ATHUS IRON AND STEEL WORKS.

No. VI.

(*Concluded from page 503, vol. lxiii.*)

Steel works' blowing engine and steam hammers.—In our fourth article on these works[1], we promised an illustration and description of the steel works' blowing engine, which is the latest development of the type so long adhered to by the Cockerill Company, and one of the early forms of which was described and illustrated in connection with the Reschitza Iron and Steel Works in Hungary.[2] The Athus engine, a side elevation and part plan of which are given on page 214, differs from its prototype in having the air cylinders below at the ground level and the steam cylinders above, mainly for greater stability, but also to reduce height. The air cylinders are 1·4 metre = 4ft. 7in. in diameter, the stroke being 1·5 metre = 4ft. 11in.; the high-pressure cylinder is 1·15 metre = 3ft. 9in.; and the low-pressure, 1·9 metre = 6ft. 3in. in diameter. With steam at about 65 lb. pressure in the small cylinder, the engines indicate 800-horse power. The usual speed at the above-named pressure is 32 or 33 revolutions per minute, but as many as 40 may be made if necessary. The jacket of the small cylinder acts as a steam reservoir between the high-pressure and the low-pressure cylinders, and each cylinder has its own condenser. A condenser may be disconnected if required, and either cylinder may be made to work with either condenser by means of a special valve and a suitable arrangement of pipes. As will be seen by the plan, the fly-wheel, 8 metres = 26ft. in diameter, and weighing 18 tons, is built up with round spokes, keyed into the boss and the square rim, is keyed on its shaft 40 cm., or nearly 16in., in diameter, and is arranged between the two cylinders. To each cylinder there is a double crosshead, with ordinary connection for the connecting-rod, and another askew for the two piston rods, guided by brasses in the frame of the blowing cylinder; and prolongations on each side of the crosshead work the beams of the air pumps by two short rods each. The shaft of the air pump beams is carried by brackets on the octagonal columns, of which there are four to each engine, that is to say, four on each side of the fly-wheel.

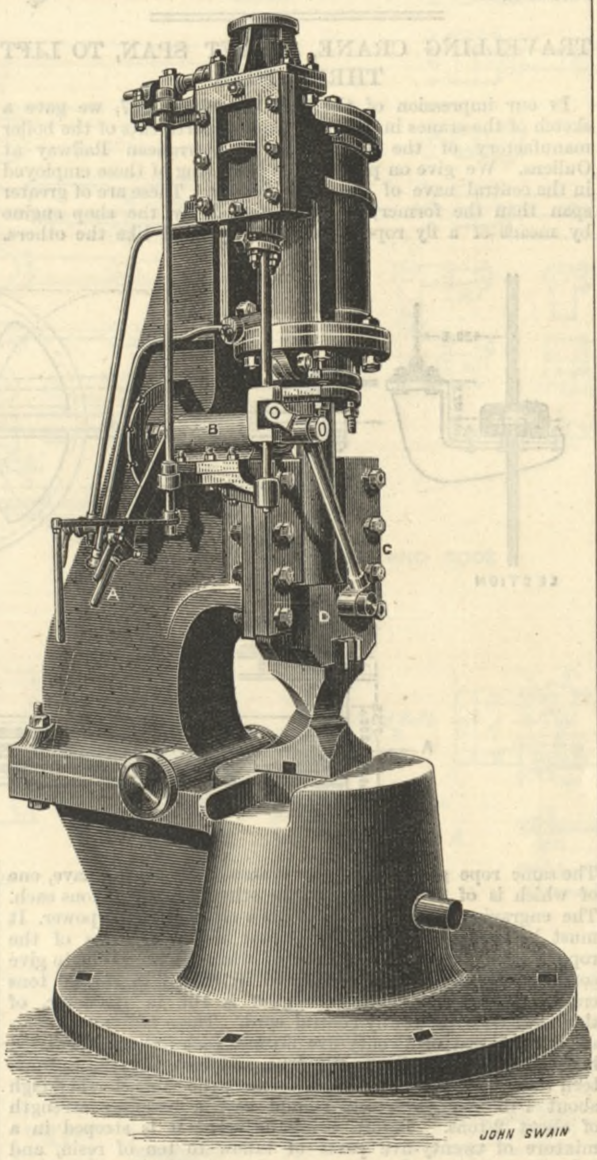
The two cylinders are apparently of the same external diameter, because of the jacket forming the steam reservoir between the two cylinders. The small cylinder exhausts into this jacket, whence it is led to the valve chest of the large cylinder by a hollow casting of square section; but this is not seen in the side elevation, being hidden by the entablature, as also is the lateral and horizontal passage for the exhaust steam from the large cylinder. The steam passes downwards to the condenser by two steam pipes of circular section, that look like columns, to both condensers in the normal working of the engine; but, as stated above, one of the condensers may be shut off when required. The distribution of steam is effected by four lifting valves worked by two horizontal cams on a vertical shaft, actuated by a pair of mitre pinions from the main shaft. On the vertical shaft are two horizontal cams, which by levers work two horizontal rocking shafts; and these actuate by rods the beams of the lifting valves. The levers have screw plugs for compensating wear. The air valves, both inlet and compression, are also worked by cams, a plan and section of each being appended. The inlet valve is of gun-metal, with a leather washer bedding on a cast iron seat; and both the compression valve and its seat are cast of a special quality of iron with no washer between.

Steam for the steel works' blowing engine and the pumps is obtained from a battery of six horizontal boilers, each with two water tubes and one superheating tube. They are fired by the blast furnace gases, and have a heating surface of 100 square metres = 1076 square feet each. Besides the boilers just mentioned—see general plan of the works, p. 22 of vol. lxii.—there are two other batteries, all fired by the blast furnace gases. Near the offices are five boilers, two with two water tubes and three with one water tube and one superheater. The steam from these is conveyed in pipes, lagged with slag wool made on the spot, and provided with four expansion joints. The pipes are carried on light trellis work columns made of a happy combination of flat bars and angle irons. The steel works being at a lower level than the ironworks, the steam is let down a vertical pipe and then up to the cylinders of the steel works' blowing engine, all water being intercepted in the bend at the bottom, which forms an effectual steam trap. Near the blast furnace blowing engines are twelve other boilers, each independent of the others, but all connected together by the common steam pipe. Six of these have water tubes, and six are without them. All the boilers at the works are horizontal, are externally fired by the blast furnace gases, and communicate together, so that no department shall be stopped in case of accident to any one boiler or battery of boilers.

The samples of each blow of steel are heated, drawn out, and bent cold, as already described, under the small double-acting steam hammer—shown in the annexed engraving—made by J. Banning, late Keller and Banning, of Hamm, Westphalia. The hammer-head, forged solid of cast steel in the same piece with the piston-rod, weighs 300 kilogs. = 6 cwt., and has a fall of 55 cm. = 22in. The action will be seen by the engraving. The slide valve-rod is actuated automatically by a striker on a short horizontal shaft, made to revolve partially on its axis by means of a rod working in a guide fixed to the hammer-head. But the intensity of blow, and also the stroke, may be regulated by a hand lever which alters the position of the eccentric horizontal shaft. The hammer-head is guided by steel slide bars, which are readily renewable. The foundation consists of 20 cm. = 8in. oak planks laid on a mass of brickwork.

The cylinder of the 15-ton steam hammer made by the Cockerill Company for drawing out the ingots, making slabs for plates, &c., has a diameter of 1·1 metre = 3ft. 7⅜in., and a fall of 2·5 metres = 8ft. 2½in. Steam is admitted below the piston by a lifting valve worked by lever and rod. The pillars, which are slightly conical, and the cross-beam, are made of plate-iron rivetted, plenty of room being afforded for getting all round the anvil. The anvil-block was cast on the spot in three pieces from metal run directly from one of the blast furnaces, and from two cupolas simultaneously. First one piece was cast, and then another, by which time the mould of the first was sufficiently cooled to receive the metal for the third. Below the anvil-block are two rows of oak balks 30 cm. = 11¾in. square, tied together by bolts, and resting on a mass of concrete 2·5 m. = 8ft. 2in. deep and 3 m. = 9ft. 10in. square. The foundations of the hammer standards consist of two masses of brickwork 4 m. = 13ft. 1in. by 6·6 m. = 21ft. 8in. by 6·4 m. = 21ft. deep, each standard being tied to the foundation plates by two rows of three tie-bolts.

Two more steam hammers, a 10 and a 20-ton, are eventually to be erected, and also several roll-trains. Until these are added, the full advantages cannot be got out of the eighteen Gjers' soaking pits in two groups, with their hydraulic crane. The castings for the large Bicheroux heating furnace, the floor-plates, and the covers of the ingot-moulds, were, like the anvil-block, cast of iron run directly from the blast furnace. In No. II. of these articles some reflection was made on the policy of erecting the fifty Modesse coke ovens near the blast furnaces, and of paying carriage on the raw coal instead of on the coke. It has been explained, however, that these ovens are only used in case of emergency, for it sometimes happens that supplies of coke cannot be obtained, while coal may be had at any time from more than one centre of production. When in full work the number of hands and officials employed at the ironworks and steelworks together approaches 300. The Belgian law as to employers' responsibility in case of accident is very stringent; but the Company subscribes to the Société Royale Belge d'Assurance contre les Accidents Industriels, which takes all risk devolving on employers, excluding, however, accidents arising from the men's own carelessness, for which they alone are held responsible.



BANNING'S STEAM HAMMER.

The Athus Steel Works have produced small ingots of extra mild steel, having a remarkably smooth external surface, which is difficult to obtain with very mild steel, containing 0·09 per cent. of carbon and from 0·2 to 0·3 per cent. of manganese. The steel works have, however, fallen on bad times, for present prices of steel ingots are not sufficiently remunerative to keep them going. An eminent authority has said that a mistake was made in stopping short at ingots, instead of going on to produce rails and bars, which would more readily have secured a market; but it is probable that customs dues and railway rates have more to do with the matter than economical production. Pig iron, however, was not so much depreciated as steel last year, and the production of the two blast furnaces—76,816 tons, the largest on record since their erection in 1874—permitted of a dividend being paid of 25f. = £1 on the 4000f. = £160 shares, besides carrying 5 per cent. to the reserve fund. This year Athus forge pig has been sold for 42f. = £1 13s. 7d. per ton, which is a great advance on the prices of last year. This improvement is due to all the stocks of basic pig in the adjoining Grand Duchy of Luxemburg having been absorbed by Germany, and the production contracted for in advance. Consequently, far smaller quantities of forge and foundry pig are now made in the Grand Duchy, which strengthens the market for the furnaces of Athus, Halanzy, and Musson, in Belgian Luxemburg. Here it will not be out of place to state that only the above-named furnaces in Belgium are in a position to produce pig economically, being situated on the ore, which is the largest bulk and weight of the three items to be taken into consideration in calculating "the survival of the fittest" in this matter of blast furnaces, taking the weight of pig iron as 1, that of the coal is 2, and that of the ore 3, approximately. Now the ore for these furnaces is absolutely on the spot in the case of Halanzy and Musson, and practically so in that of Athus, exception being made for the comparatively small quantities of extraneous ore required to secure a good mixture and proper working of the blast furnace, as well as the Nassau ore for basic pig. The coal, or rather coke, has to be brought from the centre of Belgium; and the product has to be conveyed to its centre of consumption; but, even in the case of raw coal, these two items only amount to the same weight as that of the ore. Now, on the other hand, Liége or Charleroi, though they have coal on the spot, incur carriage on the ore or on the pig; that is 4 to 2, so they are manifestly in an uneconomical position for making pig, though eminently in a favourable one, especially the former, for making finished iron—thus bearing out the truth of the adage: The blast furnace on the ore; the rolling mill on the coal. There is, however, a *raison d'être* for a few blast furnaces at Charleroi, viz., to work up the tap cinder, which is produced in large quantities by the puddling and heating furnaces of the district—containing sometimes as much as 55 and 50 per cent. of iron respectively. There is little doubt but that all the blast furnaces in Belgium, except in the province of Luxemburg, embracing those already named, and perhaps a few at Chaleroi, would soon be put out, were they not helped up by the tax of 5f. = 4s. per ton imposed by the Belgian Government on all foreign pig. This tax is exceedingly unfair to England, because all Scotch pig, which is after all only a semi-finished product, required to secure tough castings in Belgian foundries, is saddled with 4s. a ton at the Belgian frontier, while, on the other hand, the English Government is so very kind as to admit Belgian iron and steel—finished products, ready for use, and representing Belgian labour as well as raw material and fuel—absolutely free, to the exclusion of her own joists and girders from buildings. This is an anomaly which requires agitation to be abolished. Let Luxemburg, both Belgian and Grand-ducal, produce pig iron, forge, foundry, and basic, for which they are so well-endowed by nature; let the coal districts of Belgium confine themselves to the production of finished iron and steel for which they are specially adapted; and, if Belgium taxes our semi-raw Scotch pig, let England turn the tables by imposing a duty on Belgian finished joists and girders, thus giving a chance to Middlesbrough producers of these articles.

[1] See THE ENGINEER of 9th July, 1886, page 34.

[2] See THE ENGINEER of 1st and 29th February, 1884, pp. 92 and 166.

THE GENERATION OF STEAM.

IN THE ENGINEER for August 19th, page 157, will be found an article on "Combustion." The following article may be regarded as a sequel to it. Like it, it is intended for the perusal of non-scientific men and students.

It will be remembered that when writing on combustion we explained how much heat can be got out of a pound of coal. We now propose to show what becomes of that heat in the process of generating steam. To make what follows clear, it will be necessary to say something of specific heat and latent heat.

We have already explained that the thermometer can only measure *temperature* or intensity. It cannot measure *quantity*. For example, it is obvious that there must be twice as much heat in two pounds of boiling water as there is in one pound; but a thermometer first put into a vessel containing one pound, and then into another vessel containing two pounds, will still give the same indication, viz., 212 deg. Now, different bodies have different capacities for heat, or in other words, their specific heat varies. That is to say, if we bring two different bodies to the same temperature, the quantity of heat in each will vary. Water has the highest specific heat of any known substance, gas, or liquid, and is therefore taken as a standard. The following table gives the specific heat of a few well-known metals, water being taken as unity:—

Lead	·03084
Gold	·03244
Mercury	·03332
Tin	·05695
Silver	·05701
Copper	·09515
Zinc	·09555
Wrought iron	·01218
Steel	·11650
Cast iron	·12983

To find the quantity of heat necessary to raise any of these metals to a given temperature, it is only necessary to multiply the quantity of heat required to raise an equal weight of water to the same temperature by the fraction given above. Thus, for example, let it be required to ascertain the quantity of heat necessary to raise, say, 10 lb. of cast iron 100 deg. We know that the quantity of heat required to raise 10 lb. of water 100 deg. is 10 × 100 = 1000 thermal units. Then 1000 × ·12983 = 129·83 thermal units.[1] In round numbers, the specific heat of water is about eight times as great as that of cast iron.

Gases have in like manner their specific heats. The specific heat varies with the pressure under certain conditions, but with this we have at present nothing to do. Nor need we concern ourselves with the specific heat

[1] See page 157.

of any gas but air, which is ·23. In round numbers, 1 lb. of water requires four times as great a quantity of heat to raise it to a given temperature as does a pound of air.

It has already been shown in the article on combustion that a pound of coal properly burned will give out about 14,500 thermal units, and that it requires for its combustion 18 lb. to 24 lb. of air. The first effect of the burning coal on the grate is to raise this air to a very high temperature; but as the air passes through the tubes or flues of the boiler it surrenders a large quantity of this heat. We may, therefore, neglect the furnace temperature and deal only with that of the gases as they leave the boiler. A very common temperature is 500 deg. If the air entered at 60 deg., then it is clear that going away to the chimney at 500 deg., it has been raised by the coal through 440 deg. The total quantity of heat wasted up the chimney per pound of coal will be found by multiplying the number of pounds of air admitted to the furnace per pound of coal by the elevation in temperature and by the fraction ·23 representing the specific heat of air. We have then for 18 lb. of air, 18 × 440 × ·23 = 1821·6, and if 24 lb. of air are admitted we have 24 × 440 × ·23 = 2428·8. From this it will be seen that the more air we admit to the furnace the greater the waste; but care must be taken not to admit too little, otherwise, as has been explained in the article on combustion, there will be still greater waste caused by the imperfect burning of the coal.

Of the 14,500 thermal units given out by the coal, then, we see that about 2000 are wasted up the chimney, unavoidably, leaving us only 12,500 to make steam with. It is to save some of this waste heat that "Economisers" are employed; these are pipes set in an enlargement of the flues, and through them the cold feed-water is pumped, and so raised in temperature. The object of all economical boilers is to send away the escaping gases at as low a temperature as possible, but this can never be less than that of the water in the boiler.

We have now to consider the work done by the 12,500 units remaining to us in generating steam. The first work is to raise the feed water to the boiling point, which varies with the pressure, increasing as the pressure increases. The following table gives a few of the more usual pressures and temperatures :—

Absolute Pressure per sq in. lbs.	Temperature. deg. Fah.
14·7	212
20	228
30	250
40	267
50	281
60	293
70	303
80	312
90	320
100	328
150	358
200	382
250	401

The safety-valve loads will always be 14·7 lb.—in round number, 15 lb.—less than these, because the pressure of the atmosphere loads the valve. Thus, 100 lb. in the preceding table corresponds with a pressure, as shown by the pressure-gauge, of 85 lb. The feed-water goes on rising in temperature till it attains the temperature proper to the pressure. Then it begins to boil, not before. Let us suppose, for the sake of illustration, that we have a boiler working at 85 lb. by the gauge; the boiling point is 328 deg. Let the feed be pumped in at 60 deg.; then each pound of it will require 328 - 60 = 268 thermal units to raise it to the boiling point. Once this is reached, the water gets no hotter. The heat is thenceforth expended, not in augmenting temperature, but in making steam, and is said to become "latent," or hidden. This expression is not strictly correct, but as it is commonly used it may be allowed to pass. Thus, then, each pound of steam contains what may be regarded as two quantities of heat—one quantity expended in raising temperature, the other in converting the water into steam. Now it is a noteworthy fact that the sum of the sensible and latent heats of steam is very nearly constant under all circumstances. Thus let us take steam at atmospheric pressure, as, for example, it comes from the spout of a tea-kettle; its sensible temperature is 212 deg., representing 212 thermal units per pound. Its latent heat is 965 deg., representing 965 thermal units per pound, and 212 + 965 = 1177 thermal units per pound, measured from zero. Steam 100 lb. pressure—85 lb. by the gauge—has a sensible temperature of 328 deg., representing 328 thermal units, a latent heat of 883 thermal units, and 328 + 883 = 1211 measured from zero, which, it will be seen, is only 34 deg. in excess of the sum of the latent and sensible heats of steam at 212 deg. The total number of units of heat which have to be used in making a pound of steam will vary with the temperature of the feed-water. Let that be 60 deg. Then each pound of steam at 100 lb. pressure represents 1211 - 60 = 1151 thermal units. We have seen that all the heat left in after the air necessary for combustion has had its share, is 12,500 units per pound of coal. Then $\frac{12,500}{1151} = 10·86$ lb. as the greatest possible weight of water that can be converted into steam of 100 lb. absolute pressure; if the admission of air is at the rate of about 22 lb. of air per pound of coal, and if the temperature of the escaping gases is 500 deg., With the data here given our readers can calculate for themselves the return to be expected under other conditions of pressure, temperature, weight of air admitted, and so on.

It must be remembered, however, that there are other sources of waste, concerning which we have said nothing. One is found in the fact that coal is not all combustible. It contains a greater or less weight of ash, which is simply incombustible mineral matter, and varies very greatly in quantity with the quality of the coal. Some of the best Welsh coals contain hardly any incombustible matter; on the other hand, lignite or brown coal, much used on the Austrian railways, contains so much light ash, that after a run of twenty-five miles or so the smoke-boxes of the locomotives become half filled and have to be cleared out. Another source of waste is bad firing, which causes unburned coal to fall through the bars. Lastly a great deal of heat is radiated from the boiler and the brickwork in which it is set. It is to prevent this loss that boilers are clothed. It does take place, however, and in some cases represents a good deal. When all these things are put together it will be seen that large deductions must be made from the total quantity of heat set free by combustion, and a boiler which can evaporate 10·8 lb. of water from feed at 60 deg. must be exceptionally excellent. What we have said indicates that economy is to be sought, first, in securing the complete combustion of the fuel and the gases it liberates; secondly, in admitting the smallest quantity of air which will suffice to secure perfect combustion; thirdly, in sending away the gases from the boiler at a temperature as near as possible to that of the water in the boiler; fourthly, in using the gases, after they have left the boiler, to heat the feed-water; fifthly, to prevent in every way possible the radiation of heat from the boiler; and lastly, we may point out that considerable advantage might be derived from heating the air required for combustion before it enters the furnace, if only it could be done cheaply and in a satisfactory way. The effect of heating it would be analogous to that produced by heating feed-water, and may be calculated in the same way.

No attempt has been made to go into minute detail, but enough has, we think, been said to give a sufficiently precise idea of the principles involved in the generation of steam, and to enable the non-scientific reader to make for himself the few simple calculations necessary to estimate the possible efficiency of a steam boiler and its furnaces. Q.

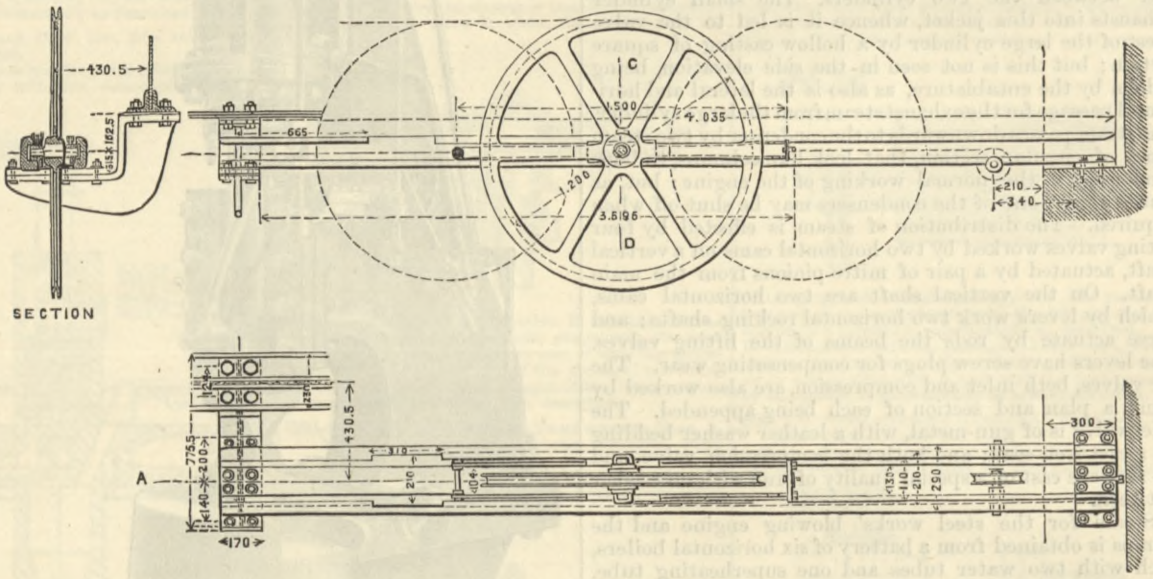
TRAVELLING CRANE, 50-FEET SPAN, TO LIFT THREE TONS.

IN our impression of the 29th of April, 1887, we gave a sketch of the cranes in use in the side departments of the boiler manufactory of the Paris-Lyons-Mediterranean Railway at Oullens. We give on page 211 an engraving of those employed in the central nave of the same factory. These are of greater span than the former, and are worked by the shop engine by means of a fly rope, instead of by hand like the others. The same rope governs the four cranes of the central nave, one of which is of 20 tons power, the others being of 3 tons each. The engraving, page 211, represents a crane of 3 tons power. It must be remembered, however, that the dimensions of the rope by which it is worked, and of which we are about to give some details, have been calculated in regard to the 20 tons crane. This rope is of cotton; it is 1in. in diameter, of three twists, without any central cord. These twists are themselves composed of twenty-five strands each; they are twisted in a contrary direction to the rope, and have thirteen to fourteen turns to the metre. Thus formed, the cable should weigh about 1 lb. per yard, and should have a breaking strength of about 2 tons. Before being adjusted it is steeped in a mixture of twenty-five parts of tallow to ten of resin, and submitted for ten days to a tension of 100 kilos. When in work it is again coated with sixteen parts of tallow to ten of resin as occasion requires. The driving pulley of the rope is placed at one extremity of the factory. It is 4ft. in diameter, and makes 319 turns per minute. At the other end of the factory, being a distance of about 170 m., the rope returns over another pulley of the same dimensions, as shown by the engraving. Fig. 5 represents the grooves of both the pulleys. The pulleys by which the rope sets in motion the mechanism of the cranes have grooves of the first type; those which receive the cable on its return have grooves of the second type. All along its course the cable is supported by brass rollers 6in. in diameter, 12 metres apart. When acted on by the cable these rollers revolve at the rate of 2546 turns per minute. So great a speed requires that the rollers should have their centres of gravity rigorously placed in the axis of rotation, and that their axes should not be allowed to have too much play in their sockets. Taking the lineal speed of the cable to be 20 m. per second as indicated, it has been calculated that the following speeds per minute are obtained for the divers movements of the crane :—

	Cranes of 20 tons.	Cranes of 3 tons.
Speed in raising a weight	0 m. 610	8 m. 090
Speed in transporting a weight	9 m. 500	9 m. 220
Speed in transporting the crane from one end of the factory to the other	8 m. 965	9 m. 105

Description of travelling crane.—The crane we propose describing is of 3 tons. The frame is composed of two large iron girders and angle irons, resting at each extremity on two transverse double T-iron girders of 6¼in. × 4¾in. × ·39in. These latter are parallel with the ground; the rollers are placed between them, to which they are suspended by forked bolts. On the side where the rope runs, a third girder of double-T iron, parallel to the two first, and having the same transverse section, serves with them to sustain the pulleys A^1, and directs the rope over the driving pulley A. Each of the large girders is formed of an iron web of ·39in., which varies from 2ft. deep in the middle to 16⅜in. at the extremities, of two flat flanges 6¼in. × ½in. from one end to the other, and of four connecting angle irons 2⅜in. × 2⅜in. × ·39in. Each of the webs is formed of three plates, which are joined together by double-joint covers of 12in. × ·39in. The plates of the lower flanges have their ends joined by joint-covers of 31·5in. × 6¼in. × ½in. Those of the upper ones have no joint-covers. Fig. 4 gives the longitudinal section of the large girders. Rails are fixed on the large girders along which runs a four-wheeled wagon J J, which carries the load. This is sustained by an iron chain of ·6in. fixed to the hook *a*, at one end of the crane, passes over the two pulleys *b* attached to the wagon, and over the movable pulley *c*, and rolls up over the barrel of the windlass U at the extremity of the crane. This disposition is the same as that of the hand crane described in our April number; it enables the wagon to run from one end of the crane to the other without either raising or lowering the load. The wagon is moved by means of an endless iron chain of 11 mm., the ends of which are fixed to the two ring bolts *d d* of the wagon, rolling over the pulley *f f* at one part, and over the nut P at another.

Working mechanism.—The fly rope enters the crane by one of the pulleys A^1, which it quits vertically over the pulley A, describing a half circle; after this it again descends over the second pulley A^1, by which it leaves the crane. The pulleys A^1 are simple return pulleys; the pulley A, on the contrary, drives the whole mechanism. It is keyed on to its shaft, which consequently turns continually while the cable is in motion; no other part of the mechanism is set in motion by this movement unless it be previously arranged so as to effect one of the three actions raising of the load, driving the wagon on the crane, or displacing the crane itself. The three mechanisms of movement are composed of conical pinions with smooth surfaces, which can at will be made closer or more distant from one another, and which work by friction. The mechanism for removing the crane is nearest to the starting pulley. The two conical pinions B B are connected by a sleeve, and controlled by one hand wheel, one or other of the pinions B being put in contact with the pinion C, which is driven in one direction or another, according to which pinion it has been brought in contact with. The displacement of the movable handle is effected by means of one of the hand wheels Y, which is worked from the platform *g h* suspended from the crane. This hand wheel is fixed to a rod, the upper end of which is screwed, and which cannot be moved without driving back one of the two springs contained in the boxes *k* and *l*. The pinions are thus forced upon the wheel C with a spring pressure, and the movement is gradually brought about by a slowly increased friction. The springs used for the purpose are as follows:—Diameter of the steel wire, 8·2 mm.; outer diameter of the spring, 60·2 mm.; number of spirals, ten; height of free spring, 210·5 mm.; initial height of fixed spring, 167 mm.; height of spring completely closed, 153 mm.; initial reaction of spring, 140 kilos.; reaction of spring completely closed, 185 kilogs. Under these conditions the movements are easy and continuous, but care must be taken to avoid the pinions being splashed with oil. In order to do so, the backs of all the pinions have been furnished with covers of brass, and screens have been placed between them for their protection. The mechanism for transporting the load is similar to that already described. The mechanism for raising the load differs from the other two in that the pinion B^{11} carried by the principal shaft is collared to a fixed post, while the pinion C^{11} approaches it by the action of the rod. Further, this rod produces no action except in the direction of raising the load. For the descent it is sufficient to loosen the brake by pulling the rope *m* when the load is heavy. In a contrary case the rope *n* must also be pulled, which draws nearer to the pinion B^{11} a pinion *p* carried by the same shaft as the pinion C^{11}, and held generally apart from B^{11} by a buffer spring. The three fly-wheels Y and the ropes *m* and *m* are conveniently united in the hand of the conductor, who is placed upon the platform *g h*, and from this elevated position easily follows and conducts the manœuvres below him. In the engraving a system of notched pinions Z Z will be observed, and the pulleys for chains X placed below the platform *g h*, and commanding the three working rods. This system was invented in order to be able to work the crane from the ground floor of the factory in case of need by means of pendent chains. But experience has proved that it is always best to work it from above on the platform *g h*.



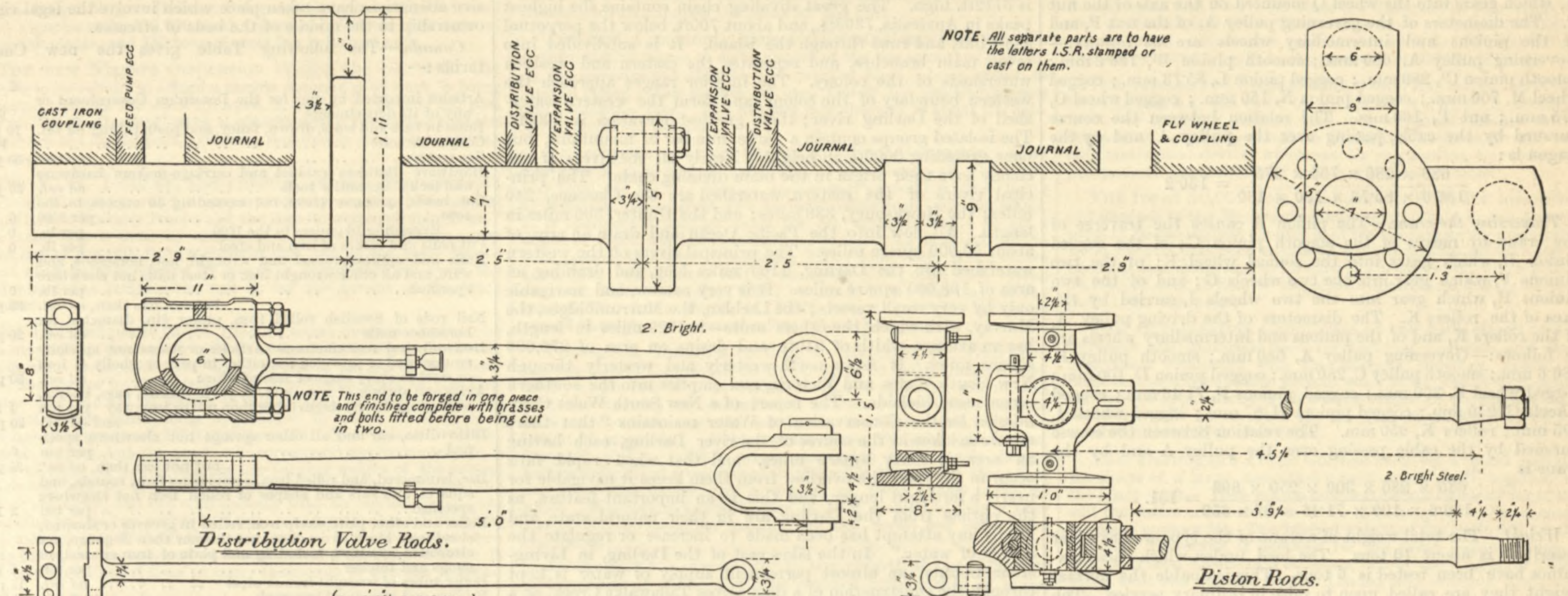
Lifting movement.—The pinion B^{11} governs the ascension movement by means of the smooth pinion C^{11} of the cogged pinion Q gearing with the wheel R and of the cogged pinion S gearing with the wheel T, which is mounted upon the axis of the barrel U. The diameters of the governing pulley A, of the barrel U, and of the pinions and intermediary wheels are as follows:—Driving pulley A, 680 mm.; smooth pinion B^1, 186·6 mm.; smooth pinion C^1, 280 mm.; cogged pinion Q, 63·15 mm.; cogged wheel R, 1200 mm.; cogged pinion S, 159 mm.; cogged wheel T, 1035 mm.; barrel U, 650 mm. The result is that the relation between the course pursued by the cable passing over the pulley A and by the load is,

$$\frac{680 \times 280 \times 1200 \times 1035 \times 2}{186·6 \times 63·15 \times 159·2 \times 650} = 388.$$

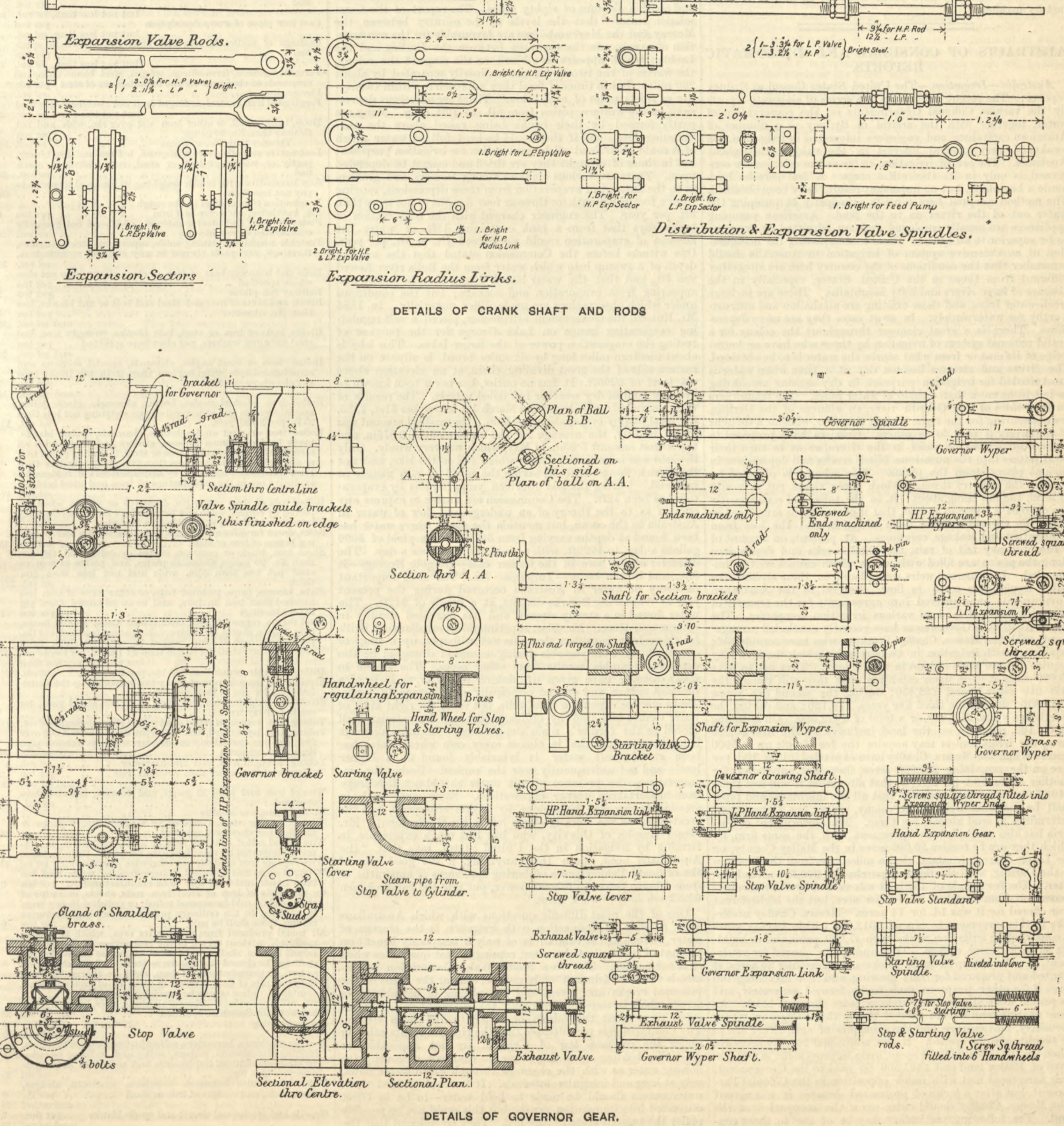
The shaft on which the pinions C and Q are keyed carries a counterpoise brake and an automatic tightening brake of the

COMPOUND ENGINE FOR THE INDIAN STATE RAILWAYS.—DETAILS.

(*For description see page 198.*)



DETAILS OF CRANK SHAFT AND RODS



DETAILS OF GOVERNOR GEAR.

Bourgougnon system, similar to that described in our April number, 1887, in connection with the hand crane of 8·80 mm. span. The diameter of the pulley of the break V is 360 mm.

Traversing the wagon J J.—The pinion B^1 causes the traversing of the wagon by means of the smooth pinion C^1 of the cogged pinion L, which gears into the wheel M, and of the cogged pinion N, which gears into the wheel Q mounted on the axis of the nut P. The diameters of the governing pulley A, of the nut P, and of the pinions and intermediary wheels are as follows:—Governing pulley A, 680 mm.; smooth pinion B^1, 186·6 mm.; smooth pinion C^1, 280 mm.; cogged pinion L, 85·73 mm.; cogged wheel M, 700 mm.; cogged pinion N, 150 mm.; cogged wheel O, 375 mm.; nut P, 160 mm. The relation between the course pursued by the cable, passing over the pulley A, and by the wagon is:

$$\frac{680 \times 280 \times 700 \times 375}{186·6 \times 85·73 \times 150 \times 160} = 130·2$$

Traversing the crane.—The pinion B causes the traverse of the crane by means of the smooth pinion C; of the cogged pinion D, which gears into the conical wheel E; of the two pinions F, which gear into the two wheels G; and of the two pinions H, which gear into the two wheels I, carried by the axes of the rollers K. The diameters of the driving pulley A, of the rollers K, and of the pinions and intermediary wheels are as follows:—Governing pulley A, 680 mm.; smooth pulley B, 186·6 mm.; smooth pulley C, 280 mm.; cogged pinion D, 100 mm.; cogged wheel E, 300 mm.; cogged pinions F, 71·46 mm.; cogged wheels G, 250 mm.; cogged pinions H, 87 mm.; cogged wheels I, 695 mm.; rollers K, 650 mm. The relation between the course pursued by the cable passing over the pulley A and by the crane is

$$\frac{680 \times 280 \times 300 \times 250 \times 693}{186·6 \times 100 \times 71·46 \times 87 \times 650} = 131.$$

Weight.—The total weight of a crane of the type we have just described is about 10 tons. The load under which these machines have been tested is 6 tons. This is double the normal weight they are called upon to raise in ordinary service. The *Portfeuille Economique des Machines*, from which we gather our information, says they have borne this test in the most satisfactory manner.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Australia—Irrigation.—The United States Consul at Sydney reports:—The recent publication of a series of elaborate reports by the various Colonial Governments on the conservation of water, together with the arrival in Sydney of a number of American capitalists and engineers interested in irrigation, has awakened very general interest in the subject throughout Australia. The art of irrigation, as far as the colonies are concerned, is only in its theoretical stage. A few persons have made a beginning, but no important results have been obtained. The method adopted here consists principally in pumping the water out of the rivers on to the land. American pumping appliances are usually employed, and are admitted by everyone to be superior to all others. Those contemplating the inauguration of an extensive system of irrigation in Australia should remember that the conditions of the country here are altogether different from those in the United States, especially in the absence of large rivers and lofty mountains. There are no large fresh-water lakes, and those existing are all shallow and untrustworthy for water supply. In most cases they are mere depressions. There is a great clamour throughout the colony for a grand national system of irrigation by those who have no knowledge of its cost or from what source the water is to be obtained. The rivers and streams become dry at a time when water is most needed for irrigation purposes, in dry seasons amounting to but little more than a chain of water holes. The landowners on both sides of the Groydir river, an affluent of the Darling, are clamouring for the right to dam the river, without a thought of the injury it may do to others. Graziers have proposed to place obstructions or weirs in the rivers, so as to turn their flood waters into the numerous blind creeks and depressions in various places upon the plains. This scheme is objected to, because the country through which these rivers run is mostly so level, the fall being about 1ft. to the mile, and consequently the current is sluggish at best, that if obstructions are placed in them the current will be more sluggish, and the loss from evaporation and soakage enormous. At present, on account of a recent heavy fall of rain, the blind creeks and depressions along the plains are filled with water, which cannot well be impounded. If numerous weirs were placed in these streams the water would soon cease to flow. Several of the Australian Governments have entered into agreements for the transfer of extensive tracts of land to various irrigation companies. The South Australian Government have recently concluded arrangements with the Messrs. Chaffey Brothers, who have considerable experience with irrigation in California, by which the firm may acquire 250,000 acres of land in that colony. They are to have 30,000 acres at once, upon condition that they will during the first five years spend £36,450; during the second five years, £145,800; during the third five years, £78,120; and during the fourth five years, £52,830, or a total of £312,500. On spending £1 0s. 10d. per acre on the land, inclusive of the first 30,000 acres, the irrigationists may acquire the fee simple up to 5000 acres. When the Messrs. Chaffey have expended £1 0s. 10d. per acre on the remaining 200,000 acres, they may purchase it for another £1 0s. 10d. per acre, so that altogether it will cost them £463,540. It is further agreed that all the machinery and pipes shall be manufactured in the colony, unless the Government determines to send abroad for them. The Government of Victoria has also concluded an agreement with the same firm, by which they are to receive 50,000 acres in the Malley County, on the Lower Murray frontage, eleven miles east from the junction of the Darling, with the right of purchasing 200,000 acres hereafter. The fee simple of the land was valued by the Surveyor-General at from 2s. 6d. to 5s. 1d. per acre, but the highest rent ever offered for it was 1d. for 14 acres. Messrs. Chaffey undertake in this agreement to expend £312,500 within twenty years in constructing irrigation works upon 47,000 acres and in building an agricultural college. The land, when cleared for settlement, is to be cut up in small blocks not exceeding 80 acres, if planted and prepared for fruit growing, and not exceeding 160 acres if for other purposes, each to be farmed separately, and no person to be allowed to purchase more than one block. As soon as 100 families are settled there, the college, in which chemistry, horticulture, and the principles of agriculture are to be taught, is to be opened. If the additional 200,000 acres are taken up, £437,500 is to be spent upon improvement of 235,000 acres of Malley land and £437,500 be paid to the Government. This agreement met with much opposition in the Colonial Parliament, but after a series of protracted debates it was agreed that Messrs. Chaffey should enter upon the occupation of the land. The following particulars may be of use to those contemplating engaging in irrigation works in Australia. The mountain system of the country is a very simple one, and can be very well understood by a reference to the various ranges in New South Wales. The system is distinguished by four main ranges. The coast on the east side of the great dividing chain, and forming the edge of the high table-land; the loftiest peak is 3712ft. high. The great dividing chain contains the highest peaks in Australia, 7308ft., and about 700ft. below the perpetual snow line, and runs through the island. It is subdivided into seven main branches, and separates the eastern and western watersheds of the colony. The interior ranges approach the western boundary of the colony and form the western watershed of the Darling river; their greatest elevation is 2000ft. The isolated groups contain a large number of mountains, but none exceeding 3000ft. in height. Nearly all the rivers of the colony have their origin in the main dividing chain. The principal rivers of the eastern watershed are the Clarence, 240 miles; the Hawksbury, 330 miles; and the Hunter, 300 miles in length. All flow into the Pacific Ocean and drain an area of about 50,000 square miles. The principal rivers of the western watershed are the Darling, 1160 miles long, and draining an area of 198,000 square miles. It is very narrow, and navigable only by very small vessels; the Lachlan, the Murrumbidgee, the Murray, with which the others unite—is 1120 miles in length, has an average width of 240ft. and drains an area of 270,000 square miles. It flows north-westerly and westerly through New South Wales and Victoria, and empties into the southern ocean near Adelaide. The report of a New South Wales Commission for the Conservation of Water maintains "that there are three lakes in the course of the river Darling, each having an area of sixty square miles, and that when rapid falls occur in the river the overflow from them keeps it navigable for nearly a fortnight longer, and this is an important feature, as the outlets from the Darling are in their natural state, and hardly any attempt has been made to increase or regulate the supply of water." In the lakes east of the Darling, in Livingstone County, an almost permanent supply of water is kept through the construction of a dam across Tallawalka Creek, at a cost of about £4150 incurred by the lessee. This dam is said to have thrown the water into a series of lakes extending north and south a distance of eighty miles. The report of the Commission states "that the levels of the country between the Murray and the Murrumbidgee are favourable for the construction of canals. In the vast area between the Darling and the Lachlan, which appears as a blank on the maps of the colony, the waters of the two rivers are ordinarily separated by about 200 miles; but in times of flood they approach to within twenty-five or thirty miles of each other." There are numerous depressions on the western plains from 8ft. to 10ft. deep. Many are partly formed by their banks being raised above the surrounding level, and if they could be kept full of water much of it could be drained off by gravitation for irrigation purposes; but in times of drought they are dried and cannot be depended upon. There are various opinions among farmers and graziers as to the amount of evaporation from these depressions, ranging from a foot per month for three or four months to not more than 3ft. per year. The engineer charged with the construction of tanks says that from a tank containing 18ft. of water the amount of evaporation would not exceed 4ft. or 5ft. per year. One witness before the Commission stated that the average depth of a swamp into which water from the Bulla river flowed was 4ft., and that the water lasted fifteen months before disappearing from evaporation and soakage; but the conditions under which observations are made differ materially. In 1885 Mr. Russell, the Government astronomer, placed a self-regulating evaporating gauge on Lake George for the purpose of testing the evaporation power of the larger lakes. This lake is about nineteen miles long by six miles broad, is situate on the eastern side of the great dividing chain, at an elevation above sea level of 2200ft. It has no outlet, has never been known to overflow, and in dry weather has failed utterly. The results of the experiments were that from March 1st to October 31st, 1885, the total loss by evaporation was 23in.; the smallest amount was 0·12in. in July, the average for the eight months 2·875in. and the largest amount 5·03in. in May, which was very windy. Only the rain was taken into account which fell on the lake, and not that which flowed into it, taking the mean of rain gauges at each end. During the last fourteen years the loss by evaporation has been 12ft. The Commission are unable to express any opinion as to the theory of an underground flow of water in Australia to the ocean, but mention the places where water has been found at depths varying from 339ft. with a yield of 5000 gallons a-day, to 1220ft. with a yield of 409 gallons a-day. The diameter of the bore in the former case—Hergott Springs—is 6in., and in the latter—Turkania—3in. The most important discovery of water in Australia occurred during the present year at Wanaaring Bowrke district, at a depth of 942ft. The water flowed in a steady stream, and has increased steadily in volume ever since. Mr. Slee, superintendent of diamond drills for this colony, considers that this well will open up a tract of country hitherto impassable during seasons of drought; he also expects favourable results from other bores. The people in many districts have given up sinking for water, as it is of a brackish nature, and depend principally upon storage in tanks. Tanks are less expensive than wells, but when the right kind of water cannot be found by ordinary seeking, the artesian well should be the farmer's main dependence. In some districts it has been noticed that in almost every case where water has been struck, salt water is invariably found at a higher level—and not unfrequently near the surface. Under the circumstances, the presence of salt water should not discourage from undertaking deeper explorations. Some good work in artesian boring has been done by private enterprise, but the greater part of the work has been left to the Government. Mr. James Harold, of this city, who has had much experience in farming by irrigation in the United States, says that "the Australians need, more than anything, a few good sets of the ordinary Pennsylvania oil-boring appliances or apparatus of from 4-horse power to 6-horse power, put into the hands of men who know how to work them."

One of the most difficult questions with which Australians have to deal in connection with irrigation is the storage of water. Much of the rainfall is of only a temporary benefit on account of its tropical character, coming in vast quantities when it is not needed. The New South Wales Commission recommends the establishment of large reservoirs at the heads of the principal creeks and rivers and the placing of movable weirs across others in time of flood, and the establishment of sluice gates to prevent the return of water to the main stream. The Commission is very decided that the riparian rights existing under the common law of England are not applicable to Australia, holding that they have to deal not so much with flowing water as with the channels through which water flows, only at long and irregular intervals. It is required that these watercourses should be made to hold water—to be in effect converted into inundation canals; but this could not be possible under the present state of the law. They recommend that the presumption of the English common law should be superseded by a clear enactment of State ownership, the effect of which would be to increase and make permanent the supply of water which now wholly fails. In the colony of Victoria the difficulty does not arise from the frontages to all rivers being reserved from sale, while in New South Wales and other colonies extensive alienations have taken place which involve the legal right of ownership to the middle of the beds of streams.

Canada.—The following Table gives the new Customs tariffs:—

	£ s. d.
Articles imported by and for the Dominion Government or any of its departments	Free.
Brass in bars and bolts, drawn, fancy, and plain tubing *ad val.*	10 per c.
Coal, anthracite	Free.
Gas-meters *ad val.*	30 per c.
Hardware—Builders' cabinet and carriage-makers' hardware and locks, tinsmiths' tools *ad val.*	35 per c.
Cut brads, sprigs, or tacks, not exceeding 16 ounces to the 1000 per 1000	0 0 1
Exceeding 16 ounces to the 1000 per lb.	0 0 1
Cut nails and spikes of iron and steel per lb.	0 0 0½
Nails and spikes, pressed and wrought hob, horseshoe, and wire, and all other wrought iron or steel nails not elsewhere specified per lb.	0 0 0¾
but not less than, *ad val.*	35 per c.
Nail rods of Swedish rolled iron, under ½in. diameter, for horseshoe nails *ad val.*	20 per c.
Iron and steel manufactures—Articles or wares not specially enumerated or provided for, either in part or wholly of iron or steel in every stage of manufacture *ad val.*	30 per c.
Axles and springs of iron or steel, parts thereof, bars, blanks, or forgings for carriages other than rail or tramway per ton	4 13 4
and *ad val.*	30 per c.
Ditto ditto, car and all other springs not elsewhere specified per ton	6 5 0
but not less than, *ad val.*	35 per c.
Bar, hammered, and rolled iron, comprising flats, rounds, and squares, and bars and shapes of rolled iron not elsewhere specified per ton	2 14 2
Boiler and other plate, skelp iron, rolled in grooves or sheared, sheet iron, black or common, not thinner than 20 gauge, not elsewhere specified, including nail plate of iron or steel, 16 gauge and thicker per ton	2 14 2
Boiler tubes of wrought iron or steel *ad val.*	15 per c.
Bridges and structural ironwork per ton	5 16 8
but not less than, *ad val.*	35 per c.
Cast iron plates and castings of iron not elsewhere specified per ton	3 6 8
but not less than, *ad val.*	30 per c.
Cast iron pipes of every description per ton	2 10 0
but not less than, *ad val.*	35 per c.
Castings of malleable iron and steel not elsewhere specified per ton	5 4 2
but not less than, *ad val.*	30 per c.
Ferro-manganese, ferro-silicon, spiegel, steel bloom ends, and crop ends of steel rails for the manufacture of steel per ton	0 8 4
Fire engines *ad val.*	35 per c.
Forgings of iron or steel, or forged iron not elsewhere specified	7 0 0
but not less than, *ad val.*	35 per c.
Hoop, band, scroll, or other iron not over 8in. wide and not thinner than No. 20 gauge per ton	2 14 2
Thinner than No. 20 gauge *ad val.*	12½ per c.
Locomotive and other steam engines, boilers and machinery, partly or wholly of iron or steel, not elsewhere specified *ad val.*	30 per c.
Any locomotive with tender weighing 30 tons and upwards to pay not less than	416 10 0
Locomotive tires of steel in the rough	Free.
Pig, kentledge, and scrap cast iron per ton	0 16 8
Plates of iron and steel combined, and steel not generally enumerated or provided for *ad val.*	30 per c.
Portable machines, planing mills, separators, steam engines, threshers, and parts thereof in any stage of manufacture, *ad val.*	35 per c.
Rails and tramway bars of iron or steel of any form not elsewhere specified per ton	1 5 0
Railway fish-plates per ton	2 10 0
Rivets and bolts of iron and steel and bolt or nut blanks, less than ⅝in. diameter per ton	7 0 0
and *ad val.*	30 per c.
Rivets, bolts of iron or steel, bolt blanks, wrought iron and steel nuts and washers, not elsewhere specified per ton	4 13 4
and *ad val.*	25 per c.
Rolled iron or steel angles, channels, special sections and structural shapes weighing less than 25 lb. per lineal yard not elsewhere specified per ton	2 6 8
and *ad val.*	10 per c.
Rolled iron or steel angles, beams, channels, girder joists, special sections and structural shapes weighing not less than 25 lb. per lineal yard *ad val.*	12½ per c.
Rolled iron or steel angles, beams, channels, eyebar blanks, made by the Kloman process, girders and joists, with all structural shapes of rolled iron or steel, including rolled iron or steel bridge plate, not less than ⅝in. thick, nor less than 15in. wide, when imported by manufacturers of bridges for exclusive use in the manufacture of iron and steel bridges, *ad val.*	12½ per c.
Rolled rods of steel under ½in. diameter or square when imported by cutlers, knob and lock makers for use exclusively in such manufactures in their own factories	Free.
Safes, doors for safes and vaults, balances, scales, and weighing beams of iron or steel *ad val.*	35 per c.
Sheet iron, black or common, coated or galvanised, thinner than No. 20 gauge, Canadian plates, and plates of iron or steel not less than 30in. wide and not less than ¼in. thick *ad val.*	12½ per c.
Slabs, blooms, loops, puddled bars, or other form of iron less finished than iron in bars, and more advanced than pig except castings per ton	1 17 6
Steel ingots, cogged ingots, blooms and slabs, bands, hoops, bars, billets, sheets, and strips, valued at not less than £18 13s. per ton, except blooms, cogged ingots, and slabs, upon which the duty shall not be less than £1 13s. 4d. per ton *ad val.*	30 per c.
but not less per ton than	2 10 0
Ditto, of greater value than £18 13s. per ton *ad val.*	12½ per c.
Steel for the manufacture of files when imported by the manufacturers for use in their factories	Free.
Steel rails weighing not less than 25 lb. per lineal yard, for use in railway trucks	Free.
Tubing, not welded, of rolled steel under 1½in. diameter *ad val.*	15 per c
Tubing, iron lap-welded, 1in. and 1¼in. diameter, but not over 2in., for use exclusively in artesian wells, petroleum pipe lines, and refineries *ad val.*	20 per c.
Tubing, wrought iron, over 2in. diameter *ad val.*	15 per c
Tubing or piping, other than wrought iron per ton	2 16 0
and *ad val.*	30 per c
Wire of iron and steel 15 gauge, and coarser, not elsewhere specified *ad val.*	25 per c.
Ditto, 16 gauge or smaller	Free.
Wire of spring steel, coppered or tinned, No. 9 gauge or smaller, not elsewhere specified *ad val.*	20 per c
Wire round-rolled rods, of iron or steel, under ½in. in diameter, imported by manufacturers for use in their factories	Free.
Wire rope, of iron or steel, not otherwise provided for *ad val*	25 per c.
Wrought scrap iron and steel, being refuse or waste that has been in use, and is fit only to be manufactured per ton	0 8 4
On all kinds of iron or steel bars, rods, sheets, or strips of steel, and on cold-hammered rolled, or polished in any way, in addition to the ordinary process of hot-hammering or rolling, there shall be paid per ton	0 15 6
All metal produced from iron or its ores, which is cast or malleable, without regard to the percentage of carbon contained therein, shall, except when known as malleable iron castings, be classed and known as steel. All articles rated as iron, or manufactured of iron, shall be chargeable with the same rate of duty if made of steel or of iron and steel combined, unless otherwise specially provided for	—
Tools and implements—Adzes of all kinds, axes, hammers, and hatchets not elsewhere specified *ad val*	35 per c.
Axes, chopping per doz.	0 8 4
ad val.	10 per c.
Mowing machines, harvesters, self-adjusting, without binders, binding attachments, reapers, sulky and walking ploughs, all other agricultural implements and machines not otherwise provided for *ad val*	35 per c.
Picks, blacksmith hammers crowbars, mattocks, sledges, track tools, and wedges of iron or steel per lb.	0 0 0½
and *ad val*	25 per c.
Shovels and spades and shovel and spade blanks per doz.	0 4 2
and *ad val*	25 per c.

RAILWAY MATTERS.

THE Midland Railway Company has opened a temporary goods station in Holliday-street, Birmingham.

A LARGE railway order is being placed upon the market by the Bengal Nagpur Railway Company. It includes 12,000 tons of steel Vignoles rails, 180,000 steel transverse sleepers, 750 tons of steel fish plates, and 180 tons of steel fish bolts and nuts.

THE new Niagara suspension bridge, the one near the falls, is to be rebuilt to afford a double common road track, it being expected to finish the work by April, 1, 1888. "The only old part left will be the towers," says a contemporary, forgetting that the towers are not an old part, but were renewed in iron two or three years ago.

DR. P. H. DUDLEY, the chemist of the Pennsylvania Railroad Company, read a paper recently on the "Mechanical Inspection of Railway Tracks and the Results obtained therefrom." The inspection is done by means of a car, which registers every deflection of the rails from a straight line, and at the same time a jet of white paint is ejected by means of compressed air upon the spot where the fault in the rail is, for the benefit of the track repairer.

AN inclined plane cable road of some magnitude is to be constructed this yearnearly in front of the Catskill Mountain House, to afford an easier and more direct access to the top of the mountain, and thence by the existing rail lines to the heart of the Catskills. The lift will be 1500ft. in a horizontal distance of 4600ft., the foot of the plane being approached by about three miles of new line on a grade of 150ft. to the mile. The "plane" will not be such, in fact, but the grade will correspond approximately to a curve of sines so as to balance the varying weight of the cables, which will run in the old fashion, one car coming up while the other goes down, and not continuously with an endless rope. On the plane will be two curves of 2 deg., one trestle about 70ft. high, and one rock cut of about the same depth. It is expected to complete the work this autumn, at a total cost of some 200,000 dols. It will save great loss of time to many thousands of summer tourists.

A FAST freight line which really deserves the name—in America at least—is, according to a Cleveland paper, now running on the New York, Lake Erie, and Western, which, with its controlled western connection, the Chicago and Atlantic, is running a regular train through each way daily between New York and Chicago in sixty hours. The distance is 986 miles, which would require a speed of 16½ miles per hour, including stops. As there must be from seven to twelve divisional stops, which probably average a half hour or more each, and numerous other stops for water and grade crossings, the speed when running must be well up to 20 miles an hour, which for nearly a thousand miles is very creditable. Doubtless, the cars are not heavily loaded. The west-bound traffic includes a good share of lightly loaded cars, and the east-bound trains probably confine themselves to high-class freight. The paper referred to says the time of these trains is to be further reduced to fifty-six hours. The best time hitherto made by regular trains on the trunk lines is probably nearly twice that; at least, we have not heard any of them boast of less than four days for a shipment between the two cities.

THE hot weather, says the *Engineering News*, seems to be having a bad effect on the sanity of locomotives. On Aug. 18, two passenger engines in the Philadelphia yard of the Pennsylvania railroad performed in a way which would seem absurd if narrated in fiction. A shunting engine took a wrong track right in front of the station and ran into a passenger engine with no fireman on it hard enough to knock the engineer off senseless and knock the throttle wide open at the same time. The engine at once started off at full speed, and a mile beyond struck another engine with no fireman on it, knocked another engineer off senseless, and knocked another throttle wide open. The two engines bounded up the track together at their highest speed with every condition present for a terrible catastrophe a few miles beyond, where they were quite sure to meet some train. But here the luck turned. For some unexplained reason there was a short stub switch open in the main track, or both engines left the rails and took it, and after running 100 yards on it, they ran off the end of the 30ft. embankment and were badly wrecked. What might have happened had these two engines in succession struck a train is fearful to contemplate.

DURING the six months ending July 1st, the output of Baldwin Locomotive Works was 318 locomotives, and for the year ending at that date 618 locomotives. This was the largest number ever manufactured in a year, being fifty-five more than in 1882, when, as it was supposed, the high-water mark was reached, with 563 engines. There are now in course of construction at the works 150 engines. The larger part of these are for roads in this country, less work being done for foreign roads than at any time during the past ten years. And all of them are for old existing roads, while the orders during the boom from 1879 to 1883 were almost exclusively for new roads like the Mexican National and Mexican Central. Consul Dupre, at San Salvador, closes his report to the State Department upon industrial and commercial topics with the following paragraph:—"The trade of the Pacific States of Central America must be confined mainly, until railroads may be built across the republics to San Francisco. Recently, C. P. Huntington bought the railroad from San Jose, a village without any harbour, on the Pacific coast of Guatemala, seventy-five miles in length, to Guatemala City. It is hardly more than 180 miles from Guatemala City to the bay of Honduras, hard by New Orleans and Mobile. But there is no harbour at San Jose, and to create one would cost an almost incalculable sum. On the contrary, though the country be rough, the construction of a railroad from a perfectly landlocked harbour, on the bay of Honduras, to another, La Union, in Salvador, on the Pacific, is the most desirable of all possible commercial and political consummations that could be achieved by American wealth and energy in Central America."

MUCH complaint has been made in consequence of the introduction of a new ticket system on overland roads to California. The *San Francisco Chronicle* says the trouble all arises from the fact that the ticket given at the Missouri River contains what is called a "punch photograph" of the holder. This is supposed to be a complete description of the passenger. Along the margin of the ticket is printed, in a straight column, the following words in small, black type:—Male—female; slim—medium—stout; young—middle-aged—elderly. Eye: light—dark; hair: light—dark; beard: moustache—chin—side—none. The passenger is photographed on the ticket bearing his signature by punching out all the words that are not descriptive of him. If for a male, the word "female" is cut out by the punch; if he is slim, the words "medium" and "stout" are punched; if his eyes are light, the word "dark" is stricken out; and if he wears no beard, the word "none" is left standing, while "moustache," "chin," and "side" are punched. Now it is readily seen how a train agent passing hurriedly through a crowded car is likely to make errors in describing his passengers on their tickets, and so far from being a "photograph" of the holder, the marginal sketch often becomes a rank caricature. Even where the punch marks faithfully pourtray the features and figure, the female passenger cannot always preserve her good temper on looking at the picture drawn for her. A well-developed lady of an uncertain age is not likely to consider it a compliment to be labelled in cold type as "stout" and "elderly." Tourist passengers on the overland trains often derive great amusement from a comparison of notes, or rather, of tickets, but their fun is turned to disgust when they are told that they cannot secure return passage on the tickets when they have been wrongly pourtrayed by the train agent.

NOTES AND MEMORANDA.

THE naval board on the plans for the Barrow battleship will assemble on the return of the president, Chief Constructor Wilson, September 15th. In the meantime, Chief Engineer Melville is at work upon the plans for the engines and Assistant Naval Constructor Nixon upon the plans for the hull.

THE first Cincinnati Edison Illuminating Company is now furnishing power to eight motors of the Sprague type running on its incandescent circuits, and ranging from 1-horse power to 5-horse power. The motors are used chiefly for printing presses and ventilating fans. The average rate charged is about 100 dols. per horse-power per year.

AN artesian well is being bored at Galveston. The city stands on a narrow sand spit, which fences off Galveston Bay from the Gulf of Mexico, and is surrounded by water, being at different places from two to forty miles from the mainland. It is therefore a peculiar place for an artesian well. So far a depth of 658ft. has been reached. The following is the stratification passed through:—Quicksand, 32ft.; blue clay, 17ft.; coarse sand, 26ft.; white clay, 107ft.; sea mud, 57ft.; olive clay, 116ft.; sea mud, 130ft.; blue clay, 26ft.; sea mud, 11ft.; blue clay, 147ft.; total 658ft. At a depth of 500ft. several palmetto logs were passed through. At present a 9in. tube is being sunk.

PROFESSOR GOULD, according to the *Scientific American*, has ascertained that aerial telegraph wires on poles transmit electricity at the rate of from 14,000 to 16,600 miles per second, and that the velocity of transmission increases with the distance between the wires and the earth, or, in other words, with the height of suspension. Subterranean wires, like submarine cables, transmit slowly. While wires suspended at a feeble height transmit signals at a velocity of 12,000 miles per second, those that are suspended higher give a velocity of from 16,000 to 24,000 miles. Wheatstone's experiments in 1833 seemed to show a velocity of 288,000 miles per second, but this result has never been confirmed.

Kuhlow says:—According to the report of the Chamber of Commerce of Halberstadt, the average consumption of potassium has increased in the five years from 1882-1886. According to a statement of the sale syndicate of the chloride of potassium factory owners at Stassfurt, 1,787,509 centners of chloride of potassium—80 per cent. per centner—were delivered in 1884, 1,939,908 centners in 1885, and 1,884,060 centners in 1886. A decline, therefore, of 55,848 centners took place in the sales, compared with 1885, but an increase of 96,461 centners compared with 1884; 1,003,100 centners were exported abroad, and 880,960 centners remained in Germany. The average receipts amounted to 6·67 marks per centner against 6·68 marks in the previous year.

AN apparatus for testing cements with a weighted needle has been described in *La Nature* by M. Bonami. The appliance consists of a tube terminating at the bottom in a flat disc which rests upon the cement specimen, and in one side of this tube is a set-screw acting upon a rod sliding in the tube. This rod carries a steel needle 0·03 m. long and one square millimetre in sectional area. On the upper end of the rod is a small flange upon which can be placed any required number of zinc discs weighing 50 grams each; the rod itself weighs 50 grams. In the side of the rod opposite the set screw is a notch whose upper surface forms an inclined plane against which the end of this screw rests, and by turning the screw the rod may be slowly lowered upon the cement. The upper part of the rod is provided with a scale from which the degree of penetration can be read.

MR. VILLON, engineer and chemist, after five months' experimentation with various tannins in order to ascertain which is most effective in preventing the incrustation of boilers, states, in the *Chronique Industrielle*, that the best results are given by *Rumex hymenosepalum*, a species of dock that grows plentifully in sandy soils in a large territory on both sides of the Rio Grande, and from there northward over a large portion of Western Texas. The bulbous root—called "canaigre"—is the part used. The roots are produced in clusters weighing several pounds. They contain 25 per cent. of tannin, along with gum, starch, and ligneous matter. A liquid extract is made from them which is purified with acetate of zinc in order to remove the gum and resin, and a brown liquid is obtained marking 20 deg. B. Of this 5 grammes—75 grains—per hydrotimetric degree of water and per cubic meter—264 gallons are used.

THE only trustworthy determinations of the quantities of substances necessary to excite the sense of smell have been hitherto carried out by Valentin. He found that the quantities thus capable of recognition were 1-600 mg. bromine, 1-5000 hydrogen sulphide, and 1-20,000 oil of roses. The authors have undertaken analogous experiments with other strongly smelling substances, and have arrived at still smaller values. In one of the experiments the quantity of mercaptan evaporated was 0·01 m.g. This was faintly but distinctly recognised. The proportion of mercaptan to the air was in round numbers 1 : 50,000,000,000, and the quantity which could come in contact with the olfactory nerves was 1-460,000,000 mg. This quantity is 250 times smaller than the quantity of sodium detected spectroscopically by Kirchoff and Bunsen.

THE property of heated gases to convey electricity has long been recognised, but some recent studies have extended our knowledge on the subject. Thus it is shown that the property is possessed in far greater degree than was first thought possible, and, even with the lowest electro-motive forces employed, reaching to the thousandths of a volt, a current has been passed over the space between the electrodes, and this though the air was heated to a comparatively limited degree. This is sought to be explained by the assumption that the electricity is conveyed by hotter threads or streamers which course within the lesser heated particles. The experiments cited elsewhere point to the fact that it is well to so dispose contiguous conductors that no arc conveyed by heated air can be formed between them, given the conditions, of course, that the heating is not effected by the current within the wire itself. The theory of the action by which electricity is conveyed by hot air, and by which the counter electro-motive force is produced in the arc, presents a number of interesting points. The *Electrical World* says by means of the phenomena observed, it becomes possible, as is well known already, to start an arc between two terminals without bringing them into contact.

AN apparatus for automatically regulating the pressure of air in blowing hollow glassware was exhibited and described at a recent meeting of the Paris Society of Civil Engineers by M. Appert. It consists of a closed cylinder, with a piston which can be fixed at various points, so as to vary its cubical capacity. Two valves are fixed to the cover of the cylinder, one communicating with the main air-supply pipes, and the other with the pipe used by the glass-blower. The main supply valve is usually open, whilst the blowing valve is closed, so that the pressure in the cylinder is equal to that in the main supply pipe. Fixed between the two valves is a lever worked by a treadle, which upon being pressed first closes the main supply valve and next opens the blowing valve. A definite amount of air thus escapes from the cylinder into the article under treatment. When the pressure is taken from the treadle, the blowing valve closes and the main supply valve opens and recharges the cylinder to the former pressure. If the treadle be again depressed, a supplementary quantity of air, but smaller than the first charge, is forced into the object being blown, and the operation may be repeated uutil the desired shape has been attained, each successive opening of the valves admitting smaller and smaller quantities of air. The *Engineering and Mining Journal* says that by setting the piston within the cylinder at various points, the apparatus is rendered suitable for the production of various sized objects.

MISCELLANEA.

COLONEL HOPE'S gun, intended to revolutionise artillery construction, burst on being tested at the first round.

STATISTICS show that 53,000 wells have been drilled in Pennsylvania and New York since the discovery of petroleum, at a cost of 200,000,000 dols. These wells have produced 310,000,000 barrels of oil, which were sold at the wells for 500,000,000 dols. This represented a profit to the producer of 300,000,000 dols.

THE republic of Switzerland, which has never heretofore had a patent law, has voted by a majority of 146,000 in 260,000 in favour of granting patents, and it is expected the law will be enacted at once. By a curious limitation, however, it will cover only mechanical devices which can be represented by model. No processes or compositions of matter will be patentable.

THE fee of 20,000 dols. paid Jas. B. Eads for his opinion in reference to the Manchester Ship Canal, is said by the American press to be the highest fee ever paid for an engineering consultation. 1,750,000 dols. has been expended upon this canal before a sod had been cut or a stone laid to forward the actual work, which is to cost 28,750,000 dols., a firm of responsible contractors having agreed to build it for this price.

THE Organisation Committee of the Exhibition of Contrivances and Materials used for Lighting Purposes, and also of everything connected with the naphtha Industry, which takes place in the winter of the present year, at St. Petersburg, informs us that the applications of those who desire to participate in the exhibition will be received till the 27th of September, and the exhibits till the 27th of October.

THE Darlington Forge Co. has secured a good order in the shape of a large three-throw built crank shaft, together with the spare shaft. They will be built entirely of Siemens' ingot steel, and the entire crank shaft is to be 27ft. long and 17in. diameter, stroke of engines 5ft. The finished weight of the shaft will be about 25 tons. The crank is destined for the great Japanese line, the Nippon Yusen Kaisha of Yokohama, one of the vessels for which is being built and engined by the London and Glasgow Engineering Company.

AN intimation has been received at Portsmouth that, in consequence of the decision of a Committee which sat to consider the question of coast defences, the armament of the Spithead Forts will shortly be considerably strengthened and modernised. It is also proposed to lay a series of submarine and electric contact wires in the channels through which large ships of war would approach Spithead, and it is probable that a telegraphic cable will be laid to connect the whole of the Forts with the mainland.

IT is well known that some of the large yachts have a great many tons of lead stowed away in their keels. It has now been suggested that this lead could be utilised in the shape of accumulators, that could thus be made to carry several horse-power, which, with the intervention of a motor, could be utilised in working the windlass, hauling in the main sheet, &c.; and furnishing light as well. As is remarked, it would be rather a novelty to have the ballast weighing the anchor or hauling at the ropes, but stranger things than that have been done before.

THE Belgian Government is making extensive arrangements for the great international concourse of science and industry, which is fixed to take place at Brussels in 1888. The director of the Belgian section, accompanied by several members of the general commissariat department, is now going the round of the provinces and appointing local committees in the different industrial centres. The duty of these committees will consist in grouping together the heads of local industries and inducing as many as possible to contribute to the national section.

THE placing of the South Staffordshire Iron Trade Wages Board upon a substantial footing is being energetically attempted. The ironworkers are being appealed to for a resumption of their quarterly contributions, and Mr. D. Jones, employers' secretary to the board, is arranging for the holding of meetings of the men, at which to enforce the claims of the institution. After these preliminary assemblies, there will probably be held a combined meeting of masters and operatives' representatives from each of the principal works in the district.

THE *American Machinist* says:—"It appears that the axles manufactured by the Troy Steel Company are tested by selecting one from every twenty, and subjecting it to three successive blows from a heavy trip hammer. On the occasion referred to several axles had successfully passed the test, and two blows had been given to another, when an accidental delay took place, and on striking the third blow some little time after, the axle broke. This being an unexpected occurrence another axle was tested in a similar way, the third blow being purposely delayed, and another breakage took place; the experiment was repeated two or three times with a similar result, though the axles from the same lot always stood the test when the blows were given in rapid succession."

SOME fine examples of roll castings have just been turned out at the Swan Village Iron Foundry, West Bromwich, of Messrs. J. and S. Roberts. One roll of 13 tons in weight, and another of 20 tons, have been cast to form part of a large machine plant which is just now being got up in this country for the United States. A third roll, also of 20 tons, has also to be cast, and the work already turned out has been of a most successful description. It is understood that the plant is intended for the manufacture of linoleum cloth in the States, and that the total weight will be something like 300 tons. The machinery, other than the rolls, is being turned out by a Gloucester engineering firm. The order is the more valuable since there is some probability of its being duplicated if the buyers find the present plant answers their expectations.

THE new French Pralon rifle has a steel bullet, and its breech action is adapted to mechanism on the same principle of absolute closure as applied to the Eange patent cannon. The rifle is of an entirely new model, quite distinct from the recently introduced Lebel, although of the same calibre. More powerful charges of powder can be used and a longer range obtained by the Pralon system, but it is calculated that in the course of a few months six army corps will receive the new small-bore rifle, model 1886, or Châlons, or Lebel. At the same time the rifle of Captain Pralon is to be served out to a crack corps told off to disable batteries of artillery by picking off gunners and horses at some fabulous distance. Experiments will shortly be made with 1000 of these rifles, and in the meantime the inventor has been rewarded with the Legion of Honour.

THE American *Sanitary Engineer* prints a set of rules respecting the stringing of wires overhead, which were adopted at a recent meeting of the Board of Electrical Control in New York City, but have since been referred to an electrical engineer for revision. It is positively stated that permits for this purpose are but temporary, "pending the providing of underground accommodation." The important provisions are those limiting the lines of poles to but one on each side of each street or avenue for similar electric service. The poles for electric lights are to be twenty feet high and eight inches in diameter at base at least, and of iron, with wood cross-arms. Other poles to be at least sixty feet high. All poles to be at least ten feet from any lamp-post or other pole, and all poles, new and old, to be plainly marked with the initials of the company owning them. No arc, electric light, or power wires are to be stretched over any portion of any house or building. No new wires to be stretched in streets where conduits are, or are being, provided. There are also provisions limiting the time that poles may lie upon the ground.

MACHINES FOR TREATING AURIFEROUS MATERIALS.

MESSRS. JORDAN, SON, AND COMMANS, LONDON, ENGINEERS.

IN a previous article on the 17th of June last, upon gold mining machinery for the Transvaal, passing reference was made to the concentration of the auriferous pulp by means of Frue vanners. We now take the opportunity of illustrating and describing the machines of which Messrs. T. B. Jordan, Son, and Commans are the sole makers in this country. It is claimed that they are the most successful form of fine ore concentrator yet introduced into the market. The most important feature in this class of machine is an endless india-rubber belt having a steady lateral shaking motion.

The employment of a revolving belt is of very old date, but the application of a steady lateral motion is a novelty, and constitutes the essential element of success in this machine.

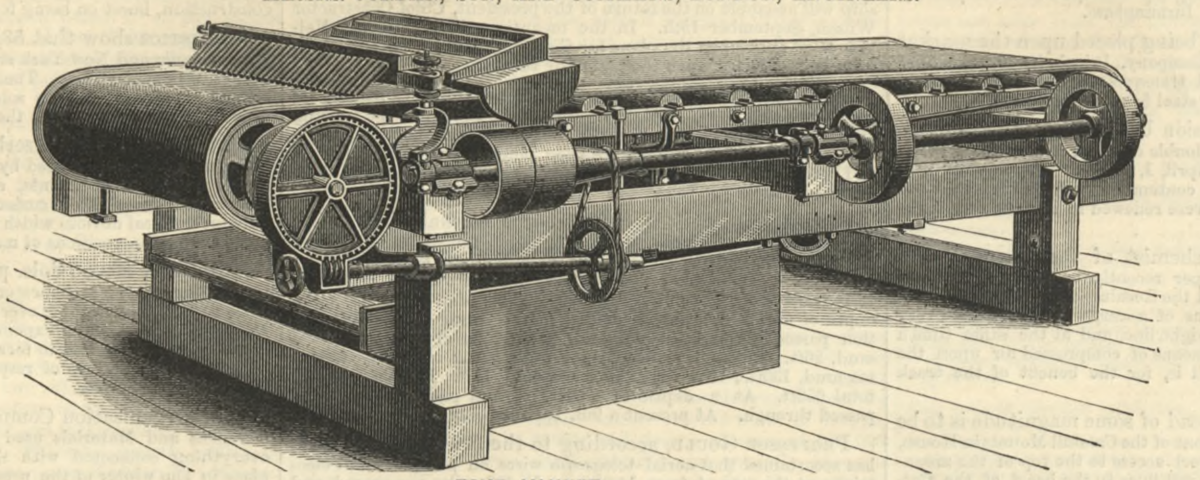
The belt is about 4ft. wide and 12ft. between the centres of the end drums, and is bounded on the sides by rubber flanges. It is supported by small rollers, and travels up a slight incline and around a lower drum, which dips into a water tank where the rich sulphurets clinging to the belt are deposited.

To understand the principle and action of this machine in extracting the metalliferous constituents of slime from the accompanying particles of rock, it will be worth while to examine the process of "vanning" on a shovel or pan, which is the most perfect method of separation we know of.

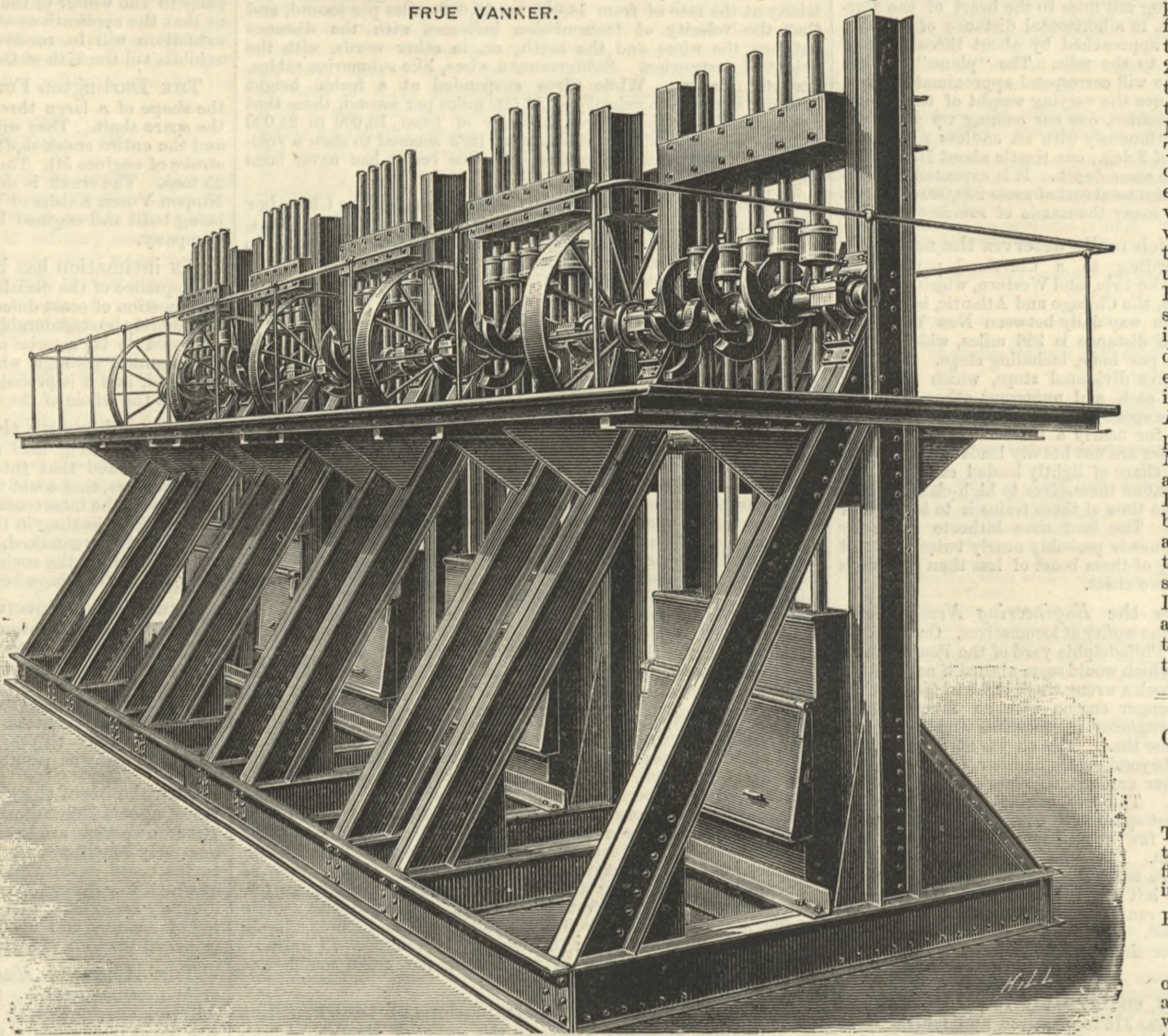
In vanning, the muddy water is kept in gentle motion for some time by a circular movement of the shovel, until the almost impalpable mineral settles to the bottom. Then a gentle wave of water is caused to flow repeatedly over it, washing the fine rock across the shovel ahead of the mineral which, owing to its greater specific gravity, offers more resistance to the flow of water. In this process the mineral cannot be thrown forward, as is done when vanning comparatively coarse particles of united rock and mineral; it has not enough mass for that, but is separated from the sand by taking advantage of the resistance it offers to a wash of water when once settled on the shovel.

This clinging property of finely-divided mineral is a most important point, and it is to this property of the slime mineral that much of the success of the Frue vanner must be attributed; in fact, the taking advantage of th's clinging property of the mineral was the feature chiefly borne in mind when these machines were first thought of, and the perfect separation obtained by them is a proof of the thoroughness with which the principle has been carried out.

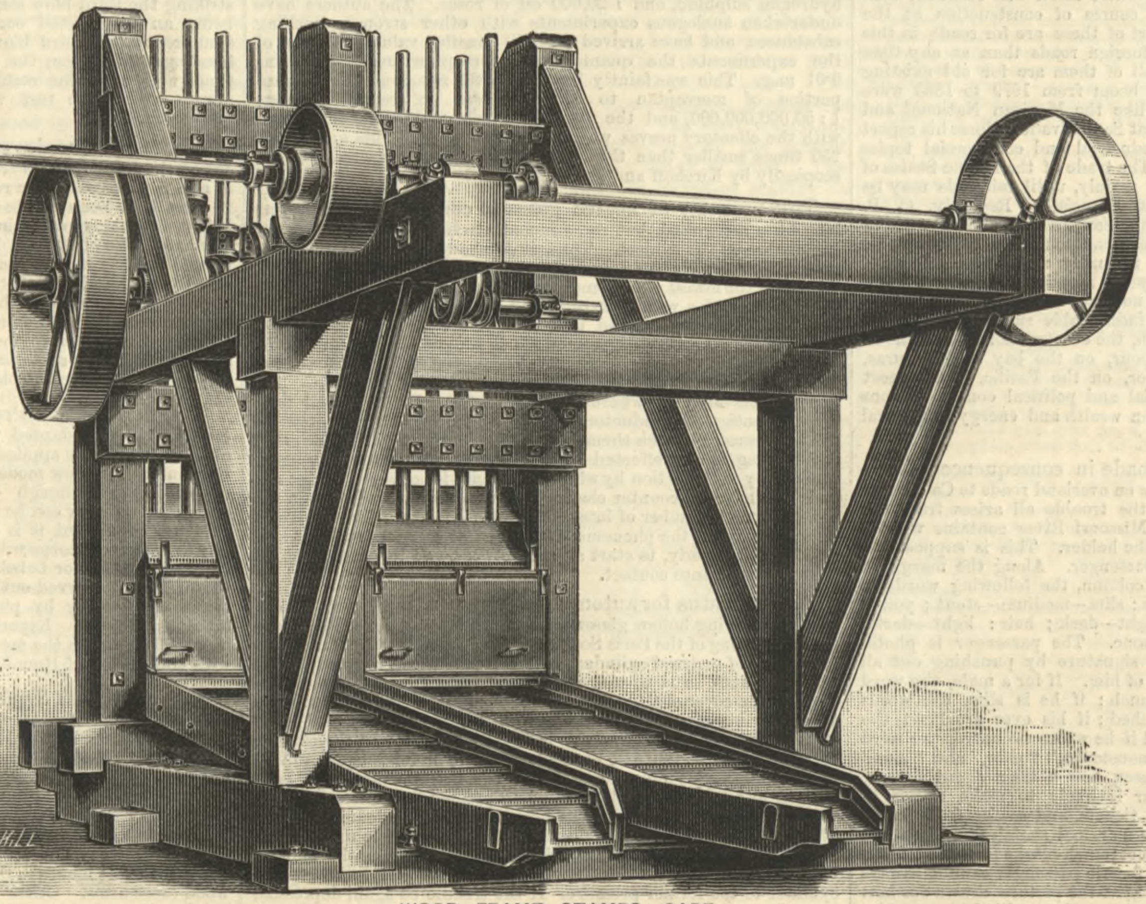
To return to the method of working the machine: The ore is fed on in a stream of water about 3ft. from the head of the belt, and flows slowly down the incline, subject to the steady shaking motion which deposits the mineral on the belt. At the head of the belt is a row of water jets. The slow upward travel of the belt brings up the deposited mineral, and the water jets wash back the lighter sand, the clinging mineral only passing on with the belt to the water tank below. We have said the side shake is the essential element of success in this machine, for not only does it cause the deposition of the mineral from the sand, but, by keeping the whole of the material in motion, the belt can be set at a slighter angle, a smaller quantity of water used and a much greater quantity of material treated, than if a simple belt without shaking motion were employed. Further, the sand cannot "pack" and cause the water to cut channels and run off in small streams, but is always uniformly distributed over the belt, and, in addition to treating a greater quantity of material, there is an almost complete separation of mineral from the sand, as much as 90 to 92 per cent. having been obtained repeatedly.



FRUE VANNER.



IRON FRAME STAMPS, AUSTRALIA.



WOOD FRAME STAMPS, CAPE.

Our other illustrations represent respectively a stamp battery of the wooden knee-frame design and a battery with framing of wrought iron. The former is the style mostly in use in the Transvaal, and is very strong and substantial; the countershafting for driving is carried on the framing well out of the dirt. The launders with amalgamated copper plates, for catching the free gold, are shown in position. Wrought iron-framed stamps are sometimes preferred to wood. The 25-head battery shown in the illustration was supplied to the No. 2 Queen Gold Mining Company, of Charters Towers, in which district only iron-framed stamps are employed, owing to the prevalence of the white ant, which is so destructive to timber. These batteries are used in conjunction with the Frue vanners above described. The plan of working these requires no special description, and can be easily understood from the illustration. The *Barberton Herald*, in speaking of a plant recently supplied by Messrs. T. B. Jordan, Son, and Commans, and Messrs. Robey and Co., says, "The battery presents an imposing appearance, the height from the Frue vanners to the stone crusher being 50ft. It is undoubtedly the finest and most complete—in fact, the only complete battery in the fields."

GILCHRIST ENGINEERING SCHOLARSHIPS, UNIVERSITY COLLEGE.

THESE scholarships, given by the Gilchrist Trustees, were first offered for competition in 1880.

REGULATIONS.—A. ENTRANCE SCHOLARSHIPS.

1. An entrance scholarship of the value of £35 per annum, tenable for two years, will, during the pleasure of the Gilchrist Trustees, be annually offered for competition subject to the following regulations:—

2. The competition is limited to those who have not previously been students of the college.

3. Candidates must show, to the satisfaction of the council, that they will not be more than nineteen years of age on the 1st of October immediately succeeding the examination.

4. Candidates must, on or before the 23rd of September in each year, send to the secretary written notice of their intention to compete, stating the subjects—see 7—in which they desire to be examined, together with certificates of age and good conduct.

5. The examination will take place in September at the college.*

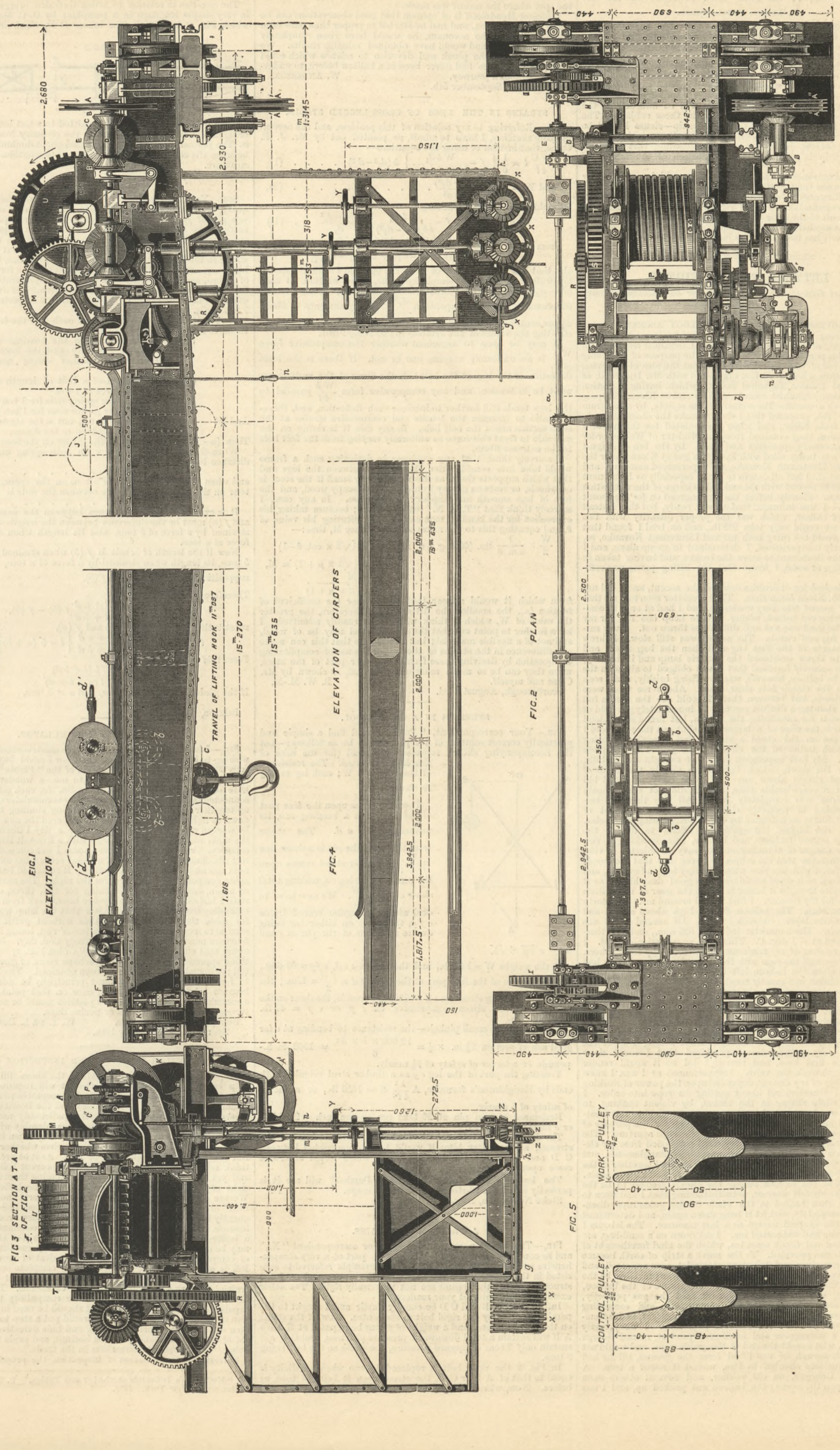
6. Every candidate must declare in writing his *bona fide* intention of taking at least the two first years of one of the engineering courses as set forth in the prospectus. The first annual payment will be made on the award of the scholarship. The payment for the second year will be contingent on the scholar entering at the commencement of that session the classes comprised in the course which he has selected, and also upon his having presented himself at the class examinations of the preceding session and obtained not less than three certificates in these examinations.

7. The subjects of the entrance examinations will be as follows: — (1) Mathematics. (2) Any two or more of the following subjects: — Mechanics; mechanical drawing; essay on one of three given subjects connected with mechanics

* The examination is held at the end of September.

50-FEET TRAVELING CRANE, PARIS, LYONS, AND MEDITERRANEAN RAILWAY.

(For description see page 236.)



or engineering; French or German; the use of tools, either carpenters' tools, or the lathe—wood or metal—or the file.

B. SENIOR SCHOLARSHIPS.

1. A senior scholarship of the value of £80—half payable at the time of the award and half in the succeeding June—will, during the pleasure of the Gilchrist Trustees, be awarded at the close of each session from 1881-82 inclusive.

2. Candidates for this scholarship must, to the satisfaction of the faculty of science, have attended college classes in the following subjects during the whole of the session immediately preceding the award:—Applied mathematics, physics, engineering, engineering drawing, geology. The scholarship will be awarded on the results of the ordinary class examinations in these subjects. The payment of the second half of this scholarship—clause 1—will be conditional upon the student's attendance on classes in any of the engineering courses, during the session succeeding that in which the scholarship is gained, to the satisfaction of the faculty of science.

The above entrance and senior scholarships will be awarded by the council upon the report of the faculty of science. Such report as regards the entrance scholarships will be based upon the result of special examinations; and as regards the senior scholarships, upon the result of the ordinary class examinations. But no scholarship will be awarded unless, in the opinion of the faculty of science, sufficient merit has been shown to justify such award.

LETTERS TO THE EDITOR.

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

PROFESSOR MENDELEEFF'S BALLOON ASCENT.

SIR,—Having had the good fortune to find Professor Mendeleeff at the meeting of the British Association, I obtained from him an account of his perilous balloon ascent for the purpose of observing the late eclipse of the sun. He told me that the idea of observing the eclipse from a high elevation originated with Mr. Djevetski, of the Imperial Russian Technical Society, which, having a section for aerostation, organised ascents at Iver and at Kleen. Here is the professor's account:—The council of the Society, by a telegram dated July 29th, proposed that I should make the observations in the ascent from Kleen, and when I stipulated for the use of a military balloon, they obtained from the Minister of War an order for all the necessary apparatus and staff. By the 6th of August the balloon was being filled with hydrogen gas at Kleen under the directions of Lieutenant Kovanko, an experienced aeronaut, and an efficient staff. I left all details to them, especially as Lieutenant Kovanko was to ascend with me and take charge of the navigation of the balloon. Shortly before the time agreed on for the ascent—6.35 a.m.—I was informed that all was ready, but that instead of 540 lb. of ballast, which was the proper quantity with two passengers, we could only take 288 lb., and on trial I found that the balloon could not carry both me and Lieutenant Kovanko, so, though utterly inexperienced, I determined to go up alone, and I requested the lieutenant to leave the basket, and having taken in two more bags of sand, I found that the lifting power was sufficient.

These unlooked-for difficulties delayed the ascent, and I did not start till 6.38, Kleen mean time. The barometer soon told me that the rate of ascent was very moderate, and I had at once to commence throwing out ballast, taking care to keep one bag for my descent. The sand was wet and difficult to throw out. I was surrounded by fog and clouds. The ascent was still slow. I threw out the contents of the first bag and then the bag itself, and attempted to throw overboard the electric lamp and its battery, but it was so securely fastened that I was obliged to abandon the attempt. The balloon, however, was now rising briskly, and I soon got through the clouds into clear space. Above me there were still a few clouds, but between them I could see the sun in full eclipse, and showing a distinct corona. I immediately got hold of the instruments for measuring the corona, but first a small cloud and afterwards the edge of a larger one shut out the view, and I could only see on the cloud a striped and irregularly-moving shadow, which indicated the close of the period of complete obscuration. My first impression was as of twilight among hills, followed by the dawn, which lighted up vividly the edges of the stratified clouds above me. A thick body of cloud hid the sun for a considerable time, and I did not see it again till the eclipse was completely over. All this time the balloon was rising in perfectly clear space from a height of 5300ft. to 11,400ft., as indicated by the self-registering barometer. I wished to rise higher, but again my efforts to detach the electric lamp proved fruitless, and besides, I was unwilling to risk the possible danger of throwing out so heavy an object. In view of the circumstance that the eclipse was over, and that the clouds which interfered with my view were still very high above me, and that the balloon as it dried would mount a good deal higher as it was, I therefore thought it better to see to the gear of the balloon and prepare for my descent. I first looked around me. The earth could not be seen. The balloon floated high above a level and apparently white layer of clouds or fog. All around me it was perfectly clear. The barometer indicated 525 mm., and the thermometer stood at − 1 deg. C. There was no sensation of cold. I verified the reading of my minimum thermometer by three others. The guide rope and the rope with the grapnel, which someone had cast loose before the balloon left the earth, were hanging down outside the basket in a greatly tangled condition. I hauled in the heavy guide rope as far as the first tangle, unravelled it, and dropped it, hoping that the shock would set the rest free. This did not occur. I then noticed that the valve rope, which passed out of a lateral aperture near the main lower opening, was greatly entangled within the gas bag of the balloon. The main aperture was wide open, and hanging through it was a long loop of the valve rope. By pulling this I perceived that I could draw together the first knot, and that if I did so it would render it impossible to work the valve. Inexperienced as I was, I knew that the safety of my descent depended upon the power of working the valve. I therefore set about getting its rope into order. I succeeded, while sitting in the basket, by violent shaking, to disentangle one loop, but the others would not yield to this treatment, and I had to climb up to the opening for the purpose of cutting a communication between it and the rope aperture. The operation proved to be unnecessary, for I succeeded from my elevated position in shaking out the remaining entanglements, and then found that upwards of 28ft. had been knotted together in the bag. Finding that the valve worked well I looked around again. The position of the balloon among the clouds seemed to be the same, but the air felt warmer, notwithstanding that I had risen to 12,300ft. I then hauled in the whole of the guide rope, disentangled it completely, and let it hang down again, and determined not to use the grapnel except as a last resource. The labours I had undergone had exhausted me. I sat down on a sand-bag, ate a roll of bread and drank some tea, which the kind forethought of some friends had provided. To the north a strip of earth became visible, a large river and tributary streamlet soon appeared, and the sun shone out through the clouds. The river proved to be the Volga, and the tributary the Doubna. The course of the balloon, by compass, was due north, and as it held the gas perfectly, I devoted some time to making observations and examining the scene beneath me. At nine I began the descent, and accomplished it safely about ten minutes past nine. I was greatly assisted by a courageous and intelligent peasant, named George Greegorieff, who caught the end of the guide rope, and would not relinquish it, though he was lifted from the ground, till he had under instructions shouted to him, wound it round a tree. A brother of George's, an old soldier, and several others soon appeared upon the scene; the balloon was packed up, and I was hospitably received by the kind-hearted proprietor of the land on which I had alighted. I had travelled only about sixty miles from the spot where the ascent was made.

Professor Mendeleeff is of opinion that good observations can be made from a balloon, and had he started in proper time, and been accompanied by the aeronaut, he would have risen completely above the clouds, and would have obtained valuable results. We must all admire the pluck and devotion to science which could prompt a man, who had never been in a balloon before, to undertake so perilous a journey.

W. ANDERSON.

Manchester, September 5th.

STRAINS IN THE LEGS OF CROSS-LEGGED STOOLS.

SIR,—Referring to my solution of this problem, and the accompanying sketches, I have to admit, as pointed out by Mr. J. E. Caine, that instead of using the equations—

$$\frac{W\,C}{4\,l}\,l = \frac{1}{6}\left\{f - \frac{W\,h\,d_1}{l\,b\,(d_1^2 - d_2^2)}\right\} b\,(d_1^2 - d_2^2) \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{and } W = \frac{2\,f\,b\,l\,(d_1^2 - d_2^2)}{3\,c\,l + 2\,h\,d^1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

I should have used the following:—

$$\frac{W\,c}{4\,l}\,l = \frac{1}{6}\left\{f - \frac{W\,h\,d_1}{l\,b\,(d_1^2 - d_2^2)}\right\} b\,\frac{d_1^3 - d_2^3}{d_1} \quad . \quad . \quad (1^1)$$

$$\text{from which } W = \frac{2\,f\,b\,l\,(d_1^2 - d_2^2)\,(d_1^3 - d_2^3)}{d_1\left\{3\,c\,l\,(d_1^2 - d_2^2) + 2\,h\,(d_1^3 - d_2^3)\right\}} \quad . \quad . \quad (2^1)$$

also that the exact length of h—if c = 6in. and l = 12in.—should be 10·39; but which, for simplicity's sake, I took at 10in. I used $(d_1^2 - d_2^2)$ so as to avoid "intricacies of calculation," seeing that the difference in using the expression $\frac{d_1^3 - d_2^3}{d_1}$ only amounts to about 2½ per cent. in the example given. The exact value of W, by substituting the values of the symbols in (2^1) being 919 lb.

It may be open to argument whether the compressive force $\frac{W\,h}{4\,l}$ is an uniformly varying one or not. If there is the least deflection of the legs at the bolt hole the fibres of the under sides must be in tension, and any compressive force $\frac{W\,h}{4\,l}$ parallel to the legs tends still further to increase such deflection, and, therefore, also to increase the tensile and compressive strains at the cross section about the bolt hole. In any case it is erring on the safe side to treat this force as uniformly varying from the bolt hole to the extreme fibres.

I scarcely think that any engineer in designing such a frame would take into consideration the friction between the legs and that which supports them, as this may be very small if the stool is on wheels, or rests on greasy iron or wet and soapy wood, and the feet of legs smooth and slippery through use. In any case, I scarcely think that "T. E. N." can be correct; because taking his expression for the bending moment, and substituting his value of θ, and equating this to the moment of resistance M, thus:—

$$\frac{W}{2} \times \frac{1}{\sin.\ \theta}\ \sin.\ (60\ \text{deg.} - \theta) \times 12 = 3\,W\,(\sqrt{3} \times \cot.\ \theta - 1)$$

$$= 3\,W\,(\sqrt{3} \times \mu + 1) = M,$$

$$\therefore\ W = \frac{M}{3\,(\sqrt{3} \times \mu + 1)}$$

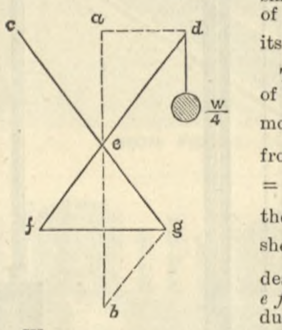
from which it would appear that the smaller the coefficient of friction (μ), the smaller the divisor; and, therefore, the greater the value of W, which I think will not be readily admitted. I have further to point out that the seat of stool may be of wood, and not of a flexible material; but I fail to see that this can make any difference in the strains of the legs or the use of complicating the question by deriving these from the upper part of the stool, when they can be so much more easily derived, as shown by Mr. Caine and myself.

R. W. M.-M.

Scarborough, August 23rd.

STRESSES IN A CAMP STOOL.

SIR,—Your correspondent, "Puzzled," will find a simple and practically correct solution of his problem to be as follows:—Let the accompanying sketch represent the stool (for the sake of simplicity) inverted. The resistance of the floor R = W; each leg taking its share $= \frac{W}{4}$.



Then the stress upon the free part of the leg $e\,d$ is a bending one, its moment $= \frac{W}{4} \times a\,d$. The stress from this upon the pin is a shear one $= \frac{W}{4}$. A similar stress comes upon the pin from the leg $c\,e$, making total shear on pin $= \frac{W}{2}$. We now have to deal with a triangular braced frame $e\,f\,g$, the stress on either leg being due to the shear of the pin at e and $= \frac{W}{2} \times \overline{e\,g} \div \overline{e\,b}$.

If the weight W = 140 lb., and the angles $c\,e\,d$, $e\,f\,g$ = 60 deg., and the length of the free part of the leg $= e\,d = \frac{f\,d}{2}$ = 12in.; the maximum bending stress on $e\,d$ = 210 inch-pounds, the shear on the pin 70 lb., the stress compressive on $e\,g$ or $e\,f$ = 41 lb. nearly.

Neglecting the small pinhole—the resistance to bending at e for good ash of section 2¼ in. × ½ $= \frac{12{,}000 \times b \times d^2}{6}$ = 1562 inch.-pounds or a factor of safety of 7½ nearly.

Treating the part of the leg $e\,g$ as a timber strut rounded both ends by Hodgkinson's formulæ, $A\,\frac{h^2}{4\,l^2}\,S$ = 1450 lb., or a factor of safety of 5 nearly.

Resistance of iron pin at 20 tons per square inch = 2195 lb., or a factor of about 31.

The dip of the flexible seat when sat upon would not increase the stresses, as the sitter himself would be in compression between C D and neutralise the bending stress, which would otherwise come upon $c\,e\,d$.

The lowest safety factor being 5, "Puzzled" will see it is perfectly safe for a 10-stone man with fair usage.

D.

Stoke Newington, Aug. 31st.

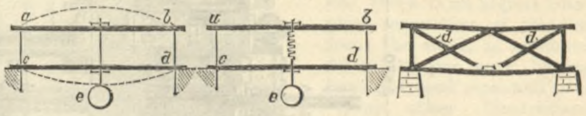
A PROBLEM IN STRAINS.

SIR,—The question propounded by your correspondent "X.," and so concisely answered by "B. C.," is part of a very comprehensive subject. The excellence of the example referred to consisted in the selection of a rigid beam for the lower member of the structure, seeing that beams are not universally rigid. Two other examples might interest your readers.

In Fig. 1 let A B and C D be equally elastic and brought to the parallel position by the rigid bolt in the centre. Now, if the stress on the bolt be 6 tons, and a weight of 6 tons be imposed at E, then A B will sustain a total downward pressure of 9 tons, and C D will sustain only 3 tons of upward pressure, the stress on the bolt being 9 tons.

In Fig. 2 the rigid bolt is replaced by one whose elasticity is equal to that of A B or C D, the stress upon it being 6 tons, as before. Now, when a weight of 6 tons is applied at E, A B will sustain a downward pressure of 8 tons, and C D will sustain only 2 tons of upward pressure, the stress on the bolt being 8 tons.

The question in relation to trussed wooden bridges is explained in very simple language in a pamphlet by D. C. McCullum, from which Fig. 3 is taken.[1] The braces D D, which are not ties, are



wedged up while the truss is submitted to a test load, so that the bridge is comparatively rigid when the ordinary load passes over it. The permanent deflection, and consequent diminution of motion between the component members, is said to lengthen the life of the structure.

C. S.

Manchester, August 30th.

SIR,—Your correspondent "C. E. S.," in his criticism of "X.'s" query, omitted to note that the latter supposed at starting that B was a stiff girder. If the girder be considered perfectly rigid, neither the lengthening of the bolt nor the depression of the spring will affect the strain on the top nut, which will be 5 tons. And if the girder deflects, I venture to think that "C. E. S." is wrong in his result, for he equates two expressions, forgetting, on his own assumption, that the bolt is subjected to a force in one case of 5 tons, and in the other of n tons. It is preferable, I think, to find the value of n from an equation giving the relation of the distances between the nuts, when the bolt is subjected to n and to 5 ton strain.

Firstly, let it be assumed that in each case the force is proportional to its effect, and let

l = the distance between the bearings of the upper nut on the spring and the lower nut on the girder—when neither spring nor girder are strained.

d = the elongation of a bolt of length l when acted upon by a force of 1 ton.

a = the amount the spring falls for 1 ton pressure.

b = the amount the girder rises for 1 ton pressure.

And let n = the pressure on top nut = the strain on the bolt when 1 ton is added to the 5 tons.

Then $(n - 1)$ = the reaction of the girder on the lower nut.

When there is 5 tons pressure on both spring and girder, the distance between the nuts is

$$l - 5\,(a + b) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad f\,(5)$$

and when there is a pressure of n tons on the spring, and $(n - 1)$ tons on the girder, the distance between the nuts is

$$l - n\,(a + b) + b \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad , \quad . \quad . \quad . \quad f\,(n)$$

It is evident that the difference between the expressions $f\,(5)$ and $f\,(n)$ must be the difference between the length of a bolt when strained by a force of 5 tons, and its length when strained by a force of n tons.

Now if the length of a bolt is $f\,(5)$ when strained by a force of 5 tons, its length when strained by a force of n tons, on the above supposition, would be $\frac{l + n\,d}{l + 5\,d}\,f\,(5)$.

Therefore,

$$f\,(n) - f\,(5) = \frac{l + n\,d}{l + 5\,d}\,f\,(5) - f\,(5),$$

substituting the values of $f\,(5)$ and $f\,(n)$,

$$l - n\,(a + b) + b = \frac{l + n\,d}{l + 5\,d}\left\{l - 5\,(a + b)\right\}.$$

From this

$$n = 5 + \frac{b\,(l + 5\,d)}{l\,(a + b \times d)}.$$

If the girder is rigid, b vanishes, and n = 5 tons.

T. N. M.

Brixton, September 1st.

AN EFFICIENT ACCUMULATOR.

SIR,—I have been experimenting with electric accumulators, and wishing to have a more efficient one than I could buy, I made two cells which were a slight modification of the "Plante" and "Union battery" combined, which gives—to me—a wonderful result. I have one pair of plates only 4in. by 4in. for each cell, and having connected them in quantity with my other accumulators, worked them up together for some weeks, every evening running them partially down to light the house. When I considered the new cells ought to be worked up, after charging them for a day I disconnected from the main and connected in series with a five-volt lamp to test the capacity. After burning for three hours I was compelled to leave it, so I disconnected for the night without recharging and lit up again next morning. The whole of that day it remained burning, so I was again compelled to disconnect for the night. The next evening I lit up again, and so on every evening for two, three, or four hours until I had obtained over thirty-five hours work from the two cells, extending over eleven days. After that the lamp would not burn for more than one hour at a time without getting duller, but seemed to recover itself after a few hours' rest, losing from twelve to fourteen minutes in duration regularly each day. Now, I am not aware that either the "Plante" or "Union battery" will give anything approaching this result; perhaps some of your readers can tell me if such a result has ever been obtained. The loss of twelve to fourteen minutes a day must principally be due to leakage, because I had taken no special care on that point, and my old accumulators placed in the same position would be nearly emptied through leakage alone in ten or twelve days.

W. T. DE L. ROBERTS, C.E.

Sunny Lawn, Marrechville, Sydney, Australia, July 16th.

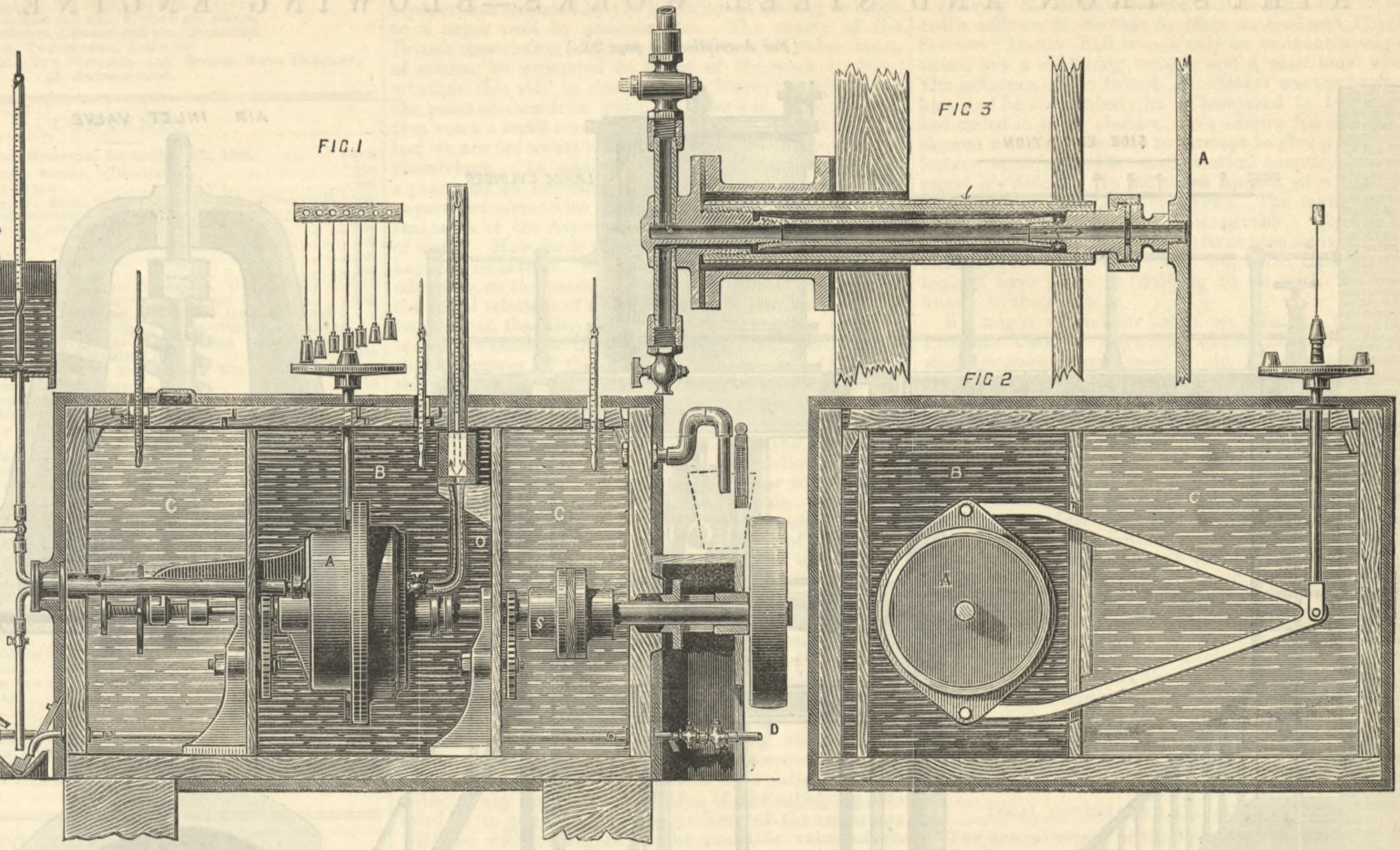
THE BOILER REGISTRY AND INSPECTION BILL.

SIR,—I have been reading a draft of the above Bill, and cannot help coming to the conclusion that it will require considerable amendment before it will render itself acceptable to engineers and steam users generally. Lord Stanley and the Board of Trade seek to acquire power which, unless very judiciously used, may cause a good deal of friction and interfere considerably with the liberty of the subject. Given that compulsory inspection is advisable—I am of opinion that it is—the question arises whether the proposed Bill grasps the whole question or not. As it at present stands, I think not. The object of the Bill is to prevent boiler explosions, and yet several important factors in bringing them about are lost sight of; for instance, the competency of the boiler attendants. We are all aware that labourers "and all sorts and conditions of men" are made to do duty, and many a good boiler has consequently been wrecked through gross ignorance or criminal carelessness. What is the good, therefore, of constantly inspecting a boiler if its attendant is not a fit person to look after it? This may be overcome to a considerable degree by granting certificates of competency. This would give a good deal of trouble; but if a Bill is needed, why not have a tolerably complete one? Again, it is admitted that malconstruction and the use of bad iron are fruitful primary agents leading up to explosions. The questions, then, arises whether it should not be compulsory that only iron capable of standing a certain test should be used in the construction of boilers. This at any rate would put a stop to those gentlemen who use poor short grain iron, and hide defective work by the aid of sal ammoniac and cast iron borings, and pride themselves on being "the cheapest boilermakers in the trade."

Referring to the question of inspection, the proposed Act says:

[1] "McCullum's Inflexible Arched Truss Bridge." S. T. Callahan, 73, Fulton-street, New York. 1859.

APPARATUS FOR DETERMINING THE MECHANICAL EQUIVALENT OF HEAT.



"Any society, company, or body of persons whose rules for the survey of boilers are for the time being approved by the Board of Trade—in this Act referred to as an approved boiler inspection society—may from time to time appoint surveyors under this Act, and assign to them such remuneration and such travelling and other allowances as may be sanctioned by the said rules." This says nothing about the considerable number of engineers in private practice who make it part of their business to inspect and report on steam boilers and engines. If the Act proposes to exclude these gentlemen from this work, I conclude it could hardly be done without giving them some *quid pro quo.*

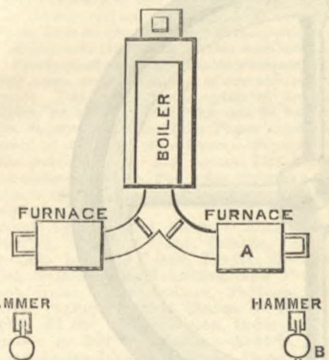
I notice that under Section 3, Clause 9, an inspector has the power to grant a certificate of fitness for a boiler for a period not exceeding twelve months, but for any less period he may think fit. The last portion of this clause appears to me an extraordinary provision. As I take it, he would be a very clever inspector who could say a boiler was fit to work six but not twelve months. If a boiler is not fit to work for twelve months, it must certainly be dangerous to work it at all. There are many other points in the Bill that might be criticised, but I will not trespass further on your space at present. I hope, however, before such an important Bill becomes law, it will be fully discussed by those chiefly affected by its provisions.

M. POWIS BALE.

Appold-street, E.C., September 5th.

FURNACE BOILERS.

SIR,—In our steam hammer shop we have an ordinary balling furnace working in connection with, say, a 20-cwt. steam hammer, which stand in the positions indicated at A and B in the annexed sketch. It is desired to put in duplicates of these, and the arrangements of the shop seem best suited for their being placed simply on the opposite hand. For the purpose of supplying steam to the hammers I propose to put in a single-flued boiler 24ft. long by 6ft. diameter, with fire-brick dampers as shown on sketch, so that either furnace may be worked alone if necessary; and to seat it in the ordinary way, carrying the flame through the centre flue, underneath the bottom of the boiler, and splitting the draught into two side flues terminating in a chimney about 3ft. square and 40ft. high. Perhaps some of your readers who have had experience in furnace boilers will be able to say whether I should get good results from this arrangement and sufficient draught in the furnaces for ordinary purposes, and I should be glad to have their suggestions. A friend who has had very considerable practical experience in such matters suggests using a double-flued boiler, and working one furnace into each flue, dividing by a centre wall and keeping each side separate, using dampers near the chimney.



A discussion on such an arrangement would be interesting, bearing in mind the fact that at times the furnaces may not be required to work both together.

F. B.

Birmingham, September 6th.

MULTI-CYLINDER ENGINES AND MONITORS *v.* TURRET SHIPS.

SIR,—The carefully considered letters of "M. E." and "U. S. N."—THE ENGINEER, p. 153, August 19th, 1887—rather tend to the increase of unnecessary and superabundant paradoxes, which, however pleasing to the legal mind, are of little use to other living beings. Thus: (1) If "M. E." assumes heat is a mode of motion, he must foresee the paradox he will be led into supposing the theory of multi-cylinder engines be a sound one with regard to steam evolved in the cumbrous and unwieldy boilers at present in fashion; he does well, therefore, to call attention to the data relied on for substantive results.

(2) In the case of monitors and turret ships, is it not also clear that if there be danger in either case of the crews being suffocated with smoke, in case anything goes wrong with smoke-stacks, fans, or ventilators, either a true monitor and turret ship has not yet been invented or the proper mode of ventilating and driving has been utterly ignored.

SLOW COACH.

ACCIDENTS ON TRAMWAYS.

SIR,—I greatly regret to find that a printer's error entirely alters my statement and makes it completely confusing. You print, "As to the practical application of *life* guards," then, by the continuation of the sentence, condemning the application of life guards altogether, while I wrote, "As to the application of *iron* guards"—condemning the application of iron guards only. I should feel greatly obliged if you would kindly correct the error and draw attention to the mis-statement so caused.

H. CONRADI.

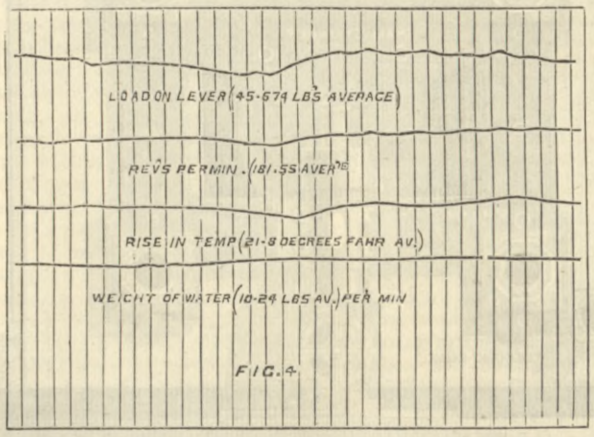
13, Soho-square, London, September 5th.

[Mr. Conradi wrote "life guards," not "iron guards," and what he wrote we printed.—ED. E.]

EXPERIMENTS ON THE "MECHANICAL EQUIVALENT OF HEAT" ON A LARGE SCALE.

By E. A. COWPER and W. ANDERSON.[1]

THE extremely interesting experiments of Dr. Joule on the mechanical equivalent of heat, led one of the authors of the present paper some years ago to speculate on the possibility of conducting such experiments on a much larger scale. It appeared that it would be possible to employ a powerful machine that would absorb a large amount of power, and to keep it continually going for a whole day at a time so as to get everything into a thoroughly normal state, and so arrange matters as to eliminate all loss or gain from radiation or conduction. The first idea was to employ an india-rubber masticating machine, which would absorb a very large amount of power in a small space, and to enclose it in a small tank, and that again in a larger tank, and then run cold water into the machine, and let the hot water from it run into the small tank so as to entirely surround the machine with hot water of the same temperature as the water coming out, and then let the water from the first small tank flow into the larger tank and from that to waste, the outside tank being kept up to the same temperature as the inside tank and the machine, so that the machine should neither lose heat nor absorb it. However, after much consideration it was thought best to employ one of the late Mr. Froude's dynamometers, such as he used for trying the power of marine engines, though on a smaller scale. Accordingly, through the kindness of Messrs. Heenan and Froude, the loan of such a dynamometer was obtained and it was fitted up at Erith as above indicated, viz., with a small tank inside a larger one, which last was made of thick wood, and well lagged outside with three thicknesses of hair felt, and this provision was found in practice to be so efficient that the tank of water only lost 2 deg. in 16½ hours when standing, or about 1 deg. in 8¼ hours.



Two very large thermometers about a yard long were specially made, having 25in. to 50 deg. or ½in. to 1 deg., and these were used throughout for taking the temperature of the cold inflowing water and the hot outflowing water, whilst other thermometers were used throughout the outside tank to enable it to be kept to the same temperature as the outflowing water. The temperature of the outflowing water was, of course, taken immediately as it flowed out from the Froude's dynamometer, not at the waste. The waste water was carefully taken at short given intervals and weighed, not measured. Several careful observers took observations continually, one took the revolutions of the engine per minute, and the total revolutions by a counter that was always going, and registered every revolution throughout the day. Another observer took the weight lifted by the dynamometer, another the temperature of the inflowing water, another that of the outflowing water, and another the general temperature of the tank, whilst one in command watched the whole, and saw that every one kept his register closely.

Before entering on the calculations and results obtained, it will probably be more interesting if the apparatus is first described; and it is to be understood that the object aimed at was to employ continuously a large amount of power—viz., about 5-horse power—and heat a very considerable quantity of water per minute—viz., about a gallon a minute—to a considerable extent—viz., about 20 deg. Fah.—whilst all effects of radiation and conduction were neutralised as far as possible. The Froude dynamometer, coloured red in the diagrams, is shown in elevation and end view, and the lever connected with it is also coloured red, with its rod and scale for the reception of the weights to be lifted. In the engraving, B is a tank, surrounding the dynamometer. C is an outer tank, surrounding the inner tank; this is well clothed outside with three thicknesses of hair felt. D is a small steam pipe to keep the outer tank up to the temperature of the inner tank and dynamometer. The water to be heated is passed into the dynamometer through an india-rubber inlet pipe, which is itself jacketted with water of the same temperature as the inflowing water. The pipe O is the outlet pipe, where the hot water flows out from the dynamometer. The power for driving the dynamometer is communicated through the shaft S, and a piece of wood is introduced between the flanges of the coupling in order to prevent the communication of heat either way, though the temperature of this shaft is kept up by the water in the outer tank. Thermometers were placed throughout the apparatus to enable it to be kept at an even temperature.

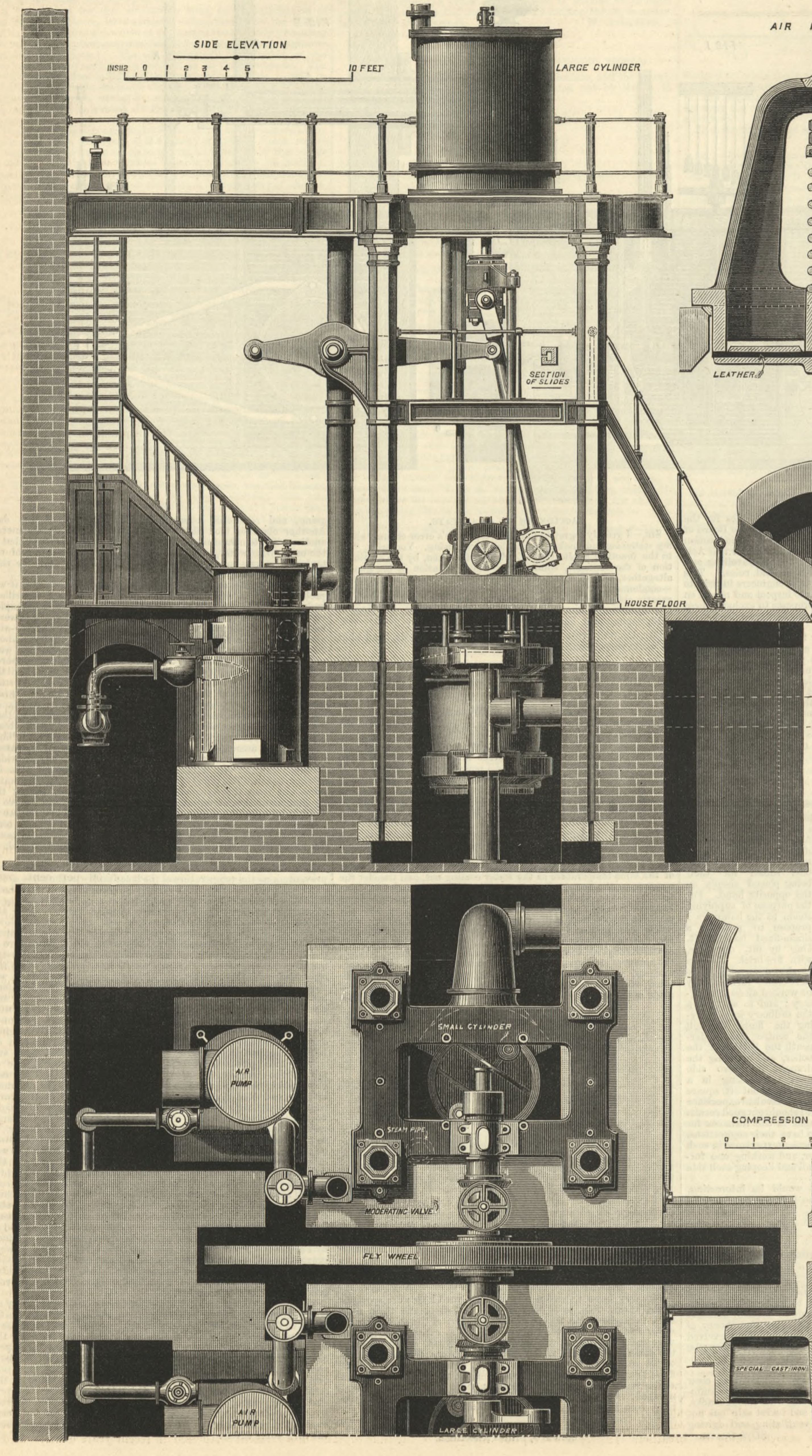
It will at once be seen how completely loss or gain of heat was prevented, as the temperature of the inner tank was the same as the outflowing hot water from the outlet pipe O, and the hot water from it flowed into the outer tank, which had a very small quantity of steam, to keep it to the temperature of the hot water from the outlet pipe O. Thus the outer tank was, so to speak, down "stream," and even if its temperature varied a little it is impossible to conceive that it could practically affect the temperature of the hot water coming out of the dynamometer, especially as the quantity passing continually was very great, and had thus full command over the temperature of the inner tank. This it was that enabled the apparatus to be kept in a normal state for many hours together, and from which results might be obtained for any given length of time. The only thing that interfered at all with the perfect regularity of the experiment, as checked every five minutes, was a very slight variation in the speed of the engine, and an increase of speed of one revolution per minute on 180 revolutions per minute, could at once be detected, and was followed after a few minutes by a perceptible rise or fall in the temperature of the outflowing water, as the quantity passing was always almost exactly the same The diagrams of the speed of dynamometer, weight lifted, and of the temperature and weight of water heated, Fig. 4, show what these very slight fluctuations were, and when they were contrasted with the large volume of water heated, viz., about a gallon per minute 20 deg., it will be seen how slight they were, and further, as no loss of power on the one hand, or loss of heat on the other, was sustained, it was of minor importance, if, indeed, of any importance, that the fluctuation should be sometimes slightly above and sometimes slightly below the given point, as the total power was accurately registered, as well as the total heat produced. The result showed a "mechanical equivalent of heat" = 769ft., that is to say, that 1 lb. of water raised 1 deg. Fah. was equal to 1 lb. lifted 769ft., and it will be remembered that Professor Joule made it 772ft. It is not to be wondered at that the "equivalent" obtained was slightly lower than that obtained by Professor Joule in his last experiments, as all losses of heat were prevented, and no losses had to be calculated, nor did the specific heat of the apparatus enter into the calculation, as the apparatus was practically kept in a normal state throughout the experiment, and, in fact, for days together.

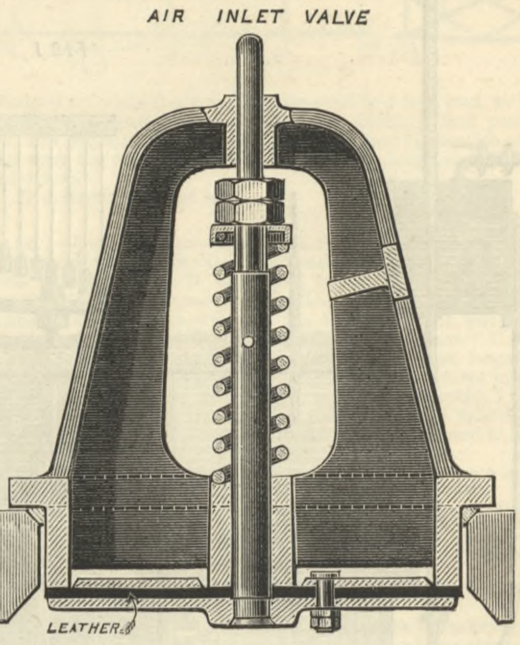
The authors are aware that the experiments described are by no means complete, and objections may on that account be justly taken to them; but they are anxious to bring the work, so far as it has gone, before the British Association, in order to benefit by the suggestions and criticisms which discussion would not fail to produce. They intend to renew the experiments at no distant date, and feel sanguine that absolutely trustworthy results will eventually be arrived at. A small improvement will be made in the machine before prosecuting further experiments, viz., certain precautions to prevent the possibility of any heat being taken up from the surrounding water by any part of the dynamometer that may be slightly below its general temperature close to the point where the cold water enters.

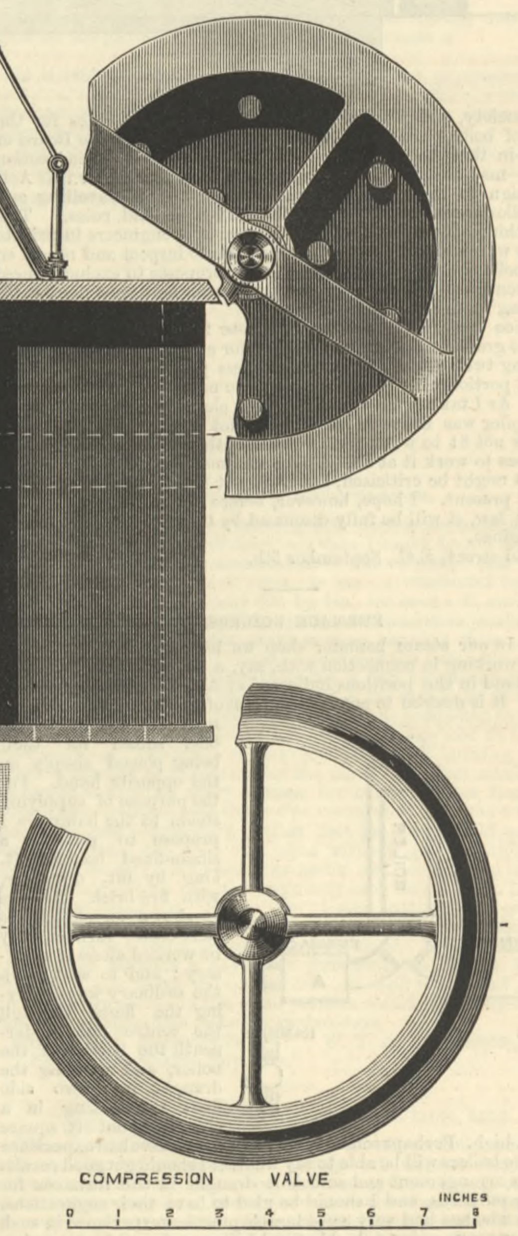
[1] Section G, British Association.

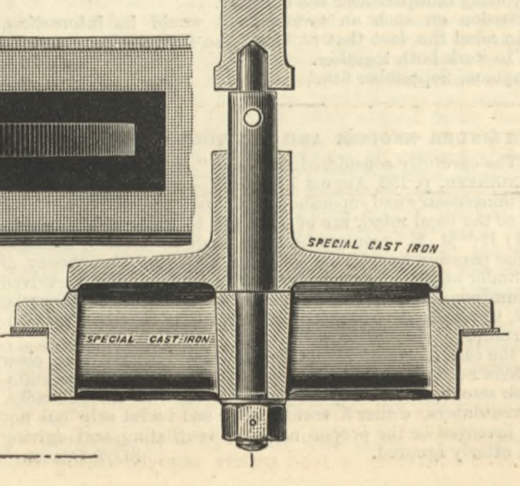
ATHUS IRON AND STEEL WORKS.—BLOWING ENGINE.

(*For description see page 205.*)









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THE ENGINEER, September 9th, 1887. PAGE

TO CORRESPONDENTS.

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SCREW BOLT.—*If you make the nut as thick as the diameter of the bolt, you can break the bolt without stripping the thread.*

EAST END.—*Steam is invisible, as you can learn for yourself by looking at the space above the water in a gauge glass. Water vapour is visible as the steam issuing from a safety valve or an exhaust pipe condenses.*

G. W. (Lincoln).—*The makers are right. The power of your engine is to be calculated by multiplying the difference in the pulls of the springs—30 lb.—by the circumference in feet of a circle, the radius of which is measured on a horizontal line from the centre of the brake wheel strap to the point where the strap becomes a tangent to the wheel; and by the number of revolutions per minute, and dividing the result by 33,000.*

HOISTS AND LIFTS.

(To the Editor of The Engineer.)

SIR,—Will any of your readers favour me with the address of Messrs. Ewing and Co., who are makers or agents for the sale of a peculiar hoist with Chinese windlass gear? SCRUTATOR.

September 6th.

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THE ENGINEER.

SEPTEMBER 9, 1887.

THE BRITISH ASSOCIATION.

THE Manchester meeting of the British Association is a thing of the past. We are told that it has been very successful. It is worth while to ask in what its success has consisted. We fear that there can be but one answer—a considerable number of persons have had a pleasant holiday, and that is about the sum and substance of the success achieved. No doubt most of the gentlemen who delivered addresses or read papers enjoyed doing so very much; but it must not be forgotten that as there is no rose without a thorn, so the pleasure derived from reading a paper was attended by the infelicity of having to listen to a paper read by someone else. The utility of the British Association is open to question. Its value must, of course, be estimated in terms of the work it does; whether this will be deemed good, however, depends on the point of view from which we regard it. The Association votes a small sum every year for "research" work, but we are not aware that much comes of the labour of the researchers. In addition, the Association meets once a year, and an immense number of papers is read. The papers and discussions which follow them represent the real work of the Association. What, may we ask, comes of them? How far is the world made wiser, or richer, or happier, or better? What effect have these papers and addresses on the course of trade, or political economy, or the social relations of man with man? The answer must be, we fear, that they have no effect whatever; and this is due, we think, to the intensely unpractical character of the utterances of the speakers and readers. Of course there are exceptions. It would be impossible, we suppose, to get a body of Englishmen together for a week who would not say, or write, or do something more or less worthy of note and commendation; but the really good things brought forth at the British Association are well-nigh overwhelmed by the mass of matter which is not good, which is poured forth on every side. It may be urged, perhaps, that if the papers read are not always admirable, this cannot be said of the presidential addresses in the various sections, which being delivered by eminent men of super-excellent mental power, cannot fail to be admirable. It is impossible to deal with such a proposition as this until some standard has been set up by which to measure them, and give them their place in the scale of merit. We ourselves, and we believe engineers in general, must perforce use a standard differing more or less—but principally more—from that of the man of science, the professor, the "researcher." There are three reasons for conducting an inquiry or making a research. One is to discover something likely to be of use to mankind; another is to satisfy curiosity without any regard to the value of the satisfying; the third is to put money in the pockets of the researcher, with or without regard to the probable value of the results to be obtained. We fear we must say that the great mass of so-called scientific work done in the present day has no nobler motive than either the satisfying of curiosity or the earning of money. The result is that much of the work done really possesses no value whatever, estimated in view of the utility of the discoveries made or the theories put forward to mankind at large. The President's address is supposed to give an account of the progress of science in the special department which he has made his own. Let us take Sir Henry Roscoe's address and see what it all comes to.

Sir Henry Roscoe is an eminent chemist, and his address was in substance a history of the atomic theory, as understood by chemists—which, be it understood, is a different thing from the atomic theory held by physicists, and flatly opposed to it in many respects. There can be no doubt whatever that this was a splendid address from one point of view. On the other hand, we fail to see how any human being can be the better for hearing or reading it. It is too deep for the superficial, too superficial for the deep. As we peruse it, we see with what fatal facility deductions can be drawn from premises about which there is really no certainty. Once grant that matter invariably appears under the atomic form, and all the rest follows. Sir Henry told his audience that a cubical box, so small that it could be just detected by the most powerful microscope known, would contain from 60 to 100 millions of atoms. This conceded, we are not surprised to hear that the mathematician comes in and tells us that hydrogen atoms move at the rate of 6225·54ft. per second, and that each atom knocks against other atoms at the rate of 18,000 millions of times in a second. We are naturally led to think of the Marchioness who told Mr. Swiveller that orange peel and water tasted like champagne, "if you make believe very much." We have only to make believe very much about the atoms, and anything is possible. There can be no possible objection to the putting forth of views concerning the ultimate constitution of matter, if only they are put forward not as being certainly true, but as being convenient working hypotheses. But leaving atoms on one side, what could Sir Henry Roscoe point to as the result of the labours of the chemist? The production of coal tar colours—a thing, in one sense of the past, although further research is producing new dyes, or possible dyes, and within a comparatively recent period, of certain febrifuges, and an artificial sweetening agent called saccharin, 250 times sweeter than sugar, but apparently in no sense a food such as is sugar. We always find in such addresses as this under notice that a portion of them is taken up in demolishing the statements made just as dogmatically by some predecessor of the speaker. Sir Henry Roscoe took occasion to show that the time-honoured views of Liebig on the value of foods as heat formers and muscle builders were all wrong; just as someone will doubtless appear in a few years who will show that Sir Henry Roscoe's views were totally erroneous. In this connection we cannot pass without notice a passage which is unworthy the pen of any man pretending to be scientific: "We thus come to the conclusion that it is the potential energy of the food which furnishes the actual energy of the body expressed in terms either of heat or of mechanical work." This sentence is worthy of the Delphic Oracle. What on earth Sir Henry means by "potential energy of food" we are quite at a loss to understand. We thought the words "potential energy" had disappeared in favour of the phrase energy of position, which has at least the merit of committing one to nothing. Sir Henry, it will be seen, completely ignores the energy of the oxygen which is breathed, the quantity of air inhaled varying very accurately with the amount of work done by the breather. This is, however, not the place or the time to discuss such a question. We must rest content with pointing out a manifest inaccuracy.

Leaving Sir Henry Roscoe, let us turn to Professor Ball's address in Section A, Mathematical and Physical Science. Doctor Ball is not only an eminent mathematician, but a charming lecturer and a most lucid writer. The influence of the British Association was too much for him, and he succumbed; he endeavoured to be popular, and ended in being obscure. We admire his courage; it showed no small temerity to attempt to give a "popular" lecture on a recondite mathematical enquiry, and we regret his defeat. He delivered himself of a mathematical parable—the theory of screws. The mathematician could learn nothing from this parable. To the non-mathematician it might as well have been delivered in the Zulu tongue. The screws with which Dr. Ball concerned himself have little or nothing to do with the screws known to the engineer.

We might extend our list, if we pleased. Concerning Professor Osborne Reynolds' address in Section G, with which engineers have most to do, it will be enough to say that the influence of the Jubilee year was too much for him. Turn in what direction we may, we still encounter the same truth—namely, that the British Association is more fertile in words than in anything else. It is not, perhaps, too much to say that no one ever yet heard a really good discussion at a British Association meeting. At one time there existed a society for the diffusion of useful knowledge. It has long since expired. No one cares now-a-days whether knowledge is useful or not. The man who ascertains that the moon is made of green cheese will be held in high esteem, though he will probably have to divide the honours with the researcher who ascertains the precise composition of the colours with which his remote ancestor painted himself when he went on the war path. All this would be amusing if it were not lamentable to think that so much that is likely to be useful remains undiscovered, because unsought, while the pursuit of the satisfaction of mere curiosity is continued with unmitigated energy. Our consolation is that the world does not depend for its progress on the "man of science" or the British Association.

LOCAL GOVERNMENT AND PUBLIC WORKS.

THE annual report of the Local Government Board is a highly composite volume, the administration of the poor law, the exercise of local government, and the care of the public health, being all combined in one department of the State. The catalogue of subjects contained in the table of contents is almost ludicrous in its variety, ranging from workhouses and pauper lunatics to highway authorities, canal boats, and cowsheds, together with the adulteration of food, the practice of vaccination, and various matters relative to the drainage of towns, water supply, local taxation, and turnpikes. Looking out for those particulars which more directly interest our readers, we refer in the first place to the topic of the water supply, especially in relation to the metropolis. The subject is discussed in the body of the report, and details are given in the appendix. Major-General A. de Courcy Scott, the successor to Sir Francis Bolton, as the Water Examiner appointed under the Metropolis Water Act of 1871, gives the usual report for the year, and Dr. Frankland's report is also printed, followed by the report of the auditor, Mr. Allen Stoneham. The Local Government Board, represented by Mr. Ritchie as president and Mr. Hugh Owen as secretary, express satisfaction in their official report at the steady extension of the constant service system, the number of houses to which the eight Metropolitan Water Companies gave constant supply on December 31st, 1886, being 24,765 in excess of the number so supplied a year earlier, while the increase in the total number of houses in their districts was 15,840. This shows a clear gain of 56 per cent. on the side of the constant supply, as compared with the number of new houses, and so far things look well. But if we go back to 1885, we find a rate of progress much more rapid than in 1886. In the former year the constant service was extended to 41,327 houses, while the new houses in the districts were 19,412. The gain, therefore, in that year was 215 per cent. on the increase in the number of houses. If no more houses were built in the districts of the Metropolitan Water Companies for the next 23 years, and the constant supply went on extending at the same rate as last year, it would take all that time for the constant supply to become universal. But if London is to go on adding 16,000 or 20,000 houses to its habitations every year, a still remoter date must be assigned to the period when every house will have a constant supply. In 1885 the prospect was more hopeful. The drop in 1886 may be partly accounted for by the circumstance that by the close of the previous year the East London Company had given the constant service to a very large proportion of the houses in their district, including apparently the whole of their metropolitan area. It has to be borne in mind that some of the London Water Companies carry their Parliamentary limits far outside the metropolitan boundary. Thus, while the population of the metropolis at the close of last year would be about 4,180,000, the population in the districts of the Metropolitan Water Companies would be 5,339,000, the latter exceeding the former by considerably more than a million. The fact is one which may properly increase our sense of the scale on which the water supply of London is conducted. After all that is said of scarcity, the average daily supply during the year was very nearly 30½ gallons per head. In the month of July last year, the Chelsea Company gave as much as 42 gallons per head. Nearly 1200 miles of streets have mains constantly charged, but the hydrants erected thereon are only eight per mile. Yet things are improving, for while 38 miles of main have been added during the year, the increase in the number of hydrants has been nearly 900.

Of the quality of the London water supply the present report speaks favourably. All the samples were clear and bright, and remarkably free from organic impurity. The improvement witnessed in recent years is attributed to the measures taken by the companies for effectually filtering the supply, and drawing an increased quantity from underground sources. Care is also taken to avoid receiving water from the river when in flood, for which purpose large impounding reservoirs are used. There are no "moving organisms" mentioned in the report, unless it be the eels which have been the cause of so much annoyance to the East London Company and some of their customers. The Local Government Board have thought it desirable to have a "thorough investigation" into this matter of the eels; but unfortunately, as the year had closed before the investigation commenced, we have to wait until the next annual report to know the result. This is the more tantalising, as we are told that the investigation is one which "from several points of view, is of considerable interest." Respecting the finances of the London Water Companies, it appears that profits have been checked by the operation of the Act passed in 1885, which compelled them to charge on the basis of rateable value, instead of "annual value," as previously understood. That it costs something to maintain the London waterworks and meet the growing demand, is shown by the fact that the companies expended on works and improvements during the year more than £237,000, raising the total of their capital to £13,865,123. Their net rental for the year exhibits an increase of £34,200. Among the improvements of the year may be mentioned the extinction of the dustyard which had long existed in close proximity to the filter beds of the Southwark and Vauxhall Company at Nine Elms. It is curious that the company looked upon this institution with great equanimity, having perfect confidence that their filter-beds were more than a match for the dustyard. But the Local Government Board and the public refused to share that confidence, and at last the nuisance has been extinguished "for a certain consideration," much to the comfort and satisfaction of those who drink the Southwark and Vauxhall water. As for the pollution of the Thames and the Lea, that is undergoing continual diminution, though it cannot be said as yet to have reached the vanishing point. The "house-boats" on the Thames, to which the present report makes no reference, are probably the most dangerous feature. But these are now being brought under the requisite regulations, and it is to be hoped they will not be allowed to infringe the rules laid down by the Conservators. Respecting the operation of the Rivers Pollution Prevention Act of 1876, the report says but little. An obnoxious paper mill in the Watford union, after causing a good deal of trouble, was at last effectually dealt with by the law courts, and soon afterwards gave up altogether. It may be interesting to know that the Local Government Board have power to extend the application of the word "stream" so as to include the sea—that is to say, such part of it as it may be deemed desirable so to include for sanitary reasons. Tidal waters come under the same rule, except apparently in the case of the Thames. Here the Conservators have jurisdiction, together with the Home Secretary, the Metropolitan Board, and the Port Sanitary Authority. In the case of the Lea, the Local Government Board get something of a foothold by their authority over the Tottenham Local Board. The statutory bodies that rule over land and water in England are apparently a bit "mixed," especially round about the metropolis.

The public works that are now being executed in England and Wales by the local authorities necessarily have an effect on local finances, in the shape of loans and rates. The outstanding loans of the local authorities exceed £173,000,000. The amount is formidable; but then many of the works are profitable. Thus waterworks take £30,000,000, and gas works are not far short of £14,000,000. We fear that sewerage and sewage disposal, represented by £16,569,000, cannot be deemed to have much in the shape of a pecuniary set-off. It is pleasant to find parks, pleasure grounds, commons, and open spaces, absorbing nearly £2,500,000. Our forefathers knew nothing of such expenditure. Yet how much of the health and happiness of our urban population depends on the provision thus made. Every pound spent in this way tends to diminish sickness, and consequently pauperism, among the people. It also helps to refine and elevate, creating a better class of workpeople, and developing brain power. The transformation of disused churchyards into green and pleasant spots in the midst of crowded neighbourhoods, is a happy change. Our cemeteries and burial grounds are often fair to look upon. So, indeed, were old rural churchyards; but the case was otherwise with many of the burial places in towns. It is a little remarkable that the expenditure for parks and other open spaces in the list of loans is about equal to that for cemeteries and burial grounds. The latter, we may assume, give a fair return for the outlay. Markets take £5,000,000, and these, of course, yield a revenue. Bridges take more than £3,000,000, and artisans' dwellings above £3,500,000. The loans for highways, street improvements, and turnpike roads amount to £27,000,000; while harbours, docks, and piers run yet higher. It is a notable fact that waterworks stand at the head of the list, comprehending more than one-sixth of the total. Amid this activity there is naturally an increase in the rates. These have risen from something over £19,000,000, in 1875, to an amount which approximates to £26,000,000 in 1885. But the rise in the rates is accompanied by an increase in the revenue from tolls, dues, fees, rents, and duties. The Metropolitan Vestries and District Boards received from the public rates last year as much as £1,624,000, in addition to £760,000 handed over to the Metropolitan Board. The public rates are shown to be growing more rapidly in urban than in rural districts. It may be predicted that water supply, whether provided by local authorities or by joint-stock companies, will have to receive increased attention in future years, both in the extension of works already large and costly, so as to meet the wants of growing towns, and in the construction of smaller undertakings to relieve the exigencies of less populous districts, now sorely pressed in seasons of drought. London, apart from any question of immediate taxation, affords the example of a large and continuous expenditure in respect to the supply of water, and is giving rise to exceptional legislation on the subject. Last year three of the London Water Companies applied to Parliament for power to raise additional capital in the form of debenture stock amounting in the aggregate to £700,000. This was granted on condition that the issue of the shares should be by public auction or tender, and that out of the profits a sinking fund should be formed, to be held in trust by the Chamberlain of the City of London, so as to be appropriated to the relief of the consumers. The way is thus prepared for "buying up" the Metropolitan Water Companies, an event looked upon as calculated to secure peculiar benefits for the community. Had the London water supply been in the hands of a public authority, it may be doubted whether legislation with reference to water undertakings would have taken so stringent a form as we have witnessed of late years. To possess the water supply is the great ambition of local authorities, especially in the metropolis. But some serious considerations lie at the back of this question, so far as London is concerned, and the Imperial Government is at a loss what to say on the subject. If the metropolitan water supply were less pure and less abundant than it is, the crisis might be nearer. The companies are wise in seeking to make the supply as perfect as they can, and the Local Government Board cannot do otherwise than admit the success which is being achieved.

CLYDE SHIPBUILDING FOR AUGUST.

If the briskness characterising the work of launching vessels on the Clyde during the month of August could be taken as an indication of a revival in trade, or of any immediate prospect of such a thing, there might be cause for rejoicing. The vessels launched numbered no fewer than nineteen, having an aggregate tonnage of as much as 36,556 tons, being fully five times greater than last month's output, and of course largely in excess of any previous month of the present year, or, indeed, of any month during the past three years. The circumstance, however, must be explained on other grounds than that of a revival in the industry. The amount of new tonnage ordered during the month scarcely amounts to one fourth of that launched, and prospects are not by any means cheering. One obvious reason why the month has been so prolific in launches is that during last month, owing to the usual summer holidays, the output was exceptionally small. The Greenock and Port Glasgow yards did not contribute a single ton to the July returns, while during this month they are to the front with 18,140 tons, or considerably more than half the total. Two firms were mainly responsible for this large output, Messrs. Caird and Co., who launched the Britannia for the Peninsular and Oriental Company, registering about 6600 tons, and Messrs. Russell and Co., who launched from their two yards no fewer than five vessels, amounting to about 8600 tons. Of the total tonnage launched over the whole river, fourteen vessels were steamers, with a tonnage of 26,623 tons, and five were sailing ships of 9933 tons. Amongst other firms, besides those already named, making substantial contributions to this result, mention may be made of Messrs. A. Stephens and Sons, Linthouse, who with two vessels totalled up 6350 tons, and of Messrs. Denny Brothers, Dumbarton, who put one vessel into the water with a tonnage of 5210 tons. As regards work on hand and prospects of fresh orders, the state of matters is deplorable. This is especially true of the lower reaches, from Dumbarton downwards. At the port named, Messrs. Macmillan and Son's yard remains empty, although statements of an important contract pending have been receiving currency. Messrs. Birrell and Stenhouse, and Murray Brothers have each launched their last vessels, and Messrs. Denny Brothers have but a single keel on their stocks, although kept employed to some extent with light draught craft for shipment in pieces. Out of eleven shipyards in Port Glasgow and Greenock, as many as five are empty, or at a standstill, while in the other six yards there are but eight vessels on hand, amounting to 13,250 tons. Messrs. Caird and Co., with the launch of the Britannia, have cleared their stocks, but it is rumoured that some important contracts are expected. It is stated also that Messrs. Caird propose making extensive alterations on their premises, so as to enable them to build larger vessels than hitherto. At Clydebank, above Dumbarton, Messrs. J. and G. Thomson are proceeding rapidly with the two notable Inman liners, and are finishing the Spanish cruiser Rena Regente. At Yoker, Messrs. Napier, Shanks, and Bell remain without work. At Renfrew, Messrs. Lobnitz and Co. continue to be busily employed with barges and dredgers for canal work, and Messrs. Simons and Co. are similarly employed. The smaller firms in Paisley are, with the exception of Messrs. McArthur and Co., without vessels on the stocks. At Whiteinch, Messrs. Barclay, Curle, and Co. have launched their last vessel, while their neighbours, Messrs. Aitken and Mansel, will follow suit in a few days. Messrs. Connell and Co. have now only one vessel on the stocks, and Messrs. Stephens and Sons have reduced their vessels to three. The yards of Govan and Partick are comparatively well off. The Fairfield yard, in addition to the two war vessels recently booked, has received the order for a passenger steamer of 1000 tons for the London, Brighton, and South Coast Railway Company, for service between Newhaven and Dieppe, to take the place of the Victoria, wrecked some time ago. This makes a total of five vessels of 15,000 tons on hand by the Fairfield Company. Messrs. Inglis, in addition to the 5000-ton steamers already well advanced, have received the order for a steamer of 2500 tons for the Tasmanian Steam Navigation Company. The London and Glasgow Company, besides the steamers it started to build some months ago on its own account, is proceeding with two large vessels ordered by a Japanese firm. Messrs. Napier and Sons are proceeding with a large steamer for the Australian service of Messrs. G. Thomson and Co., and a steamer for cable laying service. While certain builders are inclined to believe that we are on the eve of an improved state of things, and are ordering quantities of steel on the prospect, there are others, and by far the largest number, who do not take such a sanguine view. Some good inquiries are certainly in the market, including one for a steamer of 6000 tons, to steam at 19 knots, and another for the Indian mail trade. Two Glasgow companies are either in the market or about to issue specifications.

MINING IN EAST SCOTLAND.

Attached to the blue book recently published on mines and minerals there is a list of mines in the districts of the various mining inspectors. Most of the inspectors give a bare list of the names of the mines, their situation, the owner, and the manager; but Mr. Ralph Moore, one of the inspectors for Scotland, gives us a much more valuable table. In addition to the facts named above he supplies particulars of the number of persons employed at many of the chief mines, of the seams of coal worked, the sizes and depths of the shafts, the mode of ventilation, and many other interesting details. We find that in more than one instance in this Scotch district seams from 1ft. 8in. up to 14ft. are being wrought, but the majority of the seams are of moderate thickness. The mode of working is most often long wall, but the stoop and room system is also in use. The number of persons employed shows great variety. One colliery is worked with "three above ground" and five below ground, but it is at once evident that this is a seam at a colliery only. From that number up to 480 seems to be about the number employed in the seams of the collieries. The depth of the shafts varies also greatly, but the deepest seems to be a downcast shaft at one of the Loanhead collieries, which is close upon 2000ft. in depth. The fan and the furnace are the chief methods of ventilation adopted, but there are steam jets, and other methods occasionally in use—several of the fans being 30ft. each in diameter and making 46 revolutions per minute. The average total quantity of air in feet per minute is also very different at the different pits, 10,000ft. to 15,000ft. being common, and from that up to about 60,000ft. being the range. There is also given another table, that of the persons killed and persons injured in the separate mines for the year the blue book refers to. It is gratifying to find that the loss of life in the separate mines in small, few cases showing more than a unit, though the injured figure much more extensively in the collieries. Other particulars are given which greatly enhance the value of this table, and render it of interest to readers instead of a mere list, as in the case of the other districts. Somewhat similar facts are given as to the ironstone mines in the same district of East Scotland; and there are also lists of shale mines, fireclay mines, and metalliferous mines. These have certainly as great value, and it is to the list of the shale mines that we look to obtain the fullest particulars of these interesting Scotch works. The depth of these shale mines varies very greatly, one at Pentland having a downcast shaft 2268ft. in depth, in which, with the adjacent mine of the same company, 480 persons are employed below ground and forty-eight above ground, whilst a fan gives adequate ventilation. It is noticeable that some of these shale mines are marked as "dipping 1 in 2"—a very heavy dip; whilst in one instance the dip is 1 in 1ft. 6in.! In these shale mines of East Scotland 3895 persons are employed—3451 of whom are employed below ground; and, contrary to the practice at some of the coal mines in the same district, all those employed at the oil shale mines are males. It is as well that attention should be drawn to this valuable appendix to the report of Mr. Moore, for it would be an extremely useful addition to our mining literature if we had similar particulars of the mines in other districts, instead of the bare lists of names with which we are furnished, that in no way convey an idea of the extent of the mine, the number of persons employed, or any allied fact.

THE EXETER DISASTER.

A theatre has been burned down in Exeter, and over 100 persons have lost their lives. This catastrophe differs in no way from others of the same kind, save in the number of deaths. In all cases the fire at a theatre breaks out on the stage, then there is a panic in the house and the exits are blocked. A great deal is said about the value of plenty of exits; we do not dispute their value, but after all they are but secondary. No matter how many and how excellent the exits are, some minutes must be lost in emptying a house, and the risk incurred is very great. It is being pointed out that those in the stalls at the Exeter Theatre escaped with ease, because there were plenty of openings to the street; but it must not be forgotten that, in case of fire, the flames and smoke always rise, and the latter would begin to stifle the spectators in the gallery before those in the lower part of the house would suffer much inconvenience. In blinding, suffocating smoke, presence of mind is lost, just as it is when a man is suddenly thrown into water. The animal instinct asserts itself, and there is a blind fight for life. Since October, 1886, theatres have been burnt down at the following places:—Ravenna, Paris, Leschin, Rotterdam, and now Exeter, all with more or less loss of life; and, further, at Philadelphia. Göttingen, Bucharest, Northampton, Laibach, Rouen, Caiceres in Spain, Venloo, and Stockport, without loss of life. According to the correspondent of the *Standard*, the Vienna papers are unanimously in favour of the adoption of the electric light in theatres, and hold that this mode of lighting, together with the provision of a larger number of exits for all classes of seats, are the only safeguards against fire and panic in theatres and similar places of public resort. If only managers would use the electric light and nothing else on the stage, while performances were going on, there would be an end to fatal fires in theatres. They might light the body of the house with gas, if they saw fit; but gas battens and float-lights should be prohibited.

RAILWAY MISMANAGEMENT IN NEW SOUTH WALES.

Particulars have just come to hand from New South Wales regarding an accident to an excursion train on the Hawkesbury Railway, near Sydney, by which the engine driver and several passengers were killed, and between thirty and forty other persons were injured. The evidence given at the coroner's inquest—which occupied nearly three weeks—reveals a condition of things in the railway department of the colony in respect of mismanagement and injustice which is simply a disgrace to those responsible for its existence. The facts disclosed afford conclusive proof, if any were required, of the necessity for at once placing on the Statute-book the measure for re-organising the railway department, to which we recently referred as having been introduced in the Legislative Assembly by the present Government, but which, like the similar Bill of their predecessors, has been shelved—after reaching its second reading—by the prorogation of Parliament. But, apart from the injustice to individuals and the general mismanagement in the department which the incidents connected with the case reveal—injustice and mismanagement intensified, in our opinion, by the finding of the board of officials selected to inquire into and to report to the Government on the subject—and which calls for serious notice, the negligence shown by the traffic officials in the making up and equipment of the train in question, and in the abuse by them of the automatic air-brake with which it was provided, and which, as the evidence shows, was the immediate cause of the accident, necessitates in the interests of the travelling public in the colony our dealing with the case at some length. This we purpose doing at an early date.

THE INVENTOR OF GAS LIGHTING.

Some two or three years ago a movement was set on foot by the North British Association of Gas Managers having for its object the raising of a fund wherewith to erect a suitable memorial to William Murdoch, the founder of gas lighting and the worthy *collaborateur* of James Watt in his improvements on the steam engine. Up to date the fund only amounts to £275, and those in charge of it rightly consider that this sum is quite inadequate to perpetuate the memory of one from whose genius all classes have reaped such incalculable benefit. In a recent letter on the subject from the treasurer of the fund—Mr. McGilchrist, Dumbarton—it is well remarked, "One cannot but be struck with the unselfishness and modesty of Murdoch when we see how keen is the competition pecuniarily for questionable inventions, or even for modifications of useful patents. What a colossal fortune some 'company mongers' or astute persons would have made out of an original and exclusive patent for gas-making. Yet Murdoch preferred to let the full benefit of his genius go to the public without any tax upon it in his own interest." Although undoubtedly one of the greatest benefactors our country has seen, Murdoch's memory is fast perishing. Those who have reaped in any way the advantages of his great invention—especially those into whose pockets large dividends have dropped—might surely see the propriety of adding their mite to the fund, and helping to make the memorial worthy of the man. The sum already subscribed cannot be considered more than a substantial nucleus, and has for most part been given by the gas profession.

LITERATURE.

Factory Accounts: Their Principles and Practice. By EMILE GARCKE and J. M. FELLS. London: Crosby Lockwood and Co. 1887.

THE matters with which this book attempts to deal, though of great importance to manufacturers, are too seldom analysed with a view to publication, and we are glad therefore to welcome this fresh attempt to state the principles on which factory accounts should be regulated. To the engineering trades, in which workshop operations are generally more varied than those in factories engaged in repetition work, the importance of systematised accounts cannot be too strongly insisted on, and often even among those who keep their ledgers and other books of purchase and sale in close order up to date, the details of cost in the workshops are either incomplete or recorded in a way that admits of error and fraud. There is not much difference of opinion as to the objects which should determine a system of accounts, for manufacturers would agree that they should correctly record the whole expenditure, but in practice there is the widest divergence, arising sometimes from inability to devise books and methods appropriate to the purpose in view, and sometimes from disinclination to spend trouble and money on what does not appear directly remunerative.

But although there is a natural reluctance to increase the clerical work in a business, it will generally be found that if trouble be once taken to arrange a proper system, it may be worked almost automatically at moderate expense, and this expense will be more than repaid in the guidance afforded and errors avoided. It is almost incredible how loosely are kept the records of expenditure in some manufacturing concerns, and accountants who are called in to disentangle a confused business are often unable, from the absence of detailed records, to clear up the past, and can only recommend a proper method for the future. In such cases it is evident that an earlier expenditure on professional assistance would have been well bestowed.

The book now before us will aid those who wish to inaugurate a proper system, for in numerous examples and workshop forms of account, it shows how in the daily routine of a factory the material, labour, and stores can be properly tabulated and allotted. But though the forms given are good so far as they go, we think the authors have hardly realised the immense variety of manufacturing trades which demand special methods, and have based their forms on too narrow an experience. They will do well in any new edition of their book to consider these differences. Piecework is becoming every day more necessary and customary; but, speaking for engineers alone, there are few branches of trade where piecework is not impossible in some departments, and where in others day and piece wages are not earned in the same shops. The contiguity and overlapping of the two afford great opportunity for errors and petty frauds, which, though singly of small importance, may in the aggregate make all the difference between profit and loss. In a private business sheer necessity often compels attention to such evils, and provides a remedy; but in large joint-stock undertakings, and still more in Government and railway workshops, cheating is possible, and, we fear, frequent. Printed forms and an admirable theoretical system are not sufficient without periodical revision, for some of the most successful frauds are those which take advantage of checks and supposed safeguards which have lulled the officials into a mistaken security.

Apart altogether from the evils of actual peculation are those arising from insufficient analysis of expenditure, especially in regard to what are known as the general or establishment charges. Much of the mystery of low tenders and final bankruptcy arises from errors in this respect. In some factories a tonnage rate is supposed to cover these expenses; in others a percentage on the wages; and sometimes a percentage on the two combined. The choice of these methods depends a good deal on the nature of the business, and the proportion which the cost of material bears to that of the labour bestowed upon it. Another factor to which sufficient consideration is not always given is that of the period of time during which any specified work is occupying space or attention in a factory. This circumstance was emphasised in a book entitled, "The Cost of Manufacture and the Administration of Workshops," by Captain Henry Metcalfe, of the Ordnance Department, United States army, published in 1885, noticed in THE ENGINEER of 16th April, 1886. The allowances for wear and tear of machinery and for the general depreciation of buildings, plant, and patterns are touched upon in the book before us, the authors making copious reference to Mr. Ewing Matheson's admirable treatise on "The Depreciation of Factories." This is a branch of factory management on which there is a wide divergence of opinion, and where accountants and auditors are unable without the co-operation of those technically informed to insist on proper allowances.

THE BRITISH ASSOCIATION.

DURING the meeting of the British Association many works and places of interest were thrown open for inspection. We have, in the following notices of a few of them, endeavoured to place before our readers only those points which are likely to possess interest for them.

EXCURSION TO NORTHWICH AND ANDERTON.

On Saturday, September 3rd, a special train, furnished by the Cheshire Lines Committee, conveyed about two hundred members to Marston, where they descended Messrs. Joseph Verdin's rock salt mine, specially illuminated for the occasion. As these mines have already been described in THE ENGINEER, we will merely remark that the pillars left to support the roof are 10 yards square instead of 8 yards, as usual, and are therefore in a better position to resist the solvent action of any water that may find its way into the mine, and so prevent a falling in of the workings, and consequent subsidence of the surface. At the present time about 1200 acres of land in and around Northwich are more or less affected by surface subsidence due to the melting of pillars in the old mines, but also and principally to the pumping out of brine and falling in of the unsupported roof. Landowners have no remedy, because they cannot fix the blame upon any particular brine-pumper; and there is a general feeling that the only practical manner in which the hardship can be met is to compensate surface owners out of the Weaver navigation dues. The visitors were shown a row of houses, only built five years ago, one of which has fallen so that the materials have been carted away; the next is in a fair way to share the same fate; and probably the whole row will yield sooner or later to the inexorable subsidence of the ground.

After the long and tedious process of lowering at least half the visitors, three or four at a time in buckets, to the depth of 55 fathoms, and raising them to the surface again, a section of the party proceeded in an open barge, under pouring rain, to the famous Anderton lift of the River Weaver Navigation, Mr. Leader Williams, formerly its engineer, and now engineer for the Manchester Ship Canal, being one of the party. M. A. Gobert, of Brussels, the engineer who stands in the same relation to the projected "Bruxelles, Port de Mer" that Mr. Daniel Adamson does to the Manchester scheme—notwithstanding his resignation of the chairmanship of the company—also accompanied the expedition. On reaching the lift, the barge was towed into one of the two troughs, 75ft. long by 15ft. wide, built up of iron plates. The gates at each end, and also that of the conducting aqueduct, were then closed; and the trough, with its barge floating in 5ft. of water, weighing altogether about 240 tons, began to descend. The lift is started by opening the valve communicating with an accumulator of 21in. diameter, loaded to 530 lb. per square inch, self-acting syphons abstracting 6in. of water from the rising trough. As soon as the simultaneous rising of one trough and descent of the other are fairly started, communication with the accumulator is shut off, and that between the two ram cylinders opened by means of another valve. The descending trough, with its 5ft. of water, then raises the ascending trough with only 4ft. 6in. of water, until the lifting force is diminished by the descending trough entering the river basin, 50ft. 4in. below the canal. The connection between the two cylinders is then closed, when the lift is completed by means of the accumulator. The rams are 60ft. long and 3ft. in diameter, the time occupied in a single lift being three and a-half minutes. Owing to delay in starting and bad weather, the intended visit to the Saltersford and Dutton locks was abandoned. They are each 230ft. long, 42ft. 6in. wide, and 15ft. deep on the sill, having a small one at the side; and one steam barge with three flats, carrying together about 1000 tons, may be passed through at one lockage. The gates are opened and closed by hydraulic power obtained from turbines; and there is a sluice arrangement for passing the top water from one lock into that adjacent, so as to partially fill it and economise the water.

The Weaver has steadily progressed in the tonnage of the boats used, and in the capacity of the navigation to take them, the ordinary depth being now about 9ft. 6in., with a width of 70ft. to 110ft. The speed is not restricted. The traffic amounts to about one and three-quarter million tons per annum, of which over one millon tons are salt. The dues for the use of the navigation are—for salt, 1s.; merchant goods, 8d.; bricks, stone, &c., nominal rates per ton, irrespective of the distance travelled. The movable weir at Dutton takes the place of two stone weirs, and is formed of masonry piers with eight sluices or floodgates, each 15ft. wide and 13ft. 6in. deep. The sectional area is in excess of that of portions of the river above, this area and the mobile character of the weir having been arranged so that the works of the trustees might not be considered to have in any way impeded the flow of water in time of flood. The new locks at Dutton took the place of two old sets; and, as they are at the lower end, the water immediately above them was raised 4ft. The flood level of the Weaver Valley has been permanently lowered; and, were it not for the difficulty of passing off the water into the Mersey at high tide, the benefit derived would be still greater. Spring tides raise the level of the pond below these sluices about 4ft.

After making the descent from the canal to the river, a few observations on the lift were made by the leader of the party, Mr. Lionel B. Wells, C.E. The visitors then embarked on board a steamer, placed at their disposal by the Weaver Navigation Committee, and proceeded along the river Weaver, noticing the subsidence of the surface and the salt lakes, especially Neumann's Flash; the great subsidence of 1880, due to the inundation of Platt's Hill rock salt mine, forming a lake eight acres in extent; and a lake called Top o' th' Brook, 100 acres in area, and in some places 50ft. deep, which in 1765 was a brook winding along the bottom of a deep but narrow valley. Disembarking at Northwich, the visitors partook of what north-country folk call a "thick tea," and left for Manchester after paying a hurried visit to the museum, with its collection of English and foreign salt specimens, sections of salt mines and maps of subsidences.

MESSRS. MATHER AND PLATT'S MACHINE AND ELECTRICAL WORKS.

The Salford Ironworks of Messrs. Mather and Platt are situated in Deal-street, Salford, and now give work to about 400 men, though as many as 1200 have been employed. The light and airy foundry, above 200ft. long, is lighted by arc lamps in the roof, and provided with two of Messrs. Craven Bros.' overhead travelling cranes, having the driver's seat suspended below the platform, so that he has a clear view of all that is going on beneath. The moulds, of ordinary foundry sand, are faced with powdered plumbago used dry; and the castings have a remarkably fine surface. The principal shop for the erection of heavy machines has a forge and smiths' fires at one end, while the fitting and small machine shops are on an upper floor, off the main shop. A great many fitters are still employed, the constant variety of work not permitting of much automatic machinery being introduced. The offices are lighted throughout by Swan-Edison incandescent lamps; and a drawing floor, for setting out important work full size, similarly lighted, is provided with Grinnell's patent automatic fire extinguishers, of which the firm is sole maker in Europe. In the event of the temperature exceeding 150 deg. Fah., a fusible joint would be melted, allowing a valve to open and let fall such a deluge of water as would speedily extinguish any fire that could break out. With fires, like that at Exeter, occurring so constantly in theatres, one is tempted to ask why these extinguishers are not universally adopted.

Messrs. Mather and Platt's business lies principally with the staple trades of Manchester and the neighbourhood; and prominent objects in the works are four large receivers for the Mather and Thompson patent bleaching process, by which goods are bleached under pressure in one-third the usual time. The receivers are large cast iron cylinders, closed by wedge-shaped disc valves, like those of a penstock, worked by a chain and hydraulic ram, and securely clamped when closed.

There is also an eight-colour calico printing machine combined with a 25-horse power diagonal engine. The engine appears strangely out of proportion to the machine; but in "setting the pattern" it is necessary that the speed of the machine be so thoroughly under control that it may be made to merely "creep" round, and may be stopped in the fraction of a revolution, so as to enable the printer to see that the rollers, each printing one colour, are properly adjusted relatively to one another. But, notwithstanding the stop-valve spindle being brought within the printer's reach, it is found difficult to stop the machine as suddenly as might be desired on account of the momentum acquired by the fly-wheel. Accordingly Messrs. Mather and Platt have combined a ten-colour machine with one of their "Manchester" dynamos, acting as motor in place of a double-cylinder engine—10in. diameter by 12in. stroke—making about 180 revolutions per minute. The dynamo makes 700 revolutions; and the speed is reduced by belt and spur gearing in the ratio of 56 to 1. The dynamo shaft is fitted with a 16½in. pulley driving a 54in. pulley by a short belt, the grip being increased by a loose jockey pulley bearing on the slack side of the belt. The speed is further diminished by two internal spur wheels and pinions forming a noiseless and effective gear, under perfect control, and occupying no more space than that which would be required for reducing the speed of a steam engine. The machine prints up to 34in. wide, with from one to ten colours simultaneously, at a speed of 30 yards per minute, and is fitted with transverse motion for the "doctors," or straight-edges for removing all excess of colour, drag roller, steam chest and drying cylinder. As the dynamo has no dead points, and therefore no fly-wheel, and the current may be interrupted instantaneously, the machine may be stopped more quickly than if driven by a steam engine. In addition to perfect control over the machine, this system of electrical driving—applicable to many machines self-contained with motor—has the advantages of economy, cleanliness, and diminished risk from fire and breakdowns, while the economy will be even more marked in cases where an electrical installation already exists. Messrs. Mather and Platt have also brought out a cloth singeing machine, in which platinum plates, raised to a bright red heat by the electrical current, take the place of copper plates heated in an ordinary furnace or of oxy-hydrogen burners, with several advantages, including the saving of about 75 per cent. in the cost of working.

There are now in the shop some steam engines, got out under the superintendence of Professor Reynolds, for demonstration at Owens College, and also for driving the workshop there. They have separate copper condensers, and are calculated to give a high degree of efficiency; but we reserve description to accompany drawings. There are also in the shop several small sizes of a convenient engine for hoisting or driving, with the cylinder sufficiently inclined from the horizontal to allow the fly-wheel to clear the floor without requiring a recess.

MESSRS. SHARP, STEWART, AND CO.'S WORKS.

THE Atlas Works of Messrs. Sharp, Stewart, and Company suffer, in comparison with more recently erected works of the same kind, in being situated almost in the centre of Manchester, and therefore cramped for space, as well as from having been added to at various times as occasion required, instead of having been laid out on a comprehensive general plan at the commencement. But the fact that these time-honoured works, now employing about 1000 men, are able to hold their own, while so heavily handicapped, says no little for the excellence of management and the quality of work turned out. Without, therefore, describing the works themselves, we will content ourselves on the present occasion with a few notes of such plant, practice, and work in hand as came under our notice in a very hurried inspection made on Wednesday afternoon.

No original drawing is seen in the shops, carefully mounted paper tracings, which present a smoother surface, less liable to catch the dirt, being substituted; but these are carefully finished, so as to be perfectly legible.

Although, of course, hand work is superseded as far as possible by machining, we noticed that the fitter and his file are by no means disestablished; but this is chiefly on account of the varied and various work undertaken by the company.

The erecting shop is so well lighted by Brush arc lamps that even a pin may readily be picked up from the floor; and the foreman would now be very sorry to do without them. By means of overhead travellers, the boilers brought in from the boiler shop adjoining are turned in any position, sideways and upside-down, so as the more readily to permit of drilling the holes for receiving the various fittings; but, unlike the topsy-turvy practice which prevails at the Cockerill works in Belgium, the engines are erected in their normal position. The fire-box wrapping plates have previously been drilled all together—as many as the number of engines ordered—under a template; but the holes are tapped to receive the stays by the company's locomotive fire-box stay tapping machine, which works by rope gear. We saw no less than six frame plates, about 1⅛in. thick, being slotted together in a powerful slotting machine made at the works. Such parts as cannot be turned, of water-gauge fittings and other similar work, are slotted very cleanly in Whitworth's compound slotting machine, the table of which may be self-acted longitudinally and transversely, and also rotated horizontally by hand.

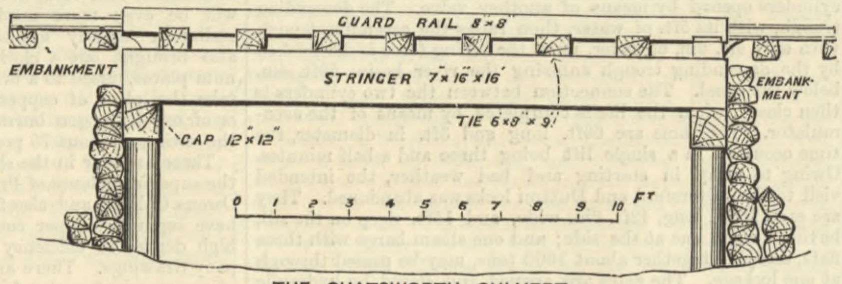
Some powerful eight-wheel coupled engines, with 20in. cylinders and weighing 46 tons, for mineral traffic in Norway, are now in the shops. They have extra large fire-boxes, the roof stays of which look quite gigantic, for burning wood at need. Some locomotives for South America are being fitted with the suspended bogies designed by Mr. Bottomley, the head draughtsman. The bogie is hung on links, which give the effect of the radial axle-box in going round sharp curves. The tenders for these engines are supported on two four-wheel trucks, the swivelling motion of which is limited by side pins working in circular recesses. Some small locomotives for colliery work are fitted with cast iron wheels, which are said to have given very good results without any breakage. They may be said to be a combination of the spoke and the disc wheel; that is to say, they are disc on one side and spokes on the other. The whole casting is hollow, the holes left for taking out the core being afterwards plugged. Previous to this, however, molten lead is poured in from the spoke portion, so as to solidify in the disc portion, and give the requisite amount of counter-weight. Steel tires are afterwards shrunk on in the ordinary manner. Some double-throw crank-shafts, with the excentric sheaves in the middle of the throws—though, of course, the greatest excentricity does not correspond with the full extent of throw—are now being finished in the fitting shop for some engines for driving dynamos; but this job is a friendly turn for other works, so no further information is available about the engines.

In the evening of Wednesday, after the President's address, the Committee of the Arts Club extended the right hand of fellowship to scientific correspondents at a very agreeable musical evening where ceremony was conspicuous by its absence. The walls of the club are adorned by a collection of highly meritorious paintings by Sam Bough, a Manchester artist, now no more.

THE CHATSWORTH DISASTER.

In this country we have been troubled by the telegraphic reports which have reached us concerning a fearful railway catastrophe, which took place in the United States near Chatsworth, Illinois, on the 10th of August. It was stated that a bridge had given way, and knowing what the recent record of American railway bridge failures has been, we suspected that the engineer and contractor had once more been to blame. The Chatworth disaster has little or nothing in common with the bridge failures which preceded it. We condense from the *Engineering News* the following account of the affair:—"A Niagara Falls bound excursion train from Peoria on the Toledo, Wabash, and Western-road, plunged through a burning 'culvert,' 2½ miles west of Chatsworth, Ill., about midnight on August 10th. There were a few more than 600 persons in the train, of whom 71 were killed outright, and two have since died of injuries received, 129 were so seriously wounded as to occupy couches, and about 250 were slightly wounded; the total being 73 dead, and 374 wounded, or 447 more or less injured. Four or five of the wounded are not expected to live, and one or two are still unaccounted for.

"The train was drawn by two engines and made up as follows, in order from the front. Baggage car, private car of general superintendent, six day coaches, two chair cars, and six Pullman sleepers. The culvert was an ordinary pile trestle, 15ft. span and 6ft. high, in a 4ft. embankment. The grade from Chatsworth east is a succession of small undulations, with a slight general descent for a mile and a-half before reaching the scene of the disaster. From the fatal culvert the grade for about 1800ft. each way is 25ft. to 30ft. per mile. The line is perfectly straight. The engineer of the leading locomotive testified that he was running 30 miles per hour; intelligent and experienced passengers place it at 40. As the train was on a descending grade, two hours late, and the engineer, as he stated, trying to make up time, the latter figure is probably more nearly correct.



THE CHATSWORTH CULVERT.

"The culvert seems to have been nearly consumed before the excursion train approached it. The engineer of the leading locomotive saw a fire under the bridge when he was about 200ft. distant; he reversed his engine, and according to the testimony of the general superintendent, who was in his special car, the second engineer immediately thereafter applied the automatic air brake. After the crash the first engine was found on the track about 250ft. from the east end of the culvert, and the tender also on the track about 50ft. back of that. The second engine was thrown on its side on the south side of the track. The baggage and special car were across the track. Seven passenger cars were piled one upon top of the other on the track immediately to the west; the forward truck of the first sleeper rested over the culvert. The *débris* of the nine cars and the engine occupied a little less than 180ft.; the waterway was filled with trucks. No one was seriously hurt in the baggage or special cars, and no one was injured in the sleepers. No part of the wreck burned, owing to the heroic efforts of passengers and citizens, and the rain which set in about an hour after the disaster.

"The accident occurred about midnight. Ample evidence was introduced at the coroner's inquiry to show that a general inspection of the track and bridges had been ordered, as a special precaution for the excursion train. The bridge engineer inspected the culvert from the rear end of a car at 4 o'clock of the day of the accident. The section men claimed to have inspected it between half-past five and six o'clock of the afternoon before the accident, but of this the evidence is not conclusive. They had been burning weeds near the trestle late in the afternoon. The hand car had been left near the bridge, and the evidence before the coroner, although conflicting, seems to show that they did nothing more than push the car over the bridge on their way home from work. The bridge engineer's special was the last train over the culvert, and the fire appears to have originated either from sparks from this train or from the fire set by the section men, probably the latter.

"On the other hand, the railroad men claim that about three weeks before, the grass under and around the culvert had been cut away for 10ft. from the timber, and the surface shovelled back for 3ft. or 4ft. An inspection of a dozen or fifteen similar structures adjacent shows that they had been so treated. However, the work had not been as carefully done as the dry dry season and the decayed condition of the timbers demanded."

We have very little comment to make. The event possesses no special engineering interest. The railway was, it is stated, a bankrupt concern, taken out of the hands of a receiver last July. It is stated to be "in very poor condition, the track overgrown with weeds and grass, the sleepers badly decayed, the rails bad, and but little rolling stock." On the other hand, it is said that special care was taken in making up the train to have it as good as possible. The event shows the necessity for having some independent inspecting authority. Had such existed the line would probably have been closed for repairs. In new countries where there is little money the population must be satisfied with imperfect lines. On such a good deal of risk is of necessity incurred. If Americans would recognise this fact, less blame would fall on them than is usually meted out them on this side of the Atlantic. Their newspapers are never done asserting that United States railways are perfect, in every respect patterns for the whole world. In reality, the great bulk of them are in no sense or way perfect, although they are well enough adapted to the wants of the community. If the little bridge had been made of iron and brick-work, it would not have been burnt down; but when the choice lies between a wooden bridge railway and no railway at all, there can be no doubt as to what the result will be. There are thousands of bridges and culverts of the kind in the United States, which will probably be better looked after than heretofore for some time to come. We regret to add that there is reason to think the bridge was destroyed by incendiaries in order to wreck the train and rob it. It is said, indeed, that several robberies actually took place. The following extract from a United States contemporary, bearing on this point, deserves attention:—

"Quite a number of our exchanges hold up their hands in horror and reject as impossible the theory that the late wreck (at Chatsworth) was due to the burning of the bridge by train-wreckers for the purpose of robbery. 'How is it possible that human nature can be so depraved?' they exclaim with one voice. 'There are on earth no fiends so black that they can be guilty of a crime so infamous.' We know that train-wrecking is a matter of every-day occurrence. Is it possible that the train-wrecker in advance estimates his work with such a degree of nicety that he contemplates the killing of two or three persons, possibly the unfortunate trainmen? Then we presume that he is not much of a criminal after all. But if he should intentionally, or through mistake, increase the number of his murdered and mangled victims to hundreds, his crime becomes of such magnitude that it is past belief."

IMPROVEMENTS IN THE MANUFACTURE OF PORTLAND CEMENT.[1]

By Mr. F. Ransome.

So much has been said and written on and in relation to Portland cement, that further communications upon the subject may appear to be superfluous. But the author hopes to present some facts which have up to the present time, or until within a very recent date, been practically disregarded or overlooked in the production of this material. Portland cement is, as is well known, composed of a mixture of chalk, or other carbonate of lime, and clay—such as is obtained on the banks of the Thames or the Medway—intimately mixed and then subjected to heat in a kiln, producing incipient fusion, and thereby forming a chemical combination of lime with silica and alumina, or practically of lime with dehydrated clay. In order to effect this, the usual method is to place the mechanically-mixed chalk and clay—technically called slurry—in lumps varying in size, say from 4 lb. to 10 lb., in kilns with alternate layers of coke, and raise the mass to a glowing heat sufficient to effect the required combination, in the form of very hard clinker. These kilns differ in capacity, but perhaps a fair average size would be capable of producing about 30 tons of clinker, requiring for the operation, say, from 60 to 70 tons of the dried slurry, with from 12 to 15 tons of coke or other fuel. The kiln, after being thus loaded, is lighted by means of wood and shavings at the base, and, as a matter of course, the lumps of slurry at the lower part of the kiln are burnt first, but the moisture and sulphurous gases liberated by the heat are condensed by the cooler layers above, and remain until the heat from combustion gradually ascending, raises the temperature to a sufficient degree to drive them further upwards, until at length they escape at the top of the kiln. The time occupied in loading, burning, and drawing a kiln of 30 tons of clinker averages about seven days. It will be readily understood that the outside of the clinker so produced must have been subjected to a much greater amount of heat than was necessary, before the centre of such clinker could have received sufficient to have produced the incipient fusion necessary to effect the chemical combination of its ingredients; and the result is not only a considerable waste of heat, but, as always occurs, the clinker is not uniformly burnt, a portion of the outer part has to be discarded as over-burnt and useless, whilst the inner part is insufficiently burnt, and has to be re-burned afterwards. Moreover, the clinker, which is of excessively hard character, has to be reduced by means of a crusher to particles sufficiently small to be admitted by the millstones, where it is ground into a fine powder, and becomes the Portland cement of commerce. This process of manufacture is almost identical in principle and in practice with that described and patented by Mr. Joseph Aspden in the year 1824, and though various methods have been patented for utilising the waste heat of the kilns in drying the slurry previous to calcination, still the main feature of burning the material in mass in large and expensive kilns remained the same, and is continued in practice to the present day. The attention of the author was directed to this subject some time since in consequence of the failure of a structure in which Portland cement formed an essential element, and he had not proceeded far in his investigation of the cause of the failure when he was struck with what appeared to him to be the unscientific method adopted in its manufacture, and the uncertain results that must necessarily accrue therefrom. Admitting, in the first place, that the materials employed were considered the best and most economical for the purpose readily accessible—viz., chalk and an alluvial deposit found in abundance on the banks of the Thames and the Medway—and being intimately mixed together in suitable proportions, was it necessary, in order to effect the chemical combination of the ingredients at an intense heat, to employ such massive and expensive structures of masonry, occupying such an enormous space of valuable ground, with tall chimney stacks for the purpose of discharging the objectionable gases, &c., at such a height, in order to reduce the nuisance to the surrounding neighbourhood? Again, was it possible to effect the perfect calcination of the interior of the lumps alluded to without bestowing upon the outer portions a greater heat than was necessary for the purpose, causing a wasteful expenditure both of time and fuel? And further: as cement is required to be used in the state of powder, could not the mixture of the raw materials be calcined in powder, thereby avoiding the production of such a hard clinker, which has afterwards to be broken up and reduced to a fine powder by grinding in an ordinary mill?

The foregoing are some of the defects which the author applied himself to remove, and he now desires to draw attention to the way in which the object has been attained by the substitution of a revolving furnace for the massive cement kilns now in general use, and by the application of gaseous products to effect calcination, in the place of coke or other solid fuel. The revolving furnace consists of a cylindrical casing of steel or boiler plate supported upon steel rollers—and rotated by means of a worm and wheel, driven by a pulley upon the shaft carrying the worm—lined with good refractory fire-brick, so arranged that certain courses are set so as to form three or more radial projecting fins or ledges. The cylindrical casing is provided with two circular rails or pathways, turned perfectly true, to revolve upon the steel rollers, mounted on suitable brickwork, with regenerative flues, by passing through which the gas and air severally become heated, before they meet in the combustion chamber, at the mouth of the revolving furnace; the gas may be supplied from slack coal or other hydrocarbon burnt in any suitable gas producer—such, for instance, as those for which patents have been obtained by Messrs. Brook and Wilson, of Middlesbrough, or by Mr. Thwaite, of Liverpool—which producer may be placed in any convenient situation. The cement mixture or slurry—instead of being burnt in lumps—is passed between rollers or any suitable mill, when it readily falls into coarse dry powder, which powder is thence conveyed by an elevator and fed into the revolving furnace by means of a hopper and pipe, which being set at an angle with the horizon, as it turns, gradually conveys the cement material in a tortuous path towards the lower and hotter end, where it is discharged properly calcined. The material having been fed into the upper end of the cylinder falls through the flame to the lower side of it; the cylinder being in motion lifts it on its advancing side, where it rests against one of its projecting fins or ledges, until it has reached such an angle that it shoots off in a shower through the flame and falls once more on the lower side; this again causes it to travel in a similar path, and every rotation of the cylinder produces a like effect, so that by the time it arrives at the lower and hotter end it has pursued a roughly helical path, during which it has been constantly lifted and shot through the flame, occupying about half an hour in its transit. To some who have been accustomed to the more tedious process of kiln-burning, the time thus occupied may appear insufficient to effect the combinations necessary to produce the required result, but it will be seen that the conditions here attained are, in fact, those best suited to carry out effectively the chemical changes necessary for the production of cement. The raw material being in powder offers every facility for the speedy liberation of water and carbonic acid, the operation being greatly hastened by the velocity of the furnace gases through which the particles pass. That such is practically the case is shown by the following analysis of cement so burnt in the revolving furnace or cylinder:—

Carbonic acid, anhydrous	·40
Sulphuric ,, ,,	·26
Silica, soluble	24·68
Silica, insoluble	·60
Alumina and oxide of iron	10·56
Lime	61·48
Magnesia, water and alkalies	2·02
	100·00

Again, fineness of the particles results in their being speedily heated to a uniform temperature, so that they do not serve as nuclei for the condensation of the moisture existing in the furnace gas. The calcined material, on reaching the lower end of the furnace, is discharged on to the floor, or on to a suitable "conveyor," and removed to a convenient locality for cooling and subsequent grinding or finishing. It, however, is not in the condition of hard, heavy clinkers, such as are produced in the ordinary cement kiln, which require special machinery for breaking up into smaller pieces before being admitted between the millstones for the final process of grinding; nor does it consist of an overburnt exterior and an underburnt "core" or centre portion; but it issues from the cylindrical furnace in a condition resembling in appearance coarse gunpowder, with occasional agglutinations of small friable particles, readily reduced to fine powder in an ordinary mill, requiring but small power to work, and producing but little wear and tear upon the millstones. The operation is continuous. The revolver or furnace, once started, works on night and day, receiving the adjusted quantity of powdered material at the upper or feed end, and delivering its equivalent in properly burnt cement at the opposite end, thus effecting a great saving of time and preventing the enormous waste of heat and serious injury to the brickwork, &c., incidental to the cooling down, withdrawing the charge and re-loading the ordinary kiln. Cement, when taken from the furnace, weighed 110 lb. per bushel. Cement, when ground, leaving 10 per cent. on sieve with 2500 holes to the inch, weighed 121 lb. per bushel, and when cold 118 lb. per bushel. When made into briquettes the tensile breaking strain upon the square inch, at four days, was 410 lb. per square inch; at six days, 610 lb. per square inch; at fourteen days, 810 lb. per square inch; at forty-nine days, 900 lb. per square inch; and at seventy-six days, 1040 lb. per square inch. A cylindrical furnace, such as the author has described, is capable of turning out at least 20 tons of good cement per day of twenty-four hours, with a consumption of about three tons of slack coal. It will be readily understood that these furnaces can be worked more economically in pairs than singly, as they can be so arranged that one producer may furnish a sufficient quantity of gas for the supply of two cylinders, and the same labour will suffice; but in order to provide for possible contingencies, the author advises that a spare gas-producer and an extra furnace should be in readiness, so that by a simple arrangement of valves, &c., two cylinders may always be in operation, whilst from any cause one may be undergoing temporary repairs, and by this means any diminution in the output may be avoided.

As compared with the more complex methods and machinery generally employed, the system described by the author is advantageous in many respects:—(1) Economy of space—the furnaces requiring only about one-fourth the space; (2) continuous working and consequent economy of fuel; (3) economy of repairs, which are of a simple and comparatively inexpensive character and of much less frequent occurrence, as the continuous heat avoids the racking occasioned by the alternate heating and cooling; (4) economy in first cost; (5) economy in grinding, a friable granular substance being produced instead of a hard clinker, whereby crushers are quite abolished, and the wear and tear of millstones greatly reduced; (6) economy of labour—the conveyance to and removal from the revolving furnace being conducted automatically by mechanical "elevators" and "conveyors"; (7) improved quality of the cement; (8) thorough control—from the facility of increasing or diminishing the flow of crushed slurry, and of regulating the heat in the furnace; and (9) absence of smoke and deleterious gases.

[1] Section G, British Association.

SPECIMENS OF STEEL PRODUCED BY SKIDDING RAILWAY WHEELS.[1]

By Jeremiah Head, M. Inst. C.E., &c., Vice-President of the Section.

Where a heavy gradient or incline occurs upon a railway necessitating the frequent and severe use of brakes to prevent too rapid descents, pieces of metal of a peculiar former resembling the leaves of ferns have frequently been found alongside the rails. A close examination of the specimens will satisfy the observer: (1) That, though differing in size and colour, they have all the same origin and the same cause. (2) That being found on steep inclines only, they are probably due in some way to the action of the brakes of descending trains. (3) That being—as will hereafter be shown—of steel, they must have come from the tires or rails, and not from the brake blocks. (4) That in assuming their present form they have undergone considerable pressure, and at a temperature higher than ordinary.

It is the purpose of the present paper to consider and determine, if possible, how these specimens have been produced, and how far their existence has significance, either practically, as an element of destruction or danger on railways, or scientifically, as indicating what may happen when the power of metals to resist pressure or abrasion has been exceeded. By favour of Sir Lowthian Bell, who has taken an interest in the matter, I have obtained from Mr. R.

[1] Section G, British Association.

Routledge, Chemical Analyst at the North-Eastern Railway laboratory, Gateshead, an analysis of some of the specimens. He found them to contain the elements—see column No. 1—in the following table :—

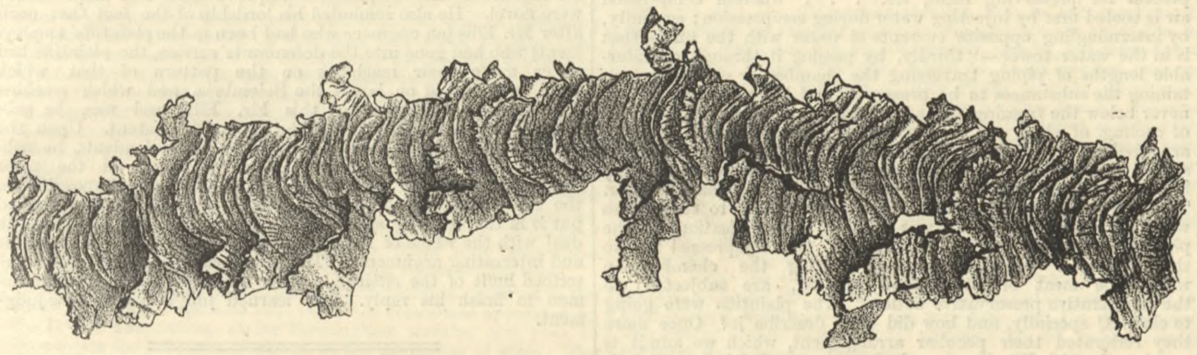
	Specimens.	Tires.			Rails.			Great'st resemblance to
Column No.	1	2	3	4	5	6	7	8
		from	to.	Average.	from	to.	Average.	
Phosphorus .. (P)	·06	·04	·05	·046	·03	·07	·05	Rails.
Sulphur.. .. (S)	·07	·01	·09	·062	·04	·14	·07	Rails.
Carbon .. .. (C)	·57	·24	·63	·486	·35	·60	·475	Tires.
Silicon .. .. (Si)	·09	·16	·33	·274	·04	·10	·07	Rails.
Manganese .. (Mn)	·79	·21	·52	·390	·80	1·00	·90	Rails.
Tin .. .. (Sn)	·07	—	—	—	—	—	—	—
Iron .. .. (Fe)	98·35	—	—	98·742	—	—	98·435	Rails.
Total.	100·00			100·00			100·00	

Mr. Routledge has also been good enough to give me typical analyses of tires and rails at present in use on the North-Eastern Railway—see columns Nos. 2 to 7 inclusive.

The railway official who—as far as I know—first called attention to the pieces on the line, and who studied them at the time and place of formation, says:—"I beg to state that the pieces of iron found near the rails leave the wheels whilst the train is in motion, and the wheels are skidding. Therefore, you will perceive it would be difficult to determine which wheels they come off." Again, he describes them as "pieces of iron picked up on the incline, that have left the wheels by abrasion with the rail."

Mr. Charles Markham, of Staveley, to whom I am indebted for information and assistance, says:—"I am certainly under the impression that the pieces are rubbed off the tires, but the matter has not been, as far as I know, investigated by any competent authority. My attention was drawn to the subject some four or five years ago, in consequence of a signalman having collected a number of specimens in his box, at the foot of an incline. For many years I had a good deal to do with the working of the Likey incline, near Bromsgrove. This appeared to me a place where there would be plenty of them. I believe that wherever there are inclined planes, and brakes are used, similar specimens could be obtained."

One of our most experienced locomotive superintendents, whose opinion I asked upon these specimens, has kindly given it as follows:—He says, "Some years ago I collected specimens of the abraded iron and steel cuttings, which had evidently been caused by skidding of wheels while passing over curves on falling gradients. At that time we came to the conclusion that these cuttings came from the tires of goods brake vans, while going down inclines with the brake fully on. The goods' guards have brake vans weighing 10 tons, and have the power by their own brakes to skid the wheels should they find it necessary. The specimens consisted of both iron and steel, and might come from either rail or tire; but I am inclined to the opinion that, except in case of worn rails, they



STEEL SCALE PRODUCED BY SKIDDING RAILWAY WHEELS.

for the most part come from the tires. They are, in my opinion, torn off when the wheels are skidded, and while passing round sharp curves when the rails are somewhat worn. With continuous brakes we do not skid the wheels, except when the drivers keep the full power on to the end of the stop, and then they may skid, just before the train is brought to a stand only. We find that tires which frequently pass over inclines wear out only in proportion to the duration of time the brake is applied, and to the number of such applications of the brake. During the applications of the brake, more especially if the wheels are skidded, sharp curves and crossings are greater factors in the destruction of tires than inclines where brakes are applied without skidding. Tires wear into flat places, indicating skidding but only in the case of guards' brake vans, and of wagon tires when spragged, and which work frequently over inclines where spragging is necessary."

The opinions I have quoted, although perhaps not in all cases very decided, seem to incline to the belief that the specimens have been torn from the *tires* rather than from the *rails*. Mr. Routledge, however, whose opinion I invited, takes a somewhat different view. He thinks that they come from the *rails* and *not* from the *tires*.

An examination of column No. 8, which shows whether the proportion of each element found in the specimens inclines most towards what is usual in rails, or in tyres, favours this view. It will be seen that in every case except that of the carbon, where the difference is very slight, the analysis agrees most nearly with that of rails. As compared with rails, the tires analysed seem to be characterised by high silicon and low manganese, which is not the case with the specimens. The presence of a small quantity of tin is somewhat remarkable; but Mr. Routledge informs me that that element occasionally occurs in pig iron.

Inasmuch, however, as the blows or charges of steel are often run indiscriminately into ingots for rails, or for tires, and as it cannot be stated certainly what was the composition of the identical tires and rails concerned in forming the specimens analysed, it is scarcely prudent to found any strong argument upon these analyses.

Such shavings as these, rubbed off from the surface of tires or of rails whenever a wheel is skidded, indicates for the time being very rapid destruction.

The lesson taught, or rather re-taught (for it has often been inculcated before), is that wheels should *never be skidded*. But, on the other hand, trains, whether passenger, goods, or mineral, should always be retarded by brakeing a sufficient number of wheels to effect the desired object with a pressure somewhat short of skidding. Skidding wheels are indeed a barbarous and ineffectual attempt at retardation, whilst they are most effectual causes of disintegration.

The specimens, looked at from a scientific point of view, are interesting. Their colour indicates that they have been formed at a high temperature, as they have clearly all been originally coated with magnetic oxide—Fe_3O_4. The comparatively large body of metal forming the rail, and its continual presentation of new surfaces during skidding, make it improbable that it could have reached any high temperature; whereas skidded wheels might easily present the same surface long enough to accumulate heat locally to a greater extent than could be, *pari passu*, dissipated by conduction.

The multitude of folds which appear in all the specimens, and the tendency to spread into various forms, seem to indicate that under the pressure to which they have been subjected the metal has "flowed" with great freedom.

Reviewing the evidence obtained so far, the writer inclines to accept the following conclusions, viz.:—(1) That the pieces have come from the tires of skidding wheels, and not from the rails; (2) that they were produced at a sufficiently high temperature for the formation of magnetic oxide, *i.e.*, at a red heat; (3) that they were forced out from behind the skidding wheels—the folds being on the under side—until from their accumulated length and weight they fell off; (4) that the only way to avoid the destructive action which they indicate is to brake more wheels to an extent short of skidding.

LAUNCHES AND TRIAL TRIPS.

ON Saturday last the Barrow Shipbuilding Company launched from its yard a fine sailing ship, named the Hainaut, for Messrs. F. Sheth and Co., of Antwerp. She is full-ship rigged, and her dimensions are 240ft. in length by 39ft. beam by 23ft. 8½in. depth, moulded. She is built entirely of steel, manufactured by the Barrow Hematite Steel Company. She has been built under the superintendence of Mr. A. G. Schaffer, of Newcastle-upon-Tyne, and the Bureau Veritas Surveyors, Liverpool, and will receive the highest class in the Bureau Veritas Register of Shipping. Her tonnage is 1750 tons gross, and will be capable of carrying 2500 tons, and she is the first sailing ship built for carrying petroleum in bulk. The hold in which the petroleum is carried is divided into ten separate compartments, and the ship has altogether fifteen watertight compartments. The divisions are necessary for the safe carrying of petroleum in bulk; but this also adds to the safety of the ship, as it renders her practically unsinkable in the event of collision. The vessel is provided with three powerful pumps, two of them for loading and discharging petroleum and one for ballast purposes. Each pumping engine has two cylinders 7½in. diameter and two pumps 7in. diameter, the stroke being 10in., and each engine capable of discharging 16,800 gallons per minute. The usual style and finish which characterises the vessels turned out by the Barrow Company has been fully maintained in this vessel, and she is a ship which will do credit both to owners and builders. The recent rapid development of the petroleum trade will, it is believed, lead to a large demand for vessels similar to the Hainant, and it will probably not be long before the owners will be in a position to duplicate her. There was a large number of ladies and gentlemen present to witness the launch, including Sir James Ramsden. As the vessel left the ways she was named the Hainaut by Mrs. E. A. Cohan, of Liverpool.

ON Saturday there was successfully launched from the shipbuilding yard of Messrs. Wm. Simons and Co., of Renfrew, one of their patent hopper dredgers. This vessel has been constructed to the order of the Bombay Port Trust, and built from designs revised by Mr. Geo. E. Ormiston, C.E., engineer to the Trust, to suit the requirements of the port, and in connection with the extensive addition to the dock accommodation which the Port Trust have under construction to provide for the rapid increases in the trade of the port. This vessel, which is one of the largest and most complete of its type yet constructed, is of the following dimensions:—Length, 222ft.; breadth, 40ft.; depth, 15ft.; and the hopper, which is situated near the centre of the vessel, is capable of containing 1000 tons of dredged material. The bucket ladder is supported on a fore-and-aft horizontal framing and is moved to project in advance of the dredger, and cut the vessel's own flotation, or dredge to a depth of 35ft. at the bottom of the quay walls, if necessary, by means of the builders' patent traversing gear. The dredger is supplied with two sets of buckets, a large and a small set; the former are for dredging in free soil, and the latter, which are alternated with ripping claws, are used for dredging in hard material. They are made entirely of steel, and the large buckets will easily raise 500 tons per hour. The gearing generally is arranged in the most improved manner and is chiefly of steel; surging wheels are fitted to prevent undue strain on machinery when dredging hard ground. The upper and lower tumblers are of solid steel. Independent steam crab winches with the barrels working independently or conjointly are fitted at bow and stern of vessel. There are two pairs of compound surface condensing engines of 1100 indicated horse-power collectively, and working independently of each other, one pair only being required for dredging. Two steel boilers, with corrugated steel furnaces, having a working pressure of 95 lb. per square inch, centrifugal pump, auxiliary engine for driving the hoisting gear, hopper door winches, steam steering gear, and turning lathes. The accommodation for the officers and crew is of the most spacious and comfortable description. Teakwood is entirely used for decks, deckhouses, &c. The vessel, which was launched with the engines, boilers, and machinery in position and nearly ready for work, presents a most substantial and fine appearance, and reflects credit on all concerned with its construction. The whole work has been carried out under the supervision of Mr. James A. McConnachie, C.E., London, and Messrs. Dutton and Sanderson, Lloyd's surveyors, Mr. W. N. Bain, Glasgow, being resident inspector. The vessel as it left the ways was named the Kuphus by Mrs. J. A. McConnachie.

THE WATER CAPACITY OF SOILS.—Herr E. Wollny arrives at the following conclusions, based on his experiments:—I. The water capacity (measured by volumes) of a soil diminishes with a rise in temperature. The opposite is the case with peat. This diminution is relatively greater the larger the pores in the soil. II. (*a*) The freezing of the water in soils usually causes a diminution in their water capacity. (*b*) This latter result is merely transient in the case of soils of only a slightly cohesive character—*i.e.*, coarsely granular, sandy, poor in vegetable matter. It is of a more permanent nature in the case of soils which show a tendency to form crumbs—*e.g.*, finely granular, argillaceous soils, or soils rich in vegetable matter. (*c*) The result mentioned in (*a*) is more marked, the greater the quantity of water in the soil, and the more frequently (within certain limits) the frosts alternate with thaws. (*d*) In the case of crumby soils the duration of the diminished water-holding capacity may be materially altered, and even converted into an increased capacity if there are frequent alternations of frost and thaw or the crumbs are loosely aggregated, as this facilitates the breaking up of the crumbs into a finer state. An explanation of these facts is the increased or diminished aggregation of the soil, resulting from the freezing of the water in the soil. III. (*a*) The water-holding capacity of a coarsely granular soil is increased by the presence of even a very thin (3—5 cm.) difficulty permeable subsoil—*e.g.*, clay. The more so, the nearer the latter is to the surface. This effect is more marked the greater the difference in water capacity of the upper and lower soils. (*b*) An easily permeated subsoil only slightly increases the water capacity of the soil above it, if the latter is of a finely granular or argillaceous character, but diminishes its capacity if it is more coarsely granular.—*Journal of the Society of Chemical Industry.*

LEGAL INTELLIGENCE.

QUEEN'S BENCH DIVISION.

Before MR. JUSTICE STEPHEN, *without a jury.*

HASLAM FOUNDRY COMPANY *v.* HALL AND ANOTHER.

THIS was an action, commenced on the 1st of August, brought to obtain an injunction to restrain the defendants from using certain inventions in which the plaintiffs claimed patent rights. The plaintiffs also claimed damages for past infringements, and an account to be taken of all profits derived by the defendants, by reason of those infringements. The defendants denied that they had infringed the plaintiffs' patent; and pleaded (*a*) that the alleged invention is not new; (*b*) that it is not useful; (*c*) that it is not proper subject matter for a patent. The defendants further pleaded that the patent was bad on account of various defects in the complete specification, and for variation between the provisional and complete specifications. Upon these pleas issue was joined.

The Attorney-General—Sir Richard Webster, Q.C.; Mr. Aston, Q.C.; and Mr. E. Carpmael, appeared for the plaintiffs; and Sir Henry James, Q.C.; Mr. F. S. Moulton, Q.C.; and Mr. Bousfield, were for the defendants.

The ATTORNEY-GENERAL, in opening the case, said that the action was brought by the Haslam Foundry and Engineering Company, Limited, who are the owners of Bell-Coleman's Patent of March 15th, 1877. That invention related to refrigerating machines, which had been so largely used in the last few years for bringing home meat from the Colonies and from the River Plate. It consisted in a new and improved apparatus whereby air is properly made cold for the purpose of keeping the meat fresh during the voyage, either in the holds of the ship or in other chambers where it is required to keep it stored. His lordship would in the course of the case have his attention directed to numerous prior machines which had a very important historical bearing upon the present case. It would be shown that for something like twenty-five years persons had striven to attain the object which Bell-Coleman's Patent claimed to achieve, and had failed, notwithstanding the ingenuity of their resource, because they one and all failed to hit upon the one mark which constituted all the difference between success and failure. Prior to the year 1877 there had practically been no successful refrigerating machine for the purpose of preserving such things as meat. There had been numbers of machines which were used for freezing, and several which were used for condensing gases and a variety of purposes which were very nearly a success, but still failed. So doubtful were the inventors themselves that this invention would prove a success that they made two or three experimental voyages to test it. Whereas the importation of fresh meat was prior to 1877 practically unknown, and continued unknown as a commercial enterprise between two or three years afterwards until the trial had been made in the last three or four years, certainly upwards of 100 of these machines had been put up on board ship, and the foreign meat trade had already—he believed—grown to a million carcases of fresh meat coming in one year from various parts of the world. He mentioned that fact in order to show that what had been before a complete failure had since, by the plaintiffs' invention become a complete commercial success. The learned counsel then proceeded to explain certain elementary principles of thermo-dynamics in order to show that when compressed air—air which had by compression had its temperature raised—was cooled by artificial or external means, and allowed then to re-expand, the consequence was that you got a greater diminution of temperature than in the single process of expansion. The plantiffs' machine, and several others, was one which worked upon that principle, viz., air was first compressed, then cooled, and then re-expanded. There were two methods of cooling air, which were perfectly well-known—one by an injection of cold water into the air itself, and another, surface cooling, by passing the compressed air through pipes surrounded by some cold medium. These cooling methods could be used separately or together. It was easy enough to reduce the temperature enormously—to many degrees below zero—but the difficulty was how to get rid of the moisture. His lordship would see in the history of this matter the various devices that were arranged for the purpose of getting over this difficulty. Amongst them was the use of chloride of calcium, which acted chemically in that way. If the moisture was not got rid of, it froze as soon as the temperature fell sufficiently and clogged the machine. He would now describe the invention which the plaintiffs had discovered to meet this difficulty, and which they had patented, and which they now complained the defendants were using. It was this, that the moisture from the compressed air could be successfully removed in the form of a liquid—in other words, that in the course of the cooling of the air there was a stage at which the liquid was not frozen, and all the moisture could then be drained off. Mr. Bell and Mr. Coleman discovered together that by an arrangement of pipes and the apparatus in a peculiar manner, they were able, at a certain stage of the cooling, antecedent to the final cooling, so to take the moisture away. The plaintiffs put either the pipes into the refrigerating chamber, or they brought the air from the refrigerating chamber round the pipes; but after the air in the pipes had been cooled by this jacket, or surrounding medium of air from the refrigerating chamber, it was further cooled after the moisture had been taken out, and was then sent into the refrigerating chamber in a highly cooled state to act upon and pass over the meat carcasses contained therein. The learned counsel then referred his lordship to the diagrams, and proceeded, with their assistance, to describe the plaintiffs' machine. The air was drawn from the refrigerating chambers by pipes into the compression cylinders. There it was compressed and its temperature raised, it might be taken—was in some machines—into two vessels in which water was mixed, and was then drawn off into the pipe which passes round the refrigerating chamber, the water and air being so far mixed together. The air did not then go into the refrigerating chamber; it was kept entirely distinct, and passed from the pipes round the chamber into the expanding cylinders, where it reached its ultimate coldness, and then it passed along pipes into the refrigerating chamber—that is, the cylinder. When it arrived in the refrigerating chamber it was at its coldest. A series of bottom cocks or taps were fitted to the system of piping conveying the moist air from the compression cylinders to the expansion cylinders, through which the moisture in the air drained away before it reached the expansion cylinders. This system of taps was the substantial subject-matter of the plaintiffs' invention. In short, the plaintiffs claimed as new the principle of drawing off the moisture of the circulating air between its compression and re-expansion by means of air already partially cooled, and a system of sloping piping and drain cocks fitted accordingly. The learned counsel then dealt with the specifications of the plaintiffs' patent, and passed on to deal with the state of knowledge on such matters prior to the plaintiffs' invention, with a view of meeting and dealing with the alleged anticipations. Continuing, he said that it might be shown that their—the plaintiffs'—refrigerating chamber was not always above the freezing point, as the specification stated was the inventors' object; but the end to be attained was to cool the compressed air to a point at which the moisture would condense and so be drawn off. The defendants would probably contend that there had been no infringement, because they—the defendants—did not bring their pipes through the refrigerating chamber. Whether they did or not, he would submit that they did the same thing by bringing the air by pipes from the refrigerating chamber and making a jacket of it round the pipes for surface cooling. The infringement which they—the plaintiffs—specifically attacked was the setting up by the defendants of a refrigerating machine on their—the plaintiffs'—principle on board the s.s. Selembria. In that machine the air was compressed, then cooled by a jacket of cold water—not by injection of cold water as in the plaintiffs'—then passed into a series of pipes surrounded by air drawn direct from the refrigerating chamber. Then the moisture deposited by that process was drawn off by cocks before the air passed along into the re-expansion cylinder, and so on into the refrigerating chamber again. He submitted that there was no practical difference in that process and the plaintiffs'. In all the eighteen previous sperifications of refrigerating machines he failed to see any hint which would indicate the application and use of these particular pipes as used by the plaintiffs for getting rid of the moisture in the circulating air. Bell and Coleman's specification expressly referred to the then state of knowledge in such matters, and pointed out the very things which are now being relied upon as anticipations.

Sir F. Bramwell, Sir W. Thompson, Dr. Hopkinson, Dr. Meidenger, and Prof. Dewar, were amongst the scientific witnesses called on behalf of the plaintiffs. The evidence of all these witnesses was of a highly technical and scientific character. Sir F. BRAMWELL stated that in his opinion the improvements patented by Bell-Coleman had converted a machine which had been before a commercial failure into a commercial success. Numerous other witnesses were also examined, including Mr. Coleman, whose evidence had been taken on commission, Mr. Haslam, Mr. Fernie, and the engineer who had charge of one of the plaintiffs' machines on board the Pavonia, before they were fitted with any such drying pipes as were now used in their machines. It was after Haslam had adopted these drying pipes that Bell-Coleman commenced an action against Goodfellow, who had been using one of Haslam's machines. Since that time Haslam had purchased Bell-Coleman's patent. The plaintiffs' evidence occupied four days and a-half, and at its close on the fifth day,

Sir HENRY JAMES, Q.C., opened the defendants' case. He said that he would give but a general outline of their contention, and leave his learned friend to deal with all the minute technical details which might become necessary in course of their case. Referring to the Bell-Coleman patent, he said he wished to keep claims 2 and 3 quite separate and distinct. As regarded Claim 1, he had nothing to say against it. They—the defendants—submitted that Claim 2 was made for that which was not proper subject matter for a patent, and that in consequence the whole patent was invalid. In other words, what was claimed was neither new nor useful. The plaintiffs, in order to support that claim, must show that they had duly described and ascertained the nature of their invention, *i.e.*, had clearly told the public what it was. This, he submitted, they—the plaintiffs—had not done. This claim was "The arranging or combining together of steam engine, air-compressing, and air-expansion apparatus in the improved manner as hereinbefore substantially described." The learned counsel then went to show by reference to the whole specification and drawings that there was therein nothing "substantially described, &c," of any improved or novel methods for working or combining the machinery in question. Dr. Hopkinson, in his evidence for the plaintiff, had sworn in his affidavit that he understood the meaning of this (No. 2) claim to be for the arrangement of steam engine, air-compressing, and air-expanding apparatus in such a manner as to avoid the use of heavy fly-wheels. Both Sir Fredk. Bramwell and Dr. Hopkinson said, "When we had the specification alone, which we had at the time we made our affidavits, we read this in the broad view of the matter as claiming one half as well as the whole combination." [Mr. Justice STEPHEN: They say I include both. I include the four cranks. I also include two cranks, and I include the machine, whether you make it with four or with two.] There was nothing new in putting two duplicate engines in the place of one, so that if desired either could be worked separately. The learned counsel had proceeded some way further in this connection, and was passing on to deal with Claim 3, when

Mr. Justice STEPHEN pointed out that if Sir Henry James' view of the case upon Claim 2 were correct it would end the case, and he thought that under the circumstances it would be better to decide that point first. After a short discussion the Attorney-General came into court, and the learned judge, addressing him, said that Sir Henry James had submitted to him that their (the plaintiffs') patent was bad, inasmuch as Claim 2 ought to be read in the manner suggested by the witnesses (Sir F. Bramwell and Dr. Hopkinson), and that, if so read, the Bathgate machine, according to their view of the case, as he puts it, was an anticipation of what the plaintiffs claim. On the other hand, it is said, if is to be read in the other way, that then the claim was bad for want of novelty and utility, and that this being so, he thought it would be best to decide this point first, and then, should it become necessary, to go on with the case afterwards.

The ATTORNEY-GENERAL explained to his lordship that unless Sir Henry James was prepared to make certain admissions—which he could not expect he would do—the course proposed by his lordship could not be followed with any advantage, owing to certain enactments in the Patent Act of 1883.

Mr. Justice STEPHEN said that he thought he was answered, and so they had better go on.

Sir HENRY JAMES then continued, and passed on to deal with Claim 3, viz., "The application of the pipes C provided for the passage of the compressed air to the expansion cylinder and traversing the chamber in which the meat, &c., are subjected to the refrigerating preservative action." Referring to the plaintiffs' specification, the learned counsel showed therefrom that when it was drawn out, Bell-Coleman had had the Windhaussen patent in their mind. That patent did not carry the pipes through the meat chamber. Apart from that it was in substance the same as the Bell-Coleman patent. This, the learned counsel submitted, Bell-Coleman knew, and in order to prevent theirs clashing with Windhaussen's patent, they made it an essential to their patent that "the pipes provided for the passage of the compressed air to the expansion cylinders," &c.—as in Claim 3. The defendants have no meat chamber, as pertinent to this special object, and they do not carry their pipes through the meat chambers in the same way and with the same object as the plaintiffs. The plaintiffs, seeing that if this remained a portion of their claim there would be no infringement by the defendants, have sought to disclaim, by asking your lordship to strike out those words, and then they would read the Claim as being "the application of the pipes provided for the passage of the compressed air to the expansion cylinders, substantially as and for the purposes hereinbefore described." That is how they—the plaintiffs—read it. They were bound so to read it, because they said, "if this is necessary to our claim the defendants have not infringed it." Now, therefore, they were, he said, in this dilemma. If they struck out those words, and if they said the claim was to be read without them, and if "the application of the pipes provided for the passage of the compressed air into the expansion cylinders" constituted their claim, and if they said that therefore the defendants had infringed, then they—the plaintiffs—fell into Windhaussen's arms, for we—the defendants—held that with the exception of the words so struck out the Windhaussen and Bell-Coleman patents are identical. The only difference suggested—if their, the plaintiffs', claim was read in the only possible way in which it could be read so that they, the plaintiffs, could succeed in their action—was that in Windhaussen's patent there was not at one particular portion of his—Windhaussen's—pipes an exit cock to get rid of the water deposited in the pipes. The admissions of all the experts went to show clearly that there must be a deposition of water in the pipes between the compression and expansion cylinders. Again, all the skilled evidence showed that where you find deposited water of course it would be common knowledge that it ought to be withdrawn, or got rid of. How? If not by a cock or valve! It would be too absurd to argue that because Windhaussen did not show these cocks or valves in his drawings—the natural and self-evident method for water freeing—and the plaintiffs did that, therefore there was any difference between the two patents. But it did not rest there, for the plaintiffs' witnesses had admitted that a cock would be placed to drain off the water from the one portion of the pipes which was the common drainage ground of both if you would drain them. Further, in the much abused patent of Nehrlich, prior to the plaintiffs', the cock was shown. At this stage of his opening the court adjourned for the day, it being arranged that Mr. Moulton, Q.C., should continue the defendants' opening from where Sir Henry James had left off. Accordingly on the following day,

Mr. F. S. MOULTON, Q.C., took up the opening, stating that he would confine himself entirely to Claim 3, he would read the whole of the passages referring to that claim, which any person desirous of knowing its true interpretation would use in ascertaining it. For a patentee was bound to let the public know exactly what it was that he claimed to be his invention, which the public would use at their peril. Reading the plaintiffs' claims in their provisional and complete specifications, he pointed out that so far from putting it that theirs was the first machine that would work, they simply put it as an improvement on the existing ones. It was a patent for improvements. They—the plaintiffs—mentioned one of their difficulties, namely, the formation of ice in the expansion cylinder. The compression cylinder, which increases the pressure of the air and its temperature as well; the coolers, which reduce the temperature of the compressed air; the expansion cylinder, which availed itself of this great pressure and makes the air do its work, *i.e.*, the cooling; and the falling of the temperature in the refrigerating chamber. These four things were, he said, common to all the refrigerating patents. It was in the structure of the four in which they alone differed. There was no suggestion but that all these were old. He submitted that every cooling pipe caused a deposition of moisture, and if that moisture was got rid of in each instance they were drying pipes, and he objected to the distinction—in that sense suggested by the Attorney-General—between Windhaussen's pipes and the plaintiffs' pipes C. All such pipes were both cooling and drying pipes. [Mr. Justice STEPHEN: Yes; drying because they do cool. Your view is that the cooling is the purpose of the pipe, but that incidentally it does dry the air, and cannot help doing so, because as its temperature falls its moisture condenses and deposits, and naturally commends its being at once got rid of.] That was exactly the position they took, and his lordship would see the enormous importance of it when he—the learned counsel—came to draw attention to the admissions that had been made by the plaintiffs' witnesses. The defendants simply used "surface coolers." It was not suggested that they used the whole apparatus. The only question was whether they used the particular position of the plaintiffs' apparatus called C. Any one reading the plaintiffs' specification would, the learned counsel submitted, understand from it that the differentia of the cooling apparatus was his arrangement of the pipes. The plaintiffs further said that they placed the pipes C in the meat chamber, and they inclined upward towards it so that as the moisture was deposited in them it drained down to a vessel B, where it was drawn off by a cock, and "in that way we get in the most convenient and economical manner that which we want." It would be noticed that these pipes were expressly described as to be made sloping, and in the chamber itself, and he submitted that anyone reading it would naturally conclude that it was this that the inventor claimed as new and useful. The plaintiffs' claim here was for an entire combination, which they thus described:—"The combination of refrigerative process for preserving meat, &c. . . . wherein compressed air is cooled first by injecting water during compression; secondly, by intermingling opposite currents of water with the air"—that is in the water tower—"thirdly, by passing it through considerable lengths of piping traversing the chamber or chambers containing the substances to be preserved, and having a temperature never below the freezing point." When he is describing his mode of cooling, of which one portion, on his own statement, is specially arranged piping, when he comes to that he describes again the special arrangement which was novel, which Windhaussen certainly had not got, and that was the pipe traversing the meat chamber. The only other place in which the plaintiffs refer to these pipes was in Claim 3, where it was said, "The application of the pipes C provided for the passage of the compressed air to the expansion cylinders, and traversing the chamber in which the meat or other food is, &c., are subjected to the refrigerative preservative action." The plaintiffs were going to claim C specially, and how did they describe it? Once more they reiterated their peculiar arrangement, which we admit is novel, and which Windhaussen had not got. Fairly interpreted, had not the patentees singled out, to their great safety, this peculiarity of arrangement in the meat chamber as being the differentia of their invention? This differentia the plaintiffs could not now depart from. The pipes traversing the meat chamber was this differentia, for the mere arrangement of the air pipes was simply Windhaussen's plan. The defendants did not put their pipes in the meat chamber, but exactly as did Windhaussen. Therefore the defendants said that if it be any special arrangement of the pipes, that is the differentia of the plaintiffs' patent, the patent must be bad, or we must be outside of it, for the only arrangement of pipes which we use is an old one, viz., Windhaussen's. The consideration for a patent is that the patentee has extended the knowledge of the world, and so far he is to have the right of monopoly over it; but if you can show that he was using old knowledge, and was doing what had been done before, either his patent does not include it, or, if it does include it, it goes too far, and is therefore bad. If, said the learned counsel, the learned judge adopted the view, which he suggested, of the specification, there would be an end of the case, because in that view the defendants had not committed any infringement.

Mr. Justice STEPHEN: If Dr. Hopkinson is right in making that part of the differentia of the invention, then you would say that the specification is wrong, because it makes the pipes the differentia?

Mr. MOULTON: Quite so, my lord; that is exactly my contention.

Mr. Justice STEPHEN: You say, whatever account the plaintiffs might have given of it so as to make their specification square with the result they wished to obtain, that they did not do it. That is the first string to your bow. Then the second string is, if they had made a claim which would not have described what is set up as being the specific peculiarity and differentia of their invention, or the specific merit of their invention, it would have been bad on various grounds, which you gave, viz., that it was old.

Mr. MOULTON: Exactly, my lord. The learned counsel then referred his lordship to the Windhaussen machine, which was admittedly the one which they were using; and pointed out that the only real difference between it and the plaintiffs' machine was that in the latter the pipes between the compression and expansion cylinders were sloping upwards towards, and traversed, the meat chamber, while theirs—the defendants' pipes—were level, and not in the meat chamber. As the defendants did not use either of those distinctions of the plaintiffs', they had clearly not infringed their—the plaintiffs'—patent; unless it were held that the exit cock for getting rid of the condensed and deposited moisture was the invention of the plaintiffs. Upon that point he submitted that the evidence was all the other way, and that its use was old and common knowledge. The learned counsel then proceeded to deal with the evidence of the scientific witnesses for the plaintiffs, and to describe and explain the various schemes which had from time to time been tried for refrigerating purposes, with the object of showing that the plaintiffs' present machine was in substance no invention, but merely a copy of the best of the old systems, with one or two novelties not present or used in the defendants' machine. In conclusion, he said, that because capital had been put into an invention that did not justify, in any way, the extension of the meaning of the patent so as to make it comprehend things which were well known before. With regard to the novelty of this invention, it seemed to him that Mr. Coleman studied very carefully the patents of his predecessors, and made his machine with a minimum of invention and a maximum of claims. He had taken from Giffard—Clarke—the water towers, and nothing else, and there was a disclaimer, and that was thrown out. In his second claim he had used up Bathgate's methods, clothing them in the too transparent dress of duplication. Then, in the third claim, he claimed there what he—counsel—admitted was novel, but a minimum of invention. It was simply using air that was not waste cold air, instead of using waste cold air. This nobody envied. And finally, it came to this, viz., that the only way in which you could make this patent a patent which would hinder the free use by the public of the old invention was by saying that a claim for sloping pipes specially arranged in the meat chamber, without any cock, ought to be read as a claim for putting a cock in a cooler in which air was used. But Mr. Coleman, in his Bathgate machine, had used cocks—as Nehrlich had done before—for the purpose of drawing off the moisture before it went into the expansion cylinder. Therefore, how could it be argued that this exit cock was a novelty? Under all these circumstances, he submitted that the plaintiffs' third claim could not be interpreted so as to include what the defendants did without making it bad. As to the second claim, the defendants contended that it was bad, whether it referred to the half machine or to the whole. That it was bad as referred to the half machine was conceded. If it referred to the whole machine it was simply claiming a patent for the duplication and putting together two twin machines which might be coupled in any way, and with regard to which the drawings showed them coupled in the worst way, and all that Coleman said was that in the specification, in working it, it was most desirable to couple them in a different way—that was to say, at 45 deg. Coleman did not, of course, restrict his claim to that. If he had it would have made no difference; it was a perfectly ordinary thing, so that in either sense, the defendants said the second claim was bad. Therefore he would submit that, on the whole case, the claims of the plaintiffs could not and had not been sustained, and that therefore the defendants were entitled to his lordship's judgment.

Herr FRANZ WINDHAUSSEN, the inventor, in 1869, of the refrigerating apparatus which the defendants alleged that they were now using, was called and examined at length by Mr. Moulton upon his and other analogous machines, and also as to the state of public knowledge on such matters prior to and at the date of Coleman's patent. He also stated that when he had come to work his machine, prior to the plaintiffs' patent, he had used a cock to drain off the deposited moisture from the pipes before the air entered the expansion cylinders. It was also stated that a combination of Nehrlich's and Windhaussen's machines would produce a perfectly workable and efficient refrigerating machine. Professor Kennedy, Herr Ulrich, and Dr. Frankland were also called as scientific witnesses, and gave evidence of a similar character to that of Windhaussen. Mr. Hesketh, one of the defendants, and several engineers and other witnesses, were also called, and at the close of their evidence,

Mr. MOULTON summed up the defendants' case in a most careful and exhaustive speech, in which he dealt with the whole of the evidence material to the case, and supporting the arguments and submissions put forward by him and Sir Henry James in their opening address.

The ATTORNEY-GENERAL then replied upon the whole case in a very minute and comprehensive manner. Dealing first with the question of novelty, he cited numerous authorities in support of his contention that the plaintiffs' improvements and combinations were novel. He also reminded his lordship of the fact that until after Mr. Ellis (an engineer who had been in the plaintiffs' employment) who had gone into the defendants' service, the plaintiffs had never made their machines on the pattern of that which they had erected on board the Selembria, and which machine was actually designed by this Mr. Ellis, and was, he submitted, an infringement of the plaintiffs' patent. Upon the question of anticipation, relied upon by the defendants, he submitted that fitting together, piece by piece, all the prior specifications in any way you liked, it was quite impossible on the evidence to put the prior knowledge any higher than he had put it in the opening speech. The learned counsel preceeded to deal with the whole of the evidence as applicable to his very able and interesting arguments. The court sat a day beyond the prescribed limit of the sittings in order to enable the learned gentleman to finish his reply. The learned judge reserved his judgment.

THE PROPOSED AGRA WATERWORKS.—A plan for furnishing Agra with a purer supply of water has been under discussion for some years. Heretofore, however, it has been but a scheme. Now that the Municipality have resolved to push forward the project, it may be considered that there is every prospect of the inhabitants seeing their wishes fulfilled. The source of supply is to be the Jumna, which, according to the *Indian Engineer*, will provide comparatively clean water, and in sufficient quantity during ten months of the year, the discharge falling in the hot weather, *i.e.*, May and June, to about fifty feet per second; and, in addition to the decrease in the supply, the water at this season contains an amount of organic matter. The system of filtration has not been finally settled, the choice of which is said to be between the lime and iron processes. The distribution of water is to be effected through twelve miles of piping, furnished with stand-posts on three patterns, viz., the ordinary one with two or four taps, those with roofs and cattle troughs for bazaars, &c., and others for filling bullock *mussaks* to provide a supply for the outskirts of the town to where the pipes do not lead.

DUNDEE MECHANICAL SOCIETY.—On the 1st inst. a paper on "A Visit to the North Derbyshire Colliery" was read to the Dundee Mechanical Society by Mr. George Worrall, jun., in the Y.M.C.A. Hall. The lecturer referred at the outset to the large number of isolated accidents which occur in the course of each year in the coal mines in Great Britain, but which attract little notice, being overshadowed by the catastrophes in which many lives are lost at one time. He stated that a large proportion—fully three-fourths—of the annual return of accidents in mines was composed of these separate cases, and his purpose in the paper was to show how these minor disasters were caused. With this intention he described in detail a visit lately paid to Norwood Colliery, near Sheffield, the property of the Sheepbridge Coal and Iron Company, which afforded striking instances of the dangers to be dreaded, and the means whereby they were overcome. Many accidents are caused by overwinding—the engine is not stopped in time, the cage strikes the headgear, the rope is overstrained and snaps, and the cage with its occupants is precipitated to the bottom of the shaft. An ingenious link has been devised which is put into operation when the link passes a bell-mouthed cylinder in the headgear, liberating the rope, which flies away, leaving the cage safely suspended by the link. Mr. Worrall described the velocity of the descent into the mine in a graphic manner, and by means of diagrams showed the position of the underground office, and the different roads which radiate from the shaft to the various parts of the mine. The method of ventilating adopted, the system of haulage by means of an endless rope, the arrangement of stables, and the motto board, by which dangerous parts of the workings are indicated, were illustrated by numerous drawings; and the details of the dangers from stored gas, fire-damp, and choke-damp were made clear by the description of the lecturer and the apparatus which he exhibited. The question of an efficient safety-lamp, which is at present exciting much attention, was considered, and the lecturer showed wherein the lamps now in use were deficient, and what was yet necessary before they would be "safe" in reality. As the distant workings of Norwood Colliery are in close proximity to an abandoned mine, he was able to describe the means adopted to prevent flooding by the accumulated water in the old shaft, and to show how this danger is minimised. The paper throughout was a most instructive one, and was listened to with close attention. An interesting discussion upon some of the points raised took place after the close of the lecture, and the proceedings were terminated by a vote of thanks to the lecturer.

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

(*From our own Correspondent.*)

THE improved tone and the greater activity recently observable in the Staffordshire iron trade is kept up. Sheets of single gauge are from £6 2s. 6d. to £6 5s.; doubles, £6 7s. 6d. to £6 10s.; and trebles, £7 7s. 6d. per ton.

Messrs. E. P. and W. Baldwin quote Severn angles £11; B., £12; B.B., £13; and B.B.B., £14 per ton; while the Shield brand is £10 for singles. Siemens steel sheets are £12 up to 24 gauge, and Bessemer ditto, £11.

Galvanisers this week again speak of an abundance of orders, chiefly on Colonial and South American account. Some firms who, though young in the trade, have established a good reputation for quality, are quoting £10 10s. for sheets of 24 gauge, delivered London, and they are firm in demanding £12 for 26 gauge and nearly £14 for 28 gauge. These last are mostly uncorrugated.

The prices of galvanised iron manufactured by Messrs. Morewood and Co. are as follows:—Crystallised corrugated sheets, "Red Star" brand, £10 15s. for 18 and 20 B.G., £11 for 24 B.G., £12 10s. for 26 B.G., £13 10s. for 28 B.G., and £15 10s. for 30 B.G.; tinned corrugated sheets, "Lion" or "Anchor" brands, £11 5s., £11 10s., £13, £14, and £16 for the respective gauges; best best close annealed and cold-rolled galvanised tinned flat sheets, "Lion" brand, £20, £21, £23, and £24 for 18 and 20, 24, 26, and 28 gauges respectively; best close annealed and cold-rolled galvanised tinned sheets, "Anchor" brand, £17, £18, £20, and £21; close annealed and cold-rolled galvanised flat sheets, "Woodford Crown" brand, £13 10s., £14, £15, and £17; close annealed galvanised flat sheets, "Wheatsheaf" brand, £12, £12 10s., £14, and £15.

Increased competition from the North of England is threatened in sheets. Up till recently only poor quality sheets were all that could be obtained from the North, and for all superior work the orders had to be placed with Staffordshire makers. But a report was this week current on this exchange that superior quality iron is now being manufactured in the North by at least one firm.

Bars and strips are affording an increase of employment in several directions. For high-class work in the colonies best bars are still selling in limited quantities at £7; second-class bars are abundant at £6, and there are frequent sales at between that figure and £5 10s. Common bars are in plentiful supply at from £4 15s. to £5, and the competition is severe.

Native pig makers, though not very busy, have yet some good contracts on their books. One of the largest firms in this district have some 26,000 tons yet to turn out in addition to the stocks now in hand, and long before these contracts are complete other good lines are confidently expected. Prices vary according to the position of makers' order books, but, generally speaking, a fair level is maintained. Some consumers stated this week that common sorts can be bought as low as 27s. 6d., but most makers decline to accept less than 28s. 6d., and quote 30s. Medium pigs are 40s. to 42s. 6d., and all mines are in slow sale at 50s. to 52s. 6d.

Sellers of foreign pigs spoke to-day of the lessened business which they are doing now that steel blooms and billets have come so prominently to the front, and are being used in increasing quantities for rolling down in the mills in place of puddled bars. Instances were mentioned in which large finished iron consumers, who formerly were in the habit of consuming 200 tons of pigs per month for sheet making, who are now taking very small deliveries on account of the circumstances mentioned. The economy which results to the sheet makers under the new order of things is considerable, and it is not for him to consider the position of the pig maker.

It is a very gratifying circumstance that United States orders are being received for large steel rounds for shafting purposes. The sizes which are being supplied are of the unusual diameter of from 6in. to 8in., and probably they are these large sizes which account in much part for the orders coming across to this side.

Steelmasters hereabouts express much technical interest in the result of the investigations thus far of the committee appointed by the British Association, at its Birmingham meeting last year, to investigate the influence of silicon on the properties of steel. The first series of experiments were undertaken to determine the effect of silicon on the properties of especially pure iron. The mechanical tests have been conducted by Professor A. B. W. Kennedy, and duplicate experiments have given corcordant results. It is proved that the relative hardness is not very greatly increased by the proportion of silicon added. Mr. T. Turner, of Mason College, Birmingham, secretary of the committee, when he presented his report at the opening of the current Manchester meeting of the Association, stated this much, together with the further fact that on adding silicon in the form of silicon pig to the purest Bessemer iron, it was seen, amongst other interesting results, that the hardness increased with the increase of silicon, but appeared to be closely connected with the tenacity. Steelmasters are awaiting a report upon the second series of experiments, which are also being conducted by the same committee, which, it should be stated, consists of Professors Tylden and W. Chandler Roberts-Austen, and Mr. Turner. This second series are not quite ready for publication, but it is made known that they show that manganese greatly modifies the effect of silicon in producing shortness, and hence enables the metal to be readily rolled, and otherwise worked, even in the presence of several tenths per cent. of silicon. It is added that for the majority of the applications of mild steel silicon does not appear to be advantageous. The discussion which is likely to arise at the next week's meeting of the Iron and Steel Institute at Manchester, when Mr. Turner's paper on the "Mutual Action of Sulphur and Silicon on Iron at High Temperatures" will be presented, is deemed likely to still further contribute to valuable information upon the same theme.

Messrs. G. Kynoch and Co., of Birmingham, are stated to have made an offer to the Australian Governments for the establishment by them of an ammunition factory in the colonies. They are said to ask from the Government: First, 25 acres of land; secondly, an advance, as a loan, of £15,000 in three instalments, to be repaid by a 10 per cent. deduction upon the State purchases; thirdly, an advance of 10 to 15 per cent. in price in the cost of imported ammunition; fourthly, a guarantee of an annual minimum purchase by the combined colonies of 10,000,000 cartridges and absolution from any loss arising from delay due to strikes, fire, or other incontrollable causes; fifthly, to be allowed to import, free of duty, and to have conveyed, free of charge, all materials required in the erection of the factory and machinery; and lastly, to have the monopoly for fifteen years. The colonies are understood to be anxious for the establishment of a manufactory of gunpowder and small arms ammunition in Australia; but it is not known with what amount of favour the Birmingham firm's negotiations have been received. But a Melbourne commercial paper refers to them as distinctly more likely to be advantageous to Messrs. Kynoch than to the Government. This authority declares that such concessions would involve a great loss of public revenue and also a loss of trade to local merchants and manufacturers. The Government is to have the privilege of purchasing the factory, supposing it to be established, for £10,000 within five years of its erection.

The South Staffordshire and East Worcestershire nailmakers are demanding an advance of 10 per cent. in the rate of wages. The masters have assumed a conciliatory attitude, and a meeting of the trade is to be called to consider the application.

The chainmakers of the Cradley Heath district have petitioned the Trades' Union Congress to take steps against the employment of female labour in their industry. They ask particularly for the appointment of a Parliamentary Commission to visit the district. Some of the masters have not yet consented to the payment of the advanced list, and there are about 400 workmen still on strike. These are determined to maintain the struggle.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is a good deal of talk about improvement in the iron trade, but, so far as this district is concerned, it is not being borne out by the actual condition of trade. If there is any improvement at all, it is confined to some descriptions of finished iron for which there is a temporary extra demand for shipment, but this does not extend to home trade requirements, which show no real sign of improvement. The tone generally throughout the iron trade of this district is one of depression, and, so far as pig iron is concerned, the tendency of the market is in the favour of buyers. This depression is not so much the result of what could be at all described as a seriously decreased trade, as there is a very considerable weight of business which is necessarily brought forward by the ordinary every-day requirements of the users of iron, but the means of production have so far overstepped requirements that the demand is not adequate to keep up with even the present restricted output. The dormant means of production which could be immediately brought into operation to more than meet any increased requirements that are likely to come forward have also a depressing effect upon the future, and the result is that prices are kept down to the lowest possible point, that, under the most favourable conditions, leaves the barest margin of profit to the producer, and in a great many cases does not cover the actual cost of production. This, more than any actual absence of business, is the most discouraging feature in the outlook of the iron trade, and the only possibility of higher prices being obtained would seem to lie in a permanently lessened output which would bring production more to the level of the actual wants of consumers.

The iron market at Manchester on Tuesday was fairly well attended, but apart from shipping orders for manufactured iron, the actual business reported was extremely small. For pig iron there has been extremely little inquiry during the past week beyond one or two offers at prices so much under the minimum market rates that makers did not care to entertain them. Prices are, however, easier in some instances, although quoted rates remaining without material change give an apparently steady tone to the market. Buyers are very chary about giving out orders at current rates, and when makers are not disposed to give way, consumers for the most part prefer to buy only for hand-to-mouth requirements. The position of makers is that they have no margin whatever to work upon for any further reduction in prices; in fact, they are already in many cases quite down to, if not below, actual cost, and there is a disposition to still further reduce the output than come down lower in price. On the other hand, consumers see no immediate prospect of any upward movement in prices, and consequently no inducement to buy beyond present wants unless they can get some concession on current rates. For Lancashire pig iron quotations remain at 38s. 6d. for forge, and 39s. 6d. for foundry, less 2½, delivered equal to Manchester. These figures place local makers quite out of the open market, but they are not at all inclined to give way, and as at present they have really only a very small quantity of iron actually to offer, they are pretty well able to move this away in small lots to regular customers from whom they are in a position to obtain their full prices. Lincolnshire iron still holds the position of the cheapest and the only really saleable iron in this market; the quoted prices for delivery equal to Manchester are about 36s. 6d. to 37s. for forge, and 37s. 6d. for foundry, less 2½, but these figures do not tempt buyers, who offer about 3d. to 6d. per ton less, and in some instances there is a little giving way to effect sales. Derbyshire foundry iron is still quoted at 40s., less 2½, delivered here, but could be bought at a little under this figure, and Middlesbrough iron is, if anything, rather easier, 42s. 10d. net cash being now about the average selling price for good named foundry brands delivered equal to Manchester, whilst in Scotch iron there is continued underselling at quite 1s. per ton below makers' quoted rates. The prices for the above-named brands are, however, still relatively too high for business beyond occasional small purchases for special requirements.

For hematites there is still only a very small inquiry in this market, but with the continued large consumption going on in the steel making centres, makers are very firm, and for delivery into this district quoted prices remain at about 52s. 6d. to 53s., less 2½, for good No. 3 foundry qualities.

In the manufactured iron trade the home demand continues only very indifferent, but most of the forges are being kept fully employed with shipping orders, and, in some instances, rather better prices are being got, although list rates are not quotably any higher. For delivery into the Manchester district bars remain at about £4 17s. 6d. per ton; hoops are firm at £5 5s.; and for sheets about £6 7s. 6d. to £6 10s. per ton is now being got.

There seems to be a fair amount of work stirring amongst boiler-makers, stationary engine builders, tool makers, and machinists, but there is still no really substantial improvement in the engineering branches of industry in this district; any new work that is got having in most cases to be taken at quite as low prices as ever, whilst in the important branch of locomotive building, trade remains in an extremely depressed condition.

The unsuccessful efforts which have been made by the Mayor of Bolton to find some means whereby an amicable settlement of the dispute in the engineering trades of the above town could be arrived at have been followed by a final offer from the employers to submit the question of wages to an open arbitration. This proposal, however, does not seem to meet with much favour from the men, and it is questionable whether it will be accepted as a means of bringing the dispute to an end. The employers having shown their willingness to meet the men fairly before an impartial arbitration, are indifferent whether the proposal is accepted or not; no reply has yet been received to it, and in the meantime the filling up of the shops with men from other districts is steadily going on.

Most of the engineering and iron works, and some of the collieries in this district, have for the past week been thrown open for inspection to the members and associates of the British Association during the meeting in Manchester, but the weather, unfortunately, has been so unfavourable as scarcely to allow of much getting about. Amongst the works visited were those of Messrs. Hulse and Co., Salford, and fortunately, the firm had just completed one of their large lathes for turning steel propeller shafts and similar steel forgings, which they were enabled to keep in their works in a complete state during the week. This lathe, which is similar to others I have described, is constructed on Messrs. Hulse's patent principle, which enables each sliding carriage to be traversed in either direction independently of the other; it is capable of operating upon objects up to 45ft. in length and 5ft. in diameter, there are four tools each of which will take a cut of 1½in. deep and over ¼in. in feed, which at the ordinary cutting speed for steel is equal to about 5 cwt. of cuttings per hour, or ten tons for four tools per day of ten hours. In the works were also other large tools in course of construction, and amongst these special mention may be made of a large lathe for finish turning guns up to 10in. bore and 32ft. long. This lathe has a powerful single, double, and treble-geared headstock with steel spindle of large diameter, the back bearing of which is collared as in a propeller for taking the end thrust. The bed is of the three-girder type, and wholly supports the sliding carriages when operating upon the exterior of the built-up guns, and self-actions are provided for screw-cutting, surfacing, and tapering. Also two patent combined vertical and horizontal planing machines, one of which is capable of planing a surface of 14ft. vertically and 16ft. horizontally. The horizontal beds in this machine are framed together forming one massive casting, this form of construction being adopted where such machines are attached to the workshop, but tresses or columns instead of independent uprights. The other machine will plane over a surface of 16ft. horizontally and 12ft. vertically, and unlike the one first described, the horizontal beds are in two parts, and firmly secured to independent uprights. These machines have self-acting feed motions graduating from $\frac{1}{32}$in. up to 1in., and are applied by regular small increments. There were also several other special tools in hand for use in gun and marine engine construction, several of their patent vertical milling machines, which are coming into increasing use for marine works, horizontal milling machines, universal cutter-grinding machines, &c., all of which were of interest to the visitors.

The wet weather also interfered greatly with the success of the show of the Manchester and Liverpool Agricultural Society held during the week. There was a very fair average display of implements and machinery, including exhibits by many of the well-known makers of agricultural engines; but following so closely upon the Royal Show, none of the exhibits presented any special feature of novelty that was not shown at Newcastle.

There is still no really material improvement to report in the coal trade. In the better qualities of round coal, suitable for house fire consumption, there has been more doing since the commencement of the week, but for other classes of fuel for iron making, steam, and general trade purposes, the demand remains much the same. Supplies of all classes of fuel continue plentiful in the market, with very few of the collieries as yet working more than four days a week, and although there is perhaps not quite such low selling as last month, the current market rates are no higher, best coal at the pit mouth still averaging 8s. to 8s. 6d.; seconds, 6s. 6d. to 7s.; common, 5s. to 5s. 6d.; burgy, 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton.

For shipment there is only a moderate demand, with steam coal averaging 6s. 9d. per ton delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—In the iron trade there is a very brisk demand, and Bessemer qualities are in especial favour, being largely used not only on home account, but by foreign steel makers. There is, however, not so heavy a shipment of pig iron from local ports as was the case some time ago; but the falling off in iron is fully compensated for by the increased shipment of steel. America is a large buyer of steel, but a small buyer of iron; but the Colonies and Continent are large consumers of both, and prospects favour the continuance of a good trade for months to come. Prices of iron are steady at 45s. 6d. per ton, net f.o.b., for parcels of mixed Bessemer iron, and 44s. 6d. for No. 3 forge and foundry iron, while sales of the former are noted at 44s. 9d. per ton, and of the latter at 44s. 3d. per ton. Makers are fully sold for prompt delivery, and are asking fuller prices for forwards. Stocks in the hands of second-hand dealers have increased, but they are small so far as makers are concerned. Steel rails are in brisk request at late prices, and there is a good demand for rails, and all classes of steel made in the district. Blooms, bars, and billets are in good demand, and firm prices are ruling. In all departments of the steel trade full time is being worked. Finished iron is in quiet demand, and likely to remain so. Iron ore finds a brisk market, and best samples are quoted still at 11s. 6d. per ton net at mines, but the supply of best sorts is short, and some of the mineowners who raise best qualities are not quoting, as they are so fully sold forward. Coal and coke is in good demand, and there is likely to be an increased consumption. There have been more inquiries for ships and steamers than for two or three years past, and it is probable a better trade in shipbuilding and engineering will soon come about.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A TERRIBLE explosion—the most serious that has ever occurred in a Sheffield workshop—took place on Tuesday afternoon at the extensive and well-known River Don Works of Messrs. Vickers, Sons, and Co. The company have at present in hand a considerable amount of ordnance work for the Government. At ten minutes to four o'clock on Tuesday a number of men were engaged on a 26-ton ingot intended for a gun jacket. The steel was poured in by means of three ladles. These ladles were filled direct from the furnaces; then they were run on their carriages along the metal lines to the top of the mould, which stood ready to receive the metal. The steel runs out of the ladles through holes known as "plugs." Mr. Job Holland, the manager of the moulding department, was in his place in charge of the operations, which were carried out in the ordinary way. The mould having received the metal, the first ladle was being removed across the shed, when a tremendous explosion shook the works, a cloud of dust and smoke hung over the pit, and the furnance was completely shattered. Mr. Job Holland and four others were killed outright; six men were terribly burnt about the body, face, and arms; some—with their legs broken—were conveyed to the infirmary, where three died the same evening, and another next morning, making the number of killed nine. Two workmen most seriously injured remain at the institution. The cause of the explosion is unknown at present. There were two explosions, the minor one following immediately after the other. This gives rise to the belief that the accident was caused by the gas which heats the furnace. Had the mould been damp the whole force of the explosion would have been expended at first. Commander Hamilton Smith, the Factory Act inspector, has examined the scene of the disaster, and the result of the investigation being made by the company and himself will, no doubt, be disclosed at the inquest, which was opened for the identification of bodies on Wednesday evening.

Lieut. Col. Rich, R.E., of the Board of Trade, conducted an inquiry on Friday into the circumstances attending the collision on the Midland Railway at Wath-on-Dearne the previous Saturday, when the 12.20 Scotch express from St. Pancras was wrecked across a coal train. The inquiry was conducted in private, and followed an investigation by the Midland officials a few days before. Col. Rich will report to the Board of Trade in due course.

The Manchester, Sheffield, and Lincolnshire Railway Company has issued a general order to its engine-drivers and firemen which seems to indicate that there is more to follow. At present the engine-drivers and firemen are guaranteed six days' pay irrespective of Sunday duty, if, through no fault of their own, the time worked by them did not reach six days, notwithstanding that they might have received overtime for some of the days within the same week. Mr. William Pollitt, the general manager, states: "This was more than had been conceded by most of the other railway companies, and having regard to what has recently occurred on another railway in connection with the same question, I think I shall be justified in terminating the arrangement come to in January, and reverting to the old practice of paying only for actual time worked. I do not, however, now propose taking this course, but shall advise the directors to allow the present system to continue in force, although at the same time I must reserve to myself the right to do so if I should find the privilege at any time abused."

Mr. William Cobby, for thirty-five years the local traffic manager of the Midland Railway, died on Sunday morning at his residence, Broomhill, Sheffield, in the 75th year of his age.

The Cutlers' Feast passed off most successfully, the Master Cutler, Mr. James Dixon, having around him a distinguished and thoroughly representative company. The chief political guest was the Right Hon. E. Stanhope, whose speech was particularly interesting from a business point of view. I have repeatedly put before you the case for the Sheffield manufacturers as against Government competition at Woolwich. Mr. Stanhope took pains to make it perfectly clear that he had noted this complaint, and his references have given the utmost local satisfaction. When he became War Minister, there were two grievances urged by Sheffield—first, that certain promises made by the War-office with regard to the production of steel forgings that used to be given out to the trade had not been fulfilled, and that capital had been expended in putting down new plant on the faith of these promises. Mr. Howard Vincent, Mr. Stuart Wortley, and Mr. Bartlett had interested themselves vigorously in the matter, and Mr. Stanhope repeated the assurance he then gave the Sheffield deputation, viz., 'Within the limits of the money which Parliament might think fit to vote, the promises made in 1884 should be observed in the spirit as well as in the letter, and we will not depart one single iota from all the engagements into which we have entered;' "nor have we the smallest desire," added Mr. Stanhope—"and I say this speaking as the head of the War-office—at the present time to extend the manufacturing departments of the Government." Its second complaint, which was not peculiar to Sheffield, related to the system of inspection. Traders in general complained that it was hardly fair to them that their products should be inspected by officials of the department which was itself producing articles in competition with them, and they asked for an independent inspection. Mr. Stanhope states that in the proposals he intends to lay before the House of Commons, he hopes to find a remedy for this grievance. He further intimated that "recent inquiries had furnished sufficient ground for thinking that there ought to be a very considerable remedy applied to the defects pointed out in various departments of the War-office, and the present Government would apply that remedy without fear, without hesitation, and without delay." Further orders have been given out by the War-office for guns to be supplied to the Mauritius and Ceylon, and these are expected to be followed by similar work for coast and harbour fortifications at the Cape and elsewhere.

On Friday the principal guests, including the Marquis of Carmarthen, M.P., Rear-Admiral the Hon. E. R. Freemantle, the Borough members, and others, visited the extensive silver and plating establishment of Messrs. James Dixon and Sons, known as Cornish-place. There they were shown the various interesting processes associated with the making of German silver, the running into ingots, and the rolling of the ingots into various lengths as required for hollow-ware goods. Larger sheets, cut into the required form, were passed into the steam stamping shop, where the sheets were placed on a die, the stamp came down with a blow of from seven to ten tons, and tray, dish-cover, or other article was embossed. It was noticed that designs in the Queen Anne style were still in the majority, fluting after this pattern being exceedingly popular at present. Public preference at present is for the embossed goods, and thus the more costly work of the engraver is not so largely called for. Nowhere has machinery been more effectively used in the production of goods than at Cornish-place, and yet there has been no reduction in the workmen employed. The visitors were much struck with the immense resources of the establishment, and in the show-room saw many splendid samples of the beautiful and costly art-productions of the firm. They were conducted over the works by Mr. H. I. Dixon, J.P. (father of the Master-Cutler), Mr. J. Willis Dixon, of Hillsbro' Hall (twice President of the Sheffield Chamber of Commerce), Mr. J. D. Fawcett, and Mr. James Dixon (the Master-Cutler). At the River Don Works (Messrs. Vickers, Sons, and Co.), the visitors were shown the processes of forging by the new hydraulic press, which has a capacity of 3000 tons; the turning and boring of shafting for the Sardegna, the Italian Government's new war-ship, and for the new Inman liner. The former has engines of 25,000-horse power, and the latter of 18,000-horse power. At the Cyclops Works (Messrs. Charles Cammell and Co.), they saw the making of an armour-plate for H.M.'s Nile, now being built at Pembroke. As it came from the furnace, where it had been heating 36 hours, its weight was about 40 tons, and its thickness some 30in.; finished, the plate will be 10ft. by 8ft. 6in., and will taper from 20in. to 8in. in thickness.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

ALTHOUGH the ironmasters' statistics for August were more favourable than was generally expected, they have not so far had much effect on the Cleveland pig iron trade. The tone of the market held at Middlesbrough on Tuesday last was quieter than a week ago, and prices were a shade easier. Sales of No. 3 g.m.b. were made by merchants at 34s. 3d. per ton, or 1½d. below last week. Certain makers, who for long have been firm at 35s., are now anxious to book orders, and are prepared to accept 34s. 9d. and even 34s. 7½d. per ton. There is no change in the value of forge iron, which remains at 32s. 3d. Foreign buyers are still holding back their orders, but they must take action soon if they desire to obtain their winter supplies without paying the increased freight and insurance which will be demanded at the end of this month.

Stevenson, Jaques, and Co.'s current quotations are:—"Acklam hematite," (mixed nos.), 45s. per ton; "Acklam Yorkshire," (Cleveland) No. 3, 35s. per ton; "Acklam basic," 36s. per ton; refined iron, 48s. to 63s. per ton, net cash at furnaces.

Business in warrants is decidedly stagnant. The price demanded is 34s. 1½d. per ton.

Ship plates and common bars are offered at £4 8s. 9d. per ton, and angles at £4 5s. free on trucks at makers' works, less 2½ per cent. discount. Even at these low prices buyers are not tempted; but few fresh orders are placed, and they are for small quantities only.

The shipments of pig iron from Middlesbrough during August were above what was at one time expected, they having exceeded the average per month for this and last year. The total quantity exported was 73,445 tons, the chief items being:—To Scotland, 32,598 tons; to Germany, 12,000 tons; to the United States, 4674 tons; to Italy, 2750 tons; to Russia, 2652 tons; to Holland, 2610 tons; to Belgium, 2555 tons; and to France, 2275 tons. The pig iron sent away during the first eight months of the year amounted to 535,230 tons as compared with 486,233 tons during the corresponding period of last year. Last month 17,246 tons of manufactured iron and 29,151 tons of steel were also exported from Middlesbrough.

The August returns of the Cleveland Ironmasters' Association show that there are ninety-five furnaces now in blast, being one more than at the end of July, and three more than in August, 1886. There were fifty-two furnaces at work on Cleveland iron, and forty-three on hematite. The output of iron of all kinds was 214,570 tons, being an increase of 3298 tons as compared with July. The pig iron in stock in the whole district on the 31st was 627,439 tons, or an increase of 2926 tons for the month. The stock of pig iron in Messrs. Connall and Co.'s store was 331,977 tons, or a decrease of 3030 tons for the month. At Glasgow they held at the same date 916,206 tons, or an increase of 9630 tons.

Last York Assizes an action was brought against the Tees Conservancy Commissioners to recover the amount of damage done to a steamer called the Castledale, by taking the ground at a berth opposite the wharf belonging to Messrs. Walker, Maynard, and Co. It was contended by the plaintiffs, the owners of the steamer, that the berth had not been properly dredged out for the accommodation of large-laden vessels; that the harbour master, a responsible servant of defendants, knew this, and nevertheless gave leave or did not prevent the vessel from being taken there, and that, therefore, defendants were liable. The vessel received damage to the extent of £8000. Judgment was given by Mr. Justice Matthews for plaintiffs, the amount payable to them to be afterwards assessed. The Commissioners held a private meeting on the 22nd ult., and after much discussion it was decided to appeal against this judgment to a higher court. They seem, however, virtually to admit their responsibility for the action of the harbour master, and to think that it was not a proper one in the present instance, for they have made up their minds to advertise for a new one.

The following official statistics of the salt industry in the county of Durham have just been issued, viz.:—Total weight of salt produced, 98,562 tons; total value, £49,281. Number of evaporating pans in existence, and their owners: Newcastle Chemical Works Company, 20 pans; Haverton Hill Salt Company, 9 pans; Lennard and Co., Hebburn-on-Tyne, 20 pans; Bell Brothers, 19 pans; total, 68. It appears from this statement that the average value of salt has been about 10s. per ton, presumably at producers' works. The present price is, however, considerably lower, being about 9s. 6d. per ton delivered on the Tyne, or, say, 7s. 6d. at works. It is clear that when the cost of raising, of fuel for evaporation, of labour, interest, depreciation, contingencies, management, and other charges are taken into account, there cannot be much, if any, profit in producing raw salt at the present time. The total value of the Durham output is so small, and the number of men employed so few, that the industry generally, though decidedly worth having, is of far less importance to the district than is generally supposed. All told, it does little more than represent the value of the production of one good blast furnace.

During the month of July the revenue of the Tees Conservancy Commissioners amounted to £5346 16s. 3d., which represents an increase of £927 11s. 9d. upon the receipts during the corresponding month of last year. The total revenue for the past nine months is £45,640 14s. 6d., or £9634 19s. 6d. more than for the corresponding period of 1886. This is remarkably satisfactory, as it is an indication of improved trade.

The Stockton and Middlesbrough Corporation Water Board find that the consumption of water by their customers has steadily increased during the present year, to the extent of about 11 per cent. over last year.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market opened very flat this week, and prices receded about 9d. below the highest figure of last week. Afterwards, however, a certain improvement took place. The past week's pig iron shipments were 8543 tons, as compared with 9192 in the same month of 1886. Of the total quantity, 2360 tons were despatched to the United States, and 1385 to Italy. It was stated on 'Change this week that the inquiry both for Italy and the States has slackened, at least for the moment, and this fact has exercised a somewhat depressing effect upon the speculative market. There is no change in the production, the furnaces in blast being 85, the same number as last week. Rather more iron is again being placed in the warrant stores.

The current values of makers' pig iron are nominally without much alteration, although makers are reported to be more anxious sellers than they were last week:—Gartsherrie, f.o.b. at Glasgow, No. 1 is quoted at 48s. 6d.; No. 3, 44s.; Coltness, 53s. 6d. and 44s.; Langloan, 49s. 6d. and 45s. 6d.; Summerlee, 51s. 6d. and 43s.; Calder, 48s. 6d. and 42s. 3d.; Carnbroe, 44s. and 40s.; Clyde, 46s. 6d. and 41s. 6d.; Monkland, 43s. 3d. and 39s. 3d.; Govan at Broomielaw, 43s. 6d. and 39s. 3d.; Shotts at Leith, 49s. and 45s. 6d.; Carron at Grangemouth, 52s. and 44s. 6d.; Glengarnock at Ardrossan, 49s. 6d. and 41s.; Eglinton, 43s. 3d. and 39s. 3d.; Dalmellington, 44s. and 40s. 6d.

The trade in Spanish iron ore has of late been in an improving position. Inquiries are being made just now for contracts for delivery over next year, and the price sought by merchants is 13s. 9d. per ton f.o.b. in Clyde. This rate is being firmly adhered to. The ore freights, Bilbao to Clyde, are 6s. 1½d. for prompt vessels, while the rate for next year is from 6s. 4½d. to 6s. 6d. The consumption of Spanish ore in our ironworks is increasing.

The steel trade is fairly active, but there are complaints that the bears are underselling makers, their object probably being to fill up future contracts at lower prices.

Malleable iron is well employed, but fresh orders do not come forward so readily as they did several weeks ago.

The past week's coal shipments have, on the whole, bulked satisfactorily. From Glasgow, 28,661 tons were despatched; Greenock, 5147; Ayr, 9390; Irvine, 2010; Troon, 6578; Burntisland, 10,423; Leith, 2326; Grangemouth, 13,359; Bo'ness, 6563; Granton, 2451; and Port Glasgow, 1050; the total of 87,935 tons comparing with 74,904 in the same week of 1886.

Coalmasters report that the miners are adhering in most places closely to the five days' work a week arrangement, and on this account supplies are pretty well cleared off at the moment, with the result that the prices are a shade firmer. No material advance can, however, be obtained, though the shipping trade is in a comparatively active state.

The general shipping trade of the Clyde is in a satisfactory condition. During August the arrivals showed an increase of 68,046, and the sailing an increase of 27,946 tons, as compared with those for the same month of last year.

It is reported that Messrs. Caird and Co., shipbuilders, Greenock, were obliged to discharge a hundred workmen at the end of the past week. The firm have only one vessel in hand, a Peninsular and Oriental steamer, which is well on towards completion.

Messrs. William Simons and Co., of Renfrew, have launched the Kuphus, a hopper dredger of 222ft. in length by 40ft. by 15ft., for the Bombay Port Trust, to be employed in deepening the port of Bombay. The vessel is one of the largest and most complete of its kind yet constructed, and its hopper, which is placed in the centre, can carry 1000 tons.

Efforts are being made to settle by arbitration the dispute between the Scottish mineral oil companies and their shale miners, who have now been on strike about two months.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE Taff Vale Railway lost this week one of its oldest officials, Mr. John Williams, the engineer to the company, one who had been associated with the line from the first, and concerned in the various plans and parliamentary Bills of the company throughout. Mr. Brewer, his able lieutenant, will no doubt succeed him. He has shown thorough engineering capacity in more ways than have been publicly notified.

With the ending of the drought the various works have resumed their old condition, and in a short time still greater activity may be expected in working off the accumulations. The Dowlais works suffered most from the drought. Last week a portion was started, and this week a further part, and by the end of the week I expect that the whole will be in action. The Dowlais Company in this respect, as in the case of the Bedlinog pit, has shown the power of large capitalists. What would shake a firm to ruin passes by with them scarcely noticed. Throughout the long period of three months I have not heard of a man discharged, and yet a population of 30,000 souls have been maintained, for there is no other industry in Dowlais.

The reputation of the steel rails of the company is, I see, spreading. Special praise was given to them lately in the Vale of Clwyd, North Wales, at a railway meeting.

There is an increase in the iron and steel exports. Good cargoes to San Diego and America have gone of late, blooms being chiefly consigned to the latter. An increase may be expected in the demand for this article, if the rails continue in the States at 36 dols., which is a late quotation.

The principal works have their books tolerably full of one kind of order or another, tin bar figuring chiefly. In tin bar Barrow is competing with Welsh ironmasters in the supply of tin works here, but this is principally due to the shortness of supply from the Welsh works, the drought having told upon all, more or less. Perhaps the least to suffer was Cyfarthfa, and the last week of the drought required all the energy and iron will of the managers to combat. Cyfarthfa, Tredegar, Rhymney, and Ebbw Vale, with Blaenavon may now be regarded as in excellent form to meet the needs of the market. Quotations are easy enough to warrant good trade, prices of rails varying from £4 5s. to £4 15s. for heavy, and to £5 10s. for light rail specifications.

An upward movement is not at all unlikely. Tin-plate is, as was forecasted in these columns, fetching better prices. The market price is going up, and those who failed to place orders last week will have to pay from 3d. to 6d. per box more this week.

The Swansea Exchange, which is going along well, showed this week conclusively the indication of this improvement.

Next to nothing of any first-class brand could be obtained for 13s.; ordinary cokes were quoted from 13s. 3d. to 13s. 6d., and more business done at the latter than at the former figure. Bessemer steels sold freely at 13s. 3d. to 13s. 9d., and for prompt delivery more was conceded; while Siemens' best obtained 14s. 6d., and in special brands as much as 18s. 6d.; those of lesser value, 14s. to 14s. 3d. Larger imports of tin bars was announced, but as stocks are no less than 60,000 boxes below the average it will be some time before makers can meet demands. The export last week was close upon 60,000 boxes, and at one time the anxiety of buyers to place orders was such that it seemed very like a rush.

The coal districts have not shown much animation of late, and with lessened demand and lessened output prices have begun to weaken. At present the fall has been a slight one, generally 3d. per ton, but in a few cases business has been conducted at a reduction of 6d. from late quotations.

Quotations for best are now from 9s. to 9s. 6d., thus almost establishing a 6d. decline. Small steam, consequent upon this, has receded to 3s. 9d., and best house coal to 8s.

Monmouthshire coal is selling at from 8s. 3d. to 8s. 6d. Coal exports from Cardiff last week were a good deal below the late averages. Swansea maintained its average, and slightly exceeded it by sending away close upon 28,000 tons. Newport coasting total was 20,964 tons.

The decline in sales and price of steam coal is not regarded as a permanent one, but merely a transitory change due to various causes, stormy weather and absence of shipping being one. There has been a crowd of ship disasters of late, and several Cardiff vessels have suffered and other steamers and ships laden with Welsh coal come to grief.

Swansea export of patent fuel shows badly, only 3612 tons having been sent away last week.

The Llanelly movement by tin-plate workers—the formation of a Workers' Union—seems to be successful. The tin-plate workers in Wales now amount to 25,000. A "General Trades Congress" is being held this week at Swansea, and makers and men may well hope that the promising industry tin-plate has become may not be marred by injudicious interference.

The death of Mr. John Griffiths, of Neath, is announced. For forty-five years he has been in charge of steamers on the Black Sea. He successfully ran the blockade during the Crimean War. He was first engineer on the Great Western, one of the first steamers that crossed the Atlantic.

There is a rumour of an iron and steel works being brought into connection and ownership with the Barry Docks, but the project is not sufficiently matured for fuller notice.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE business doing in the iron trade of this country continues, though it is quite the summer season, to increase in a steady, healthy manner, and if no political disquiet of any serious kind ensues, it seems likely to hold this improved condition for some time to come. Confidence on the part of consumers and industrials is gaining ground, and in consequence more speculation and an increase of works is here and there taking place and new ones are projected; amongst them another tube-rolling mill in Bohemia, in which Westphalian houses are engaged. This will make Austria independent of foreign supplies, which only a very few years back came in large quantities, chiefly from Staffordshire. Again, on the Rhine, by Duisburg, an extensive chain and chain-cable smithy, with testing machines complete, has just been set to work. Till lately chains for ships and lifting purposes all came from England. Nothing can show better than this how necessary it is for English manufacturers to seek in time new outlets beyond seas for their wares. There is now but one manufacture in which England still has the exceptional pull everywhere, and that is in tin-plates; but how long this will last, who can tell?

The pig iron market in Silesia keeps satisfactory, the demand is brisk, especially for puddling sorts, and M. 48 to 50 p.t. is being paid by consumers, but speculation and imports from other parts are likely to soon lower these quotations. Foundry pig has been advanced beyond the figure founders will readily give, but as these are very busy just now sellers will not give way, and the former will in the end have to acquiesce. The wrought iron and steel works are all well engaged on bars, rods, plates, and sheets, at prices tending upwards, and are despatching far more goods at present than for years past. M. 127·50 to 130 is asked for bars at works, and 135 by merchants at Breslau, and for plates 145 to 155 p.t. The machine works are well supplied with work to go on with.

In the Siegerland there is a full demand for crude iron of all sorts and for forge pig in particular, and a great deal has already been sold into the next quarter. M. 45 and 46 is easily obtained for good forge pig. Spiegel and Bessemer, after having been some time neglected, are both in good request, America being the chief customer for the 20 p.c. quality of the former. The latter costs M. 47 to 48 and 12 p.c. spiegel 50 to 51 p.t. Iron ores range from M. 9 to 12·50 p.t. for calcined steel stone, which, as also red hematite, is rare just now, for mineowners, not expecting a rush, had of late only driven their mines slackly. The rolling mill business is brisker than before for years, and, thanks to the conventions, prices are steady, and as those for thin sheets are now in proportion to the prices of pig iron and a rise of M. 5 is again contemplated, the trade has a more hopeful look than heretofore.

The position of the Rhenish-Westphalian iron market is a thoroughly firm one, and promises to remain so permanently. Demand is very brisk and prices rather on the rise than remaining stationary. The pig iron market becomes more and more satisfactory, and production is slowly rising—280,347 t. and 326,075 t. last July and this respectively. As the foundries are fuller of orders, M. 49 to 55 p.t. for foundry sorts of pig are obtainable, and the convention price of M. 46 to 46·50 for forge sorts is readily paid, as the consumption at the rolling mills is very large just now. The bar mills are especially well placed, and the Syndicate price of M. 115 p.t. can be realised without trouble, but in justice it should be raised a trifle to compensate for advances in pigs as they occur. At present, however, the large old parcels of bars in dealers' hands forbids it. Hoops are in greater request, and have been advanced to M. 125. Plates are noted at M. 150, and anything under this price buyers are ready to give, but they must soon be raised in proportion to the pig iron advances. Thin sheets are up to M. 140, though 135 is perhaps nearer the actual selling price. Wire rods in either steel or iron can be maintained at M. 109 to 110, and drawn at 127·50, as the demand from abroad has increased. In Holland, Krupp has just taken the order for 9770 tons of steel rails and accessories for Sumatra at 68·85 fl. delivered at Brandenwijnbaai, and German works have taken the Danish order in competition with England and Belgium. The nominal price of light section steel rails is M. 110 p.t. Some of the machine shops are very full of work, while others again are only moderately well off. The wagon works have very little on hand, but autumn orders are in expectation.

In Belgium the position of the iron market, has for some weeks past, is extremely strong, and even the French market shows a few hopeful symptoms of a revival. In the Nord Department business is partially pretty satisfactory, if the Paris houses would not continue to sell *à tout prix*, which mode of doing business has extended to some of the provinces. Girders have been selling in Paris at 120f., while bars are 130 p.t. Some of the French works are anticipating the receipt of work for war material for Belgium, presumably for the Maas (Meuse) fortifications. If so, surely English works stand a chance of participating in such supply.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, August 27th.

CONTRACTS have been placed within two weeks for 60,000 tons of foreign iron and steel, and negotiations in hand will probably increase it to 100,000 tons by September 1st, or soon after. Blast furnace production is gaining ground, as all the coke furnaces are in blast and the entire producing capacity is being increased to maximum limits. Tin and tin-plates have been selling well. Bridge builders are now in market for over 8000 tons of material to be delivered during the winter months, ready for construction. Bessemer pig is selling well. Old rails are in active demand, and quotations are 24 dols. New steel rail contracts are being placed in 5000 and 10,000-ton lots at 37s. dols. to 38 dols.

The iron and steel mills are being overcrowded, and as yet there are no indications that supply is overtaking demand. Nails are 2·10 dols. to 2·25 dols. The railroad builders are placing large orders for all kinds of material and equipments. The summer season has been exceptionally hot, and the production of mills has been curtailed more than in former years.

Western advices, as far as Chicago and St. Louis, show great activity, as the wheat, corn, and cotton-growing interests are confident of strong prices. The manufacturing interests are exceptionally prosperous. Quotations are:—Iron, Bessemer, foreign, 20 dols.; American, 18 dols. at furnace; forge, 17 dols.; foundry, 19 dols. to 22 dols.; merchant iron, 40 dols. per ton at mill; plate, 40 dols. to 50 dols. The autumn trade is at hand, and an immense demand is in sight for all kinds of iron and steel and manufactured products. Crop reports are favourable. Machinery is in very active demand.

NEW COMPANIES.

THE following companies have just been registered:—

Cornish Ochre Company, Limited.

This company was registered on the 26th ult., with a capital of £20,000, in £5 shares, to acquire mining rights in Cornwall, upon terms of an agreement of the 24th ult. between Richard Sanford and Moritz Steinberger. The subscribers are:—

	Shares.
Felix Target, C.E., 3, Great Queen-street, S.W. ..	1
A. N. Stansfield, 26, Barrow-road, S.W., medical student	1
W. O. Lyon, Harlesden, N.W.	1
A. E. Sarti, 108, St. Paul's-road, N., engineer ..	1
A. W. Hervé, 152, Farringdon-road, manufacturer	1
H. Hurran, 4, Tollington-road, N., manufacturer	1
H. Barnett, 12, Ockenden-road, N.	1
R. J. Atcherley, 23, Bucklersbury, engineer ..	1

The number of directors is not to be less than three, or more than seven; the subscribers are to appoint the first, and are to act *ad interim*. Under the said agreement the company will acquire leasehold mining grants, and licenses to work for ochre, ironstone, copper, and other minerals, upon the Grogley Estate, in the parish of St. Brockin, Cornwall, for £10,000 in fully-paid shares.

Improved Fusee and Patent Light Syndicate, Limited.

This syndicate was registered on the 26th ult., with a capital of £10,000, in £10 shares, to purchase certain inventions for improvements in the manufacture of cigar lights or fusees, and stems or holders for the same, and apparatus therefor. The subscribers are:—

	Shares.
C. T. J. Vautin, 46, Connaught-street, metallurgist	25
R. Bally, Queen's-road, Forest Hill, merchant ..	25
R. Berkin, Nottingham	25
C. G. Hill, Nottingham	25
J. P. Cox, Nottingham..	25
J. A. Jacoby, 45, Queen's-gate, merchant	25
C. Howard, 23, Old Jewry, clerk	1

Most of the regulations of Table A apply. Directors' qualification, 20 shares.

John Bright and Brothers, Limited.

This is the conversion to a company of the business of cotton spinners, manufacturers, and silk goods manufacturers, carried on at Fieldhouse Mills, Rochdale, by Messrs. John Bright and Brothers. It was registered on the 26th ult., with a capital of £250,000, divided into 1420 ordinary shares of £100 each, and 1080 preference shares of £100 each; the latter to be entitled to an unvarying preference dividend of £5 per cent. per annum, less income-tax. The subscribers are:—

	Shares.
*Right Hon. John Bright, M.P., One Ash, Rochdale..	1
*Thos. Bright, Green Bank, Rochdale, cotton manufacturer	1
*Jacob Bright, 31, St. James's-place, London, cotton manufacturer..	1
Frank John Bright, Bentfield, Rochdale, manufacturer	1
John Albert Bright, Rose Hill, Rochdale, cotton manufacturer	1
W. Leatham Bright, M.P., 117, Leadenhall-street	1
L. C. Bright, Whitworth, near Rochdale, cotton manufacturer	1
Philip Bright, 2, Newgate-street, engineer	1

The number of directors is not to be less than three, nor more than five; the first are the subscribers denoted by an asterisk, who are appointed for life, provided they each continue to hold at least £5000 of the capital. Messrs. Thos. Bright, Frank John Bright, and John Albert Bright are appointed life managing directors, provided they continue to hold the said qualification. The remuneration of the directors will be such sums respectively as they may determine, subject to confirmation by the company in general meeting.

Salterforth Stone and Brick Company, Limited.

Registered on the 25th ult., with a capital of £5000, in £10 shares, to purchase the Park Close Farm, with quarry buildings, &c., at Salterforth, York, from the executors of Mr. William Bracewell. The subscribers are:—

	Shares.
E. Heap, Burnley, contractor	1
H. Marsden, Salterforth, boat owner	1
T. Bell, Burnley, architect..	1
J. Heap, Nelson, canal agent	1
M. Hawley, Nelson, contractor..	1
E. W. Bateman, Skipton, canal inspector	1
J. Hawley, Colne, contractor	1

Most of the articles of Table A will govern the company.

Steamship "Great Eastern" Company.

This company proposes to adopt an agreement of the 1st inst. between Joseph Worsley, of Houghton House, Swinton, Lancaster, and Charles Woolverton, of Bootle, near Liverpool, under which Mr. Worsley has agreed to sell to the company the Great Eastern steamship. It was registered on the 30th ult., with a capital of £40,000, in £1 shares. In addition to transacting shipping business, the company proposes to use the said ship as a place of exhibition and amusement, and to carry on the business of licensed victuallers and refreshment dealers thereon. The purchase is made subject to a first mortgage of £17,000, bearing £6 per cent. per annum, given to Henry Gowan, of Belfast, and to a second mortgage of £13,000, carrying £6 per cent. per annum interest, given to Sarah Ann Worsley. The purchase consideration is 2000 fully-paid shares, and the payments of the amounts secured by the several securities subject to which the said steamship is agreed to be sold. The subscribers are:—

	Shares.
*Joseph Worsley, Johnson-street, Manchester, merchant	1
*James Brocklehurst, Market-street, Manchester, valuer	1
Mrs. S. A. Worsley, Swinton, Manchester	1
C. Woolverton, Bootle, agent	1
J. H. Brown, Ancoats, Manchester, cotton manufacturer..	1
J. E. Robinson, 16, Mark-lane, Manchester, tobacco manufacturer	1
G. H. Browne, Higher Walton, Cheshire, cashier	1

The number of directors is not to be less than two; the first being the subscribers denoted by an asterisk. Mr. Joseph Worsley is appointed managing director, and will be entitled to 5 per cent. on the earnings of the ship.

Universal Electric Company, Limited.

On the 29th ult. this company was registered, with a capital of £50,000, in £5 shares, to carry on in any part of the world the business of an electric light company in all branches. The subscribers are:—

	Shares.
C. Capito, M.E., 63, Queen Victoria-street	1
M. P. Haroz, 63, Queen Victoria-street, electrical engineer	1
E. Daminquet, 24, Rue Baudin, Paris	1
A. de Cavaillon, 24, Rue Baudin, Paris, financier	1
T. Fardon, M.E., Luton	1
J. R. Marsh, Luton, accountant	1
W. N. de Mattos, 27, Leadenhall-street, merchant	1

The number of directors shall not be less than five, nor more than seven; the subscribers are to appoint the first; qualification, 100 shares; remuneration of ordinary directors, £200 per annum. Messrs. Charles Capito, E. Daminquet, and A. de Cavaillon are appointed managing directors and engineers of the company for ten years, at salaries of £100 each, to be increased to £300 per annum when 5000 lamps are in operation by the company, and, in addition, they may divide in equal proportions one-half of the surplus net profits after 15 per cent. dividend has been paid; the right to such share of profits to be continued for fifteen years.

Cramlington Coal Company, Limited.

This company was registered on the 1st inst., with a capital of £252,000, in £100 shares, to take a transfer from the partnership firm of the owners of the Cramlington Collieries of all their collieries, engines, plant, &c. The subscribers are:—

	Shares.
*B. W. Lamb, Newcastle-on-Tyne	1
*R. O. Lamb, Ryton, Newcastle-on-Tyne	1
*T. Wrightson, Stockton-on-Tees	1
E. A. Potter, M.E., Cramlington House, Northumberland	1
John Wrightson, Downton, Wilts, professor ..	1
Rev. W. G. Wrightson, Worthing	1
*Lieutenant-Colonel D. M. Potter, Edinburgh ..	1

The number of directors is not to be less than three, nor more than seven; the first are the subscribers denoted by an asterisk and Mr. Wm. Scott; remuneration, £600 per annum.

New South Wales Colliery Company, Limited.

This company was registered on the 1st inst., with a capital of £100,000, divided into 75,000 preference and 25,000 ordinary shares of £1 each, to acquire the leasehold property known as the Lake Macquaire Coal Estate, consisting of 5100 acres, situate in the parish of Wallarah, Northumberland, New South Wales. The subscribers are:—

	Shares.
W. Salmon, 4, Mansion House-buildings	1
W. Ashley Cooper, 11, South-square, Gray's-inn, surgeon	1
G. C. Harrower, Snaresbrook, chartered accountant	1
F. M. Still, 64, Edith-road, West Kensington ..	1
C. Bright, C.E., 79, Philbeach-gardens, S.W. ..	1
John Warren, 90, London Wall, solicitor	1
J. F. Allright, C.E., Mansion House-chambers ..	1

The number of directors is not to be less than two, nor more than six; qualification, 500 shares; the first are Messrs. R. D. Adams, W. Lishman, G. B. Walker, C. S. Smith, and W. J. B. Salmon; remuneration, £300 per annum each.

PROPOSED RAILWAY FOR SUMATRA.—The Dutch Government contemplates the construction of a railroad on the island of Sumatra, for the purpose of utilising some coalfields discovered about twenty years ago. The coal is stated to be superior in quality to the best English coal, and the yield is estimated at 200,000,000 tons. The work on the railroad is to extend over six years, and the cost will be about 16,000,000fl.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

30th August, 1887.

11,727. BENDING TUBES, H. J. Allison.—(*J. H. Kelly and C. H. Broad, United States.*)
11,728. RESERVOIR PEN, W. E. Burton, London.
11,729. LETTER FILES, B. Lawrence, London.
11,730. FODDER for HORSES, &c., C. A. Coombe, Sheffield.
11,731. RAILWAY BUFFERS, T. and W. Latham, Sheffield.
11,732. FIRE-ALARMS and SPRINKLERS, R. A. Wilson, Manchester.
11,733. TREATING METALLIC CHLORIDES, J. E. Bennett, Manchester.
11,734. SLEIGHING SLIDE, W. G. B. Parr, Gateshead.
11,735. PRESSING PAPER, J. Baldwin, King's Norton.
11,736. RELEASING GEAR for BOATS, F. J. Davis, London.
11,737. PROPELLERS for SHIPS, W. Welch, Portsmouth.
11,738. DRIVING GEAR of BICYCLES, J. L. Garsed and F. W. Green, Halifax.
11,739. GOUT MIXTURE, J. L. Bury, Manchester.
11,740. SITZ BATHS, J. Drake, Halifax.
11,741. WASHING MACHINES, T. Frater, Glasgow.
11,742. DRAIN PIPES, J. Honeyman, Glasgow.
11,743. KEYS for RAILWAY CHAIRS, T. H. Heard, Sheffield.
11,744. BRICK-MAKING MACHINES, T. T. Crook and W. Ormrod, London.
11,745. SELF-LUBRICATING MOULD for BRICK-MAKING, W. Ormrod, London.
11,746. RECREATION RAILWAYS, J. C. Sellars, Liverpool.
11,747. PERAMBULATORS, L. L'Hollier and T. Luckett, Birmingham.
11,748. SMOKING TOBACCO, T. E. Hughes, Liverpool.
11,749. HEAVY GUN EMPLACEMENTS, Major A. R. Puzey, Alverstoke.
11,750. ELECTRIC CURRENT INDICATOR, E. J. Paterson, C. F. Cooper, and S. Joyce, London.
11,751. ELECTRIC AUTOMATIC BLOCK SIGNALLING, A. E. Nicholl, London.
11,752. BRICKS for FIXING WOODWORK, J. H. Goodman, Reading
11,753. TELESCOPE BLIND ROLLER, J. Siree, Gateshead-on-Tyne.
11,754. SPRING LOCOMOTIVE RAILWAY CABLE TRAM LINE, J. Farnsworth, Manchester.
11,755. GAME, J. Brierley, Halifax.
11,756. PROTECTING the ANKLE from KICKS, S. Heywood, Heywood.
11,757. STEAM ENGINES WORKING COMPOUND in ONE CYLINDER, A. H. Wallis, Basingstoke.
11,758. DESKS, &c., A. Ashworth, Manchester.
11,759. RAILWAY, &c., CARRIAGES, F. E. Canda, London.
11,760. RAISING, &c., RAILWAY CARRIAGE WINDOWS, F. Shorten.—(*E. Gebauer, Germany.*)
11,761. STOPPERING BOTTLES, C. L. Morehouse and H. W. Rozell, London.
11,762. SEAL LOCKS, A. J. Boult.—(*P. Brown.*)
11,763. MECHANICAL MOVEMENTS, E. B. Coxe and S. Salmon, London.
11,764. FILLING SACKS, J. B. Williams and I. Bradburn, Liverpool.
11,765. WHEELS for CARRIAGES, &c., A. J. Boult.—(*E. Battle, Spain.*)
11,766. FIXING STOPPERS for BOTTLES, T. E. Harper, Essex.
11,767. WINDOW FITTINGS, G. H. Couch, London.
11,768. PEDESTRIAN'S SPEED INDICATOR, M. D. Rucker, London.
11,769. PENCIL CASES, O. Wollenberg, Berlin.
11,770. WATCH SYSTEM CALLOTE, J. Jullierat-Berthoud, London.
11,771. SCREWING in the CORKS of BOTTLES, C. A. Beney, London.
11,772. WINDOW FASTENING, S. J. Spencer, London.
11,773. SNAP HOOKS, H. H. Lake.—(*J. R. Macmillan, United States.*)
11,774. SCREW-THREADED NAILS, H. H. Lake.—(*H. E. Russell, United States.*)
11,775. HORSE-SHOES, W. D. Bohm, Acton.
11,776. SYNCHRONISING ELECTRIC TELEGRAPH INSTRUMENTS, W. H. Beck.—(*G. A. Cassagnes, France.*)
11,777. BUCKLES, G. F. Attwood, London.
11,778. ROTARY STEAM ENGINES, P. Jensen.—(*W. H. Bright, United States.*)
11,779. BUTTON-HOLE ATTACHMENTS for SEWING MACHINES, H. H. Lake.—(*The Peerless Button-hole Attachment Co. (Incorporated), United States.*)
11,780. COOLING APPARATUS, R. Cahn, London.
11,781. TRANSPORTING HEAVY GOODS, P. Gasc, London.
11,782. SLIDING SHUTTER for PHOTOGRAPHIC PURPOSES, J. T. Mayfield and J. T. Todman, London.
11,783. MANUFACTURE of ARTIFICAL FUEL, J. Hall, London.
11,784. SEWING SILKS, T. W. S. Wheatley and E. J. Thompson, London.

31st August, 1887.

11,785. STUDS for STAY BUSKS, &c., G. Twigg, Birmingham.
11,786. EGG BOILING APPARATUS, J. Thropp, Birmingham.
11,787. CUPBOARD TURN, E. V. Bailey, Birmingham.
11,788. BELT PULLEYS, &c., J. P. Tapley, C. Wilson, and W. T. Alexander, Manchester.
11,789. MANIFOLDS for STEAM GENERATORS, W. Fairweather.—(*The Badcock and Wilcox Company, United States.*)
11,790. FIRE-ESCAPE, W. R. Lawson, London.
11,791. SEWING MACHINES, J. Gutmann, London.
11,792. RUNNING RABBIT for SHOOTING PRACTICE, H. Hendley and H. Jones, Wolverhampton.
11,793. MOULDING BOXES, J. Sinclair, North Hylton.
11,794. FRICTION GEAR, J. W. Howlett, Birmingham.
11,795. MILLING MACHINES, J. Garvie, jun., London.
11,796. CURLING FLOCKS, R. Ellis, Halifax.
11,797. PREPARING FERRUGINOUS MATERIALS for SMELTING, A. M. Crossley, Glasgow.
11,798. RACE GAME, E. R. Barnett, Birmingham.
11,799. DISTILLING AMMONIACAL LIQUORS, R. Wyllie, Liverpool.
11,800. HYGIENIC HOUSEMAID'S DUST and SELF-SIFTING CINDER-BOX, B. W. and H. M. Dove, London.
11,801. SAFETY WHEEL with TWO RIMS, H. Coleman, London.
11,802. INCANDESCENT LAMPS, A. Shippey, London.
11,803. HEAT ENGINES, H. W. Cook, London.
11,804. ARGAND LAMPS, A. J. Boult.—(*W. Duffield, Canada.*)
11,805. TREATING RESINS, &c., S. Banner, Liverpool.
11,806. TAKING COPIES of WRITTEN or PRINTED MATTER, W. Bland, London.
11,807. CALCULATING MACHINES, W. P. Thompson.—(*C. Lorenz, Germany.*)
11,808. REGISTERING THERMOMETER, W. P. Thompson.—(*D. Draper, United States.*)
11,809. BICYCLES, &c., T. Cooke and W. H. Boyens, London.
11,810. LOCKS, C. A. Day.—(*J. T. Cole, New South Wales.*)
11,811. REGULATING the SUPPLY of GAS, J. H. Hayes, London.
11,812. BLEACHING COTTON, &c., J. Smith and P. W. Nicolle, Jersey.
11,813. OUTWARD CURATIVE APLLICATION, A. Dubois, London.
11,814. VELOCIPEDE, G. Singer and R. H. Lea, London.
11,815. PREVENTING LOSS of LIFE through FIRE, &c., O. A. Rode, London.
11,816. MAGNETO-ELECTRIC APPLIANCES for MEDICAL PURPOSES, R. Lonsdale, London,
11,817. WINDING or ROLLING WIRE-NETTING, W. P. Bullivant, London.
11,818. TRAVELLING by WATER without the AID of OARS, J. R Barrett, Carshalton.
11,819. LEAD PENCILS, H. J. Allison.—(*B. B. Goldsmith, United States.*)
11,820. PENCILS, H. J. Allison.—(*J. Hoffman, United States.*)
11,821. EXTRACTING CHLORINE from SOLUTIONS of CHLORIDE of MAGNESIUM, T. Schloesing, Paris.
11,822. RUCHES, C. G. Hill, London.
11,823. VELOCIPEDE, &c., WHEELS, W. Clegg, London.
11,824. COUPLINGS for PIPES, F. H. and L. Lecellier, London.
11,825. PORTABLE OVEN, J. L. Watkins, London.
11,826. MILLS for GRINDING QUARTZ, &c., R. Morris and J. Wood, London.
11,827. CLUTCHES and COUPLINGS for SHAFTING, R. Morris and J. Wood, London.
11,828. RUDDERS for SHIPS, J. H. Laidman, London.
11,829. LOCKING SASH FASTENER, W. R. Crozier, London.
11,830. LAYING PERMANENT WAY, G. Anderson, London.
11,831. ELECTRIC LAMPS, E. A. G. Street and F. V. Maquaire, London.

1st September, 1887.

11,832. AUTOMATIC COUPLINGS, S. Hawkins and R. Littlejohn, London.
11,833. WALL PAPER, R. Herrmann, London.
11,834. MOTORS worked by VAPOUR, A. Fehlen, London.
11,835. STEAM EXCAVATORS, J. Gill, London.
11,836. MACHINE for TURNING in CARTRIDGES, G. H. Hockey, Bristol.
11,837. VELOCIPEDES, J. Sharp, Birmingham.
11,838. VALVE GEAR, H. C. Lobnitz, Glasgow.
11,839. BOOTS and SHOES, S. E. and H. Michelstädter, Vienna.
11,840. GRAVITY RAILWAY RACECOURSES, B. T. Hembry, Liverpool.
11,841. BUTTONS, T. Hughes, Manchester.
11,842. HORSES' SHOES to PREVENT SLIPPING, T. Walley and J. Brownlee, Glasgow.
11,843. TOOL HANDLES and DRILL CHUCKS, G. Challenger, D. D. Rees, and E. Jones, Swansea.
11,844. PIPES for SMOKING, P. M. Walker, Halifax.
11,845. PIPES for SMOKING TOBACCO, J. Wood, Bath.
11,846. ALKALIES, G. E. Davis, Manchester.
11,847. POTS and PANS for COOKING PURPOSES, A. J. Lehmann, Liverpool.
11,848. PEN-HOLDER, G. Bennett, Birmingham.
11,849. C-SPRING CLIPS for HOLDING PAPERS, &c., M. Myers and J. Low, Birmingham.
11,850. ROUGHING and BORING BOBBINS or SPOOLS, A. Greg, London.
11,851. REGULATING the BACKING-OFF MOTION in SELF-ACTING MULES, J. T. Ainsworth, London.
11,852. PREPARING BLOCKS for CALICO, &c., PRINTING, W. Duxbury, London.
11,853. FLEXIBLE SUPPORTS for TELEGRAPH WIRES, F. Caws, London.
11,854. BOOTS and SHOES for FOOTBALL, &c., H. Howe, Leicester.
11,855. TOBACCO PIPES, E. Brennan, Liverpool.
11,856. MONEY TILLS, J. E. Farrow, Manchester.
11,857. APPARATUS for COUNTING COINS, C. Borchardt, London.
11,858. ORNAMENTAL DESIGNS on WATERPROOF FABRICS, B. Birnbaum, London.
11,859. GUNS, CANNONS, &c., W. Reynolds, jun., London.
11,860. ARTISTS' BRUSH and PENCIL CASES, W. H. Wood, Kingston-on-Thames.
11,861. SLIDING TRIVETS, E. Burrows, London.
11,862. PREPARING MOULDS for CASTING HOLLOWARE, C. F. Clark, London.
11,863. DRAW-BACK and RIM LOCKS, D. H. Kempson, London.
11,864. PLANTING POTATOES, &c., J. G. Hall, London.
11,865. FILTER, R. Gough, London.
11,866. INDEPENDENT FIRE ESCAPE, H. F. Dale, London.
11,867. AUTOMATIC SYPHONS, S. Cutler, London.
11,868. WORKING up of SCRAP IRON and STEEL, J. Gilligan, London.
11,869. BUTTON-HOLE SEWING MACHINES, F. H. Bennett, Twickenham, J. Dowling, London
11,870. COAL BUNKERS for TORPEDO and other STEAM VESSELS, H. O. Arnold-Forster, London.
11,871. VENTILATING HATS, &c., M. Postlethwaite, London.
11,872. DIFFERENTIAL PUMPS, J. Miller, London.
11,873. COMBINED SHEARS and HOLDER, L. A. Fosbery, London.
11,874. STEAM BOILERS, F. W. Cannon, G. P. Addison, and F. R. Burnett, London.
11,875. FIRE-BARS, F. W. Cannon, G. P. Addison, and F. R. Burnett, London.
11,876. GENERATING STEAM, F. W. Cannon, G. P. Addison, and F. R. Burnett, London.
11,877. LIQUID GAUGES, J. Nicholas and H. H. Fanshawe, London.
11,878. AUTOMATIC WEIGHING MACHINES, M. Alexander-Katz, London.
11,879. PRODUCTION of COMPOUNDS and ALKALINE ANTIMONIC FLUORIDE, C. D. Abel.—(*C. Wachendorff, Germany.*)
11,880. AZO COLOURING MATTERS, C. D. Abel.—(*The Actiengesellschaft für Anilin-Fabrikation, Germany.*)
11,881. BOLTING MACHINERY, F. G. Winkler, London.

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11,882. REGENERATIVE GAS LAMPS and BURNERS, E. Derval, London.
11,883. FLAX BREAKING and DOUBLE-ACTING SCUTCHING MACHINE, F. Kasparek, London.
11,884. ATTACHING LIDS to EARTHENWARE TEAPOTS, &c., J. Rhodes, Longport.
11,885. TRUSSES, T. G. Daw, Sevenoaks.
11,886. WORKING and LOCKING RAILWAY SIGNALS and SWITCHES, J. Holms.—(*J. A. Zinn, United States.*)
11,887. DRUM HEADS and MANIFOLDS for SECTIONAL STEAM GENERATORS, W. Fairweather.—(*The Babcock and Wilcox Company, United States.*)
11,888. APPLYING POSTAGE STAMPS and LABELS, C. Ziegler, Germany.
11,889. ENAMELLED METALLIC [PLANT LABELS, T. Stocker, Liskeard.
11,890. OIL CANS, C. Gaul and T. Wolstenholme, Bradford.
11,891. LUBRICATOR for LOOSE PULLEYS, D. Hartley, Bradford.
11,892. LOWERING SHIPS' BOATS, L. C. Niebour, Kingston.
11,893. WEDDING-CAKE BOXES, &c., H. A. Stuart, Bletchley.
11,894. MAKING and WORKING FURNACE ROCKING BARS, B. D. Healey, Bamber Bridge.
11,895. SCREENING COAL, &c., G. C. Greenwell, jun., Manchester.
11,896. CHINESE or JAPANESE SHOE, W. Hoyle, Rochdale
11,897. SEWING and REPAIRING MACHINERY for BOOTS and SHOES, J. Brown, Leeds.
11,898. BENDING ANGLE, TEE, and other BARS, N. Arthur, Newcastle.
11,899. BOILER FLUES and FIRE-BOXES, H. P. Fenby, Farnley.
11,900. EXTRACTION of ANTIMONY from its ORES, A. J. Shannon, London.
11,901. LAMP-HOLDERS or SOCKETS for INCANDESCENCE LAMPS, R. A. Scott, London.
11,902. MEASURING and FOLDING CLOTH, A. Dobson, Belfast.
11,903. HEATING and CIRCULATING WATER, H. H. Hosack, London.
11,904. MANIFOLD COPYING-BOOK, S. S. Bromhead.—(*J. L. O'Conner, United States.*)
11,905. PACKAGE HOLDER and CARRIER, S. S. Bromhead.—(*C. W. Dudley, United States.*)
11,906. CRYSTALLISATION of GLASS, J. Budd, London.

11,907. Sword, H. J. Allison.—(*V. F. X. P. Pags, France.*)
11,908. Hansom Cabs, J. Carter, London.
11,909. Carpet Lining, C. H. Cole, Arkansas, U.S.
11,910. Window Cleaner, A. T. Allom, London.
11,911. Gas Engines, J. Atkinson, London.
11,912. Door Fasteners, A. J. Boult.—(*J. Sharpe and J. A. Banfield, Canada.*)
11,913. Horseshoes, R. Bradshaw, Liverpool.
11,914. Sorting Pills, W. S. Hubbard and R. Gibbins, London.
11,915. Motor Engines, A. J. Boult.—(*J. F. Case, United States.*)
11,916. Clutch-boxes, J. C. Johnson and A. Rea, Manchester.
11,917. Continuous Current Dynamo Electric Machines, R. Kennedy, Glasgow.
11,918. Life Belt, A. H. Williams, London.
11,919. Air-tight Chambers, &c., A. H. Williams, London.
11,920. Raft-seats, A. H. Williams, London.
11,921. Fire-escape, G. W. Hick, London.
11,922. Bicycle or Tricycle Bell, A. Guye, jun., London.
11,923. Plates for Electric Batteries, C. L. R. E. Menges, London.
11,924. Napkin Holder and Ring, C. W. Higgins, London.
11,925. Looking-glass Centres, C. F. Hall, London.
11,926. Heart-shaped Cam and Needle-bar Appliance for Sewing Machines, H. Hengstenburg and R. Wittenstein, London.
11,927. Concentrated Essences of Tea, &c., A. McDougall, jun., London.
11,928. Indicating the Presence of Fire-damp in Coal-mines, &c., J. W. Swan, London.
11,929. Fire-bars or Grates, B. Willcox.—(*M. Perret, France.*)
11,930. Harmonicas, H. H. Lake.—(*J. T. Smith, United States.*)
11,931. Spectacles, T. and E. Rowley, London.
11,932. Joints of Electrical Conducting Cables, C. D. Abel.—(*Siemens and Halske, Germany.*)
11,933. Electrical Apparatus, R. Harrison, London.
11,934. Saddle-bars, &c., A. Douglas-Hamilton, London.
11,935. Shrinking and Drying Cloth, E. James, London.
11,936. Gas Engine, C. Wells, London.
11,937. Fireproof Floors, J. Homan, London.
11,938. Self-winding Clocks, J. G. Lorrain, London.
11,939. Self-winding Clocks, J. G. Lorrain, London.

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11,940. Looms for Weaving, D. B. Bailey, Halifax.
11,941. Controlling the Direction, &c., of Boats, W. P. Thompson.—(*G. C. Baker, United States.*)
11,942. Carriage, &c., Window Sashes, C. T. Clegg, Manchester.
11,943. Velocipedes to Carry Four or Five Riders, T. Timberlake, Maidenhead.
11,944. Locks, J. Lawrence, Birmingham.
11,945. Casting of Metals, H. A. Rowland, Manchester.
11,946. Hose and Belting, F. Reddaway, Manchester.
11,947. Separating the Solids from the Fluids of Sewage Matter, G. Liscoe, London.
11,948. Straw Plaits, S. P. Howard, London.
11,949. Bill-posting Stations, H. R. and W. H. Ramm, Longport.
11,950. Electrical Telephones, J. S. Ross and H. Baines, London.
11,951. Hydrocarbon Lamps, J. S. Muir, London.
11,952. Jacquards or Dobbies for Looms for Weaving, J. Wild, Halifax.
11,953. Delivery of a Measured Quantity of Liquid in Exchange for Coin, &c., E. G. Matthewson, Upper Norwood.
11,954. Jacquard and other Looms, E. Pont y Ricart, London.
11,955. Collar, &c., Ironing Machine, J. Ritchie, Glasgow.
11,956. Attaching Glass Oil Containers to Lamp Stands, J. A. Ellis and G. W. Pridmore, Handsworth.
11,957. Mounts of Doors and other Knobs, J. F. Wiltshaw, Birmingham.
11,958. Felt Hat Bodies, J. Nasmith, Manchester.
11,959. Felt Hat Bodies, J. Nasmith, Manchester.
11,960. Testing the Grip of your Hand, E., A., and A. Kelly, Birmingham.
11,961. Door Springs, B. Turner, London.
11,962. Shackles and Scroll Irons, B. F. Cocker, Sheffield.
11,963. Powder Sifting Machine, A. Struthers and W. R. Craig, Glasgow.
11,964. Ships' Logs, G. W. Heath.—(*W. M. Walters.*)
11,965. Indicators, T. Bassnett and R. C. Saxby, Seaforth.
11,966. Stoves, &c., J. B. Petter, London.
11,967. Pumps, W. Clarke, J. B. Furneaux, and C. Dowsen, London.
11,968. Steam Generators, W. Clarke, London.
11,969. Heating and Steaming Husk, &c., A. C. Nagel, R. H. Kaemp, and A. Linnenbrügge, London.
11,970. Steam Pumping Engines, J. Tangye and R. J. Connock, London.
11,971. Condensers, J. Tangye and R. J. Connock, London.
11,972. Driving Belts, H. Müller, London.
11,973. Garnett Wire for Cards, J. Thornton, London.
11,974. Converting Sea-water into a Thirst Assuaging Drink, G. S. Hazlehurst, Liverpool.
11,975. Keys for Locks, H. H. Lake.—(*T. Kromer, Germany.*)
11,976. Azoic Colouring Matters, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl, France.*)
11,977. Wrappers, J. Pascall, London.
11,978. Boots and Shoes, L. E. Scafe, London.
11,979. Milling or Fulling Fabrics, W. Fox, London.
11,980. Portable Filters, P. Everitt, London.
11,981. Amalgamating Apparatus, W. Leigh, London.
11,982. Indicator for Tram-cars, &c., J. R. R. Lawrence, London.
11,983. Rock-breaking Machines, A. Myall.—(*J. H. Lancaster, United States.*)
11,984. Producing Currents of Air, &c., H. F. Green, London.
11,985. Standard Oil Lamp for use in Photometry, A. G. V. Harcourt, London.

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11,986. Protection of Life at Railway Level Crossings, W. T. Folks, London.
11,987. Wheel Tire, W. Beale, London.
11,988 Rosaniline Sulpho Acid, J. Dawson Kirkheaton, and R. Hirsch, Huddersfield.
11,989. Alpha-naphtylamine-mono-sulpho-acid and Alpha-naphtylamine Disulpho-acid, J. Dawson, Kirkheaton, and R. Hirsch, Huddersfield.
11,990. Soles and Heels of Boots and Shoes, A. A. Walker, Birmingham.
11,991. Steam Engines, A. H. Charters, London.
11,992 Lighting Railway Carriages, &c., J. Lawson, Haxby, near York.
11,993. Sash Fasteners, G. F. Woodcroft, Birmingham.
11,994. Alarms for Steamers in Foggy Weather, R. W. Roberts, Menai Bridge.
11,995. Propelling Tramcars, &c., B. Journeaux, Dublin.
11,996. Bricks, S. G. Rhodes, Leeds.
11,997. Automatic Pleasure Railway, H. Thwaites, Preston.
11,998. Wheels of Railway Engines, F. B. von Wechmar, Birmingham.
11,999. Burning Oil for Heating, J. W. Newall, London.
12,000. Double Action Refrigerators, E. Schofield, Liverpool.
12,001. Polishing Cut Glass, J. Millar and The Sowerby's Ellison Glass Works, London.
12,002. Buckles, S. May, London.
12,003. Pulverising Hard Substances, J. R. Alsing, London.
12,004. Bleaching Vegetable Fibres, A. C. Henderson.—(*U. C. G. Hérisson and C. Lefort, France.*)
12,005. Directing the Fire of Machine Guns, W. T. Goolden, London.
12,006. Omnibuses, &c., S. and F. E. Andrews, Liverpool.
12,007. Cooking Ranges, W. Mitchell and W. Morrison, Glasgow.
12,008. Egg Boxes, A. H. Storey, London.
12,009. Ticket Holder, E. G. Armstrong and W. G. G. Jackson, London.
12,010. Means for Extinguishing Fires, H. C. Carver, London.
12,011. Globe Holders of Candle Lamps, W. Nunn, London.
12,012. Opening and Closing Carriage Windows, R. Hicks, London.
12,013. Copying Writings, H. J. Allison.—(*G. N. Sanders, United States.*)
12,014. Closing Doors, G. Brewer.—(*E. Bender and E. Stevens, Belgium.*)
12,015. Incandescent Electric Lamps, W. Lönholdt, London.
12,016. Boots, J. T. Southorn, London.
12,017. Carbons for Voltaic Batteries, P. L. Vercherè, London.
12,018. Permanent Way of Railways, V. G. Webb, London.
12,019. Electro-magnetic Motors, H. Hartig, London.
12,020. Colouring Matters, J. Imray.—(*La Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis, A. F. Poirrier, and D. A. Rosenstiehl, France.*)
12,021. Fastening Envelopes, D. C. A. Thatcher, London.
12,022. Pocket Knives, L. A. Rigaux, London.
12,023. Bars of Glazed Sashes, C. Hayes, London.
12,024. Winding Thread upon Quills, H. H. Lake.—(*J. Nightingale, United States.*)
12,025. Facilitating the Rapid Publication of News, &c., E. F. Law, London.
12,026. Mowing or Harvesting Machines, H. H. Lake.—(*F. B. Dole, United States.*)
12,027. Preventing Damage to Walls or Paper, C. E. Clark, London.
12,028. Spring Mattresses, S. P. Kittle, London.
12,029. Disinfectant, J. Bennett, London.

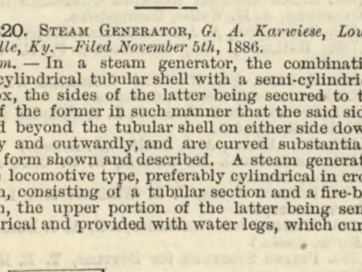
SELECTED AMERICAN PATENTS.

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

365,820. Steam Generator, *G. A. Karwiese, Louisville, Ky.—Filed November 5th*, 1886.

Claim.—In a steam generator, the combination of a cylindrical tubular shell with a semi-cylindrical fire-box, the sides of the latter being secured to the end of the former in such manner that the said sides extend beyond the tubular shell on either side downwardly and outwardly, and are curved substantially in the form shown and described. A steam generator of the locomotive type, preferably cylindrical in cross section, consisting of a tubular section and a fire-box section, the upper portion of the latter being semi-cylindrical and provided with water legs, which curve

365,820

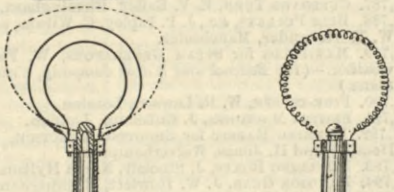


downwardly and flaring at the bottom, whereby the fire-box is enlarged, in combination with circulating transverse inclined tubes, and a central inclined supporting tube, for the purposes set forth and described. The combination, with the fire-box of a locomotive, of the air chamber located on the smoke-box, provided with a perforated plate and controlling valve, the conveying duct, the air chamber in the rear of the furnace, and the perforated fire-brick, all arranged to operate in the manner set forth. The combination of the fire-box of a locomotive with the front air supply duct having front and back chambers and the exhaust steam heating and distributing pipe located within said duct for heating air and inducing a current, in the manner and for the purpose set forth.

365,832. Refractory Filament for Lighting, *C. M. Lungren, New York, N.Y.—Filed August 12th*, 1885.

Claim.—(1) An incandescent organ for gas or other burners, consisting of a filamentary body of refractory earth, such as lime, magnesia, zirconia, and the like.

365,832

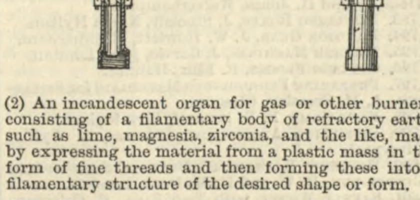


(2) An incandescent organ for gas or other burners, consisting of a filamentary body of refractory earth, such as lime, magnesia, zirconia, and the like, made by expressing the material from a plastic mass in the form of fine threads and then forming these into a filamentary structure of the desired shape or form.

365,836. Boiler Flue Cleaner, *F. L. McGahan, Indianapolis, Ind.—Filed September 25th*, 1886.

Claim.—(1) In a flue cleaner of the class described, the combination, with the nozzle having annular discharge ports and the valve actuating plate, of the

365,836

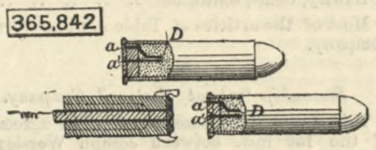


guide frame consisting of a series of converging bars secured to said plate, arranged between said ports and projecting beyond said nozzle, substantially as and for the purpose specified. (2) In a flue cleaner, the combination, with the nozzle A, valve F, and plate B, of the series of converging bars formed integral with said plate, substantially as and for the purpose specified. (3) In a flue cleaner, the combination of the plate B, having bars *l*, and the annular elastic packing ring I, for the purpose specified.

365,842. Electric Cartridge, *E. A. Monfort, New York, N.Y.—Filed January 13th*, 1883.

Claim.—An electric cartridge having an annular depression with a conductor, as *a*, and a central depression with a conductor, as a^1, the inner ends of

365,842

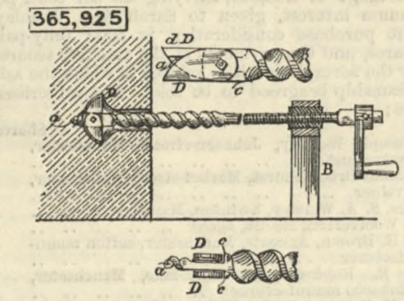


said conductors being connected by a metal piece, as D^1, embedded in the powder, constructed and adapted to serve with an arm having projections to agree with the depressions and electrical connections, as set forth.

365,925. Drill for Mining Purposes, *W. H. Larimer, Terre Haute, Ind.—Filed February 23rd*, 1887.

Claim.—(1) A drill of the character described, having knives or blades pivotted to its opposite sides whose corresponding edges are curved or bevelled, the same being formed with the screw point *a*, designed to operate in advance of the blades when revolved or rotated, and shoulders *c c*, limiting the spread of the knives, substantially as specified. (2) The combina-

365,925

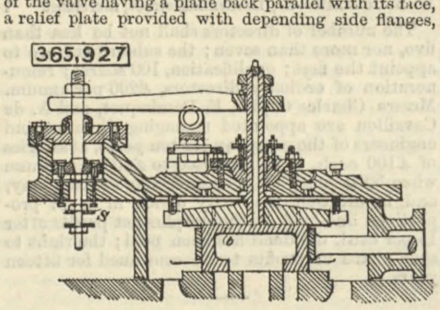


tion, with the drill formed with screw point *a*, designed to operate in advance of the blades when revolved or rotated, and shoulders *c c*, limiting the spread of the blades, of the oppositely pivotted blades B D, having ribs *d* on their inner faces designed to abut against the point *a* for preventing the said blades from crossing each other when closed together, substantially as described. (3) The combination, with a drill of the character described, formed with lugs or shoulders *c c* and screw point *a*, and flattened, as at *b*, of knives D D, pivotally attached and formed with ribs *d* on their inner faces, substantially as set forth.

365,927. Balanced Valve, *W. W. Lewis, Cincinnati, Ohio.—Filed March 12th*, 1886.

Claim.—(1) In a balanced valve, the combination of the balancing plate and its supporting rod with the adjustable stuffing-box in the steam chest cover, substantially as set forth. (2) In a balanced valve, in combination with the balancing plate, its supporting rod, the steam chest cover, and the adjustable stuffing-box, the bolts threaded in the steam chest cover and adjustable against the back of the plate, substantially as set forth. (3) The combination, in a balanced valve, of the valve having a plane back parallel with its face, a relief plate provided with depending side flanges,

365,927

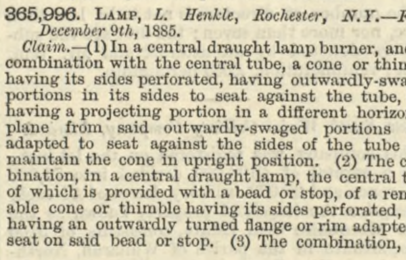


forming a horizontal slot-and-feather engagement with the valve, and means, substantially as described, for balancing the plate against pressure in both directions, substantially as set forth. (4) In a balanced valve, in combination with the relief plate, a valve provided with apertures *t*, opening into the exhaust cavity, substantially as and for the purpose set forth. (5) In a balanced valve, in combination with the balance plate and its supporting rod, the springs S, composed of two members acting in opposite directions to resist pressure of steam upon the plate and to relieve the weight of the plate when steam is shut off, substantially as set forth. (6) In a balanced valve, the steam balancing piston provided with one or more check valves, in combination with adjustable screws *o*, arranged and operated as set forth.

365,996. Lamp, *L. Henkle, Rochester, N.Y.—Filed December 9th*, 1885.

Claim.—(1) In a central draught lamp burner, and in combination with the central tube, a cone or thimble having its sides perforated, having outwardly-swaged portions in its sides to seat against the tube, and having a projecting portion in a different horizontal plane from said outwardly-swaged portions also adapted to seat against the sides of the tube and maintain the cone in upright position. (2) The combination, in a central draught lamp, the central tube of which is provided with a bead or stop, of a removable cone or thimble having its sides perforated, and having an outwardly turned flange or rim adapted to seat on said bead or stop. (3) The combination, in a

365,996

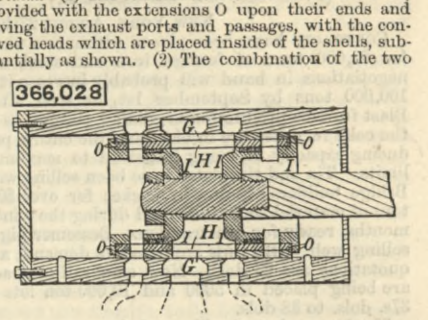


central draught lamp, the central tube of which is provided with a bead or stop, of a cone or thimble having its sides perforated, and having outwardly-swaged projections in said sides and an out-turned flange or projection at its lower end, having seating on said bead or stop, substantially as set forth. (4) The combination, with the central tube of a central draught lamp, of a cone or thimble formed in one piece, having an imperforate top and perforated sides having outwardly-swaged projections adapted to seat against the sides of the tube, and a projection or out-turned portion at its lower end also seating against said tube, substantially as set forth. (5) A removable cone or thimble made of a single piece of metal having perforated sides, in combination with the central tube of an Argand lamp, substantially as set forth.

366,028. Steam Valve, *C. F. Rigby, Foxburg, Pa.—Filed March 24th*, 1887.

Claim.—(1) The combination of the two shells G H, provided with the extensions O upon their ends and having the exhaust ports and passages, with the concaved heads which are placed inside of the shells, substantially as shown. (2) The combination of the two

366,028

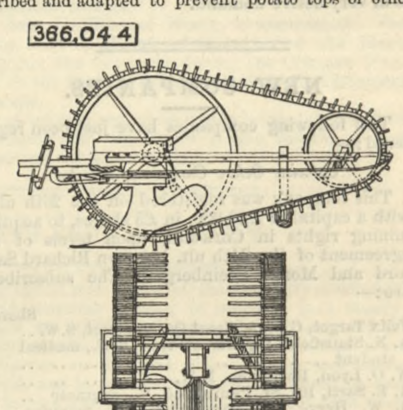


shells G H with the concaved heads I placed therein and provided with suitable packing rings, and the groove which is filled with soft metal, substantially as described. (3) The combination of the two split shells G H, provided with inlet and exhaust ports, with the concaved heads I, also provided with inlet ports and suitable packing rings, and the plates Q, which are inserted in the edges of the outside shell, substantially as set forth.

366,044. Potato Digging Machine, *F. M. Thorn, Orchard Park, N.Y.—Filed October 12th*, 1886.

Claim.—(1) In a potato digger of the type hereinbefore indicated, the combination, with the plough, and transporting wheels, and pulleys arranged in rear of the latter, of the endless chains, carrying fingers or rods that project inward toward said plough, substantially as shown and described, whereby the mingled soil and potatoes turned on to the rods or fingers are carried backward and upward and separated, as specified. (2) In combination with the endless chain and system of sifting rods or fingers, the combined shield and carrier, constructed substantially as described and adapted to prevent potato tops or other

366,044

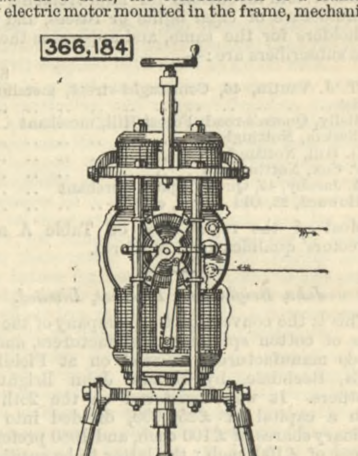


materials from falling into the wheel spokes or otherwise clogging, and to remove the potatoes, soil, or other materials from the sifting rods or fingers at any desired height from the ground, as specified. (3) The combination of the endless chains with systems of sifting rods or fingers with the combined shield and carrier, arranged as specified, and the double plough having its mould board curved spirally, substantially as shown and described, whereby the soil and potatoes removed by the plough are not only turned laterally upon the sifting rods or fingers, but also inverted, so that the centre of the row, which contains most of the potatoes, is thrown toward the outside of the systems of rods and next to the shield and carrier, leaving most of the soil nearer the inner or free ends of the sifting rods, so that it will be first pushed off by the carrier, as specified.

366,184. Electric Rock-drill, *L. J. Phelps, New York.—Filed December 31st*, 1885.

Claim.—In a drill, the combination of a frame, a rotary electric motor mounted in the frame, mechanism

366,184

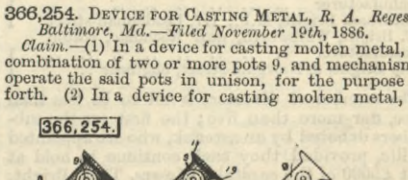


for adjusting or feeding the motor relatively to the frame, a drill stock, and a crank-and-pitman connection by which the drill stock is connected with the spindle of the motor.

366,254. Device for Casting Metal, *R. A. Regester, Baltimore, Md.—Filed November 19th*, 1886.

Claim.—(1) In a device for casting molten metal, the combination of two or more pots 9, and mechanism to operate the said pots in unison, for the purpose set forth. (2) In a device for casting molten metal, the

366,254.



combination of the pots 9, mechanism to operate said pots in unison, and the frame 8, for the purpose set forth. (3) In a device for casting molten metal, the combination of the pots 9, mechanism to operate the said pots, the frame 8, and the mould 5, with its gates 7 so placed that each gate will receive a stream from one of the spouts 19, with which the pots 9 are provided, for the purpose set forth.