69. DRY GLAZING, R. Stevens, London.
70. PREPARATION of DRAWINGS to EARTHENWARE ARTICLES, C. D. Abel.—(*F. C. Glaser, Germany.*)
71. WORKING REGULATING GAS COCKS, W. B. Rickman, London.
72. MEASURING EQUAL QUANTITIES of FLUIDS, J. H. Wüster, Austria.
73. AUTOMATICALLY CLOSING TAP HOLES, C. Burnett, London.
74. COLOURED RELIEF IMPRESSIONS on SHEET METAL, F. Priester and O. Weidemann, London.
75. FLOOR and OIL-CLOTHS, C. Wells, London.
76. DECORATIVE MATERIAL for WALLS, C. Wells, London.
77. DECORATING LINOLEUMS, &c., C. Wells, London.
78. GRAINING TOOLS, C. A. Watkins, London.
79. STOPPERING BOTTLES, &c., T. Durrans, London.
80. WARP DRYING MACHINES, E. Wilford, London.
81. BRUSHES, W. J. Payne, London.

4th January, 1886.

82. GIMP for UPHOLSTERING, A. Edwards, New York.
83. APPARATUS for KIERS used in BLEACHING, W. Bracewell, Brinscall, near Chorley.
84. PNEUMATIC SUBWAYS, T. W. Rammell, London.
85. CUTTING BREAD, N. C. Whyte, London.
86. DELIVERING POST-CARDS, F. C. Lynde and J. Lees, Manchester.
87. TUNE-PLAYING TOPS, W. H. Duncan, Coalbrookdale. —*30th November*, 1885.
88. COMBINATION HEMISPHERES, W. A. Round, Oldbury.
89. FASTENING BOOTS, &c., J. Smith, Stoke-upon-Trent.
90. CAST METAL WATER CONDUITS, H. V. Howson, Birmingham.
91. MATCH BOXES, F. W. Lambert and J. G. Rollason, Birmingham.
92. CART WHEELS, A. Meikle and Son, Edinburgh.
93. PUMPS for RAISING LIQUIDS, T. Eddleston, Halifax.
94. COMBINED CAPES and HOODS, H. Frankenburg, London.
95. COKE CRUSHING MACHINERY, J. Craven, Leeds.
96. GENERATING or UTILISING GASES, S. Fox, London.
97. MANUFACTURE of FLEXIBLE PIPES, A. Spencer, London.
98. RAILWAY SIGNALS, W. Tearle, London.
99. OVENS, R. M. Ritchie, Glasgow.
100. NUT FASTENERS, H. J. Allison.—(*G. Haseltine, United States.*)
101. PORTABLE APPARATUS for DIPPING SHEEP, A. Blackie, London.
102. VENTILATING RAILWAY CARRIAGES, W. Y. Ober, London.
103. TOPPING BOILED EGGS, J. Badcock, London.
104. WICKS for BURNING PARAFFIN WAX, A. M. Taylor, Glasgow.
105. SECURING the SEAMS of INDIA-RUBBER TOBACCO POUCHES, D. Peck, London.
106. ATTACHING the SHOES of BEASTS to THEIR HOOFS, C. Colombati, London.
107. CONDUCTION of ARTIFICIAL LIGHT, W. Richards, London.
108. BUTTONS, &c., for WEARING APPAREL, W. A. Fisher, London.
109. BRACES for DRILLS, &c., H. H. A. Schwarz, London.
110. LOW-PRESSURE STEAM MOTOR, W. D. Wansbrough and R. K. Evans, London.
111. FEED MECHANISM for REPEATING, &c., FIRE-ARMS, H. A. Schlund, London.
112. PERCUSSION FUZES, H. A. Schund and A. Martin, London.
113. APPARATUS for CABS, &c., to enable the FARE to SIGNAL DIRECTIONS to the DRIVER, H. A. Schund and A. Martin, London.
114. LAWN MOWERS, C. Warren, London.
115. COUNTER MEASURES, J. H. Reddie, London.
116. AUXILIARY SPRINGS for the MAIN BEARING SPRINGS of RAILWAY CARRIAGES, &c., A. G. Spencer, London.
117. BUTTON ATTACHMENT for FASTENING the RIGHT-HAND GLOVE, J. Badcock, London.
118. BUCKLE, E. Edwards.—(*P. Rovers, Belgium.*)
119. BELLS, &c., for SIGNAL, &c., PURPOSES, S. Johnson, London.
120. PLAITING MACHINES, D. R. Malcolm, London.
121. VESSELS, &c., for DRY CONDIMENTS, J. M. Napier, London.
122. BRANCH PIPES for DISCHARGING WATER for DISTINGUISHING FIRES, &c., A. Tozer, London.
123. CUPOLA FURNACES, A. Montupet, London.
124. CONTROLLING RAILWAY POINT LOCKS, &c., A. G. Walker, London.
125. TALLOW for INDUSTRIAL PURPOSES, T. Goodman. —(*A. Vignat and V. Capoul, France.*)
126. PAPER BAG MACHINE, F. W. Leinbach, C. A. Wolle, and E. H. Brunner, United States.

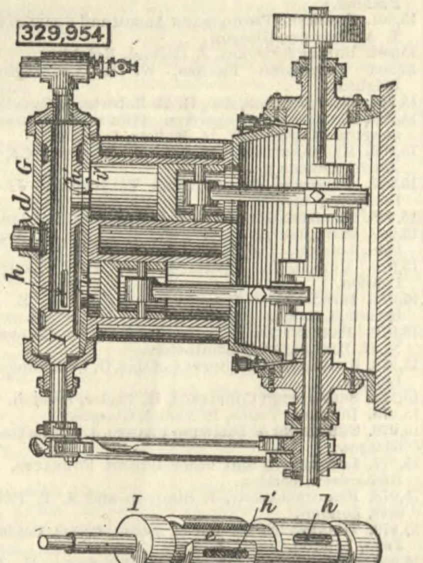
SELECTED AMERICAN PATENTS.

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

329,954. STEAM ENGINE, *John S. Robins and Julius T. Foster, Racine, Wis.—Filed 1st September*, 1884.

Claim.—The hollow oscillating valve I, closed at one end, formed with the annular channel d, and with the longitudinal passages e f out of line with each other, and having the ports h h^1, the said parts being relatively arranged as shown, in combination with two or more vertical cylinders having ports i i^1, and the valve chamber and steam chest G, secured longitudinally above and to the cylinders and constituting the cylinder heads, substantially as and for the purposes described.

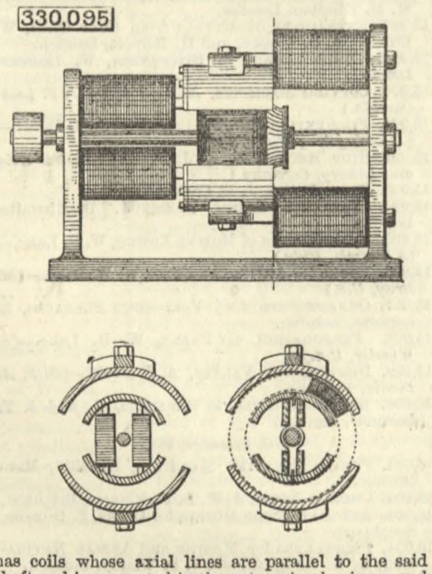
329,954



330,095. DYNAMO-ELECTRIC MACHINE, *Ernest P. Clark, Owego, N.Y.—Filed June 17th*, 1885.

Claim.—In a dynamo-electric machine, the combination of a shaft provided with an armature, internal pole pieces and magnets connecting them to each other, and two additional field magnets, one of which has coils whose axial lines are parallel to the said shaft and is connected to the external pole pieces, and the other of which has coils whose axial lines are parallel to said shaft and is connected to the internal pole piece.

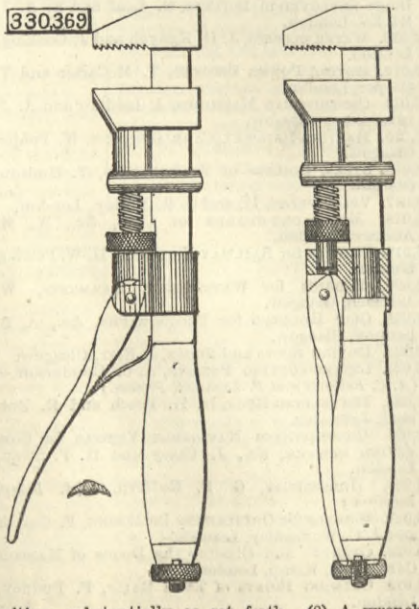
330,095



330,369. WRENCH, *George A. Barnes, New Haven, Conn.—Filed March 23rd*, 1885.

Claim.—(1) A wrench having a sliding jaw, a lever for operating the same, and a chambered nut located upon a stud projecting from the end of the handle of the tool for positively locking the lever in its closed position, substantially as set forth. (2) A wrench having a sliding jaw, an adjusting screw for operating the same, a cam-faced lever engaging with the screw for longitudinally moving it, a threaded stud projecting from the end of the handle of the wrench, and a nut located upon the said stud and chambered to receive the end of the lever for locking the same in its closed position upon the handle of the tool, substantially as set forth.

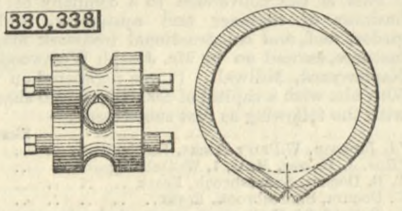
330,369



330,338. MANUFACTURE OF TUBING, *John Lippincott, Baltimore, Md.—Filed 11th June*, 1885.

Claim.—In the manufacture of butt-welded wrought iron tubing, the method of forming a butt weld, which consists in first bringing the edges together at their inner angles on a line corresponding with or approximating the outer circumference of the tube and then welding by radial pressure, substantially as described.

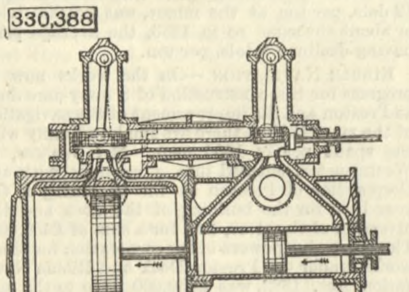
330,338



330,388. COMPOUND STEAM ENGINE, *George E. Dow, San Francisco, Cal.—Filed August 7th*, 1885.

Claim.—(1) In an engine, the high and low-pressure cylinders with pistons, piston rods, common valve chamber having ports in its ends corresponding with those in the cylinders, and the double-ended valve, as shown, in combination with the balance pistons fitting vertical chambers in each end of the valve, above the ports, and links by which the pistons are suspended from points above the valve, substantially as herein described. (2) In an engine, high and low-pressure cylinders with pistons, piston rods, common valve chamber having ports in its ends corresponding with those in the cylinders, and the double-ended valve, as shown, in combination with the balance pistons fitting vertical chambers in each end of the valve, above the ports, and links by which the pistons are suspended from points above the valve, substantially as herein described.

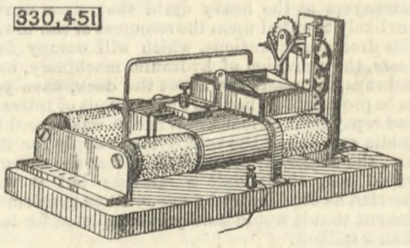
330,388



330,451. ELECTRICAL METER, *Edward Weston, Newark, N.J.—Filed May 21st*, 1885.

Claim. — The combination, with a multiple arc system or circuit, of a mercury receptacle and connections for passing the main current through the same, tubes connected to the opposite sides of the receptacle, arranged in the manner described, for the transfer of mercury from one to the other, means for measuring the amount of mercury transferred, and an electro-magnet or magnets included in a branch or cross circuit, and between the poles of which the mercury receptacle is placed, as set forth.

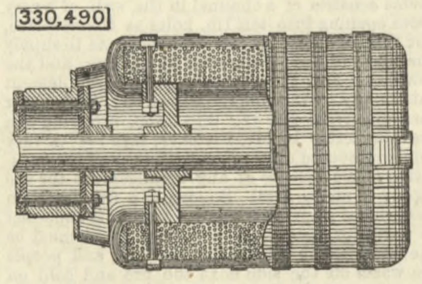
330,451



330,490. ARMATURE FOR DYNAMO-ELECTRIC MACHINES, *C. D. Jenney, Indianapolis, Ind.—Filed July 20th*, 1885.

Claim.—(1) The combination, in an armature, of a shaft, spiders mounted thereon having lugs upon the outer ends of their arms, holes in said lugs, the armature body, bolts passing through said body and said holes in said lugs on the arms of said spiders, and insulating material placed around said lugs and between them and said bolts, substantially as set forth. (2) The combination, in an armature, of a shaft, spiders upon said shaft, the armature body, bolts passing through said body and engaging with the arms of said spiders, and a non-conducting covering for the heads of said bolts, substantially as set forth. (3) The combination, in an armature, of the shafts, spiders upon said shaft, the body of said armature, bolts passing through said body and connecting with the arms of said spiders, insulating material between said spiders and said bolts, and non-conducting material over the heads of said bolts, substantially as set forth. (4) The combination, in an armature, of a shaft, spiders, the armature body, and bolts passing through said body from the outside and engaging with the arms of said spiders, nuts on the inner end of said bolts, a non-conducting covering for the heads of said bolts, and bands passing around the body and over said covering for the heads of the bolts.

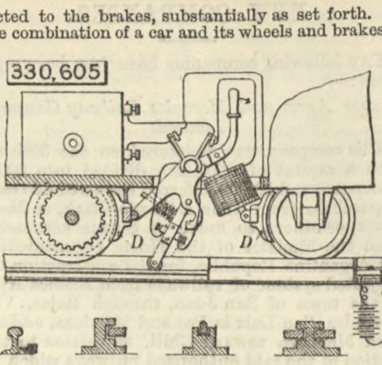
330,490



330,605. ELECTRIC RAILWAY, *James F. McLaughlin, Philadelphia, Pa.—Filed December 26th*, 1884.

Claim.—(1) The motor car of an electric railway, provided with a motor and car brakes, and a single lever having connection with both the motor and the brakes, to throw one out of action when the other is thrown into action. (2) The combination of the motor car of an electrical railway with a motor and car brakes and a lever controlling the brakes, and also carrying a switch to throw the motor into and out of circuit. (3) The combination of the motor car of an electrical railway and a motor with an electric car brake and a lever carrying a switch for both motor and brake, to throw the brake into circuit as the motor is thrown out. (4) The combination of the motor car of an electrical railway and a motor with car brakes and a lever carrying a switch to throw the motor into and out of circuit and mechanically connected to the brakes, substantially as set forth. (5) The combination of a car and its wheels and brakes D, suspended from the body of the car, with solenoid coils having cores movable within the coils and connected to the said suspended brakes, substantially as set forth.

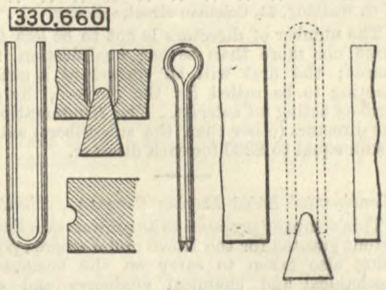
330,605



330,660. METHOD OF MAKING COTTER PINS, *John Adt, New Haven. Conn.—Filed September 25th*, 1885.

Claim.—(1) The herein described improvement in the manufacture of cotter pins, consisting in swaging ths extreme ends of the legs to form a bevel upon the inside of both, the bevel of the two forming a V-shaped recess between the two legs and without bending the legs, substantially as described. (2) The herein-described improvement in the manufacture of cotter pins, consisting in swaging the extreme ends of the legs to form a bevel upon the inside of both, the bevel of the two forming a V-shaped recess between the two legs, and at the same time swaging the outer surface of the points of the legs into conical shape, substantially as described.

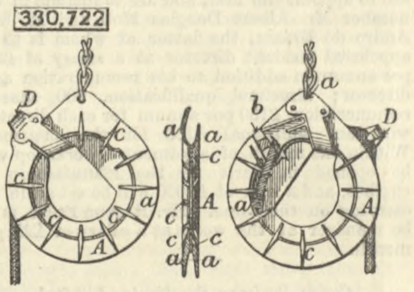
330,660



330,722. DEVICE FOR COUPLING ROPE, *James Milne and Joseph J. Milne, Scotch Grove, Iowa.—Filed August 27th*, 1885.

Claim.—(1) In a fastening device for ropes, a disc having side flanges so as to provide a circumferential recess, one of said flanges having a tangential recess through which the end of the rope may pass, substantially as shown, and for the purpose set forth. (2) In a rope-fastening device, a disc having a circumferential recess or groove, a notch b formed in one of the flanges, and a hook formed on the opposite flange, substantially as shown. (3) In a rope-fastening device, a disc having a chain or connecting device attached thereto, a circumferential recess with a spiral base, said disc being provided at the beginning or commencement of said spiral base with a tangential notch b, substantially as shown, and for the purpose set forth. (4) A disc A having side flanges a a, braces c, and a circumferential recess having a notch b in one of the said flanges, the opposite flange being provided with a hook which overlaps the circumferential recess, and a fastening device located between the hook D and notch b, the parts being combined and organised substantially as shown, and for the purpose set forth.

330,722



330,910. METAL TUBE, *Eugene Levavasseur, Paris, France.—Filed September 10th*, 1885.

Claim.—(1) A tube consisting of a strip of metal wound helically, with its convolutions connected flexibly together and packed at the joint with a yielding packing, substantially as set forth. (2) A tube consisting of a strip of metal formed with two channels relatively reversed and wound helically, thereby interlocking the two channels, in combination with a flexible packing strip confined in the space between said interlocking channels and making tight the joint between the adjoining convolutions of the metal strip, while permitting sufficient play to render the tube flexible, substantially as set forth.

330,910