THE DRAINAGE OF FENS AND LOW LANDS BY STEAM POWER.

By W. H. Wheeler, M. Inst. C.E.

No. XII.

Glassmoor.—This is a district in the Middle Level consisting of about 6000 acres of Fenland. It discharges its water into one of the main drains of the Middle Level system about twenty-seven miles from the outfall sluice in the Ouse. The average lift is about 5ft., rising occasionally in floods to as much as 8ft. The machinery consists of a pair of 15-N.H.P. high-pressure condensing vertical engines; the crank shaft, is carried on cast iron A frames, the fly-wheel working inside these, and toothed into a horizontal bevel wheel attached to the vertical shaft of the pump, which is placed in a well immediately under the engines. The steam cylinder, condenser, and pump, are outside the frame, the latter being worked by a rocking beam, one end of which is connected with the piston-rod, and the other to the floor. Steam is supplied by two Cornish boilers, the working steam pressure being 40 lb., the engines making forty-seven revolutions a minute, and the pump at this speed 116. The culvert for connecting the pump drain with the river passes under the engine-house, the pump well being in the centre. The pump has 4ft. fan, 1ft. 1½in. deep. The engine and boilers are contained in a well-designed building of white bricks with red brick arches and dressings, which present a very pleasing appearance; the chimney is about 70ft. high. This machinery was put in about twenty-four years ago by Messrs. Easton and Amos, and has stood and worked during that time without any material repairs. The whole thing is well and compactly arranged, and is an excellent example of a small pumping-station, and well illustrates the suitability of the centrifugal pump for Fen drainage, and shows that pumps, equally with scoop-wheels, will run for a great number of years without accident or repair. The framework of the engines only occupies a space about 6ft. square, and with the pump being placed under this frame the cost of foundations is reduced within a small compass. The long time that the engines have run is considered to be partly due to their being of the vertical type, the wear and strain on the cylinder being less than in a horizontal engine, and a settlement in the foundations having less effect on the working of engines arranged as these are. The consumption of coal for the three years, 1881-83, has averaged about 60 tons a year—equal to 100 acres per ton of coals. Taking the cost of coals at 15s. a ton, this is equal to 1·80d. per acre for coals, or taking the lift at 5ft., ·36d. per foot lift.

Wexford Harbour Reclamation Works, Ireland.—A large area of land was reclaimed from Wexford Harbour by embankments. From the level of this land, as compared with the water in the harbour, it was necessary to use steam power for the drainage. The reclamation is divided into two districts, termed respectively the North, containing 2489 acres, and South, containing 2410 acres, each having a separate pumping station; that for the south side being a scoop wheel and for the north a centrifugal pump. The water pumped off is exclusively rainfall, which in ordinary seasons amounts to about 45½in. It was calculated that three-fourths of this would have to be pumped, the remainder being absorbed by the vegetation or taken up by evaporation. Spring tides in the harbour rise 5ft., and neap tides 3ft. The pumping station for the south reclamation is situated at Drinagh, and consists of a scoop wheel driven by a condensing beam engine. The engine has one 36in. cylinder, with 6ft. stroke. A variable rate of expansion can be given by sliding the cams which work the steam valves. The engine runs at the rate of 25 revolutions a minute. Steam is supplied by two Cornish boilers, 21ft. 6in. long, the working pressure being 13 lb. on the inch. The scoop wheel is 40ft. diameter by 10ft. wide, the scoops being 3ft. long. The wheel makes 4½ revolutions a minute when the engine is making 25, the velocity at the periphery being 9·42ft. per second. At this pace the wheel was calculated to raise 170 tons of water per minute. The water approached the wheel with a velocity of 9·42ft. per second—equal to that due to a fall of 1·4ft., leaving the net calculated lift 8ft. The useful effect on the trials was found to be 68·2 per cent., leaving the loss from all causes, including the engine, 31·8. The fuel consumed was found to be 4½ lb. per indicated horse-power per hour. The total cost of the machinery for this pumping station was £5000—equal to £2·08 per acre drained. Taking the greatest duty at 170 tons lifted 11ft. per minute, and the total cost at £5000, this gives about £40 per horse-power of water lifted for the machinery, the contract price for the wheel being £760. The wheel weighs 34¼ tons, and is carried by a cast iron hollow shaft 13in. diameter, working in brass bearings 12in. diameter by 16in. long. It has three cast iron spoke centres 6ft. diameter; twenty flat wrought iron spokes radiated 14ft. from the periphery of the centres. A ring of flat iron 34ft. diameter connects the ends of the arms. To this ring and a smaller one, 28ft. diameter, are rivetted flat iron float spokes, bent to give the scoops the proper rake. The spur wheel is 31ft. 6½in. diameter, 10½in. wide, and 3½in. pitch. The spur pinion, 5ft. 3½in. in diameter, is keyed on to the fly-wheel shaft, and gears into the annular wheel 7ft. below its centre on the discharging side, by which arrangement it was considered that the weight of the water would be borne directly by the pinion. There are forty scoops each 9ft. 11¾in. wide by 3ft. deep, drawn tangents to a circle 13ft. diameter, and formed of 3in. Memel planks grooved and tongued and secured by hook bolts to the float spokes. The clearance between the wheel and the masonry is from ¼in. to ⅜in. The water is delivered over a crest 4in. broad, 11ft. higher than the bottom of the race under the wheel, and 3ft. 6in. below H.W.S. tides. Water is admitted to the wheel by cast iron sluices. The channel from the wheel to 8ft. outside the inlet is level, 10ft. 7in. wide on wheel side of sluice, and 11ft. 7in. on outside of sluice, the cill of which is 3in. higher than the bottom of the channel. The pumping station for the North Reclamation was erected after the scoop wheel had been in operation some time, and it was determined to adopt a centrifugal pump as the more effective machine under all circumstances, its great advantage over the wheel being its adaptability to varying lifts and less cost of foundations. The pump used was one of Appold's type supplied by Messrs. Easton and Anderson. It is self-contained in a cast iron frame with galvanised fan of sheet iron 4ft. diameter by 15in. deep, with diaphragm in middle of its depth and revolving in cast iron case. Two suction pipes conduct the water to above and below the fan, which is carried by a vertical spindle making 133 revolutions a minute. Motion is given to the spindle by a bevel pinion with forty-three teeth geared into mortice bevel fly-wheel with 114 teeth, keyed on to the crank shaft. The pump is driven by a pair of direct-acting condensing engines having cylinders 18¼in. diameter with 2ft. stroke; steam being used at pressure of 50 lb. with high degree of expansion, and supplied by a Cornish boiler 22ft. long by 6ft. 6in. diameter. The consumption of fuel at the trials was found to be 4½ lb. per I.H.P. The cost of the pump and engines complete was £1850. The buildings, culverts and foundations cost £2725; together, £4575, equal to £1·84 per acre drained, and £37 per horse-power of water lifted for the machinery, and £54 10s. for the buildings, together £91 10s. per horse-power. Trials of this pumping-machinery were made soon after the erection, steam in the boiler being from 30 lb. to 35 lb., and the mean pressure on the piston varying from 14·79 lb. to 17·02 lb., the enging making 47½ to 54½ revolutions, and the lift—that is, the difference of level of water in mouth of inlet culvert and in outlet at engine house—varying from 6ft. 2in. to 10ft. 2in. The indicated horse-power varied from 43·6 to 58·8, and the horse-power of water lifted 24·07 to 31·67, giving a mean effective result of 55·2 to 53·8 per cent., or allowing one-sixth of indicated horse-power as the resistance of the engines, the mean duty of the pump was 67 per cent. The particulars of these two stations are taken from a paper by Mr. W. Anderson in the "Proceedings" of the Institution of Civil Engineers in Ireland, for 1862, vol. vii., in which will be found the full details of the trials and drawings of the scoop wheel, &c. For the three years 1881 to 1883, the average rainfall at these stations was 40·34in. The scoop wheel, which drains 2410 acres, worked on an average 1800 hours each year, and the engines consumed about 350 tons of coals. The pump on the North Reclamation, which drains 2489 acres, ran on the average 1516 hours, and the engines consumed 215 tons of coal each year. Taking the average lift throughout the year in both cases as 5ft. 6in. and coals at 18s. per ton, this gives 26·3d. per acre per annum for the scoop wheel, and 18·45d. for the pump for coals only, or per acre per foot of lift 4·82d. and 3·35d. respectively.

Ferrara Marshes, North Italy.—This pumping station contains one of the largest combinations of centrifugal pumps for the drainage of land. The machinery was erected in 1874, by Messrs. J. and H. Gwynne, for pumping the water from the Ferrara Marshes in North Italy. The reclaimed land extends over an area of nearly 200 square miles, and the work done by the pumps consists in raising a little over 2000 tons of water per minute for a mean lift of 7ft. 6in.—the maximum being 12ft.—and delivering it into the river Volano, at Codigoro. The machinery consists of four pairs of centrifugal pumps having vertical discs, each set driven by a pair of compound engines. Each pump is constructed to deliver 9150 cubic feet—255 tons—a minute, or a total for the eight machines of 2040 tons. The pumps are placed one on each side of the engines, the pump shafts forming prolongations of the crank-shaft, and being connected to the latter by disc couplings. The pump shafts are of steel, 8½in. diameter, and are provided with bearings beyond the pump casings. The pumps have discs 5ft. 9in. diameter, with delivery pipes 54in. diameter, and double-suction pipes, in area jointly equal to the delivery pipes. The casing of each pump is made in a single casting, 15ft. diameter. The engines have cylinders 27¾in. and 46⅝in. diameter, the stroke being 2ft. 3in.; both cylinders are jacketted. For some years after the starting of these machines the low-pressure cylinders of each engine exhausted into a pair of surface condensers, placed on the discharge pipes. These condensers were cylindrical chambers traversed by a number of 3in. tubes, connected with the pump casing and discharge pipe. It was suggested that the efficiency of the pumps was interfered with by the presence of these surface condensers in the delivery pipes. They were removed, and condensation by injection, with auxiliary air pumping engines, substituted. The alteration was, however, a doubtful improvement, the difference in efficiency was not very observable and the auxiliary engines involve extra attention. Steam is generated by two groups of boilers, each consisting of five, of a compound, double-flued type, with Galloway tubes and horizontal marine tubes. At the official trial made in May, 1875, the consumption of fuel was 2½ lb. per indicated horse-power per hour, or 4 lb. per horse-power of water lifted—doubtless the best result obtained on drainage works up to that time. All these pumps worked continuously day and night from the 10th October, 1878, to 31st May, 1879, in a satisfactory manner. Since the latter date the seasons have been drier and the work lighter. These engines and pumps are at the present time in perfect order, the cost for repair having been very light. About the same time that these pumps were put up by Messrs. Gwynne, four scoop wheels were fixed by a Dutch firm for draining the Marrozzo Marshes on the other side of the river Volano. In accordance with the recommendation of a commission of engineers these are now about to be taken down and replaced by Messrs. J. and H. Gwynne with two of their centrifugal pumps calculated to discharge, each, 9951 cubic feet—277 tons—a minute. The new pumps are to be worked by the existing engines, and in addition a supplementary compound engine and pump, to discharge 70 tons a minute, is to be added. Although the large pumps will measure 17ft. over their cases, their weight will hardly be one-fourth of that of the four wheels which they are to replace. The old foundations will be utilised to a large extent, and the suction pipes will dip into the old wheel pits.

Fos, Bouches du Rhone, South of France.—In this district large reclamation works were carried out in 1884-85. Pumping was required, and Messrs. J. and H. Gwynne were commissioned to erect at Fos a pair of their "Invincible" compound direct-acting centrifugal pumping engines, each pump to raise 60 to 70 tons per minute; and at another pumping station—Gallejon—some miles distant, a third "Invincible" pumping engine was provided, to raise 90 to 100 tons per minute. The lift was low—1·0 metres to 1·80 metres—and experience has shown that with such lifts a low efficiency was to be expected. The makers, nevertheless, guaranteed that for the smaller machines the steam used would not exceed ·0718 kilogs. for each cubic metre of water raised one metre, and that the steam per indicated horse-power per hour would be from 20 lb. to 24 lb. English. For the larger machine the figures were ·07 kilogs. and 20 lb. to 22 lb. English. Very carefully conducted trials were made with the smaller pumps by Mr. A. C. J. Vreedenberg, a Dutch engineer, when the following results were obtained from No. 2 engine, with a mean lift of 1·379 metres—4·52ft.:—Water raised, each pump per minute, 65·7 tons; horse-power in water lifted, 20·18; horse-power indicated, 37·0; efficiency indicated horse-power compared with water horse-power, ·54; coal consumption per water horse-power per hour, 4·45 lb.—2·033 kilos. Owing to a slight defect in the machinery, discovered after the trial of No. 1 engine, the results obtained were not quite as good as those from the other engine; but this having been remedied, there was found to be very little difference in the working of the two sets of machines. Given on terms of the guarantee, the result was ·0627 kilos. of steam per cubic metre of water raised 1 metre, and 20·66 lb. English per indicated horse-power per hour. The boilers were of French design and construction, their evaporative efficiency is not very high, 8·33 lb. of water per pound of good coal. The coal per I-H.P. per hour was 2·47 lb. These results were subsequently confirmed by trials of eight hours on each pump, conducted by Mr. Dornés, engineer of the reclamation, who obtained with one pump, lift 65·75in.; mean delivery, 64·7 tons; efficiency of whole machine, ·579; steam per indicated horse-power, 20·32 lb.; coal per indicated horse-power, 2·44 lb. per hour; coal per water horse-power, 4·21 lb. per hour. The result from the other pump is practically the same, as it ought to be, the machines being made throughout strictly to the same dimensions, and expressed in terms of the guarantee, the steam used per cubic metre of water raised one metre high being for one pump ·059 kilos., for the other ·062 kilos. On the larger pump at Gallejon some interesting experiments were made by French engineers with progressive speeds and lifts. The lifts varied from 3¼ft. to 6½ft. Three runs each of thirty minutes were made with each lift, and with a different number of revolutions for each half-hour. The results showed that an efficiency of ·50 was obtainable on a lift of 3·28ft.; on the other lifts the average efficiencies were for 4½ft., ·56; for 5ft., ·607; for 6ft., ·66; and for 6½ft., ·698. All efficiencies represent, as in the experiments with smaller pumps, the ratio which the water horse-power bears to the indicated horse-power. The details of these trials are given in the following table. These short experiments may not give results so strictly accurate as more lengthened trials, but they are consistent in agreeing with the results obtained from the smaller pumps, and it is evident that in these machines Messrs. J. and H. Gwynne have obtained remarkably high efficiencies considering the small horse-power in the water, the small indicated horse-power, and the low lifts. The difficulty in preventing waste of energy while raising a large volume of water rapidly through a small height is obvious enough. Pump and engine friction must also make a larger fraction of the total power uselessly expended when the lift and water horse-power are small, and it is important to observe in these experiments the steady increase of efficiency with increase of lift.

Trials of the Gallejon pumps.—Table of discharge and efficiency corresponding to different heights of lift and to variable speeds.

Height of lift in metres.	Revolutions.	Discharge in litres per second.	Efficiency between work shown on pistons and effective work in water raised.
1·000 (0·900 to 1·100)	65·4	458	0·325
	71·5	716	0·428
	86·5	1280	0·446
	101·3	1634	0·504
1·325 (1·300 to 1·350)	90·6	1241	0·603
	107·7	1748	0·568
	117·5	1990	0·511
1·540 (1·520 to 1·560)	93·0	1070	0·622
	103·0	1461	0·618
	116·0	1884	0·581
1·800 (1·760 to 1·840)	94·0	950	0·658
	106·5	1448	0·797
	120·0	1892	0·634
2·000	107·0	1314	0·718
	119·0	1738	0·678

ON THE CONSTRUCTIVE IRONWORK IN TERRY'S NEW THEATRE.

By Max am Ende.

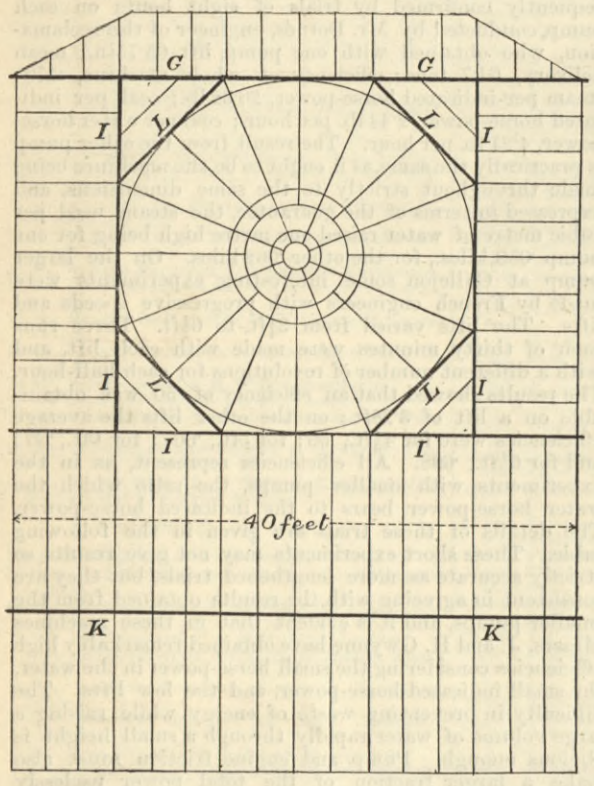
On page 257 the construction of the galleries was described generally. The details of the cantilever, the anchorage and the baseplate are shown in Figs. 3 and 7, and the details of the steps are shown in Figs. 4, 5, and 6. The risers of the steps have flat-bar bracing, which is almost identical throughout, while the bracing in the treads has a different angle in each step. The object of making this latticework and not plates was partly to obtain greater economy of metal, partly to enclose the

iron entirely in concrete, by which means it is better protected, not only from fire but also from corrosion. The thickness of the concrete is only 3½in., and thus the whole structure is as light as it possibly can be under these conditions. As an objection to this construction should, however, be mentioned that the centering for laying the concrete is somewhat expensive, perhaps more than balancing the saving of metal; and it might have been admissible to forego the advantage of entire protection from corrosion and from fire by making the steps of solid plates and covering them only on the top with concrete, painting them underneath. This would not have been objectionable, inasmuch as for acoustic purposes an additional ceiling of a conical form was introduced, made of wire gauze and plaster.

The structure is finished at the parapet in a peculiar manner. In the usual way there would have been at the parapet a girder similar to one of the risers, and this girder would rest on the large cantilevers, projecting so far as to reach it. In the present case a series of small cantilevers, which at the same time form the structural parts of the parapet, and which resemble in outline the letter U, are hung from the first riser, the horizontal part of the U containing the first tread, which is constructed like the other treads. These cantilevers produce strains in the second tread the reverse of those which already exist in it, and balance them to some extent. Fig. 5 shows the load P on the first tread and another vertical force, the resistance of the first riser, which forms a couple with P; it also shows the two resisting forces of the first and the second riser, forming together a horizontal couple, which keeps the vertical couple in equilibrium. By this arrangement the large cantilever is shortened by the width of a tread, and the girder at the parapet is reduced to a light angle iron, so that the thickness of the first tread is only like that of the other treads, viz., 3½in. This is of some importance, as this tread forms the upper limit of the field of sight of spectators in the back seats below.

Fig 12

Plan of ironwork in Roof.



If a slight digression from the case in hand be permissible, it may be pointed out that the wider application of the stepped or zig-zag construction offers a great deal that is worth consideration and study. There is, for example, from a theoretical point of view, the question how these zig-zag structures behave under a concentrated load—a question of great importance in the construction of bridge-floors; for although the true zig-zag form has not yet been carried out as a bridge floor, there is a large number of other forms in use which rank in the same class. It may here be mentioned, as the result of an investigation, that the capacity for distributing a concentrated load is in most of these forms—unless they are effectually stiffened between the bearings by a distributing structure—less than the value of one-quarter of a zig-zag or corrugation on each side of the loaded corrugation, and that therefore these structures are ill suited to support concentrated loads. On the other hand, if the load consists of many small elements, as in the present case, or is evenly distributed over a large area, they are well suited to support it. If the zig-zags or corrugations are developed from the solid corrugated plate into light lattice work, with a corresponding enlargement of their depth and width, as in the present case, or in the case of the screens of the National Agricultural Hall at Kensington, a new system of iron or steel construction is produced, which combines lightness and elegance with a fair degree of economy, and which might be applicable to other kinds of structures besides those here referred to. This subject cannot, however, be gone into here, as the description of the present structure must be continued.

The steps terminate in girders or stringers on each side. These are not shown in detail, but their position is indicated in Fig. 2, page 257. The stringers, as well as the cantilevers, are supported by solid round steel columns, the details of one of which are shown in Fig. 8. In order to facilitate the erection, and to distribute the pressure equally over the sectional area, they are made with ball pivots at each end, and they have been wedged in at the sockets by a number of steel wedges, so as to give them the strength of columns with fixed ends. This, of course, was done after the greater part of the dead oad had got its bearing on the columns. The roof was planned by the architect to be an iron structure bedded entirely in concrete, and without any support between the walls, which are 40ft. apart. The dead load upon this roof amounts to an average of about 140 lb. per foot superficial, and the weight of the ironwork is 15¼ tons, or, as it covers an area of about 2200 square feet, its weight per square is about 13½ cwt. This is not an excessive weight, taking into account that the corresponding strain on the gross sectional inch of iron does not exceed four tons. If the depth of the main girders had been limited, or their shape determined, as in the construction of floors, the weight would have been much greater; but in this case there was no limit as to the depth, and only a partial restriction as to shape, and therefore shape and proportions could be chosen so as to attain a very economical distribution of the metal. The details of the cupola are shown in Figs. 9 and 10, and Fig. 11 shows one of the roof principals or main girders. Fig. 12 is a plan of the ironwork in the roof. The architect of the theatre is Mr. Walter Emden, of London.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Mining rents and royalties—Austria-Hungary.—All minerals are reserved to the State, and their extraction can only take place in accordance with the mining law. To extract minerals, it is necessary to apply for a permit to search in a certain district, the area of which must be accurately stated. The permit is for one year, but may be renewed on application before its expiration. Upon the permit being granted, one or more free diggings in the district are to be applied for, each of which must not measure more than 1391ft. in diameter. An arrangement must then be concluded with the owner of the land either for its purchase or temporary occupation at an annual rent, but the latter case is of rare occurrence. The proprietor can be compelled to cede his property, and if the parties cannot agree as to the rent or price to be paid, the amount is fixed by sworn experts appointed by the mining authorities. The taxes to be paid to the State are: For each free digging of 1391ft. diameter, giving no right of extracting ore, 6s. 8d. per annum; for the actual working of each mine of 11·15 acres, and for surface minings of 28·44 acres, also 6s. 8d. per annum; in addition, the first class of the income-tax, amounting to 5 per cent. on the net income, with an addition of 100 per cent., and of from 60 to over 100 per cent. thereof for provincial and municipal taxes; for coals there are allowed eight parallelograms, and for other minerals four parallelograms each, of 11·15 acres. Larger groups are not permitted.

Mining rents and royalties—Belgium.—The law of 1810 provided that no mining operations could be undertaken without a direct concession from the Government. This concession granted the ownership of the mine in perpetuity, but it could not be divided or sold without the previous consent of the Government. The mines, with all the necessary plant and tools, were to be real property, but products of and shares in a mine were to be personal property. Any landowner could search for mines on his own land, but could not work mines when found without the sanction of the Government. No one could search for mines on another's land without his consent. In exceptional cases the Government might grant authority for such search after hearing the proprietor's objections, and fixing the amount of indemnity to be paid him. Should the proprietor of the mine occupy the surface for any length of time, he had either to return the land in the same state as he found it, and pay twice as much as the net product of the land, or purchase the land at double its value before mining commenced. In 1837 the law was considerably modified in the landowner's interest, who now receives a double royalty, one fixed as settled by the Act of Concession, but not to be less than ·96d. for each acre per annum, another proportional, varying from 1 to 3 per cent. of the net product of the mine. The proprietor of a sufficient quantity of land who can show that he possesses the necessary capital is entitled to the concession. The Government can expropriate the owner of the land if they consider the interest of the mine requires it, not only for the purpose of erecting necessary buildings, but also for the construction of railways or roads to carry away the produce of the mine. In such case the owner receives a double indemnity, as fixed by the law of 1810, for instances of temporary occupation. This indemnity includes not only the value of the land of which the owner may be deprived, but also takes into account any disadvantages which may result from his property being crossed by a new railway or road, as well as any enhanced value which the land may have for him through having been long in his family or for any other reason. In certain districts of the province of Liège the landowner receives in addition every eightieth bucket brought up, or 1¼ per cent. of the gross produce.

Mining rents and royalties —France.—All mines are the property of the State, and even the owner cannot work a mine on his land without permission. A concession confers a right of perpetual property in a mine and its buildings, engines, galleries, horses, materials, pits, tools, and utensils. No person can search for minerals unless he has previously arranged to pay an indemnity to the owner of the land. If the works undertaken by a concessionaire or explorer will allow of the grounds being cultivated as before at the expiration of twelve months, the indemnity is not to exceed twice the net return of the land so damaged. If the owner is deprived of the use of his ground for more than twelve months, or it is rendered permanently unfit for cultivation, the concessionaire or explorer must purchase it at not more than double its value before the occupation. To obtain a concession, application must be made to the prefect of the department, with full particulars and plans. The final decision rests with the Council of State, which being obtained, a decree issues determining the extent and kind of the mine. From the date of the concession there is to be paid a yearly rent to the owner of the surface, a yearly rent to the same amount for the surface area occupied by the machinery and plant; also to the State a yearly rent of 20s. 9d. per square mile and 5 per cent. of the net produce of the mine, and an additional ½ per cent. to form a relief fund for accidents. There are three forms of rents to owners of surface lands, proportional to the gross yield of the mine, fixed, or a mixture of both. The proportional rents in twenty-two mining concessions in the Departments of the Loire were: For seams of 2·19 yards and more thick, in pits 164ft. deep, ⅛; in pits 164ft. to 328ft. deep, ⅛; in pits 328ft. to 656ft. deep, $\frac{1}{10}$; in pits 656ft. to 820ft. deep, $\frac{1}{14}$; in pits 820ft. to 984ft. deep, $\frac{1}{16}$; over 984ft. deep, $\frac{1}{20}$. These fractions were to be reduced one-third for seams of 3·28ft. to 6·56ft., by one-half for seams of 1·64ft. to 3·28ft., and by three-quarters for seams less than 1·64ft. thick. The proportional rent habitually paid in the Loire basin amounted to between 4⅛d. and 6¾d. per ton, according to depth. In the basin of the Aveyron, the rent for the collieries of Aubin, Cransac, Negrin, and Ruhles, is, per ton, ·9d. for depths of less than 164ft.; ·45d. for depths down to 328ft.; and ·225d. for depths greater than 328ft. This in practice is much less than the rent in the Loire basin. In iron mines the proportional rent varies from 7·90d. to 9·84d. per ton. Fixed rents are more frequent than proportional. In the salt mines de l'Est they are high, £5 6s. 5d. per acre; in the manganese mines of Romaneche, 17s. 7¾d. per acre; for anthracite coal in Ariege and Hautes Alpes they are as low as ·117d. and ·156d. per acre. In the majority of cases they range from ·194d. to ·388d. per acre. Instances of mixed rents are, for anthracite coal, Rochebaron, Hautes Alpes, ·78d. per acre, and 2 per cent. of the produce extracted; coal, Soulie, Department of the Lot, ·39d. per acre, and 2·5 per cent. of the value of the coal extracted. There are large coalfields, such as Aniche on the Belgian frontier, and Anzin, which do not pay any rent to the landowner. Iron mines worked as quarries do not require a concession.

Mining rents and royalties—Germany.—In Prussia and the territories accruing to it minerals generally are not at the disposal of the owner of the soil, who cannot even dig for them without a licence from the mining authorities. In the old electoral lands coal and brown coal, and in the Duchy of Silesia iron, are the property of the landowner, certain of the old mining regulations still being in force. The German mining law of 1865 does not recognise in the owner of the soil any claim to a rent, royalty, or similar advantage of the nature of compensation for the raising of minerals, but the owner of the mine has to give full compensation for such superficial portions of the property as he may require, also for any damage which he may cause to the property by his mining operations. The law of mines does not accurately state what rights attach to the minerals before a concession has been granted, but leaves the interpretation of these rights to the Courts, whose views on the subject are divided. A claim to a licence to work minerals will be recognised as belonging to the person who has discovered the same and makes a proper application for the concession. The licence to work the mine is granted for limited and bounded areas, marked on the surface by straight lines, in depth by perpendicular lines and conveys the right to work the minerals mentioned in the licence within the prescribed area, and to erect above and below ground any necessary apparatus. The licence can only be cancelled when the higher mining authorities have decided that it is necessary on public grounds to take over the working of the mine and the owner refuses to come to terms. No charge is made for the licence beyond the expenses incurred by the authorities and the stamp duty. The State levies a tax of 2 per cent. on the value of the output from all mines with the exception of iron mines, which are free, and a payment has to be made to the miners' benefit fund for providing assistance in cases of accident or death and for the relief of widows and children. Most of the German States have adopted mining laws practically the same as those of Prussia, though the scale of taxation varies in different places. In some States there is a tax on allotments at the rate of ⅜d. per acre; in others there is the tax of ⅜d. per acre in addition to that of 2 per cent. on the output. In some cases mining is placed under the general tax on industry. In those States which have not adopted the principles of the Prussian mining law, the payment of rent to the owners of the soil is, generally speaking, the exception.

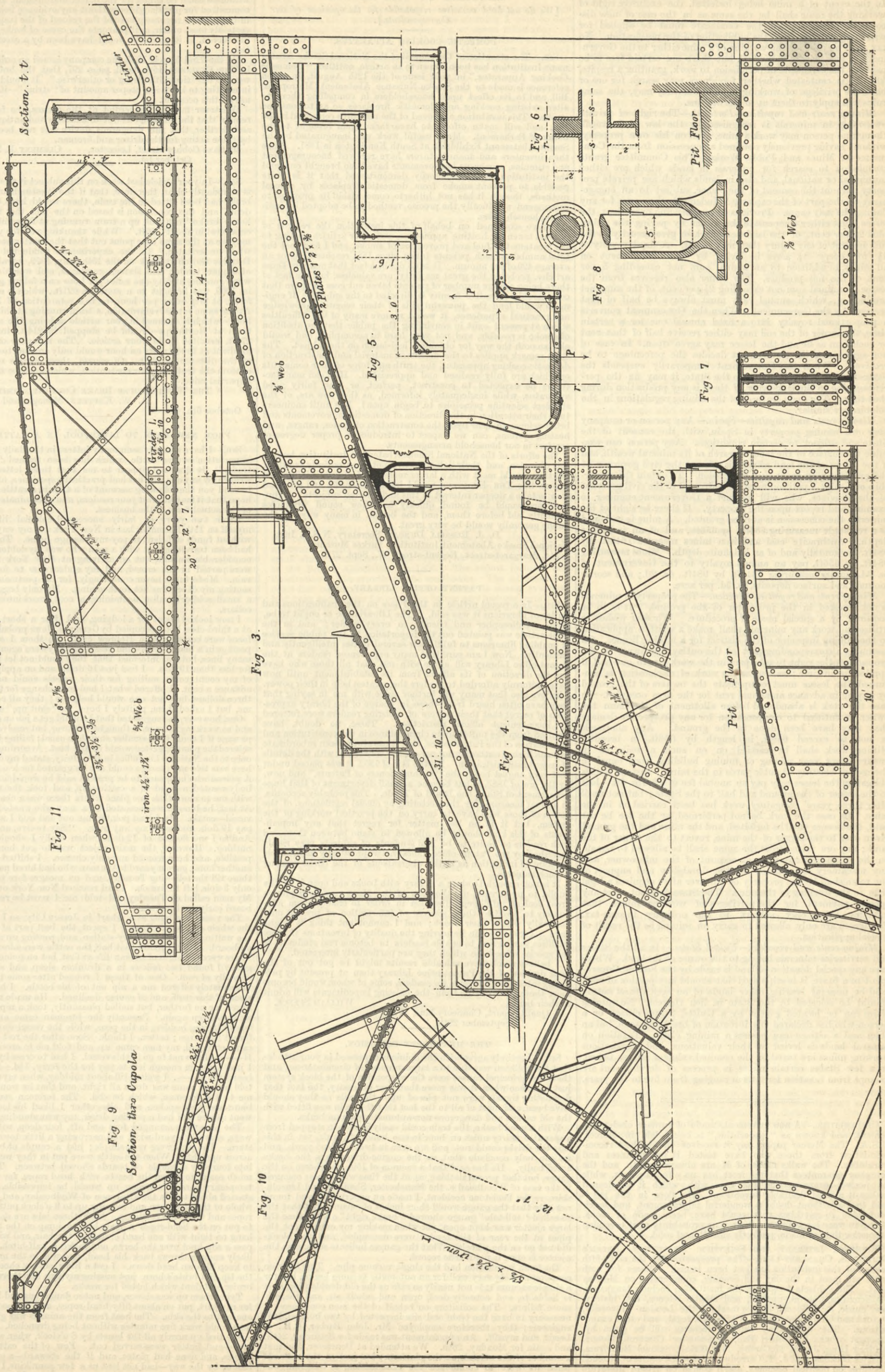
Mining rents and royalties—Italy.—There is no uniform legislation respecting the ownership of mines and minerals applicable to the whole kingdom. The most contradictory systems exist side by side, from those which identify the ownership of the subsoil with that of the surface, to those which consider them independent and separate. In the island of Sardinia and the greater part of the Italian territory—all Central and Upper Italy except the Tuscan provinces—mines can only be worked by a concession from the sovereign, which renders the mine a new and permanent property, capable of being disposed of or transferred. Permission for explorations or survey may be obtained even where the owner of the land refuses his consent. The person undertaking the exploration is bound to make good any damage caused by the works. Permits for exploration are granted free of charge. Any person may obtain a mining concession, though the discoverer of the mine is entitled to the preference. If he cannot undertake the working of the mine he is entitled to remuneration. Concessions cannot be divided without the consent of the Government, who may insist upon several mines in the same neighbourhood being placed under the same management when their independent working may prove dangerous to their own existence or to the safety of life. Holders of concessions of neighbouring mines may be combined in an association for the preservation of the mines or carrying out works necessary for the public safety. Compensation must be given for the advantage or injury which the works in one mine may occasion to another. Holders of concessions must make good any damage resulting from their works. Concessions are subject to a fixed tax of 1·94d. per acre, and to the payment of income-tax on the produce of the mine. No industrial works for treatment of minerals can be established without the consent of the prefect. Such works are further subject to special regulations in the interests of public safety. In the provinces forming the late kingdom of the two Sicilies mines may be worked by the owner of the soil. If he neglects to do so they may be conceded by the Government to other persons possessing the necessary qualifications, preference being given to the discoverer. The preference reserved in favour of the owner of the soil renders it most difficult for other persons to develope mining industries. When a mine is once opened all excavations may be continued into adjoining properties without their owners being able to interfere. Concessions are granted for any term and upon any conditions at the discretion of the Government. In the Tuscan provinces mines are the absolute property of the owners of the soil, except the iron mines in the island of Elba and the territory of Piombino, which belong to the State.

Mining rents and royalties—Norway.—The owner of the soil has no special right to metals and ores beyond that of participating in the working to the extent of a tenth part of the claim, which right he may transfer to others. Any one discovering a vein not already lawfully claimed may present a notification to that effect to the constable or magistrate of the parish or town, who shall publish it in the customary way. The publication gives to the person presenting the notification for eighteen months a preferential right to obtain a certificate of permission to work the mine. Applications for permission to work a mine are to be made to the superintendent of mines, accompanied by a specimen of the ore. To prevent the forfeiture of the exclusive privilege thus obtained, and the reversion of the find, the mine in question shall be continually worked, or else a respite shall be applied for within a month after ceasing work. Upon application for a respite, the exclusive privilege of working the mine shall be renewed for one year and six weeks, which con-

THE STRUCTURAL IRONWORK OF TERRY'S THEATRE, STRAND, LONDON.

MESSRS. MATTHEW T. SHAW AND SONS, LONDON, CONSTRUCTORS.

(For description see page 283.)



cession may be renewed as often as the same lawful causes occur. In the event of a mine being forfeited, the exclusive right of working the mine shall be the same as in the case of new discoveries, provided that the certificate must be applied for within six months from the publication of the notification. No tax shall be paid for the working of a mine either to the Government or any private individual, but there are certain fees to be paid for the certificate of permission to work, granting a respite, &c. It is contested whether foreigners may search for ore or have the privilege of working a mine; if they may, the same rules will apply to them as to Norwegians.

Mining rents and royalties—Portugal.—The right of private ownership in minerals is recognised by the law of Portugal, though no person may work a mine, even on his own property, without having previously obtained a concession from the Committee of Mines and Public Works. This Committee grants permission to search for minerals in lands which are either municipal or national, and also in lands which are private property without the consent of the owner, subject to an engagement on the part of the explorer to indemnify the owner for any damage he may cause. Previous to commencing operations, the lessee must either compensate the owner by paying the value, plus 20 per cent., of the land set apart, or give security to the full amount of any injury that may result. A fixed royalty of 4½ for every 8¼ acres is levied by the Government on all mines, in addition to an annual sum not exceeding 5 per cent. of the net produce. The owner also receives from the lessee an annual sum not exceeding 2½ per cent. of the same net production, which annual rent must always be half of that received by the Government. When the Government converts a proportional royalty into a fixed annual one for a certain time, the owner of the soil may either receive half of that rent or such sum as he and the lessee may agree upon. In case of non-agreement, the Government decides the percentage to be received. When the Government temporarily suspends the payment of the royalties due to the State, it may fix the percentage due to the landowner, if there is any production during that time. The main features of the mining regulations in the colonies are similar.

Mining rents and royalties—Spain.—Any person or company may own mining property in Spain, with the consent of the State and subject to certain conditions. Any person can examine the surface of the land in search of its mineral wealth, and if the owner of the land refuse his consent the civil governor of the province may grant such permission. To obtain the ownership of a mine a petition must be addressed to the civil governor of the province, who will instruct a Government engineer to examine and report upon the property. If there be sight of the minerals the concession is at once granted. A mine is reckoned as a rectangle measuring 984ft. by 656ft., and of an indefinite depth. Anthracite coal and iron mines measure 1640ft. by 984ft. horizontally and of an indefinite depth. Mines measuring 984ft. by 656ft. pay an annual royalty to the Government of 6s. 3d.; mines measuring 1644ft. by 984ft., 4s. 2d.; and scoriæ mounds and surface deposits, 8s. 3d. per acre.

Mining rents and royalties—Sweden.—The property in minerals is not invested in the proprietor of the ground. It is to be acquired by a special mode of procedure. Whoever wishes to utilise and work any minerals shall make a written application to the mining inspector of the district for a mining licence. On assuming a corresponding part of the outlay, the owner of the ground has the right to take part in the work up to one-half if applied for in time; as long as the work of exploration is continued, the lessee must compensate the owners of the ground by paying in advance an annual rent for the area occupied. In case the work is abandoned before allotment of the claim the owner is entitled to compensation for any prospective damage that may have been done to the ground. Any allotment is not to exceed 656ft. in length by 656ft. in breadth. Mining work shall be carried on on such a scale as to ensure every year mining or mining building work equal to the cost of blasting 13 cubic yards in the mine. Instead of this obligation the lessee may pay an annual fee of £2 15s. 7d.—half to the owner of the ground and half to the State; but not until after three years' obligatory work has been carried on in the mine. In case the work be not performed, or the fee be not paid, the licence shall be forfeited, and the mine and the ground given over to the owner of the mine, revert to the owner of the land; any ore raised from the mine shall be allowed to remain on the ground for two years on account of the mineowner, and any machinery constructed for the durability and support of the mine shall be the property of whoever after acquires a legal title to the working of the mine. The State does not exact any special payment for the privileges of working mines, that industry being only subject to the ordinary income-tax. Foreigners are only allowed to carry on mining as the result of special application.

Mining rents and royalties—United States.—In all the States and territories minerals belong to the owner of the land. Whenever any special donation of land is made by the Federal Government to a State, it is stipulated that should any portion of such land be mineral bearing, other lands of an agricultural nature should be selected by the State in lieu thereof. No mining claim can be located except by a United States citizen or a person who has declared his intention of becoming such, but an alien and a citizen can possess a mining claim. Taxation on mineral lands is levied on their valuations, and corporations working mines are taxed on the nominal value of shares issued. In a few States certain mines in process of development are exempt from taxation for a term ranging from five to ten years.

Cinderlithic.—A new pavement, made of furnace cinder and cement, and known as "cinderlithic," is being laid in Mercer, U.S.A. The Mercer papers say it receives the highest recommendation from those who have tested it for neatness and durability. The walks made of it are always smooth, and the company guarantees that the frost has no effect upon it, while its perfect evenness and the ease with which it is cleaned makes it a most desirable invention. The floor in the jail is said to be without doubt a wonderful improvement, and much preferable to anything that could have been made of stone. Being in very large blocks, there is no probability of it becoming otherwise than as made, perfectly smooth and solid.

Birkbeck Literary and Scientific Institution, Bream's Buildings, Chancery-lane.—The prospectus for the sixty-fifth session of this institution has just been issued. Classes for both sexes will meet in the day and evening, commencing on Monday next. The subjects taught in the institution include languages, mathematics, natural, applied, and mental science, art, history, law, music, &c. Special classes meet for the London University, Oxford and Cambridge local, Civil Service, legal, and other examinations. The Wednesday evening lectures will be given by, amongst others, Sir Robert Ball, Commander Cameron, Messrs. Andrew Lang, Justin McCarthy, Max O'Rell, Samuel Brandram, Charles Dickens, and J. T. Carrodus. A special course of Mitchell Lectures on political economy, and a course on Hindu literature and philosophy will be delivered during the session.

LETTERS TO THE EDITOR.

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

DOMESTIC COOKING APPARATUS.

Sir,—The attention of the council of the National Smoke Abatement Institution has been drawn to an article, entitled "Domestic Cooking Apparatus," in your issue of the 12th August, in which reference is made to the Smoke Nuisance Abatement (Metropolis) Bill, and to its effect upon householders in compelling them to alter existing cooking and domestic fireplaces, so as to consume smoke. This institution approved of the measures contained in the Bill, and will make efforts to have them again brought to the notice of Parliament. Much useful work was inaugurated by the Smoke Abatement Exhibition at South Kensington in 1881. Since then inventors and manufacturers have received encouragement and stimulus, numerous improvements have been brought out, and the institution has satisfactorily demonstrated that it is quite possible to prevent smoke from domestic fireplaces by several methods, though it has not hitherto come within its province to recommend specifically the precise method to be adopted by individual householders.

I have examined on behalf of this institution the records of patents taken for heating appliances, and other articles relating to the treatment of fuel and prevention of smoke, and I find that the total number of such patents taken since 1881 reaches 2100, or an average 420 of per annum. It is no doubt a fact that many of these articles, probably the great majority, are valueless, but the fact of there being a large number of patents taken out goes to prove that considerable inventive faculty is directed to the subject. If engineers would lend the powerful aids of their scientific knowledge and practical experience, it would remove many of the difficulties which at present exist in convincing the public that the abolition of smoke is possible, and not very hard to accomplish, and would also smooth the way for obtaining legislation on the subject. The same remark applies to the defects in material and construction of domestic cooking apparatus, the truth and force of your comments on which are fully realised and appreciated. How can manufacturers be expected to construct, perfect, or even fairly good apparatus, while inadequately informed, as they now are, of the simplest scientific principles to begin upon? Not until engineers turn their attention in the direction of domestic improvements and bring science to bear upon the construction of grates, ranges, and heating systems, can we expect to introduce a proper degree of comfort in our household arrangements.

The efforts of the National Smoke Abatement Institution tend in this direction, and their labours have not been entirely fruitless, but they would meet with a larger measure of success if influential papers like The Engineer would induce scientific and practical men to take a deeper interest in this and kindred subjects. Manufacturers would be found quickly to follow sound principles explicitly laid before them, and the benefit in many ways to the public generally would be very great.

D. J. Russell Duncan, Secretary, N.S.A. Inst.
National Smoke Abatement Institution, Parkes Museum,
74A, Margaret-street, Regent-street, W., Sept. 27th.

PATENT OFFICE LIBRARY.

Sir,—In a recent article in the *Times* on the qualifications and duties of librarians it was said, "The Librarian is, or ought to be, guide, 'philosopher and friend' to every reader;" and in the same article was pointed out the importance to the public service of enabling librarians to fulfil their several duties intelligently and efficiently. Now I am sure that many experienced readers at the Patent-office Library will agree with me, that all those who have had the direction of its affairs from its establishment until now have uniformly afforded to readers the greatest help in their power. I believe also that many will further agree with me in saying that they have often heard from those in charge of the library expressions of regret that their powers of assisting readers were fettered by inconvenient official restrictions. These, no doubt, have resulted from the unfortunate circumstance in the constitution and organisation of the Patent-office, that it has always been subordinate to some higher authority not necessarily conversant with the details of patent administration. By the law of 1852, it was placed under that very august body, the "Commissioners of Patents," and now, by the law of 1883, it has become a small department of that huge department of State, the Board of Trade. This probably accounts, in a great measure, for the fettering by official regulations of the action of those who have to carry on the practical working of the system, but it is no less matter for regret that any impediments of this kind should be allowed to stand between them and such readers as desire to be real students of subjects very richly furnished by the Patent-office Library, but practically inaccessible for want of indication as to the whereabouts of the books relating to such subjects.

It is not enough to store a library with books and open it to the public to make what use they can of it. Many readers require a great deal of intelligent direction in order to enable them adequately to profit by these sources of information at present only nominally within their reach; and I cannot but think it might have a great effect in improving the quality of inventions if more facilities were given to enable readers to become real students of the special subjects in which they are particularly interested.

I believe much more valuable results might be got out of the book division of the Patent-office Library than at present by providing intelligent direction for readers, some of whom would become more thorough students than the existing impediments will admit of their being. William Spence.

8, Quality-court, Chancery-lane, W.C.,
September 26th.

THE HEXTHORPE COLLISION.

Sir,—I entirely agree with the opinions expressed in your articles that the collision was due to a large number of circumstances, and that the principal causes were the suspension of the block system just at a time when it was more than ever necessary, the fact that detonating signals were not placed upon the rails as they should have been, and most of all to the fact that the train was fitted with the old useless and dangerous non-automatic vacuum brake.

With a good brake, the train could easily have been stopped from a speed of thirty miles an hour in one hundred yards, yet in this case the driver could not pull up even in two hundred yards, and we can only conclude that, as the engine-driver says, the brake acted badly. He has said that a vacuum of 15in. was shown on the gauge, but that proves nothing, as, at the time when I was engaged in the case of Woodhead *v.* the Manchester, Sheffield, and Lincolnshire, *re* the Penistone accident, I made an experiment, and found not only that the gauge would show inches of vacuum, but that the so-called "tell-tale" gauge showed "brake right" all the time the large ejector was kept open, yet when making my experiment the pipes at the rear of the tender were uncoupled, and the blocks did not go on the wheels. What the gauges indicate so long as the ejector is open is not a true record.

The train in question had the single vacuum pipe. This Clayton coupling may do very well for an automatic vacuum brake, but for a simple vacuum it is not nearly so safe as the old double pipe, as it is liable to, and actually does, open and admit air, and thereby cause failure. The solicitors on behalf of the men considered it necessary to have the train and site inspected by two independent engineers; they therefore employed Mr. John Barber, C.E., of Leeds, and myself. An appointment was made for Saturday, 24th, and again for Monday, 26th. We attended at Doncaster, and met a number of the officials on the platform; but just at the moment when we were to commence the examination, a telegram was received from the general manager preventing any inspection being made on behalf of the men. The result was that at the inquest no witnesses could be called for the driver and fireman, and they were committed for manslaughter without any evidence being produced in their favour in consequence of the refusal of the inspection. It is certainly most unfair, as it prevents the cause of brake failing being discovered, as it no doubt would have been by a careful examination.

On the 22nd March, 1887, the company issued an order, published in The Engineer, 15th April, page 297, that the brake-couplings were to be "tied with string or otherwise." It would at least be interesting to know if a proper amount of "string"—if any—was in use on this occasion.

Whatever may be the verdict at the assizes, the fact will ever remain that the collision was due to a useless and antiquated brake, and further, that this dangerous device has not been examined by those acting for the driver and fireman.

40, Saxe Coburg-street, Leicester, Clement E. Stretton.
October 1st.

Sir,—In your article last week on this subject it was stated: "It is abundantly clear, therefore, that if the Westinghouse automatic brake had been fitted to the train, there would have been no accident," and this conclusion is based on the fact that the Westinghouse brake "can pull up a train running at fifty miles per hour on a level in about 750ft." While thanking you for your remark, may we at the same time point out that the matter has been somewhat understated. In the experiments conducted by Captain Douglas Galton at York on the 15th July, 1879, a train consisting of engine, tender, and sixteen carriages, and weighing 208 tons, when running at fifty-one miles per hour on a falling gradient of 1 in 1200, was brought to a stand in 621ft., which is equivalent to 594ft. at fifty miles per hour, or to a retardation of 14 per cent. At the same rate of retardation, a train running at thirty miles per hour—which is assumed in your article as being the speed of the train at Hexthorpe—would be stopped in 214ft., instead of the 270ft. credited us in your article. The influence of the falling gradient at thirty miles an hour would only amount to an extension of the distance by 20ft. Of course, these figures only tend to confirm the truth of your contention, which must be that of every impartial mind.

The Westinghouse Brake Company, Limited.
A. W. Kapteyn, Manager and Secretary.
October 6th.

FROM NEW YORK TO LIVERPOOL IN A CATTLE-SHIP.

Sir,—I have recently seen many letters in the daily press on the importation of live cattle, which has been termed "a dreadful trade." It does not appear to me that these letters have been written by any one who has had practical experience, and I venture to send you the following account of a trip in a cattle boat, in the hope that it may interest your readers, and disseminate a knowledge of the actual facts of the business.

After two years of fairly successful colonial life, I found myself on 11th December last in New York on my way to England without funds sufficient to pay my passage home. The fact was, I had been travelling east with a man who was my debtor for a pretty considerable amount, but on arriving at New York terminus we were parted in the crowd, and my endeavours to find him were vain. Misfortunes never come singly, for my portmanteau on presenting my check was not forthcoming. My only baggage left was a small soldier's valise, containing a coat, mackintosh, and a few collars.

I now looked about for a lodging, and after a short hunt put up at a third-class hotel occupied by Germans, Jews probably, for their faces were certainly of a Hebrew cast. To them I applied for a passage in a homeward-bound vessel, as they were agents for a good many lines, but was informed that they could not let me have one for less than 19 dols. I had just 16 dols., and on applying to some of my countrymen waiting for their vessels could not get one to advance a cent. I offered what I had in exchange for the necessary three dollars, but not one would help me; they all commiserated me, but I asked them, politely I hope, to "shut up," and left.

One, however, had suggested that I should get a job on a cattle-ship, and so work my passage. I thought this over, but resolved to obtain a passage if I could for a smaller sum than usual; failing in this, I considered the plan suggested would be the best. Accordingly, I went at once to the National Line office in Broadway, stated my case, but even here was told my passage could not be granted for less than 18 dols. A person who happened to be present said he would find out if anybody wanted a hand in a cattle-ship, and took the trouble to go with me to more than one place where there was a chance of a job. At last, he himself was accosted by a man who wanted hands for a vessel—cattle. My friend pointed me out and said I was willing to pay 10 dols. and work my way over. "Say twelve, and it's done;" And so I was fleeced of 12 dols., when really I should have paid nothing. However, the main object was to get home as soon as possible, and here seemed my only chance. I shifted my berth to another hotel, gave my card to the man who had hired me, and stayed there till the following Tuesday, and on meagre fare too, for I had only 3 dols. left to live on. I had reached New York on the Friday. My man called on Tuesday and told me I must be ready to go on board early next morning.

The vessel was lying at a wharf in Jersey City, so I had to cross the whole city to get there. I spent the best part of the night in the waiting-room at the ferry-station, and, rousing up at 6.30, went on board. Here I found that half the cattle were already shipped. There were few signs of human life at first, but on going down to the galley I found two fellows in a drunken sleep, and smelling consumedly of rum. One of these I roused after some trouble. He immediately offered me a nip out of his bottle. I hate even the smell of this stuff, and of course declined. He made no comment, urged me no further, but smiled pleasantly, took a nip himself, and went to sleep again. Presently the foreman came and set us to work littering bedding in the pens, while the vessel was loading. I forget the cargo; cotton, I think. Soon after the rest of the cattle came on board, my man came up and told me to cross over to the H——, as I was not to go in this vessel. I had to cross by the ferry—I just had coin enough left to pay for the ferry, 1½d.—and went on board the H——. I waited till about midday, when my man arrived, told me my name was down all right, and that he would introduce me to the foreman, which he did. The foreman seemed pretty blunt and plain-spoken, and altogether I liked his looks. We all went ashore and had a parting drink, my man standing treat.

The pens were arranged fore and aft, four deep, with two gangways, scarcely a yard wide, and narrowing a little towards bow and stern. The pens were very simple; just a couple of boards nailed across uprights. When the cattle were put in they were separated into fours by a couple of boards shoved between. This made it much easier to fasten the beasts with head ropes, for without this temporary barrier fastening up would be impossible. The vessel started about two in the afternoon of Wednesday, and we were the whole of the afternoon and evening up to 9 o'clock putting on head-ropes and tying the cattle up. Both these jobs are dangerous, for to put on the head-ropes a man has to jump on the beast's back, hang on tight with one hand clutching the hair, and with the other pass a slip-knot over the horns, and make a half-hitch. The beast likely enough throws back his head, and woe to the man who fails to keep his own head down. I got a blow on my cheek bone from the tip of a brute's horn, just missing my eye, and therewith a large bruise and dent which lasted for weeks.

Tying them up was slower, and not so dangerous and hot a job. I for my part, put on about fifty head-ropes, and jumped off the last one wet to the skin. The heat from the animals was great, and no man could work five minutes without being drenched.

We tied up nearly all the beasts by 8 o'clock, when some tea and bread-and butter were served out. Few of the cattle-men had knives, and none had plates, and if the steward—a good-natured fellow, by the way—had not lent us a few pannikins, I do not know how a good many of us would have managed. Five more besides

myself were working their way across. The foreman and four hired cattle-men made up our number. The general appearance of these last was by no means prepossessing, while their horribly profane and obscene language was really sickening. The others were very decent fellows in their way, hard up, of course, and home-sick, except a canny Scot who had sent home his money and preferred to work his way to paying his passage.

We had hardly a cent among us, and my tobacco was nearly all gone. This was my only comfort, and its scarcity was trying. Sometimes I could get a pipe from a sailor, but the cattle-men were as selfish about it as they well could be. We slept in the after part of the ship, close to the stern, in two small rooms with rough bunks knocked up, a world too big to be comfortable, for a narrow one prevents a sleeper's rolling from side to side. These were filled with hay and made pretty soft lying. As soon as I got into mine on the first night I noticed that the roof was damp, and now and then a drop would fall either on my feet or on my head by way of variety. I was at first at a loss what to do, as there were no vacant bunks, and I could not sleep on the loose hay, for the hatches were open for ventilation, so I finally put my overcoat over my head, screwed up my legs as far as possible, and so slept. However, next day a night watchman was appointed and I secured his bunk, which fortunately was under a dry spot, and my future comfort so far secured.

We were awakened next morning by a man who went by the name of Tom, one of the regular cattle men, who never attempted to bully as his fellows did, but went about his work quietly, and seldom swore! Out we tumbled about 5 a.m. We were then divided into two gangs, one for the starboard, the other for the port side. Great hogsheads were placed at intervals, generally by a hatchway, and while one man held a light, the rest had to water the beasts, one filling, two passing the buckets, the fifth man giving the water. It was nasty wet work, especially as the gangways were blocked up with bales of pressed hay. The narrowness of these, too, made the position at times exceedingly dangerous, for the beasts could very easily thrust their horns into a man's eye; but they were afraid of a stick, and most of the men carried a short one, though I for my part troubled myself perhaps too little about the matter. The hay in the gangways we used first, and in four days had a clear passage, which made the watering business easier, and less water was spilt. Watering occupied about an hour, and I was glad the morning's work began with this, as I could afterwards work myself dry.

Our next job was to feed the cattle with hay. This took far less time. The trusses were bound with wire, which we cut with tomahawks. The hay came out in cakes, very tightly pressed. These were shaken loose, and put just inside the pens at the beast's head. Feeding took scarcely half an hour. We then had breakfast about 8 o'clock, consisting of stew, bread, and coffee. Twice a week we had stirabout—generally pretty good, the coffee filthy, and by me undrinkable; but as we could always get plenty of good water from the tank, this was no hardship.

After breakfast we had to pump water for the cattle. The first supply was put on board in the hogsheads before leaving port, but every day afterwards we had to pump the day's allowance. The water was condensed into a tank close to the fresh water tank. One man had a bad arm, so we were divided into gangs of three, as that number could work at one time. The pump leaked very badly at first, and it was not till 12 p.m. on the second night, and ten on the next that all the hogsheads were filled. Then the carpenter, after several unsuccessful attempts, fixed the pump, and for the rest of the voyage we finished by 12 o'clock noon, and had the afternoon till 4 o'clock to ourselves. I spent most of my spare time on deck, though the weather was very cold at times; but I ensconced myself to leeward of the smoke stacks, and was pretty comfortable.

At 4 o'clock we had to feed the cattle again, and at five had tea and bread and butter. This meal was the best of all, as the tea was very good and the bread excellent—a contrast to our dinner, consisting of potatoes and boiled or roast meat, awfully fat, and soup with quantities of grease floating on the surface. Twice a week we had pea-soup, which was not so bad; but I made my dinner usually of biscuit and potatoes. After tea we sat in our little cabin, smoked and told stories.

Sometimes we would be called upon to open the portholes, or little round windows just behind the cattle. This was a nasty job, as it was impossible to get in between the beasts, unless they were lying down, without getting a kick, and the chance, almost certainty, of being trampled to death. The best way was to get on their backs, not very hard to do, as the beasts were all tied by the head; or, when there happened to be any, to stand on the dividing boards and steady oneself by the projecting iron beams. One morning we were called at 3 o'clock to shut these ports, as the water was coming in. Only four men would turn out at all, nothing would induce the rest to stir. The vessel was rolling terribly, and how the beasts escaped with sound limbs I cannot think. The scene, with tossing horns and eyes flashing in terror under the lantern light, the moans of pain and terror from the poor beasts, I shall not soon forget. We were all four very much aghast, and could hardly stand. If I looked like the others I should say that I looked in mortal fright, but the sound and sight of water coming through the portholes told that the job had to be faced. I jumped on to a beast's back, then another followed, and the other two, after being "cussed" at slightly, followed, and the very hard and risky work of closing the ports and screwing them home as well being done at last, I turned in wet through with perspiration, to be called again in half an hour to water the cattle.

The men were always quarrelling and fighting, but I saw two fights only. One was during watering-time in the early morning before daylight. One man spilt water over another. This man immediately "let out," and they fought for about five minutes, while I held a light and saw fair play. One was a Yankee, the other a Scot. I had plenty of opportunities to fight, but always kept clear of a row if I could.

We had splendid weather for the first three or four days, and the vessel pitched and rolled but little. Then came a change for the worse. Frequently a drizzly rain would set in for hours together. We did not pitch much, though the vessel rolled a good deal, as we had a full cargo. When we met a large wave we seemed to cut right through, shipping plenty of water. M., the Scot, and I used to sit on deck gazing at everything that was to be seen. The porpoises are great fun.

Little things please little minds, and really I got to be amused at very trifling things. We spent hours fancying figures in the clouds. We sighted three vessels only during the whole voyage. One of these passed us, the Assyrian Monarch, in which I ought by rights to have been, if I had not been tricked. If the wind was cold we got in a group on the frame round the smoke stack and under its lee, and talked till feeding time, or read aloud if we could get hold of anything in the shape of print. I had a copy of the *New York Herald*. This paper I read, advertisements and all, several times, till I began to know what was coming, and all interest was lost; but any scrap in the shape of literature was *so* welcome. A man soon finds out that by having to go without it for ever so short a time.

I had to pass occasionally by the cook's galley on my way to breakfast, and there see the fellow dishing up the captain's and officers' dinners, while several enticing tarts and pies were browning in the oven. The knowledge that these were not for me drew forth, I confess, many a sigh, and it seemed hard that we poor fellows were condemned to eat food unfit for dogs sometimes. I believe the steward has to cater for all hands; he gets a commission or something, and it pays him to be parsimonious. Our fare at tea consisted of one cob of bread each. This was barely sufficient to satisfy most of us, and M —— made no scruples about going to the baker's oven, when he was away, and collecting what he could. Once he got up and said, "I can't stand this half-ration business any more. I say, E ——, I am going to snatch." He left the place, returning in a few minutes with an enormous loaf of bread under his arm. His coming was received with acclamations by our mess, five in number, and as we happened to have plenty of butter—"conshy," as Tom Cringle hath it—sat as easy as the full ration under our belts.

One day was very like another, and it was with surprise and delight that after watering the cattle one morning I went on deck and saw land on our port side, some six or seven miles away. It was still not quite daylight, and the light on Old Head of Kinsale still burning. I was told we had fetched Queenstown at 4 o'clock. I learned, too, that we should have to lie at anchor outside the Mersey bar for some hours next day, to wait for the tide. All this proved to be the case, and there we had to lie kicking our heels. At last we got off, the pilot having boarded us at Holyhead, and cast anchor in the river at 8 p.m. Next day we had to land the cattle, and a noisy, exciting time we had of it; knocking away the barricades and untying the beasts—a pretty hard feat, for they strained their halters as tight as they could, trying to get away and follow. However, they were all got out with little serious mishap. We lost by death two beasts only, and those we landed were distinctly and decidedly in better condition than when they were shipped; but we had, on the whole, a very fair passage. On the voyage previous, I was told on board, only fourteen out of a full cargo of 250 were landed alive. The live cattle trade therefore must be a very risky business, to say nothing of the inhumanity of it. The sight below among the poor beasts after a rough night, even when only one or two are seriously injured, is a very pitiable one, and I shall have to be very hard up to ship as a cattle man again.

We landed from the launch at the custom house pier and were searched! Not one of us had a cent., except M——, who had half-a-dollar. Some had spare clothes to sell. I caught sight of our foreman. We four passage-workers hurried up and told him we thought it hard to be chucked ashore penniless. He heard what I had to say, and exclaimed, "Well, come on, and see what I can do for you two,"—to me and the Irishman,—and coolly added to M—— and the other, "I don't want you two," who, I am bound to add, had shirked as much as they could all through. We went to a grog shop, the foreman stood drink all round, after which he called me aside and gave me five shillings! I thanked him and left, feeling very badly used, with an odd sensation about pride, which I can hardly describe, but put calmly into my breeches pocket together with the five shillings. After I got home I found in a few days that I had been vaccinated for nothing, and had many pustules, on my legs especially—the result, no doubt, of much bare-back riding on board—of a very decided cowpox.

R. S. Edwards.

Underhill, Auckland-road, Norwood, October 3rd.

THE MERSEY BAR.

Sir,—As the state of the Mersey, with that of its neighbours the Dee and the Ribble, is causing much discussion, you will, perhaps, allow me to invite attention to the following facts, absolute and inferential, which affect the consideration of any method of improvement.

The cartographic history of Liverpool Bay is very complete for two centuries, and shows that for that period a steady advance westward of the coast of Lancashire, which is illustrated on a small chart accompanying the report of the Mersey Committee to the British Association in 1856. The report includes tables illustrative of the growth of the sandbanks. The advance of the coast-line continues to this day, and there is strong evidence it had been in progress for centuries before any historic record.

It seems impossible, after careful consideration of the charts, to doubt that the whole bay is covered with sand from a depth of 40ft. to 50ft. below low-water, except, perhaps, where the bar of the Rock Channel underlies Burbo's Bank.

The changes in the channels through the bay and the condition of the three rivers are greatly influenced by the indrift of sand, which injuriously affects the whole coast between Menai Straits and Wigton Bay.

From the earliest record there have always been two entrances to the Mersey—from the northward by Formby Point, from the westward by Hoylake and east Hoyle Bank. The channel, which is now the principal access to the Mersey, has not been in existence sixty years, and no doubt the dock walls of Liverpool have been instrumental in forming the channel and in the mutations it has undergone.

The fact that the tides which travel round the north and south of Ireland meet off Formby Point, but do not exactly synchronise, is very important in any examination of this subject. It is also very necessary to observe that the northern part of the Irish Sea is a basin with two entrances, one between Holyhead and Kingstown, the other at the Mull of Cantire; that when the tide begins to flow at the first entrance, it is ebbing at the Scilly Isles, and that the tide is rising at the other entrance for four hours after the ebb has begun in Ballycastle Bay. The range at Holyhead is 16ft.; at Dalkey Island, near Kingstown, it is 13ft.; at the Mull of Cantire, and in Red Bay on the coast of Ireland opposite, 4ft.; and in Ballycastle Bay, 3ft. When the time of high water at Holyhead is 10h. 11m., it is 10h. 35m. at the Mull of Cantire.

From these facts it is clear that there is not any material influx of water through either entrance, because none passes either the Scilly Isles or Ballycastle Bay for six hours and four hours respectively. Whence, then, is the apparent increase at high water derived?

Again, where the half-tide level is constant it is clear there cannot be any increased volume of water available—that at springs and neaps the quantity of water in which the tide works is constant.

In the Mersey are two tides with an interval of from twenty minutes to half an hour. With this information your readers may appreciate more accurately the difficulties which beset the several suggestions for improving the different harbours affected.

Liverpool, October 3rd. Joseph Boult.

THE PRESTON DOCK SCHEME.

Sir,—Your article on the Ribble is very amusing. First you admit that the Preston Dock scheme was supported by the opinions of competent engineers, and you finish your article by suggesting that five hundred or a thousand guineas should be spent, no matter what the tenour of the report might be. I take it that the Corporation have more sense than to spend even £500 in obtaining that which they have already got.

You say that the scheme will not pay because the cost of maintenance and the interest on capital expended will come to a larger sum than the docks can earn. Please let the ratepayers have your facts, figures, and data showing what the docks can earn, with the imports and exports, the receipts and expenditure, say, after the docks are established. No doubt before making such a sweeping assertion you have gone carefully into figures.

Further, you say that docks cannot be made to pay unless steamers can be got in and out of them at all states of the tide. I ask you can steamers, drawing, say, 24ft. of water, be got over the bar at Liverpool, or over the Clyde Bar, or Fleetwood Bar, &c., at any state of the tide, although Liverpool has spent over £18,000,000 and the Clyde Trustees over £10,000,000. You refer to the report of your own engineer eminently qualified to deal with this subject. What does he say? First, that the rise of the tide at the bar is 24ft. spring tides; it is 29ft., so that is understated by 5ft.—rather a considerable feature at the bar, when we are only expecting the bar to be lowered by scour 4ft. He also makes a comparison with the Tees, and says it passes through a sandy estuary of a somewhat similar character to that of the Ribble, and that the main cost of the dredging was 5½d. per cubic yard, including depreciation, and that the depth of the bar has increased from 3½ft. to 18ft. by scour only.

Surely testimony such as the above speaks strongly in favour of the Ribble undertaking, certainly as far as the dredging is concerned. The bar is lowered without any dredging 14½ft. by scour only, and that my estimate for dredging the Ribble is more than three times the actual cost of dredging the Tees.

October 5th. Benjamin Sykes.

[Mr. Sykes has obtained permission to apply to Parliament for £510,000. The outlay of this sum will probably, but not certainly, decide whether we are mistaken in the views we hold or not. Time alone can decide between us. We withdraw nothing that we have advanced. Our object in criticising the scheme was simply to advocate caution. The people of Preston are content, however, to expend more money on what they deem sufficient security. We should do no good by continuing the discussion. We have done Mr. Sykes no harm by beginning it. For the present, as far as we are concerned, the matter drops. Our correspondence columns are, however, open to Mr. Sykes, or anyone else, who can deal intelligently with the subject.—Ed. E.]

A PROBLEM IN STRAINS.

Sir,—One day, years ago, I was engaged tightening up the nuts on a large cylinder cover. On going round to give a last general squeeze, I had the assistance of another at the end of the spanner. The foreman's attention was directed towards our "tuggings." He said, "Don't put too great a strain on the bolts; leave some strength in them to resist the steam pressure." Well, Sir, I remembered the words, and have acted on the advice given, and have always believed the initial strain imposed on a bolt, due to tightening up, detracted from the strength of the bolt, or in other words, that the initial tension would be additional to the afterwards imposed tension. But now, thanks to "X.'s" most instructive problem, I believe the former supposition to be erroneous, and I believe that the strain due to the initial tension on any bolt is not augmented by any increment of load until such time as the load becomes greater than the initial tension. When in such case, the strain is due to the load alone.

R. Hartland.

October 4th, 1887.

TEST OF STONE BREAKERS.

Sir,—Kindly allow us, in fairness to Blake's machine, to say that there is no machine made to do more work than this on the class of work it is made for. Your report does not give the maker's name who competed against Baxter and Co., but in last week's report we note the belt broke in the test, so was not a fair trial. We may say we had a trial with Baxter and Co. with a Blake's of our make which broke the allotted quantity in about half the time of theirs. This was not a fair test, as our machine was a little larger. The best way to get a proper test is for both machines to be the same size, and to be worked by the same engine, and run at the same speed, and the swing jaws to be set to the same movement, say ½in. If this is done, no doubt both machines will do the same amount of work. We are well aware there are a lot of Blake's machines in the market which appear useless through having too much movement. This is the main cause of machines breaking. We are the only makers of a machine that does not alter its movement by wear, and to do different kinds of work.

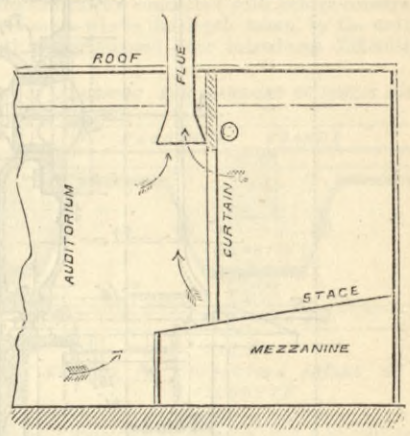
S. Mason and Co.

Leicester, October 3rd.

FIRES IN THEATRES.

Sir,—While the Exeter disaster is yet fresh in our memories will you permit me to suggest an extremely simple and inexpensive addition to all theatres, which would, I venture to think, prevent altogether loss of life.

It is well known that when the scenery, &c., of a theatre takes fire, a great body of smoke and flame rushes into the auditorium and rises to the roof, stifling and blinding those in the galleries and upper circles. All the exits in the world will not save people in these places once the smoke overtakes them.



My suggestion is to prevent the smoke from filling the upper portion of the theatre by making an exit for it, and this exit I would construct as shown in the accompanying sectional sketch, which goes far to explain itself. Right across the proscenium, and in front of the curtain wall, I would construct a wrought iron flue with a species of funnel mouth. There would be at all times a draught up this flue from the hot theatre. The moment flame entered it from below there would be a raging draught created in it. Air would rush into the theatre through all the exits opened for the escape of the audience, and this would drive before it every particle of smoke and all sparks and floating fragments of fire. The audience would have nothing to suffer from but radiant heat, and there would be no suffocation and blinding in the galleries and upper boxes.

Bob.

London, October 3rd.

STRESSES IN A CAMP STOOL.

Sir,—With your permission, I beg to ask your correspondent, Mr. Batey, to kindly favour your readers with a diagram and strain ditto of a camp stool, elucidating the direction of the "direct pull of 35 lb. on the leg," with reference to his letter of September 30th.

R. Hartland.

Cork, October 4th.

AXLE BOXES.

Sir,—In your description of the 5-ton permanent way hand crane for the New Zealand Midland Railway, you describe the axle boxes as Beuther's patent. They, however, are those known as Austin's patent Immurum axle boxes, of which some thousands have been made for South America and the colonies, and are the most successful and economical in use. They are *made* by Beuther's Patent Railway Axle-Box Company, Saltley Works, Birmingham.

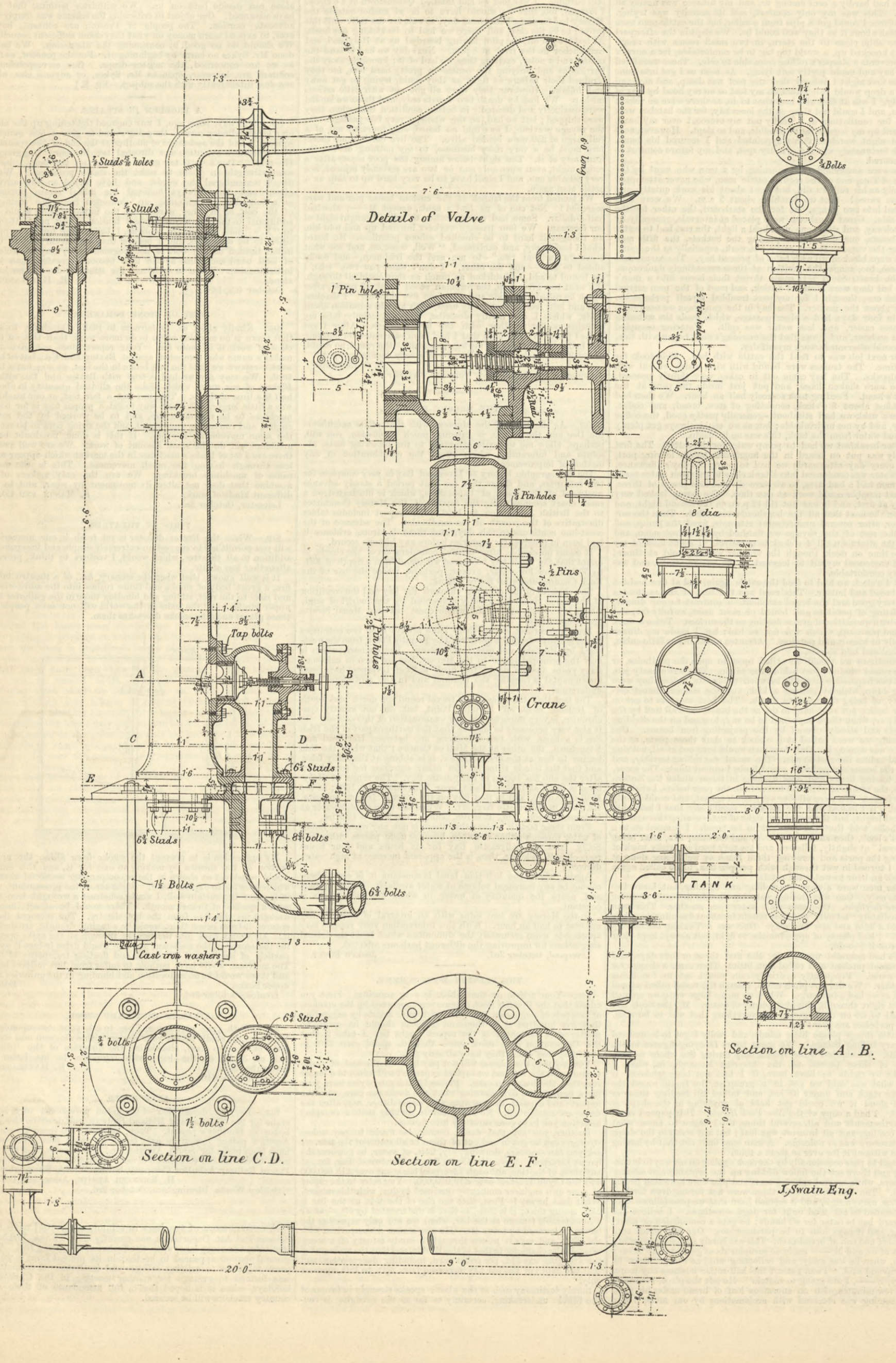
H. Kenneth Austin, Assoc. M.I.C.E.

Saltley Works, Birmingham, October 3rd.

A conference of teachers in schools connected with the Science and Art Department was recently held at the Birkbeck Institute, Chancery-lane, upon the Technical Education Bill. The general opinion appeared to be that in its present form it would prove injurious to existing colleges and institutes. A committee was formed to arrange for another meeting in the Christmas holidays, when it is hoped that a full attendance of town and country teachers will be secured.

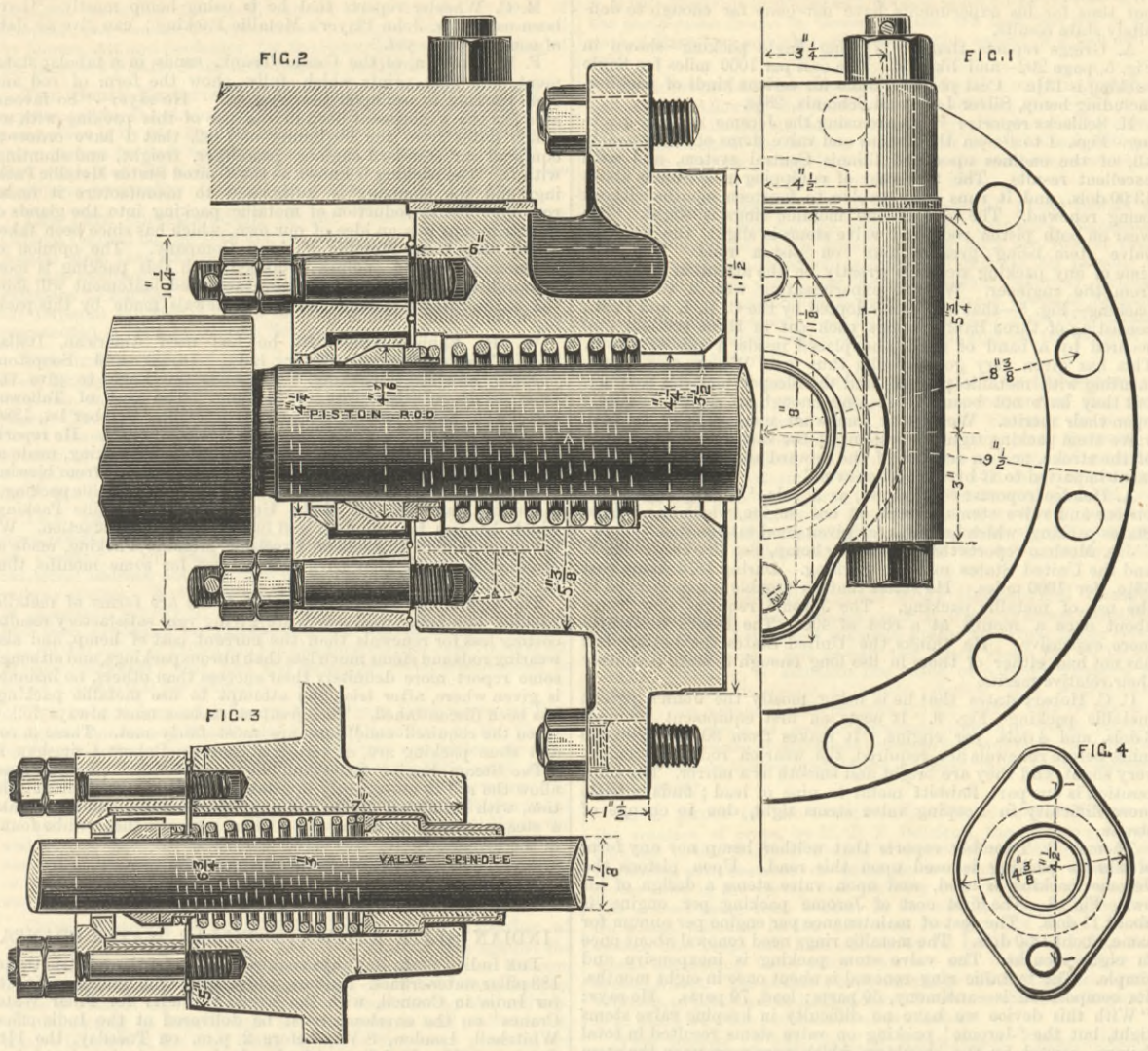
CONTRACTS OPEN—WATER CRANES FOR THE INDIAN STATE RAILWAYS.

(*For description see page 290.*)

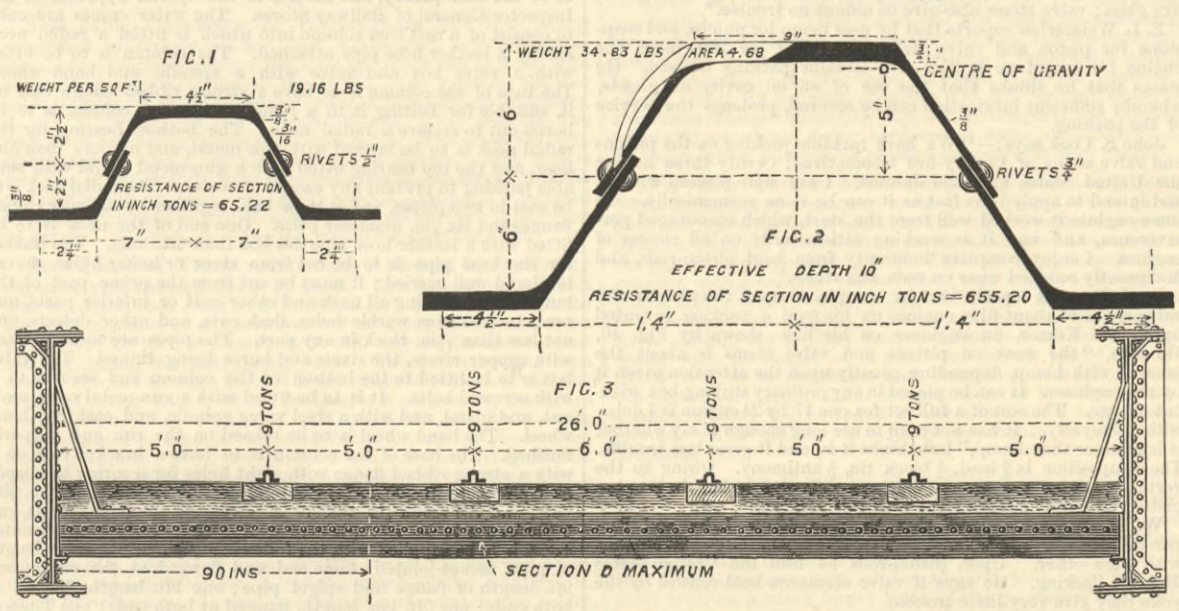


JEROME'S METALLIC PACKING.

(*For description see page* 290.)

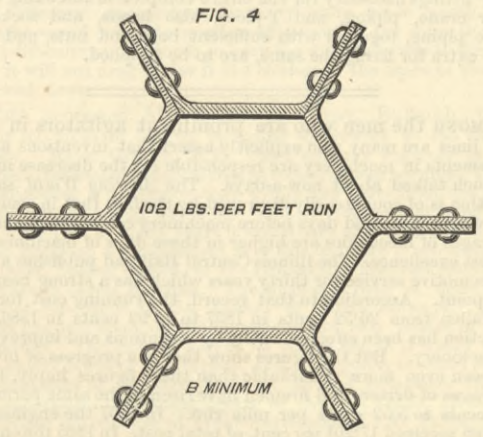


LINDSAY'S STEEL FLOORING.



LINDSAY'S STEEL DECKING.

Few specialities of the widely applicable order have so rapidly found favour amongst engineers as the steel decking of Messrs. W. H. Lindsay and Co., which we illustrate herewith in some of its many applications. The section of the decking is in general of the forms shown at Figs. 1 and 2, which are respectively as used for small or single-line bridges, for piling, for ordinary

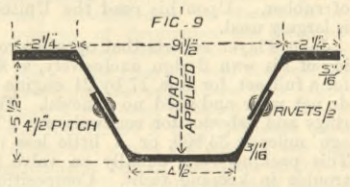


floors in buildings, and other purposes, and as used for large floors, heavy piling, and more particularly for bridges for double lines of railway without intermediate girders, thus making transverse girders wholly unnecessary, as shown in Fig. 3. Figs. 4, 5, 6, and 7, show some of the sections as used for constructing columns of great strength, and in such a form that they lend themselves in the most complete manner to fireproof construction. The sections 6 and 7 of cylindrical and fluted columns are taken from two amongst many, all of which can be built at prices which are less than those of cast iron columns of the same strength.

Fig. 8 shows some of the many forms of fireproof construction to which these deck irons lend themselves with a facility which is not apparent at first sight. Concrete or concrete and brickwork may be built together, and great strength is obtained with the best means of holding the fireproof work.

The strength of the decking is very well shown by the experiments recorded as follows. The experiments were made for the Great Northern Railway Company by Mr. Henry Sadler, who states:—"I have loaded the piece of decking that you sent me, and the result exceeded my expectations. I was not, however, able to break it, as I could not get a sufficient load put on it. I enclose you an account of the experiments. Experiment No. 1, on a single trough; a min. section, weighing 16 lb. per foot; span 10ft., and the load applied in centre of span on bottom flange in the direction indicated by arrow:—

Load applied.	Deflected.
9 tons	$\frac{9}{16}$in.
10½ ,, ...	¾in.
12 ,, ...	1in.
15 ,,	bent downward without fracture.

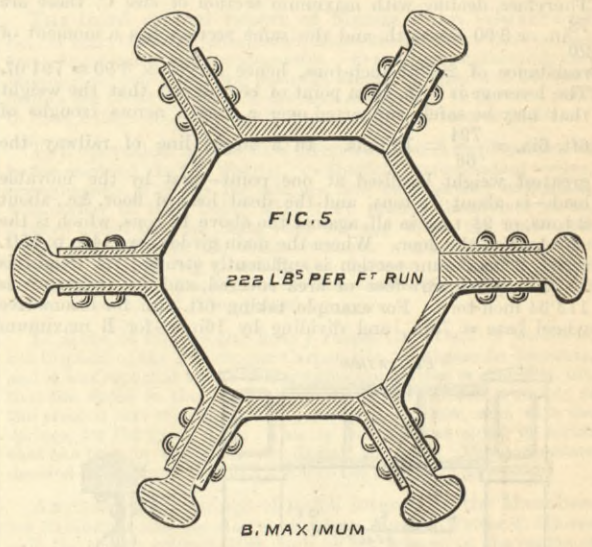


The load of dead weight applied on the bottom of the centre trough on an area of 2ft. at centre of the central trough, Fig. 10:

Load.	Deflection at A.A.	Deflection at B.B.
4½ tons	$\frac{3}{16}$in.	Nil.
8½ ,, ...	⅜in.	Nil.
11½ ,, ...	$\frac{9}{16}$in.	⅛in.
13½ ,, ...	$\frac{3}{4}$in.	$\frac{3}{16}$in.
15½ ,, ...	1⅛in.	—

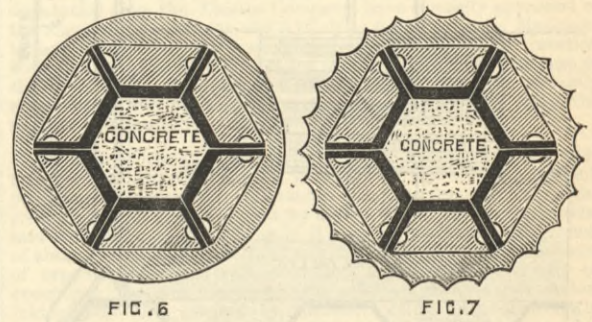
It will thus be seen that one trough, unaided by the support of its fellows, and only weighing 16 lb. per foot, took the astonishing load of 15 tons applied in the centre to cripple it.

The ready way in which short bridges may be built by using these trough sections for the floor is shown by Figs. 11, which illustrate the method of making up the whole of the ironwork of occupation and short road bridges. The floor carries the



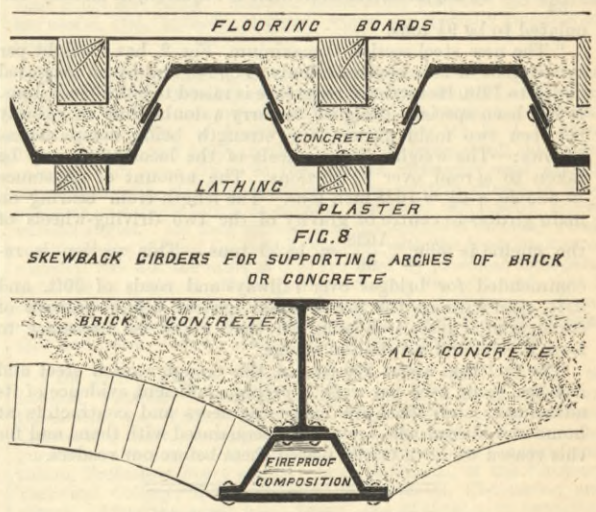
whole load, though the side lattice may be built and attached so as to make it do some work as well as form a parapet.

The method of using the decking for large bridge floors is shown in Fig. 3, but it should be mentioned that these troughs provide the means of making a bridge floor when constructed on the curve. It is only necessary to drop the troughs at one end, thus bringing them a little closer together at that end. Any curve may in this way be laid without any trouble or extra



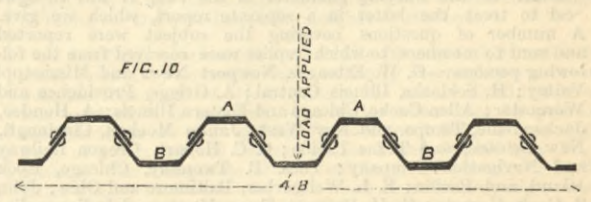
labour. The same may be done when constructing the towers for lighthouses or other purposes, or curved river and sea walls when built with a batter.

From the facility with which these trough sections may be applied for light or heavy bridge floors, they have greatly lessened the difficulties connected with bridge construction, and especially in cases where the depth taken by the ordinary cross girder with superimposed floor introduces difficulties. Each



trough forms a girder in itself, but as every trough is firmly rivetted up to those adjacent, any load is widely distributed, and the floor for a given weight is thus stronger than other kinds.

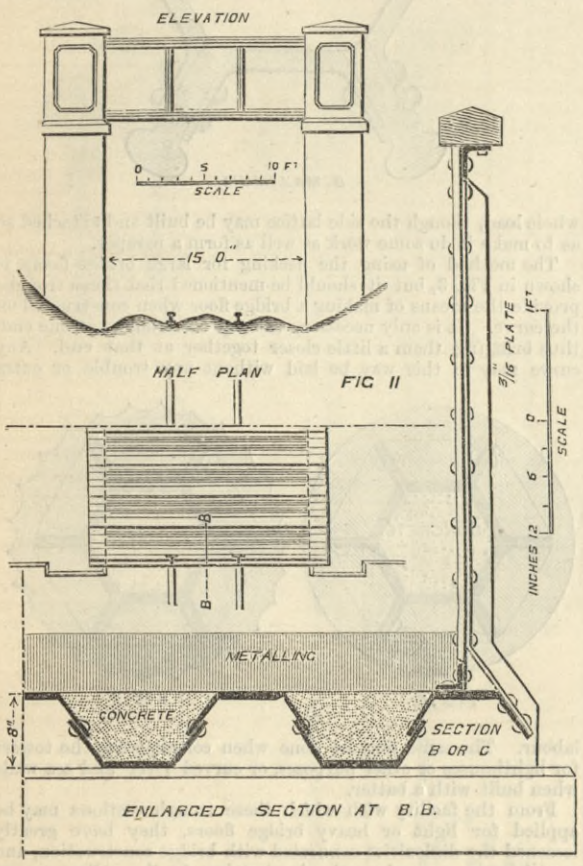
The sections have been designed so as to obtain the greatest strength the system of construction will allow, and their actual strength has been found by experiment. The moment of resistance, in inch-tons, is appended to each section, so that users



may determine the particular trough required for any case. The effective area brought into action is graphically shown on maximum section, Fig. 2, by the white curved space at the left-hand side of the section, which in this case, for the complete section, is equal to 9·36 square inches. Mr. Lindsay calculates the necessary section as follows:—"The effective depth being 10in., making the safe working strain 7 tons per square inch, the moment of resistance of the section = area by depth by 7 tons = A × D × 7 = 9·36 × 10 × 7 = 655·20 inch-tons; the sectional strength thus obtained is shown to each section of maximum and minimum strengths, with which information it becomes a simple calculation to decide on the proper section. The sections B and C, which are the sizes following Fig. 1 and are less than Fig. 2, are recommended for supporting the traffic for

a single line of railway where the main girders are 14ft. to 16ft. apart.

"The floor, when fixed in place, must be regarded as a series of girders rivetted together, and the longitudinal sleeper carrying the railway distributing the load over a certain number of troughs. It will be correct to take 6ft. 6in. as locomotive wheel base. Therefore, dealing with maximum section of size C, there are $\frac{78}{20}$in. or 3·90 strength, and the same section has a moment of resistance of 203·61 inch-tons, hence 203·61 × 3·90 = 794·07. The leverage is 66in. from point of bearing, so that the weight that may be safely supported over a length across troughs of 6ft. 6in. $= \frac{794}{66} = 12$ tons. In a single line of railway the greatest weight localised at one point—first by the movable load—is about 7½ tons, and the dead load of floor, &c., about 2 tons, or 9½ tons in all, against the above 12 tons, which is the safe load of the floor. Where the main girders are 14ft. to 15ft. apart, B maximum section is sufficiently strong; its weight is 25·05 lb. per square foot of area covered, and its resistance is 113·34 inch-tons. For example, taking 6ft. 6in. for locomotive wheel base = 78in., and dividing by 16in. —for B maximum



section—the result = 4·875 strengths and 113·34 × 4·875 = 552·53 inch-tons. Supposing the main girders to be 14ft. apart, there is a leverage of 54in. from point of bearing, hence $\frac{552·53}{54} = 10·23$, an excess over what is required, as already calculated to be 9½ tons.

"The new steel section D maximum, Fig. 2, has a weight per square foot of area covered of only 34·83 lb., and by an increased depth to 12in. its sectional resistance is raised to 655·20 inch-tons. It has been specially designed to carry a double line of railway between two main girders, the strength being computed as follows:—The weight of the wheels of the locomotive may be taken to spread over 2½ sections. The amount of resistance = 655·20 × 2½ = 1638 inch-tons. The length from bearing on main girders to centre of gravity of the two driving-wheels of the engine is 90in. $\therefore \frac{1638}{90} = 18·20$ tons. This section is recommended for bridges over railways and roads of 30ft. and 35ft. span without the use of main girders, a light parapet of corrugated or plate iron being all that would be necessary to form a good and substantial bridge."

The fact that about 200 tons of this trough section steel and iron are being used per week is perhaps sufficient evidence of its advantages; but there are many engineers and contractors at home and abroad who are not yet acquainted with them, and for this reason we have briefly placed them before our readers.

PISTON ROD PACKING.

During the meeting of the American Railway Master Mechanics' Association, held at St. Paul, Minn., last June, the report of the committee on piston and piston-rod packing was read.

Although the committee on cylinder packing and piston-rod and valve stem packing were instructed to consider both subjects, on account of the varying character of the two, it was thought best to treat the latter in a separate report, which we give. A number of questions covering the subject were reported and sent to members, to which replies were received from the following persons:—G. W. Ettenger, Newport News and Mississippi Valley; H. Schlacks, Illinois Central; A. Griggs, Providence and Worcester; Allen Cooke, Chicago and Eastern Illinois; A. Hendee, Jacksonville, Tampa, and Key West; James Meehan, Cincinnati, New Orleans, and Texas Pacific; C. C. Hobart, Oregon Railway and Navigation Company; Thos. B. Twombly, Chicago, Rock Island, and Pacific; E. L. Weisgerber, Baltimore and Ohio; John S. Cook, Georgia; G. H. Prescott, Terre Haute and Indianapolis; W. H. Stearns, Connecticut River; W. H. Thomas, East Tennessee, Virginia, and Georgia; John Mackenzie, New York, Chicago, and St. Louis; F. G. Brownell, Burlington and Lamoille; J. N. Lauder, Old Colony; John Player, Central Iowa; John McGrayel, Des Moines and Fort Dodge; M. C. Wheeler, Chicago, St. Paul, and Kansas City; F. L. Wanklyn, Grand Trunk of Canada, and W. C. Ennis, New York, Susquehanna, and Western. As the replies are all very interesting, the committee regrets that any abridgment was necessary, and have endeavoured to present the most instructive parts for the information of the members.

To the first question, "Do you use hemp exclusively?" only three replies in the affirmative. Others say that hemp is more or less used. Many indicate that a better substitute is being sought because different forms of metallic packing are being used, while some have entirely discontinued the use of hemp. The committee think that the purpose of this report will be best accomplished by giving the exact replies as given in these reports upon the most pertinent points of the subject.

G. W. Ettenger reports that he uses soap stone with rubber core with fair results. The cost per 1000 miles for passengers is 16⅞c.; for freight, 47½c. He is now experimenting with metallic packing, but thus far his experiments have not gone far enough to definitely state results.

A. Griggs reports that he is using Eagle packing—shown in Fig. 5, page 292—and likes it. The cost per 1000 miles for Eagle packing is 13½c. Cost per 1000 miles for various kinds of packing, including hemp, Silver Lake and Schœnix, 28½c.

H. Schlacks reports: "We are using the Jerome metallic packing—Figs. 1 to 4[1]—on the pistons and valve stems of all, or nearly all, of the engines upon the Illinois Central system, and with excellent results. The first cost of equipping an engine is about 13·00 dols., and it runs from twelve to fourteen months without being renewed. The cost of the metallic rings is slight. The wear on both piston rods and valve stems is slight, the wear on valve stem being greater than on piston rods. The lifetime of any packing depends greatly on the attention it receives from the engineer. We are experimenting with a valve stem packing—Fig. 8—that has been adopted by the C. R. I. and P. R., consisting of three Babbitt rings, each cut in three sections and secured by a band of steel, and placed inside a rubber sleeve. This has given very good results thus far. We are also experimenting with metallic packing and the Sleeper metallic packing, but they have not been in use long enough to report definitely upon their merits. We find it somewhat more difficult to keep valve stem packing tight on account of the variation in the length of the stroke, and on account of the upward and downward movement imparted to it by the rocker arm."

A. Hendee reports:—"We use, as a rule, 'Eagle packing' for pistons and valve stems, except on one engine, which has United States packing, which has thus far given good satisfaction."

Jas. Meehan reports that he is using hemp, also Deed's, Jerome's, and the United States metallic packing. During 1876 hemp cost 33½c. for 1000 miles. He states that no trouble is experienced in the use of metallic packing. The Jerome requires new rings about once a month at a cost of 40c. The Deed's is slightly more expensive. He thinks the United States the better, but has not had either of them in use long enough to state definitely their relative merits.

C. C. Hobart states that he is using mostly the John's patent metallic packing—Fig. 9. It costs on first equipment between 3 dols. and 4 dols. per engine. It makes from 30,000 to 40,000 miles before renewals are required, the wear on rods and stems is very slight, and they are bright and smooth as a mirror. The composition is one part Babbitt metal to nine of lead; finds a little more difficulty in keeping valve stems tight, due to change of stroke.

Thomas B. Twombly reports that neither hemp nor any form of fibrous packing is used upon this road. Upon pistons the Jerome packing is used, and upon valve stems a design of his own—Fig. 8. The first cost of Jerome packing per engine is about 11 dols. The cost of maintenance per engine per annum for same, about 1·50 dols. The metallic rings need renewal about once in eight months. The valve stem packing is inexpensive and simple. The metallic ring renewal is about once in eight months. Its composition is—antimony, 30 parts; lead, 70 parts. He says: "With this device we have no difficulty in keeping valve stems tight, but the 'Jerome' packing on valve stems resulted in total failure—caused by the shoulders which were worn upon the stem by unequal travel. The metallic packing which we use, both for piston-rods and valve stems, is eminently satisfactory. I have had rods running in hard service for seventeen months, with a reduction in diameter of one sixty-fourth of an inch, and with a surface like glass; valve stems also give us almost no trouble."

E. L. Weisgerber reports that he uses hemp for pumps, and soapstone for piston and valve stems. The cost per 1000 miles per engine for soapstone is 25c. No metallic packing is used. He states that he thinks that the use of an oil cavity on glands, whereby sufficient lubrication can be secured, prolongs the service of the packing.

John S. Cook says:—"We have metallic packing on the pistons and valve stems of twenty-five locomotives; twenty-three having the United States and the Jerome. I am well pleased with it, and intend to apply it as fast as it can be done economically. On some engines it worked well from the start, which encouraged perseverance, and now it is working satisfactorily on all classes of engines. I enjoy complete immunity from bent piston-rods, and find greatly reduced wear on rods and stems."

G. H. Prescott reports that he has placed upon the pistons and valve stems of about fifty engines on his road a packing invented by R. W. Kilmer, an engineer on his line—shown by Fig. 10, He says, "the wear on pistons and valve stems is about the same as with hemp, depending greatly upon the attention given it by the engineer. It can be placed in any ordinary stuffing-box without charge. The cost of a full set for one 17 by 24 engine is 4 dols., without royalty. It has not been in use long enough to say whether it is cheaper than hemp," but thinks it is, and it gives less trouble. The composition is ¾ lead, ½ block tin, ½ antimony. Owing to the vertical play of the crosshead, more difficulty is had in keeping pistons than valve stems tight with this packing.

W. H. Stearns reports that he uses Silver Lake and Prepared locomotive packings. These compare quite favourably with each other. Upon piston-rods he uses the United States Metallic Packing. He says if valve stems are held central by the yoke they give very little trouble.

John W. Mackenzie reports that he uses only hemp on piston-rods. Upon valve stems he uses three Babbitt rings, each ring cut three times, with a rubber sleeve on the outside. This will run 20,000 miles, and by removing the rubber sleeve will run 20,000 miles more. With this packing he finds less trouble on valve stems than piston-rods.

W. H. Thomas reports that he uses hemp and soapstone, and also finds the Eagle packing very good and serviceable; has used asbestos with good results, a great deal depending on the engineer on its use. He also states that he has in use United States Metallic Packing, which he has run 100,000 miles without requiring repairs, and he does not see why metallic packing will not give good results on piston or valve stems if properly cared for.

F. G. Brownell reports that he has in use upon all engines on his road the Brownell Patent Packing—shown in Fig. 11—for the past year, and upon some engines on an adjoining road, which come under his charge, for six months. They are giving the best satisfaction. Asbestos costs 10c. per 1000 miles; soapstone and flax as high as 2 dols. per month on some engines.

J. N. Lauder reports that he uses hemp to some extent, but uses none of the prepared fibrous packing, and especially avoids the use of rubber. Upon his road the United States Metallic Packing is largely used.

John Player reports that upon his road he uses a metallic packing of his own design exclusively, as shown in Fig. 12. The cost for a full set for one 17 by 24 engine is 7 dols. The brass rings do not wear and need no renewal. The cost for 1886 for Babbitt rings and asbestos for renewals was 2·10 dols. per engine. Average mileage 33,900, or a little less than 6¼c. per 1000 miles. This packing runs equally on valve stems or piston-rods. No trouble in keeping tight. Composition, tin 80 parts, antimony 10 parts, copper 1 part. "Have been using this packing for the past seven years, and experience proves the wear on rods and stems to be exceedingly small."

John McGrayel reports that on piston-rods he uses Jerome's metallic packing, and that it gives entire satisfaction, more especially in the wear of rods, which run about 150,000 miles between turnings, and the reduction in diameter is usually not more than $\frac{1}{64}$in. Its first cost is 15 dols. per engine, and 10c. per 1000 miles will keep it in repair until rods need turning. "On valve stems we used asbestos, and with proper care by engineers it will run six months with one packing. We have not had very good success with metallic packing with valve stems."

M. C. Wheeler reports that he is using hemp mostly—"have been using Mr. John Player's Metallic Packing; can give no data of comparison as yet."

F. L. Wanklyn, of the Grand Trunk, sends in a tabular statement, and blue prints which fully show the form of rod and stem packing in use upon that system.[2] He says:—"So favourable has the experiment been in the use of this packing with us, which dates from the beginning of 1882, that I have orders to equip all our standard engines, passenger, freight, and shunting, with it. The packing is known as the United States Metallic Packing, and the company is authorised to manufacture it under royalty. The introduction of metallic packing into the glands of the air pumps was an idea of our own, which has since been taken up by the U.S. Metallic Packing Company. The opinion of engineemen running engines equipped with this packing is most favourable. An inspection of the tabulated statement will show the extraordinary mileage between renewals made by this packing."

W. H. Ennis reports that he has used American, Italian and Tallowed hemp, Silver Lake, Dirigo and Soapstone packing, also Eagle packing. He finds the Eagle to give the best results of this class of packing. The cost of Tallowed hemp and Eagle packing for one year ending October 1st, 1886, for each engine upon which it was used, was 78 cents. He reports having tried one set of Bold's patent metallic packing, made at St. Louis. It gives fair satisfaction so far as freedom from blowing is concerned, "but is expensive for renewal of the metallic packing." "We also have one set of the United States Metallic Packing, which has run for one year and has given good satisfaction. We have now on trial two sets of Excelsior Metallic Packing, made at Middletown, N.Y., that have been in use for some months, thus far requiring no repairs."

The reports show conclusively that there are forms of metallic packing now being used which are giving very satisfactory results, costing less for renewals than the current cost of hemp, and also wearing rods and stems much less than fibrous packings, and although some report more definitely their success than others, no instance is given where, after trial, the attempt to use metallic packings has been discontinued. The greatest success must always follow when the required conditions are most fairly met. These in rod and stem packing are, as tersely stated by Robert Grimshaw in "The Steam Engine Catechism"—"A piston-rod packing must allow the rod to move freely up, down, or sidewise with little friction, with little wear of the rod or of the packing, and must make a steam-tight joint under the highest pressure that will be found in the cylinder."

1 Our engraving shows the Jerome packing as used on the London and South-Western Railway.

CONTRACTS OPEN.

INDIAN STATE RAILWAYS—PILLAR WATER CRANES.

The Indian State Railways require tenders for the construction of 188 pillar water cranes. Tenders, addressed to the Secretary of State for India in Council, with the words "Tender for Pillar Water Cranes" on the envelope, must be delivered at the India-office, Whitehall, London, S.W., before 2 p.m. on Tuesday, the 11th October, 1887. If delivered by hand, they are to be placed in a box provided for that purpose in the Store Department. The water cranes are to be constructed in strict accordance with the engraving, page 288. The whole of the materials used for this contract are to be of the best quality, and subject to the special approval of the Inspector-General of Railway Stores. The water cranes are each to consist of a cast iron column into which is fitted a radial neck having a leather hose pipe attached. The column is to be fitted with a valve box and valve with a spindle and hand wheel. The base of the column is to have a strong ribbed flange cast on it, suitable for bolting it to a foundation. The column is to be bored out to receive a radial neck. The bottom bearing for the radial neck is to be bushed with gun-metal, and not less than 5in. long, and the top bearing fitted with a gun-metal gland with suitable packing to prevent any escape of water. The radial neck is to be cast in two pieces, and is to be held together by strongly ribbed flanges and six ⅞in. diameter bolts. One end of the neck is to be fitted with a leather hose pipe not less than 6ft. long. The leather for the hose pipe is to be cut from steer or heifer hides, shaved level and well curried; it must be cut from the prime part of the butt only, excluding all neck and other soft or inferior parts, and must be free from warble holes, flesh cuts, and other defects, and not less than $\frac{3}{16}$in. thick in any part. The pipes are to be rivetted with copper rivets, the rivets and burrs being tinned. The valve box is to be fitted to the bottom of the column and secured to it with screwed bolts. It is to be fitted with a gun-metal valve, seat, nut, and gland, and with a steel valve spindle, and cast iron hand wheel. The hand wheel is to be turned on the rim and properly finished. The base of the column is to have a bracket cast on it with a strong ribbed flange with eight holes for securing the bends or T-pieces to it. The pipes, bends, and T-pieces are to be 6in. bore, and the metal ½in. thick. All flanges in the pipes, bends, and T-pieces are to be strengthened with cast iron ribs. Each water crane is to be supplied with the following piping:—One 9ft. length of pipe, socket-jointed at one end and flanged at the other; one 9ft. length of flange and spigot pipe; one 9ft. length, flanged at both ends; one 5ft. 9in. length, flanged at both ends; one T-piece, flanged, 2ft. 6in. long, flange of T-piece, 1ft. 3in. from centre, with one blank flange and bolts; one short piece for tank, flanged at one end; three quadrant bends, flanged at both ends. One water crane is to be completed for inspection, testing, and approval before proceeding with the rest. The whole of the remainder are to be erected and tested; the tests are to be made by hydraulic pressure, the cranes to 100 lb., and the valve boxes and piping to 200 lb. per square inch. The whole of the ironwork, cast and wrought, gun-metal, copper, leather hose, and all bolts, nuts, and other fittings necessary for the entire completion and fixing of each water crane, piping, and T-piece, also bends, and socket and flange piping, together with sufficient bolts and nuts, and 20 per cent. extra for fixing the same, are to be supplied.

Among the men who are prominent agitators in industrial lines are many who explicitly assert that inventions and improvements in machinery are responsible for the decrease in wages so much talked about now-a-days. The *Milling World* says the assertion is of course easily disproved by the fact that in comparison with wages in the old days before machinery came into general use, the wages of mechanics are higher in these days of machines of the highest excellence. The Illinois Central Railroad publishes a record of locomotive service for thirty years which has a strong bearing on this point. According to that record, the running cost for a mile has fallen from 26·52 cents in 1857 to 13·93 cents in 1886. This reduction has been effected wholly by inventions and improvements in machinery. But the figures show that the progress of invention has been even more remarkable than these figures imply, because the wages of drivers and firemen have risen in the same period from 4·51 cents to 5·52 cents per mile run. In 1857 the engineers and firemen received 17·201 per cent. of total cost. In 1865 the engineers and firemen received 15·091 per cent. of total cost. In 1867 the engineers and firemen received 20·865 per cent. of total cost. In 1886 the engineers and firemen received 39·627 per cent. of total cost. Improvements in machinery, not only in railroads, but in other important lines as well, are a benefit in every way to everybody concerned. The general public are better served at cheaper rates, and the mechanic receives increased wages.

2 This is almost identical with Figs. 1 to 4.

RAILWAY MATTERS.

It is stated that work on the Hudson River Tunnel has been again partially suspended for a time.

The Porte has referred to a military commission the *mazbatta* specifying the modifications made by the Council of Ministers last week in the concessions to the syndicate, represented by Messrs. Alt and Seefelder, for the construction and working of the proposed Asiatic Main Line Railway to Bagdad.

The South-Eastern Railway Company, presumably as represented by the chairman, Sir E. Watkin, has had another new name given it by Mr. Ruskin, who writing to a local paper concerning a picture he had bought, says "New Folkestone has sold all that was left of Old Folkestone to the service of Old Nick in the multiform personality of the South-Eastern Railway Company."

The Pera correspondent of the *Times* says that at a Cabinet Council on the 28th ult. the draught of a concession of the Asiatic Main Line Railway was examined and approved, including the last modifications suggested by order of the Sultan for an extension to Bagdad. The Ministerial decision will be submitted for Imperial sanction for the final acceptance of the syndicate represented in Pera by Messrs. Schroeder and Seefelder.

The first section of the Scarborough, Bridlington, and West Riding Junction Railway was begun on Monday near Driffield Junction, and the work is expected to be completed in about two years. The line will bring the large towns of West Yorkshire into direct communication with Scarborough and Bridlington, besides opening up an important agricultural district. The line is to be worked and maintained by the North-Eastern Railway Company for 50 per cent. of the gross receipts.

The annual session of delegates representing the Amalgamated Society of Railway Servants commenced at Newcastle on Tuesday. Mr. Stewart Macliver, president, delivered the inaugural address, and enlarged upon the enormous growth of the railway system. Sixty-two years ago there was not a single mile of passenger railway at work, whereas now 800,000,000 sterling had been expended on railways in the United Kingdom alone. The 20,000 miles of railway in the kingdom carried over 700,000,000 of passengers every year, and the passenger receipts amounted to about £70,000,000 per annum.

The recent loss of life on the steam tramways in Birmingham has caused the Public Works Committee of the Corporation to address a communication to the companies, drawing attention to the fact that the safety of the public must stand before everything in connection with the running of the trams, and that unless it is possible to prevent loss of life the withdrawal of the permission to use steam will sooner or later follow. Up to the end of last year the accidents were very few relatively to the amount of traffic—only five fatalities to 25,000,000 of passengers, or one death in 5,000,000; but this year raises the total average to one in 3,000,000 of the passengers carried.

Chief Justice Wallbridge delivered on Tuesday at Winnipeg the judgment in the Red River Railway case against the province of Manitoba, on Mr. Browning's application for the continuance of the interim injunction. The court held that the province is without legal rights or merits in constructing the railway, or attempting to expropriate Mr. Browning's land; but his exclusive interest in the land being doubtful, the court reserved the order respecting the injunction until judgment was delivered in the whole case. This decision, viewed in connection with the Provincial Government's failure to float the Red River bonds, will, it is believed, have the effect of putting a stop to the scheme for the present.

The cable tramways in Birmingham are not being completed so rapidly as had been anticipated, but there now remain for completion only a few sections, which can be dealt with without serious obstruction to the traffic. The ropes for the new cable tramway were delivered last week in Birmingham by Messrs. J. and E. Wright, of the Universe Works. They were in two coils, each coil having a length of two miles. The ropes are 3⅜in. circumference, with a breaking strength of 33 tons. Each rope is made up of six strands, with nineteen wires in each strand, and the test of strength has been very rigidly applied—indeed, it is believed to be the highest standard of quality the firm has been called upon to supply. We published the specification a short time ago.

The Board of Trade returns show that in 1886 railway expenses were reduced under all heads. The rate of expenditure also was diminished from 53·2 in 1885 to 52·7 per cent.; whilst the cost per train mile run on the railways of the United Kingdom, which in 1876 was 36·13d., was last year 30·41d. only, or the lowest figure touched during the last eleven years. This reduction has been mainly effected through the fall in the prices of materials, and the principal saving is thus under the head of maintenance, the figure having fallen from 7·52d. in 1887 to 5·22d. per train mile. There is also a substantial reduction in the locomotive power from 9·39d. in 1876 to 8·05d., the fall in the price of coal having assisted the officials in their efforts to reduce expenses in this department. Under the head of repairs and renewals the returns fluctuate, and the 1886 figures are higher than in many previous years.

About five months ago a description was given in our columns of a new safety apparatus for steam tramway use, which had been designed by Mr. S. Collier, coach-builder, and Mr. R. Plant, Birmingham. It was explained that the contrivance, which was based on the "cow-catcher" principle, and travelled in front of the engine, was fitted at the extremity with rollers revolving upwards, so that the safety appliance, coming in contact with any substance, would, according to theory, raise the obstruction and deposit it harmlessly in a grooved receptacle. The experiments, however, made this week under the inspection of members of the Birmingham Corporation were not, our Birmingham correspondent writes, a success. Proceeding at a slow rate and on even ground, the results were satisfactory, but when running at the rate of eight miles an hour the contrivance proved itself valueless. Several suggestions, however, were made which it was thought would result in greater efficiency to the invention. The great difficulty at present is to keep the guard so close to the ground that it will not drag under it the clothes or the limbs of the person knocked down.

The proposed Mu Valley Railway, Burmah, will be about 360 miles in length, including the branch to the Chindwin Valley. Major Gracey, R.E., chief military engineer in Upper Burmah, estimates the total cost at 60,000 rupees per mile. The chief commissioner is of opinion that within two years from the opening of the line it would pay 2 per cent. on the capital expenditure, and within six or eight years it would earn at least 4 per cent. The *Times* Rangoon correspondent says this estimate is probably within the mark, having regard to the remarkable financial results of the railways in Lower Burmah. The success of both of those lines is without precedent in the history of Indian railways. The proposed line will open up the important and rich valleys of Mu and Chindwin. Throughout almost its entire length it would traverse rich paddy lands or fine forests, and at Mogoung it would reach the headquarters of the large india-rubber and jade-stone trade, and the important distributing centre of the salt trade, all of which industries are capable of great development. At Paungbyin, the other terminus of the line, the traffic of Upper Chindwin would be tapped, and a district producing much rice, and having forests in which india-rubber in large quantities is known to exist, would be opened up. For the purpose of establishing communication with the Toungoo-Mandalay line, a short branch will be constructed from Mandalay to Ava, on the banks of the Irawaddy. It is proposed next year to commence the construction of the first eighty miles from Tsagain to Myana.

NOTES AND MEMORANDA.

In Greater London last week 3098 births and 1571 deaths were registered, corresponding to annual rates of 29·8 and 15·1 per 1000 of the population.

The Madrid newspapers report that coincidently with the earthquake shocks in Greece on the 4th inst. the sea in the port of Barcelona suddenly subsided to the extent of a foot and a half.

In London 2420 births and 1244 deaths were registered last week. Allowing for increase of population, the births were 299 and the deaths 163 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had declined in the preceding nine weeks from 24·8 to 14·4, rose again last week to 15·4.

The deaths registered in twenty-eight great towns of England and Wales for the week ending Saturday, September 24th, corresponded to an annual rate of 16·2 per 1000 of their aggregate population, which is estimated at 9,244,099 persons in the middle of this year. For the week ending Saturday, October 1st, the deaths registered in twenty-eight great towns of England and Wales corresponded to an annual rate of 17·5 per 1000 of their aggregate population, which was estimated at 9,244,099 persons in the middle of this year.

The report of the British Association on the nature of solution states that the constants of supersaturated and non-saturated solutions have been examined. Starting from non-saturated solutions, the temperature was lowered until the point of saturation was reached, and the physical properties of solutions near the point of saturation were examined at a constant temperature—20 deg. There appears to be no difference of physical properties within these limits from those of ordinary solutions. Experiments are also described on the specific viscosity of solutions, and there is added also a report on the bibliography of the subject.

It is not generally known what the fanciful diamond weight, carat, is. The diamond grain is equal to about four-fifths of a troy grain, hence four diamond grains are equal to one carat, or 3·174 troy grains. But as half the rough stone has to be cut away in polishing, to estimate the value of a rough diamond we must ascertain its weight in carats, double that weight, and multiply the square of this product by £2, which may be taken as the average price of rough diamonds that are worth cutting. Formerly the price of diamonds was as to the square of their weight, but this rule no longer holds good, as their value mainly depends upon quality.

In a paper in the *Comptes Rendus* on observations on the rotation of crops, by M. P. P. Dehéran, the system generally adopted in the North of France is described as lasting five years, beginning with beetroot or potatoes, or followed by wheat with clover sown in the spring and yielding two crops the third year. The ground being then broken in the autumn, is again prepared for wheat, followed in the fifth and last year by oats. In this system two crops are here shown to be badly placed, the first wheat succeeding badly after beetroot, and oats badly after the second wheat. The author's experiments prove that the four years' rotation, as practised in England, and known as the Norfolk system, is in every way the best and most profitable.

The report of the British Association Committee on "The Influence of Silicon on the Properties of Steel," states that one series of experiments has been completed, and the results obtained are:—On adding silicon to the purest Bessemer iron, the metal is originally red short, especially at a dull red heat, though it works well at a welding temperature; the red shortness is increased by silicon. Silicon increases the elastic limit and tensile strength, but diminishes the elongation and the contraction of area, a few hundredths per cent. having a remarkable influence in this respect. The hardness increases with the increase of silicon. With 0·4 per cent. of silicon and 0·2 per cent. of carbon, a steel was obtained difficult to work at high temperatures, but tough when cold, capable of being hardened in water, and giving a cutting edge which successfully resisted considerable hard usage.

In a recent number of the *Comptes Rendus* is a paper on "The Reduction of Alumina," by M. G. A. Faurie. Two parts of pure and finely-powdered alumina with one of petroleum or other hydrocarburet are worked into a paste, which is well kneaded, and one part of sulphuric acid added. When the mass becomes homogeneous, with a uniform yellow colour, and begins to liberate sulphuric acid, it is put in a paper bag, and placed in a crucible heated to a good red over 800 deg. C., so as to decompose the petroleum. After cooling, the product thus obtained is carefully pulverised, mixed with its weight of a powdered metal, placed in a well-closed crucible in plumbago, and brought to a white heat with the blow-pipe. After again cooling, more or less rich grains of aluminium alloy will be found in the middle of a black metallic powder. The process is equally applicable to silica, lime, magnesia, &c.

Dr. Clemens Winkler has published an account of his latest work upon the new element germanium, recently discovered by him in the Freiberg mineral argyrodite. In his first announcement last year Dr. Winkler stated that the metal was obtained by reduction of the oxide in a stream of hydrogen gas, but since that time large quantities of the mineral have been found and dealt with on a much larger scale. The powdered oxide, after undergoing an elaborate process of purification, is intimately mixed with 15 to 20 per cent. of starch meal, made into a paste with boiling water, and rolled into balls. These balls are then placed in a crucible in contact with powdered wood charcoal and heated to redness. On cooling, each ball is found to be converted into a regulus of metallic germanium. After removal of the adhering charcoal they are placed in a second crucible, covered with a layer of powdered borax glass, and melted in a gas furnace, when they fuse together to a single brittle regulus, fine octahedral crystals being formed at the outer surface. There can no longer be the slightest doubt, *Nature* says, that the gap in the periodic table between silicon and tin must be occupied by germanium, for Dr. Mendelejeff predicted that the metal thus filling up this particular gap would be found to form, if discovered, a tetrethide of specific gravity about 0·96 and boiling at 160 deg.

The well-known Lake of Marjelen, 7710ft. above sea level, has, the *Globe* says, once more emptied itself through the Aletsch Glacier, the ice walls of which form the western shore of the lake, and the river Massa—which drains the glacier respectively. The Massa enters the Rhone above Brieg, and the effect of the Märjelensee suddenly pouring its waters into the Rhone might, under certain circumstances, be disastrous in its consequences. On the evening of September 4th the level of the Rhone rose at Brieg 5½ft., from about 3½ft. to 9ft., and at Sitten 4ft., from 6½ft. to 10½ft. The greatest rise observed since the regulation of the Rhone from the same cause took place on July 19th, 1878, and although it was then at Brieg only 5ft., and at Sitten only 3ft.,, it was considered a very fortunate circumstance that the event took place at a very low level of the Rhone for the season, while immediately before and after it the river was pretty high. A sudden irruption of the waters of the Lake of Marjelen, however, may not always be coincident with a low level of the Rhone, and it is consequently projected to provide an outlet for the lake towards the Viesch Glacier, and a subvention has been granted by the Swiss Federal Council for the purpose. By means of this additional outlet, the level of the lake will be maintained at a normal condition, and the volume of its waters reduced to about half what it is at present—10,000,000 cubic metres.

MISCELLANEA.

The engineer and superintendent of the Australian United S.N. Company have completed plans for four new steamers which the company proposes to have built for the intercolonial trade. The *Colonies and India* says the new steamers are to be capable of making 15 knots an hour, and will each provide accommodation for 100 saloon and 80 second-class passengers.

The third annual report of Messrs. John Walker and Co., of Maryborough, Queensland, shows that some at least of the Queensland industries are successful. From their engineering and shipbuilding and importing business, Messrs. Walker and Co. have made a net profit sufficient to declare a dividend of 12 per cent., and to hand a large sum over to the depreciation and reserve funds.

The operation of the new Merchandise Act promises to be far-reaching. In this district, our Sheffield correspondent writes, consignments of goods for sale are now very strictly examined, with a view to their being what they profess themselves to be. I heard lately of wine being sent for sale which the auctioneer would not offer in his rooms without a guarantee from the owners. In this way we are likely to have an effort after purity and honest dealing even outside the trades which were mainly the cause of the Act being passed.

In spite of the recent heavy rains, the stock of water at the disposal of the Manchester Corporation continues to decrease, and it was reported to the Waterworks Committee on the 29th ult. that the water in the reservoirs now will only afford a supply at the present rate of consumption for twenty-six days, and, with the springs, for thirty-six days. This is the smallest stock of water that has been in the reservoirs during the year. The committee decided to continue the restriction of the supply to consumers.

Amongst other things of much interest in the Manchester Exhibition and its electric lighting, Messrs. Walter T. Glover and Co. show a column, 10ft. high by 3ft. square, in the centre of the dynamo shed, which represents the quantity of copper used for the main conductors utilised for the incandescent lighting of the Exhibition. The total quantity of highly insulated cables manufactured by this firm, and fixed in the Exhibition, is over nine miles, and the gross weight of the copper alone represented by the column is ten tons.

The movement for the registration of plumbers is securing a footing in Scotland, and the Edinburgh and Leith master plumbers, as the result of the recent conference with a deputation from the London Company, have cordially approved of the scheme. Manchester also is likely to follow suit, the Manchester and Salford Sanitary Association having taken up the question with vigour. *The British Architect* says:—"And as in the case of the Law Society and solicitors, the Plumbers' Company certainly seems to be the most appropriate corporate body to keep the register and conduct the examination of plumbers."

At a meeting of the Midland Gas Managers' Association, held at Birmingham, on Thursday of last week, Mr. Hack presiding, a paper on differential charges for day and night consumption of gas was read by Mr. C. Hunt, Birmingham, who said that such prices could rarely, if ever, be justified on the ground of abstract right, however valid might be their defence as a measure of expediency. As a rule, to which, however, there might be exceptions, he was convinced that solid progress in gas undertakings was best assured by successive all-round reductions in price, the profits being kept within moderate and reasonable limits.

It is expected that the Sheffield firms will make a goodly show at Glasgow. Between the two towns there is an extensive business connection—greater, our Sheffield correspondent thinks, than between any other centres in the kingdom—and as all Scotland will go to St. Mungo, even more than to Edinburgh, the firm which fails to display its goods in creditable style, both as to quality and quantity, will lose a point. The decision of the Glasgow Executive to give no awards is a bold step, yet in view of dissatisfaction at other exhibitions, and the statements as to how awards are said to have been "engineered," the conclusion come to that Glasgow is to give none is not surprising. Still, for advertising purposes the medals are useful, and, honestly decided, would be specially valuable at Glasgow.

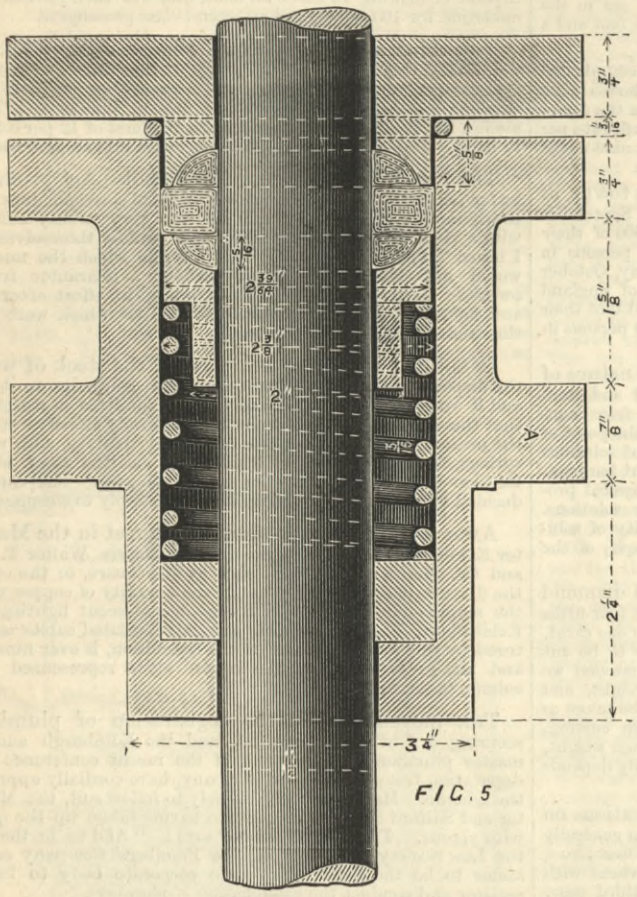
The Society of Engineers held its first meeting for the Session 1887-8 on Monday evening, at the Town Hall, Westminster, Professor H. Robinson, president, in the chair, when a paper was read on "Stability of Factory Chimneys," by Mr. R. J. Hutton. The author entered fully into the theory of stability of tall chimneys, pointing out some errors in the formulæ ordinarily used, and in connection with stability, considered the relative effects of wind pressure on various forms, as circular, octagonal, and square, and at various angles. He then showed that the section of chimney which combined the highest theoretical stability with the least amount of material was not the same as that required by practical considerations for its greatest efficiency in producing draught, and that a compromise had to be effected between the two forms. Some examples of successful chimneys were then given, and also of some that had failed, with an examination of the causes of failure.

The third annual dinner of the City and Guilds of London, Finsbury Technical College, was held at the Holborn Restaurant on Friday, 29th ult. The president, Mr. Alfred Chatterton, B.Sc., occupied the chair. Amongst the numerous guests were Professors Ayrton and Armstrong, of the Central Institution, Professors Berry and Sylvanus Thompson, of the Finsbury Technical College, Messrs. Blaine, Millis, J. H. Chatterton, and others. After the usual loyal toasts, the chairman, in proposing the Finsbury Technical College, remarked upon the extremely rapid rate at which the College had grown, and attributed the success achieved to the earnest efforts of the distinguished men who formed or had formed its staff. The permanent success, however, of the plan the City Guilds had adopted for the solution of the problem of technical education depended on the students they produced, and the greater their individual success the greater would be the demand for scientifically trained engineers, electricians, and chemists. Professor Thompson, responding, said he hoped soon to see the College extensions made so that room might be found for the ever-increasing number of students.

A letter, which appeared in the *Scotsman* a short time since, written by someone who is evidently thoroughly conversant with the iron trade of Great Britain, has not received the attention to which it is entitled. The writer commences by pointing out that there are now in Connal's store about 900,000 tons of pig iron, of which 360,000 tons are of No. 3 and 540,000 tons No. 1 quality. The manganese, silicon, sulphur, and phosphorus in the latter quality of Scotch iron, with which alone he proposes to deal, average 1·72, 3·23, ·027, and 1·37 respectively, against ·52, 2·8, ·04, and 1·46 in Cleveland pig. From this he argues that they are, from an analyist's point of view, of nearly equal commercial value. Why then, he asks, should there be 8s. per ton difference in the f.o.b. price. He proceeded to say:—"It must be plain to all that as long as the public are foolish enough to purchase these warrants—Scotch—makers will undoubtedly store iron, as at the present moment it is the only market available. "While therefore," he continues, "the makers are able to supply all the demands that are likely to be made on Scotch iron, the public are in the unfortunate position of paying at the rate of £137,000 per annum for rent and interest, or, in other words, an annual cost of 3s. per ton!" These figures and arguments do not seem to have been as yet disputed, and the presumption is therefore that they cannot be.

AMERICAN STUFFING-BOX PACKINGS.

(*For description see page* 290.)



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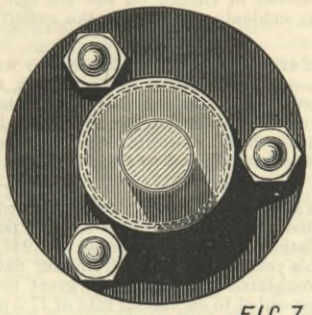

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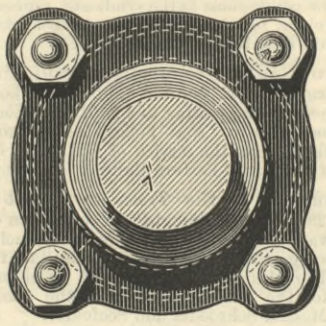

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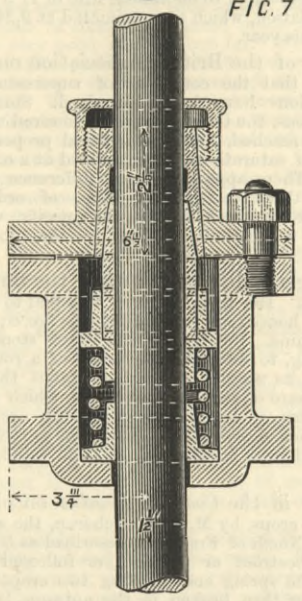

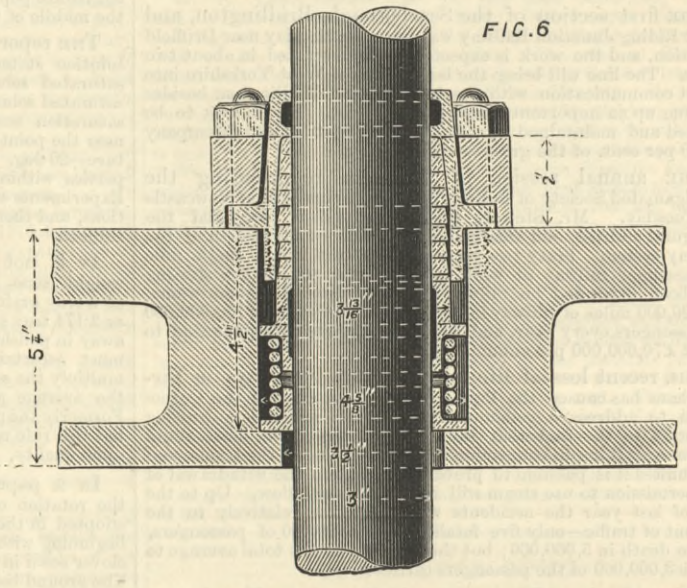

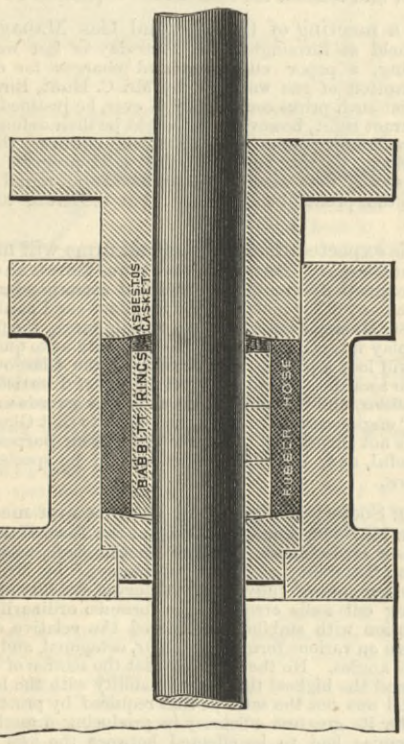

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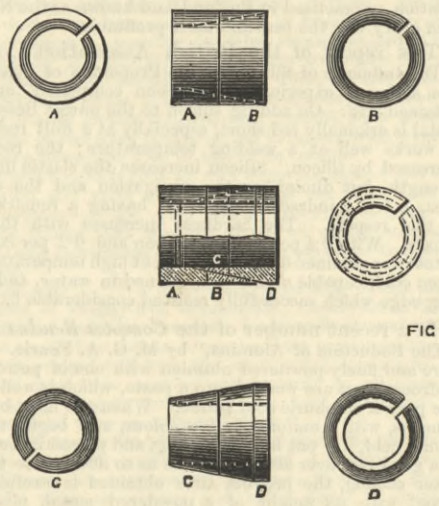

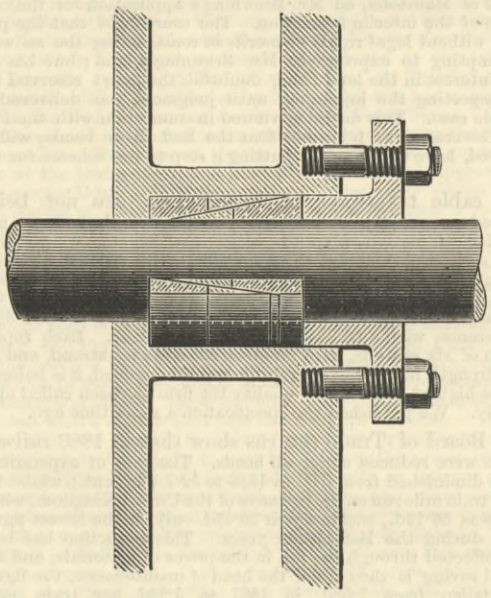

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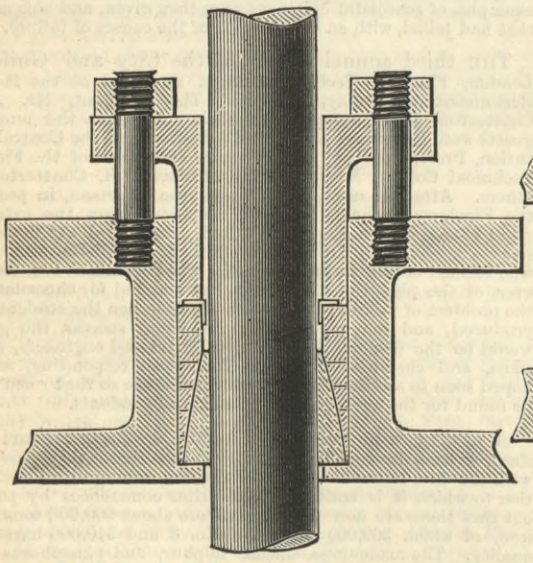

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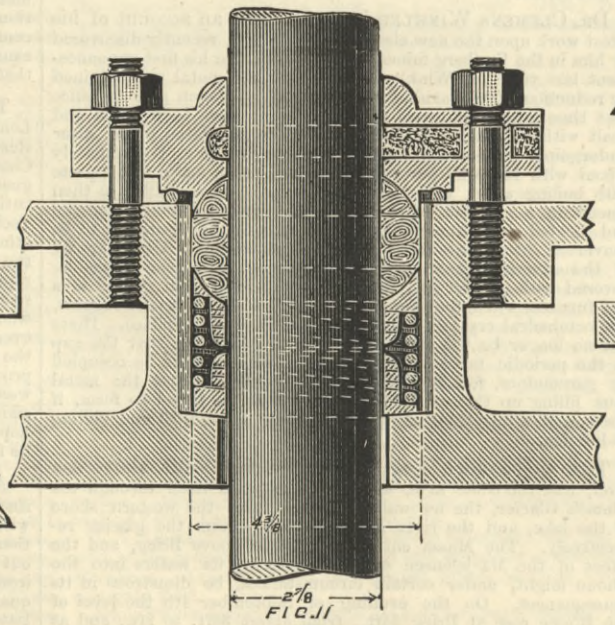

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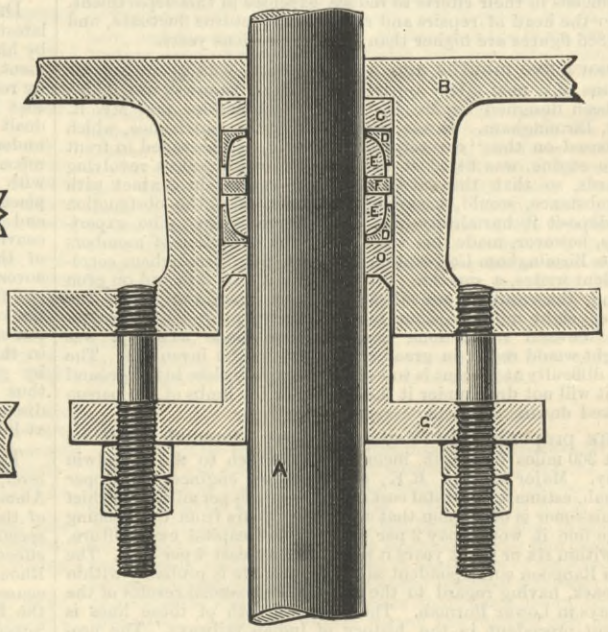

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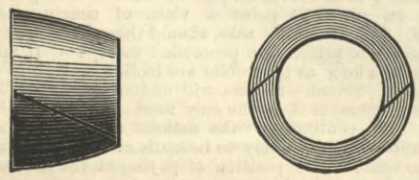

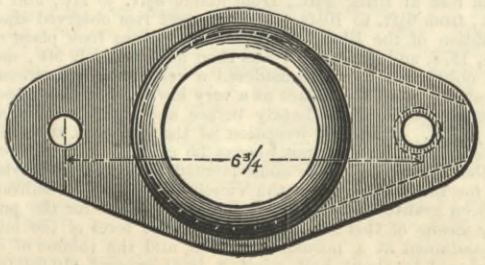

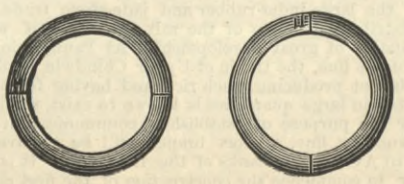

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NEW YORK.—The Willmer and Rogers News Company, 31, *Beekman-street.*

CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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

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

P. T. (Lisbon).—*You cannot do better than purchase and read a little book on the indicator, published by Messrs. Elliott, West Strand, London. We could not spare the space here required to reply adequately to your question.*

Progress.—*We gather from your letter that you have been very little at sea, and, in fact, possess no experience concerning the matter on which you write. If you had you would not assert that a screw propeller is half its time out of the water.*

Ajax.—*The necessary sectional area of the column will probably be rather more than doubled; but much depends on the actual dimensions and conditions of use. The strength of iron columns may in a general way be taken as varying in proportion to the* 1·7*th power of the length.*

J. M.—*You would perhaps best obtain what you require by taking some French and German papers, such as the "Genie Civil," "Annales Industrielles," "La Lumière Electrique," the "Electrotechnische Zeitung," the "Zeitschrift des Vereines Deutscher Ingenieure," and others. You can see these at any time in the library of the Patent-office, and select for yourself.*

Puzzled.—*The stress in the strut or tie found by the formula as given by you must be divided by the number of triangles whose bases are within the base of the triangle formed by the lattice under calculation and its fellow. In the second case, the stress due to the moving load must be taken as acting upon every lattice, as it cannot be assumed that the main booms are sufficiently stiff to transmit a concentrated load over a large length.*

SHEET BRASS WITH DIAGONAL INDENTATIONS.

(To the Editor of The Engineer.)

Sir,—We shall be glad if any of your numerous readers could inform us where we can obtain sheets of brass with diagonal indentations, say $\frac{3}{8}$ and $\frac{1}{4}$ deep.

J. C. and Co.

Sheffield, September 29th.

WELDING AND TEMPERING CAST STEEL.

(To the Editor of The Engineer.)

Sir,—Will any of your numerous readers tell me how to weld up a cast steel ring, made of flat steel, bent flat-wise, and what I must use for a flux in the shape of chemicals? Also, providing I have been successful in the above, how to temper it so as to be able to cut out circular pieces of paper laid together, under a steam press?

N. W.

October 1st.

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Remittance by Bill on London.—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Sandwich Isles, £2 5s

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Advertisements cannot be inserted unless Delivered before Six o'clock on Thursday Evening in each week.

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

THE ENGINEER.

OCTOBER 7, 1887.

FOREIGN COMPETITION.

Those who assert that in the spread of technical education England can find the means of fighting the foreigner in the markets of the world are either very ignorant of the facts, or for some motive even less honourable than ignorance, determined to obscure the truth by raising side issues. We publish every week abstracts of the reports furnished by our consuls in all parts of the world. In these we find the reasons why we are so hard pressed to maintain our position. In some cases the consuls speak out plainly and to the point; in others they content themselves with statements of fact from which our readers can draw their own deductions. The story, however and wherever told, seems to be the same. The foreigner beats us because he is more a man of the world than are our representatives. He beats us because his men work for less pay and longer hours. He beats us because we have a heavy tariff against us. He beats us because we will not supply just what the customers want and he will. We do not anywhere hear that our goods are bad, or that the thing we hope to sell is inferior, because we have not enough technical education to make it good. Indeed, if Englishmen could sit down and calmly contemplate the difficulties which stand in the way to prevent them from doing any trade whatever with other nations, they might well lose heart and give up an apparently hopeless struggle. Whatever we may think on the subject, there can be no doubt that very considerable numbers of men of all classes practically engaged in production and trade begin to fancy that Free-Trade is, after all, not such a boon as it at one time was. No one, we suppose, who has thoughtfully considered the subject can doubt that on the whole the great balance of advantages is in favour of absolute international cosmopolitan Free-Trade;—every nation interchanging its commodities with every other without let or hindrance. But it is easy to see that this is a very different state of affairs from that which really obtains at present, and has existed for many years past; and the very serious and important question begins to be asked, what is to be the end of all this? Let us suppose, for example, that the progress of such a country as Germany or France in the development of her industries should be rapid and continuous—and nothing but war or the rumour of war has prevented this from being the case hitherto—the result must be that Germany and France would require none of our goods, and might accordingly put on a tariff against us which would be simply prohibitive. What would be the result? Obviously the practical extinction of not alone our manufacturing supremacy, but so far of our manufactures altogether. This is the answer which many men repeat to themselves with inward quakings, and desires to put away unpleasant anticipations. We suppose that never at any time within recent years has more attention been devoted to trade and foreign competition than now, and it is a noteworthy fact that men who have never thought much about these things before, resting content to let the political economist in his study do the thinking while they did the working and making and selling, are now beginning to do the thinking as well, and even to venture on expressing—with bated breath, it is true, and inward terror—the opinion that perhaps, after all, political economy is not an exact science; that nations do not rise and fall by mathematical rules; and that the man practically engaged in trade really knows more than the professor of political economy who never sold anything or made anything in his life. It is in the action of such men that we see hope for the future, and venture to believe that the nation may yet manifest that power of adapting itself to circumstances, that supreme art of making the best of things, however bad, which has ere now brought England through worse difficulties than those which now surround her, worse dangers than those which now threaten to assail her commercial prosperity.

What practical shape shall national action take in the struggle to maintain our position in the markets of the world? We may dismiss at once the promotion of so-called technical education as useless; but there is an education which may be—nay, must be—of the utmost value. We confine ourselves now to that class of the community with which we have most to do, namely, engineers. It is simply essential to success that the engineer should possess a knowledge of modern European languages. Two at least he ought to know colloquially, namely, French and German. It is, we may add, little more than a waste of time for an English lad or young man to try to learn them in an English school. The man who attempts to do business abroad with the aid of an interpreter is heavily handicapped. Again, much more geography should be learned. As a nation we are, after all, wonderfully ignorant concerning other countries. We use the word "geography," perhaps, in a somewhat abnormal sense. We do not refer to what is commonly taught at school under that title. What we mean is that young men should acquire a more or less intimate knowledge, not only of the countries with which we do trade, but of the inhabitants, their wishes, their wants, their mode of life, habits, customs, trade, manufactures, &c. To paraphrase a well-known sentence, what is wanted is not a knowledge of countries, but of men. The German appears to be far ahead of us in this kind of knowledge. It is not easy to say why. Furthermore, we want, if not more energy, at least better directed energy in pushing our trade in new markets. We want more knowledge of what goes on. The German traveller for a Berlin house soon contrives to make himself at home, even in outlandish places; the English traveller under similar circumstances is, with a few exceptions, a helpless individual, who has to be looked after and taken care of. Some of the most successful firms in this country owe their success to the constant labours of a partner abroad. We could name one firm for example, which, rising from small beginnings, now does a very large trade indeed, principally in France and Italy, never lacking orders at remunerative prices, while its neighbours are nearly idle, and this is almost entirely due to the tact and energy of one of the principals, who spends at least half of every year on the Continent. He has to our own knowledge carried away valuable orders—snatched, so to speak, out of the very jaws of French and Italian engineers. There is an old adage to the effect that, "Heaven helps those who help themselves," and it is especially applicable in the present day. Our readers may rest assured that work will not come to them; they must go in search of it.

Probably one of the worst aspects of the present difficulty is, that the honest manufacturer has to contend against the dishonest. We fear that we must say that neither Frenchmen nor Germans are scrupulous in pushing trade. A premium is held out by the corruption which exists abroad for practices which deserve strong condemnation. That bribery should be practised in Turkey or Russia is nothing new; and now an ugly story comes to us from Japan, to the effect that Germans have contrived to get English iron and steel practically prohibited in favour of their own metals by the liberal use of money. We can only hope that the story is not true. Worse foes than German or French rivals are dishonest English manufacturers, of whom there are, we fear, only too many. These men sell worthless goods as the best that England can produce, and simply devastate our trade. We have cited many instances of this. One or two more may be of use. We were shown the other day an inquiry for a large quantity of tin-plate, to be of the commonest and cheapest quality, but to be branded and sold as "extra good charcoal." Need we say that the order was refused. In another case several tons of horseshoe iron were sent to Turkey branded as the very best English iron, with a first-class trade mark, which, for obvious reasons, we shall not name. The iron was red short to the last degree. It was fairly good while cold, but no smith could turn or fuller a shoe made of it. Germans found this out, and, putting in a moderately good German iron, did much damage to English trade, urging on the consumer that English iron was bad because the Englishman could not make good iron, pointing out that the brand proved it to be the very best that England could turn out, yet it was useless. In the same way rubbishy tools of all kinds find their way abroad, and do irreparable injury to British reputation. Measures should be taken to make it clear in foreign markets that goods of this kind are frauds. But, unfortunately, our national ignorance of foreign countries, our slowness and want of appreciation of the consequences of the mischievous policy we have cited, seem to stand in the way, and prevent any adequate publication of the facts abroad.

VILLAGE SANITATION.

There is a branch of local government which, especially as regards its control of sanitation, and although it affects public health just as nearly as does the local government of considerable towns, attracts but little public attention; this is what may be called village or rural sanitation. With this the poor law sanitary regulations are closely allied; the dispensary medical officer is also the medical sanitary officer; and his colleague, the relieving officer, may be also lay sanitary officer. Both these are under the control of the Local Government Board, whose medical inspector periodically visits the dispensaries and examines the books and dispensing arrangements generally. In theory this system ought to work very well; in practice, however, certain defects are easily discernible by any observer. The social feelings of the members of communities affect this question not a little. Any student of human nature, if told the population of a village or town, will readily be able to draw his own conclusions as to the relations of its inhabitants, and this influences the powers of the sanitary officer a good deal. Thus, in a village of two or three hundred inhabitants, there is much commonality of feeling, though leavened perhaps with individual jealousies. All are about equally poor; all have about the same scale of education; all have much the same habits, and these last are not always conducive to health; because, from some cause or other, poverty and cleanliness usually go in inverse ratio. Cleanliness may not cost much, but it, like most other good things, cannot be had quite gratis; and those whose pence are scarce will prefer to spend them on bread or beer rather than on soap or whitewash. Here is the difficulty of the health officers; their difficulties are probably greater in the village than in a good-sized town of six or eight thousand inhabitants. In it there is never the same commonality of interest; cliqueism bears rule, and the means of life are not on the same dead level of poverty as in the village, therefore the sanitary officers, if possessing any tact, can generally get the support of one or another of the parties into which the population is divided. It is true that the larger the town and the more dense the population, the greater the need for good sanitary administration; but, nevertheless, it can be shown without difficulty that even a village death-rate depends largely on the efficiency or otherwise of the sanitary supervision exercised in it. The low scale of diet usually attendant on poverty prepares the way for certain diseases quite as much in the hamlet as in the city, and thus it comes that while attention to cleanliness is as necessary to health in the individual as for the crowd, the powers of the health officer are, though nominally the same, virtually less as the population is smaller. One reason for this is that, as we have shown above, there is but one interest in a village, and the health officer is paid out of rates levied in his district. The average village mind thinks it bad enough to have to pay a tax at all, but in many cases considers it still worse to have to expend also money or trouble in cleaning premises or investing in whitewash, just because the dispensary doctor or relieving officer think proper to order him to do so. If the doctor or his colleague be men of energy, and desire to really exercise

their powers, they are sure to make enemies for themselves, and perhaps get into hot water with their local committee. The doctor, too, may in some cases lose some private practice, and even have his professional reputation impugned. All this applies also to some extent to sanitary engineers of small local boards, against whose narrow views and parsimony their engineers have to wage a constant contest, one in which they contend against their own paymasters. Agitation now springing up to extend, in a remarkable degree, the scope of existing sanitary legislation, may perhaps strengthen the hands of all Government or locally governed sanitary officers. An active and discreet dispensary doctor or local board engineer may make a noticeable improvement in the death-rate of his district; but unless they are men exceptionally endowed with the power of persuasion, such men will be so unpopular, as a rule, that their hold of their office is extremely slender. Were even the fact set aside, that their orders often involve money outlay, and always trouble outlay, the circumstance that they are of the nature of reformers will of itself make them disliked, and disliked, too, by the very class who most need protection against themselves—the poor and uneducated.

As regards village sanitation, improvement might be effected by the following means:—First, a more complete system of registration of the populations of villages and hamlets, and also of their diseases and death-rates; second, a capitation grant to the sanitary officers on all percentages of reduction of a particular death-rate. While readily recognising the zeal and honesty of purpose of sanitary officers generally, whether as engineers or as medical men, a spirit of emulation and the encouragement afforded by payment for results are excellent stimuli for every one—and for the reasons we have already given, that the zealous men are usually unpopular; compensation of some sort such men certainly deserve. We would also suggest that an external support ought to be afforded to village and hamlet, as well as to local board officials, by increased supervision from without, in the shape of more frequent independent inspection by a superior officer. This could easily be effected without in the least wounding the *amour propre* of the resident officer. A house-to-house inspection by some one from without, at uncertain intervals, would greatly strengthen the hands of the residents. It would silence the remark, "Oh, Mr. So-and-so need not be so particular about the cleaning and whitewashing." He would be known to be pushed on from behind, and could not help himself. In fact, a little infusion of the "Spenlow and Jorkins" system would operate beneficially. It would, we repeat, be not distasteful to energetic and efficient officers, and at the same time it would keep indolent men up to their work, and even, we fancy, save many a man of that kind from losing his position and his name, by urging him on. Local board engineers have for years had, as a rule, a hard, difficult, and thankless position—one which nothing but the thought that it is but a training school for higher positions, could be at all endured.

Another point about rural or village sanitation needs attention, and although pertaining more to medical journals, still, as it is closely akin to the work of the sanitary engineer, we cannot leave it unnoticed. We refer to the superannuation of medical officers. It frequently happens that they retain their position beyond the time when their mental energies are active enough to fit them to do efficient work. To illustrate the affinity between the engineer and the medical man: a poor person may be bedridden and neglected also, to such an extent as to endanger not only his or her own chance of recovery, but also to put the house itself in an unsanitary state. The engineer, where such officer exists, can do nothing until the doctor first does his duty, by either sending a nurse—for doing which he renders himself responsible to the ratepayers—or else by inducing the patient to go to the hospital, a thing he has no power to enforce. Health officers also ought to be pensioned off at earlier ages than they now are, and their powers of dealing with pauper or semi-pauper patients ought also to be increased. Then, and not till then, will the sanitary engineer who has to deal at all with rural matters, be able to act efficiently.

WATER-TUBE BOILERS.

Water-tube boilers are used so largely on the Continent that at first sight it seems strange that they have not found favour, save to a very limited extent, in this country. They have not been rejected, however, without cause. They have been very extensively tried at all events in England from a very early period in the history of the steam engine. There are now several thousands of horse-power of water-tube boilers at work in Great Britain, and it cannot therefore be urged that the system has been neglected or rejected without proper inquiry. It is said that the water-tube boiler is not in favour principally because it takes up more room, power for power, than other boilers. It is also stated by those who have had experience with them, that although water-tube boilers are perfectly safe, and such repairs as they need can be easily effected, they require more "tinkering" than either the Lancashire, Galloway, or Cornish boiler. On this latter point we possess no definite data, because those who have had most experience are very reticent as to delay, or worry, or annoyance incurred in frequently having to stop to make petty repairs. A joint has to be tightened up here, or a bolt is weeping there, or fire-tiles have broken and fallen down, or the inside of the brick furnace wants mending, and so on; but on this point nothing definite is ever published. Our own view is that the water-tube boiler lacks popularity, first, because it is set in brickwork; and, secondly, because it will not stand forcing. It may be said, of course, that a Cornish or Lancashire boiler is set in brickwork, but the analogy goes little further than words. In the case of the normal boiler, the fires are made inside the flues. They are surrounded with water on all sides, and the products of combustion are, comparatively speaking, cooled down before they reach the bricks. But the water-tube boiler consists essentially of a number of small tubes set in a furnace or oven, and the bricks are intensely heated. Good firebricks will not melt or run down to any serious extent, but, unfortunately, they expand and contract through very large ranges. If only steam were kept up night and day for weeks at a time this would not cause inconvenience. But the temperature in a factory boiler furnace varies day and night, and the consequence is that the life of the furnace is shortened in a way well understood by every one who has much to do with furnaces of any kind. Again, clinkers form on the bricks at the sides of the furnace. These have to be broken off, and the bricks get broken at the same time. It is not to be disputed that a firebrick furnace means frequent delays for small repairs, and the inventors or makers of water-tube boilers would do well to try and dispense with bricks altogether, or at least they ought to be used only in the shape of an external casing, wholly or partially protected from the direct impact of flame and radiant heat.

Water tube boilers need considerable space, because the heating surface is not efficient. That is to say, it is not good generating surface. The upper half of each tube may be taken as of no value whatever for this purpose; but putting this on one side, we have still the circumstance to deal with that the remaining surface cannot be used to as good effect as a similar area in almost any other form of boiler. The reason why, introduces us to certain curious phenomena in the generation of steam, to which not much attention has been given. A thermometer placed in a vessel of boiling water shows that it is equally hot in every portion. No test sufficiently delicate has yet been made which proves that the water is hotter just over the fire, let us say, than it is to one side or the other. Why is it, then, that large masses of water do not flash suddenly into steam, the interval of ebullition being followed by one of rest? There is apparently no reason whatever why continuous and comparatively quiet ebullition should take place instead of spasmodic conversions of portions of the fluid into steam. Such a mode of boiling would, we need scarcely say, be almost fatal to the utility of the steam engine, yet in practice we are very much nearer to it than is usually supposed. All the phenomena of what is known as spasmodic ebullition are familar to the chemist. Water from which air has been removed by long boiling is converted into steam in glass vessels with explosive violence. The influence of the surface with which the water is in contact seems to be very powerful, and it is a fact not generally known that the whole of the steam produced in a large boiler may arise from one or two small centres of conversion. We have ourselves seen a glass model of a Cornish boiler—that is to say, the flue of the boiler was of copper, while the ends and shell were of glass. The water was heated by a Bunsen flame. Looking down on the top of the water, it was seen to be apparently all in violent ebullition. The appearance was deceptive. Looking through the glass ends, it was seen that the whole of the steam was rising from one point, not larger than the head of a pin, on the top side of the copper flue. From this spot a great rush of bubbles rose unceasingly. The main body of water was in very slow motion, as shown by the movement of small impurities. By shaking the boiler, the centre of conversion changed its place to some other point. Apparently the place was determined by the existence of some small roughness or inequality in the metal. Now, in a boiler of the ordinary type, one or a few centres of conversion may suffice for the whole body of water, and there is therefore really very little frothing or foaming. The boiler is, for the most part, full of "solid water." In the case of the water-tube boiler this can scarcely be the case. Each water tube must generate steam, and near the fire there can be very little "solid water" indeed. Every exertion has therefore to be made to keep the tube well supplied with water, and this is a very difficult thing to accomplish. Let us take a glass tube, communicating at each end with a vessel containing water, and let the tube be put on an incline, one end higher than the other. Apply heat to the tube, and watch the result. So long as the water is below the boiling point a considerable current will be set up, the water flowing towards the highest end of the tube; but when once the water has been raised to the boiling point, it can get no hotter, and being all of the same density, circulation all but ceases. It would cease entirely if it were not that external radiation, by promoting the cooling of the water, sets up downward currents in the vessels coupled by the glass tube. In a little time ebullition begins, and the steam being light runs merrily along the tube to the highest end, and so ascends to the surface of the vessel. To all appearance, violent circulation is now taking place in the glass tube. This is, however, a pure delusion; scarcely any change of water may be taking place, the phenomena resembling that of waves, which appear to move, the form only moving, not the water. If the boiler is hard pressed, and if the tubes are long and small in diameter, the steam may be made so quickly in the tube as to blow the water out before it, leaving the tube dry for the moment. This is a result which is not to be coveted. In practice, indeed, it is well known that the production of steam in water-tube boilers is so irregular that large receivers have to be provided to prevent water from passing over to the engine. The more moderately the boiler is worked, and the greater the surface provided for the supply of a given amount of steam, the better are the chances of success. When there is plenty of boiler power, the water-tube boiler can be used with advantage and perfect safety, and it has a great deal to recommend it; but, as we have said, it is quite unsuitable for driving or forcing.

It might be worth the consideration of makers of such boilers whether it would not be possible to prevent ebullition altogether in the tubes with considerable advantage. Thus, for example, means might be provided for ensuring a constant circulation, say, by a pump, which would absorb very little power. Let, now, the working pressure be 150 lb. Then the pressure in the tubes could always be kept at 200 lb. by causing the water circulating in the tubes to escape from them to a suitable drum through a valve loaded, say, to 200 lb. per inch. The moment the water passed the reducing valve a portion of it would flash into steam, and its temperature would fall from 390 deg. to 366 deg. Fah. It would only be necessary to circulate the water fast enough to prevent the formation of steam where it was not wanted. A boiler worked in this way would be eminently suitable for torpedo boats. Provided solid water was maintained in the tube or tubes, these last might be made of small diameter, and any length. Anomalous as it may seem, the last thing wanted in the tubes of a water-tube boiler is steam.

ENGLISH AND FRENCH RAILWAY COMPETITION IN THE EAST.

On a recent occasion we described at length the proposals made by Messrs. Colquhoun and Hallett for extending railway communication between Burmah and Siam to the southward, and between the former country and India and China to the north and east. That there must be experienced delay in carrying out projects of such magnitude we were well aware, and we are not surprised therefore that, as yet, but little advance has been made towards their active commencement. But events have now taken place which seem to demand that that delay should be shortened as much as possible. The French, who now exercise a great influence on the whole south and west frontiers of the Siamese peninsula, will shortly commence a railway work which, if not forestalled, or at all events met by immediate work by ourselves, will probably interfere very materially with the prospects upon which the two gentlemen above named have relied as constituting a basis for a part at least of their complete scheme. France, we understand, has forced a treaty on China, and intends the early commencement of a railway from Tonquin to Yunnan. The effect of our rival being the first in the field will be to establish the course of much trade over the route under her protection which we might otherwise reasonably hope to see swelling the traffic of the lines designed to serve our own Burmese provinces. If for that reason only, it is manifest that the sooner the lines which are to connect our existing and proposed railways in Burmah with a Siamese system are begun, the less chance will there be of our having to yield to foreign competition a source of much valuable traffic. We are pleased to learn that those who have so actively interested themselves in the provision of railways in and outside of British Burmah are showing themselves alive to the necessity French action on the Siamese frontiers imposes upon us. Chief Commissioner Crosthwaite arrived at Rangoon on September 13th, and he has, we learn, already applied to the Viceroy of India for permission at once actively to undertake the survey of certain of the lines involved in the proposals to which we have above made reference. It is fortunate, at the present conjuncture, that we have at the head of the Government of India so able and large-minded a man as Lord Dufferin. That nobleman has had a wide and varied experience which must especially fit him to assign due importance to railway communication. In Canada, while Governor-General of that dependency, his policy was always in the direction of extending such communication. We may be certain therefore that he will not fail duly to weigh and recognise the importance of a similar question with regard to our territories in Burmah. Moreover, during his term of office in Canada, Lord Dufferin had to consider a frontier competition not very dissimilar in character to that with which we are now threatened by the French in Burmah and Siam. If he was able to meet such competition by the astute projectors of the United States, it may be relied upon that he will exhibit no shortcoming in dealing with similar competition by those of French nationality. Objection we know is taken by some to either the Indian or Imperial Governments accepting any responsibility for railways in Burmah. Those who object contend that there is no more obligation on either of those Governments to do so than could rest upon them with reference to Canada, Australia, or the Cape. But we hold there is no analogy between the cases cited. Burmah occupies, as regards our interests and responsibilities in and towards her, a perfectly exceptional position. The statements made by Sir J. Gorst when speaking upon the Indian Budget recently submitted to Parliament, demonstrate that until our recent acquisitions in Burmah are pacified and brought under regular government and administration, they must prove a heavy annual drain upon the Indian exchequer. Past experience in many parts of the world has proved that nothing contributes so much or so rapidly towards securing those advantages as the establishment of the means of facile and rapid communication. It is almost certain that judicious expenditure on railways in Burmah will effect a corresponding reduction in the cost of armed force. The employment their construction would give to large masses of people would alone do much to remove the primary cause of that system of dacoity which, so long as it exists, must greatly retard development. The conditions therefore of Burmah differ greatly from any we have had to face in other of our Colonial Possessions, and it must be remembered that its inhabitants, as well as those of the protected Shan States, are of an intelligent race, and are born traders by nature. We have in previous articles named the remunerative character of the lines hitherto constructed in British Burmah, and we need not therefore now further refer to this strengthening argument in favour of early continuance of a system already so auspiciously inaugurated. If this fact, and others which we have before cited, formed the sole basis for our recommendation of such early continuance, it would be of sufficient importance. But when we now have to add to them the results which threaten to follow upon the course already decided upon by French competitors, the urgency of the case becomes greatly increased. We have seen and noted the good effects which have attended railway extension in Lower Burmah during our comparatively short occupation of that country. It is now one of the most prosperous British Possessions abroad. Not only does the revenue derived from it cover all expenses of the Government, but there is now an annual surplus of that revenue of over a million sterling. When all the circumstances we have named are reviewed, we think it will scarcely be contended that a good case has not been made out for very liberal support being given to the proposals made for immediate action by both the Indian and Imperial Governments. Acceptance of responsibility by either one or both of these is not likely to involve them to the extent which the guarantee system in India involved the Indian finances. It is not the creation of trade which is the object sought. The trade is already known to exist, and all that is needed is to give it the means for that fuller development of which we know it to be readily capable.

CLYDE SHIPBUILDING TRADES.

In spite of the wholesale reduction in hands, and the leisurely pace at which Clyde shipbuilding operations have been carried on for many months past, the rate of output continues to

be greatly in excess of the income of fresh orders. Indeed, little or no new work has been received during the month of September, while the output is represented by ten vessels of about 17,000 tons; a good average result, though greatly less than that for last month, which reached the unusual figure of 36,550 tons. The most important launches during September were those of the Latin, a magnificent steel screw steamer of 6500 tons for the North German Lloyds' Co.; and the Rosarian, a steel screw steamer of 3000 tons for the Allan Line—the Fairfield Company and D. and W. Henderson and Co. being the builders respectively. The total output for the nine months now passed aggregates somewhere about 148,000 tons, a somewhat better figure than for the corresponding period during the past three years. It is in the highest degree doubtful, however, whether the comparison will be so favourable for the year, when the whole twelve months' doings come to be computed. So far as present indications go, the next three months will be dull in the extreme, and a hard winter season will result for the Clyde artisans. Already in some of the districts affairs are in a worse state than ever they have been. In the Whiteinch district, with shipyard capacity in the way of berths for some twenty vessels, only one solitary ship is on the stocks, and in the course of a week or so she also will be launched. Matters in the Port Glasgow district are scarcely any better—Messrs. Blackwood and Gordon's yard is empty, and in the market for sale; Messrs. Hamilton and Co.'s berths are entirely vacant; Messrs. Duncan and Co. and Russell and Co. have each only one vessel on hand, while Messrs. John Reid and Co. have two small vessels under way. In Messrs. Russell and Co.'s Greenock yard matters are more cheerful, and they have just booked an order for two additional steamers, one of 2000 tons and one of 3000 tons. Messrs. Caird and Co. have nothing on the stocks, and have only retained a limited number of their workmen to finish the Peninsular and Oriental steamer Britannia, which they launched some time ago. At Dumbarton, out of five yards employed in ordinarily busy periods, there is only one, Messrs. Denny and Brothers, where any work is in progress. This chiefly consists of light draught river steamers and barges to be shipped abroad. At Clydebank efforts are concentrated on the two Inman liners, in which a marked degree of interest is taken by all concerned in the Atlantic mail and passenger service. One is nearly plated and the other is in frame. The two yards in Renfrew making dredgers and hopper barges a speciality have been kept exceptionally well employed for a considerable time, and though they have been turning out new vessels with great rapidity, seem still to have a goodly number of craft on hand. The yards in the Govan and Partick districts are also fairly well off. Messrs. R. Napier and Sons have in a forward state a steamer of 3500 tons for Messrs. Thompson and Co., of Aberdeen and London, the only other vessel on hand being a steamer of 1100 tons for a telegraph company. The London and Glasgow Shipbuilding Company is making good progress with the two 2500-ton steamers for a Japanese company booked six weeks ago, and the vessel it is building on speculation. The Fairfield Company, after having launched the large German Lloyd steamer, has still on the stocks a steamer of 1800 tons for the China trade, a paddle passenger steamer of 1000 tons for Channel service between Newhaven and Dieppe, and the two steel wood-sheathed cruisers ordered by the Admiralty some time ago, the keels of which are being laid. Messrs. A. Stephen and Son, Linthouse, have launched within three months four vessels aggregating 11,690 tons, which reduces the work on hand to three vessels of 6500 tons. Messrs. Inglis, of Pointhouse, have three vessels on the stocks aggregating about 8500 tons, and Messrs. Henderson, of Meadowside, have a 3000-ton steel steamer for the Allan Line, similar to one just launched for the same company. This vessel, and one for which they have just received the order, makes the work on hand by this firm amount to 4400 tons.

LEVIATHANS OF THE DEEP.

During recent years the tendency to invest in large steamships has been more than once commented on; and in a Blue-Book we have some interesting figures as to the places where these large steamships are owned in the United Kingdom. If we take the steamships above 2500 tons, we shall find that they are chiefly owned at a few ports. Barrow-in-Furness—taking the alphabetical order—has 5 steamers between 2500 tons and 3000 tons, and 2 above 3000 tons; the old port of Bristol has not one of over 2000 tons, nor has Cardiff. Hull even has only 1 above 2500 tons; but Liverpool has 43 between 2500 and 3000, and 13 above the latter tonnage. London has 13 steamers between the two tonnages named, and 3 above 3000 tons. Southampton has one of 2755 tons, and 1 of 3003 tons. Thus in England there are owned 63 steamers between 2500 tons and 3000 tons, the aggregate tonnage being 173,137 tons, whilst there are 24 above the limit last named, the aggregate being 90,828 tons. In Scotland, Glasgow owns 17 vessels between the limits stated, and 8 above 3000 tons; Greenock has 10 between 2500 and 3000 tons; and Port Glasgow has 1 above 3000 tons—the total for Scotland being 27 between the limits, with a tonnage of 71,605, and 8 above the highest of those limits, with a tonnage of 25,747. In Ireland Belfast and Dublin are the only ports which near the lower limits, and they do not pass them. For the United Kingdom as a whole, then, we find that 90 steamers of 244,742 tons are owned, as well as 32 of an aggregate of 116,575 tons. There are also 12 sailing vessels of the size given, but of these we have taken no account. It will be seen that the monsters of the deep are owned at a few ports only, and that though their number is increasing, and though the tonnage is large in the aggregate, there is not as yet any very great proportion of the 6630 steamers registered as owned in the United Kingdom included. But the number is growing, and it is one which is likely to be enlarged more rapidly in the future, for it is found that there is the greater profit in the large vessel even for cargo-carrying purposes; for the expenses of working do not increase concurrently with the enlargement of the size of the vessel. It would be found, if a census could be taken of the steamships of the world of the magnitude named, that by far the larger proportion is owned by us, though in the last few years Germany and France have increased their holding. It will be well in future numbers of the Blue-Books on Shipping and Navigation if we could have the details as to other and rival shipowning countries.

RESTRICTION IN THE COAL TRADE.

In a short time representatives of the coal miners will meet in Scotland to consider the desirability of restricting the output of coal. Last winter, local attempts in this direction were made in Scotland, but this was due to exceptional circumstances, especially to the fact that much of the coal was needed for blast furnaces which could not be well interfered with for any length of time. But this would not affect the whole coal trade of the kingdom, and it may well be believed that the large number of miners working under sliding scale regulations, and unable to join in any such attempt, will of necessity lessen the possibility of any large measure of success arising from it. There are some facts officially vouched for, which are worth quoting in this connection, and these establish the statement that low prices enlarge the average output of the individual miner. In 1874, the average output of each person engaged in the coal trade in the United Kingdom was 235 tons, but it increased year by year as the coal trade became more and more depressed. In 1877 it had risen to 278 tons, and by 1880 it had shot up to 303 tons, but there was a year or two after that, in which prices of coal were raised owing to the demand for iron for America, and in those years it is a singular fact that the output of coal per man did not show that increase which had been known in the years when prices and wages were falling. In some parts of the coal field the decrease did not set in so early. Thus, in the Yorkshire district, in 1880, the output was below that of the kingdom generally—it was 296 tons per person, and it rose until the year 1883, when it had reached 317 tons, but the fall set in, and in the two following years the average production per person employed was brought down to 298 tons, but there is now recovery. It is found universally, almost, that low prices and low wages cause the average yield in a given time to be increased, and that as the wages rise with the prices the average yield falls off. This has a most important bearing on the question of restriction in the coal trade, for we may now be said to be almost at the lowest range of prices, and of course wages have followed. It is certain that if there be restriction of the time worked, then in that time the miners will work more coal. If, for instance, the plan suggested by the miners of Scotland be followed, and fewer days be worked, then in these days the yield of the men will be naturally more, and so there will be to the extent of the operation of that law which seems universal, a defeat of the intention of those who urge restriction. This is the fact which the leaders of the men cannot overcome—for the inherent tendency to make a given sum will urge the miners to make the most of their time, and thus defeat the design which the leaders have in view, that of lessening the total yield of the mines. It remains to be seen how far the miners of the kingdom will join in the proposal, but it cannot be concealed that there is the probability of at least a considerable amount of annoyance to the coalowners being caused, for the proposal comes forward at a time when the home consumption of coal, for the purposes of gas making, for house consumption, and other methods of use here, will be approaching the height. It will not affect the foreign trade much, but it will—to the extent that it may influence prices—punish the home consumers, without, as far as can be judged, being likely to yield much good to the miners as a body.

AWARDS AT EXHIBITIONS.

While the policy of withholding awards at exhibitions seems to be amply justified in the great success which has attended the Manchester Exhibition, and in the fact that the same principle is to be followed as connected with the Glasgow Exhibition of next year, it is not a little curious to learn that a committee of dissatisfied exhibitors at the Edinburgh Exhibition of last year are persisting, even at this late date, in demanding genuine medals from the Executive Council in place of some other equivalent which had been tendered. So anxious are they, indeed, for the conventional badge of appraisement, they have just compromised their original demand, and now make the curious suggestion that the Executive Council should agree to cut dies, and give the exhibitors an opportunity to provide themselves with medals at their own expense at the net cost price! What an article to conjure with must an exhibition gold medal be, when men are found, twelve months after the occasion of its award, striving to procure it by means which certainly appear to an outsider undignified and childish. A medal may perhaps have some talismanic effect in recommending certain kinds of wares patronised by the general public; but surely it cannot be of such signal service in cases of large and costly items of manufacture, the purchase of which is a matter involving close and serious consideration, and such as no exhibition award can materially influence. Articles such as we refer to are the thousand-and-one kinds of machinery which generally constitute the department of greatest interest and value in international displays, of which that at Manchester is an instance. Experience at recent exhibitions has indeed tended to altogether discredit the systems of adjudication and award obtaining at exhibitions, and for one firm now disposed to attach importance to exhibition medals there are dozens, if not hundreds, who depreciate them. This is largely borne out by the experience of the Glasgow Exhibition Council, members of which, in recently laying the claims of the forthcoming exhibition before the Council and leading citizens of Birmingham, Sheffield, and other large manufacturing towns, found that the avowed intention of the Council to give no awards to exhibitors was uniformly and heartily applauded. What has proved true of the Manchester display will doubtless hold good in that of Glasgow, viz., that the reward of public though unofficial appraisement is in itself sufficient to stimulate competition for, and rivalry in excellence of, exhibits. The forthcoming exhibition will suffer neither in comprehensiveness nor excellence through the no-award principle, and dissatisfaction and agitation respecting medals shall be unknown at any time during the course of the exhibition, far less twelve months after it has been closed.

HARBOUR IMPROVEMENTS AT MELBOURNE, AUSTRALIA.

On a former occasion we gave details as to the proposals under consideration for improving the approaches from the sea to the city of Melbourne. By recent advices we learn that one of the most important features of these proposals—the straightening of the curves in the river known as the "Fishermen's Bend"—has just been completed, and a very much needed improvement has thereby been secured. So much of the full design having been carried out, we may naturally expect that the citizens of Melbourne will be anxious that the fuller measures of relief they deem to be necessary for their trade shall be shortly undertaken. We learn, however, that public opinion in the great Austral city is much divided respecting this matter. To judge from the statements of the local press, there are those of its citizens who hold that the whole design, of which a first instalment has now been completed, is unnecessary in an economical sense, that is to say, that equal advantage might have been gained by alternative and much cheaper measures; but into this question it would be impossible for us to enter. Those responsible for the works adopted the design for them on the recommendation of high engineering authority, and it would be waste of time therefore to discuss the views in opposition to its dictum put forward by non-professional disputants. But all parties in Melbourne seem to be united in opinion as to the desirability of establishing docks in the immediate neighbourhood of the city itself; yet although there is unanimity of view on the main point, there is great divergence of feeling as to the method on which these docks should be constructed, and it seems not unlikely—to judge from the tone of the arguments publicly put forth—that the dispute may cause great delay in the realisation of what is, as we have said, a want unanimously recognised. A large section of the population of Melbourne, enticed by the apparent economy in first cost, desires to see the docks required constructed entirely of timber. Now we fully acknowledge the very fine and lasting qualities of many of the Australian woods, especially that known as Jarrah, with which, we believe, the advocates of the use of timber propose to build the quays. But while granting a comparatively long life to Jarrah, we know from reports recently published that even that wood has not been found to have remained sound in sea-water for any longer period than thirty years. We doubt if a longer term of safe life could be assigned to it. The question the Melbourne people are divided upon is therefore whether the economy in first cost of using timber will compensate for the re-construction certain to be necessary at the end of such a term? We cannot ourselves pretend to reply to such a question; but having in view the peculiar strains and wear to which quay walls are subjected, we should greatly doubt the wisdom of using any material in their construction which did not promise the fullest and most permanent durability under every possible condition; and we think timber hardly suitable for quay walling against which there will be a pressure of some thirty feet depth of water, to say nothing of other objections.

GERMAN IMITATION OF TRADE MARKS.

The German commercial journal *Export*, the organ of the Berlin central committee for the increase of German trade abroad, discusses in a recent issue the charges made against German manufacturers by commercial journals of falsifying foreign trade marks. The writer repudiates the charges made, stating that in all cases they are without facts and names, both of which he demands, so that the charges may be answered and examined. Until the required facts are produced, foreign critics of German industry are begged to be a little more modest. He contends that assuming that they are imitations, and under foreign marks, they must be better than the foreign wares under the same marks. The editor of the journal in a note observes that he has traced the source of these violent assaults on German trade to Paris, and principally to the Patriotic League there, which is now engaged in stirring up commercial animosity against Germany. Probably the editor of the *Export* had not at the time seen a report of the United States Consul at San Salvador on the subject of spurious American goods in Salvador. That report, dated 13th April, 1887, gives the necessary facts, and effectually disposes of the *Export's* contentions. "Products of American industry, skill, and toil, are supplanted in Salvador, and I suppose everywhere in Central America, by base imitations. Iron machetes are substituted for those of steel as manufactured in Connecticut and New York. The trade marks of American artisans are imprinted or stamped on the worthless German implements. American calicos, muslins, osnabergs, and sheetings, are driven out of Central American markets by goods bearing the brands and trade marks of the best American mills. These worthless German goods, made of Egyptian and East Indian, cheap, short staple cotton, are utterly valueless. Perhaps the poorest beverage I ever imbibed was German claret, sold here and bearing the trade mark of the best wine grower of California. Beautiful bottles bearing on their exteriors pretty labels of the great beer distilleries of Milwaukie, Philadelphia, and Saint Louis, are full of foul decoctions brewed in Germany. Perhaps the deadliest of all these beverages is the Kentucky whiskey, so labelled, but distilled in Germany These illiterate untravelled natives demand the cheapest goods—cast iron sewing machines, German acid beverages, and wares, and are supplied with them by Germany. May not the co-operation of the American producers send hither an agent selling nothing but American products? Would not such a wholesale agency, educating the people, speedily expel fraudulent and worthless goods from Salvador?"

PUMPING ENGINES AT WORK IN STAFFORDSHIRE.

The work of draining the mines of South Staffordshire so as to allow of the continued drawing of the coal, and of unwatering underground areas now drowned out, with the object of rendering them again available for coal getting, continues to be vigorously prosecuted under Parliamentary powers obtained by the body known as the South Staffordshire Mines Drainage Commissioners. From information presented by the engineers at the annual meeting of the constitution this week, it appears that the object which the Commissioners have of late been setting themselves to accomplish, namely, the concentration of the water at fewer pumping stations, and a consequent reduction and economy in the engine power employed, is steadily being attained. The Commissioners' engines proper have now been reduced in the Tipton district—which is by far the most important section—to seven; and the water in the Bilston portion of that area has been lowered 76ft. in one locality, that of the Stow Heath engine, and about 25ft. in the other portion. At no part of the ground is the water now nearer the surface than 123ft. The greatest fall effected at any one place during the twelvemonth has been 27ft. Satisfactory as these figures are to a certain extent, they are less satisfactory than would have accrued but for repeated breakages of the valve boxes at the largest engines. These accidents have entailed delay in the work, and have led to a larger expenditure than had been estimated. The excessively dry summer has not lessened the enormous "come" of water, against which the engineers have had to battle, to anything like the extent that might have been anticipated. Here is proof positive that one of the greatest difficulties which the Commissioners have to contend with is the constant leakage from the bed of the chief canal serving the Staffordshire district. Water is constantly finding its way into mines from this source. The tunnelling of underground levels to convey the water to the main pumping stations is being continued at much first cost, but with considerable ultimate economy. Upon the whole, though the works of the Commission are slow in accomplishing all that had been looked for, yet the pumping plant is, beyond dispute, rendering admirable service.

School of Art Wood Carving.—The School of Art Wood Carving at the City and Guilds Institute, Exhibition-road, South Kensington, has re-opened after the usual summer vacation, and we are requested to state that there are vacancies for the free studentships maintained by the Institute in the day and evening classes of the school. Forms of application for these free studentships may be obtained from the manager. To bring the benefits of the school more within the reach of the artisan class a remission of half fees for the evening class is made to artisan students connected with the trade. Instruction is also given by correspondence to amateurs unable to attend the school classes. During the past year the students have been engaged on various architectural and other important works. The public are permitted to visit the school and inspect the work in hand, on application to the manager on any week day except Saturday, between the hours of 11 a.m. and 4 p.m.

LITERATURE.

Electricity for Public Schools and Colleges. By W. Larden, M.A. London: Longmans, Green, and Co. 1887.

In this volume the author "aims at giving a sound though elementary knowledge of the modern science of electricity," and he is to be congratulated upon having accomplished his task with what—considering the elementary character of the mathematics employed—must be considered a remarkable degree of success. The course is very comprehensive, ranging as it does, in considerable detail, over every branch of the subject, and the reasoning is everywhere clear and continuous, the occasions on which the reader is required to take for granted the results of higher analysis being extremely few. A conspicuous feature of the book is the avoidance of the dogmatic tone. The uncertainty and obscurity in which some portions of the science are still involved are candidly pointed out, and matters which are still subjects of dispute are freely introduced. Whether this method will recommend the work to science masters in schools remains to be seen, but it will undoubtedly increase its value and interest for natural science students in the universities, and for engineers who are reading the theory of their subject concurrently with a course of practical experiment.

The first three chapters, on magnetism, include Hughes' molecular hypothesis, a very clear description of the magnetic units, and an account of an elementary series of experiments on the earth's magnetic field. After a summary of the fundamental properties of statical electricity, we have a chapter on the electrostatic potential regarded as "level." The subject is here considered entirely with reference to the hydrostatic analogy, but under all due precautions. In Chapter X., on the other hand, we have an account of the theory of potential in general as connected with energy and work. The properties of equipotential surfaces and of lines and tubes of force are well explained, as also is the Faraday-Maxwell theory of electric tension. Chapter VI. is devoted to the theory of Leyden jars and other forms of condenser, and Chapter VII. to induction machines, including Sir W. Thomson's "water-drop accumulator" and the replenisher for the quadrant electrometer—described in Chapter X.—and also the Holtz and Voss machines. In Chapter VIII. we have the methods of observing atmospheric electricity, the theory of the formation of thunder clouds, and the properties of lightning conductors. Chapter IX. includes the theory of specific inductive capacities with an account of Cavendish's, Faraday's, and Gordon's experiments.

Passing to current electricity, Chapter XI. begins at the beginning with Galvani's and Volta's experiments, and after a sketch of the theory of the cell, and an intelligible account of polarisation phenomena, passes to the principal modern batteries. Chapter XII., on electrolysis, includes the hypothesis of Grothüss, Faraday's laws, and a sketch of the processes of electro-plating and its applications. The Planté and Faure accumulators are also described here. We next have a very clear account of Ohm's and Kirchhoff's laws, a chapter on the application of Wheatstone's bridge to the comparison of resistances and electro-motive forces, and one on Joule's law and the theory of current-energy. Chapter XVI., on thermo-electricity, makes the best of the available material, but the entire beauty of the theoretical deduction from Tait's hypothesis as to the law of the Thomson effect is, of course, lost, owing to analytical limitations. This section ends with a chapter on the various forms of galvanometer, including a preliminary sketch of the magnetic action of a current.

Chapters XVIII. and XIX. contain an excellent summary of the modern theory of electro-magnetism, with an account of the "absolute" and "practical" systems of units, and a table of dimensions introducing the fundamental constant "*v*." The equivalence of closed circuits and conterminous magnetic shells is fully explained, and leads in the next chapter to the account of solenoids and electro-magnets. Chapter XX. also contains a description of the phenomena of diamagnetism and of electro-optics, and ends with an elementary sketch of Maxwell's theory of light.

Chapter XXI. is devoted to the theory of electro-magnetic induction, and Chapter XXII. describes several practical and experimental applications, including Arago's disc and Barlow's wheel, the earth inductor and the Ruhmkorff coil. The properties of the secondary discharge in various media, and in high and low vacua as investigated by Crookes, are well sketched.

Chapter XXIII. sketches lightly the theory of dynamos and magnetos—from which latter term Mr. Larden excludes machines with a separately excited electro-magnetic field—with an allusion to the "lead" controversy. Chapter XXIV. considers dynamos as motors, and Chapter XXV. describes the applications of electricity to telegraphy, telephony, and illumination.

There is a collection of questions on each chapter, with answers, and a good index. A useful list is also given of original treatises and papers that have appeared in *Nature*, for further reference. The diagrams throughout the book are clear, and the printing is in general very good. In the copy before us, however, pages 279 and 379 have been interchanged, with embarrassing effect.

Theory and Practice of Electro-Deposition; including every known Mode of Depositing Metals, Preparing Metals for Immersion, taking Moulds, and rendering them Conducting. By Dr. G. Gore, F.R.S. London: Charles and Co. 1887.

This is a new edition of a little book so well known that it would be unnecessary to do more than announce it but for the fact that it contains a good deal of additional matter, and more especially that which, through recent developments in the dynamo-electric machines, and thereby the production of enormous currents, had become necessary to bring the book up to theory and practice of to-day. In this respect it is essentially the book of why and how, and its concise, precise, and exceedingly clear and definite style make it a handbook for constant use by those interested in its subjects. It deals with the theoretical principles in a practical manner, and then with the practice of electro-deposition. It is provided with a good index and table of contents.

BOOKS RECEIVED.

Electricity for Public Schools and Colleges. By W. Larden, M.A. London: Longmans, Green, and Co. 1887.

A Treatise upon Cable or Rope Traction as Applied to the Working of Street and other Railways. By J. Bucknall Smith, C.E. London: Offices of *Engineering*. 1887.

Commercial Geography, considered especially in its Relation to New Markets and Fields of Production for British Trade. By Kenric B. Murray, F.R.G.S. London: T. C. Jack. 1887.

Analysis of the Accounts of Metropolitan, Suburban, and Provincial Gas Undertakings for the Year 1886. Compiled and arranged by John Field. London: Eden Fisher and Co. 1887.

Minutes of Proceedings of the Institution of Civil Engineers. Vols. lxxxix. and xc. Edited by James Forrest, Assoc. Inst. C.E. London: The Institution. 1887.

Steam Boiler Explosions in Victoria: April, 1884—*March,* 1885. By A. C. Wannan and E. R. Meekison. (Victoria Engineers' Assoc. papers.) Melbourne: E. J. Stephens. 1887.

Tabulated Weights of Iron and Steel Angles, Tees, and Plates. By J. Squire Capstaff. London: Walter Scott. 1887.

Metal-plate Work: its Patterns and their Geometry. By C. T. Millis, M. Inst. M.E. London: E. and F. N. Spon. 1887.

Technical School and College Building: a Treatise on the Design and Construction of Applied Science and Art Buildings and their Suitable Fittings and Sanitation; with a Chapter on Technical Education. By Ed. Cookworthy Robins, F.S.A., F.R.I.B.A. London: Whittaker and Co. 1887.

Electrical Distribution by Alternating Currents and Transformers. By Rankin Kennedy. London: H. Alabaster, Gatehouse, and Co. 1887.

Azimuth: a Treatise on this Subject, with a Study of the Astronomical Triangle and of the Effect of Errors in the Data. By J. E. Craig, Lieut.-Commander, N.S.W. New York: Wiley and Son. London: Trübner and Co.

Report of Proceedings of the Master Car Builders' Association, Niagara Falls Meeting, July, 1886. New York: Martin P. Brown. 1886.

The Metallurgy of Silver, Gold, and Mercury in the United States. By Thos. Egleston, LL.D. Vol. i.—Silver. London: Offices of *Engineering*. New York: J. Wiley and Son. 1887.

THE LATE MR. O. E. WOODHOUSE.

With great regret many of our readers will have heard of the death of the senior partner in the firm of Woodhouse and Rawson. Otway Edward Woodhouse was born in London on the 21st October, 1855, was educated at Marlborough College from 1867 to 1872, and was afterwards at King's College, London. He then passed three years as pupil with Messrs. Hunter and English, engineers, of Bow, during which time he chiefly applied himself to practical engineering education in their fitting shop. In August, 1877, he entered the service of the Great Eastern Railway Company—engineers' department—and on Mr. W. Adams, the locomotive superintendent of that railway, changing to the London and South-Western Railway Company, Mr. Woodhouse changed with him, and continued in the service of that company until the beginning of 1881. In July, 1880, Mr. Woodhouse, in the company of Mr. J. C. Peache, the assistant to the London and North-Western Railway Company's locomotive department at Crewe, went to America, and spent six months making a tour of inspection of the engineering and general scientific works both in the United States and Canada, returning to England at Christmas, 1880. In 1881 Mr. Woodhouse went into partnership with Mr. F. L. Rawson, under the title of Woodhouse and Rawson. His firm is now well known in the electrical world, a result largely due to the extremely energetic and able manner in which the business was pushed at its commencement. The decease of Mr. Woodhouse is primarily due to overwork, and we fear that the extremely long hours he devoted to the development of the business of his firm must have had a serious effect upon his health, he being too often found in his office late into the night. At the commencement of 1885, just before the well-known action of the Edison Swan Company against Woodhouse and Rawson, Mr. Woodhouse, on account of his health, left England for Cannes, from whence he returned to England rather worse, owing to a fever he had caught whilst there. Although he gradually gained strength he never returned to business, and his sudden death on the 21st instant at Brighton was not altogether unexpected. His funeral on the 26th instant at Kensal Green Cemetery was largely attended by personal friends and employés of the firm, showing the great estimation in which he was held by all who came into communication with him. Before he died, Mr. Woodhouse saw his business successfully transferred to a limited company. Mr. Woodhouse, besides being an able engineer, was well-known in athletic circles. Until his work took up too much of his time, he played regularly in the lawn tennis championship matches at Wimbledon, being second in the all-comers, and winning the silver prize in 1880. In this year also he won the lawn tennis champion cup of America. In addition, he had the distinction of being the only lawn tennis player who has ever beaten W. Renshaw for the championship.

DEATH OF MR. CHARLES MOSELEY.

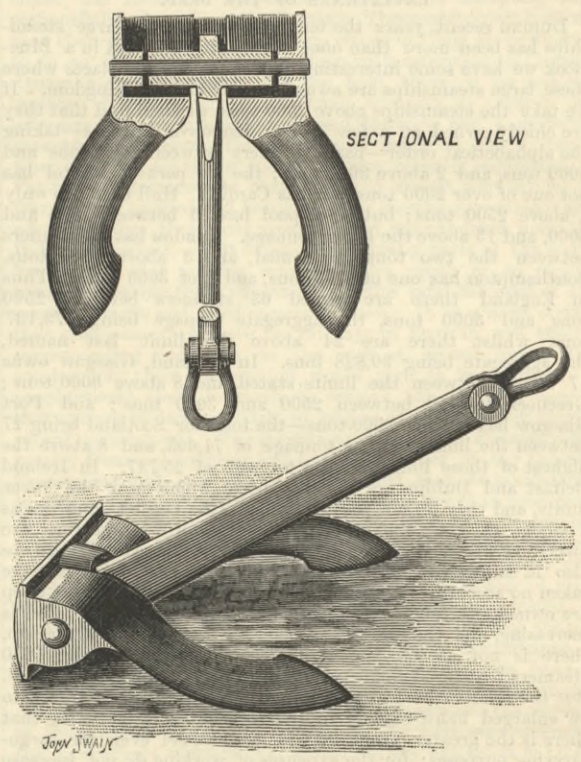
The Manchester papers announce the death, on Saturday last, of Mr. Charles Moseley, of Manchester. He had for some time suffered from occasional acute indisposition, and after death it was found that an ulcer had perforated the stomach. The *Manchester Guardian* says:—

"Manchester has given birth to few more remarkable men than the gentleman whose untimely death we have to-day to record. The firm of D. Moseley and Sons has now almost a world-wide reputation as of one of the largest India-rubber manufacturers in the world. It employs nearly a thousand hands, and has fostered an industry which is all the more remarkable as being entirely unassociated with the staple trade of the district. Besides the ordinary kinds of rubber goods, the works turn out large quantities of engineering and electrical rubber articles. Originally established by Mr. David Moseley, the business was still in its infancy when his sons Joseph and Charles were introduced into it. While both were still young men the death of their father left them with the responsibilities of the growing business, and by an arrangement agreeable to both, Mr. Charles Moseley devoted himself almost exclusively to the general management of the works, leaving his elder brother to represent the firm on 'Change and elsewhere. As a consequence of this Mr. Charles Moseley was for many years little known to the general public, and it was not until some eight or nine years ago that his interest in the telephone induced him to step forward into public life. He at one time contemplated establishing a private telephonic exchange in this city, but after the amalgamation of the Edison and Bell companies he was induced to accept overtures from the Lancashire and Cheshire Company which resulted in his appointment as their chairman. The development of the policy of the company owes much in its initiation to the foresight of its chairman. In nothing was his energy more displayed than in a contest with the Post-office, who strove under the Telegraphs Act to prevent the establishment of telephonic communication between adjoining towns. Mr. Moseley put himself in correspondence with the various Parliamentary representatives of this district, and so convincing were his arguments, that from time to time questions were asked in the House which Mr. Fawcett had great difficulty in answering. Subsequently Mr. Moseley had frequent interviews with the Postmaster-General, and it is not too much to say that he succeeded in converting him almost entirely to his own views. As a result the present "trunk-line" system has been developed, by which it is possible for most of the Lancashire towns to hold telephonic communication with each other. During the period that this matter was before Parliament Mr. Moseley not infrequently left Manchester after a day's labour at his works, was in the lobby of the House of Commons interviewing members towards midnight, returning to Manchester an hour or two later for the duties of the following day. Such extraordinary energy could not but attract the attention of all who were cognisant of it, and from that time Mr. Charles Moseley had been one of the most noticeable persons connected with Manchester life. When the Edison Electric Light Company was formed his interest in electricity induced him to take a leading position, and as a director he has never ceased to attend assiduously to its welfare. When the fortunes of the Ship Canal seemed at their lowest he was one of those who consented to form a consultative committee to consider and report upon the merits of the scheme. By this time Mr. Moseley's name had become a synonym for sound judgment and clear commercial insight, and when he and several other gentlemen reported in favour of the scheme the faith of the public in the venture was practically established. Mr. Moseley was called upon to take a leading part in arranging for the Jubilee Exhibition. The lavish expenditure on lighting and music would hardly have been ventured on but for the confidence the Committee felt in the good sense, admirable judgment, and exceptional experience of Mr. Moseley.

"A hard worker himself, he had no sympathy with idleness in any form. But struggling worth or undeserved misfortune never appealed to him in vain. Hardly a day passed in which he was not asked to assist in the development of some new invention or to forward some fresh scheme of commercial enterprise. Many of these were, of course, chimerical in their nature. Mr. Moseley's clear judgment and searching questions, however, soon disclosed the real features of any proposal made to him, and a very short interval usually sufficed to show a sanguine 'interviewer' that Mr. Moseley was a difficult person to convince except upon absolute evidence. Mr. Moseley was in his forty-eighth year."

HALL'S PATENT CAST STEEL ANCHOR.

The accompanying engraving illustrates a new stockless anchor, patented by Mr. Hall, of the firm of Jessop and Co., of Sheffield. The engravings give a perspective view and a section, so that description in detail is unnecessary. It will be seen that the shank is so secured to the head that even if the central pin

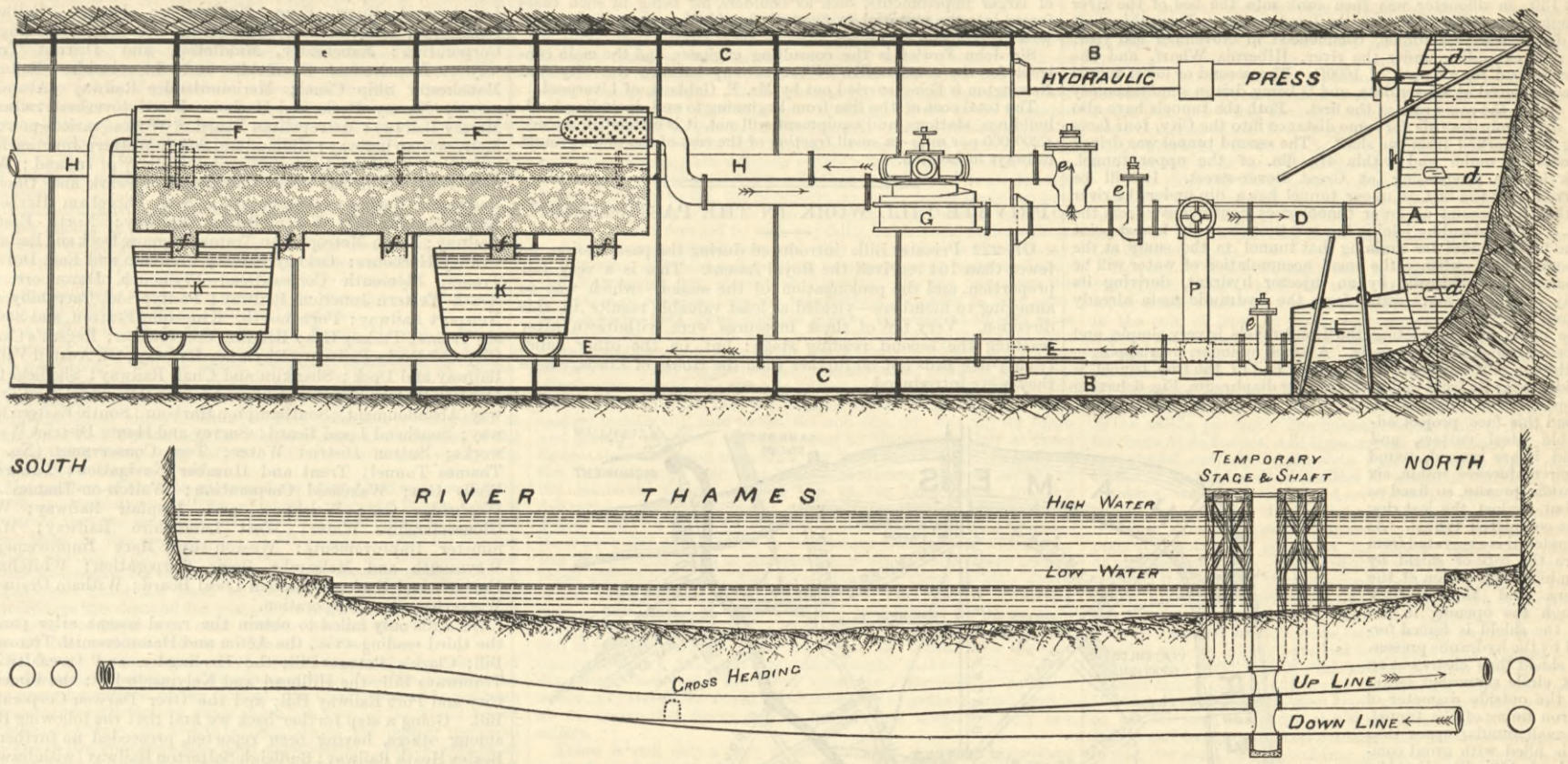


were broken or fell out, the anchor would, for all holding purposes, be as good as ever. This appears to be an extremely simple and satisfactory anchor in all respects. It supplies another instance of the ready way in which steel castings lend themselves to the wishes of engineers.

The Harbour of Montreal.—A plan has been proposed by Mr. F. J. Gilman for building an embankment nearly a mile long, from the abutment of Victoria Bridge down to Bonsecour Market; this bank to be about 300ft. wide, and considerably higher than the highest flood ever known. By means of a division embankment, an upper harbour will be thus enclosed 4000ft. long, 2000ft. wide, and 27ft. deep, opening into Lachine, and also a lower harbour opening into the river, which will be about 1900ft. by 3000ft. It is claimed that no damage will be caused to the waterway, but that by stopping the collection of ice and snow on the shallow area covered, there would be an equally free passage to all floods. Room will be afforded on the embankment for two lines of railroad forming junctions with the Grand Trunk and Canadian Pacific lines. The cost is estimated at 2,500,000 dols.

THE CITY OF LONDON AND SOUTHWARK SUBWAY.

MR. J. H. GREATHEAD, M. INST. C.E., WESTMINSTER ENGINEER.



Figs. 1 and 4.—SECTION OF RIVER THAMES AND TUNNEL, AND PROPOSED TUNNELLING APPARATUS.

THE CITY OF LONDON AND SOUTHWARK SUBWAY.[1]

On the south side of the Thames are some of the most densely populated districts of the metropolis, and beyond these are others of the most rapidly growing. The only direct communication with the City existing is that afforded by omnibuses traversing crowded thoroughfares, including London Bridge. The tramways from the southern, south-eastern, and south-western districts terminate about three-quarters of a mile short of the City, because they have not been and could not be permitted to enter upon the over-crowded roads northwards of Great Dover-street—see map, page 298. For the purpose of giving better access to and from the City, the Subway Company was incorporated by Act of Parliament in 1884, and empowered to construct a double line of subway from King William-street to the "Elephant and Castle," Newington, and by an Act of the present session the company has been invested with power to extend the line to the Clapham-road at Stockwell, as also shown on the map. The subway will then be rather more than three miles in length. The "up" and the "down" lines will be carried in separate tunnels placed at such a depth under the surface of the roads as to avoid all interference with sewers and other underground structures. An inspection of the map will show that, except where the line is under the river and an adjoining wharf, it will pass throughout its whole length under the streets, thus enabling it to accommodate the great stream of passenger

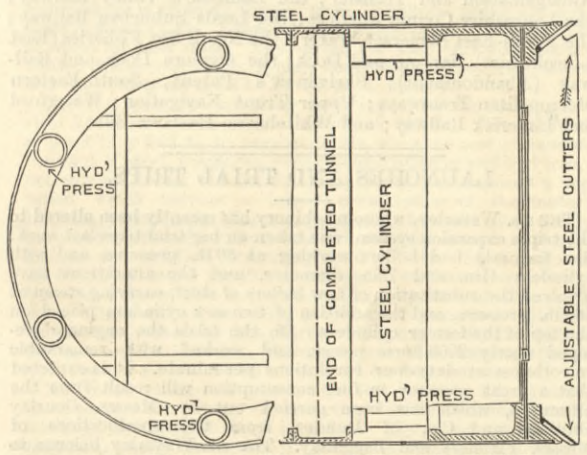


Fig. 6—SECTION OF TUNNEL END AND SHIELD.

traffic between the City and the Borough, Newington, Kennington, Stockwell, &c., now passing over London Bridge, without appreciable deviation from the present course of the traffic.

There will be stations at the Monument, King William-street; Great Dover-street; the "Elephant and Castle;" New-street, Kennington; the Oval; and Stockwell; and, if satisfactory arrangements can be made with the railway company, near the Brighton Railway Company's terminus on the south side of the Thames. At each station powerful hydraulic lifs are to be provided in addition to stairways for the purpose of giving easy and speedy access between the street and the platform levels, and in order to avoid double establishment on opposite sides of the road, at each station, the "up" and "down" tunnels will there be placed at different levels, so that passengers may pass readily from the lifts or stairs on one side of the road to either platform. The steepest gradient against the load will be about 1 in 30, but the line throughout the greater part of its length will be practically level.

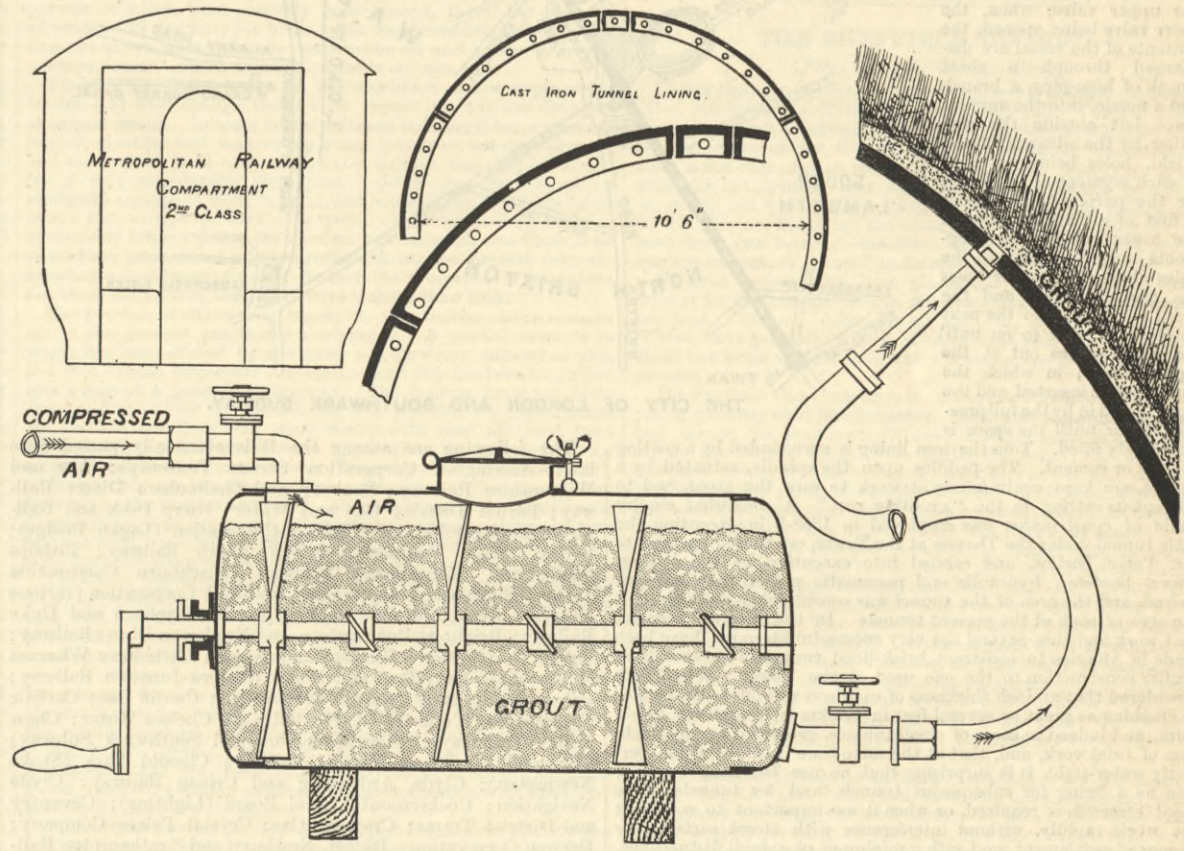
Steam locomotives are not to be used upon the line. The Act specifies that the "traffic shall be worked by means of carriages propelled upon the system of the Patent Cable Tramways Corporation, Limited, or by such means, other than steam locomotives, as the Board of Trade may from time to time approve." The endless cable system of traction has for some years been in successful use in a number of cities in America and elsewhere in connection with street tramways, and it is now being laid down in Edinburgh and in Birmingham—where it will shortly be at work—having been first introduced in this country on a small scale at Highgate. In this connection the system is hampered by the presence of the general street traffic, and by the necessity of burying the cables in small tubes beneath the surface carrying the traffic, the attachment of the carriages to the buried cable having to be made through a continuous narrow slot in the street. In the subway the cable system will have a fairer field.

The cable system of working tramways has been so frequently described that it will suffice now to state that the endless cable passing from the hauling engine to the termini of the line upon one line of pulleys, and returning to the engine upon another line of pulleys, is kept in continuous motion throughout the period of working from the start in the morning to the stop at night. Along the course of the line the carriages are, by attaching themselves to or detaching themselves from this moving cable, continually starting, running, and stopping as their own or the general street traffic requires. By using one line of cable, they run "up," by using the other they run "down." Steep gradients have no terrors for them, and they pass up a hillside of 1 in 4½ at the same speed as they run upon the level. All moving independently, they are yet actuated from one station. This power of independent motion is secured by the use of what is termed a "gripper"—simply a pair of jaws actuated from the carriage by levers or screws so placed and adjusted as to close upon the moving cable when it is desired to start and to release the cable when it is desired to stop. One great advantage of this mode of working in the subway is that light trains can be economically run at short intervals, in place of the usual heavy locomotive trains at longer intervals, and thus delay and accumulation of passengers at the stations will be avoided. As the average speed will be about the same as on the Underground Railway—ten miles per hour—it follows that, the initial delay being less, the service will be more rapid, especially for short-distance traffic. It is intended in the first instance to run every two minutes trains capable of seating 100 passengers. Steam locomotives being excluded, the question of ventilation becomes a very simple one, and the traffic in each tunnel being always in one direction, a continuous current of air will be established in the same direction, which current can readily be dealt with by a small expenditure of mechanical power if necessary. It is expected, however, that the variations of pressure, due to the movement of the trains on approaching and leaving the stations, will accomplish all that will be required.

The whole of the power for the traction and the lifts will be concentrated at one point, about the middle of the line, viz., at the "Elephant and Castle." There will be two endless cables, one passing to and from the City, the other to and from Stockwell. Hydraulic pressure and return water pipes will be placed throughout the length of the subway for the working of all the lifts, and any other small power machines in the subway. HIM

The carriages are to be of the longitudinal type, with platforms and entrances at the end, similar to Pullman and ordinary tramway cars. They will be very commodious, giving greater height and width than the second and third-class carriages in use on the Metropolitan Rrailway—see Fig. 5—and to each passenger about 30 cubic feet of capacity as compared with the 20 required by the Board of Trade regulation for railways. The stations are to be lighted by electricity, with gas in reserve. In connection with the permanent way no ballast will be used, and the absence of heavy locomotives will enable a smooth line to be maintained at comparatively small expense.

Having given this short description of the nature of the subway communication, the author will now proceed to give some details of the mode of construction of the works, and the appliances devised for driving through water-bearing strata should such be met with. The two tunnels for the "up" and "down" lines are absolutely separate and distinct between the termini, and are therefore capable of being carried in any desired position relatively to each other. Commencing side by side in the City, the "down" line falls more rapidly than the "up," in order that when Swan-lane is reached the former may be immediately under the latter, because, except in this position, they could not be constructed without encroaching upon private property or rights. In this position they pass under the northern foreshore of the river Thames, but before the southern shore is reached they are again side by side—as required by a clause in the Act—and at each intermediate station as already described they are at different levels. The diagram—Fig. 1—shows the tunnels as they have been constructed under the river. Each of the tunnels is 10ft. in diameter, and is formed of rings of cast iron segments bolted together through internal flanges, as shown in Fig. 2. The rings are 1ft. 7in. long. All the flanges are 3½in. deep, and 1¼in. thick. In the longitudinal joints thin strips of pine are inserted between the flat surfaces of the iron, and subsequently pointed with cement. The circular joints are made by tarred rope and cement.



Figs. 2, 3, & 5—SECTIONS OF TUNNEL CYLINDERS, GROUTING APPARATUS, AND CARRIAGES.

[1] Paper read before Section G British Association.

The Act for the first section of the subway was, as already stated, passed in 1884, but it was not until May, 1886, that the company, under the chairmanship of Mr. C. G. Mott, was in a position to go on with the work. The first operation was to erect staging in the river at Old Swan Pier for the purpose of sinking a temporary shaft and constructing the river tunnels. An iron-lined shaft 13ft. in diameter was then sunk into the bed of the river through sand and gravel into the London clay. From this shaft was driven the first tunnel, commenced in November last year, and now extending under the river, Hibernia Wharf, and the Borough-road for a length of 1600ft. The second or lower tunnel was commenced at a later date, and is being driven simultaneously with and at the same rate as the first. Both the tunnels have also been driven northwards for some distance into the City, four faces being thus worked from one shaft. The second tunnel was driven immediately under and within 4ft. 6in. of the upper tunnel. Work is also progressing at Great Dover-street. It will be observed that the first or upper tunnel has a dip under the river and that the second or lower tunnel rises continuously from the shaft. A cross-heading joining the two tunnels at the lowest point of the first provides for draining that tunnel to the sump at the temporary shaft, whence the small accumulation of water will be discharged automatically by an injector hydrant, deriving its supply of high-pressure water from the hydraulic main already referred to.

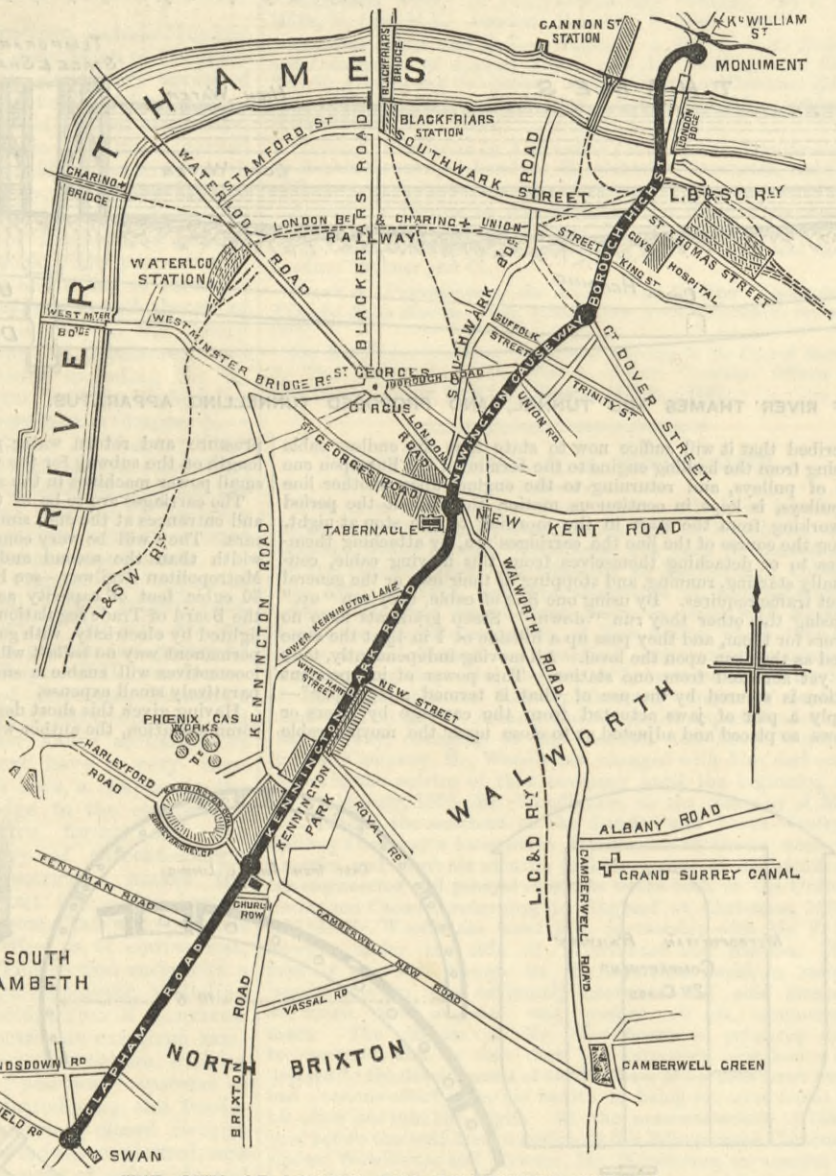
The mode of constructing the iron tunnels is very simple, and can be described in a few words. A steel cylinder, overlapping—like the cap of a telescope—the forward end of the iron tunnel, is provided near its front end with a strong diaphragm, Fig. 6, having an opening or door in it. Beyond this face project adjustable steel cutters, and behind it are ranged, round the circumference inside, six hydraulic presses, so fixed as to abut against the last ring of the completed tunnel. As the material is excavated from before the cap or shield by the miners and action of the cutters, and thrown back through the opening in the face, the shield is forced forward by the hydraulic presses. The shield thus clears out an exact circle somewhat larger than the outside diameter of the iron lining of the tunnel. The small annular space thus left is filled with grout composed of blue lias lime by means of an apparatus to be presently described. When the shield has been forced forward sufficiently far, a fresh ring of iron lining is built up inside and under cover of the overlapping steel cylinder. Six of these rings can be erected daily, representing a rate of progress of 9ft. 6in. at each face.

The apparatus for grouting is shown in section upon the wall. The lime is mixed with water in the cylindrical vessel Fig. 3, the lid is closed, and compressed air at a pressure of about 30 lb. per square inch, from a compressor at the shaft, is admitted through the upper valve, when, the lower valve being opened, the contents of the vessel are discharged through a short length of hose-pipe, a branch and a nozzle, into the annular space left outside the iron lining by the advance of the shield, holes being provided in each segment of the lining for the purpose. The grout is first of all forced through the lower holes in the segments until it appears at the holes above; the lower holes are then plugged, and the grout is forced into the next holes above, and so on until the grout comes out at the topmost hole, in which the nozzle is then inserted, and the grout forced in by the full pressure of air until the space is completely filled. Thus the iron lining is surrounded by a coating of lime or cement. The paddles upon the spindle, actuated by a handle, are kept continuously at work to mix the grout, and to prevent its setting in the "grouting pan." A somewhat similar mode of construction was employed in 1868-9 in executing the little tunnel under the Thames at the Tower, originated by the late Mr. Peter Barlow, and carried into execution by the author. There, however, hydraulic and pneumatic power were not employed, and the area of the tunnel was considerably less than half the area of each of the present tunnels. In the interval between that work and this, several not very successful attempts have been made in America to construct brick-lined tunnels with shields of similar construction to the one used at the Tower. When it is considered that an inch thickness of cast iron will offer a resistance to crushing as great as several feet in thickness of well-set brickwork, and indeed in cases of small tunnels, greater than any thickness of brickwork, and, that at the same time it can be made perfectly water-tight, it is surprising that no use has been made of iron as a lining for subaqueous tunnels, and for tunnels where great strength is required, or when it was important to construct the work rapidly, without interference with street surfaces, or danger of settlement, and with a minimum of subsoil disturbance. In cases where tunnelling has to be done through soft or loose material full of water, in place of the single opening in the shield as already described, the arrangement shown in longitudical section—Fig. No. 4—can be employed. The shield remains much the same, but the material is removed from its path by other means, viz., by a current of water aided by disintegrating protruding tools actuated from the inside of the shield.

Referring to Fig. 4. The cylinder B of the shield slides over the completed part of the tunnel C. Through the front of the shield A protruding tool of the form shown, or a revolving crosshead, or both, pass through stuffing-boxes and assist in loosening the material in front, while water forced by the rotary pump G through the nozzles D scours out the *débris*, and carries it into the depositing tank F. The *débris* settles in the tank, and the water is used over again. The circuit of the water being closed, the pump has no more work to do than overcome the friction of the pipes and give the required velocity to the current. To empty the depositing tank, the valves E E are closed, and tubs K K filled with water are brought under the outlets F F, so that the projecting lip of each outlet becomes immersed in the water. Upon opening the valve the *débris* from the tank falls into the tubs, while water from the tubs ascends into the tank to take its place. The pocket or chamber L is provided for the purpose of dealing with boulders or larger pieces of *débris* than would pass through the pipes, and the face of the shield is put together in such a way that any portion of it can be taken down from the inside under air pressure when desired. In some cases the face may be divided into cells or compartments provided with tightly-closing doors, one or more of which could be opened at a time for working on the material in front or clearing it of larger impediments, such as boulders, air being in such cases forced into the material in front of the shield so as to displace the water therefrom.

Sir John Fowler is the consulting engineer, and the main contract for the construction of the subway between the City and Newington is being carried out by Mr. E, Gabbutt, of Liverpool.

The total cost of the line from beginning to end, including land, buildings, stations, and equipment will not, it is estimated, exceed £200,000 per mile—a small fraction of the cost of the underground railways in London.



THE CITY OF LONDON AND SOUTHWARK SUBWAY.

PRIVATE BILL WORK IN THE PAST SESSION.

Of 222 Private Bills introduced during the past session, no fewer than 164 received the Royal Assent. This is a very fair proportion, and the prolongation of the session—which was so annoying to members—yielded at least valuable results in this direction. Very few of these measures were withdrawn after reaching the second reading stage; but, on the other hand, twenty-five Bills got no further than the House of Lords, where they were introduced.

The following are among the Bills eventually passed into law:—Accrington Corporation Steam Tramways; Ayr and Wigtonshire Railway; Banbury and Cheltenham Direct Railway; Barnet District Gas and Water; Barry Dock and Railways; Basingstoke Gas; Belfast Corporation (Lagan Bridge); Belfast Main Drainage; Bexley Heath Railway; Bishops Castle and Montgomery Railway; Blackburn Corporation Trams; Blyth and Cowpen Gas; Bradford Corporation (various powers); Brentford and District Trams; Brighton and Dyke Railway; Brighton, Rottingdean, and Newhaven Direct Railway; Bristol Corporation; Burnard and Alger's Cattedown Wharves (Plymouth); Bury Port and North-Western Junction Railway; Caledonian Railway; Cardiff Corporation; Cardiff Gas; Carlisle Corporation; Cathcart District Railway; Chelsea Water; Chew Valley Tramways; City of London and Southwark Subway; Cleveland Extension Mineral Railway; Clissold Park (Stoke Newington); Clyde, Ardrishaig and Crinan Railway; Clyde Navigation; Cockermouth Local Board (Lighting); Coventry and District Trams; Croydon Gas; Crystal Palace Company; Darwen Corporation; Didcot, Newbury, and Southampton Railway; Downham and Stoke Ferry Railway; Dublin Southern District Trams; Dublin, Wicklow, and Wexford Railway Amendment; Dundalk Commissioners Gas; Dundalk Gas; Dundee Street Trams and Improvement; Easingwold Railway; East Huntingdonshire Water; East London Water; Easton and Church Hope Railway; Edinburgh Improvement; Edinburgh Municipal Buildings; Edinburgh Northern Trams; Felixstowe and Bawdsey Ferry Railway; Flamborough Head Tramways; Freshwater, Yarmouth, and Newport Railway; Furness Railway; Golden Valley Railway; Great Eastern Railway; Great Eastern Railway and Felixstowe Railway and Dock Company; Great Northern Railway; Great North of Scotland Railway (further powers); Greenock and Port Glasgow Tramways; Highland Railway; Holywell and District Water; Hull and North-Western Junction Railway; Hull, Barnsley and West Riding Junction Railway and Dock; Isle of Wight Central Railway; Kanturk and Newmarket Railway; Kenmore Junction Railway; Kilrush, and Kilkee and Potnasherry Reclamation; Kilsyth and Bonnybridge Railway; Kingsbridge and Salcombe Railway, Kingstown and Kingsbridge Junction Railway; Kirkcaldy and District Trams; Kirkheaton, Dalton, and Lepton Gas; Lincoln, Horncastle, and Skegness Railway; Liskeard and Caradon Railway; Liverpool Hydraulic Power Company; Liverpool Water and Improvement; Llangammarch and Neath, and Brecon Junction Railway; London and North-Western Railway; London, Brighton, and South Coast Railway; London, Hendon, and Harrow Railway; London Street Tramways Extension; Lough and River Erne Navigation; Lynton Railway; Lancashire, Bury, and Oldham Steam Tramways; Manchester Corporation; Manchester, Middleton, and District Tramways; Manchester, Sheffield, and Lincolnshire Railway; Manchester Ship Canal; Merionethshire Railway (Abandonment); Mersey Docks and Harbour Board (overhead railway); Mersey Railway; Metropolitan Board of Works (various powers); Metropolitan Railway; Midland and South-Western Junction Railway (No. 2); Midland Great-Western Railway of Ireland; Millwall Dock Municipal Trust Company; Newark and Ollerton Railway; Newport Waterworks; New Shoreham Harbour; Northampton Gas; North British Railway; North-Eastern Railway; North Metropolitan Trams; Ogmore Dock and Railway; Orkney Harbours; Orkney Roads; Peckham and East Dulwich Trams; Plymouth Corporation; Plymouth, Devonport, and South-Western Junction Railway; Pontypridd, Caerphilly, and Newport Railway; Portsmouth, Kingston, Fratton, and Southsea Trams; Pudsey Gas; Reading Corporation; Regent's Canal; City and Docks Railway; Rhymney Railway; St. Austell Valleys Railway and Dock; Shanklin and Chall Railway; Sheffield Corporation Water; Skegness, Chapel, St. Leonards, and Alford Tramway (Abandonment); Southampton Harbour; South-Eastern Railway; Southend Local Board; Surrey and Hants District Waterworks; Sutton District Water; Tees Conservancy (No. 2); Thames Tunnel; Trent and Humber Navigation; Tunbridge Wells Gas; Wakefield Corporation; Walton-on-Thames and Weybridge Gas; Welshpool and Llanfair Railway; West Gloucestershire Water; West Lancashire Railway; Westminster Improvements; Weston-super-Mare Improvements; Weymouth and Melcombe Regis Corporation; Whitehaven Harbour and Dock; Willesden Local Board; Witham Drainage; Wolverhampton Corporation.

Six Bills only failed to obtain the royal assent after passing the third reading—viz., the Acton and Hammersmith Tramways Bill; Clark's Patent Bill; the Haslingden and Oswaldtwistle Tramways Bill; the Hillhead and Kelvinside Bill; the Limerick City and Port Railway Bill; and the Over Darwen Corporation Bill. Going a step further back we find that the following Bills, among others, having been reported, proceeded no further:—Bexley Heath Railway; Budleigh Salterton Railway (withdrawn); Croydon and Norwood Tramways (withdrawn); Liverpool, Southport, and Preston Junction Railway (dropped); and the London City Tithes; while these were reported as not having proved their preambles:—Ambleside Railways; Glasgow Subway; Harrow, Ealing, and Willesden Railway; North-Western and Ealing Railway; and Uckfield Water. In the case of the Kensington Vestry Bill, this having been reported, was put off for six months; and the parties did not proceed after the report stage with the Liverpool, Southport, and Preston Junction Railway Bill.

In only one case, viz., that of the Peckham and East Dulwich Tramways, was the Suspension of the Standing Orders refused; and the Votes and Proceedings only record one instance of a measure being discharged after leave being given to introduce it—that being the South-Eastern Metropolitan (Lewisham, Greenwich, and District) Tramways Bill.

The schemes that were initiated in the House of Lords and never got through the Lower Chamber were these:—The Ayr and District Tramways; the Bolton Corporation; the Bristol Consumers Water; the Cambridge Rating; the Cardiff and Monmouthshire Valleys Railway; the Chesterfield, Hasland, North Wingfield and District Tramways; the Cockermouth Gas; the Croydon Corporation; the Dover (Corporation) Harbour; the Dundee Suburban Railway; the Edinburgh Gas; the General Traction Company; the Gilbert and Sinclair's Patent; the Glasgow Tramway and Omnibus Company; the Isle of Wight Railways Amalgamation and Transfer; the Lambourn Valley Railway; the Lancashire County Justices; the Leeds Suburban Railway; the North-East Somerset Water; the North Sea Fisheries (East Lincolnshire) Harbour and Dock; the Ogmore Dock and Railway (Abandonment); Skrivanow's Patent; South-Eastern Metropolitan Tramways; Upper Trent Navigation; Waterford and Limerick Railway; and Whitehaven Harbour Bills.

LAUNCHES AND TRIAL TRIPS.

The s.s. Waverley, whose machinery has recently been altered to the triple expansion system, was taken on her trial trips last week. She formerly had boilers working at 80 lb. pressure, and with cylinders 41in. and 78in. diameter, and the alterations have involved the substitution of new boilers of steel, carrying steam at 160 lb. pressure, and the addition of two new cylinders placed on the top of the former cylinders. On the trials the engines developed nearly 2000-horse power, and worked with remarkable smoothness at sixty-four revolutions per minute. It is expected that a great economy in fuel consumption will result from the alteration, which has been carried out by Messrs. Gourlay Brothers and Co., of Dundee, from the specifications of Messrs. Flannery and Baggallay. The s.s. Waverley belongs to Messrs. Williamson, Milligan, and Co., and, with her sister ship the s.s. Peveril, is well known in the eastern trade. We hope shortly to publish drawings of these boilers and engines.

On Saturday, Oct. 1st, Messrs. Earle's Shipbuilding and Engineering Company launched from their yard at Hull an iron steam trawler, named the Scorpio, a sister ship to the Saggitarius, which they have built for the Grimsby and North Sea Steam Trawling Company, and which will be launched from the same yard shortly. These boats are 107ft. 3in. long by 20ft. beam, by 10ft. 9in. depth of hold, and are of somewhat similar design and arrangement to the Zodiac, the plans of which took prizes at the Shipwrights' Exhibition in London in 1882, and at the International Fisheries Exhibition in 1883, but in many respects they are a decided improvement on that ship, as well as on the Virgo and Libra, recently constructed by Earle's Company for the same owners. The new vessels will be provided with all the modern requirements for trawl fishing, such as Earle's special steam trawling winch, windlass, &c. They will also be fitted by the builders with their triple-compound three-crank engines, capable of indicating 200-horse power, and having cylinders 11½in., 17in., and 30in. diameter by 18in. stroke, which will be supplied with steam from a steel boiler made in accordance with Lloyd's rules for a working pressure of 140 lb. per square inch.

On Wednesday, September 28th, the s.s. Bertha was taken to sea for a trial of her engines. This vessel has had the compound engines removed and replaced by new tri-compound engines by the North-Eastern Marine Engineering Company, Wallsend. The new engines are 21, 35, and 58, with a stroke of 39in., and a working pressure of 160 lb. The mean speed of four runs over the measured mile was 11½ knots, which was considered highly satisfactory, the engines running with smoothness and without hitch. The Bertha is a vessel 302ft. long, 35ft. broad, and 25ft. deep. After the trial she was taken to Messrs. Edwards' yard at Howdon. The engines during construction were superintended by Mr. Menzies, of Newcastle.

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

(*From our own Correspondent.*)

On 'Change at Wolverhampton yesterday, and at Birmingham to-day—Thursday—there was considerable speculation as to the probable course of the market at the quarterly meetings next week. Producers spoke of a probable further strengthening, alleging, as to sheets especially, that the shortness of supplies will result in an advance of prices of galvanised corrugated sheets. The outlook is generally regarded as satisfactory. Sheet makers are unable to meet all the requirements of the galvanisers and export merchants. Black sheets have here and there risen in quotation on the fortnight by 2s. 6d. per ton for doubles; and for galvanised sheets of 24 gauge an advance of about 10s. per ton is quoted by a few makers.

Should this advanced quotation, as is wholly likely, be declared at the quarterly meetings, the advance will then be generally recognised. At present there is a complete absence of uniformity in the prices of galvanised iron, and any action which would induce a more equable quotation would be very acceptable. There are new firms in the trade who, anxious to stimulate a good export trade, are willing to make occasional sacrifices.

The re-start this week of the works of Messrs. Morewood and Co., Smethwick, has occasioned general satisfaction, and the hope is expressed that it will be found possible to carry them on permanently under some new arrangement. Messrs. Jno. Lysaght, Wolverhampton, have, it is reported, determined to lay down additional sheet mills to their already extensive works; and at their Osier Bed Works they are contemplating the adoption of the electric light, being fully satisfied with the working of the system at their Swan Garden Works.

The position of the iron-plate makers is rendered very precarious by the successful competition of steel. Already it has become apparent that the only hope of the iron-plate makers is to adapt their plant to the manufacture of steel-plates. Only for railway wagon building is any preference being shown for iron-plates, and there is no reason for dissatisfaction at the demand which is being experienced under this head on account of the Indian railways. For bridges the demand for iron-plates is small in consequence of the large consumption of steel in their construction. Tank-plates are £6 10s., and boiler sorts £7 10s. to £8 10s.

No change in the quotations of marked iron is at all probable at the quarterly meetings. Any advance would not be justified by the present condition of the market. The past quarter has not been altogether unsatisfactory, since there has been on the whole a good average of orders, but at the termination of the quarter the usual decline in the enquiries has been experienced. Prices remain at £7 for bars, a quotation which has prevailed since April of last year. Sheets and boiler-plates by the same firms are £8 10s. to £9.

The current list of Messrs. William Barrows and Sons is as here:—Bars, round, square, and flat, £7; best bars, suitable for chain making and other purposes, £8 10s.; double best, suitable for superior chains, bars, and the like, £9 10s.; plating bars, £7 10s.; best angle, tee, and rivet iron, £9; and double best, £10. Boiler plates the firm quote £8 10s., £9 10s., £10 10s., and £14 10s., according to quality; and sheets, £8 10s. for 20 gauge, £10 for 24 gauge, and £11 10s. for 27 gauge. Hoops are quoted £7 10s.; best, £9; wide strips, £8 10s.

The New British Iron Company quotes:—Slit rods, £6 5s. for Corngreaves, £7 C.G.C. brand, £7 10s. Lion, £9 best Lion, and £11 10s. best charcoal. Steel rods are £8, and iron horseshoe rods £6 10s., £7 10s., and £9, according to quality. Hoops the company quotes £7, £8, and £9 10s. Steel hoops are £8 10s. and best charcoal £8.

Operations at the unmarked bar works are less regular than recently. Hoops and strips, though in lessened demand from some markets, are in larger inquiry from the Colonies, South America, and India. There is a good Australian demand for medium quality bars, which are priced at from £5 10s. to £6. Common bars are by no means brisk. For hurdle and bolt-making iron can be procured at as low as £4 12s. 6d., but the general quotation for common bars is an average of £5.

Strip iron is in larger call from the wrought iron tube makers, in consequence of their having now entered upon the brisk period of the year. The lock trades, however, being in a depressed state, the demand from this source is much below the average. Narrow Company's tube strip is quoted at £4 17s. 6d. to £5; and strip for lock-making is £6 to £7 for 6in. sizes. Common hoops are not in large demand at £5. Coopers' hoops range from £5 10s. to £6 10s. at works for best sorts. The season for sales of baling hoops on United States account is rapidly concluding. The price, selected and cut to lengths, is £6 to £6 5s. f.o.b. Mersey.

The iron mills are extending their capacities for melting down steel into various forms from blooms and billets. This conversion of plant they find to be very desirable, since the cost of manufacture out of steel, compared with the utilisation of puddled iron, is not only much less, but the finished product has acquired a reputation which induces a larger consumption of the material. Bessemer billets from Wales are quoted at from £4 10s. to £5 per ton; and steel strip rolled from this material is sold to the lock-makers and saddlers' ironmongers at £7 10s. Steel angles are £7 10s., a quotation which also rules good sections of tees down to 1in. An extra of 20s. is quoted on ⅜in. sizes, and of 40s. on ¾in. sizes. These extras, however, are practically nominal. Bessemer blooms are quoted by the Barrow Company at £4 12s. 6d., and tin bars at £4 17s. 6d., delivered into this district. Siemens qualities are £4 15s. for billets and £5 for bars delivered.

Not much change is perceptible this week in imported pigs. Some makers are taking advantage of the forthcoming quarterly meetings to attempt to push up prices. The ruling rates are, they maintain, wholly inadequate to justify the acceptance of forward contracts, and only on the occurrence of a substantial advance will the many furnaces now out of blast in Derbyshire be put in blast again. The small supply of Derbyshire pigs upon the market is assisting makers in their object. For the Stanton brand of Derbyshire pigs the quoted advance during the past three weeks has been as much as 1s. 6d. per ton, the quotation now being 38s. Other brands of Derbyshire pigs were quoted this—Thursday—afternoon at 37s. at stations, and Northampton pigs at 36s. to 36s. 6d. Lincolnshire pigs vary considerably, but 40s. to 41s. may be taken as the average.

No distinct alteration has appeared in the native pig iron trade, neither in the extent of the output nor in the amount of stocks. Cinder iron is still procurable at 29s. to 30s.; part-mines at 38s. to 40s., and hot blast all-mines at 50s. Hematites from the West Coast district are firm at 54s. for quay and forge sorts delivered here. The quotations of the Barrow Company for Bessemer qualities is 56s., and for No. 1 foundry qualities, 57s. 6d. delivered.

The Cannock Chase collieries have this week issued new lists showing an advance in the quotations of house coals of 1s. per ton. This leaves best deep coal at the chief collieries at 10s. 6d. per ton. In reality, however, only 6d. per ton rise can at present be commanded, and 9s. 6d. is nearer the correct figure for best sorts. Second-class collieries on the Chase are selling deep coal at 8s. to 9s. per ton. Best forge coal, in sympathy with domestic sorts, is occasionally worth more by 3d to 6d. per ton, but it is not yet easy to realise the advance. Prices of slack are unchanged.

Much success is attending the association in the wrought iron tube trade. A suggestion has been made to further advance prices, but the association have decided that the better policy is not to disturb existing discounts for the present. Pump makers are looking to be busier during the new quarter in their steam pump department. The flooding of the collieries, occasioned by the wet season, always makes it better for the steam pump trade. Demand for hand pumps on home account is, however, less active in winter months. Orders at date are a fair average. Autumn tillage implements show some movement, though the impecuniosity of the farming classes prevents any briskness in the demand. Chaff-cutters, root pulpers, and other food-preparing machines are beginning to be inquired after.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is a continued generally despondent tone in the iron trade of this district; not only is the present business doing very unsatisfactory, but the future still holds out no prospect of improvement. Both common pig iron and hematites meet with only a very slow sale, and although there is no quotable material change in prices, the tendency is in the direction of weakness. Finished iron is for the present kept fairly active by the extra push to complete shipping orders which is usual at this season of the year, and this gives a steady tone to prices. For all descriptions of iron, however, the prospects, so far as home trade requirements are concerned, are very discouraging, and the ensuing winter is being looked forward to with anything but hopeful anticipations.

A fair average attendance, with only a very slow business doing, and in some instances a disposition to underquote, describes briefly the Manchester iron market on Tuesday. In pig iron, with the exception of occasional special transactions, business is only practicable at the very lowest possible prices; the current market rates are much the same as last week, but buyers have the market in their favour, and here and there a little less is taken by sellers, rather than allow orders of any weight to pass. In many cases, however, sellers decline to give way at all upon late quoted rates, but so far as ordinary business is concerned they are practically out of the market. Lancashire makers still hold to 38s. 6d. and 39s. 6d., less 2½, for forge and foundry qualities, delivered equal to Manchester, but at these figures they are doing comparatively little or nothing. In some of the district brands there has been a moderate business doing; at the minimum figures of 37s., less 2½, for Lincolnshire foundry delivered equal to Manchester, sales are reported; but most of the makers hold for 3d. to 6d. per ton above this figure; fair transactions have also taken place in Derbyshire foundry, for which 40s., less 2½ delivered equal to Manchester, is about the average quoted price, although for anything like quantities there is little doubt orders could be placed at something under this figure. There has been so little doing in outside brands that prices for these have barely been tested; they are, however, quite as low as last week, and in some instances a trifle less would be taken. For the best named foundry brands of Middlesbrough, makers still hold to 42s. 10d., net cash, delivered equal to Manchester, as their minimum; but there would be no difficulty in getting good brands at 6d. under this figure, and in Scotch iron there are very low sellers.

There is still only a very limited business doing in hematites; quoted rates remain at about 52s. 6d. to 53s. 6d., less 2½, for good No. 3 foundry qualities, delivered equal to Manchester, and it would be difficult to buy except in quantities at under these figures, but the tendency of the market is, if anything, in the direction of weakness.

Manufactured iron makers are mostly kept fully employed completing shipping orders to ports where the season will shortly draw to a close, and prices are steady at £4 17s. 6d. for bars, £5 5s. for hoops, and £6 7s. 6d. to £6 10s. for sheets, delivered into the Manchester district. For inland consumption there is, however, still no improvement in the demand, requirements for home use continuing very poor, and when the extra push of the shipping season is over, there is only the prospect of a very quiet trade generally.

There would seem to be a falling-off in some branches of the steel trade, and sheets, which have recently been very firm at £7 5s., are now to be got at about £7 per ton, delivered into the Manchester district.

In the metal market, the upward movement which has recently taken place in raw materials has given a stronger tone to some of the manufactured goods, and in copper sheets for India, fair parcels of which have recently been placed, there has been an advance of £1 per ton; for home trade requirements, however, the demand shows no appreciable improvement, and prices, although perhaps firmer, remain without quotable change.

There is very little change in the condition of the engineering trades, and what change there is to report is not in the direction of improvement. In some branches there is, if anything, a slackening off, machine-tool makers reporting less work coming forward, and some of the local concerns are now quieter than they have been for a very considerable time past. Generally, there is still a moderate amount of work in hand, and some departments are fairly busy; but, except for work of a special character, it is still only at excessively low-cut prices that orders are secured, and there is no immediate prospect of any improvement on the present very unsatisfactory condition of trade. In fact, the prospects for the future are even less hopeful than they were a short time back.

The position of affairs with regard to the Bolton strike remains up to the present practically unchanged. A partial advance in wages has been offered by one firm, not, however, connected with the Iron Trades Employers' Association, and this has been magnified into a sign of a general giving-way. The leading firms are, however, as firm as ever in maintaining the position they have taken up, and are steadily filling their works with men obtained from other districts, considerably more applications being received for employment than are entertained. The men on strike also hold out, although they can hardly expect a continuation of the support they have up to the present received. Another attempt is being made at a settlement by means of a conference between the employers and the men, but whether this will have any more successful results than previous attempts in the same direction remains to be seen.

The Union Engineering Company, of Manchester, is introducing a new air propeller, which has lately been invented by the above firm, and for which it is claimed that it has the capacity to exhaust about 45 per cent. more air than any of the older types. A special conformation of the blades on the "Schiele" principle is adopted, and one of these propellers, which is very compact in arrangement, has recently been fixed experimentally in one portion of the Manchester Exhibition building, to exhaust the hot and vitiated air, the results obtained being, I understand, very satisfactory.

Mr. W. A. Bryson, who has charge of the electric lighting arrangements at the Manchester Royal Exhibition, has, I understand, received a similar appointment in connection with the forthcoming Exhibition at Glasgow.

The annual meeting of the Manchester Geological Society was held on Tuesday, and Mr. Joseph Dickinson Hill, chief inspector of mines, was elected president for the ensuing year. The report of the Council which was presented shows that the Society continues in a very satisfactory position, the membership has slightly increased, the number on the books being now 220, a large proportion of whom are the leading mining engineers in the district, and there is a balance in hand of nearly £100. The report referred to one or two matters of special interest, and expressed gratification at the approaching completion of the new geological museum at Owens' College, which in all probability will be one of the most important centres of the kind in the kingdom, and to which the Society some time back made a gift of its geological collections. Reference was also made to the improvements which had recently been effected in the ordinary miner's safety lamp, and the adaptation of the electric light to underground mining operations, as exhibited at the closing meeting of the previous session, and which pointed to the probable introduction in the near future of a portable electric lamp at a reasonable price, possessing the manifest advantages of a greater illuminating power and increased safety to the miner.

In the demand for all descriptions of fuel suitable for house fire purposes, the coal trade shows a steady improvement; the better qualities are moving freely, and the collieries are being kept on practically full time; whilst as regards prices, although there has not been an actual general advance, there has been a pretty general levelling up upon the minimum prices taken last month, representing practically an advance of about 6d. per ton. At the pit mouth best coal now averages 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; and common house-fire coal, about 6s. per ton. Other descriptions of fuel for general trade and manufacturing purposes remain without material change. The increased requirements for house-fire consumption tend, of course, to take off the market some of the surplus supplies of common round coal, but the demand for steam and iron-making purposes shows no appreciable enlargement, and no very materially better prices are being got, 5s. 6d. being still about the average figure for good ordinary qualities at the pit mouth. For engine classes of fuel there is a fairly good demand, but with the increased quantity of round coal now being screened supplies are more plentiful, and at some collieries slack is a drug. Prices of necessity remain low, burgy averaging 4s. 6d. to 5s.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton at the pit mouth.

In the shipping trade better prices are being got for house-fire coals, but common coals for steam purposes continue very bad to sell, and as low as ever, ordinary qualities being still obtainable at 6s. 6d. to 6s. 9d. per ton, delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—There is a steady tone in the hematite iron trade, and the quieter aspect which the trade has shown of late is accounted for by outside influences which are affecting warrants, and resulting in the sale of iron by holders of warrants at lower prices than makers are disposed to do business at. But makers are in a position to withhold from actual sales, and this they will probably do until prices are higher than at present. The quotation value of parcels of Bessemer iron in mixed numbers at makers' works, f.o.b., is 44s. 6d. and 43s. 6d. for No. 3 forge, net. Sales are, however, noted as low as 42s. per ton. The business doing with makers is chiefly for forward deliveries, and these are at firm prices. Prompt sales are almost entirely confined to warrants. The chief weight of stocks is in the hands of holders of warrants. Makers, generally speaking, are low in stock, and are delivering direct from the furnaces to consumers. Iron merchants are urging speculators to buy hematite iron at present, inasmuch as it is considered that present quotations represent far below either its immediate or prospective value. The probability is that the output will be reduced if holders of warrants continue to sell at the low rates now ruling, and which represent the cost of production of pig iron without allowing any margin of profit to the producer. Steel rails are in brisk demand at full rates, and makers are as busy as they possibly can be. They have had to refuse a large number of orders owing to the great bulk of work already on their books. The value of steel rails is steady at from £4 2s. 6d. to £4 6s. per ton net, f.o.b. In other branches of the steel trade there is activity, except so far as blooms and steel for shipbuilding purposes are concerned. Billets and bars are in good demand, and in liberal output, and the inquiry for steel for shipbuilding purposes is giving evidence of an improvement and extension which are likely to lead to considerable activity at the mills which have been put down for the production of plates, angles, &c., by the Siemens-Martin process. Steel wire is in good demand, as also are steel hoops, but merchant steel generally is only in ordinary request. Shipbuilders have not booked any new orders, although some have been expected of considerable importance. Negotiations are, however, going on which it is believed will greatly improve the trade. The foreign inquiry for sailing and steam ships is brisk. There is a poor demand for finished iron, and the market seems to show less and less life in proportion to the utilisation of steel for the purposes to which finished iron was usually employed. Engineers in the marine department are fairly well employed, although they could do much more work if they had the orders. The same remark applies to boilermaking. There is a very brisk trade in iron ore, which is much firmer in tone in consequence of the increase in freight which has been established on iron ore imported from Billao to this country. Native ore is now quoted at from 9s. to 12s. per ton net at mines according to quality, and raisers are well sold forward at good prices.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

There has been recently a very considerable demand for tires and axles, causing the makers' books to be very full. This has had the inevitable result of advancing prices 5s. per ton, which is an indication of improvement, though even at the higher quotations the work is not regarded as remunerative. Home railway companies, evidently anticipating that any change in values will be upward, are giving out specifications freely for various kinds of rolling stock. In this they are following the example of the Indian railways, who have been our leading customers for a long time, and are still sending important "lines" in railway material.

No fresh orders have been placed for armour plates, but the armour for the turrets of the Nile and Trafalgar will shortly be required. Messrs. John Brown and Co., Atlas Steel and Iron Works, have practically finished their large share of the plates for these two huge vessels. No new war-ships are being laid down at present.

The Sheffield Gas Company, in its report submitted to the half yearly meeting held last Saturday, were able to announce that it had earned its maximum dividend of 10 per cent. without touching on the reserve fund. This gratifying result was due to the company having sold an unusually large amount of gas, and owing to a rise in the price of residuals. There had been £3429 more gas consumed, and the receipts from residuals were £2672 more. A singular difficulty has arisen about the light, as stated by the chairman, Sir F. T. Mappin, Bart., M.P. Complaints having been made as to want of light, the company, after searching examination, had found that naphthaline had been deposited either in the meters or the pipes, producing the results against which the consumers grumbled. Two scientific gentlemen had been employed to advise on the subject. With regard to the supply from one of their works, there had been no complaints whatever, but as to the other works the complaints were continued up to the present time. The coals were supposed to be in fault, and they began using precisely the same kind that was used at the works from which no complaints had been received; but no different results have been received.

The Sheffield Telephone Exchange Company is making rapid progress. Sheffield and Rotherham have long been connected, and the subscribers are having a local service as well. The wires are also being pushed forward to Barnsley, and they will *en route* connect the towns of Swinton, Wath, Kilnhurst, Mexbro', and Wombwell. This extension is exceptionally important, as it will effectively unite the great South Yorkshire coalfields with Sheffield and Rotherham, as well as with the town of Barnsley itself. Over the entire way the local authorities have granted permission with the utmost readiness for the erection of poles and wires.

On October 1st the price of house coal in South and West Yorkshire was advanced from 8d. to 1s. per ton. In some extreme instances 1s. 6d. per ton is said to have been imposed; but the general advance has been about 10d. on best qualities and 8d. on others, the colliery companies which do a large London trade quoting 10d. and 1s. per ton higher. Following this rise in values is an intimation from the Colliers' Union agent, Mr. Benjamin Pickard, M.P., that the miners intend to ask for an advance in wages. At present the house pits are working full time in this district with few exceptions.

The directors of the Manchester Sheffield, and Lincolnshire Railway Company were waited upon on Tuesday by a deputation representing the various *employés* of the company, who offered to subscribe a week's pay to express, in a practical manner, their sympathy with the directors and shareholders in the heavy loss they would sustain through the deplorable accident at Hexthorpe, near Doncaster. Sir Edward Watkin, M.P., while most cordially thanking the *employés* for the kind, self-sacrificing spirit which had been shown, stated on behalf of the directors that they did not

think it consistent with their duty to tax those who lived by the sweat of their brow to the extent which had been proposed. The chairman afterwards moved a resolution expressing the thanks of the directors and shareholders to the staff in all departments for the cordial good feeling and practical sympathy exhibited by the men at large in the disaster which had befallen the company. This was seconded by Lord Auckland and carried unanimously. The proposition was acknowledged on behalf of the men, who moved a resolution of thanks to the directors for the courtesy displayed, and expressing admiration at the conduct of the chief officials of the company in connection with the disaster. The workmen's offer was equal to £6000, and would probably have risen to £12,000.

Another disastrous cage accident adds to the colliery casualties of the year. The Staveley Coal and Iron Company has undertaken a new colliery to work the coal underlying the Sutton estate. It is known as the "Markham" Colliery, after Mr. Charles Markham, the chairman. In the course of the sinking operations on Monday, when eleven sinkers were engaged, Mr. John Radford, who had charge of the operations, was standing a little way from the head of the shaft when he heard a crash, which called his attention to the fact that skip was "on the wheel." This meant that the large iron pail or tub used as a means of communication with the bottom of the shaft had overwound itself, and was on the wheels of the uphauling apparatus. Then followed an ominous rumbling in the shaft. On inquiry at the engine-house Mr. Radford found that just as the skip was nearing the top a fireman had gone into the engine-house and asked the engine-tenter a question, and in the moment of answering the skip was overwound. Two large beams were detached at the top and crashed down the shaft, bringing with them other heavy woodwork. Four men have been killed and several injured. The engine-tenter bears a very high character both for his attention and skill in his work.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

The attendance at the iron market held at Middlesbrough on Tuesday last was above the average; though prices were lower the general feeling was not quite so flat as reported last week. Buyers seemed more inclined to operate, and sellers were, towards the end of the market, a little firmer in their quotations. The principal merchants asked 33s. 4½d. per ton for prompt delivery of No. 3 g.m.b.; buyers freely offered 33s., but sellers could not be found at that figure, and the lowest at which any transaction took place was 33s. 3d. On the previous Tuesday the price of No. 3 was 33s. 9d. per ton. Some makers endeavoured to book orders at 33s. 6d., but they do not succeed in finding any one willing to give that price in face of the lower offers made by merchants.

Stevenson, Jaques, and Co.'s current quotations: "Acklam Hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire," Cleveland, No. 3, 34s. 6d.; "Acklam Basic," 35s.; refined iron, 48s. to 63s., net cash at furnaces.

Little or nothing is being done in warrants. The price at Middlesbrough remains at 33s. per ton, but at Glasgow somewhat less is quoted.

The stock of pig iron in Messrs. Connal and Co.'s store on the 30th of September was 331,572 tons, being equivalent to a decrease of 405 tons during the month. At Glasgow it was 919,040 tons, representing an increase of 2834 tons.

The quantity of pig iron exported from the Tees last month was 72,512 tons, or 933 tons less than was shipped in August. The chief items are as follows, viz., to Scotland, 30,547 tons; to Germany, 13,475 tons; to Holland, 3789 tons; to the United States, 3710 tons; to Russia, 2750 tons; to Portugal, 2440 tons; and to Belgium, 2266 tons. Shipments of manufactured iron reached 20,897 tons, and of steel 20,059 tons. As usual India proved the best customer, 10,969 tons of finished iron and 5865 tons of steel having been sent there.

The accountant's certificate in connection with the North of England Board of Arbitration, which has just been issued, shows the average net selling price of iron during the past two months to have been £4 12s. 7d. per ton, as against £4 12s. 5d. for the previous two months. There has been a slight falling off in the sales of plates and angles. The total output of rails, plates, bars, and angles amounted to 42,188 tons, as against 42,534 in the preceding period.

The quarterly certificate of the Northumberland coal trade sliding scale, for the months of June, July, and August, has just been issued. It declares the average selling price of coal to have been 6s. 7·90d. per ton. This will occasion no alteration in the wages of colliers.

The inhabitants of Middlesbrough were beginning to congratulate themselves that the capture of one misguided incendiary had put a stop to the occurrence of fires for some time to come, when on the 2nd inst. another one took place. This time it was a large wooden shed containing a stock of coal, straw, &c., belonging to a dealer in those articles. The fire brigade and steam fire engine were called out and did their best, but not in time to save the shed and its contents from complete destruction. This makes the tenth fire which has recently taken place.

The deepening of the river Tees between Middlesbrough and Stockton continues to exercise the minds of the River Commissioners, especially of those who are connected with the town of Stockton. The latter say that since the improvements below Middlesbrough were effected there has been a less depth of water at Stockton by 4ft. than formerly, even though at high water the depth is greater. The total range has indeed increased, the sea water flowing in more rapidly and flowing out more completely. Whilst as large, or larger, vessels than ever can ascend the river as far as Stockton Bridge, they are soon left aground in more or less dangerous position. They demand that dredging shall be immediately undertaken to an extent sufficient to restore 2ft. out of the 4ft. of depth which have been lost, and that the other 2ft. shall subsequently also be restored. The engineer—Mr. Jno. Fowler—in an able report estimates the cost of the necessary dredging at £15,000, and the formation of a deep-water berth at a further £800. He is of opinion that this work can be done without danger to any of the existing quays or wharves, as the required depth within a few inches already exists in front of the worst of them. At a meeting of the Tees Conservancy Board, held on the 3rd inst., the above matter was discussed with some warmth, and in the end it was decided to hold a special meeting at an early date to consider it further.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The Glasgow pig iron warrant market was greatly depressed at the end of last week, Scotch warrants having fallen to 40s. 6d. per ton, while both Cumberland and Cleveland warrants were at the lowest point. A very large amount of iron changed hands at the beginning of the present week, and an upward turn occurring afterwards in the quotations, the tone became stronger. The downward course of the market last week was partly the result of the failure of a broker, whose holding of 15,000 tons had to be taken back by the sellers. Although the prices have since recovered a little, there is still a want of strength in the market in consequence of the current inquiry for export being poor. The past week's pig iron shipments were fairly good, amounting to 9463 tons, as compared with 7645 in the same week of last year. The foreign shipments embraced 915 tons each to the United States and Canada, 300 to Australia, 620 to France, 2580 to Italy, and 215 to Holland. The coastwise shipments were 2833 tons. Since last report an additional furnace has been put on hematite pigs at Calder Ironworks, and there are now eighty-three in blast as against seventy-seven twelve months ago. The quantity of iron being sent into store is small, but the total warrants stocks amount to 919,442 tons against 823,906 at the corresponding date, an increase of 95,536 tons.

The current values of makers' pigs are as follows:—Gartsherrie, f.o.b. at Glasgow, No. 1, 47s. 3d., No. 3, 43s. 6d.; Coltness, 52s. 6d. and 43s. 6d.; Langloan, 48s. 6d. and 45s.; Summerlee, 50s. and 42s. 6d.; Calder, 48s. and 41s. 6d.; Carnbroe, 43s. 6d. and 39s. 6d.; Clyde, 45s. 6d. and 41s.; Monkland, 43s. and 38s. 6d.; Govan at Broomielaw, 42s. 6d. and 38s. 6d.; Shotts at Leith, 47s. 6d. and 45s.; Carron at Grangemouth, 53s. and 44s. 6d.; Glengarnock at Ardrossan, 48s. and 40s. 6d.; Eglinton, 43s. 6d. and 38s. 6d.; Dalmellington, 43s. 6d. and 39s. 6d.

The past week's imports of Cleveland pig iron into Scotland are 8151 tons, against 8320 in the corresponding week.

In accordance with the report of the examiner of the North of England Arbitration Board, there will be no change at present in the wages of the Scotch puddlers, whose rates of pay are regulated in accordance with the fluctuations in the English prices. The trade of the puddler seems fast passing away, as puddled iron is being rapidly displaced by basic and mild steel.

Spanish iron ore is firm, and slightly higher in the Glasgow market this week, and freights from Bilbao to the Clyde are up to 7s., an advance of 9d. within the last two or three weeks.

There was shipped from Glasgow in the past week steel goods to the value of £6815; iron ditto, £21,186; machinery, £14,388; sewing machines, £788; and locomotives, £1100. It will be of interest to note that during the three quarters of the present year now finished, the steel manufactures exported from Glasgow are worth in the aggregate £321,486, against £232,217 in the same period of last year; iron manufactures, £912,830, against £1,807,821; machinery, £340,422, against £214,824; sewing machines, £121,885, against £129,302; and locomotives, £182,342, against £349,094. There is thus a decrease in the money value of iron manufactures, sewing machines, and locomotives this year, while steel goods and machinery have increased.

The home demand for merchant bars is again quiet, and except for Italy the foreign inquiry is likewise slack. The price is £4 2s. 5d., less 5 per cent. discount. Makers are busy producing unbranded iron for the Indian market, but the fresh orders for this article are now becoming scarce. The current price is £4 7s. 6d. per ton net; old rails are quiet at 57s. 6d.

In the coal trade there is a fair business doing, and the shipments are good. There was shipped from Glasgow in the past week 25,907 tons; Greenock, 3657; Ayr, 5716; Irvine, 2998; Troon, 6364; Ardrossan, 2320; Burntisland, 16,726; Leith, 9443; Grangemouth, 19,450; Bo'ness, 7831; and Granton, 1715—total, 102,217 as against 71,523 tons in the same week last year. There is no material change in prices.

The coal miners are again restricting the output, and they talk of taking an entire week's holiday, with the object of allowing stocks to be cleared away.

During September, ten vessels with an aggregate tonnage of 16,880 were launched from the Clyde shipyards, compared with sixteen vessels of 28,421 tons in the same month of last year. The output of new shipping for the nine months is 148,521, as compared with 138,890 in the corresponding period. Several new contracts have been fixed within the last few days, but there is less work on hand than there was a month ago.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The sliding scale, which has had a long and successful operation in the district is in danger of being upset through the jealousy of some of the representatives. These worthies must, however, take care lest they are upset instead of the scale, for I hear on all sides very hearty approval by the men of the usefulness and rigid impartiality of the scale. There was a time, as remembered too well in Wales, when the ironmasters were almost ruined by blind obedience to representatives, who were swayed more by personal interest than a consideration of public welfare. Men have learnt better now by bitter experience, and I have little fear of the scale being discarded. The opinion is, it must be admitted, not shared, and my excuse for retouching the subject is the great discussion prevailing. Alarmists are predicting stoppages, and strikes. A meeting of the coalowners was held this week, and meetings amongst the men are frequent. At a Merthyr meeting colliers agree to pay 1½d. per week towards an association.

Last week's coal trade at Cardiff was a bad one, but it is slightly better this week, and prospects are getting a little more hopeful. One of the largest shipments of coal which has taken place at Penarth occurred on Monday, when 15,148 tons 11 cwt. were cleared. Cardiff shipment of coal last week was fully 20,000 tons below the average. Newport showed better, and its coasting total was 25,000 tons. Swansea also exhibited a full sheet and kept up its late high total, namely, 30,000 tons. A few weeks will decide the course of things, and as the week is closing with firmer prices and the leading coalowners are resolute in not accepting long contracts at the lowest quotations, some little hope is entertained. Large steam is quoted at Swansea at 8s. to 9s. 6d.; Cardiff, 8s. to 8s. 6d.; but its best coals yield more. Monmouthshire coals are 7s. 9d. to 8s., and at pit good house coal is quoted at 6s. Rhondda No. 3 can be bought at 8s. Small steam at Cardiff varies from 3s. 3d. to 3s. 6d.; at Swansea 3s. 9d. is quoted. Pitwood is very firm at 15s., and this in the face of 8000 loads having come into the port of Cardiff alone during the week. Swansea price is 16s. net into trucks. Every year attention has been called to the waste lands in Wales, and the urgent need of growing pitwood, but the public have not seen any great results. I am glad to know, however, that a good deal is being done, and a few years hence substantial progress will be shown both in the Aberdare and Brecon valleys. Large clearances are being made in the Cyfarthfa district, and this will be all replanted, but the ground is to remain fallow for a year or two. Sir W. T. Lewis is directing the formation of large plantations on his estates at Cwmtaff.

Coke is in demand at 12s. to 12s. 6d. furnace quality; foundry quality up to 16s. 6d. f.o.b.

In a dull season of the coal trade like that it is now passing through steamship ventures are not popular. In Cardiff there is a little more speculation in that way, but only little. Outside shareholders have found that though profits are made by skilful management, they do not share, coalowners, ships' husband, and captain getting the benefit. It is suggested that a company floated on stock-sharing principles, everything fairly divided, even to the ships' husbands profits would pay. I give the hint.

The steel industry is looking up, and in a short time I shall have to report re-starts in several directions. The Treforest Steel Works are getting into order, and signs of life are beginning to show. Cyfarthfa will soon have another furnace in blast, and the elaborate range of coke ovens by the Evance Coffee Company are getting into a forward state. Cyfarthfa is evidently on the highway to take the same position in steel manufacture as the former Crawshay did in iron. At present strides it will soon be the largest in the country. The works generally are active, and importations of iron ore speak well. Wales now is a very large buyer. Prices are from 12s. to 12s. 6d. at all ports. Rails are not in large request; blooms are better, bars better still. The chief quotations given at Swansea Exchange on Tuesday were as follows:—Steel rails, heavy section, £4 5s. to £4 7s. 6d. at works; light, up to £5 2s. 6d.; steel sheet, £7 10s. to £8 10s.; steel blooms, £4 5s.

I referred last week to the competition between Welsh and Scotch blooms. That it is keen is evidenced by the sea rate from Ardrossan to Port Talbot being only 3s. 1½d. per ton! Bessemer bars are at £4 15s., Siemens bars £5 2s. 6d., delivered at works, Swansea.

In tin-plate a good deal continues to be done all over the district, and preparations are being made for a new works at Briton Ferry. The old ones are now doing so well that this is not to be wondered at. An additional and a very large one, is also to be started in the district of Swansea.

Swansea despatched last week substantial cargoes of 2000 tons to Philadelphia and Baltimore, and 2589 to home ports. The exports altogether amounted to 27,454 boxes, a great falling off as compared with the previous week, but Goliath exports like 80,000 boxes weekly could not be met. The make last week was only 30,000 boxes, and all the works may be said to be busy.

The latest quotations were those given at a full "'Change" on Tuesday at Swansea. Coke iron tins per box, 12s. 9d. to 12s. 10½d.; Bessemers, 12s. 10½d. to 13s. 1½d.; Siemens, 13s. 3d. to 13s. 6d.; wasters, 12s. 3d. It will be seen that prices have dropped slightly. Makers' books are tolerably full, and there is no apprehension about the future. There will be some large clearances again by Saturday, and stocks are by no means large anywhere in the district.

It was rumoured in Cardiff a few days ago that in all likelihood an effort will be made to transform the Glamorganshire canal into a railway. This would be a fiercely contested affair if true, and I should not be surprised, as it has long been looked upon as probable.

NOTES FROM GERMANY.

(From our own Correspondent.)

The iron markets show continued steadiness, with every appearance of a quiet, satisfactory development in prospect. Of course, the amalgamation of the four groups of the wrought iron conventions is absorbing a good deal of the attention of both buyers and sellers, and the future must show what the result will be. Unfortunately, all the works are not included in it at present, and those that are have pledged themselves till the 15th inst. not to enter into any contracts with dealers extending beyond January 1st, 1888, but till then they can; so no doubt buyers will avail themselves of this advantage to lay in extensive stocks—that is, if the works are able to deliver any quantity—for fear of an attempt to raise the price after the above date. It thus seems very improbable that any enhancement of price will be practicable for some months to come—at least till the stocks laid in are exhausted. However, the present base price stipulated by the conventions leaves a small margin of profit.

The movement in the Silesian iron market is brisk, and the output of the blast furnaces has been increased, and they, as well as the rolling-mills, are in full activity. Basic pig is scarce, and complaints are current that there is great shortness of charcoal brands. The rail-mills, too, are busy, and prices of pig-iron remain as last noted. Reports from the neighbouring markets of Austria and Hungary are also very satisfactory, more especially as concerns the wrought iron branch, which shows a continued firm tendency.

Returning to the western districts, the market for iron ores continues to expand favourably, and best Siegerland calcined steestone changed hands last exchange day at M. 12·50, while brown, red, and other sorts ranged from that figure down to 8·80 on trucks at station. Luxemburg minette is M. 1·70 to 2·40 p.t. The pig-iron trade is necessarily quiet, though firm, because most of the output for this year is disposed of, and it is rather too early to contract for next quarter, though this is here and there talked about. Stocks continue to decline, only small parcels are now changing hands, but these are frequent, and at present there seems no likelihood of prices receding yet awhile. The August production, including Luxemburg, was 337,297 t., against 264,902 t. last year for the same month. Spiegel and forge amounted to 159,506; Bessemer, 39,664; basic, 96,796; and foundry, 41,331. From January 1st to August 31st, 2,511,853 have been produced, against 2,248,417 t. last year. The trade in spiegel is satisfactory at home, and large lots have gone to France, but otherwise there has been no increase of sales abroad. The highest quality costs M. 70, inferior brands falling gradually away to 50 p.t.

Forge pig finds ready sale at prices as formerly noted, best Siegerland brands being this week M. 46 to 47 p.t. Foundry is in better request, but this does not affect the prices. Bessemer and basic ore are in a little better demand. The wrought iron branch continues active for home wants, but for export there is much left to be desired. The special Rhenish-Westphalian Convention has so far worked to the satisfaction of all parties concerned The boiler-plate demand is improving, but not the prices, which are still at M. 150 p.t.; but this is firm. The mills are well employed on these, as well as on sheets, which have gone up on the week M. 2 p.t. in the Siegerland. The wire rod trade has remained unchanged from last report.

The steel works keep steadily employed. The result of the tendering at the Haag for steel sleepers, &c., for the Dutch E. I. Railways was that a Westphalian firm took the order for 4100 t. at fl. 314,000. The other offers, one from Belgium, ranged from 318,000 to 368,000 florins. In this and the next week 3674 t. of rails and 700 t. of fish-plates are to be tendered for at Altona for the German State Railways, as well as other large lots at Cologne, Frankfort, Hanover, and Magdeburg.

The wagon works are terribly in want of further orders. It is the oft-told tale as regards the machine and constructive iron workshops; still prices seem gradually improving a little, as they ought to do, for they are not in harmony with those of the raw materials. The Schwartzkopf Machine Company, of Berlin, makes an enviable exception to the rule, for the directors have just declared a dividend of 35 against 33½ per cent. for last year.

The French iron market, as far as prices are concerned, shows no improvement, though there is a little employment at the works. Bar iron is not in great demand; on the other hand, the foundries are pretty busy, if not exactly on big contracts. The present prices in the Nord are — merchant bars, 120f.; angles, 115f.; ordinary plates, above 3 mm. gauge, 145f. to 150f.; and below this gauge, 165 to 170f.; boiler plates, 175f. to 180f.; best sorts of ditto, 195f.; and very thin sheets, 255f. to 300f. per ton. The demand for girders is as brisk as ever, and the prices as unstable and low as ever, 120f. being the nominal price at Paris, where building is still very active. It is said that Creusot has received considerable orders for steel cannon material for the arsenal at Fu-Ischëu and for Hong Kong (?)

The Belgian iron market is a little quieter, but still continues very firm; this does not produce much effect, as the rolling mills have engaged for the whole of their output for a long time to come. Forge pig has been contracted for in large parcels at 43f. for the first quarter of 1888. Foundry pig is in excellent demand, and No. 3 sort is not to be bought under 48·50 p.t. Italy is a chief customer for most articles. The coal trade is very firm for home consumption and export to France.

The Vielle Montagne Company has a second time raised its zinc prices, which now are—for Belgium, 430f.; Holland, 207·50fl.; and England, £17 10s. p.t.

The Bilbao ore market continues unchanged; the demand is active, but mine-owners are hanging back, satisfied with the present, but in expectation of better things in the future. The present prices are, however, not unsatisfactory, for Campanili selling at 7s. to 7s. 3d., and best red ore 6s. 7d. to 6s. 10d. p.t. Last week 68,200 t. were shipped. From January 1st to September 17th 3,208,436 t. had been exported, against 2,359,175 t. last year to same date.

Reports from St. Petersburg announce a steady general augmentation in the present customs dues. Out of 241 articles only eighty-eight are to remain intact.

Another rare accident has just occurred in a briquet factory in Saxony, where, at a temperature in the drying room of 60 to 65 deg. Ream., the coal dust ignited, and a very serious explosion took place. At the time, in a three-storied building, forty-five workpeople were engaged, the majority having presence of mind enough to escape into the open air, but fifteen were most seriously injured, many of whom, it is feared, fatally.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, September 24th.

THERE is a surprising firmness of prices in all iron and steel products, and in lumber, coal, and petroleum. The crude iron output is higher than for many months, and when projected and building furnaces are completed the weekly product will reach 150,000 tons. Bessemer furnaces are sold up for sixty days. Foreign material is selling at 20·50 dols. for Bessemer, 21 dols. for steel blooms, 31·50 dols. for billets and slabs, and 41 dols. to 42 dols. for wire rods. Foreign steel rails are quoted at 39·50 dols. Gulf American No. 1 foundry iron is 21 dols. to 22 dols.; No. 2, 18 dols. to 20 dols.; mill iron, 15 dols. to 17 dols.; merchant iron, 2c. per lb. at mill. Merchant steel is 7½c. to 9c. for tool, and 4½ to 6 for machinery. Foreign scrap iron, 20·50 dols.; old rails, 22·50 dols. to 23·50 dols. for tees; double heads, 23·50 dols. to 24 dols.

Advices from Pittsburgh, Wheeling, Cleveland, and Chicago show a strong consumptive demand. Financial disturbances are threatened on account of the decline of loanable funds at eastern financial centres. The rapid growth of the country, the construction of so much railway, the building of houses and manufacturing establishments, and the development of resources of all kinds has absorbed all the ready capital of the country. The possibility of scarcity is causing a hoarding by some monetary interests in a position to do so. Many projected enterprises have been temporarily withdrawn from the market, because of the scarcity of money. A collapse would afford opportunities of purchasing properties at only nominal values.

Railroad earnings are large, and the facilities are constantly taxed to the utmost. All manufacturing establishments are crowded with work for autumn and early winter. Commercial failures are of rare occurrence, and settlements are made promptly in most cases between debtor and creditor. The prosperity is on a solid basis, and no break is probable. A few companies have relinquished some railroad building enterprises for the present, and this gave rise to rumours of a falling off in rail demand. Rail mills are expanding their facilities, and next year will be able to furnish rails for twenty-five thousand miles of track. The iron industries in the South are surpassing all anticipations. Rolling mills, bridge works, stove, implement, tool works, and machine shops are being built as fast as men and material can be had.

Numerous engineering enterprises are under consideration. The Dominion of Canada has appropriated one million dollars for the construction of a ship canal on the Canadian side of the St. Mary River. The canals on the American side are free. A London company has purchased extensive coal property in Virginia. The influx of American capital into Northern Mexico has been so great of late that two, or perhaps three, branches of road will be built from the main lines into the remote mineral regions. Mining machinery makers are filled with orders for improved machinery for the Far West and South-West, and the reports of experts are attracting capital and enterprise to enter upon the development of territory only recently brought to the knowledge of the public.

NEW COMPANIES.

THE following companies have just been registered:—

C. Townsend, Hook, and Co., Limited.

This company, which emanates from the City of London Contract Corporation — Messrs. O'Hagan and Co. —proposes to take over the business of the firm of C. Townsend, Hook, and Co., of the Snodland Paper Works, Snodland, near Rochester—including the business of manufacturing and supplying gas, as well as the business of paper manufacturing—power being also taken to carry on business as electricians. It was registered on the 26th ult., with a capital of £100,000, in £10 shares, with the following as first subscribers:—

	Shares.
*Thos. May Dunster, 202, Upper Thames-street, paper merchant	50
*Wm. Tennant, 9, Mincing-lane, merchant	50
*Alderman G. R. Tyler, 17, Queenhithe, wholesale stationer	50
J. G. Gibson, Snodland, Kent, assistant manager C. T. Hook and Co.	25
John Bates, Snodland, Kent, foreman paper maker	20
J. Hyde, Snodland, Kent, engineer	20
W. Dedrick, Snodland, Kent, clerk	25

The number of directors is not to be less than three, nor more than seven; qualification, £500 in shares or stock; the first are the subscribers denoted by an asterisk and Colonel T. J. Holland, C.B.; the remuneration of the ordinary directors is to be at the rate of £150 per annum each, with an additional £150 for the chairman. The contracts entered into have not been registered, so that we are unable to give any information as to the real purchase consideration and the promotion expenses.

Fuller Nail and Rivet Rolling Machine Company, Limited.

This company proposes to manufacture nails and rivets, and to carry on business as engineers, and for such purposes it will adopt an agreement of 5th ult., between H. E. Full and T. F. W. Crawhal-Wilson. The company was registered on the 28th ult., with a capital of £10,000, in £50 shares. The subscribers are:—

	Shares.
H. J. Barclay, 30, Trinity-square, Tower-hill, accountant	1
T. Clifford Hogg, 15, West-road, Tottenham, consulting engineer	1
E. Butler, Newbury, Berks, engineer	1
J. A. Lamont, 49, Lime-street, engineer	1
W. Macrorie, 49, Abbeville-road, Clapham	1
H. Emery Fuller, 1, Leadenhall-street, engineer	1
G. Stephenson, 67, St. George's-square, S.W., articled clerk	1

The number of directors is not to be less than three, nor more than seven; the first directors will be appointed at the first general meeting, the subscribers acting as directors *ad interim*.

Electric Car and Power Company, Limited.

This company proposes to acquire and work the letters patent No. 2783, dated 26th February, 1886, granted to Alfred James Jarman, for "improvements in the construction of electromotors for the propulsion of tram-cars, electric locomotives, vehicles, and other purposes." It was registered on the 29th ult., with a capital of £100,000, in £1 shares. The company will adopt two agreements — unregistered — dated respectively the 18th of August and the 6th of September, the first being between Messrs. A. J. Jarman and Percy Dobson, of the one part, and the Contract and Agency Corporation, Limited, of the other part; and the second being between the said corporation and Thomas Henry Church, as trustee for this company. The subscribers are:—

	Shares.
A. J. Jarman, 82, Willett-road, Brixton, electrical engineer	1
C. J. B. Reed, Holland House, Highbury New Park, engineer	1
T. H. Church, Winchester House, Old Broad-street, secretary	1
F. Twinch, 83, Devonport-road, W., colliery proprietor	1
R. Sindall, Woodlands, Catford, cashier	1
C. E. M. Barker, Harold Wood, Essex, banker	1
P. Dobson, 68, Mervan-road, Brixton	1

The number of directors is not to be less than three, nor more than seven; qualification, shares or stock of the nominal value of £250; the subscribers are to appoint the first and act *ad interim*. The remuneration of the board will be at the rate of £100 per annum each, with an additional £100 per annum for the chairman, to be doubled in any year in which the dividend shall reach or exceed 10 per cent. Mr. A. J. Jarman is appointed general manager of the company's works for seven years.

Hitchin's Fire-proof Plastering Company, Limited.

This is a reconstruction of a company of the same title, carrying on business at Grayling Works, Manor-road, Stoke Newington. It was registered on the 1st instant, with a capital of £20,000, in £1 shares. The new company is to discharge the liabilities of the old company, and is to issue one fully-paid share in respect of every three vendors' shares, and one fully-paid share in respect of each other share held in the old company. The subscribers are:—

	Shares.
N. J. Whitcombe, 1, Gresham-buildings, chartered accountant	10
C. W. Emson, Surbiton, secretary to Underwriters' Association	10
F. E. Whitcombe, 18 and 19, Bishopsgate-avenue, leather merchant	10
J. Stuart, 20, Bucklersbury, iron merchant	10
H. Adams, 32, Finsbury-pavement, gun manufacturer	10
*P. D. Holland, Coventry Park, Streatham	10
J. South, 18 and 19, Bishopsgate-avenue, leather merchant	10

The number of directors is not to be less than three, nor more than five; qualification, £100 in shares; the first are Hyman H. Collins, 61, Old Broad-street; John Stuart, 11, Queen Victoria-street; P. D. Holland, and G. A. Bell, of Ford, Shrewsbury. Remuneration — chairman, £75 per annum; each director, £50 per annum; with an additional £10 each for every £1 per cent. dividend in excess of £5 per cent. per annum.

NEW PERMANENT WAY FOR THE BELGIAN STATE RAILWAYS.[1]

THE Minister of Railways in Belgium has decided on the adoption of a Vignoles rail, weighing 101 lb. per yard—50 kilograms per metre—designed by Mr. Flamache, to be manufactured by the Cockerill Society.[2] The new rails are 5·71in. high, 5·32in. wide at the base; the head is 2·83in. wide, rounded at the top, with a radius of 7⅞in., for a width of 1·8in., merging into each flank with a radius of 0·59in. The vertical web of the rail is ⅜in. thick, and the bearing surfaces for removing the fish-plates are inclined at the rate of one in five. This low rate of inclination is conducive to the stability of the joint. The rails are 29½ft. —9 metres—long, on twelve transverse sleepers of oak, creosoted. The sleepers are placed 31½in. apart, from centre to centre, except at the joints, where they are 23½in. apart. On each intermediate sleeper a metal plate, 9½in. wide by 5½in., is placed under the rail. It is slightly recessed to receive the flange of the rail, and to check any tendency to lateral displacement. It is pierced with three spike-holes, but only two spikes are used. The additional hole admits of a third spike being used, if needful; the spikes are about 1in. in diameter, screwed with a strong thread of about ⅓in. pitch, cut 0·16in., or about ⅓in. deep. The rails are fished with angle-brackets, or fishes, formed with a wide bottom flange, for the sake of stiffness, and also to take a bearing on the joint sleepers. For this purpose, the fish-plates are made 28⅜in. in length. They are secured to the rails with four 1in. bolts and nuts, of which the bolts are formed with fang-heads let slightly into the fish-plates to prevent them from turning round.

All the details of the fastenings have been designed with a view to the opposing of sufficient surfaces of contact to the action of horizontal forces. Summing up, it is stated that the resistance to flexure is augmented by one-half; the stiffness doubled; the intensity of the pressure on the wood, fifty per cent. less; and nearly all the abutting surfaces twice as much as when compared with the old rail.

[1] "Proceedings" Institution of Civil Engineers.

[2] A section of this rail may be seen at the Inst. C.E.

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.

27th September, 1887.

13,038. DETACHABLE CHAINS, A. Bagshawe, London.
13,039. GLOVES, J. Kayser, London.
13,040. CASH BOXES, H. H. Chilton and B. J. Botwood, Wolverhampton.
13,041. CONTRACTABLE VESSELS, W. H. Wells, Evershot.
13,042. WOOL MATTRESSES, A. Leech, Manchester.
13,043. INJECTING AIR into FURNACES, H. and A. Wilson, Stockton-on-Tees.
13,044. EXPANDING GUSSET ENVELOPE, F. H. Harrison, Bradford.
13,045. GUIDE BARS CARRYING PATTERN THREADS, J. Jardine, Nottingham.
13,046. OUTSIDE JAUNTING CAR, T. J. Haslam, Dublin.
13,047. CLEANSING POWDER, J. W. Paton, Moorfields.
13,048. MANUFACTURE of SULPHURIC ACID, J. Beveridge, Frodsham.
13,049. PRESERVING SYSTEM, I. Allegretti, London.
13,050. TWIN CONTROLLING SPRINKLER FIRE-EXTINGUISHER, S. B. Wilkins, Edinburgh.
13,051. AUTOMATIC SPRINKLER PLUG, F. Gartside, Glasgow.
13,052. PISTON VALVES for STEAM ENGINES, P. Armington, London.
13,053. SCREEN HOLDER, N. C. A. Parker, London.
13,054. REGULATING the BAND of TIES, J. Hunt and G. Smith, London.
13,055. BRUSH-MAKING MACHINERY, C. Gutsmuths, London.
13,056. ELECTRIC-MAGNETIC MOTORS, W. Aldfred, London.
13,057. COMBINED LAMP for BURNING OILS, &c., J. F. Sleat, London.
13,058. BALLOT-BOXES, P. A. Staley, London.
13,059. CLEANING LEAVES containing FIBRE, J. G. Tongue.—(*The Hemphill Fibre Machine Company, United States.*)
13,060. STEAM BOILERS, T. A. York, London.
13,061. BOXES for TEACHING SPELLING, C. A. Maynard, London.
13,062. WATERPROOF FELT, S. Barnwell, Birmingham.
13,063. PADLOCKS, G. Harrison, Birmingham.
13,064. MANUFACTURE of CARBONATE of SODA, P. Bateson and M. C. Arnholtz, Liverpool.
13,065. ATTACHING SAW BLADES to HANDLES, E. Weldon, Sheffield.
13,066. RING for UMBRELLAS, T. Widdowson, Sheffield.
13,067. JOINTS for RAILS of RAILWAYS, T. H. Heard, Sheffield.
13,068. SECURING HEADS of PICKS, J. G. Hawksley, Bedford, and S. Willington, Sheffield.
13,069. TELEGRAPHY, F. van Rysselberghe, London.
13,070. COLLAR BUTTONS, N. Mitchell, London.
13,071. MACHINES for MINCING MEAT, T. Williams, jun., London.
13,072. DETECTING COUNTERFEIT, F. Chamberlain, Waltham Cross.
13,073. WARP LACE FABRICS, A. Lees and F. H. Lees, London.
13,074. ENSURING the SAFETY, &c., of BAGGAGE, H. A. Deraismes, London.
13,075. WIRE-ROD REELS for ROLLING MILLS, F. H. Daniels, London.
13,076. REELING MECHANISM of ROD ROLLING MILLS, F. H. Daniels, London.
13,077. COMBINED PLUG and OVERFLOW PIPE, R. Edwards, London.
13,078. SEPARATING DUST, &c, W. R. Lake.—(*The Knickerbocker Company, United States.*)
13,079. COUPLING for VELOCIPEDES, &c., F. Haisman, Hanwell.
13,080. DYNAMO-ELECTRIC MACHINES, W. Fritsche, London.
13,081. CARBON FILAMENTS, J. Pullman, London.
13,082. SCREW PROPELLERS, W. J. Steves and A. J. Hill, London.
13,083. AUTOMATIC SALE and DELIVERY of LIQUIDS in EXCHANGE for COIN, H. Dalgety, London.
13,084. APPLYING HAIR to DOLLS' HEADS, A. J. Boult.—(*J. Kubelka, Austria.*)
13,085. TREATMENT of FATTY ACIDS, W. P. Thompson.—(*La Société Industrielle des Glycerine et Acides gars, France.*)
13,086. STRAIGHT KNITTING MACHINES, G. Verdier and E. Schultz, London.—*29th March*, 1887. [Received 27th September, 1887. Antedated 29th March, A.D. 1887. Under International Convention.]
13,087. SAFETY APPLIANCES for WHEELED VEHICLES, Vincenzo, Count di Tergolina, London.
13,088. METHYLENCHLORIDE, B. Willcox. —(*Farbenfabriken vormals Friedr. Bayer and Co., Germany.*)
13,089. STEAM ENGINES, L. Durant and A. Lencauchez, London.
13,090. FILING LOOSE PAPERS, E. H. Meyer, London.
13,091. ELECTRIC MOTOR for CLOCKS, M. Viau, London.
13,092. CARBON FILAMENT, W. R. Lake.—(*La Société A. Cruto and Cie., Italy.*)
13,093. PAPER BAG MACHINERY, J. Duerden, London.
13,094. TORPEDO and other VESSELS, J. Y. Short, London.

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13,095. WINDOW BLINDS, T. Turner, London.
13,096. OIL, &c., BURNERS, R. Wallwork and A. C. Wells, London.
13,097. EXTINGUISHER for OIL LAMPS, H. B. Parish, Birmingham.
13,098. ENVELOPE-MAKING MACHINE, F. H. Harrison, Bradford.
13,099. BATHS, SINKS, &c., D. P. Menzies, Glasgow.
13,100. VELOCIPEDES, W. Banning, Birmingham.
13,101. FIRE-ESCAPE, J. Surridge, Cardiff.
13,102. SUGAR MILLS, J. G. Hudson, Glasgow.
13,103. PICKERS for LOOMS, W. Bartle and G. M. Bell, Bradford.
13,104. FIXING SUBSTANCES to BEDSTEADS, A. L. Bayley, Sutton Coldfield.
13,105. VALVE, J. Butterworth, Rochdale.
13,106. DOOR MATS, &c., J. Whiteley, Manchester.
13,107. SPRING FASTENING for BUTTONS, &c., J. Mellor, Manchester.
13,108. ROTARY PUMPING ENGINES, J. Robertshaw and J. T. Collinge, Manchester.
13,109. INJECTORS, T. H. White and W. Hardy, Manchester.
13,110. THEATRE CURTAINS, A. Harris and J. B. Hannay, Glasgow.
13,111. HOISTS, S. G. Bennett, Handsworth.
13,112. ADAPTING TABLES to the GAME of BILLIARDS, F. C. Williams, Leicester.
13,113. BOTTLE STOPPER, L. T. Plose, London.
13,114. PREVENTING HORSES SLIPPING, T. Walley and J. Brownlee, Glasgow.
13,115. CAPSULING MACHINES, J. D. Mitchell, Glasgow.
13,116. STONE-BREAKING, &c., MACHINES, W. H. Baxter, Halifax.
13,117. FUEL ECONOMISER, J. Rowley, Manchester.
13,118. ATTACHMENT for BRACE ENDS, &c., S. Taylor, Manchester.
13,119. EXCENTRIC PRESS, C. Whitfield, Kettering.
13,120. GAS LAMPS, F. W. Clark, London.
13,121. GAS INCANDESCENCE LAMPS, R. H. Courtenay, London.
13,122. CIGARETTES, J. F. Forth, London.
13,123. CURTAIN HOOKS or SUSPENDERS, S. Atkins, Birmingham.
13,124. STRENGTHENING STEAM and FEED PIPES, W. B. Thompson, Dundee.
13,125. OBTAINING FRESH WATER from the SEAS, C. L. Wells, Naples.
13,126. WASTE-PREVENTIVE BALL VALVE, T. Feller Kingston-on-Thames.
13,127. BUTT HINGE, A. Stephenson, Halifax.
13,128. REGULATING VALVE for STEAM and other PIPES, J. Prégardien, Barmen, Germany.
13,129. CLIP HOOK and PLATE for SHOW and PRICE TICKETS, C. Beardall, Brighton.
13,130. OBTAINING POWER from WIND FORCE, J. C Sellars, London.
13,131. BASSINETTE BODY, E. R. Billington, Liverpool
13,132. COMBINED SHIRT and COLLAR STUD, J. J Rowley, London
13,133. STAMPING or BEATING MACHINES, W. P. Thompson.—(*J. Winkler, Germany.*)
13,134. BOTTLES and STOPPERS, A. B. Warhurst, Manchester.
13,135. HYDRANTS, W. A. Stevens, London.
13,136. HYDRAULIC CRANES and LIFTS, W. R. Green and R. Carey, London.
13,137. CLOTHES-HORSE for AIRING CLOTHES, W. Seward, London.
13,138. HORSE COLLARS, H. W. Loads, London.
13,139. SOAP-MAKING, M. I. and H. G. Whibley, and A. Williams, London.
13,140. LENS ATTACHMENTS for LAMPS, A. Gerken, London.
13,141. AUTOMATICALLY SUPPLYING CIGARS, E. Edwards. —(*C. Back, Switzerland.*)
13,142. SEAMLESS BOXES and CASES, T. Sparham, London.
13,143. CLINICAL THERMOMETERS, T. P. C. Crampton and W. Usher, London.
13,144. TOBACCO PIPES, W. Fraser, London.
13,145. SPATULAS for MIXING PILLS, J. F. Golding, London.
13,146. LOCK BOLTS and NUTS, S. de la G. Williams, London.
13,147. TORPEDOES, J. O'Kelly and B. A. Collins, London.
13,148. PRODUCING RECTILINEAR MOTION, F. Ross and A. Franzen, London.
13,149. DEVICES for HOLDING HATS, R. Spier and C. Bender, London.
13,150. INDICATING the PRESENCE of EXPLOSIVE GASES, G. F. Redfern.—(*J. Molas, France.*)
13,151. TREATING SEAL SKINS, M. Horn and R. Bach, London.
13,152. INJECTORS, T. H. Williams, London.
13,153. REPEATING ORDNANCE, C. F. Hengst, London.
13,154. CONTROLLING GAS, &c, COCKS by ELECTRICITY, H. R. Fisher, London.
13,155. JACQUARD APPARATUS, S. Holdsworth, London.
13,156. LETTERPRESS and LITHOGRAPHIC ROLLERS, W. A. Simmons and J. Silvester, London.
13,157. BUTTON-MAKING MACHINE, A. Gruhl, London.
13,158. AUTOMATIC ESCAPE VALVE, J. A. Fowler, London.
13,159. ELECTRO-MOTORS, W. W. Dunn, London.
13,160. OPERATING the SLIDE VALVES of STEAM ENGINES, G. W. Garrett, London.
13,161. FACILITATING the CLEANSING of DRAINS, S. G. Huntley, London.
13,162. COUPLINGS for RAILWAY VEHICLES, E. Vogt, London.
13,163. ROTARY ENGINES, G. A. Tabourin, London.
13,164. WATER SPRINKLERS, T. Walters and A. Pell, London.

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13,165. HOLLOW METALLIC BOW HANDLES, S. H. Keeling and F. C. Smith, London.
13,166. SHOE for PROTECTING HORSES in SLIPPERY WEATHER, A. Pearson, Birmingham.
13,167. ADJUSTABLE DRAPER'S STAND, J. Goodwin, London.
13,168. WALKING and UMBRELLA STICKS, J. Gullery, Belfast.
13,169. SAFETY EXPLOSION PROOF PETROLEUM LAMP VASE, J. Roberts, Cumberland.
13,170. GAME of CURLING and SIMILAR GAMES, T. B. Sharp, Smethwick.
13,171. LIFTING INBOARD and OUTBOARD, J. C. Kenworthy, Cheshire.
13,172. ENGINES for RAISING or FORCING BEER, &c., A. Bruce, Glasgow.
13,173. ILLUSTRATING and RECORDING the COMBINED PLAY and PLAYERS of FOOTBALL, &c., J. Baines, Bradford.
13,174. CALLING UP DIAL for HOTELS, &c., G. Slater, Sheffield.
13,175. INSTANTANEOUS EMERGENCY GOVERNOR, H. Aspinall, Liverpool.
13,176. GUARD for TRAM-CARS, &c., T. B. Waterfield, Dublin.
13,177. INGOT MOULDS, S. Appleby, Middlesbrough-on-Tees.
13,178. VALVES for STEAM, &c., ENGINES, J. W. Melling, Manchester.
13,179. DELIVERY of PREPAID GOODS, J. Owen, Liverpool.
13,180. CEMENT, J. Hargreaves, Liverpool.
13,181. BANJOS, J. Ormerod, Manchester.
13,182. PEN-HOLDERS, T. Garnett, Bradford.
13,183. BOOTS, H. W. Robinson, Northampton.
13,184. FIRE-ARMS, A. Lindner, London.
13,185. STEAM SCOURING DREDGERS, A. Harrison, London.
13,186. SHUTTERS for PHOTOGRAPHIC LENSES, J. M. Elliott, Glasgow.
13,187. SPRING MATTRESSES for BEDSTEADS, C. W. Hainsworth, London.
13,188. FORMING SHEET DOUGH WITHOUT ROLLING, F. Herrissé, London.
13,189. SHUTTLES for LOOMS, R. Greenwood and W. Tait, Glasgow.
13,190. FIXING BOTTLE-WASHING BRUSHES, W. Thomson, Glasgow.
13,191. VELOCIPEDES, J. H. Hall and H. L. Phillips, London.
13,192. APPARATUS for RECEIVING COINS, J. Edwards, Birmingham.
13;193. EXTINGUISHING FIRES, J. M. and T. B. Stanley, London.
13,194. CABLE RAILWAY, A. J. Boult.—(*C. Vogel and F. Whelan, California.*)
13,195. WASHING the HEAD, W. P. Thompson.—(*A. Heinemann, Germany.*)
13,196. PURIFICATION of EXTRACTS from FRUITS, &c., W. P. Thompson.—(*F. Kleemann, Germany.*)
13,197. BOOTS and SHOES, G. Nichols, T. G. Evans, and J. B. F. Clows, London.
13,198. FIELD KITCHEN, L. A. Groth.—(*M. R. von Pittoni, Hungary.*)
13,199. TABLE, WRITING DESK and SEAT, J. Eckardt, London.
13,200. SAFETY SELF-LOCKING TAP, J. E. Waizeneker, London.
13,201. LAWN and DRAWING-ROOM POCKET TABLE, J. E. Hughes, Walthamstow.
13,202. FOLDING and ADJUSTABLE CHAIR, E. Smith, London.
13,203. WINDOW CLEANING CHAIRS, H. J. Allison.—(*A. Dormitzer, United States.*)
13,204. CARD, &c., CASES, A. J., H. C., and W. C. Needham, London.
13,205. SPIRIT TORCH, H. Squire and S. Pamington, London.
13,206. FEEDING BOTTLES, &c., S. J. Pocock and J. J. Keevil, London.
13,207. INDICATORS for ELECTRIC BELLS, A. Morley and H. W. Wilson, London.
13,208. WATER HEATER for FIRE ENGINES, J. C. Merryweather, London.
13,209. FIRE ESCAPES, J. C. Merryweather, London.
13,210. FIRE-EXTINGUISHING APPLIANCES, J. C. Merryweather, London.
13,211. FASTENING TOPS on BILLIARD CUES, T. F. Smith, London.
13,212. PIANOFORTES, T. Snaith, London.
13,213. VENT and GIMLET PEGS, A. Vaudiot, London.
13,214. MOULDING ARTICLES in CEMENT, J. H. Greathead, London.
13,215. SHIELDS used in EXCAVATING TUNNELS, J. H Greathead, London.

13,216. Carriage Lamps, W. Howes, jun., London.
13,217. Fire Escape, C. Aedy, London.
13,218. Lifting or Hoisting Blocks of Ice, A. H. Scaife, London.
13,219. Incandescent Electric Lamps, E. Böhm, London.
13,220. Testing and Cleaning Cotton, &c., H. Offroy and C. Pfeiffer, London.
13,221. Controlling Reciprocatory, &c., Movements of Armatures, J. H. Holmes, London.
13,222. Open Gas Fires, J. F. Wright and G. E. Wright, Birmingham.
13,223. Paring Potatoes, &c., G. R. Holding, London.

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13,224. Centralising Differential Circular Rack Gearings, D. T. Weston, Stockton-on-Tees.
13,225. Brace Buckles, J. Cadbury and J. G. Rollason, Birmingham.
13,226. Mouthpieces, F. T. Glover, Birmingham.
13,227. Cutting Screw-threads on Pipes, C. and A. Carrodus, Manchester.
13,228. Turbine Water Wheel, J. Staincliffe, Oakworth.
13,229. Pipe or Barrel Keys, D. E. Baker, Guisborough.
13,230. Drawing Boards, H. Marle, Birmingham.
13,231. Collars, Cuffs, &c., W. M. Gay, London.
13,232. Communicating with a Railway Train in Motion, A. E. Porte, Dublin.
13,233. Envelopes, J. S. Galbraith, London.
13,234. Wheels, G. W. Moon, London.
13,235. Self-acting Match-box, H. Power, Solihull.
13,236. Shaving Apparatus, A. E. Green, Birmingham.
13,237. Mechanism for Changing the Shuttles in Looms for Weaving, C. Holdsworth and J. Horton, Halifax.
13,238. Shuttles for Weaving Textile Fabrics, S. Whitworth, Rochdale.
13,239. Connecting Pipes, J. Smith, Warwickshire.
13,240. Heating and Ventilating Buildings, W. J. Scott, Bradford.
13,241. Removing Dust, R. Boote and W. Kent, London.
13,242. Open-hearth Method of Manufacturing Iron and Steel, G. Hatton, London.
13,243. Dies for Striking the Caps, &c., of Boxes, &c., W. H. Allen, London.
13,244. Cutting and Stamping Machines for Biscuits, A. Harvey, Glasgow.
13,245. Placing Railway Trains in Communication with an Electric Conductor, E. Graefe, London.
13,246. Raising, Lowering, and Holding Railway Carriage Windows, J. W. Stott and J. W. Ashton, London.
13,247. Combination Needle or Needle Case, J. W. James, Birmingham.
13,248. Inhaling Nitrous Oxide Gas, E. G. B. Barlow, London.
13,249. Lamps for Lighting, &c., F. H. Lenders, London.
13,250. Breech Boots, H. de Laspée, London.
13,251. Automatic Extinguishing Safety Lamps, I. Werber, London.
13,252. Fastening Shoes, F. S. Stark and J. W. Tonge, London.
13,253. Buttons, A J. Boult.—(*O. W. Ketchum, Canada.*)
13,254. Shafts for Vehicles, W. P. Thompson.—(*J. Squadrilli, France.*)
13,255. Paper for Toilet, &c., A. B. Warhurst, Manchester.
13,256. Mixing Substances in a Dry State, F. W. Allchin, London.
13,257. Steam and other Boilers, T. A. York and J. C. Edwards, London.
13,258. Revolving Door Posts, W. H. Dutton, London.
13,259. Self-acting Let-off Motions for Power Looms, R. Hunter and J. Huggan, Glasgow.
13,260. Compound Engine, S. Wolfson, London.
13,261. Stiffeners for Dress Bodies, F. C. Nutter, London.
13,262. Children's Carriages, &c., W. Cork, London.
13,263. Valve Tap, R. Morant, London.
13,264. Cash Indicators and Registers, J. J. Webster, London.
13,265 Starting Tramcars, &c., E. Dredge, London.
13,266. Valves for Regulating Gas, A. T. Clarkson, London.
13,267. Screw Press, S. G. A. de Pont, London.
13,268. Catch Pit for Street Gullies, J. F. Clarke, London.
13,269. Valve Gear for Pumping Engines, H. Davey, London.
13,270. Pumping Engines, H. Davey, London.
13,271. Holding Ships' Rudders, T. G. Stevens, London.
13,272. Knitting Machines, C. H. Aldridge, London.
13,273. Scissor Trimming Attachment, C. Mundy, London.
13,274. Treatment of Sewage, T. Donnithorne, London.
13,275. Travelling Dust Fillers, H. Simon, London.
13,276. Refrigerating, &c., Food, J. H. Greathead and L. Sterne, London.
13,277. Production of Quinine, F. Nettlefold, London.
13,278. Dog Lead, W. R. Clarke, London.
13,279. Escape of Smoke from Halls, &c., W. L. Wise. —(— *Noppuis*, ——.)
13,280. Locks, P. Schwenke, London.
13,281. Securing Hose to Couplings, J. Hunter, F. W. Tuerk, jun., and J. C. Hunter, London.

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13,282. Air Check Football, W. Fraser, London.
13,283. Delivering Sweets, &c., H. F. Studds, London.
13,284. Safety Saddle or Stirrup Bars, S. Withers, Birmingham.
13,285. Dress and Hair Pins, F. Iles, Birmingham.
13,286. Varnish for Leather, S. Washington, Manchester.
13,287. Polishing Metals, S. Washington, Manchester.
13,288. Combined Van and Pleasure Trap, C. Scutt, Birmingham.
13,289. Controlling the Dampers of Steam Boiler Furnaces, D. Parsons, D. J. Parsons, J. H. Parsons, and S. J. Parsons, Birmingham.
13,290. Regenerative Hydrocarbon Lamp, L. Chandor and C. H. Nölting, London.
13,291. Smoothing Irons, L. S. d'Iszoro, Manchester.
13,292. Lubricators, J. L. Grandison, Manchester.
13,293. Wheels for Perambulators, &c., J. Hudson, Birmingham.
13,294. Tools for Expanding Tubes, R. W. Tayler and F. J. Tayler, Bury St. Edmunds.
13,295. Protection of the Outer Soles of Boots and Shoes, C. W. Hancock, Leicester.
13,296. Preparation of Tea, H. Jackson, Manchester.
13,297. Keeping Bicycles Upright, G. Hansell, Bradford.
13,298. Reels or Frames, W. Rhodes, Halifax.
13,299. Ploughs, D. Paterson, Glasgow.
13,300. Stoppering Bottles, A. H. Storey, London.
13,301. Flexible Tube Couplings, T. Thorp, Whitefield.
13,302. Coupling-up Tubing and Bibs, T. Thorp, Whitefield.
13,303. Corliss Valve Gears, S. H. Shorrock and J. Mangnall, Bolton.
13,304. Variable Blast Pipes, C. J. Nicholson, Birmingham.
13,305. Preventing the Waste of Gas, R. S. Barnes, London.
13,306. Bows for Stringed Instruments, E. Latchmore, London.
13,307. Releasing Fastenings of Turnstiles, &c., G. Williamson, Leeds.
13,308. Bicycles, W. M. Walters, London.
13,309. Dynamo-electric Machine, C. V. Burton, London.
13,310. Continuous Supply of Oil, W. Perkins, London.
13,311. Wheels and Pulleys, R. A. Hansell, London.
13,312. Dredging, J. A. Radley, Lowestoft.
13,313. Anglegraph, J. A. Boorman, London.
13,314. Promoting Combustion, W. G. Griffiths, London.
13,315. Screw Propellers, B. Dickinson, London.
13,316. Counteracting Vibration in Tricycles, &c., W. Goulden, London.
13,317. Automatically Registering, F. W. Morley, London.
13,318. Velocipedes, A. J. Boult.—(*F. Rourk, Canada.*)
13,319. Food and Liquid Delivering Apparatus, P. Everitt, London.
13,320. Electric Regulators, J. G. Statter and S. L. Brunton, London.
13,321. Mechanical Movements, C. C. Barton, London.
13,322. Lime Kilns, E. Solvay, London.
13,323. Revolving Furnace, E. Solvay, London.
13,324. Recovery of Precious Metals, J. Nicholas and H. H. Fanshawe, London.
13,325. Electro-chemical Process for Recovery of Metals, J. Nicholas and H. H. Fanshawe, London.
13,326. Producing Electric Shocks, J. Douglas and H. Abbot, London.
13,327. Covering Buttons, G. A. Page.—(*J. Fiala, Germany.*)
13,328. Springs, J. Richards, Birmingham.
13,329. Safes, D. R. Ratcliff, London.
13,330. Keyless Watch, W. Falk, London.
13,331. Suction and Force Pump, A. Thiéry, London.
13,332. Photometer, J. Decoudun, London.
13,333. Secondary Generators, L. Gaulard, J. D. Gibbs, and E. Fesquet, London.
13,334. Axles-boxes, W. R. Lake.—(*G. M. and J. A. Brill, United States.*)
13,335. Magazine Rifles, J. J. Speed, London.
13,336. Acetic Acid, J. E. Johnson-Johnson, London.

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13,337. Bobbins, &c., R. N. and J. Wailes, Halifax.
13,338. Electric Lamp Attachments, W. Hartnell, Leeds.
13,339. Wood Planing Machines, T. N. Robinson, Manchester.
13,340. Spindle Holder, J. and J. Vaughan, and J. Walker, Manchester.
13,341. Hame Couplings, F. M. Franklin and J. G. Ryersee, London.
13,342. Window-sash Fastener, R. Platt, Hyde.
13,343. Locking the Doors of Railway Carriages, A. Bruce, Glasgow.
13,344. Boot, &c., Rivets, C. A. T. Rollason and T. H. Slater, Birmingham.
13,345. Preserving Milk, Cream, &c., T. Carroll, Dublin.
13,346. Winning Coal, T. Archer, jun., Newcastle-on-Tyne.
13,347. Looms, O. Drey, Manchester.
13,348. Safety Lamps, J. Cooke, Birmingham.
13,349. Coupling Railway Wagons, J. R. Burchall, Ashton-under-Lyne.
13,350. Fixing Winches to Fishing Rods, W. Phillips, Redditch.
13,351. Theatrical Scenery Screw, S. Henshaw, Birmingham.
13,352. Shoe-sole Sewing Machines, J. Albrecht, Berlin.
13,353. Chain, W. Rose, Birmingham.
13,354. Firing Marine Artillery, A. H. Broadbent, Fairfield.
13,355. Railway Chairs and Fastenings, A. T. Harvey, Glasgow.
13,356. Toy Race Game, W. C. Owston, near Pontefract.
13,357. Street Advertising, C. R. Gourlay, Newcastle-upon-Tyne.
13,358. Imprinting Marks on Piece Goods, J. A. Cundall, Manchester.
13,359. Union Joint and Check-valve Co mbined, P. Buckley, London.
13,360. Lamps for Oil Burning Purposes, E. Sherring, Manchester.
13,361. Perforated Correspondence Tablets, H. Jones, London.
13,362. Brace Buttons, A. E. Parsons, Sidlesham.
13,363. Looms, F. Senior, Yorkshire.
13,364. Medicating Woollen Felt, V. F. Wood, London.
13,365. Chamelon Lamp Shade, E. G. Such, London.
13,366. Retene, W. L. Wise.—(*The Actien Gesellschaft für Chemische Industrie, Germany.*)
13,367. Life-saving Apparatus, B. Craig, London.
13,368. Concave Plate with Rod and Projecting Knob, A. Kingshott, London.
13,369. Ink Rollers, C. H. B. Dornblut, F. E. Lang, and M. H. Melley, London.
13,370. Nuts Prevented from Working Loose, W. Bayliss, London.
13,371. Milk Cans, &c., R. Stroud, London.
13,372. Refrigerator Buildings, E. Schroeder, London.
13,373. Clocks, H. D. Cole, London.
13,374. Explosive Projectiles, J. MacDonald, Glasgow.
13,375. Meters for Compressed Air, J. Sturgeon, London.
13,376. Artificial Compounds to Imitate Wood, B. Harrass, London.
13,377. Fitting Radial Axles, K. Marek, London.
13,378. Splitting Coal, &c., W. Scorer, London.
13,379. Safety Hydrocarbon Lamps, S. A. Johnson, London.
13,380. Pipe Joint, D. Lang.—(*F. J. Garnier and N. Curé, Belgium.*)
13,381. Tightly Closing Tanks, B. G. Sinclair and E. G. Wansbrough, London.
13,382. Wheels for Velocipedes, W. R. Lake.—(*F. H. Harris, United States.*)
13,383. Preventing Delivery Boxes being Opened, T. Melville, London.
13,384. Looms, P. A. Staley, London.
13,385. Velocipedes, A. S. Ford, London.
13,386. Scarves, A. Jones, London.

SELECTED AMERICAN PATENTS.

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

367,557. Balanced Valve, *W. A. Short and E. Lalime, Malone, N.Y.—Filed April 29th*, 1886.

Claim.—(1) The cylindrical slide-valve H, consisting of the body portion H^1, the heads H^2, the bolt H^3,

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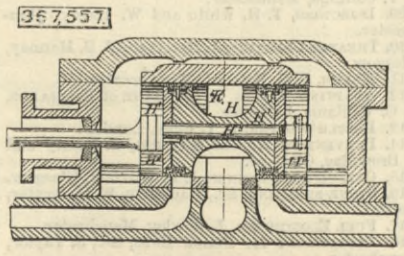

having the offset H^4 for the reception of the valve-rod, and the packing rings K placed one above the other at each end of the valve, substantially as herein shown and described. (2) In a balance-valve for steam engines, a steam chest having inlet and outlet ports and lugs or projections on its sides, and a valve rod having a T-end, in combination with a cage having inlet and outlet ports and being adapted to slide vertically between the lugs on the sides of the steam chest, a cylindrical valve having three packing rings placed one above the other at each end and operating in the cage, and the valve bolt having a recessed projection in which fits the T-end of the valve rod, substantially as shown and described.

367,617. Gun Carriage, *H. Gruson, Buckau, near Magdeburg, Prussia, Germany.—Filed January 13th*, 1887.

Claim.—(1) The combination of a shield or casing, a revoluble cap or cover supported at its edges by said shield, and a gun carried by said cap or cover, substantially as set forth. (2) The combination of a shield or casing, a convaco-convex cap or cover supported at its edges by said shield or casing, and a gun carried by said cap or cover, substantially as set forth. (3) The combination, with a shield or casing,

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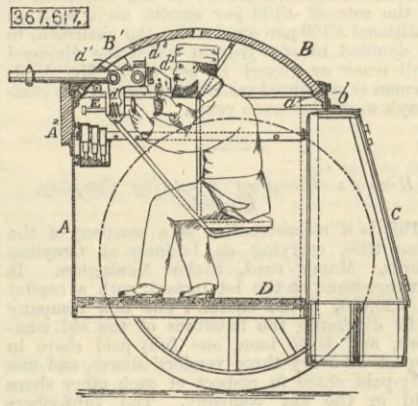
of a revolvable armour resting upon said shield or casing, a gun carried by said armour, a seat also carried by said armour, and a fixed platform or floor located at such distance from the seat as to be conveniently reached by the gunner's feet, substantially as set forth. (4) The combination, with a shield and a bearing ring supported thereby, of a revoluble cap or cover, rollers interposed between the edge of said cap and the bearing ring, and the gun carried by said cap, substantially as set forth. (5) The combination, with the metal shield or casing, the revoluble cap or cover, and the gun carried thereby, of the seat for the gunner suspended from said cap or cover, substantially as set forth. (6) The combination, with the sheet metal shield or casing A, the armour plate or ring A^2, secured to the top thereof, the bearing ring *a*, the superposed revoluble armour plate B, resting upon the bearing ring through the medium of rollers

367,617.

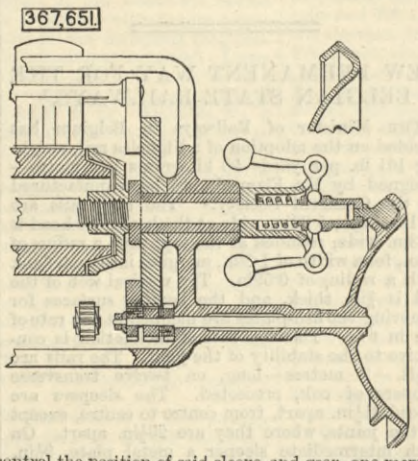


b, and the gun carried thereby, substantially as set forth. (7) The combination with a revoluble support for the gun, of a circular track or way, and an ammunition box having wheels resting upon said track, substantially as set forth. (8) The combination, with the shield or casing A, and the ground wheels A^1 of a gun, and a revoluble support surmounting said casing by which the gun is carried, substantially as set forth. (9) The combination of the brackets E, the bell-crank lever d^1, fulcrumed therein, the gun having trunnions bearing upon one arm of said lever, the segment *d*, formed on the other arm, and the worm engaging said segment, substantially as set forth. (10) The combination of the shield or casing A, having the door C at one side thereof, the revoluble top, the gun carried by said top, and the ground wheels A^1, supporting said shell or casing, substantially as set forth.

367,651. Electric Motor, *A. W. Meston, St. Louis, Mo.—Filed February 13th*, 1886.

Claim.—(1) In combination with the shaft, commutator carried thereby, and commutator brushes of an electro motor, a brush-supporting device pivotal about said shaft, a sleeve capable of longitudinal but not rotary movement relative to said shaft, governor arms and balls supported from said shaft and adapted to

367,651.

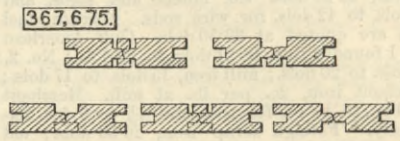


control the position of said sleeve, and gear, one member of which is carried by said sleeve and the other by an independent shaft having connection with the brush-supporting device, said gearing being made to engage so as to move the brushes in one or the other direction when said governor balls are moved, substantially as set forth. (2) In combination with the shaft, commutator, and commutator brushes of an electric motor, a yoke or disc supporting said brushes and having a toothed segment, a shaft having a pinion engaging with with said segment, a friction disc supported on said shaft, a second frictional member so supported as that its opposite faces shall engage with said disc alternately, and governor arms and balls having operative connection with the motor shaft and with said frictional member, substantially as and for the purpose set forth. (3) In combination with a motor shaft, commutator, and commutator brushes, a yoke or disc supporting said brushes, having a toothed segment, additional toothed segments fixed to said yoke or disc at the extremity of the first segment in separate planes therefrom, a centrifugal governor actuated from the motor shaft, a pinion operating shaft, gear connecting said shafts and controlled by said governor, and three pinions on said pinion operating shaft, one rigid on said shaft and the others loose thereon, but having oppositely turned clutch connection with said first pinion, the said pinions being adapted to engage with the toothed segments of the brush-supporting yoke or disc, substantially as set forth. (4) In combination with a motor shaft, commutator, and commutator brushes, a yoke or disc supporting said brushes, a shaft having operating connection with said yoke or disc, clutch mechanism for connecting said shaft with the motor shaft, and a centrifugal governor operated by said motor and controlling said clutch mechanism, substantially as set forth.

367,675. Art of Double-tongueing Boards, *S. J. Shimer, Milton, Pa.—Filed November 12th*, 1886.

Claim.—(1) The improvement in the art of double-tongueing a board during a single passage through the tongueing machine, which consists in cutting parallel grooves in both faces of the board, the lower cutting thereof following in sequence the upper cut thereof, and then cutting out the cores left standing between said grooves consecutively from above and below, with cutters shorter than the distance between the outer walls of opposite grooves, substantially as described.

367,675.



(2) The improvement in the art of double-tongueing a board, which consists in cutting parallel grooves in the one face of the board, then cutting parallel grooves in the opposite face of the board in alignment with the first-made grooves, then cutting the core or ridge out between one set of grooves, and then cutting the other core or ridge out, such sequence of cuts following each other as the board passes continuously through the machine, substantially as described.

367,734. Terminal for Electric Cables, *R. H. Widdicombe, Chicago, Ill.—Filed August 16th*, 1886.

Claim.—The combination, with the lead pipe of a telegraphic cable and the core of separately insulated conductors, of a metallic box united with the end of

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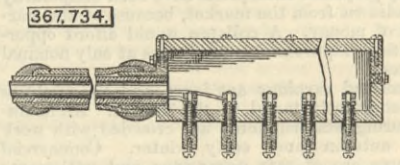
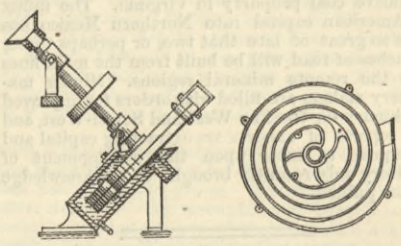


the lead pipe and provided with binding posts inserted through the box, said box being rectangular and provided with binding posts arranged upon one face of the box, and an opposite removable face for affording access to the interior connections, and when closed forming an air-tight and water-proof chamber at the end of the core, whereby the core may be protected from moisture, while connection may be made with the different wires at the binding posts outside the box, substantially as shown and described.

367,803. Pump, *J. H. Frenier, Rutland, Vt.—Filed January 27th*, 1886.

Claim.—The combination of a pump consisting of a wheel and a pipe rigidly connected with its centre and continuous to the point of final discharge at its upper end, both rotating as one and constructed with a constantly open and valveless passage which is spiral or helicoidal in the wheel, with a receiving mouth at the

367,803.

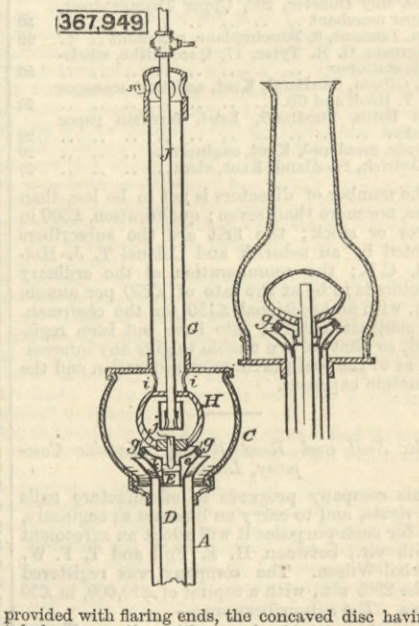


periphery, and continuous to the point of final discharge at the upper end of the pipe, the wheel being arranged to rotate in a plane oblique to the perpendicular with the pipe extending at an inclination therefrom, bearings for the pipe, and gearing whereby rotary motion is transmitted to the pipe and through the pipe to the wheel, substantially as herein described.

367,949. Regenerative Gas Lamp, *C. E. Bell, Greenfield, Ohio.—Filed September 1st*, 1886.

Claim.—(1) In a regenerative gas lamp, the combination of the tubes provided with flaring ends, the concaved disc having tubular connection with one of said tubes, the apertured ring inserted between said disc and one of said flaring ends, the heating chamber connecting by a tube with a transverse tube connecting with the space or chamber between said concaved disc and the flaring end of the inner tube, and the gas supply pipe entering the heating chamber, substantially as and for the purpose set forth. (2) In a regenerative gas lamp, the combination of the tubes

367,949.



provided with flaring ends, the concaved disc having tubular connection with one of said tubes, the apertured ring inserted between said disc and one of said flaring ends, the heating chamber connecting by a tube with a transverse tube connecting with the space or chamber between said concaved disc and the flaring end of the inner tube, the gas supply pipe entering the heating chamber, the globe with its support applied to the outer of the first-named tubes, and the chimney, substantially as and for the purpose set forth. (3) The combination, in a regenerative gas lamp, of the tubes A D, provided with flaring ends, the apertured ring *g*, concave disc *e*, tubes E *k j*, heating chamber H, the globe C, tube G, having opening *i m*, and the gas supply tube J, substantially as specified.