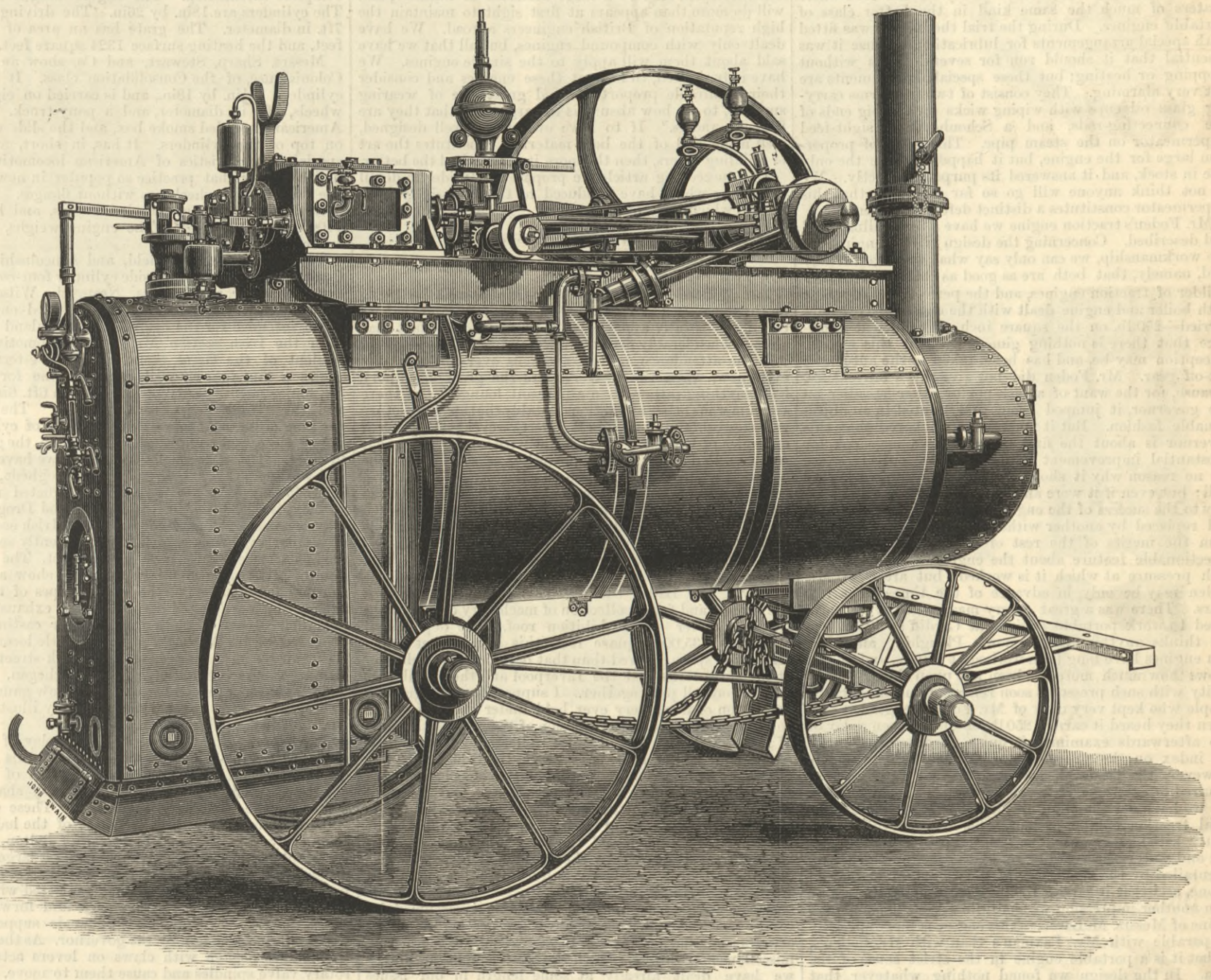
THE NEWCASTLE ENGINE TRIALS.

ALTHOUGH we are not yet in possession of all the data collected by the judges during the engine trials concluded last week in the showyard of the Royal Agricultural Society, we have sufficient to enable us to draw certain deductions which are not without value. We do not as yet know what was the weight of air used per pound of coal burned, nor the indicated horse-power, for the calculations have not yet been completed; and the grate areas which we have already given are those supplied to us by the competitors, and must not be regarded as minutely accurate, though no doubt they are near enough for all practical purposes. Before going further we must correct one or two inaccuracies which occur in the table setting forth the performance of the compound engines—inaccuracies due to hurry in going to press. In the thirty-second line of the table, on page 45, the mechanical time for Mr. Foden's engine is given as 4·583 hours. It should be 4·4583. In the same page, however, in the last column, line 8 from the bottom, the correct figures are given. In line 36 of the same table two errors will be found. The foot-pounds per pound of coal are given for Mr. Foden's engine as 782,241. The correct figures are 1,070,000. For Messrs. J. and H. McLaren, the foot-pounds per pound of coal are given as 1,071,608. They should be 949,852. These inaccuracies do not affect the statement of coal per brake horse-power, which is correctly given, and that they are erroneous will probably have been detected at once by our readers, who, having all the necessary data before them, have no doubt already made the necessary correction. It is of course clear that as Mr. McLaren's engine required 2·08 lb., while Mr. Foden's engine burned but 1·858 lb., the foot-pounds per pound of coal must be greater for it instead of less than was the case with Messrs. McLaren's engine as stated in the table.

One of the first points calling for consideration is the construction of the engines. In a word, how far, if at all, are they unfit for ordinary use? The word "racer" is applied as a term of ignominy to competing portable engines. It has long been used in that sense; and not a few persons may be led away with the idea that the engines exhibited were got up for a race and for nothing else; that, in fact, all good qualities have been sacrificed with the one object of saving fuel. Now, this is an entirely erroneous impression, and we think our readers will be disposed to admit as much before we have done. That an engine intended to be very economical of fuel must be different from an engine which is not economical, will be admitted at once; it is a self-evident proposition. It is with these differences, then, that we have to do, and whether they are or are not objectionable depends entirely on the standard which we set up. For example, a sensitive governor controlling the point of cut-off is known to be essential to the economical working of steam engines. Now, if a portable engine is wanted to do rough work—say, to drive a mortar mill for a builder or contractor—we concede at once that a first-class governor will be out of place. But are we to assume that engines which can be moved about from place to place on wheels are never to rise in quality above that which will satisfy the demands of a mortar mill? There can be but one answer to this question. There is not a builder of portable engines in Great Britain who would not feel insulted, and with reason, if he were told that his productions were fit for nothing better than driving mortar mills. We must assume, therefore, that by a far higher standard than this the portable or traction engine is to be judged. The use of the portable engine is no longer confined to driving thrashing machines. On the contrary, it is used for an infinity of purposes, such as dynamos, mills, sawing, pumping, &c. We find it used to an enormous extent in mining work, and usually under conditions which render the utmost economy of fuel imperative—as, for example, in the African diamond mines, whereat as much as £10 a ton has been paid for coal, and even then the value of the coal was not so much the question as the difficulty of getting it at any price. There are portable engines and portable engines; some are cheaper and less economical in fuel than others. But because cheap engines are built and sold, are we to say that dearer and better engines are not to be built? The best answer is to be found in the practice of the country. All makers of note or reputation build two classes of engine—the simple and the compound—and they have a demand for both; that is to say, high-class engines are wanted by the world quite as much as those of lower quality. It seems almost a waste of time to argue thus at any length; but we find it necessary to make this point perfectly clear, so persistent are the attempts which are made now, and always have been made, to disparage engines which have taken prizes in the showyards of the Royal Agricultural Society.

Holding, then, that the engines which have just competed at Newcastle are high-class machines, it only remains to be seen whether they possess elements of construction, material, or design which are objectionable even in a high-class engine. It is clear that for our present purpose we need not concern ourselves with any other engines than those of Messrs. Davey Paxman and Co., E. Foden and Sons, and J. and H. McLaren. These are the engines whose performance is noteworthy, and, dividing them into classes, we see how close they run each other. No more striking mode of comparison can be suggested than that based on the foot-pounds per pound of coal. In the simple class we find the following figures:—Paxman, 783,091; Foden, 774,782; McLaren, 773,388. Thus Paxman beat Foden by 8309 lb., and McLaren by 9703 lb.; while Foden beat McLaren by only 1394 foot-pounds. In the compound engines we have:—Paxman, 1,096,796, Foden, 1,070,000, and McLaren, 949,852 foot-pounds per pound of coal. Thus Paxman beat Foden by 26,796 and McLaren by 146,944 foot-pounds, while Foden beat McLaren by 120,148 foot-pounds. This, again, is very close work, and is very far in advance of anything ever before done with non-condensing engines. Let us see how far the Paxman compound engine deserves to be called a racer in the modern sense. We illustrate the engine below, so that our readers can judge to a certain extent for themselves. The boiler presents no peculiarities, save that it is more heavily stayed, as it has to carry 150 lb., than it would be if it carried 50 lb., the old commercial portable pressure. The fire-box is of the ordinary make. The only difference that we can discover is that instead of twenty-five tubes 3in. in diameter—the regulation number in old days for commercial 8-horse portables—it has fifty-three 2in. in diameter. As to the question of the extra cost of this modification we need say nothing, because we have already presupposed that the better class of engine must be dearer than the inferior class. The objection may be urged that the tubes will weigh more. Assuming that they are the same thickness and the same length in each case, we shall have twenty-five tubes 3in. in diameter outside. These may be taken to weigh about 3 lb. the foot run, while a 2in. tube will weigh 2 lb. the foot run. We have for the twenty-five tubes $25 \times 7 \times 3 = 525$ lb.; while for the compound engine we have $53 \times 7 \times 2 = 742$ lb., or 217 lb. against the compound engine. How far an increase of 1 cwt. 3 qr. 21 lb. is prejudicial in an engine we must leave our readers to say for themselves. The heating surface is augmented, thanks to the extra weight, from about 131 square feet to 194 square feet; but besides this, it is rendered very much more efficient because the escaping products of combustion are split up into fifty-three columns, each with a cross-section of less than four circular inches area, instead of twenty-five columns with a cross-section of about eight circular inches area. Apart from the increase in the number of tubes we find nothing abnormal about the boiler. That it cannot be a delicate affair, easily put out of order, or dangerous, is proved by the circumstance that it was to work at so high a pressure as 150 lb. per square inch.

Turning now to the engine, we find that a solid frame of I iron is secured to wrought iron brackets rivetted to the boiler. This is intended to spare the boiler from the racking stresses to which it is exposed when the cylinders are bolted to it at one end and the crank shaft saddle at the other. To this frame are secured the cylinders and the pedestals of the crank shaft, and the brackets carrying the guide bars and the governor. In all this we fail to find any feeble, gimcrack designing; on the contrary, we



MESSRS. DAVEY, PAXMAN, AND CO.'S PRIZE COMPOUND ENGINE.

see nothing but excellent and skilful mechanical engineering. If we examine the crank shaft and its bearings we shall find them of ample dimensions. The fly-wheel balances the cranks. The slide valves present nothing unsound, nor do the excentrics. The automatic governor gear may be regarded, perhaps, as a complication; but it is none the less certain that automatic governors are freely used in engines that are not called racers, but ordinary commercial engines; and if a result as good as that got by Mr. Paxman can be got by simple means, well and good. We can only say that we are not aware of any device with fewer parts applicable to a portable engine which gives the same result. But whether this is so or not, the fact remains that about the automatic gear there is nothing delicate or likely to wear out in a hurry. It is an ordinary weighted governor, driven by mitre wheels and a belt in the usual way, and working a link up and down on a die block instead of operating a throttle valve. There is a feed-water heater fitted to this engine, which consists of lengths of copper pipe put in the exhaust steam. It is quite possible—nay, we are certain—that in process of time these tubes will choke up with deposit. If this circumstance is to tell against the use of heaters, then the great majority of portable engine builders are sinners in the same direction, for they all use feed-water heaters of much the same kind in the better class of portable engines. During the trial the engine was fitted with special arrangements for lubrication, because it was essential that it should run for several hours without stopping or heating; but these special arrangements are not very alarming. They consist of two iron arms carrying glass oil cups with wiping wicks for the big ends of the connecting-rods, and a Schonheyder's sight-feed impermeator on the steam pipe. This is out of proportion large for the engine, but it happened to be the only size in stock, and it answered its purpose perfectly. We do not think anyone will go so far as to say that this impermeator constitutes a distinct defect in the engine.

Mr. Foden's traction engine we have already illustrated and described. Concerning the design of this engine and the workmanship, we can only say what we have already said, namely, that both are as good as that of any other builder of traction engines, and the perfect way in which both boiler and engine dealt with the enormous pressure carried—250 lb. on the square inch—is sufficient assurance that there is nothing gimcrack about this engine. Exception may be, and has been, taken to the automatic cut-off gear. Mr. Foden did not give this a fair chance, because, for the want of a dash-pot or other steadier on the governor, it jumped about and hunted in an objectionable fashion. But it must be remembered that this governor is about the first made, and we may look for substantial improvement in future. For ourselves, we see no reason why it should not be made to work very well; but even if it were an entire failure, it is not necessary to the success of the engine, and it might be removed and replaced by another without in any way detracting from the merits of the rest of the design. The most objectionable feature about the engine is the extremely high pressure at which it is worked; but after all, Mr. Foden may be only in advance of the times by a few years. There was a great outcry made when it was proposed to work portable engines at Cardiff at 80 lb. No one thinks anything of this now. Ploughing and traction engines have long been worked at 170 lb., and no one knows how much more has been put upon them. Familiarity with such pressures soon renders them acceptable. People who kept very clear of Mr. Foden's engine at first when they heard it carried 250 lb., might be seen a day or two afterwards examining it quite unconcernedly while the index on the pressure gauge stood close to 300 lb. However, the trials all go to show that 250 lb. is not required to get as good a result as that got by Mr. Foden, and we have not the slightest doubt that at 150 lb.—the usual traction engine pressure—his will prove an eminently satisfactory machine, quite capable of saving in coal and water the cost of any extra repairs which may be entailed by the fact that it has two cylinders instead of one, and that it carries 150 lb. instead of 50 lb.

In another impression we shall illustrate the compound engine of Messrs. McLaren. This engine is more specially comparable with Mr. Paxman's than with Mr. Foden's, in that it is a portable engine in the strict sense of the term. In the design we found nothing whatever that constitutes a racer in the invidious sense. The boiler is of the ordinary type, save that it is a little longer than those of some makers. What we have said concerning the tubes in the Paxman boiler applies here. They are 52 in number and 2in. diameter. The boiler is well stayed and well made in every respect. Nothing flimsy or likely to get out of order. The cylinders constitute, as we have said, one casting, of a very perfect kind, and designed with extreme ingenuity and skill. The crank shaft is heavy and well proportioned, and carried in flexible bearings, tied to the cylinders by stays, so as to spare the boiler racking strains. There is in all this nothing to which exception can be taken. It is true that there is an automatic cut-off, but this consists of a grid-iron slide working on the back of the main slide, and actuated itself by a Turner-Hartnell governor on the crank shaft, and these governors are now sold by Messrs. Turner, of Ipswich, at about £6 10s. complete and ready for use. These have only to be examined by any engineer to render it clear that they may be put with safety in the hands of any labourer who can drive an engine.

It appears, then, that all arguments which can be urged against the competing engines tried at Newcastle, based on the ground that they are delicate machines unfit for hard work, must fall to the ground. They really come to this, that the best of the engines do not represent ordinary commercial practice. This is quite true in one sense, and in one sense only. They represent commercial practice of one kind, and the Alnwick Company's engine may be taken to represent another. Both classes find purchasers, but it is beyond dispute, we think, that the duty of the Royal Agricultural Society is not to stimulate the production of inferior engines by awarding prizes to machines which repeat the practice of twenty-five years ago, but to promote in every possible way the production of better and still better portable engines. We believe that certain of the firms who signed a well known circular letter now feel that they have made a mistake; and already rumour asserts that a demand will be made for another trial at an early date, possibly next year, in which all may take part. The effect of the recent trials will soon make itself felt on foreign agents, who are not enamoured of old-fashioned practice. It would be difficult indeed to name an eminent firm that does not already build compound engines which, it is at least asserted, are just as good as those tested. The fact that the makers of them have shrunk from submitting them to public trial will not have good results, and this is we think to be regretted. The advantage lies now with Messrs. Paxman, Foden, and McLaren, and they thoroughly deserve that it should be so. It is true that the last two firms have not got prizes, but the splendid performance of their engines, and the high quality of design and workmanship which have secured these results, convert their failure into a triumph, and the three firms we have named stand to-day as the proved makers of the best engines of their kind in the world. This should, and no doubt will, lead to a large accession of business, and will do more than appears at first sight to maintain the high reputation of British engineers abroad. We have dealt only with compound engines, but all that we have said about them will apply to the simple engines. We have only, indeed, to look at these engines and consider their admirable proportions and great size of wearing surfaces, to see how absurd is the argument that they are "merely racers." If to have everything well designed, well made, and of the best materials constitutes the art of building racers, then the more it is practised the better.

In a succeeding article we propose to consider in detail the causes which have conduced to the excessively high results which have been obtained.

THE MANCHESTER EXHIBITION.

The Manchester Exhibition may claim with justice to be the finest seen in this country since 1862, and that its excellence is fully appreciated is proved by the fact that already considerably over a million and a-half have visited it. The attendance indeed averages over 16,000 a day even now, when the heat renders the great machinery hall anything rather than a pleasant lounge. But there are numerous other attractions, notably the thirteen picture galleries, containing the finest collection ever got together of examples of British art. It is not with art, however, that we have to do, but with engineering as set forth in the Great Machinery Hall, which much resembles in shape, and the importance of its contents, the Machinery Hall in the Antwerp Exhibition, the principal exhibits in which we described pretty fully at the time. On Saturday afternoon the Manchester Association of Engineers visited the building, and we quote the following passage from the address of Mr. Alderman H. Bailey, president of the society. Mr. Bailey said:—"This Exhibition contains the largest and finest collection of machinery ever brought together under one Exhibition roof. The department comprises 135,000 square feet, this being about 60 per cent. more space covered than that occupied by machinery at the Inventories and the Liverpool and the Edinburgh Exhibitions all put together. I suppose that the greatest exhibition of machinery ever held under one roof in this country before was on the occasion of the great Exhibition of 1862; and yet this Jubilee collection of machinery covers fully 50 per cent. more space than the Exhibition of twenty-five years ago. The committee have had a heavy responsibility in making the selections. But we know that the chief manufactures of this district are well represented. The engines of Bolton and Hyde, the textile machinery of Oldham, and the mechanical tools of Manchester are represented by the finest examples, triumphs of skill and design. Even Salford is represented in a small way at this Exhibition."

A very large portion of the building is occupied by textile machinery, with which we are dealing in special articles; our purpose now is to say something concerning miscellaneous exhibits. With the electric light machinery we have dealt already at some length in our issues for May 6th and 20th, and we need not refer to it further at present. Several firms have sent identically the same class of machinery to Newcastle as that which they exhibit at Manchester, and as it has been fully described already in our notices of the Newcastle Exhibition, we need not say more about it here.

The most important exhibits in the machinery at rest department are, no doubt, the locomotives. Mr. Webb, of Crewe, shows the old Trevithick stationary engine, which he found in Hereford, and bought in 1883. It has a cast iron boiler and ⊃ flue, the fire being made in one of the legs of the ⊃, while the chimney is attached to the other. The cylinder is sunk into the boiler, and the piston-rod carries a long crosshead straddling across the boiler and working the crank shaft below by two connecting rods. The steam is distributed by a four-way cock, worked by a plug rod. Close to this is the full-size model of the Rocket, which was shown last year at Liverpool, and was illustrated in The Engineer for Feb. 25th. Mr. Webb's principal exhibit is a new type compound goods tank engine. The two outside high-pressure cylinders are 14in. by 24in., and the single low-pressure inside cylinder is 30in. by 24in. The engine is carried on eight wheels, the two leading wheels, about 3ft. 6in. in diameter, being just in front of the cylinders. The six-coupled driving wheels are 5ft. 2½in. diameter, and are arranged with two axles behind the fire-box under the tank and foot-plate, and one axle in front of the fire-box. This axle is driven by the low-pressure cylinder, the other pair of axles by the high-pressure cylinder. This is a very fine and well-designed engine, a distinct departure not only from existing practice in general, but from Mr. Webb's ordinary compound practice in particular. The tank is fitted with a Ramsbottom scoop, and is of large capacity—in fact, the engine is a cross between the ordinary tank and tender engines, partaking much more of the nature of the latter than it does of that of the former. The Lancashire and Yorkshire Railway Company shows a passenger engine with some peculiarities in the way in which the carrying springs are arranged. We have engravings of this engine in preparation, and will therefore postpone a description. It was built by the Vulcan Foundry Company, of Newton-le-Willows, and is a very satisfactory piece of work.

Standing almost side by side with the Rocket is a little engine, the Dot, for the 2ft. gauge, constructed by Messrs. Beyer, Peacock, and Co., for use in ironworks, &c. The same firm show an engine built for the Dutch Government, with four-coupled wheels and a very long wheel base, intended for working the express traffic between Flushing and Germany. This engine has the flat-topped Belpaire fire-box so much in favour on the Continent, and is in most respects similar to the express engines built by the same firm for the same service, and illustrated in our pages on the 4th of March, 1881. The fact that the Dutch Government continue to order these engines in England is sufficient proof that they have given complete satisfaction. The engine weighs full 39 tons. The cylinders are 18in. by 26in. The driving wheels are 7ft. in diameter. The grate has an area of 23·5 square feet, and the heating surface 1324 square feet.

Messrs. Sharp, Stewart, and Co. show an engine for Colonial use, of the Consolidation class. It has outside cylinders 15½in. by 18in., and is carried on eight coupled wheels, 3ft. in diameter, and a pony truck. It has the American extended smoke box, and the slide valves work on top of the cylinders. It has, in short, many of the special characteristics of American locomotive practice, which render that practice so popular in new countries; the two central wheels are without flanges. The tender is carried on two four-wheeled bogies, and holds about 1400 gallons of water. The engine weighs, in working order, about 28 tons.

The Manchester, Sheffield, and Lincolnshire Railway Company exhibits a fine inside cylinder four-coupled bogie express engine, and Messrs. Nasmyth, Wilson, and Co. have close by a well-designed four-coupled engine with a bogie, intended for the Midland New Zealand Railway.

In the Irish section Mr. Ivatt, locomotive superintendent of the Great Southern and Western Railway, shows a fine four-coupled bogie engine for the Irish 5ft. 3in. gauge. The driving-wheels are 6ft. 6in. diameter, and the cylinders are 18in. by 24in. The weight in working order is 39 tons 4 cwt. A pair of cylinders cast in one piece, and unfinished, is shown on the ground just in front. This is as good a casting as we have ever seen, and was made by Mr. Grendon, of Drogheda, who built in 1845 the first engine ever constructed in Ireland, namely, the Victoria, for the Dublin and Drogheda Railway, who shows in another part of the Irish section a pair of similar cylinders, which have evidently seen a great deal of service and are still quite perfect. The smoke-box door of Mr. Ivatt's engine is open to show a somewhat unusual arrangement of the ejector pipes of the vacuum brake, which are placed parallel to the exhaust pipe and get their steam through the cylinder casting. In the Irish section is also shown a curious little locomotive constructed by Mr. Spence, of the Cork-street Foundry, Dublin, to the designs of Mr. S. Geoghegan, of Dublin. This engine is intended for use on narrow gauge railways or tramways, and, as we shall probably illustrate it, we shall not further describe it now.

It might be imagined that the display of stationary engines would have been very large, but this is not the case. The principal exhibits in this class of machinery are the four engines which drive the lay shafts giving power to the machinery in motion. These engines all stand close together, near the centre of the hall. One of them is by Messrs. J. and E. Wood, of Bolton. It is like its fellows, a horizontal engine, driving a large fly-wheel grooved to take six cotton ropes. The valves are worked by a modified Corliss gear; a flat bar fitted with notches at either end is caused to move back and forward by an excentric. The weight of the bar is supported on a balanced cam, acted on by the governor. As the bar moves the notches engage with claws on levers actuating the rotary valve spindles and cause them to move. The cam throws the plate out of gear with the levers, according as it is shifted by the governor. This is a very simple device with few parts, and works very well. Beside the engine stands one of the speed recorders of Messrs. Goodbrand and Holland, of Manchester—Macbeth's patent. The paper is placed on the inside of a drum; an arm carrying a pencil is caused to revolve by a clock, and if the speed of the engine were uniform it would draw a straight horizontal line on the paper. A sensitive governor in the bottom of the case carrying the drum is made to revolve by the engine, and causing the pencil arm to rise or fall, the pencil describes a line which indicates the variations in speed of the engine.

Another of the four engines is a fine double compound, that is to say, two horizontal engines on independent bed plates driving the same crank shaft. This is by Messrs. Daniel Adamson and Co., and is an admirable piece of work. The high-pressure cylinder is fitted with modified Corliss gear almost identical with that shown applied to a horizontal engine in the Inventions Exhibition by the same firm. The fly-wheel is grooved, and drives six ropes. The third engine is by Messrs. J. Musgrave and Co., of Bolton. It is a compound engine with a modified Corliss gear of simple construction, which, however, it would be very difficult to explain without drawings. The grooved fly-wheel carries ten ropes.

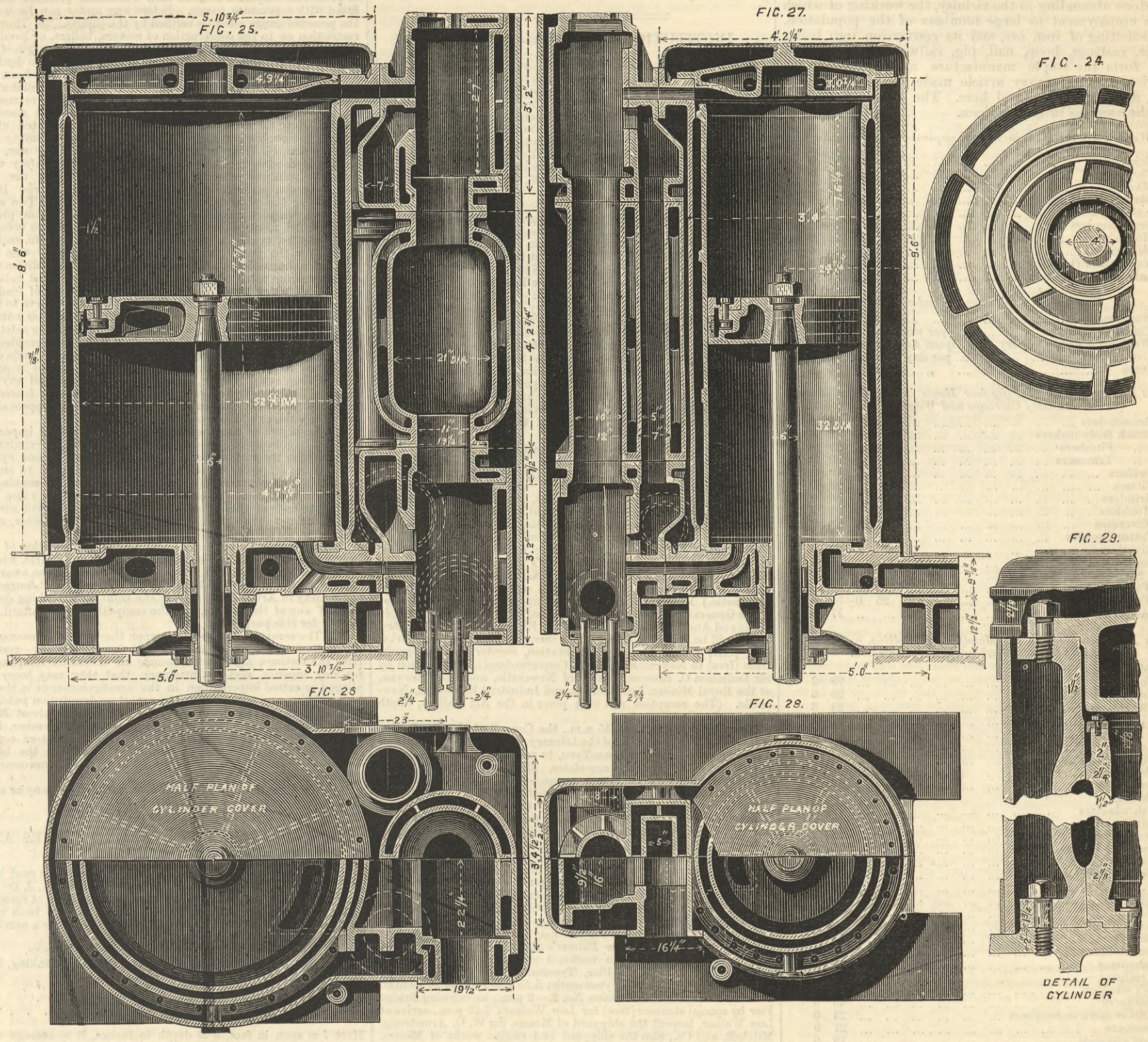
The fourth engine is a very fine example of Messrs. Hick, Hargreaves, and Co.'s well-known single cylinder Corliss engines. The construction of these engines is so familiar to engineers that we need not give one word of description.

Messrs. Bentley and Ford, of Longton, in Staffordshire, show a well-made horizontal engine—the "Portland"—

COMPOUND VERTICAL ROTATIVE PUMPING ENGINE—CYLINDERS.

SOUTHWARK AND VAUXHALL WATERWORKS, HAMPTON.

(*For description see page 69.*)



fitted with the firm's patent automatic expansion gear. The main valve is cylindrical and hollow, with oblique ports, and is worked in the ordinary way by an excentric. The cut-off valves are placed inside the main valve, and are cut to the same angle as the main valve, and are worked by a second excentric. The governor is connected to the cut-off valve spindle in such a way as to twist it axially at the same time as the excentric is causing it to travel backwards and forwards through the main valve. As the governor rises or falls, the expansion valve cuts off sooner or later, the variation of cut-off being from one-sixteenth to three-fourths of the stroke of the engine.

Gas engines are shown in numbers, the principal display being by Messrs. Crossley, who have not only several in the Machinery Hall, but, in the yard outside, a shed containing a complete Dowson gas plant at work. Messrs. Crossley, however, have not the field all to themselves. The Stockport engine may be seen working with great regularity and in perfect silence.

Messrs. Henry Wallwork and Co., of Charter-street, Manchester, show Sturgeon's gas engine, which works very satisfactorily, as far as can be judged from what is to be seen in an Exhibition. As this engine is not very well known, we may describe it a little fully. On the mixed charge of gas and air being ignited, the expansive force is received equally and simultaneously upon two pistons, the one moving up and the other down in a vertical cylinder. Each of these pistons separately and independently imparts this force to one of a pair of cranks on a double crank shaft, to which it is connected by means of a sway beam and connecting-rod. The cranks on the double crank shaft are set opposite to each other. It will thus be seen that, not only are the principal working parts of the engine perfectly balanced, but the expansive force of the charge is received equally and in opposite directions upon the crank shaft, by which means the crank shaft and bearings are relieved from the detrimental effects of a constant repetition of sudden shocks being thrown on to them all in one direction. The charge is drawn into a horizontal cylinder, in which runs a very light piston, actuated by one of the cranks, which on its return stroke delivers the charge into the working cylinder, midway between the two pistons. The admixture of gas and air is thereby effected. This charge is then rapidly compressed and ignited, the shaft receiving one impulse for every revolution. The expansion of the charge is carried down almost to atmospheric pressure before opening the exhaust port, thereby extracting all the good that can be got out of the gas, and rendering the exhaust practically silent. The pistons and slide valve are each oiled independently by means of Wallwork's patent automatic lubricator, which feeds the oil drop by drop as required by these parts. All other parts requiring lubrication are furnished with capacious oil-cups. All parts can be readily got at. The pistons can be slipped out of the cylinder and put back in a few minutes, there being no cylinder cover to take off or joints to undo and make good again. The shaft is carried out a sufficient length on both sides of the bed, so that the pulleys may be put on either side of the engine to suit the convenience of position. The necessary strains are distributed through a number of bearings, each of which bears its proportion of the work to the relief of other parts. The result claimed is that wear and tear are thus diminished, and the durability of the engine greatly increased. This engine runs in perfect silence at a very high speed.

The Dougill patent gas engine is shown by the makers, Messrs. Hindle, Norton and Co., of Oldham. This is a simple horizontal engine, but it has some peculiarities in the valve gear which we could not hope to make intelligible without drawings.

The display of steelwork of all kinds is remarkably fine. Nothing like it has before appeared in England. The most noteworthy exhibits, at all events the largest, are those of Whitworth and Co.; they include a magnificent steel propeller shaft 18¼in. diameter, with a hole 10in. diameter through its entire length, and a complete set of steel forgings for a 68-ton breech-loading gun. The most remarkable exhibit is, however, a boiler hoop of steel 14ft. in diameter, 5ft. wide, and 1in. thick, made from a single steel ingot. This ingot was cast solid, a hole was then driven through it, and it was gradually swaged by hydraulic pressure into the boiler hoop exhibited. The swaging was done from the inside, the principle involved being very much like that by which Mr. Haswell, of Vienna, "chewed"—we can think of no more expressive word—iron blooms into shape a quarter of a century ago by means of his great hydraulic forging press. If such hoops as that shown can be made at a price not too great, they cannot fail to be freely adopted by marine engine builders.

Messrs. Jessop make a good display of steel castings, but nothing very large. They show a photograph of a flywheel, 21ft. 3in. in diameter, to which is connected a crucible steel spur rim, 16ft. in diameter and 16in. wide, with a pitch of 5½in., made for Messrs. Scott and Hodgson, of Guide Bridge. This is a remarkable piece of work. The mere statement of the dimensions gives no idea of the massive character of the wheel.

The Hadfield Steel Foundry Company's stand will not be passed by without attracting the attention of the visitor. It contains specimens of nearly all the articles for which the firm enjoys a well-deserved reputation.

Messrs. Bolckow, Vaughan, and Co. have a fine trophy, showing specimens of ore and pig iron, spiegel, and finished work. Among the last may be mentioned a very large steel pinion.

The Steel Company of Scotland has a small but beautiful trophy.

The visitor should by no means overlook a small but very interesting exhibit made by the Credenda Cold-drawn Steel Tube Company. The tubes exhibited are of such beautiful workmanship that they resemble finished rifle barrels more than anything else. They are of all sizes, from several inches in diameter down to a fourth of an inch, and appear to be of a material which will do anything rather than split or crack.

WATER POWER FOR MILLS.—In our last impression a water wheel was described as erected for Mr. W. R. Mallet, of Exwich, near Exeter, by Messrs. Bodley Brothers. We are, however, informed that the wheel was designed by Mr. Alfred Bodley, and constructed and erected by Messrs. Taylor and Bodley, of Exeter.

WAGES IN GREAT BRITAIN.

No. XIII.

Wolverhampton.—Wolverhampton being situate nearly in the centre of the great Midland mining district, derives its prosperity from the extensive beds of coal and ironstone abounding in the vicinity, the working of which gives employment to large numbers of the population. The smelting of iron ore, and its conversion into boiler plates, castings, hoop, nail, pig, railway, rod and sheet iron, form the staple manufacture and trade of the district. Almost every article made from brass, iron, steel, and tin, is produced here. The labour conditions are the same as in Birmingham.

Wages Paid per Week in Wolverhampton—General Trades.

	s.	d.
Bricklayers	34	0
Carpenters	33	9
Masons	35	0
Blacksmiths	34	0
Strikers	22	0
Brassfounders	32	0
Horseshoers	22	0
Millwrights	32	6
Nailmakers (hand)	16	0
Labourers	21	6

Wages Paid to Members of Trades Unions.

Stonemasons ... per hour	0	8
Tin-plate Workers ... per week	30	0—42 0
West Bromwich, Oldbury, and Tipton Association of Miners ... per day nominal	3	4
Ditto ,, actual	4	2

Wages Paid per Week of Fifty-four Hours in the Manufacture of Railway Carriages and Wagons.

Brasscasters	28	0
Coach Body-makers	32	3
,, Finishers	29	10
,, Trimmers	30	0
Drillers	19	4
Fitters	26	0
Grinders	26	9
Moulders	27	0—34 9
Olivermen	28	9
Patternmakers	33	9
Rivetters	24	6
Smiths	32	4
Strikers	21	9
Wagon-makers	30	5
Wood Machinist	25	0—36 6
Labourers	17	6

Wages Paid per Week in the Manufacture, Rolling, and Smelting of Iron in the neighbourhood of Wolverhampton.

Blast furnaces :—		
Chargers	29	2
Enginemen	29	6
Fillers, coke	24	3
,, lime	22	11
,, mine	23	1
Keepers	36	0
Pig weighers	34	0
Slaggers	26	9
Labourers	17	6
Puddling :—		
Ash wheelers	17	6
Bar drawers	19	6
Coal unloaders	19	6
Hammer drivers	18	6
Helpers	17	8
Metal breakers	17	9
,, wheelers	17	6
Puddlers	29	3
Rollers	29	3
Roll turners	29	3
Shinglers	58	0
Stocktakers	19	6
Labourers	16	8
Bar rolling :—		
Ash wheelers	17	8
Bloomers	48	6
Bolters down or roughers	24	0
Chargers	21	9
Coal wheelers	19	6
Cutters down	24	0
Furnacemen	29	2
Heavers over or hookers	19	6
Rollers	48	6
Roll turners	29	2
Labourers	16	8
Hoop-rolling :—		
Ash wheelers	17	6
Boilermen	19	6
Bolters down	24	3
Bundlers	24	3
Catchers	17	0
Coal wheelers	19	6
Cutters down	24	3
Enginemen	29	2
Fitters	24	3
Furnacemen	29	2
Helpers—boys	5	9
Rollers	48	6
Smiths	24	6
Stocktakers	24	3
Labourers	16	8
Plate and sheet rolling :—		
Bloomers	68	0
Bolters down or roughers	24	3
Chargers	19	6
Cutters down	24	3
Furnacemen	38	9
Heavers over or hookers	17	6
Pilers	19	6
Plate loaders	19	6
Rollers	68	0
Shearers	38	9
Stocktakers	29	2
Wheelers	19	6
Weighers	29	2
Labourers	17	0

Wages Paid per Week in Collieries in the Neighbourhood of Wolverhampton.

Banksmen	—		18	9
Enginemen	25	3	29	2
Firemen	—		16	8
Helpers up	—		21	6
Hewers	—		22	0
Overmen	43	8	48	6
,, deputy	29	2	34	0
Platelayers	—		16	9
Shifters—master	—		21	6
,,	—	—	18	9
Smiths	—		23	6
Switch keepers	—		13	3
Tunnellers	—		20	6
Wastemen	—		21	6

Rent averages 4s. 9d. per week: Coal 12s. per ton, and gas 2s. 4d. per 1000 cubic feet.

INSTITUTION OF NAVAL ARCHITECTS.

The meetings of the summer session at Newcastle-on-Tyne and Sunderland, 1887, will be held as follows:—On Tuesday, July 26th, at the Hall of the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne, at 10 a.m. punctually. On Wednesday, July 27th, at the Hall of the Subscription Library, Fawcett-street, Sunderland, at 10 a.m. punctually. On Thursday, July 28th, at the Hall of the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne, at 10 a.m. punctually. On Friday, July 29th, excursion to Consett, to visit the Consett Iron and Steel Works. The Right Hon. the Earl of Ravensworth, President of the Institution, will occupy the chair.

The following programme of proceedings has been issued:—

Tuesday, July 26th.—Morning meeting at the Hall of the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne, at 10 a.m. punctually. Official Reception of the Institution by the President and Council of the North-east Coast Institution of Engineers and Shipbuilders, the Mayor of Newcastle, and the General Reception Committee. Address by the President. The following papers will then be read and discussed:—(1) "On the Application of Hydraulic Pressure to Naval Gunnery," by the Right Hon. Lord Armstrong, C.B., D.C.L., F.R.S. Vice-President, and Mr. J. Vavasseur, Associate; (2) "Recent Developments in Marine Engineering," by Mr. Frank C. Marshall, Member of Council. 12.30 p.m., leave by special conveyances (free) from the Hall to Elswick; 1 p.m., Luncheon at Elswick on the invitation of Messrs. Sir W. G. Armstrong, Mitchell and Co.; 2.15, inspection of Messrs. Sir W. G. Armstrong, Mitchell and Co.'s Works and Shipyard, at Elswick; 4.30 p.m., return from Elswick by special conveyances to Central Station, Newcastle. The evening of this day will be without engagements.

Wednesday, July 27th.—Morning meeting at the Hall of the Subscription Library, Fawcett-street, Sunderland, at 10 a.m. punctually. 9.15 a.m., a special train (free) will leave the Central Station, Newcastle, for Sunderland. Official Reception of the Institution by the Mayor, Shipbuilders, and Engineers of Sunderland. The following papers will be read and discussed:—(1) "On Some Recent Experiments with Basic Steel," by Mr. W. H. White, Director of Naval Construction, Vice-President; (2) "On the Present Position Occupied by Basic Steel for Shipbuilding," by Mr. B. Martell, Chief Surveyor to Lloyd's Register of British and Foreign Shipping, Vice-President. (N.B.—The debate on these papers will, if necessary, be resumed on Thursday morning, at Newcastle.) 12.45 p.m., Luncheon in Sunderland, on the invitation of the General Committee; 2 p.m., the party will drive to the Chain Cable and Anchor Testing Works of the River Wear Commissioners, which will be seen in operation, and thence to view the Pier Works; 5.20 p.m., return from Central Station, Sunderland, by special train (free) to Newcastle; 8 p.m., Conversazione and Reception by Sir Benjamin C. Browne, Mayor of Newcastle, and Lady Browne, at the Royal Mining, Engineering, and Industrial Exhibition, Newcastle. (The reception will take place in the Art Gallery, South Court. Evening dress.)

Thursday, July 28th.—9.45 a.m., the Council of the Institution will meet in the small room of the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne, to recommend the election of candidates as members and associates. Members having candidates to bring forward for election are requested to send their proposal forms to the secretary as soon as possible. 10 a.m., meeting of the members at the hall of the Literary and Philosophical Society, Westgate-road, Newcastle-on-Tyne, for the election of members and associates, and for the transaction of other formal business. The debates on Mr. W. H. White's and Mr. B. Martell's papers will, if necessary, be resumed. The following paper will then be read and discussed: "Tyne Improvements," by Mr. P. J. Messent, Engineer to River Tyne Commissioners. 12.30 p.m., luncheon in the Town Hall, Newcastle-on-Tyne, on the invitation of the General Committee. Excursion No. 1.—1.50 p.m., leave Central Station by special train (free) for Jarrow, or leave Swing Bridge Pier by special steamer (free) at 2 p.m., for Jarrow, as may be hereafter arranged; 2.30 p.m., arrive at Messrs. Palmer's Shipbuilding and Iron Company's Works, inspect the works; 4 p.m., depart by steamer; 4.30 p.m., arrive at North Pier, Tynemouth; 5.15 p.m., return by special train (free) from Tynemouth; 5.35 p.m., arrive at Central Station, Newcastle. Excursion No. 2.—2 p.m., leave Swing Bridge Pier by special steamer (free) for Low Walker; 2.20 p.m., arrive at Low Walker, inspect the shipyard of Messrs. Sir W. G. Armstrong, Mitchell, and Co., also the shipyard and engine works of Messrs. Wigham, Richardson and Co.; 3.45 p.m., depart from the latter yard; 4.30 p.m., arrive at the North Pier, Tynemouth; 5.15 p.m., return by special train (free) from Tynemouth; 5.35 p.m., arrive at Central Station, Newcastle; 7 p.m., dinner of the Institution at the Newcastle Exhibition. Tickets, 7s. each, exclusive of wine; morning dress; tickets will be paid for at the dinner; members are at liberty to invite their friends to the dinner. Two excursions are set down for Thursday. Members can choose which they will take. Members going to Jarrow can, if they desire, return by ordinary train to Newcastle (1st class, 1s.). Members going to Low Walker can, if they desire, return by ordinary train to Newcastle from either Low Walker or Wallsend Stations (1st class fare, 7d.).

Friday, July 29th.—9.55 a.m., leave Central Station, Newcastle, for Consett by special train (free). Arrive at Consett, and inspect the iron and steel works of Messrs. the Consett Iron Company. Luncheon by invitation of the Consett Iron Company. 2.50 p.m. or 3.40 p.m., return by special train (free) to Newcastle.

TRIALS OF MOTORS FOR ELECTRIC LIGHTING.

1887-8.

The form of application for entry of motor in these trials has been sent out by the Secretary of the Society of Arts, with the revised conditions.

The Council of the Society of Arts are prepared to award four gold medals and four silver medals for prime motors suitable for electric light installations. The medals will be awarded on the results of practical tests, the conditions of which are as follows:—

(1) The motors will be divided into two classes, A and B. Two gold and two silver medals will be allotted to each class. A—Motors in which the working agent is also produced. Steam: Ordinary portable or semi-portable non-condensing engines; ordinary portable or semi-portable condensing engines. Gas: Coal gas or water gas with producer, hydrocarbon vapour, liquid hydrocarbon. B—Motors to which the working agent must be supplied. Steam: Detached engines, non-condensing, without boilers; detached engines, condensing, without boilers. Gas: Engines worked by illuminating or other gas. Hydraulic: Water motors. Air: Compressed air motors; exhaustion motors.

(2) Each class will be subdivided into two groups—those declared to develope not more than 10-horse power, and those which will develope more than 10-horse power and less than 20-horse power. Each motor will be worked at or about the power at which it is entered. [The horse-power herein mentioned is equivalent to 33,000 lb. raised one foot high in one minute, as measured on the brake.]

(3) For 4-horse power and under the entrance fee will be £10; above 4-horse power, the entrance fee will be £2 10s. per horse-power. The fees to be paid on entry.

(4) No competition will be held unless ten motors at least are entered.

(5) In case of no competition being held the entrance fee will be returned.

(6) The Council reserve the right of refusing any entry.

(7) All engines and boilers must be fitted up in accordance with the regulations of the Royal Agricultural Society, viz.:—(*a*) All motors or producers subjected to more than a nominal pressure must be fitted with a pressure gauge. Before any motor can be worked, the pressure gauge must be verified by the judges. (*b*) There is no restriction as to the construction of motors, boilers, or producers, but the judges must be satisfied that the bursting strength of them is at least four times the working pressure, and that a hydraulic test of one and a-half times the working pressure has been satisfactorily applied, if considered desirable. (*c*) Each exhibitor must declare the greatest pressure at which he proposes to work his motor. (*d*) No old boilers, that is, boilers that have manifestly been at work for a considerable time, will be admitted without special thorough examination and a certificate of safety from the judges. (*e*) Each boiler, of whatever form or size, must be provided with the following mountings:—Two safety valves, each of sufficient size to let off all the steam the boiler can generate, without allowing the pressure to rise 10 per cent. above the pressure to which the valve is set. Two sets of gauges for ascertaining the water level. One steam pressure gauge, which must be tested and verified by the judges before the boiler can be used. A ½in. cock, terminating in a ½in. male gas thread, for the purpose of receiving a testing pump. One check feed valve, immediately attached to the boiler, in addition to the ordinary pump valve, whenever the feed is introduced below the lowest safe water level, or where there is a length of feed pipe between the engine and boiler. (*f*) The judges reserve to themselves the power of affixing any gauges that the peculiar nature of the machinery may call for, with the object of ensuring safety and of obtaining information. (*g*) Exhibitors must be provided with all the appliances necessary for taking the working parts of the machinery to pieces for examination, should the judges require it. (*h*) Shafting, belts, gearing, high-speed machinery, and any other exhibits likely to prove dangerous, shall be securely fenced and protected to the satisfaction of the judges, but such approval shall not relieve the exhibitor from his own liability.

(8) The points of merit considered of the greatest importance are—(*a*) Regularity of speed under varying loads; (*b*) regularity of speed during the various parts of one revolution, or one cycle of revolutions; (*c*) power of automatically varying speed to suit arc lights; (*d*) noiselessness; (*e*) first cost; (*f*) cost of running; (*g*) cost of maintenance. [In estimating the comparative value to be allotted to each of these points of merit, the judges will give due consideration to the characteristics of each kind of motor, steam, gas, water, &c.]

(9) The tests will be carried out under the direction of three judges appointed by the Council of the Society of Arts, who will report to the Council, and will confer with them on the awards.

(10) The Council will publish the awards in the "Journal" of the Society of Arts. They reserve the right of publishing descriptions of any of the motors, and the competitors must afford every facility for this purpose.

(11) The competitors must take upon themselves, in exoneration of the Society, all claims in respect of damage—if any—resulting from the testings, and must renounce all claims for compensation for any injuries, real or imaginary, that they may incur from alleged or actual imperfection in the arrangements or in the testings, or from any statement in the report or description published.

(12) The competition will take place in London about May or June, 1888. Entries must be sent in by the 31st December, 1887.

(13) All costs of fitting up and working the motors must be borne by the exhibitor. The Society will provide the brakes, indicators and apparatus, electrical and other, necessary for making the tests.

(14) The Council reserve the right of withholding any or all the medals.

FORMULÆ FOR WEIGHTS OF BRIDGES AND DEPTH OF TRUSSES.

The formulæ given below were presented in a paper read before the American Society of Civil Engineers by Professor A. J. Du Bois; in that paper they are supported by an elaborate train of reasoning, and are supplemented by tables calculated on the basis of the formulæ, and giving weights, depth of truss, &c., for a number of cases:—

Du Bois Formulæ for Weights of Bridges.

For railroad bridges take weight of rails, ties, planking, &c. = 400 lb. per lineal foot for single track.

Weight of plate girder in pounds =

$$\frac{12\,W l^2 + 2\,R\,l\,d^2}{1.2\,R d - 12\,l^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Here l = span in feet, d = depth in inches, R = average flange stress in pounds per square inch, W = total external load in pounds, including allowance for impact.

Economic depth in inches =

$$\frac{10\,l^2}{R} + \sqrt{\frac{6\,W\,l}{R} + \left(\frac{10\,l^2}{R}\right)^2} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Total weight of wind bracing = N (540 + 3.6 l).

Here N = number of panels. l = span in feet.

For bridge trusses:—

W_1 = equivalent uniform load per foot per truss due to live load.

W_2 = load per foot per truss due to cross-girders, stringers rails.

W_3 = load per foot per truss due to wind bracing.

W_4 = weight per foot of one truss, not including bedplates or rollers.

$$\frac{W_4 = W_1 + W_2 + W_3}{\frac{3.6\,\mu\,d}{A + \frac{\mu\,(45\,p^2 + 202\,a^2)}{(W_1 + W_2 + W_3)\,p}} - 1} \quad . \quad . \quad . \quad . \quad (3)$$

Here d = depth in feet. p = panel length in feet. μ = the numerator of the strut formulæ used. A is found as follows:—

For single intersection Pratt truss:—

$$A = p^2\,(2\,N^2 + 3\,N - 2) + 3\,d^2\left(2\,N - 4 + \frac{11}{N}\right)$$

For double intersection Whipple truss:—

$$A = 2\,p^2\left(N^2 + 3\,N - 10 + \frac{12}{N}\right) + 3\,d^2\left(N - 2 + \frac{16}{N}\right)$$

For Warren girder truss:—

$$A = p^2\,(2\,N^2 + \therefore 5\,N - 2) + 6\,N\,d^2.$$

The formulæ for depth of truss is as follows:—

Economic depth in feet =

$$\frac{l}{N}\sqrt{\frac{\alpha + \frac{45\,\mu}{(W_1 + W_2 + W_3)\,p}}{\beta + \frac{202\,\mu}{(W_1 + W_2 + W_3)\,p}}} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

The depth and weight of the cross girders and bracing can be found by formulæ 1 and 2.—*Railroad and Engineering Journal.*

Colombo is at last to be provided with a decent shipping wharf. In the last Supply Bill there was a vote for 47,000r. for the construction of a new jetty and for other needful alterations at the wharf. It is to be constructed in such a position that access from the town will be by main instead of the narrow crowded streets.

RAILWAY MATTERS.

THE Treasury have authorised the Irish Board of Works to advance a loan of £25,000 in aid of the Coachford tramways.

THE bonded loan of the Deli, Straits Settlements, Railway Company of 500,000f. has met with success. The subscription exceeded thirteen times the amount required.

A CONTEMPORARY says a bridge of 1600 tons weight, spanning the Pennypack, at the Homesburg Junction of the Pennsylvania Railway, was on June 26th moved a distance of 50ft. within 11½ minutes. Only thirty-two men were engaged in the operation.

THE railway between Nish and Pirot is now completed, and the first steam-engine was driven to Pirot on Monday. There now remain only the 150 kilometres of Bulgarian line between Pirot and Tatar Bazardjik to be finished, and Constantinople will then be in direct railway communication with Calais.

THE receipts of the Selangor, Straits Settlements, Government Railway, which have averaged exceedingly well since the line was opened for traffic, are rapidly increasing. It is reported that the development of the Selangor Railway, which is to be proceeded with, includes the construction of a bridge over the Klang River.

IN concluding a report on the collision (with buffer stops) which occurred on May 9th, at Battersby Junction-station, on the North-Eastern Railway, Major-General C. S. Hutchinson, says:—"Unless the rule for running into stations with block ends is made absolute in prohibiting the use of continuous brakes—except in cases of emergency—and drivers are severely punished when they transgress it, such collisions as the present will be certain to recur from time to time."

THE action of the Dominion Government in disallowing the Act passed by the Manitoba Legislature for establishing railway communication between Winnipeg and the United States frontier was due to a clause in the Act, which provided that the contractors or others engaged on a contract which has the written approval of the provincial Minister of Public Works become *ipso facto* servants of the Crown. Under this Act, a railway contractor would have had power to take property without being liable for claims for damages, or to the operation of injunctions.

AN arbitration case of some importance has been concluded in Victoria. Mr. John Robb, the contractor for the Bacchus Marsh Railway, was ordered by the Victorian Government to perform certain extra work when constructing the line and the viaduct over the Werribee. These extras he valued at £26,000, but the Railway Commissioners refused to recognise his claim to that amount. It was then agreed, the *Colonies and India* says, to refer the question to arbitrators, Mr. Zeal, M.L.C., Mr. G. Webster, and Mr. George Gordon, C.E. They award Mr. Robb the sum of £8000.

ACCORDING to a statement which has appeared in a German paper, the omnibuses and tramways of Paris carried in 1884 250 million persons, the cabs had 48 million fares, while 65 million travellers arrived at and departed from the railway stations, and 88 millions of passengers travelled by steamers. The circulation in public conveyances exceeds half a million per day. On Sundays and fête days it rises over 600 thousand, and on Fridays it sometimes falls below the half million. A more striking fact, however, than any of these is that the Paris omnibus and tram cars carry more than twice as many persons as all the French railways put together. Paris is the tramway capital of Europe.

MAJOR MARINDIN and Mr. Farrer, who were sent out to Egypt to make inquiry into the working and condition of the railways, have handed to the Egyptian Government a voluminous report. During their stay they have visited every mile of line, inspected every workshop, and examined every department. It is understood that they have found the permanent way in better condition than was anticipated, but that the amount of rolling stock is deficient. They consider 45 per cent. of the receipts sufficient for the maintenance of the line, without any necessity for extra credits. They confirm the general opinion given by Lord Northbrook and others that the constitution of the Railway Board is an impracticable one.

A FRIGHTFUL railway accident occurred on Friday night last at a grade crossing of the Grand Trunk Railway over the Michigan Central Railway at St. Thomas, Ontario. A heavy excursion train on the Grand Trunk ran into a goods train upon a level crossing, although the signal was against it. The brakes would not arrest the first train. The driver reversed his engine, and sounded his whistle as an alarm, so that many passengers jumped from the coaches. The excursion engine crashed into some oil-laden cars, and both trains were set on fire, the coaches being destroyed, together with the adjacent buildings. A large number of passengers were burnt to death, and many were injured by the explosion of the oil tanks. The newpapers are filled with horrible details of the scene.

A GENERAL classification of the railway accidents in the United States in May, as published by the *Railroad Gazette*, gives the following:—

	Collisions.	Derailments.	Other.	Total.	P. c.
Defects of road	—	5	—	5	6
Defects of equipment	4	6	2	12	14
Negligence in operating	8	4	—	12	14
Unforeseen obstructions	—	8	3	11	13
Maliciously caused	—	1	—	1	1
Unexplained	23	19	—	42	52
Total	35	43	5	83	100

The number of trains involved is as follows:—

	Collisions.	Derailments.	Other.	Total.	P. c.
Passenger	16	12	2	30	28
Freight and other	43	33	3	79	72
Total	59	45	5	109	100

MAGISTRATE KUNG, of Tientsin, has issued the following proclamation:—"The directors of the railway company have received instructions from his Excellency the Viceroy to construct the line from Taku to Tientsin, as described in the memorial of the Board of Admiralty and approved by Imperial decree. This line is to extend from Lutai to the south shore of the Peiho, at Tientsin. When the land has been properly surveyed, wherever the line has to pass through villages measures will be taken to avoid the people's farms and their roads of traffic; and for whatever land may be needed for the line, after having been carefully surveyed, a just price will be paid. The owner of the land so appropriated for the railway will no longer be liable to the taxes heretofore levied. Such land will become exempt from tax, or it will be paid by the railway company, and the people will not suffer in the least. The railways being now only in the introductory stage, you, the people, must not entertain suspicion and offer obstruction to the work. This proclamation is issued to inform all classes that the construction of railways is in obedience to Imperial command, the object being not only to meet the emergencies of war, but also to facilitate the means of traffic and benefit the people at large. When the land required shall have been properly marked out by stakes the just value will be paid, and you must not obstruct and thus bring punishment upon yourselves."

NOTES AND MEMORANDA.

THE rainfall at Greenwich in 1886 was 24·2in., being 0·5in. below the average of the preceding forty-five years.

HERR U. KREUSLER has determined the amount of oxygen in the atmosphere for forty-five consecutive days, and found only very slight variations, the extremes being 20·901 and 20·939 per cent.

IN London, during the week ending the 9th inst., 2562 births and 1610 deaths were registered. The annual death-rate per 1000 from all causes, which had been 15·9 and 16·6 in the two preceding weeks, rose to 19·9. In Greater London, 3272 births and 1939 deaths were registered, corresponding to annual rates of 31·5 and 18·7 per 1000 of the population.

THE deaths registered during the week ending July 9, in twenty-eight great towns of England and Wales, corresponded to an annual rate of 19·6 per 1000 of their aggregate population, which is estimated at 9,245,099 persons in the middle of this year. The six healthiest places were Nottingham, Sunderland, Halifax, Wolverhampton, Bradford, and Derby.

TO make a good black varnish for ironwork, the *Scientific American* says, take 8 lb. of asphaltum and fuse it in an iron kettle; then add 2 gallons of boiled linseed oil, 1 lb. of litharge, ½ lb. of sulphate of zinc—add these slowly, or it will fume over—and boil them for about three hours. Then add 1½ lb. of dark gum amber and boil for two hours longer, or until the mass will become quite thick when cool. After this it should be thinned with turpentine to the proper consistency.

THE new contact apparatus of the Westminster clock was brought into action on May 22nd, 1886, and the automatic signals from the clock have been received at Greenwich regularly from that date, except on three days following the snowstorm of December 26—27. The error of the clock was insensible on 25 per cent. of the days of observation, 1 sec. on 40 per cent., 2 sec. on 22 per cent., 3 sec. on 11 per cent., and 4 sec. on 2 per cent. On one day the signal was 15 sec. late, and on another day 10 sec. late.

THE following is given for a lecture experiment by C. Schall:—The specific heat of zinc is nearly twice as great as that of tin, and this, taken in conjunction with the fact that both metals have nearly the same specific gravity, renders them suitable for demonstrating Dulong and Petit's law for lecture purposes. Rods of the two metals of similar section and equal weight are heated to 150–170 deg., and then placed on paraffin-wax; the paraffin melted by each can be weighed, and is proportional to the specific heat of the metal in question.

A PAPER was recently read before the Paris Academy of Sciences on "The Molecular Specific Heats of Gaseous Bodies," by M. H. Le Chatelier. Since Dulong and Petit's discovery of the law of specific heats for solid bodies, numerous attempts have been made to generalise this law, and to extend it to the gases; but the experimental researches of Regnault have shown that at the ordinary temperature there exists no equivalence either between the molecular heats or the atomic heats of the gases. The experiments here described, on the combustion of gaseous mixtures, lead to the same conclusion for high temperatures.

ACCORDING to observations on the Grazac meteorite, by MM. Daubrée and Stanislas Meunier, this meteorite, which fell two years ago, and to which M. Caravin-Cachin first drew attention, is of a new carbon type, somewhat analogous to those of Orgueil and of the Cape, but distinguished from them by its general appearance and chemical properties. Its breakage is granular, and in many respects it resembles certain varieties of the oxides of manganese and copper, and the bituminous cinnabar of Idria; density, 4·16. This new specimen is all the more remarkable that it belongs to the class of rare and interesting meteorites which in their resemblance to our combustible minerals have suggested indications of biological phenomena beyond the globe.

AN official note has been published on the great bell for the Cathedral of Cologne, the solemn inauguration of which took place some days ago with great pomp. The bell weighs 27,000 kilos., or about 26 tons 13 cwt. The clapper alone weighs 800 kilos., or nearly 15¾ cwt. Its perpendicular height is almost 14½ft.; its diameter at the mouth nearly 11½ft. Twenty-two cannons taken from the French were assigned by the Emperor William for its manufacture; 5000 kilos. of tin were added. It was cast by Andreas Hamm, of Frankenthal, and 21,000m. (£1050) were paid for the casting. It will be known as the Kaiserglocke, or Emperor's bell, and as the two other large bells in the cathedral bear the epithets respectively of Pretiosa (precious) and Speciosa (beautiful), this one is styled Gloriosa.

AT the last meeting of the Physical Society a paper was read on "Sounding Coils," by Professor W. Stroud, D.Sc., and Mr. J. Wertheimer, B.Sc. The paper describes experiments on coils and helices of wire, which emit sounds when variable electric currents are passed through them. The pitch depends on the frequency of the current variations. The authors believe the sounds due to the attractions of adjacent parts of the wire, which cause shortenings and lengthenings as the current increases or decreases. To prove this, two identical coils were made, and one of them embedded in plaster of Paris. This gave no sound when the variable current was passed, whilst the other emitted the usual note. It was also found that no sound could be got from a single turn of wire, whilst one and a-quarter turns gave an audible sound under the same conditions.

HERR WIENGARTNER has suggested the following method, says the *Brewers' Guardian*, of determining the quantity of carbonic acid in beer:—100 cubic centimetres of the cooled beer are mixed with 50 cubic centimetres of a standard solution of baryta water in a 200 cubic centimetre flask, which is afterwards filled up to the mark with cold water: the flask is then closed, and its contents are thoroughly well shaken. The carbonic acid precipitates a portion of the baryta, and a further portion combines with the extractive matters of the beer. To determine this latter portion, the experiment is repeated with 100 cubic centimetres of the beer from which all carbonic acid has been expelled by boiling. Then 100 cubic centimetres from each of the two flasks are filtered rapidly, and known excess of a standard solution of sulphuric acid added to each, the excess of acid being afterwards determined by aid of a standard solution of alkali and an indicator such as litmus, or still better, phenolphthalien. From the data obtained it is easy to calculate the percentage of carbonic acid in the beer.

ON account of the use which is frequently made of sulphates in atomic weight determinations, it is important to ascertain to what temperature they can be heated without undergoing decomposition, as it is necessary to apply heat in order to dehydrate and expel adherent acid. In a paper recently read before the Chemical Society, "On the Temperatures at which various Sulphates undergo Decomposition," Mr. G. H. Bailey, D.Sc., says he heats the sulphate containing excess of acid, in the apparatus which he has previously described, at a known temperature—say 360 deg.—until of constant weight; the temperature is then raised, and the heating continued, &c. For a considerable range of temperature the weight remains constant, but a point is ultimately reached at which further loss of weight occurs, indicating that the temperature has been reached at which the normal sulphate decomposes. Zinc sulphate begins to decompose at 410 deg.; bismuth sulphate at 405 deg.; lead, magnesium, and sodium sulphates are stable up to 500 deg. at least. The behaviour of didymium sulphate is quite different from that of the other salts, and the limits of temperature within which it is stable are not sharply defined.

MISCELLANEA.

THE Swiss National Assembly, by 189,355 to 56,474 votes, has determined to incorporate a law for the protection of patents.

MR. T. H. BEARE, B.Sc., Assoc. Mem. I.C.E., for some years one of the principal demonstrators in the engineering laboratory at University College, London, has just been appointed Professor of Mechanics and Engineering in the Heriott-Watt College, Edinburgh. Mr. Beare came over to this country in 1880, as the holder of the South Australian Scholarship, which he had gained at Adelaide.

THE fourth excursion of the Liverpool Engineering Society of the season will be made on Monday, August 1st, when, by permission of Sir John Fowler, K.C.M.G., and Mr. Benjamin Baker, M. Inst. C.E., a visit will be paid to the Forth Bridge works at Queensferry. Members will assemble at Lime-street Station at 1.50 p.m., on Saturday, July 30th, and proceed to Edinburgh by train leaving at 2 p.m., returning on the Monday or Tuesday following.

THE annual meeting of the Association of Municipal and Sanitary Engineers and Surveyors commenced on Thursday, the 14th inst., at Leicester, and extended over three days. Mr. J. Gordon, borough engineer of Leicester, gave an address as president, and several papers were read, including one on "Asphalte and Concrete Pavements," by Mr. G. Strachan; one on "Experiments on Sewage Treatment," by Mr. Peregrine Birch; and one on "Cremation," by Mr. W. Eassie.

THE foundation stone of a new reservoir, which is now being constructed by order of the Croydon Corporation on the Addington Hills, was laid a few days ago. The estimated cost will be between £40,000 and £50,000. The work will be carried out under Mr. Baldwin Latham, M. Inst. C.E., and will be known as the "Addington Reservoir." It will have an overflow of 465ft. above the level of the sea; its length is 420ft., its breadth 124ft., a depth of 16ft. 8in.; and a capacity of 5,000,000 gallons.

MR. C. L. HETT, of the Brigg Foundry, has sent out a small turbine catalogue, in which he gives some useful information concerning steam measurement, pulleys, belts, rope gearing, and strength of shafting. His table and rules for belting give 34·2 as the power of a double leather belt 6in. wide, running on a pulley 30in. in diameter, which makes 300 revolutions per minute. Such a belt in ordinary practice would probably carry more like 50-horse power, though most rules agree with Mr. Hett's.

AN inquiry was held on Thursday, the 14th inst., at Leicester by Major Tulloch, R.E., relative to an application by the Billesdon Rural Sanitary Authority for a loan of £15,000 for works of sewerage for the parishes of Humberstone and Evington, two of the rapidly growing suburbs of Leicester. The only opposition was in connection with the area of the contributory districts, but this was ruled by the inspector as foreign to the inquiry. The scheme was explained by the engineer, Mr. J. B. Everard, M. Inst. C.E., Leicester, and favourably commented upon by the inspector.

THE new drainage scheme for Wolverhampton, briefly described in THE ENGINEER last week, was sanctioned by the Town Council on Monday, and the necessary powers for raising the £8000 required to carry out the work were granted, subject to the plan being approved by Sir Joseph Bazalgette. This sum provides only for the construction of works for separating the rain water from the sewage. On this portion of the scheme being completed the Town Council will consider the advisability of granting another £17,000 for constructing precipitation, pumping, and other works.

MESSRS. W. JESSOP AND SONS, Brightside Steel Works, have forwarded this week to Newcastle a remarkable casting, remarkable not so much for its weight—it was only 12 tons—but for its singular shape and size. It is a very large stern frame, 27ft. long and 17ft. across. It could only be carried by railway by blocking both lines on a Sunday, and it would have taken two, if not three, Sundays to get it to its destination—viz., Messrs Swan and Hunter, of Wallsend, Newcastle-on-Tyne. The firm therefore sent it by road with a traction engine. It left the works at five o'clock on Tuesday night, and got to Doncaster before eleven. Thence it travelled by the high north road, which is a good highway. The stern post is for a specially designed steamer, that has to manœuvre and turn very quickly in the water.

THE desirability of always attaching safety hooks to cages in winding shafts was strikingly demonstrated a few days since at the Liverton Iron Mine, near Loftus, in Cleveland. Twelve men were descending the shaft, when they approached the bottom the speed was fully maintained much longer than it should have been, and the cage landed in the sump with a terrible crash, seriously injuring several of the occupants. It was afterwards ascertained to have been a case of overwinding. The ascending cage mounted up into the gearing; fortunately the rope was secured to it by means of one of Walker's safety hooks, which prevented it from falling back into the shaft; had it done so, it would certainly not have left one of the twelve men alive. The latter were removed to their homes, and their injuries attended to. It is scarcely yet known whether the accident will prove fatal to any of them or not.

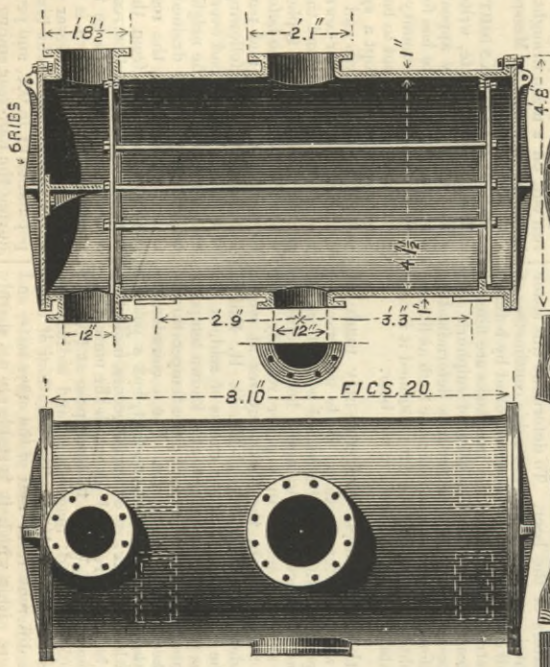
THE s.s. Furao was launched July 7th, on the Mersey, from Messrs. J. F. Waddington and Co.'s shipbuilding and engineering works at Seacombe, Liverpool. This vessel has been built for towing and general passenger trade at Lisbon, and is built of steel throughout. Length, 70ft.; breadth, moulded, 12ft.; depth, moulded, 7ft. She is fitted with two neat cabins, well ventilated by large teak skylights, in addition to the crew accommodation. The engines are inverted compound, having cylinders 12in. and 24in. by 18in. stroke, steam being supplied at 100 lb. pressure from one of the above firm's special horizontal marine boilers. The trial trip took place off the Mersey on July 13th, the Furao showing herself capable of a speed of 11 knots, and she sailed the following day for Lisbon, carrying on board 16 tons of coal, sufficient for the run out, on a mean draught of 5ft. This is the eleventh vessel launched this year by Messrs. J. F. Waddington and Co.

MR. WILLIAM KNIGHT TREVES, F.R.C.S., Medical Officer of Health for Margate, writes concerning the injurious comments which have recently appeared with reference to the health of Margate:—"Margate has for many years enjoyed a low death rate and considerable immunity from zymotic disease. Under these circumstances, it is not to be wondered at if the Town Council have been unwilling to adopt a system of sewerage which might render them liable to the evils and dangers which have followed tubular drainage in many other towns. The evils arising from street ventilators and gratings, and the facilities afforded by tubular drainage for the spread of typhoid and other zymotic diseases, have made the Council pause before following the advice of the Local Government Board, and perhaps by this means increasing their low mortality. The following are the facts: Last year an epidemic of typhoid fever spread over this part of the country, involving not only Margate, but the neighbouring towns and district. Margate, being only partially drained, invited the attention of the Local Government Board, the result being Dr. Page's report. If the conclusion is drawn from this report that Margate is unhealthy, such conclusion is not correct. Dr. Page disapproves of cesspools, and thinks we ought to be in an unhealthy condition; but, as a matter of fact, the town is very healthy indeed. There is not a single case of typhoid fever in Margate. I have the certificate of every practitioner in the town to this effect; secondly, in a certain population of 18,000, and probably more, there were but 144 deaths during the half-year ending June, giving a gross death rate, without correction, of 16 per 1000."

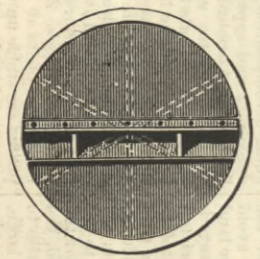
COMPOUND DIRECT-ACTING PUMPING ENGINES, HAMPTON—DETAILS.

MR. J. W. RESTLER, M. INST. C.E., ENGINEER; MESSRS. RICHARD MORELAND AND SON, CONSTRUCTORS.

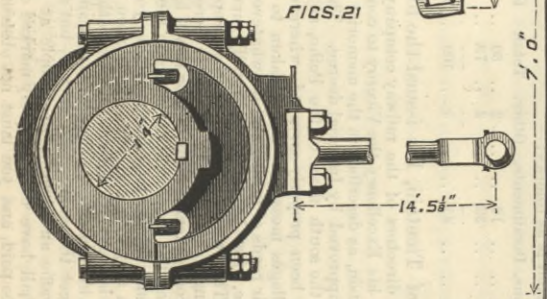
(*For description see page* 69.)

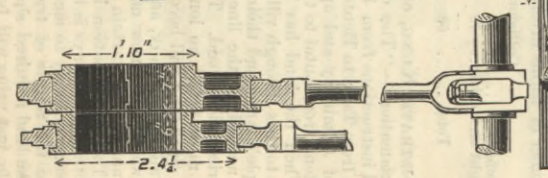


FIGS. 20.



FIGS. 21





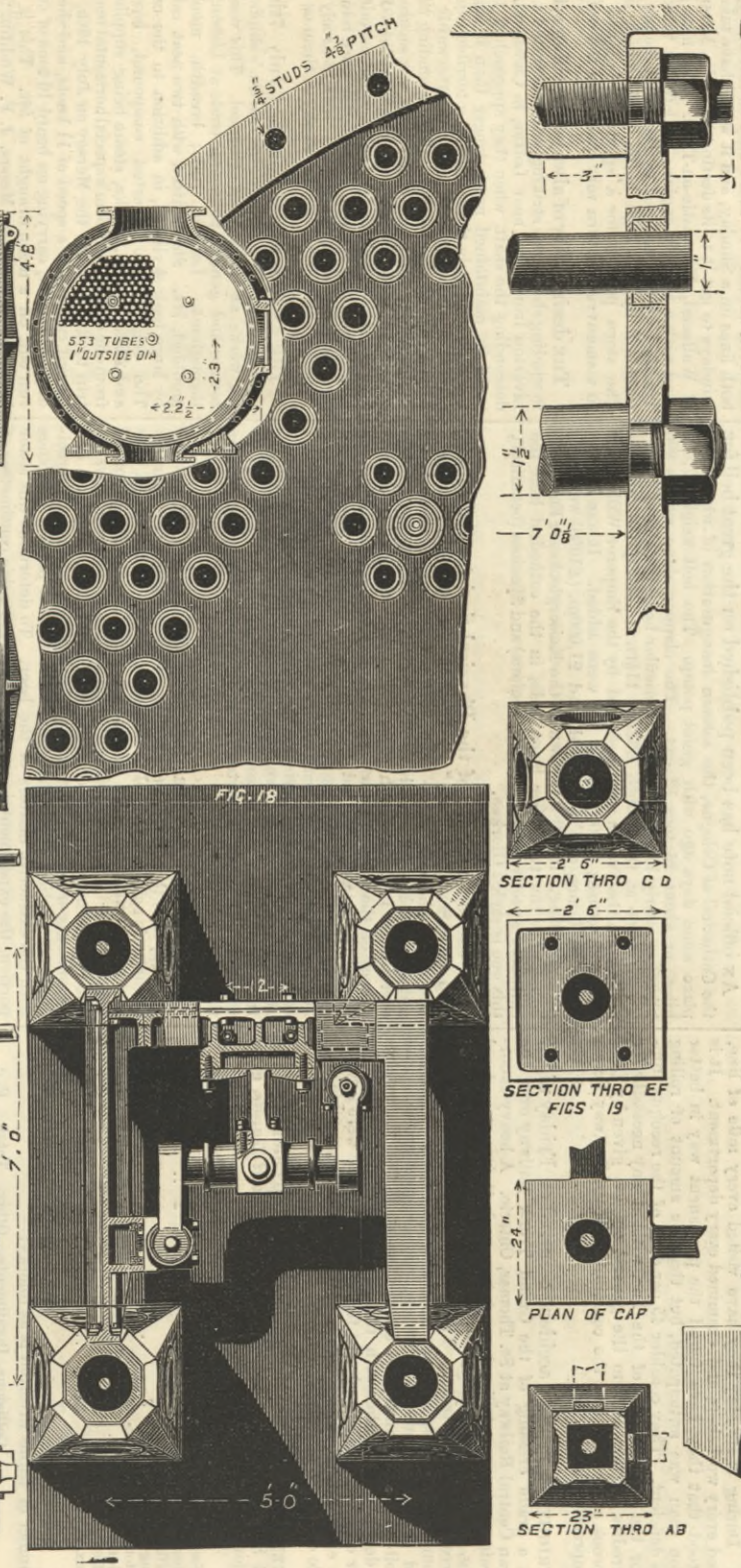


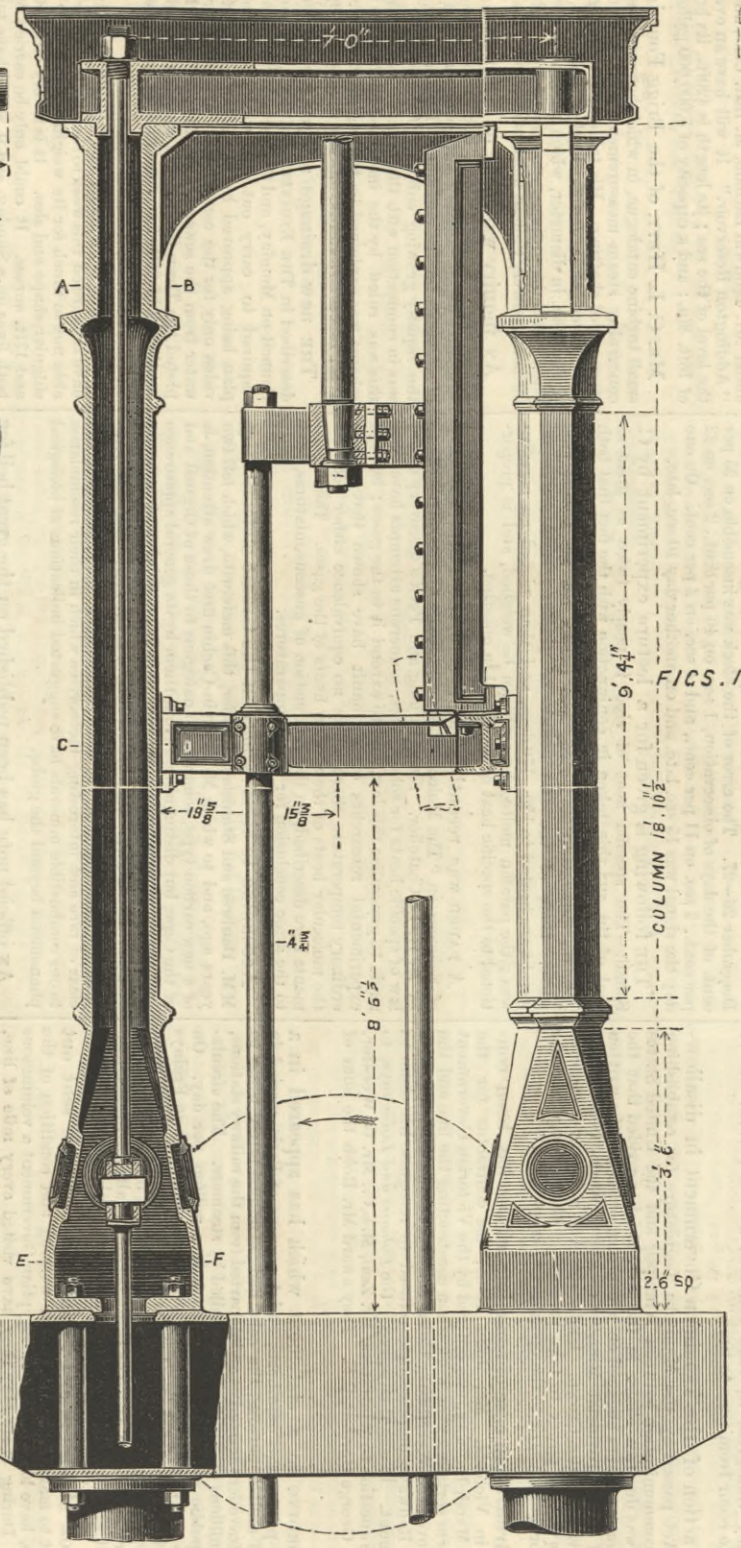
FIG. 18

SECTION THRO C D

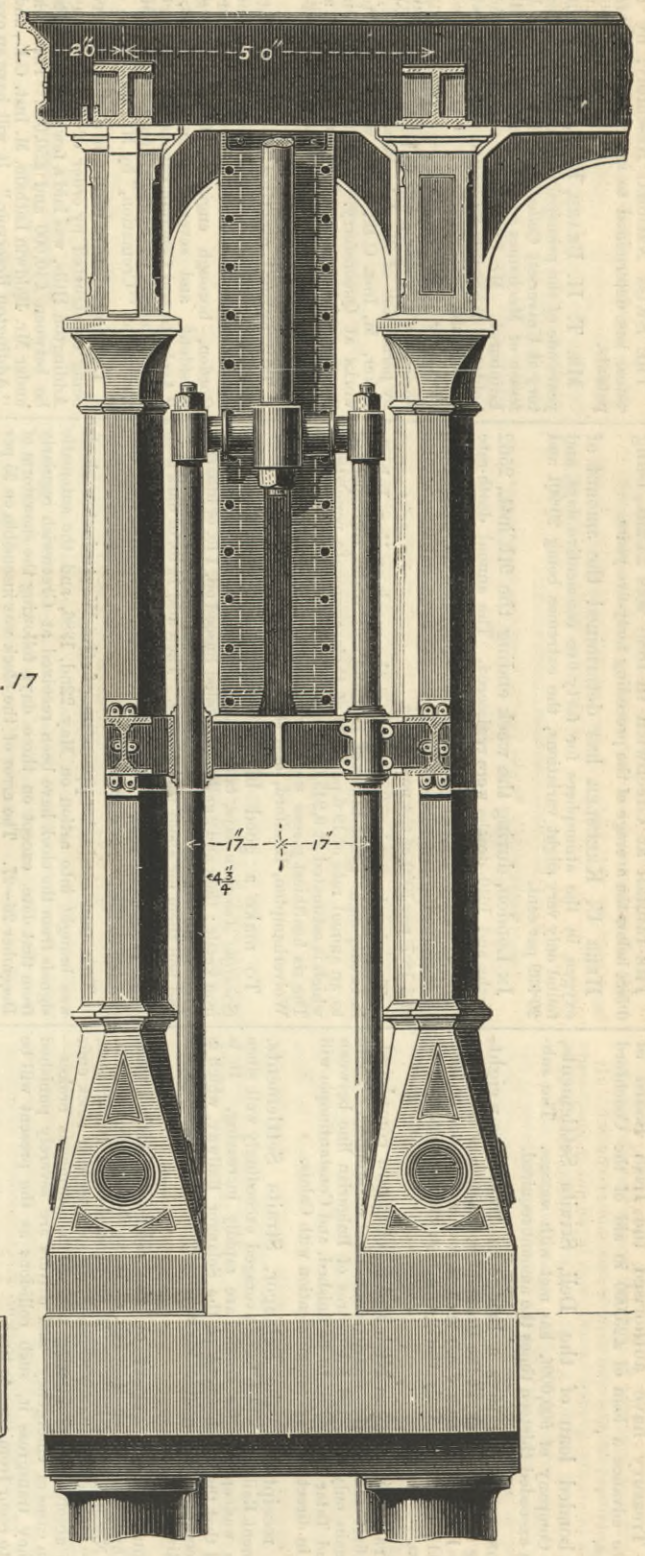
SECTION THRO E F
FIGS 19

PLAN OF CAP

SECTION THRO A B



FIGS. 17



COMPOUND PUMPING ENGINES—SOUTHWARK AND VAUXHALL WATER COMPANY.

IN the Engineer of the 1st July, p. 10, and of the 8th July, p. 30, were published a plan of the engine, engine house, and pumps, and detail views of pumps erected by the Southwark and Vauxhall Waterworks Company from the designs of their engineer, Mr. J. W. Restler, M. Inst. C. E., by Messrs. Richard Moreland and Son, London. They are of great interest to engineers as being of unusual type, and remarkably economical and efficient, as will be seen hereafter. We this week publish a two-page supplement showing these engines and pumps in their house, as well as other engravings of the boiler houses and engine details. The engines are inverted double cylinder compound direct-acting rotative, as shown on the supplement and on p. 30, and have many novel features in arrangement and construction. The engines are supported on framing arranged as shown on the supplement and on p. 68, the pillars being of cast iron and 2in. thick in any part. The four foundation girders to each engine

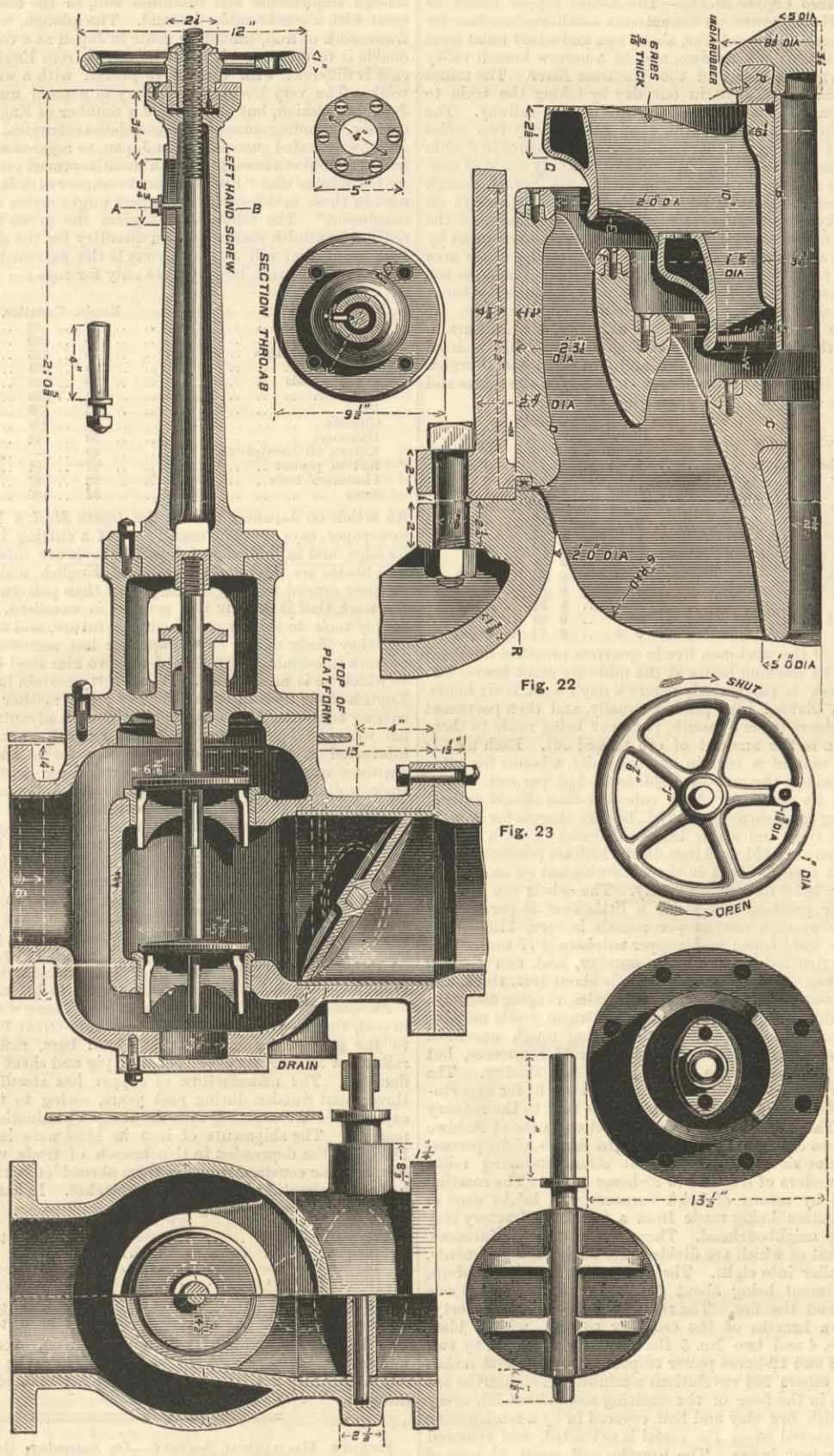


Fig. 22

Fig. 23

DETAIL OF EQUILIBRIUM AND THROTTLE VALVE AND OF MAIN PUMP VALVES.

are supported on three granite blocks, 5ft. by 2ft. 6in. by 2ft., imbedded in a mass of concrete. The bottom girders are 3ft. deep at the centre, those fixed on either side of the fly-wheel extending across the house from side to side, and having lugs cast on for receiving the side struts as shown, and for taking the thrust of the girders on the crank-shaft floor. These struts are 12in. wide by 18in. deep and 2½in. thick. The vertical pillars supporting the girders on the crank-shaft floor are of H section, 1ft. 9in. wide, 2ft. deep, and 2½in. thick. On the top of the vertical pillars there are four strong cast iron girders to each engine, the two inner girders being formed to receive the bearings for carrying the crank-shafts, and panelled as shown on both sides, the centre girders being panelled on one side only, with the opposite side prepared to receive the flooring joists. These girders are connected to wrought iron spring beams, 1ft. 9in. deep by 1ft. 3in. wide, at each end, which latter run the whole length of the house and are carried on stones, 2ft. by 1ft. 6in. by 1ft. at each end, and in the centre by a cross box girder, 2ft. 6in. deep by 1ft. 9in. wide. The main pillars for supporting the entablature are erected on the panelled girders, to which they are each to be attached by four turned steel bolts, 2½in. diameter, and in addition by a wrought iron bolt 3in. diameter, fitted at top with a square-threaded screw, 3¾in. diameter, with extra deep nut. These bolts are in two lengths, extending through the pillars from the top of the entablature to the bottom of the foundation girders, and fastened under the bottom girders and at the centre by cotters. The high-pressure cylinder is 32in. inside diameter, and the low-pressure cylinder 52⅝in. inside diameter, stroke 7ft. Both cylinders, see Figs. 1 to 13, p. 65, together with all steam passages, covers, valve chests, and receivers, are completely steam jacketted on the top, bottom, and sides, with copper steam flow and return pipes to steam jackets, the whole of which are coated with Leroy's non-conducting composition 2in. thick, and then covered with alternate beaded strips of polished teak and rock elm, and brass bands nickel-plated. The cylinders have an internal liner of mild steel, so arranged that there is in the low-pressure cylinder a space of 1½in. between the exterior of the liner and the interior of the body of the cylinder; this space being filled with air. The cylinders are arranged as shown on p. 65, the bottoms provided with covers, a base being cast on the cylinder for resting on the girders. False covers of ornamental design are provided for Fig. 17. The connecting rods are of wrought scrap iron, the ends being of the marine type forged with solid T heads, and caps of phosphor bronze. The crank-shaft is of steel, 16in. diameter in the body, with journals 14in. diameter and 21in. long, and to be turned all over. The fly-wheel for each engine is 21ft. outside diameter. The rim is made in two castings, 15in. on the face and 18in. deep. The boss and arms—six in number—are cast in two pieces and are dovetailed, keyed, bolted, and dowelled to the rim. The excentrics are made of cast iron, the excentric sheaves being also of cast iron, as shown at Figs. 21, p. 68. A high-speed governor of the "Galloway" type is fixed on the cylinder stage, driven by steel gear from the crank-shaft; this governor controls a gun-metal equilibrium throttle valve—see Fig. 23, below—the casing of which is attached directly to the high-pressure valve chest. An ingenious automatic expansion gear, controlled by the governor, some parts of which are seen at Fig. 21, is ordinarily in use instead of the throttle valve, and will be described hereafter. A gun-metal cylinder, with spring loaded plunger, is also fixed on the platform, the underside of the plunger of which is connected with the delivery main by suitable bright copper piping; the plunger of this cylinder is connected to the throttle valve spindle to close it in the event of the pressure in the main exceeding the amount of pre-determined compression given to the spring; the pressure of the spring is transmitted to the plunger through Naylor's arrangement of levers. The valve gear for the high-pressure cylinder consists of cast iron piston and slide valves driven by three excentrics, carried out as will be gathered from the cylinder sections, Figs. 25 to 59, the relative position of the pistons of the inner or expansion valve with the main valve being arranged to be altered by hand while the engine is in motion, and provided on the outside with an index to show the grade of expansion employed. The valve gear for the low-pressure cylinder is similar to that of the high-pressure, excepting that the alteration in the expansion is solely controlled by hand. The valve chests are prolonged to enable the ports communicating with the end of both cylinders being led direct into the cylinders without bends, see page 65. The valve spindles are all of mild steel, and the excentric rods of scrap iron. The main pumps are vertical piston pumps, double-acting in both suction and delivery, as seen at p. 10. They are worked from the lower crossheads, the pump rods, which are of iron, being 4½in. diameter. The pumps are of cast iron, 19in. diameter, with suction and delivery valve boxes arranged as shown at p. 10. The pumps are fitted with strong covers, having very deep gun-metal bushed glands, and bushed stuffing-boxes for the pump rods also extra deep. The pump piston consists of a deep plain cast iron piston, finished to fit the pump barrel. The valves and the seatings are of the double-seated gun-metal Cornish type, as seen at Fig. 4, p. 10, and Fig. 22, annexed. The valve boxes are fitted with strong ribbed covers, each having an eye screwed in the top for lifting. The pump capacities are measured by the displacement of the pump piston, minus 5 per cent. for slip. The pump throughout is of massive construction, the working barrels being not less than 2¾in. thick, and sufficiently strong to enable it to withstand a working pressure of 350ft. head of water. A range of 4in. cast iron pipes is provided and connected to each of the main pumps, fitted with the necessary cocks for the purpose of charging them when starting. See supplement and p. 30. The air vessels, one to each engine, are 4ft. 6in. outside diameter, and 17ft. 3in. high above the centre line of the branches, and 2½in. thick in the body, gradually increasing to 3¾in. thick at the top of the dome, with six radiating ribs inside the bottom casting, and the full depth thereof. The whole of the flanges are in proper proportions, and well bracketted and hooped with wrought iron. These vessels after being jointed were subjected to a hydrostatic pressure of 750ft. head. The condensers are as shown at Fig. 20, p. 68. The bend in each exhaust pipe, immediately under cylinder stage, is of polished copper, the rest of the pipes being of cast iron with faced flanges. From the engine house wall to the flange on the copper bend, the eduction pipe is lagged and banded in a similar manner to the cylinders. The air pumps are attached to the vertical pillars, and are of cast iron, fitted with gun-metal liner, gun-metal piston, with hard brass spring rings, gun-metal junk rings, and phosphor bronze bolts and nuts. The valves are of best red rubber. The foot valve consists of a strong gun-metal grid, provided with a gun-metal guard, and held in position with a phosphor bronze bolt, 2in. diameter, fitted with a square threaded screw, with nut and locknut. The top valve consists of a strong gun-metal grid and guard, with a solid gun-metal stuffing-box and gland, which is fitted with four square threaded phosphor bronze bolts and nuts. The grid is fastened to the air pump by sixteen phosphor bronze studs, fitted with gun-metal nuts as shown. The cold water pumps are of the plunger type, 11½in. diameter and 3ft. 6in. stroke, of the form shown on p. 10. They are single-acting, with india-rubber suction and delivery valve with gun-metal grids and guards. The boiler feed pump has a plunger 3¾in. diameter. The suction valve box—see p. 10—of this pump is connected to the hot well with a copper pipe 4in. diameter, fitted with gun-metal flanges and provided with double-faced sluice valve and hand wheel. The delivery valve-box is fitted with a direct spring loaded safety valve. The air charging pump to each engine—see p. 10—is of sufficient capacity to make up the loss of air carried away with the water and to keep each air vessel continually charged with air.

(*To be continued.*)

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—E. J. Jeffery, chief engineer, to the Flamingo, to date June 29; S. G. Follett, chief engineer, to the Icarus, to date June 19; and John W. Ham, assistant engineer, to the Euphrates.

SHIPBUILDING ORDERS FOR THE CLYDE.—An intimation which has given general satisfaction not only in Govan, the district more immediately affected, but throughout Glasgow and the Clyde, is to the effect that the Fairfield Shipbuilding Company has secured the contract from the British Admiralty for the construction of the hulls of two steel wood-sheathed protected cruisers, each of 2950 tons displacement, to be named Magician and Marathon. The vessels will be 265ft. long, 42ft. beam, and 19ft. draught. They will carry a formidable armament similar to that of the Archer class, and will have a protective deck over vital parts. Horizontal engines will be fitted, the contract for which it is believed has gone to Messrs. Hawthorn, Leslie, and Co., on the Tyne. The horse-power of the engines will be about 10,000; the speed to be attained by the vessel being twenty knots per hour. The execution of the order, if carried out with the dispatch which usually characterises the operations at Fairfield, will provide employment for a large body of workmen. Govan, like the other districts on the Clyde, is suffering severely from the prevailing stagnation and depression, and the news of this important order is hailed with great satisfaction. The only other vessel on the stocks at Fairfield is a large Transatlantic steamer for the North German Lloyd's Company. The only other orders recently booked are one for a steamer of 2000 tons, by Messrs. John Reid and Co., Port Glasgow; one for a stern wheel steamer, 170ft. long, by Messrs. McArthur and Co., Paisley; and a steamer of 1250 tons, by the Ailsa Shipbuilding Company, Troon.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

China—English apathy.—Commerce in China is mostly in English hands, and was so once in a greater degree. We have become apathetic and indifferent, the energy, push, and willingness to run risks, once characteristic of British merchants, having succumbed to the deadening effects of monopoly, while other foreigners profit by our supineness. The French are beginning to gain a commercial footing in China; Germans have the ear of high officials, and supply arms, guns, and even ships. In some localities many of our merchants have made their fortunes, derive most of their income from land, and regard business as an agreeable and customary mode of employing their leisure hours. They regard with indifference all attempts to provide new kinds of goods, to strike out new paths for trade, or in any way to adapt their goods and patterns to Chinese ways. Foreign competition is not considered in any way serious. Younger men better understand the position, but they chiefly depend on their seniors to gain a footing in commerce. At the small ports there is more energy, but in China energy must be combined with influence to obtain advantages. Englishmen too often squabble and thwart each other, while foreigners assist and combine with each other all over China. Englishmen will not advance with the times—the old patterns, prices, and qualities must suit the Chinese; but the foreigner, a skilled, trained man, soon discovers the weak spots in our methods of manufacture, and changes or modifies accordingly. In many cases he speaks Chinese, and is usually a fair linguist, while he is assured of official support both at home and in China. All descriptions of goods tell the same tale. Foreign articles are cheaper, and nearly as good as English, and drive them out of the market. The awakening in England, as in China, is perhaps beginning, and it is high time this should be the case in view of the competition in arms, goods, guns, loans, mail-steamers, and ships; and, above all, in the energetic, skilled, trained men who are making their presence more and more felt every day in commerce in China. At present, English discontent evaporates in grumbling, and little or not enough is done to remedy defects. To overcome difficulties has been the special business of Englishmen, and they are likely to have ample opportunities in the future to gratify their ambition in this respect.

China—Trade of Swatow for 1886.—A point which has not received the attention it deserves is advertising. Advertisements of all kinds of goods are poured into China by every mail, addressed to those persons whose names are to be found in the yearly directories published at Hong Kong. These advertisements never reach the general Chinese public for whom they are intended. The local Chinese press in Hong Kong and Shanghai is still in its infancy, and has but a comparatively small circulation, except among such Chinese as are already in direct communication with foreigners. There only remains the Chinese plan of advertising by posters. These posters are struck on bright-coloured paper from wooden blocks, a very inexpensive method, which might be used with advantage by British merchants to push their wares. There would be no difficulty in getting Chinese translations of advertisements made at the various treaty ports. For the plan to be effective, the establishment of retail shops on a small scale would be necessary; but that ought not to present any great difficulty. The time is yet far distant when there will be any market in China for complicated agricultural or metal and woodworking machinery, but there are a vast number of articles used by Chinese which do not essentially differ from European things.

Germany — Trade in Frankfort in 1886.—The ironfounding branch was quiet during the first half-year, but improved considerably in the second half, principally through the demand of the chemical industries. The optimist expectations of the iron trade were only partially realised towards the end of the year, as the American trade upon which these expectations were based did not improve. The German industry suffered most from the breaking up of the International Rail Convention, by which German works were suddenly exposed to Belgian and English competition, and in consequence prices of steel rails declined still further. In the latter months an improvement of from 5 to 8 per cent. in all German foundries was to be noted. Prices were as follows:—

	December, 1885. £ s. d.	January, 1887. £ s. d.
Charcoal iron	3 5 0	3 10 0
Foundry ,,	1 12 0	1 18 0
White raw iron	1 8 0	1 12 0
Iron plates	2 10 0	2 15 0

Iron in bars also went up about 5s. per ton. In the machine trade the same observation holds good, and some works increased the number of hands. In locomotives, special engines of various descriptions, and steam engines, a good many orders were effected. High duties prevented export to foreign countries, increased the competition at home, and caused prices to decline. Wages remained stationary, with a tendency to increase for local workmanship. Good workmen in general are in demand, as the machine industry in Germany is steadily reviving. In steel utensils and wares prices are flat on account of foreign—chiefly English—competition, but hopes are entertained that the daily improving German industry will by degrees entirely supplant foreign makes.

Italy.—Trade of Naples in 1886.—There was an increase in machinery imported from England of £32,524, and in pig iron of £17,267. In iron and steel bars and plates England meets with an active competition from Belgium and Holland. The principal industries in this Consular district are situate in the neighbourhood of Salerno, which town may be said to be the centre of the cotton spinning, printing, and weaving establishments. Importations from England would be increased by studying closely the tastes and wants of customers, new descriptions of goods being exhibited by intelligent and well-educated commercial travellers having a good knowledge of the Italian language. The Germans have obtained a great hold on the trade of this country by attending to these methods, while English manufacturers are fast losing Italian trade by their own fault. The Italian Government has of late years studied how to encourage native industry so as to render this country as much as possible independent of foreign manufacturers; and in the matter of machinery for the navy have urged the principal firms who are in the habit of supplying the navy to place their establishments on such a footing as to enable them to compete successfully with foreign makers, both in designs and workmanship, having also all the latest improvements. At the same time, the Italian Government suggested to the principal engineering firms in England with whom it did business that it is the intention to do as much of the work as possible in this country, so that it would be to their advantage if they could arrange to co-operate with engineering firms in Italy and construct the machinery on the spot, with the understanding that if this was carried out they might rely on the support of the Government. In this city Messrs. R. and W. Hawthorn, Leslie, and Co., engineers at Newcastle-on-Tyne, have formed a partnership with Messrs. Guppy and Co. under the name of "La Societie Industriale Napolitana Hawthorn-Guppy," Mr. F. C. Marshall being the consulting engineer and Mr. Nelson Foley the local technical director. These important works will now undergo extensive alterations and improvements so as to enable them to make the larger class of marine engines for the Italian Navy, and this firm has just concluded a contract with the Minister of Marine to construct the engines for the Sardegna, which are to be on the triple expansion system, capable of developing a maximum force of 22,000-horse power, fitted with forced draught and all latest improvements. The large works now being erected at Pozzuoli by Messrs. Armstrong, Mitchell, and Co., are advancing rapidly, and will be able to commence operations about the middle of the year. A temporary shop has been at work since January last, which is chiefly occupied on the work for the large turntables for the 110-ton guns of the Italian ironclad Morisini. Attention will now be given to the setting up of the heavy machine tools, which are already on the ground, and are of such a size that the heaviest class of artillery can be dealt with.

Japan-Ashiwo Copper Mines.—The Ashiwo copper mines lie in the Tochigi prefecture, on the extreme south-western boarder of the province of Shimodzuke, about two and a-half miles from the small post town of Ashiwo, and in a narrow branch valley connecting with the valley of the Watarase River. The mines can be reached from Tokyo in one day by taking the train to Honjo station on the Uyeno-Maebashi line of railway. The works lie fifteen miles south-west of Nikko, forty-two miles north-west of Tochigi, and forty miles west of Furuto in Joshin in the province of Rodzuke. At present the only mode of conveyance from and to the mines is by using pack horses, though it is proposed to build a branch railway from Utsunomya on the main Tokyo line to Imaichi within twenty-four miles of the mine. The mine is leased from the Japanese Government by Mr. Furnkawa Tehibei, of Tokyo. The rent of the whole area of 290 acres for a term of fifteen years is £128. The mine has from the first been conducted entirely by Japanese, without foreign assistance and reflects great credit on their energy. It is under the direction of a general manager, Mr. Kimura, a graduate of the Imperial College of Engineering, Tokio, assisted by Mr. Oki, consulting engineer and Mr. Ota, metallurgist. The number of officials and workmen employed in the mines and treating works is 4160. The wages paid are:—

	Per Day. Lowest. s. d.	Average. s. d.	Highest. s. d.
Blacksmiths	0 6½	0 9¾	1 6
Carpenters	0 6	0 9	1 0
Engineers	0 10½	1 2	1 6½
Machinists	0 10½	1 2	1 6½
Miners' assistants	0 7¼	0 9¾	0 10½
Ore treaters	0 7¼	0 7¾	0 10½
Roasters	0 8	0 9¾	0 10
Smelters	1 0¾	1 3	1 8
Assistant	0 9½	0 9¾	0 10½
Stokers	0 8	0 9	0 10½
Timberers	1 1½	1 3¾	1 10
Assistant	0 7	0 9½	0 10½
Labourers	0 6	0 7½	0 10½

The whole of the workmen live in quarters provided for them rent free. The working hours at the mine are eight hours, but where the work is particularly severe a day's work is six hours. The work is divided into pitches equally, and then portioned out to the miners twice a month, payment being made to them in proportion to the amount of ore turned out. Each man is expected to extract a certain amount daily, a bonus for extra work being paid at the rate of 10¾d. to 1s. 1½d. per cwt. of ore according to its fineness. As a rule one man should extract 191 lb. per day, and earns about 10d., besides charges for shovels, food, powder, rice, and straw bags, which cost 1s. 4d. a day for each man. There are 151 workings, 35 of which are productive, and there are 363 men at work in them, turning out on an average 31½ tons, or 191·3 lb. a man per day. The whole ore is a sulphide (copper pyrites), and yields a little over 24 per cent. of copper. The average output per month is—ore, 1190 tons; rough copper, 308¼ tons; and copper sulphate, 4·77 tons. The most productive lodes are six in number, and run parallel to one another. The Champion lode is about 10ft. thick, and there are about twelve other workable lodes, ranging from 4ft. to 5ft. in thickness. The ore after treatment yields metallic copper and sulphate of copper, the first being rough unrefined copper resembling the ordinary Chili bars of commerce, but differing in the size of the ingots, which are smaller. The copper as turned out at the Ashiwo works is not fit for exportation, and before being put on the market is sent to the refinery at Tokyo. The machinery in the reduction works at Ashiwo consists of two crushing mills, forty-eight jiggers, eight percussion tables, nine sieves or sorters, eight steam stamping mills, three steam motors of from 10 to 29-horse power. The roasting is conducted by means of brick furnaces, the bricks used in their construction being made from a suitable refractory clay found in the neighbourhood. There are six of these furnaces, the four largest of which are divided into twelve compartments, and the smaller into eight. The furnaces are graded in steps, each compartment being about 3in. higher than the next one between it and the fire. The roasted ore is smelted in forty-eight German hearths of the ordinary pattern, with a blast from one No. 4 and two No. 3 Root's blowers, worked by two engines of 16 and 12-horse power respectively. The first makes 404 and the others 264 revolutions a minute. The hearths are shallow holes in the floor of the smelting room about 2ft. every way, lined with fire clay and half covered in by a semicircular clay roof, removed when the metal is extracted, and renewed every twenty-four hours. The hearths will smelt 3⅓ tons of ore every twenty-four hours with nearly three-fifths of a ton of charcoal. The charcoal fuel and timber used for the works is procured from the neighbouring hills. The mining company have bought the right of cutting timber from the Government at an average price of 2d. per tree. The cost of charcoal amounts to 4d. per cwt., besides cost of transport, which is about 2½d. for 2½ miles. The refinery at Tokyo was instituted for the purpose of getting rid of the antimony, which was found in considerable quantities in the copper sent from the mines, and which rendered it practically valueless in the market till it is refined for export by the Welsh refining process in furnaces designed by Mr. W. Gowland, of the Imperial Mint, Ozaka, and the workmen employed are all trained men from the copper-refining department of the same institution. These Tokyo works can refine nearly 18 tons of copper per day, and the copper, as refined, costs £2 0s. 4d. per cwt. The amount exported annually is about 294 tons, being seven-tenths of the entire amount exported from Japan, and as Mr. Furnkawa, the owner, is also holder of several copper mines in the country, he virtually has entire command of the copper market in Japan. A large proportion of the annual export of copper goes to Calcutta, where it is used by the native population in the manufacture of tools and other utensils. In 1884 a contract was made with the Chinese Government for the delivery of 105 tons of copper at £40 6s. per ton, and in 1885 another contract was entered into for the delivery of 126 tons of copper, the first half at £40 6s., and the second half at £39 4s. per ton. The machinery from abroad has not hitherto been purchased from any one country in particular, but indiscriminately, as both English, French, and German machinery is in use. As a German metallurgist has been lately engaged by the mining company, it is probable that any machinery or materials required by the mine will be imported from Germany.

Japan—Native manufacture.—The price of English iron is about half that of Japanese, and although the tenacity of the latter is superior, there is but very little difference in the general quality. Everything is made by hand in Japan, and there can be little doubt that the iron portion of the farmer's tools could be made in England, and laid down in Japan at a lower cost than they can be made here. The difficulties and expenses of distributing them in the more remote districts, and persuading the farmers to use them, would be so great that not much hope could be entertained of any large and prosperous trade. Some of the large landowners have adopted the foreign plough with success, and as more land is brought under cultivation, it is confidently expected that not only ploughs but other foreign implements and machines will, in the course of time, meet with a considerable demand. The plough, with an entire framework of iron, cannot be made in Japan at a cost which will enable it to compete with that imported from England, but the case is different with the native plough with a wooden framework. The very low cost of cutlery in general made in purely Japanese fashion, but also that of a number of English forms of cutlery, including some of the most delicate surgical instruments, are now imitated successfully in Japan, as regards appearance at least, and sold at a lower price than those improved prototypes, lead me to the belief that "English cannot compete with Japanese workmen in these articles, but an expert might arrive at a different conclusion." The following list gives the prices at which the native blacksmith makes tools in quantity for the dealers. The first point that will strike anyone is the extremely low prices. Some of the lowest, however, are only for toys:—

	Kinds.	Varieties.	Prices. d.	Prices. s. d.
Adzes	7	26	5½	1 6
Awls	15	289	½	1 1
Carpenters' planes	15	135	1	1 8
Chisels	28	253	¾	1 10
Coopers' tools	18	82	½	1 11
Drills	15	209	½	1 1
Files	33	55	⅝	4 4
Gimlets	15	209	½	1 1
Hammers	33	46	½	5 0
Knives, all descriptions	49	—	⅞	11 8
Knives, pocket	27	81	½	0 4
Plasterers' tools	22	87	1	1 4
Saws	32	166	¾	11 0

An article on Japanese tools in the *Japan Mail*, a local English newspaper, says:—"The useful part of a cutting instrument is its edge, and in this respect Japanese tools are inferior to none. The blades are thicker than those of English make. There is no more crucial test of good carpentry than pattern making, and the work that is done in this country is excellent. Who is to supply tools to this large industry in future, and of what shape are they likely to be? The Japanese has accustomed himself to work in certain positions, and we give him steel in the shapes to which he is accustomed. It is pretty certain he would find English-made tools more satisfactory; but neither the present cutting edges nor forms can be altered with advantage to him or his wants." I was informed by an English merchant largely interested in the iron trade that the forms and shapes of Japanese-made tools are in many cases very primitive, and if their imitation were attempted in England, the makers might be tempted by this primitive appearance into the opinion that quality was of no importance, a mistake that may at once be absolutely fatal to the creation of any trade in the future.

Sweden—Trade of Gefle in 1886.—The export of iron and steel decreased considerably. The shrinkage in value during 1885 continued in 1886 as far as bar and pig iron are concerned. The production of iron in all the forms which we have been accustomed to in this district cannot be carried on with profit at present selling prices, and has largely been given up. The firms who have turned their attention to specialities in steel do better, though the condition of trade leaves much to be desired.

Sweden—Trade of Stockholm in 1886.—There was a decrease in coal, the principal article of import from Great Britain, owing to the general dulness of trade. Iron bars, machinery, and rails show an increase over 1885, but pig and sheet iron a slight decrease. The manufacture of copper has steadily decreased throughout Sweden during past years, owing to the difficulty experienced in competing with the cheaper productions of foreign markets. The shipments of iron in 1886 were larger than in 1885, but the depression in this branch of trade was seriously felt, and the constant rumours from abroad of a rise in prices had a deteriorating influence on the market. In hammered iron, prices ranged on an average:—

	£ s. d.		£ s. d.
Bloom	5 10 0	to	6 0 0
Bispberg	9 5 4		—
Dannemora	14 0 0		—
Ordinary brands	8 7 6		—
Persberg	9 5 4		—
Pig iron	3 5 0	to	3 15 0
Rolled iron	7 10 0	to	8 5 0

The high prices quoted for Dannemora iron, exceeding other well-known brands by £4 15s., do not indicate the state of the market, as they are prices stipulated in contracts of four years duration.

Dundee Mechanical Society.—On Saturday, the 11th inst., the members of the Dundee Mechanical Society, to the number of fifty, visited Messrs. Shanks and Sons' Dens Ironworks, Arbroath. They were received by Mr. Cooke, the manager, who accompanied them through the works, and gave them a detailed description of the various departments. The members were first taken to Mr. Cooke's room, where a fine collection of photographs illustrative of the various types of mechanism produced by the firm was shown. They were then conducted through the several departments, and very much admired the arrangements for carrying on a large production of a varied class of machinery. Among the specially noteworthy machines were a compound engine in course of erection for an Australian firm, and a very compact steam pump, which was shown at work. As illustrative of the force with which the water was being ejected from the pump, the simple experiment was tried by some of the members of endeavouring to push their finger into the issuing volume, but without success, it being practically a solid body. The description of the malleable cast department was very interesting and novel, Mr. Cooke showing the brittle nature of the metal before being annealed, and the ductility of the same after the process. Mr. Cooke stated that Mr. Shanks was the first to introduce this process on the East Coast, having adopted it some twenty-five years ago. The department for the production of their well-known lawn mowers was full of clever appliances. It was mentioned that the firm manufactured about 3000 of these per annum. On the termination of the visit Mr. Cooke was heartily thanked for his kindness and attention. The members then spent the remainder of the afternoon in visiting the places of interest for which Arbroath is famous.

THE PANAMA CANAL.

IN the annual report read yesterday at the general meeting of the shareholders of the Panama Canal Company, M. de Lesseps bears up against the disappointing facts concerning the real state of things by protesting energetically against "the manœuvres of speculators, who attack the credit of the company in the hope of intimidating the shareholders and bondholders and of ruining the present enterprise, with the object of building some sort of cosmopolitan company on its ruins." The report, as a matter of course, expresses confidence in the firmness of the shareholders, and proceeds to point out that during the first six months of the current year the quantity of earth removed does not come up to the estimate made last July. Two reasons are given for this—the difficulty encountered in obtaining labour (*sic*) and the extraordinary violence of the rainy season, which commenced this year as early as June 14th. (People generally would think that the 14th June was not very far off the end of the first half of the year.) The company will aid the contractors, who are determined, immediately the fine season returns, to push forward the works with such energy as to compensate for the momentary want of sufficient workmen and for the present extraordinary rains. M. de Lesseps, therefore, hopes that the difference at the end of the year between his estimate and the work really done will not be more than a few millions of cubic metres. (A few millions.) "If," says the Paris correspondent of the *Standard*, "the difficulties encountered during the first half of the present year should increase or continue, the company must seek means to simplify the task undertaken by the contractors, or take measures to increase the rapidity of the excavation. There are only two means to insure the inauguration of the canal in 1889—either to realise the programme of works in 1887 and 1888 by augmenting the power to accomplish the work, or *to simplify the task by restricting the works which would be completed after the inauguration out of the profits resulting from the traffic.* The company is applying both these means simultaneously. M. de Lesseps indicates in his report important simplifications of the programme for the construction of the works. The chamber and lock at Panama will not be constructed, for it is, he says, established that the maximum current in the canal would not exceed 2½ knots, which did not seem to the Consultative Commission of a nature to interfere with the navigation of steam vessels in the canal. M. de Lesseps also points out that it will not be indispensable to make the five kilometre siding, and that the ports of Colon and Panama will be reduced to strictly necessary proportions. It is provided that the canal shall be nine metres deep and twenty-two metres wide at the bottom, but the present report says that as the works advance it will be necessary to see what provisional restriction will have to be made in these dimensions. In conclusion, M. de Lesseps announces his intention to start shortly for Panama to inspect the works. On his return he promises to tell the shareholders under what conditions vessels will first pass from one ocean to the other through the canal." Simplifying the work seems to mean not doing it.

At a recent meeting of the American Society of Civil Engineers, held at the Society's House in New York, M. Boulangé, a French engineer, who has been for three years Chief of Section on the Panama Canal, was present, and upon invitation addressed the Society, giving some account of the condition of the work upon the canal from his actual experience and observations. He also answered numerous questions which were put to him by members present. He had left his position on the canal on account of a severe attack of Isthmus fever, from which he has just recovered. The view of the present condition and prospects of the canal given by this gentleman were exceedingly discouraging to those who desire its completion. The total amount of work to be done, according to the lowest estimate, amounts to 140,000,000 cubic metres of excavation, and of this only 30,000,000 has been done The canal company has already spent 90,000,000f., and has at present only money enough on hand to continue the work some four or five months longer. Not only, said M. Boulangé, has less than one-fourth of the excavation been completed, but two of the most important works in connection with the canal, the damming or diversion of the Charges River, and the improvement of the port of Colon (Aspinwall) have not even been touched. There has been, apparently, a great lack of system about the work. M. Boulangé said that when he first took charge of his section he asked for a map and profile, but none were furnished him, and he subsequently ascertained that the only map in existence was one made by Lieut. Wyse from his survey, which was not in any sense intended to be a location for a canal, but merely a preliminary reconnaissance. This state of affairs has not been remedied up to the present time, and most of the engineers have been working almost in the dark on their respective sections. In several places excavations have been made of short sections of the canal, while there are intervening sections of which not even a preliminary survey has been made, and no point of junction with the finished work has been indicated. At the port of Colon there have not even been preliminary borings, and nothing has been done to ascertain the nature of the bottom on the possibility of improving the channel by dredging. From Colon westward the canal is now open for 16 kilos., but of this distance the average depth attained is only two metres. Nevertheless, it is expected that there will be an official opening of this short section in the fall, when M. de Lesseps intends visiting the Isthmus. At one point of this section a dredge has been occupied for nearly a year in taking soft clay and mud from the bottom of the canal and dumping it on the bank. The ground, however, is so soft and swampy in its nature that the weight of clay thus dumped raises the bottom of the canal, and the dredge is engaged in apparently an endless task. The most difficult work on the canal is at the great cut at Culebra, where there will be a cutting 315ft. deep and nearly 500ft. wide at the top. Work has been going on for about a year, and an excavation has been made for a short distance, which is now about 38ft. deep and 70ft. wide. An unanticipated and very singular difficulty has been encountered here in a movement of the whole mountain, which commenced as soon as work was begun upon the cutting. The cause of this is not known, and the fact has completely puzzled the engineers in charge. It was, however, predicted by the first Chief Engineer that water would be found in this cutting. M. Boulangé believes—and he stated apparently good reasons for his belief—that much of the work already done will have to be abandoned, and it is very likely that a large part of the line of the canal will have to be re-located on lines differing considerably from the Wyse survey.

In answering questions M. Boulangé said that a preliminary study had been made for a canal with locks. Under present conditions no locks could be made and no level established more than 11·8 metres above tidewater to secure a permanent supply of water, but by damming the Chagres and establishing reservoirs this limit might be increased to about 23 metres above tideway, but the advantage gained in this way would not be very great. In relation to the regulation of the Chagres he considered it a very difficult problem on account of the great volume of water brought down by the river at certain seasons. From his own observation he has known the river to rise 21ft. in six hours. Every chief engineer who has been connected with the canal has had a different plan for this work. The first plan proposed required a masonry dam 1200ft. long, 210ft. high, and 300ft. thick at the base. This was abandoned on account of the enormous expense involved and of the uncertainty as to finding proper foundations for such a huge mass of masonry.

At present, a contract for regulating the river has been let to the *Société des Travaux Publiques*, and that society's engineers are now engaged in making surveys and preparing plans. M. Boulangé also stated that a great difficulty in the work had been the scarcity of labourers, owing to the unhealthy nature of the Isthmus. Manual work there is impossible for a white man, and the supply of negroes from the West India islands had given out, those from Jamaica, Trinidad, and the Bahamas declining to go there any more. The average mortality on the canal during one year had been 60 per cent of all the labourers and 80 per cent. of all the white men. He said that of 72 Frenchmen, assistant engineers, clerks, draftsmen, &c., who went out to Panama a year ago, 45 were dead and only 11 were still at work, 16 of the survivors having been disabled by fever. The men who had stood the work best were negroes who were imported—probably kidnapped—from the East Coast of Africa, but they were not inclined to do much work. The Company had recently resolved to try the experiment of importing Chinamen from Hong Kong and 800 had been brought over, but no more were to be brought until it was ascertained whether these men could stand the climate, as the expense of conveying them to Panama was considerable. On the Panama end of the canal there is a considerable stretch through low, swampy ground where hardly any work has been done, simply for the reason that no man has yet been found who can work there and live. In answer to questions again, M. Boulangé stated that the current prices paid for excavation under existing contracts were 48 cents per cubic metre for clay; 1·05 dols. for mixed earth and rock; 1·80 dols. for rock from 30 to 100 metres above tide-water; 2·40 dols. for rock from the water level up to 30 metres above. The price paid for rock excavation below water level was kept secret.

ROLLING MILL FOR CORRUGATED SHEETS.

THE manufacture of corrugated sheets by the use of rollers with undulating surface has the disadvantage of straining the metal and drawing the sheet in from the outside in the same measure as the rollers are approached. A German inventor Herr Vital Daelin, has

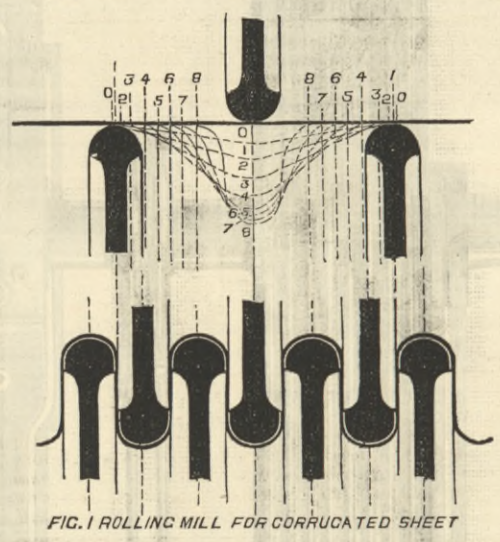


FIG. 1 ROLLING MILL FOR CORRUGATED SHEET

endeavoured to substitute for this treatment of the sheets a more easy process of folding them into corrugations by means of rollers with movable ribs. This rolling mill is being manufactured by Messrs. August Bachmeyer and Co., of Berlin. Fig. 1 shows the

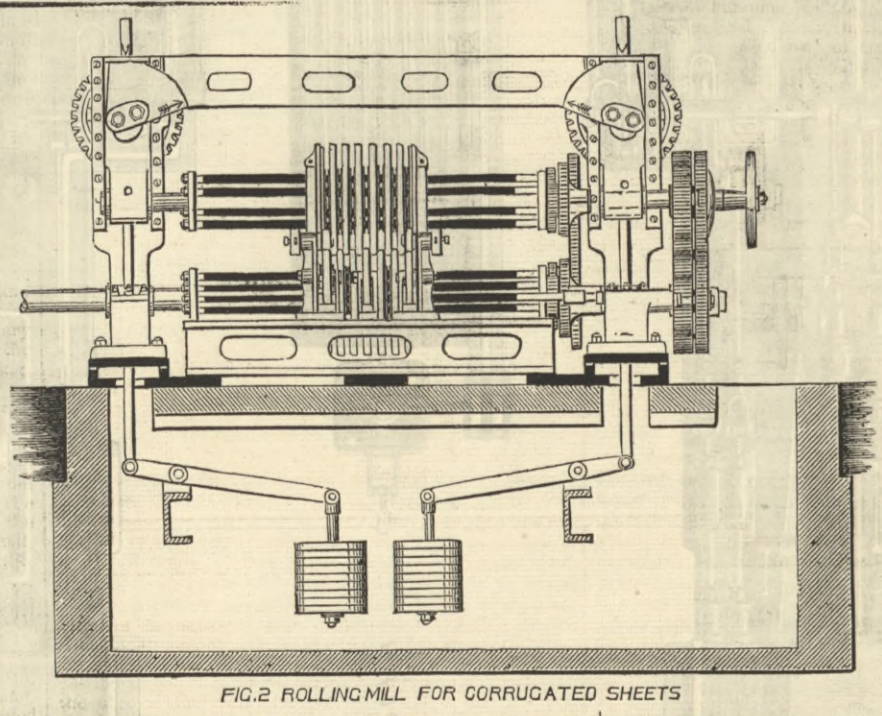


FIG. 2 ROLLING MILL FOR CORRUGATED SHEETS

action of the movable rolls, the dotted lines representing the amount of corrugation successively assumed by the sheet, whilst the rollers are approached from the position 0 to the position 8. It is thus possible to roll sheets with very deep corrugations without straining the fibre of the metal more than is absolutely necessary in the simple process of bending. The mill consists of an upper and lower roller, the latter being fixed and the former vertically adjustable as usual. The rollers consist of a number of discs, which are movable longitudinally by means of screws and nuts, worked from a train of wheels at one side. The pitch of the different screws is so adjusted that the approach to the centre of the outer discs is more rapid than that of the discs nearer the centre, the proportion of speeds being exactly that required to fold the sheet without drawing it laterally. By means of a friction coupling the gear which approaches the discs can be coupled to that which lowers the upper roller, both movements being effected whilst the sheet is travelling in one direction through the rollers. In this manner the corrugations in the sheet are, so to speak, conical; that is to say, the sheet is narrower at the end where it left the rollers than at the end where it entered them. The motion is then reversed, and the sheet is rolled backwards without further alteration in the distance of the discs or the position of the upper roller. In this manner the whole of the sheet is brought down to the width and depth of corrugation at the smallest part. It can now again be passed through the rollers, and the corrugations can be further deepened until the desired profile has been obtained. Fig. 2 shows an elevation of this rolling mill with balanced upper roller. One of these mills has been erected at the Carlshutta, in Upper Silesia, for the manufacture of sheets with corrugations up to 8in. deep, in metal ·2 of an inch thick.

IT has been found necessary by the Geologists' Association to postpone the Sheppey excursion to Saturday, July 30th, the hour of leaving and everything else being as in the circular.

THE FORTH BRIDGE.

OUR readers are now so well acquainted with the design and general characteristics of the Forth Bridge, that the following from the seventeenth quarterly report of inspection by Major-General Hutchinson, R.E., of the works in progress, will be readily understood:—

Main piers, South Queensferry.—The platforms have been raised to their final level, viz., 355ft. above O.D. The vertical columns have been built up to the special part connecting them with the top junctions, *i.e.*, to a level of 336ft. above O.D. The diagonal tubes have also been built up to their connections with the top junction, or to an average level of 325ft. above O.D. The vertical columns are rivetted to a level of 325ft. above O.D., and the diagonal tubes from their base up to their intersection. A commencement has been made with the two eastern top junctions, and all the large diaphragms are in place. The bottom members of the northern cantilever have been built out to a distance of 130ft., and those of the southern cantilever to a distance of 122ft. from the centres of the adjacent vertical columns. Lengths of 103ft. on the two northern members and of 90ft. on the S.E. member have been rivetted. Of the horizontal bracing at the level of the intersection of the diagonal tubes, the portion between the vertical columns has been erected, and the diagonal bracing commenced. The second bay of vertical wind bracing between the columns is in place. The rivetted steel work at South Queensferry main pier now amounts to 3450 tons, an addition of 950 tons during the quarter.

Cantilever and viaduct piers.—The girders on the southern nine spans have been raised to 130·75ft., and the masonry to 122·5ft. above O.D., making additions of 28ft. and 26ft. respectively during the quarter. The masonry of the pier at the south end of the first span has been raised to 124·75ft. above O.D. The foundation of the first pier south of the iron viaduct has been laid at a level of 107ft. and the concrete brought up to a level of 109ft. above O.D.

Main piers.—Inch Garvie.—The platforms have been raised to 242ft. above O.D. The vertical columns have been built up to a level of 251ft., and the central ties to 255ft. above O.D. The columns have been rivetted to a level of 195ft., and the ties of 230ft. above O.D. The first bay of bracing between the vertical columns and the central ties, as well as the cross girders and supports carrying the internal viaduct, are in place. The diagonal tubes have been built up to the crossing, and a large portion of the crossing is bolted together. A length of about 12ft. of each tube beyond the connection with the skewbacks has been rivetted. The bottom members of the northern and southern cantilevers have been built out to an average distance of 107ft. and 85ft. respectively from the centres of the adjacent vertical columns; lengths of 95ft. and 72ft. on the northern and southern cantilevers respectively have been rivetted. 3600 tons of steel work have now been rivetted on Inch Garvie, an addition of 930 tons during the quarter.

Main piers.—North Queensferry.—The platforms have been raised to their final level of 355ft. above O.D. The vertical columns and diagonal tubes have been built up to the connection with the top junctions, or to the levels of 336ft. and 332ft. respectively above O.D. The vertical columns are rivetted to a level of 325ft. above O.D., and the diagonal tubes from the skewbacks up to the crossing. The second bay of bracings between the vertical columns has been placed in position, and the first bay, as well as the cross girder and the supporting column between the northern vertical columns, rivetted. All four top junctions are now being erected, and a commencement is now being made with the top members. The bottom members of the northern and southern cantilevers have been built out 130ft. from the centres of the adjacent vertical columns, and lengths of 120ft. and 120ft. respectively have been rivetted. The total amount of steelwork at North Queensferry main piers now amounts to 3540 tons, an increase of 760 tons during the quarter.

Cantilever and viaduct piers.—The masonry of the north cantilever piers and of the viaduct piers has been raised to 149ft. and 140·75ft. respectively, or to within 1·25ft. of the top. The large pier of the north abutment has been built to 141·5ft, and piers Nos. 1 and 2 to 147ft. above O.D. The girders have been raised to their permanent level.

General.—Masonry and concrete.—Up to the present date 511,000 cubic feet of granite have been delivered and 496,000 cubic feet set; and about 107,300 cubic yards of rubble masonry and concrete work have been built.

Steel work.—The internal viaduct for Inch Garvie pier is fitted, and nearly the whole of this viaduct has been drilled for bay No. 1 of all the cantilevers. The top and bottom junctions of bay No. 1 are all drilled, and the fitting of the latter is progressing rapidly. The Inch Garvie top members of bay No. 1 have now been drilled, as well as all the bottom members of bay No. 2 and of strut No. 2. The drilling of the bottom members of bay No. 3 has been commenced. In all 41,400 tons of steel—5000 tons since last report—have been delivered. The temporary appliances required for the erection of the first section of bay No. 1 of the South and North Queensferry cantilevers are nearly completed. The link ties used for the erection of the temporary plate ties have all been fixed. The horizonal portions of the plate ties have been erected at both piers, and the sloping parts—fixed at their upper ends to the vertical columns and to the horizontal ties, and at their lower ends to points on the bottom members at a distance of about 110ft. from the vertical columns—have also been erected, except at the south cantilever at South Queensferry. In the yard, the first vertical permanent cantilever ties, which are to be used as temporary lifting columns, are being fitted, and the other arrangements connected with the building out of the cantilevers are in a forward state. The average number of men employed during the past quarter has been 3410, and the number employed on May 16th was 3600. With the exception of the latter part of March, during which snow and frost were frequent, the past quarter has, on the whole, been favourable for the progress of the work. The highest wind pressures observed during the quarter have been 7 lb. per square foot on the large gauge, and 21 lb. per square foot on the small gauge.

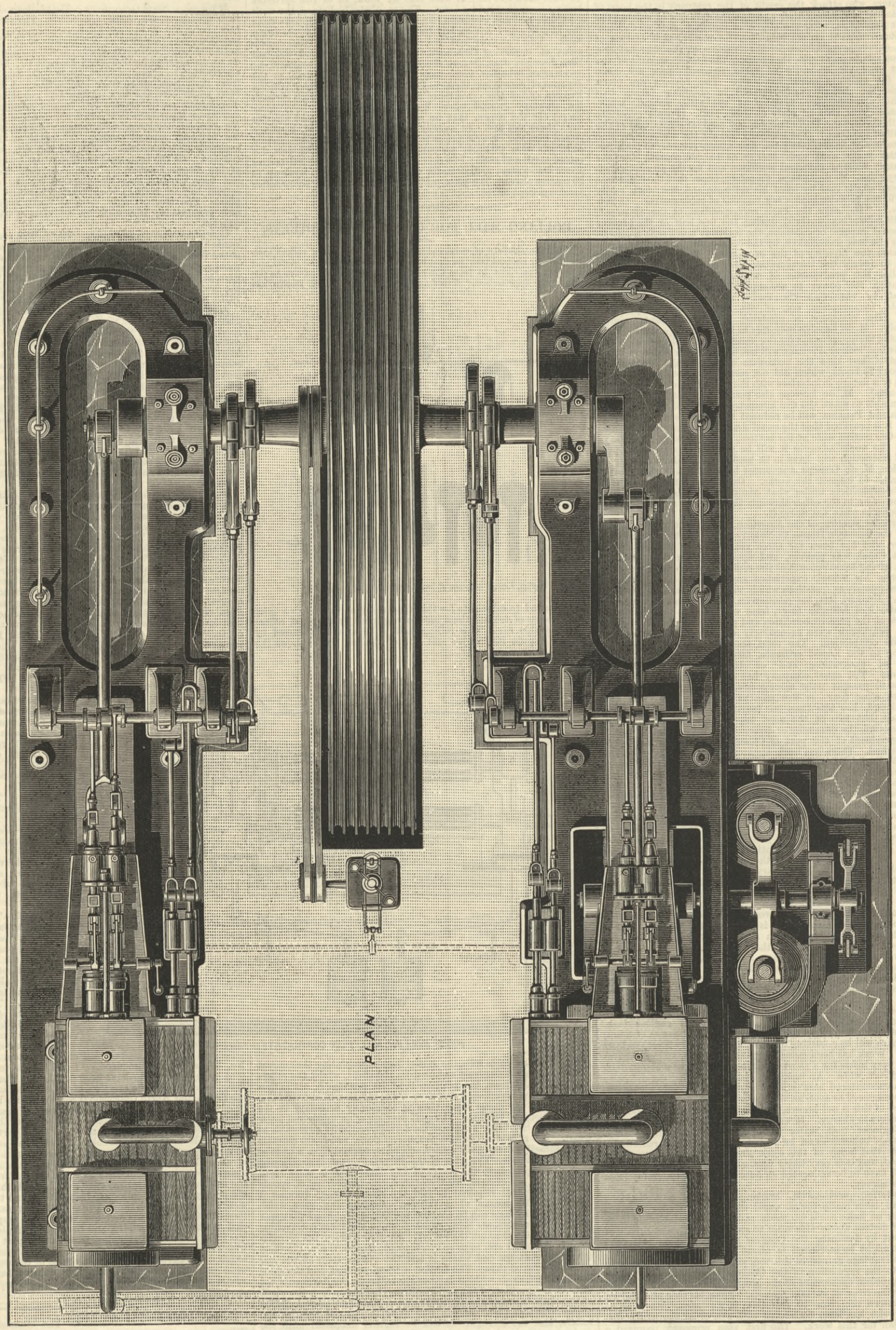
FINSBURY TECHNICAL COLLEGE.—The students of the above College gave a very successful conversazione on Friday last. Exhibits of the manufactures of over fifty leading firms were laid out in the laboratories. The mechanical department showed their 60-horse power engine driving the well-fitted workshops.

THE GREAT EASTERN STEAMSHIP.—The Great Eastern has arrived at Greenock from Liverpool. She made a very successful voyage, running from Liverpool Bar to Gareloch, a distance of about 220 miles, in 34 hours against a head wind. The engines worked very well, but the boilers, as usual, primed badly, so much so that fires had to be drawn three times in two of them, but no accidents occurred

COMPOUND ENGINE—LAUBARDEMONT FLOUR MILL.

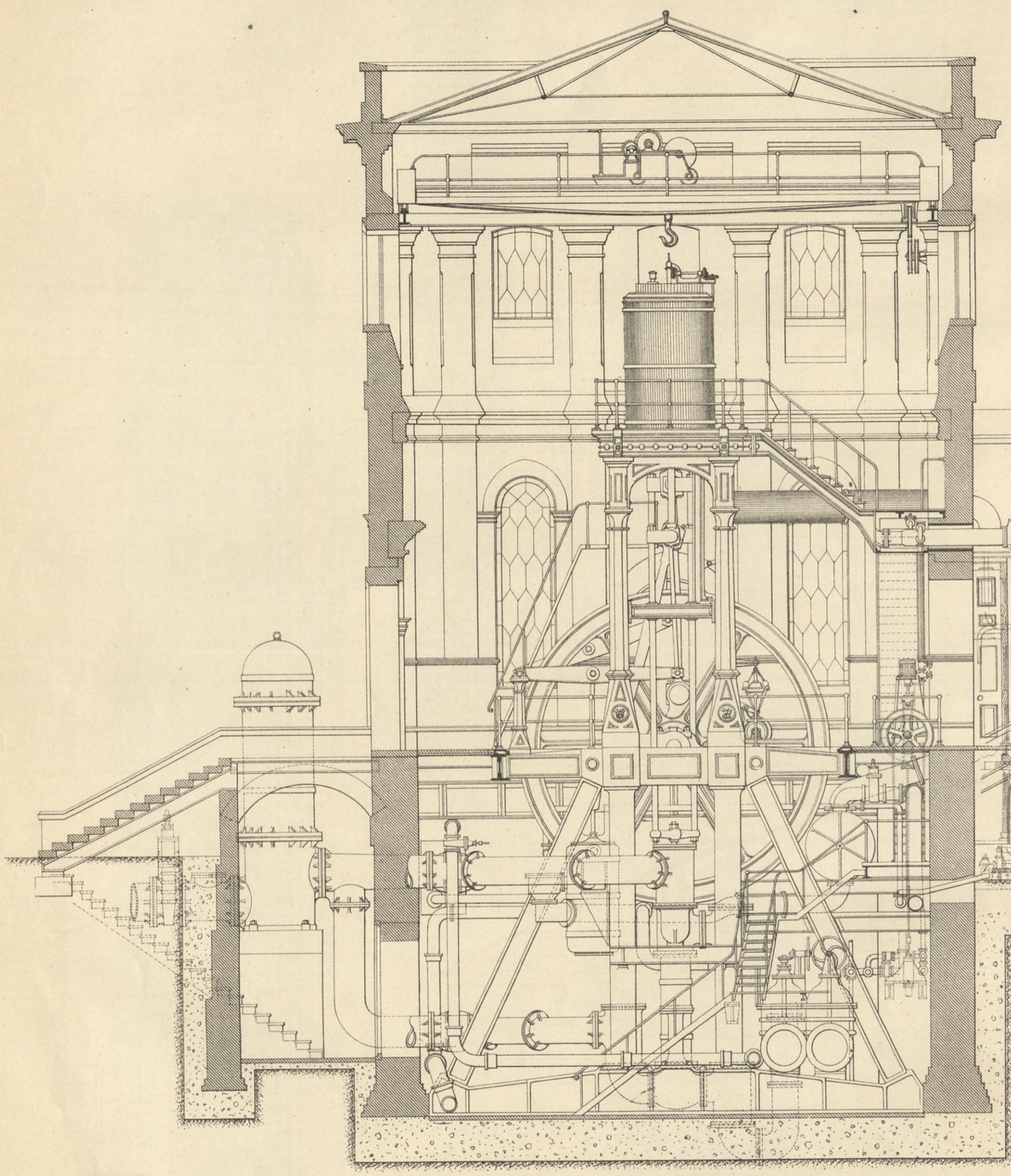
MESSRS. T. POWELL AND CO., ROUEN, ENGINEERS.

(For description see page 55.)

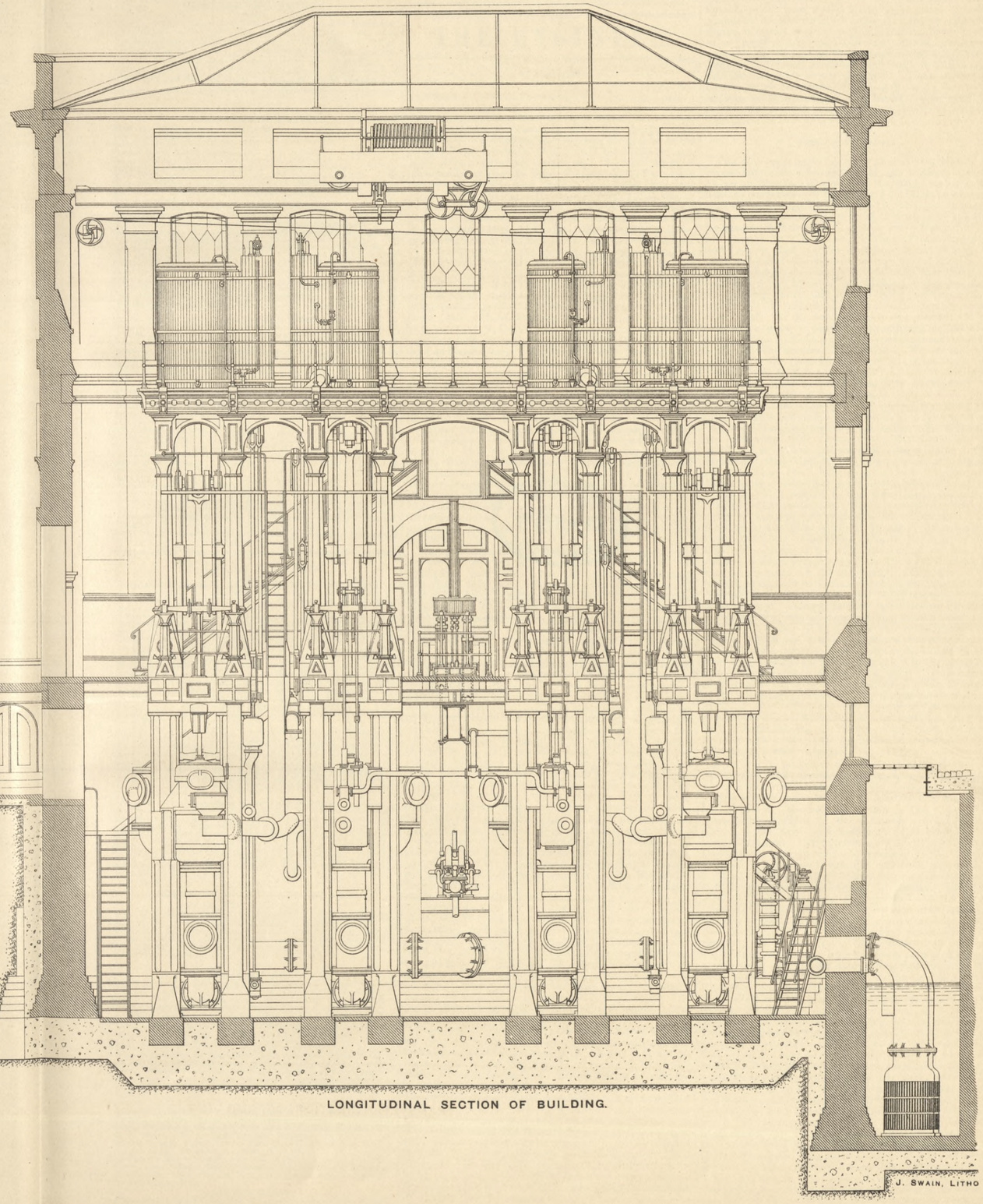


COMPOUND ENGINES, SOUTHWARK AND VAUXHALL WATERWORKS, HAMPTON.

CONSTRUCTED FROM THE DESIGNS OF MR. J. W. RESTLER, M. INST. C.E., BY MESSRS. RICHARD MORELAND AND SON, LONDON.



TRANSVERSE SECTION OF BUILDING.



LONGITUDINAL SECTION OF BUILDING.

J. SWAIN, LITHO

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*** *We publish this week a Double Number of* THE ENGINEER, *containing the Index to the Sixty-third Volume, and also a Supplementary Engraving showing the large Compound Condensing Engines, Pumps, and Engine-house erected at Hampton, for the Southwark and Vauxhall Water Company, from the designs of Mr. J. W. Restler, M.I.C.E., by Messrs. Richard Moreland and Son, of London. Price of the Double Number,* 1*s.*

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TWO-PAGE SUPPLEMENT, SHOWING A LARGE COMPOUND CONDENSING ENGINE AT HAMPTON.

TO CORRESPONDENTS.

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*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1*d. 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.*

J. W. G.—*Make the steam pipe* 1½*in. bore, steam ports* 3*in. by* ⅝*in, exhaust* 3*in. by* ¾*in. It is impossible to answer the other questions off-hand. Make a proper drawing, and set out the valve gear and link motion, if you have one, and from this you can deduce the best proportions. The point of cut-off will vary as you link the engine up. You will probably find a lap of about* ¼*in. sufficient, and you will not be far wrong if you set out your gear on that as a basis.*

AIR.—*Your client has fallen into a very common error. A little reflection, however, will show that what he proposed is impossible. By compressing the air you raise its temperature, by cooling it, you simply reduce the temperature to what it was before it was compressed. In order to really cool the air you must make it do work after it has been cooled, and for this purpose the addition of a second cylinder to your plant is essential. If you couple it on to your engine you will get useful work out of it. But you may make it overcome a resistance in any way you find convenient, with the same result —the production of cold air.*

A. B. (Acre-lane).—*The question contained in your letter, namely, who bears the expense of the local board fees for opening roads to lay mains, is not governed by usage. Sometimes the work of excavating the trenches is let to one contractor, and the providing and laying of the pipes to another; but frequently both excavating and laying are let to one man. Whoever breaks up the surface usually gives the highway authorities the necessary notice, and satisfies their demands; but there is nothing to compel the contractor to do so. There should be a properly drawn specification particularising what the contractor's responsibilities are, and without this there is no power of compulsion.*

STRESSES IN ROLLING MILLS.

(To the Editor of The Engineer.)

SIR,—In an ordinary plate-mill for rolling ship and boiler plates, where the top chilled cast iron roll is 24in. diameter, what diameter should the bottom roll be to bear an ultimate twisting moment of 15,000,000 inch-pounds, in addition to the work done by the top roll? An answer from any of your correspondents will be esteemed. R. T. C.

Stockton-on-Tees, July 16th.

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THE ENGINEER.

JULY 22, 1887.

EFFECT OF RECENT EXPERIMENTS ON OUR SHOT AND ARMOUR.

THE competitive shot trials that have taken place at Shoeburyness during the past year have been conducted as confidential experiments, and requests to give even the most ordinary reports in public print have been refused. Most of us, however, are aware that the main result of these trials has been to cause the admission of a certain number of forged steel Holtzer projectiles into the service, and to stimulate the manufacture of steel shot or shell in this country. Messrs. Hadfield have for some years advocated cast steel shot, and have submitted some very excellent samples for trial at Shoeburyness. A 9in. projectile, now in the Manchester Exhibition, was fired in 1885 with about 1800ft. velocity, and passed through a 16in. wrought iron plate and some oak backing, and got its point through an 8in. plate behind it without fracture beyond cracks. Since that time Hadfield has obtained a very successful result with a 6in. forged steel projectile, which passed through a Brown 8in. compound or steel faced plate without breaking up. Holtzer's projectiles have similarly perforated steel-faced plates intact. Some excellent Firminy experimental projectiles have also been fired at Shoeburyness. Whitworth's shot have been too late for trial with the others. We believe there is special anxiety to send nothing from Whitworth's factory that should be beaten by the now very formidable competitors, and we hardly know when to expect the projectiles by which Whitworth's reputation may be maintained, although we learn that one champion projectile is offered. For many years past we have urged the pressing need for encouraging the manufacture of steel projectiles in this country. This we hope is coming—better late than never. But it will be necessary to enlist the manufacturing power of our private firms in the task for many years to provide anything that deserves the name of a store of steel projectiles, and it will be some time before they can begin to manufacture with any confidence of success, and all applications for means to make steel armour-piercing projectiles in the Royal Laboratory have hitherto been refused.

The development of projectiles is, however, only one part of the question at issue, for the efficiency of our armour is indirectly tested by trials of this kind. The plates have, for convenience sake, been too small, and not sufficiently supported, to enable us to regard the Shoeburyness experiments as fair tests of armour, nor were they intended for this purpose. Nevertheless, they show the resisting powers of the material sufficiently to indicate roughly how one kind of plate behaves compared with another. As to projectiles, no one can fail to see that steel shot are much more effectual than our best chilled iron ones, except, perhaps, in certain cases of oblique impact, when chilled shot have repeatedly produced an effect which is not easily explained. Our plate-makers now naturally inquire whether some modification in the plates might not be desirable to meet the attack of the steel shot, and we do not hesitate to say that some such modification is likely to be adopted. That this should be so, only reminds us of the fact that we ought to have tried foreign shot long since, seeing that it is their attack, and not that of our own projectiles, that our armour would have to encounter in war. Our makers have hitherto had to fulfil certain conditions drawn up by the Admiralty. When steel first was proposed seriously in 1877, our authorities laid down the condition that our plates must bear a certain amount of fire without through fracture. A plate now must not exhibit through cracks after one blow, and no one of the first three projectiles fired at it must get through it. To resist through cracks, the plate's back must be soft. The metal at the back must elongate easily—that is, its elastic limit must be low—or, as experience has taught us, it will crack under impact. Metal may have great powers of elongation when tested in ordinary ways, but unless its elastic limit is low such powers are unavailing under impact, for the metal cracks instead of stretching. It is this Admiralty condition that, for good or evil, has fixed the character of our armour hitherto. This we may describe as soft and flexible in its mass, although its face has been hard. Steel-faced armour alone could have satisfied our conditions. So far as we have seen, steel plates tested at Gâvre are apt to crack through on the first blow.

The question is now forced home on us whether we have not gone too far in this direction, whether to meet the tremendous penetrative powers of steel it will not be necessary to follow the French so far as to allow our plates to crack through, and trust to bolts to hold the pieces on. In a measure this may surely be admitted. The first fracture of a plate is generally across the middle. Is there anything so unalterable in the exact dimensions of our plates that it may not be allowable for them to divide approximately in half if by such means we keep shot out that would otherwise penetrate? We are inclined to think that we shall have to go some distance in this direction. We are, in fact, satisfied that the plates now being turned out from Sheffield and sent to Shoeburyness are harder than they were a year ago. This is admitted for the face, we are inclined to believe that it is true also of the back.

Does this mean that we are coming to steel instead of compound plates? Not solid steel on the Schneider's system, we think, because we believe it is becoming more and more thoroughly established that its powers are played out. The face of a solid steel plate can only differ from its back by the effect of hardening, and the functions performed by face and back require a wider difference in quality than can thus be given. Thus the face must be too soft, or the mass and back must be too hard. Should plates be allowed to crack through, even in a limited degree, it is very possible, we think, that compound plates consisting of a hard steel face and soft steel back may come in, but it is also very possible that the present construction of hard steel face and tough iron back may hold its own, at all events at present. The main fact as regards plates that seems forced upon us is, that more cracking must be allowed, and harder plates must be employed to stop the forged steel projectiles which have come in.

THE PANAMA CANAL.

THE announcement just made that it is necessary to immediately raise a further sum of nine millions sterling for the continuance of the work of cutting a ship canal through the Isthmus of Panama, will doubtless be received with varied feelings by those investors who have hitherto supported this great scheme of M. de Lesseps by the free investment of their money. It was but comparatively a few months back that the celebrated French engineer drew a large draft on the confidence of his supporters. The readiness of the response to the appeal then made doubtless led M. de Lesseps to the belief that that confidence admitted of unlimited reliance being placed upon it. It may prove that he was fully justified in that belief; but it must be admitted that this further strain upon it will tax its continuance to the utmost. M. de Lesseps we know to possess in no ordinary degree that sanguine temperament which is an important aid to success in all great and unusual undertakings. We are not concerned with the financial aspect of this great work, but we may well at this time consider it side by side with the reports made by professional men which reach us from the other side of the Atlantic.

The statements made by M. de Lesseps respecting the progress made and making at Panama have been accepted with the fullest reliance upon his known high character and professional skill. But even the best of men may be self-deceived. Their judgment is always liable to be biassed by their desires, and although we are always ready to bear most fully in mind how triumphantly M. de Lesseps disproved the constant allegations of his opponents with respect to the Suez Canal, we cannot entirely refuse credence to the statements authoritatively made by unprejudiced engineers and others who have recently inspected the works at Panama. After reading these, and after considering them in the light of the fresh serious demand for additional capital, we are constrained to ask whether, even if the great canal maker be able to overcome all the engineering difficulties of his project, it will not be at a cost which must prevent the results of its working when open being satisfactory in a financial sense. Among English capitalists we can have no hesitation in saying there has long existed some such feeling, but among M. de Lesseps' own countrymen, confidence in him has hitherto continued almost unabated. Will this fresh demand upon it, coming as it does at the time when reports are rife most inimical to the prospects of success, strain it to the breaking point? It is impossible to leave out of sight the condition of public elements at the present day in the country whence alone may be expected to be derived the money required for continued prosecution of the work, and if that condition, coupled with adverse reports, should have a bad effect, we may possibly have to regret the complete abandonment of the vast works already executed.

Now ever since these passed their initiatory stages, we have heard the expression of much opinion, which, but for the antecedents of M. de Lesseps, must have greatly shaken public trust in the reliance to be placed on his judgment. We had hoped that as the works progressed the strength of the criticisms opposed to the scheme would have been weakened by the measure of success attained. But unfortunately this is not the case. Depreciatory opinion seems to intensify as the results obtained are compared with the enormous expenditure incurred. This we believe to have already passed beyond the first estimates framed by M. de Lesseps. The *New York Herald* has but lately given publicity to the views of an engineer just returned from a visit to the Isthmus. We may presume that a journal of the standing of the *New York Herald*, while withholding the name of its authority, would not have lightly admitted to its columns the dictum of any one whose position as a professional man did not demand for that dictum due weight. We find it stated that the work done during the last twelve-month has been "astonishingly small," and the enterprise is described as "dragging along in a hopeless sort of way." Several Scotch-built dredgers, purchased at a cost of £60,000 each, are said to be lying idle in the bay of Panama; while the few that are at work are described as dredging in silt that washes backward and forward with the tide. As regards labour, the provision of which necessary it has often been asserted constituted the only real difficulty in the execution of the work, we are told that in spite of having already more hands than it can find work for, the company is still importing labour at a vast expense from Liberia and China, and that idle men are to be encountered in daily increasing numbers in all directions. It is also asserted that, for some reason as yet undeclared, the company is meditating the removal of its offices from Panama to Colon in September next. If this removal is effected, the enormous expense of constructing Panama City, and of the large and expensive buildings owned by the company within it, will have been thrown away. What that would mean in the way of financial sacrifice may be estimated from the statement

made that the main office alone is said to have cost £60,000.

We are by no means disposed, when quoting such evidence, to overlook the fact that there has always existed in the United States a disposition to regard this great effort of foreign interference in American enterprise with much disfavour, and that tendency, we admit, should not be overlooked in assigning weight to the criticism offered by its public press. But the contention raised rests by no means on the observations of American engineers alone. Professional men of almost every nationality have recorded varying opinions, many of them in accordance with this latest comment. It does not do therefore to refuse some amount of credence to it. It stands by no means alone. The demand for nine millions sterling for a work which is dependent for execution mainly on the skill and judgment of a single individual, however eminent he may be, may well create in the minds of those asked to contribute such a sum very serious doubt as to whether that skill and judgment are infallible. The successful construction of the Panama Canal would be an engineering triumph of which all the world could and would be proud. We are justified therefore in watching its course towards that success or towards failure with the closest possible attention, hoping throughout that, in spite of all, what is probably the closing labour of the great French engineer's career may fitly crown it.

PORTS AND STEAMSHIPS.

ONE of the peculiarities shown by the recent blue-book on shipping is that the tonnage of steamships is so largely held at a few of the ports of the United Kingdom. An old port like Barnstaple possesses only 36 tons of steam shipping, whilst Barrow has 54,527 tons. Again, Bristol has 22,226 tons in sixty-two steamers, whilst Cardiff has 148,378 tons. Dover has only seven small steamers, of 559 tons, Folkestone has none, Grimsby, 9877 tons; Hull, 157,913 tons; and the young port of West Hartlepool has 183,089. Plymouth possesses 5275 tons; Middlesbrough, 35,893 tons; Scarborough, 10,191 tons; and Southampton, 45,935 tons. Whitby, on the other hand, has 62,210 tons; Sunderland, 202,326 tons; and the Tyne ports, 332,189 tons. Again, it is clear, on an analysis of the figures, that the ports which have a comparatively small tonnage of steamers have a large number therein; whilst ports such as Newcastle, West Hartlepool, and Hull, have their steamers of a larger average size. For instance, West Hartlepool owns ninety-two steamers of more than 1000 tons each, nearly one-half the number it owns being above that large size; but Grimsby has only one above that size out of the fifty-six that it owns. Hull has not so large a proportion of its steamers above the size named as has the port instanced above. Out of 252 owned at the great Humber port, only a fourth are above 1000 tons each; but it owns also a large and more numerous fleet of sailing vessels, the tonnage of sailing ships from the South Durham port being few, and of small average size. It will be found that the determination of the steamships to certain ports, and especially the determination of the ownership of large steamers to those ports, is due to the principle of associated ownership. The older ports, as a rule, have not had so many of the ship-managing—as distinct from ship-owning—firms formed in the past two decades, but at the ports of Cardiff, Sunderland, West Hartlepool, and the Tyne, there has been a large number of such firms formed, and, in consequence, we notice that the ownership of fleets of cargo-carrying steamers has very greatly gravitated thereto, and the position of the ports of the United Kingdom, as regards ownership and the ownership of ships of a full average tonnage, has been altered very considerably. The past year or two has checked the multiplication of such firms; but now that there seems the probability of an era of trade better than during the last three years for our steam shipping fleet, it may be expected that there will be an increase in the ownership held by what has been called associated capital, and managed at and registered at the leading ports. Meantime—and it is one of the facts most noticeable—the ownership of these vessels is widely diffused over the country, the shares being more often held in inland towns than in the ports the vessels are registered at. It is a fact that has its influence alike on the shipbuilding and engineering trades, that there is an ownership of vessels over a wider area than that of the ports, and an ownership which is keenly alive now to the improvements in building and in the results.

THE BERLIN SCREW INDUSTRY.

IN reviewing the present situation of the screw industry, the *Berliner Tageblatt* lately remarked that Berlin makes screws in such quantities and of such qualities that its products are esteemed not only in Germany but in other countries. The principal manufacture is that of fine screws worked bright, from the larger sizes for machinery down to the smaller kinds for watch work, &c.; the materials employed being iron, steel, brass, German silver, &c. Efforts are now being made to increase the production of rough black screws for ordinary wood and iron-work; this class of screws having been hitherto principally made in Westphalia, but the development of machinery instead of hand labour in Berlin will, it is considered, alter this situation. There are in the Westphalian district—near Hagen—fifteen screw factories employing in all about 3000 workpeople. The Berlin industry comprises twenty-eight factories with about 1500 workpeople. As these are, however, almost exclusively engaged in the manufacture of screws—while at the various establishments near Hagen only about one-third of the work-people are employed in this particular industry—it is claimed that Berlin is at least as important a seat of screw manufacture as the Hagen district. Berlin used at one time to draw its supplies of raw material almost entirely from Westphalia, but of late years the constantly increasing employment of ingot iron and ingot steel instead of welded iron has developed the use of Brunswick raw material—from Peine—which are cheaper than the Westphalian articles, this being partly due to the shorter railway journey they have to make. Steam machinery is exclusively employed for making bright screws, one factory having lately erected a new steam engine of 45-horse power. The screw-making machines in use are upon a system invented by Kernaul some thirty-five years ago, but which has since then been much improved. The manufacture of these screw-making machines constitutes a special branch of Berlin industry. The introduction of the new patent automatic machinery will, it is expected, lead to a further development of the manufacture of screws, more particularly in connection with the making of nuts to go with the larger sizes of normal machine bolts. The history of the Berlin screw manufacture is considered to disprove the assertion that an important metal article can only be made in the immediate vicinity of the works where the raw material is produced. This result is attributed to the intelligence and manual skill of the Berlin workmen. One factory at Köpenik produces annually 2,000,000 steel horseshoe calkins, the steel for which comes from Hagen.

ACTIVITY IN THE STEEL TRADE.

THE position of the steel trade at the present time gives rise to the liveliest satisfaction. Not for a long time past have the prospects of the industry looked so promising as now. From all the centres of production accounts speak of much activity at the works, and prices are rising. Some of the north-east coast works have six or eight months' work ahead. The railway extensions now going on in India, South America, and the Colonies are furnishing large orders to the steel rail, steel sleeper, and to the railway constructive engineers in the matter of bridges and girders, steel wheels and axles and rolling stock. We should be glad to see a better price for rails, which at £4 2s. 6d. to £4 5s. per ton cannot but be considered low. It is satisfactory, however, that steel sleeper prices are fairly healthy at £5 to £6, and great things await the steel trade in the assured rapid development of the sleeper business. One firm in South Wales is at the present time engaged in the execution of an order for the Indian State railways for 280,000 sleepers, and within the next few days another large Indian contract which is now subject to competition will be decided. Tin bars, and other allied classes of finished material, are finding abundance of work for the Welsh steel makers, though at the moment the drought is checking execution. One of the most satisfactory features of the outlook is the renewed buying by America from English mills of blooms and billets, in consequence of which prices in Scotland have just quotably advanced 2s. 6d. to 3s. 6d. per ton. Open hearths, Bessemer, and basic steel are all sharing in the current prosperity, and there is abundant reason for believing in its continuance.

LITERATURE.

Matter and Energy: Are there Two Real Things in the Physical Universe. By B. L. L. London: Kegan Paul, Trench, and Co. 1887.

Cogito, ergo sum. Like Descartes, B. L. L. refuses to assume the existence of anything but his own consciousness—the *ego*, which for the metaphysician must ever be the basis and starting point of all reasoning. Having begun with this very modest assumption—for B. L. L., as far as we follow him, does not even go so far as to permit himself the existence of a physical frame—our author points out that he is conscious, nevertheless, of receiving impressions and sensations from without. To quote his own words, "We are constantly conscious of the counter-power which we call gravitation, and of others more occasional. We thus become aware of other energy, sometimes greater sometimes less, than we can ourselves command." In short, we are conscious that our mental state is continually being modified independently of our will. While B. L. L. admits that we cannot prove the existence of matter, he insists that we can be, and are, conscious of an agency external to ourselves, capable of producing sensations in us over which we have no control; and this agent, which has generally been believed by all but a few to be the material world around us, he would prefer to call Energy. That is, let us say, we are crossing a crowded thoroughfare and we are knocked down and considerably mutilated by a heavy wagon. B. L. L. will not permit us to speak of the wagon as having any existence outside our own mind, holding that what is incapable of proof should not be assumed as existing. What he does permit us to take cognisance of is the energy, which coming in contact with—*not* our material body, of whose existence we can have no proof, but with our own energy, produces a startling and very violent change in our consciousness. This, to use B. L. L.'s expression, "foreign energy," happens to be associated with the form and colour of a wagon. But is form matter, is colour matter? And if they are—and it requires a distinct intellectual act to convince ourselves that they are not—can form or colour have produced such agonising pain, such an agitated consciousness? No, we reply, it is the *substance* of the wagon; but as the only possible knowledge we could have of its substance or matter would be through our own sensations, it seems to follow—as B. L. L. points out—that our own feelings and the substance of the wagon are identical. B. L. L. here makes the suggestion, with which we are quite disposed to agree, that while by no conceivable argument can the existence of matter be proven, that of which matter has long been held to be, as it were, the vehicle, namely, Energy, is the only entity with which we need concern ourselves. But is not all this somewhat old ground? Without desiring to disparage B. L. L.'s careful and thoughtful little treatise, we cannot help feeling that he is preaching to the converted. Students of the laws which govern what is, after all, to all intents and purposes a material physical world, concern themselves chiefly with the energy, potential or kinetic, which B. L. L. is so anxious to have recognised as the only real entity outside the mind which is conscious of it, and the vexed question of the existence or non-existence of matter, full of deep interest as it is from a speculative point of view, is of extreme antiquity, and is being left more and more to the metaphysician.

The Geology of England and Wales. By HORACE B. WOODWARD, F.G.S. Second Edition. 8vo., 670 pp. London: G. Philip and Son. 1887.

ALTHOUGH this volume appears as a second edition, it is far from being merely a reprint. More than ten years have elapsed since the first edition, founded upon the classic "Outlines of the Geology of England and Wales," by the late Rev. W. J. Conybeare and Professor John Phillips was published, and the great activity of geological research since that time has been such as to render large additions necessary in order to present a fairly accurate view of the present state of topographical geology in this country. The work has been most conscientiously done, the whole body of geological literature has been searched and the result incorporated in the text, while in every case references to the original are given at the foot of the page. The number of these references must amount to several thousands, as they range from two to eight or ten for nearly every page. As a store-house of facts concerning the occurrence and distribution of rock masses in England it is likely to be of great and enduring value.

As might be expected in a work covering so many subjects, the different sections are not all of equal merit. Thus the coal measures being restricted to about twenty-five pages are necessarily somewhat scantily treated. The statement at p. 311 that the Northamptonshire iron ore yields from 40 per cent. to 55 per cent. of pig iron requires qualification, as nothing like such a yield is obtained on the large scale. It probably refers to selected samples. On the other hand, it is only fair to remark that the districts with which the author has become personally acquainted during his work on the Geological Survey are exceedingly well described, and the sections devoted to the secondary rocks of central and eastern England are very full and accurate as far as we have been able to test them. The volume is accompanied by a coloured map on the scale of about 1in. to 16 miles, drawn by Mr. Goodchild, of the Geological Survey, which is sufficiently large for most ordinary travelling purposes.

A Practical Treatise on Petroleum. By BENJAMIN J. CREW. 8vo., pp. 508. Philadelphia: Baird and Co. London: Sampson, Low and Co., 1887.

THIS volume is due to an author who was connected with the practice of petroleum refining almost from the beginning of that branch of American industry, but who, unfortunately, did not live to see it through the press. It contains, in 480 pages of large type, notices of the origin, distribution, history, method of working and refining of mineral oils, as well as of the tests and uses of the finished products for lighting, heating, and pharmaceutical purposes. There is also a short account of the natural gas wells in the neighbourhood of Pittsburg. As might have been expected from the author's special familiarity with the subject, the section devoted to the distillation and purification of the various hydrocarbon products is most complete, the different operations being described in considerable detail, with some illustrations. The latter, however, are mostly of a diagrammatic character, and not such as might be looked for in a professedly practical treatise, many of them being merely perspective sketches, without scale or figured dimensions. The general theory underlying the distilling operations is, however, well given. The editors have added greatly to the value of the book by adding in an appendix the papers on the product and exhaustion of the oil region of Pennsylvania and New York, and on the geology of natural gas that were contributed to the Halifax meeting of the American Institute of Mining Engineers in 1885 by Mr. C. A. Ashburner, of the Geological Survey of Pennsylvania, which are among the most exact and authoritative contributions that have as yet been made to our knowledge of these very obscure subjects.

BOOKS RECEIVED.

Transactions of the Society of Engineers for 1886. Edited by Chas. J. Light, secretary. London: E. and F. N. Spon. 1887.

The Health of Nations: a Review of the Works of Edwin Chadwick, with a Biographical Dissertation. By Benjamin Ward Richardson. 2 vols. London: Longmans, Green, and Co. 1887.

The State Purchase of Railways. By Chas. Waring. London: Chapman and Hall. 1887.

A Manual of Practical Solid Geometry, adapted to the Requirements of Military Students and Draughtsmen. Compiled by William Gordon Ross, R.E. London: Cassell and Co. 1887.

Notes on Concrete, and Works in Concrete. Especially written for those engaged upon public works. By JOHN NEWMAN, Assoc. M. Inst. C.E. London: E. and F. N. Spon.

HERR ALFRED KRUPP.

THE Steel King is dead. Herr Alfred Krupp died at his Villa at Essen, on the 14th inst., aged seventy-seven. The materials probably exist, although they are not yet available, for writing a history of this man, who has done at least as much as Bessemer and Whitworth, though in a different way and on different lines, to develope the manufacture of steel. Krupp was the greatest crucible steel founder in the world, and many of his largest castings depended for their success on the wonderful discipline with which, like trained soldiers, his men obeyed the word of command. The privacy with which Krupp carried on his work, and the natural reticence of the man, render it difficult to obtain minute information concerning his life and career. Herr Krupp was born on April 11th, 1810, at Essen, where his father, Frederick Charles Krupp, had set up a small foundry. When his father died Herr Krupp and his brother carried on the business in partnership with their mother until 1848, when Alfred became sole possessor of it, and—preserving the firm's old style of "Friedrich Krupp"—developed it into the greatest steel-casting industry in the world. The Krupp steel foundry a few years ago covered an area of 500 hectares, and employed 10,600 workmen, in addition to the 5000 men employed in other undertakings at the firm. No fewer than seventy-seven steam hammers were constantly at work. Railway lines connected the works with the railway system of the country; and the establishment included a chemical laboratory, a photographing and lithographing house, and book printing and binding workshops. The articles produced included axles, wheels, machinery of various kinds, cannon, and shells and other missiles, some of the cannon rivalling in size and power the most tremendous productions of Whitworth and Armstrong. His achievements in the course of a long and active career have more than once been rewarded by his Sovereign and by foreign princes, and some time ago it was announced that the Emperor had conferred upon him the rank of baron.

THE inauguration of the new docks at Dieppe took place on Sunday, the 17th inst., with much ceremony.

COTTON MACHINERY AT THE MANCHESTER EXHIBITION.

No. III.

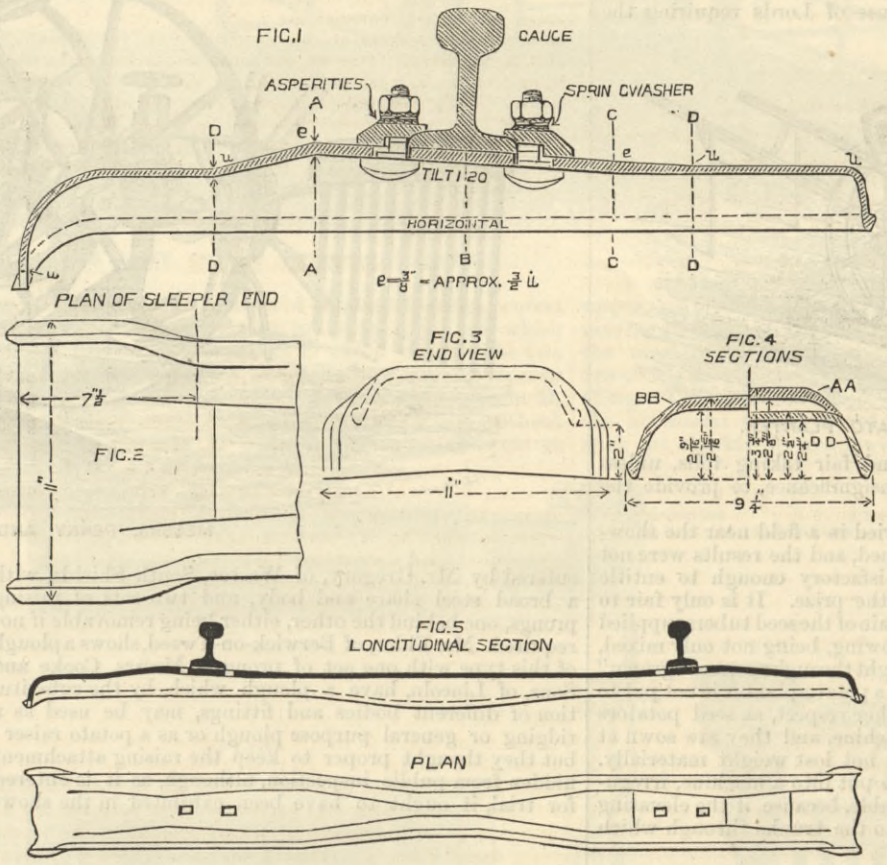
FOLLOWING the order of the successive processes in the spinning and manufacture of cotton, we have in previous articles noticed the principal exhibits of machinery for opening, cleansing, and carding or combing of the staple. The fibres at this point are laid approximately straight and parallel, freed as far as may be from foreign substances, and are deposited in the form of a rope or sliver in tall cylindrical cans. If impurities cannot be got rid of now, there can be no hope of eradicating them by subsequent treatment. What remains to be done is to draw out the slivers and to equalise them by repeated "doublings," until at last they are sufficiently thin and even to be spun into the requisite "counts," or "numbers" of yarn. The first machine used in this series of operations is the drawing frame, of which exhibits are made by Messrs. Curtis, Sons, and Co., Platt Brothers and Co., Howard and Bullough, Samuel Brooks, Samuel Walker, and Asa Lees and Co. The essential part of the drawing frame is a series of rollers, or rather, series of pairs of rollers, each pair revolving more rapidly than the preceding one. Six slivers, after being drawn through the rollers, are combined in one, and the process is repeated two or three times until the equalisation has been carried as far as may be deemed necessary, the final form being still that of a sliver deposited as before in a cylindrical can. Drawing frames are so much alike, and the work performed by them so simple, that there is little room for variety of construction. They run, however, at a very rapid rate, and consequently need to be well made in all the moving parts, and these must, of course, be constructed of the most suitable and durable materials. The bottom rollers, which are fluted externally, are case-hardened, and the roller bearings are bushed with brass. The top rollers, which are covered with leather, are pressed down closely when the machine is at work upon the lower fluted rollers by means of weights hung from the saddles resting between the bosses of the rollers. In all well-made machines of this class there is a weight relieving motion, by means of which when the machine is not at work the pressure is removed, and thus the upper rollers are prevented from becoming indented and uneven. All except one of the machines exhibited have the ordinary balanced "spoon" stop motion, by means of which the driving-strap is at once turned off, and the frame stopped whenever a breakage occurs in one of the "ends" or slivers entering the rollers at the back. This stop motion is quite efficient for its purpose—viz., to prevent the frame from working without the proper complement of "ends" at the back, and so producing uneven "drawings." Messrs. Howard and Bullough have, however, by an ingenious application of electricity, introduced a method of automatic stoppage which not only accomplishes this purpose more promptly than the ordinary spoon motion, but provides also for the quick stopping of the machine in other emergencies. Occasionally, for example, the drawn sliver, as it emerges rapidly from the finishing rollers, becomes knotted as it enters the calender rollers, through which it passes before being deposited in the can. Again, the cotton, when being drawn, occasionally becomes "lapped"—especially in damp weather—round the upper leather rollers of the drawing series; and lastly, injury may result from the attendant allowing the receiving can to become "choked" full. Provision is made in the Howard and Bullough frames by which the frame is at once brought to a halt in each of these emergencies through the electric stop motion. The electric current used for these various stop motions is obtained by means of a small magneto-electric machine worked as part of the drawing frame itself. It is always available, therefore, whenever there is a possibility of its being brought into action for the purpose of arresting the frame, and ceases to be produced when there is no need for it.

Messrs. Asa Lees and Co.'s, and Messrs. Platt's drawing frames have mechanical stopping motions serving the same purposes as the electric arrangement just described, and providing therefore for breakages at the front as well as at the back of the rollers, and for stopping the machine whenever a recipient can is full.

Following next after the operation of drawing are those of slubbing, intermediate slubbing, and roving. These three processes are substantially identical, and the machines employed in them are very much alike; their object is to further equalise and attenuate the sliver, which at each operation receives a slight twist in order the better to make it hold together. The cans filled at the drawing-frame are placed behind the slubbing frame, from which the slivers are slowly drawn through a series of rollers similar to those used in the previous operation, each one being then wound upon a hollow wooden tube. When full these tubes or bobbins are treated in precisely the same manner by the intermediate frame, which further reduces the thickness of the thread and again winds it upon still smaller tubes. For the purpose of securing evenness, however, two slubbings are united and passed together through the rollers. The roving is simply a repetition of the intermediate process, but with further attenuation, and the loosely twisted roving is then ready for the final operation of spinning. The specimens of machinery exhibited illustrating this section of the cotton industry are all excellently finished, and anyone who is acquainted with such machinery as it was constructed twenty years ago will see considerable improvement in the workmanship and arrangement of the several parts, although very few fundamental changes have been made within that period. Generally, however, the improvements are such as enable the frames to be driven at a much higher speed than formerly without risk of breakage, and without in any way interfering with the efficiency of the work. The apparatus in most of the frames for adjusting the speed of the bobbins to the varying diameter of the coil of cotton placed upon it is that known by the familiar name of the "jack-in-the-box," invented about forty years ago. An improvement upon this arrangement is exhibited in machines of Curtis, Sons, and Co., and Platt Brothers and Co. The advantages claimed for the new arrangement are that there is much less wear and tear, greater compactness, much less noise, and steadier working than is possible with the old winding motion, as well as greater regularity in the winding. It is not easy to describe this arrangement, even with the aid of diagrams, and those who are interested in it will do well to inspect the motion for themselves. The patent knocking-off motion of Messrs. Asa Lees and Co. should also hail attention, as well as the modified differential motion of Messrs. Howard and Bullough. The last-named firm have also adapted their electrical stop motion to their intermediate and roving frames for the purpose of preventing the troublesome occurrence of "single"—bad breakage of one of the two threads which in these machines are united and drawn through the rollers together.

POST'S METALLIC RAILWAY SLEEPERS.

THE accompanying engravings illustrate sleepers made from the designs of Mr. M. Post, the permanent way engineer of the Netherland State Railways at Utrecht, and in use on those railways. The sleeper is of steel, rolled of the varied thickness



and section shown, and with a rail-tilt of 1 in 20. The design of the sleeper and fastenings is fully shown by the engravings, and very large numbers are now down on railways in Holland and elsewhere. The method of rolling or the cost we are not acquainted with, but the result is a sleeper that has largely commended itself, and which has some very good features.

THE FRENCH RAILWAY EXHIBITION.

THE following statements have appeared in the *Temps*:—The Municipal Council, who, on the 15th of December last, conceded, for the purposes of an especial Exhibition, a portion of the Bois de Vincennes to the company formed to celebrate the fiftieth anniversary of railways, moved on the 13th of June for an enquiry into the proceedings of the company.

The enquiry has been a long and laborious one. The results are given in a report drawn up by M. Daumas, and divided into two parts; the one touching in a few words on personal questions, the other setting forth the position and actions of the said company. The following are the principal passages of the report on these two points:—The Civil Company—composed of MM. Gabriel Lévy, Achille Weille (M. Lévy's employé), Ernest Bloch, Isaac Lévy (son of G. Lévy), and Samuel Serf (M. Lévy's sleeping partner)—inspired very little confidence; so little indeed that the third and fifth Commissions asked permission to communicate with the organising committee, which was composed of MM. Montant, deputy-president; Salvaire and Ollivier, vice-presidents; Sautereau de Glatigny and Sincholle, secretaries; and it is in fact only with the members and delegates of this committee that all the questions relative to the project of ceding a portion of the communal lands were discussed and treated.

The project, presented and accepted by the Council, consequently bears the title "Authorisation to the Company and to the Fiftieth Anniversary Committee," &c. However, the organisation committee was dissolved, MM. Montant and Salvaire having resigned on the 2nd of May. Under these circumstances the committee ought certainly not to have retired. If it was obliged to do so it ought to have given notice of its intended withdrawal to the municipal administrators, with whom it had been in treaty. The commemorative Exhibition depended in a great measure on the concurrence of the principal railway companies. This was the opinion of all the competent persons who gave their evidence in the inquiry. At the meeting, which took place on the 11th of December, before the third Commission, the delegates of the organisation committee affirmed on two different occasions that the Midi, Orleans and Ouest companies would assist at the Exhibition, and then that they had replied negatively. These facts took place previous to the deliberations of the Council on the 15th of December, and prove that its confidence was deceived. The following facts bear the same character.

The City had only one engagement to fulfil. It had to make over a part of the Bois de Vincennes to the company and to the committee; but possession of the land could only take place on the ratification of the definitive construction of the company and on the assurance of the deposit of a capital of 1,000,000f. This capital of 1,000,000f. has not been deposited by any of the partners. M. G. Lévy again endeavoured to save appearances by presenting a cheque for one million, drawn on the "Comptoire d'Escompte" by his own employé, M. Argan, while there was no corresponding provision for the payment of the cheque. M. Argan was perfectly known to M. Hussemat-Desenonges as having been for a long time in the employment of M. Lévy, and it is useless to add, that although he had a private account at the Comptoire d'Escompte, his deposits in this bank had never amounted to more than some hundreds of francs. The solicitor who drew up the contract for the Civil Company, M. Hussemat-Desenonges, did not even assure himself of the reality of the deposit. The facts brought to light by the inquiry show that the first and most important condition of the contract has been violated by the Civil Company. The City of Paris has, consequently, an absolute right, independently of the declaration of failure pronounced against the company on the 6th of July, to resume possession, if and when she thinks proper, of the land in the Bois de Vincennes, which she placed at the disposition of the Civil Company, and of the organisation committee. The other conditions stipulated for in the contract have not been better observed than that relating to the constitution of capital.

Passing on to personal questions, they are condensed in the following terms:—Accusations have been made against persons, notably against some municipal councillors who had a material interest in sustaining the enterprise of M. Gabriel Lévy. These accusations have been carefully examined into, and all persons likely to be able to throw any light upon the subject have been called before the Council, but the statements have not been verified. The matter was further discussed at a meeting, when it was declared that not only had the Municipal Council the right to withdraw the concession of land made to the society, but that it could demand indemnification for the damage done in the Bois de Vincennes. Further inquiries were called for on both sides, and it was decided that the discussion should be resumed on the following day.

MULTI-CYLINDER ENGINES.

FOR some reason or other modern marine engines are called out of their names, to use a popular expression, and it is singular that engineers should generally adopt the terms triple-expansion and quadruple-expansion engines to indicate types, when such names are manifestly improper. The grades of expansion are far higher than the terms used signify. It would be more correct to say that any given type of engine was a three-cylinder expansion, or four-cylinder expansion engine, instead of triple-expansion and quadruple-expansion engine.

This leads us to remark that engines of this class present a complete paradox for engineers to solve. Engineers generally are agreed—tacitly or otherwise—that the extraordinary economy of these engines is due to the lessened cylinder condensation, and the ability to expand steam from very high to very low pressures with less loss than is incurred by expanding to equal ratios in one cylinder; but no one has yet explained satisfactorily how this can be. In three and four-cylinder expansion engines there is an enormous increase of cylinder surface; there are very greatly enlarged clearances—in the high-pressure cylinder of quadruple cylinder engines these latter are tremendous—and there is the friction of four engines and their details, the leakages and wear of parts, and the dead weight to be carried. Yet, with all these well-known disadvantages, a ship can make longer voyages with less coal with four engines than with one engine. In plain words, the more cylinders of certain diameters there are used in a steam engine the higher is the economy. This is the paradox, for it is not only contrary to good mechanical practice, but it is opposed to common sense; nevertheless, it is a fact that triple-cylinder and quadruple-cylinder expansion engines are much more economical for shipowners than compound or single-cylinder engines. The coal bunkers say so, and their testimony comes from the court of last appeal. We may theorise and argue as we please, but if four engines drive a ship at a certain speed with less coal than one engine will, the men who pay for the coal will use four engines.

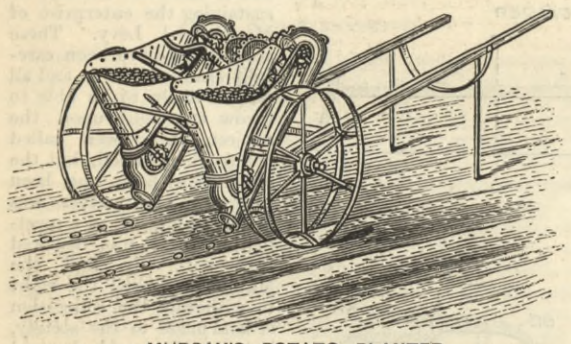
In default of better information on the subject, we must accept the statement that this economy is derived, as before stated, from the greater efficiency of the steam by using it in four cylinders instead of one, but we accept it under protest. No one has ever tried anything like the pressures used in four-cylinder engines on a single cylinder, and it will be a long time before they do, for mechanical reasons and for professional reasons also; no one has yet had the pluck to build a single-cylinder marine engine of high power to use steam at 160 lb. per square inch. The highest that we know of is 90 lb. on the Hudson of the Cromwell Line, and her performance per pound of coal is equal to the best compound engine. Until this is done we must regard the argument of multi-cylinder engines *v.* single-cylinder engines as not proven.—*U. S. Mechanical Engineer.*

DR. PAGE'S report to the Local Government Board on the general sanitary condition of Margate in relation to the continued existence of typhoid fever in the borough was published on Saturday. The report, which is dated June 14th last, states that the population may be estimated at 18,000, living in 3067 houses, and in August the number of inhabitants is probably trebled. Dr. Page speaks first of the water supply, which is pumped from a well at Tivoli—on the south-west inland boundary of the town. With regard to the quality of the present supply, there is, says the report, every reason to regard it with the gravest suspicion. With regard to the sewerage, Dr. Page sums up his conclusions by saying that Margate is a "cesspool town." Some fragmentary sewerage, however, exists in places next the sea front. The report concludes by urging the Town Council to take immediate steps to improve the sanitary state of the town. Counter reports have appeared.

THE IMPLEMENT TRIALS AT NEWCASTLE-ON-TYNE.

APART from the trial of engines, it must be admitted that the Society's efforts to develope competition among the manufacturers of implements and machines have proved disappointing. A prize of £20 was offered for the best potato-planter, and only two firms competed. For the trial of potato-diggers, or raisers, to be held in the autumn, there are eleven entries by ten firms; but it remains to be seen whether all will put in an appearance in the trial fields. For a one-man power cream-separator, to be worked by hand, capable of dealing with 20 gallons of milk per hour, the prize of £25 was offered, and this brought three entries, one of which failed to appear, while a second was disabled by an accident. For the best weighing-machine for horses and cattle, the Society offered £25, and for a machine of the same kind for sheep and pigs, £20. Here there was no competition at all. Messrs. Hart and Co., of London, whose machines have been used for weighing animals at the Smithfield Show for many years, being left in possession of the field with three entries. This is the more remarkable because great efforts have lately been made to introduce in the United Kingdom the system of selling stock by live weight, long adopted with entire satisfaction in the United States; and a Bill has passed the House of Lords requiring the

FIG. 1

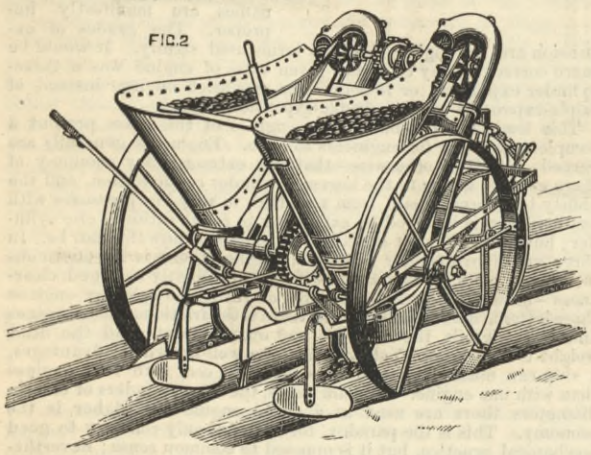


MURRAY'S POTATO PLANTER.

authority of every market and fair taking tolls, unless exempted on the ground of insignificance, to provide the means of weighing cattle.

The potato-planters were tried in a field near the show-yard before the show was opened, and the results were not considered by the judges satisfactory enough to entitle either of the competitors to the prize. It is only fair to state that the exhibitors complain of the seed tubers supplied to them as utterly unfit for sowing, being not only mixed, large and small, but also very light through age, and "grown" as well. In ordinary practice a potato-planter is not put to so unfavourable a test in either respect, as seed potatoes are always sorted for the machine, and they are sown at a time when the tubers have not lost weight materially. When potatoes of all sizes are put into a machine, irregularity in dropping is unavoidable, because if the elevating cups which raise the tubers to the trunks through which

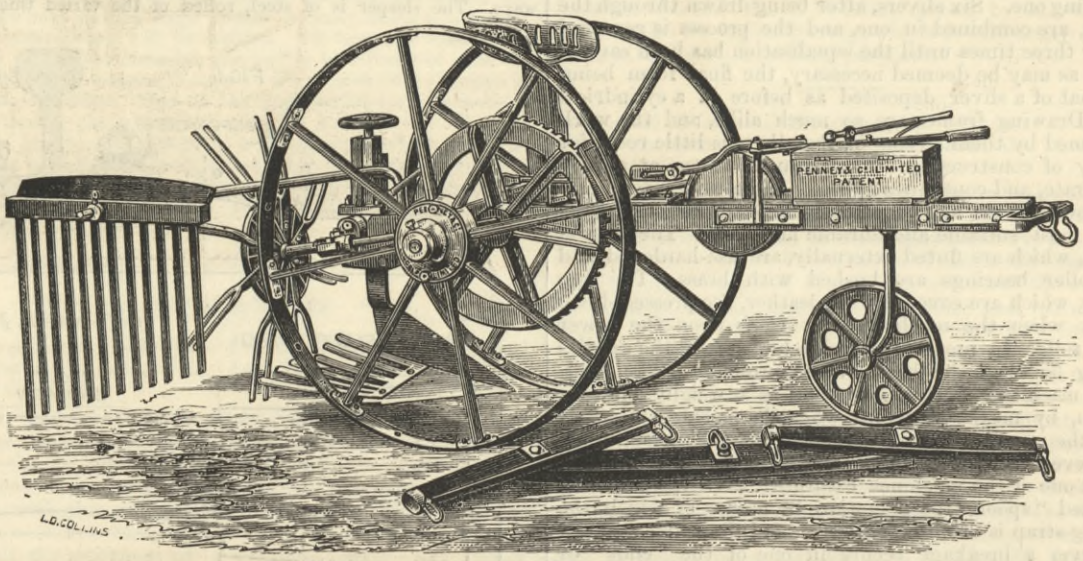
FIG. 2



MURRAY'S RIDGE POTATO PLANTER.

they are dropped into the furrows are big enough to carry one large potato each, they will carry two small ones. Messrs. Murray and Co., of Banff, entered six machines, four of which drop the seed between the ridges made by the plough, leaving the plough to split the ridges and cover the seed; while the other two split the ridges, deposit the seed, and cover it in one operation. The work of the last two was not satisfactory, as the seed was not deposited deeply enough. This, the makers contend, was owing to the field being full of grass, the land having been under grass till recently. On the other hand, the soil was very dry and powdery, and we imagine that on heavy land in a showery spring the difficulties to contend with would be much greater than they were in the trial field. Of the four dropping machines, one does one row at a time, two deal with two rows each, and one drops four rows. In each case the seed can be dropped at three distances, and one of the two-row machines will plant on different widths of ridges. Mr. Kyd, of Coupar Angus, the only competitor of Messrs. Murray, had a two-row planter which, like four of Murray's machines, simply dropped the potatoes in the drills. This type of machine has been in use in Scotland, and some parts of England, for many years, various improvements in detail having been made from time to time, and on this account it is all the more to be regretted that the conditions of the trial were not more carefully and fairly arranged. At first sight, the splitting and covering machines seem the more desirable; but there is not so much advantage in their use as might be hastily concluded. Growers like to have the manure underneath the seed tubers, and to insure that the manure must be put in the drills after the land has been ridged once. In using a planting-machine which simply drops the seed, it would be set to work directly after the manure had been spread, and then the plough would split the old ridges to cover the seed and form new ridges. If the splitting and covering type of planter is used, the second ridging is done in front of it instead of after it, and then the seed cannot be covered so well, nor can the ridges be left as neat, as when the plough does the finishing operation. No doubt, if a field in good order be manured on the flat, one ridging instead of two suffices if the planting and covering be done in one operation; but the manure is not so well-placed as when put in the furrows, and it is certain in the case of farmyard manure to be brought more or less to the surface by a splitting and covering machine. Another disadvantage of this type of machine is that any irregularity in dropping is hidden by the immediate covering of the seed.

There are two types of potato raisers among the eleven machines entered for trial in the autumn. The first is the old potato-raising plough, with prongs behind the share. The only novelty in this form of raiser is a plough

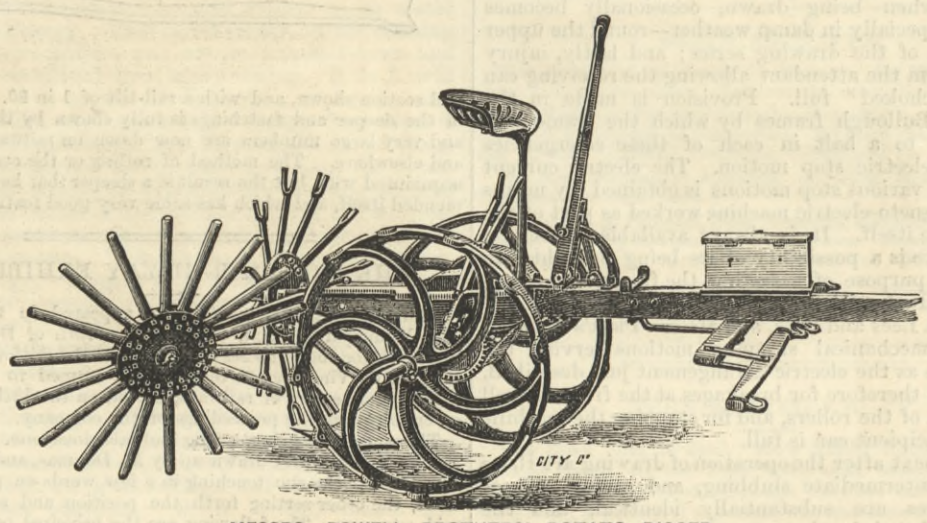


MESSRS. PENNY AND CO.'S POTATO DIGGER.

entered by Mr. Gregory, of Westoe, South Shields, with a broad steel share and body, and two sets of raising prongs, one behind the other, either being removable if not required. Mr. Elder, of Berwick-on-Tweed, shows a plough of this type with one set of prongs. Messrs. Cooke and Sons, of Lincoln, have a plough which, by the substitution of different bodies and fittings, may be used as a ridging or general purpose plough or as a potato raiser; but they thought proper to keep the raising attachment hidden from public inspection, although, as it is entered for trial, it ought to have been exhibited in the show-yard. Messrs. Lankaster and Co., of London, exhibited an American plough for raising potatoes, which has no notable feature about it.

Of the diggers, all but one have a wide steel blade-shaped share to go under the potatoes and lift them, and this is followed by revolving prongs which detach the tubers from the soil and spread them on the surface, while in some cases there is a shield, fixed or revolving, which keeps the potatoes from rolling about. Messrs. Powell Brothers and Whittaker, of Wrexham, exhibited the most elaborately-arranged of these machines. The revolving wheel is cone-shaped, the forks being set at an angle, so as to work under the ridge and avoid covering the tubers. A light wooden revolving wheel or cratch is fixed behind the forks, to keep the potatoes from spreading, and to sift the soil, which can pass through the spokes, from the tubers. This wheel is caused to revolve gently by the soil striking against it, and by this means the potatoes, it is claimed, are kept from being bruised. The gearing is entirely enclosed, the speed being gained by spur and bevel-wheels, and the fork spindle is raised above the main axle so as to give the revolving forks the proper angle. The bevel-wheel has a bearing on each side to insure level running. The machine is fitted with a pole to prevent it from running askew and cutting through the potatoes, as one drawn by whippletrees may do if the horses swerve. A seat for the driver is attached to the pole, and the lever by which the depth of the digger can be regulated is well within his reach, as well as the arrangement for putting it in and out of gear. Messrs. Penny and Co., of Lincoln, have entered for trial a digger similar in character to that just described; but the horses are attached to whippletrees instead of to a pole; the spliced shield or cratch, to keep the tubers from spreading, is fixed instead of revolving, and rectangular in shape, while the share resembles an ordinary ploughshare; whereas, the other machines of this type have a curved blade more like a large and strong turnip-hoe. In this last respect Messrs. Penny's machine seems to have the advantage, as the share is well-adapted to pulverise the soil and raise the tubers towards the revolving prongs. Messrs. Allan and Co., Dunkeld; Elder, Berwick-on-Tweed; Jack and Sons, Maybole; Kyd, Couper Angus; and Thompson, Berwick-on-Tweed, have entered diggers similar to those described except in weight and various minor details.

The only hand-power cream separator tried was the Laval, exhibited by the Dairy Supply Company of London, and described and illustrated in THE ENGINEER of April 22nd. Since that date the machine has won the gold medal of the Bath and West of England Society, it being the only separator to compete at the Dorchester show of that association. It was then worked without much difficulty for an hour without stopping, by a rather small man, a Swede, and the analysis of the separated milk was very satisfactory. When tested last week at Newcastle, the Swede was again the operator; but there was not enough milk for more than a run of forty minutes, instead of the full hour arranged for. It appears that the milk used had begun to turn sour, so that the separation could not be effectively done, as sour milk clogs a separator. Consequently the analysis of the separated milk was not at all satisfactory, and is not to be published, the judges practically admitting that they were to blame in not seeing that milk fresh from the cow was supplied for the use of the machine. At Dorchester, where this separator was thoroughly and repeatedly tested, there was only 0·14 per cent. of fat left in the separated milk, a remarkably satisfactory result. The judges, satisfied that the working of the machine was well within the power of one man, and knowing that the unsatisfactory analysis was not the fault of the separator, awarded to the Dairy Supply Company the prize of £25. The machine, we should have mentioned, is supposed to separate 25 gallons of milk per hour, and it dealt with 23 gallons at Dorchester. A larger machine, to separate 35 gallons an hour, was tested, though its price is beyond the limit named in the conditions of competition. It has the separating cylinder horizontally placed, instead of vertically, as in the case of the smaller and all other separators. It has been declared by some people who have tried both machines that it is easier to work than the smaller one, but the judges pronounced it beyond the power of one man to turn for an hour at a stretch.

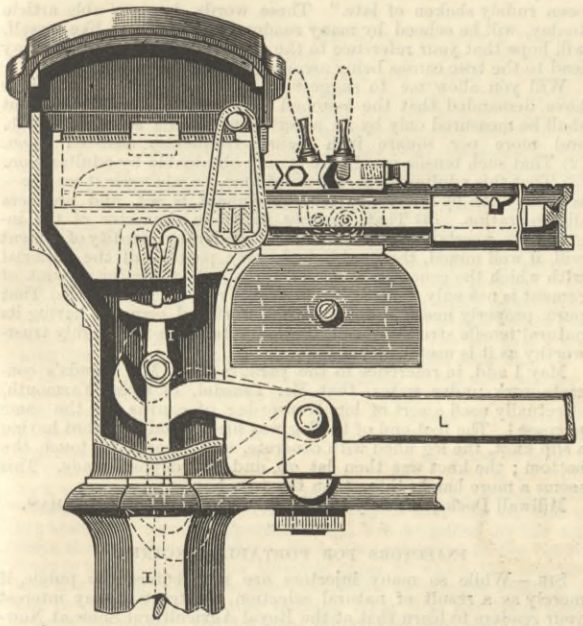


MESSRS. POWELL BROTHERS' POTATO DIGGER.

The Aylesbury Dairy Company had a hand-power separator of Danish manufacture on the ground, but it was not submitted to trial, because it had been injured by a spanner having somehow got into the cylinder when it was being privately tried, and the balance had not been perfect in repairing. This machine, a cut of which we may give, is strikingly like the Laval in construction, differing chiefly in the larger size of the separating cylinder, which therefore requires less rapid revolution to effect its purpose. This separator consists of a flat drum fixed to a vertical spindle driven by a system of cogged wheels and

belt, one turn of the winch handle producing 100 on the drum spindle. The last wheel in the gearing, which is mounted loose on a rocker arm, carries the belt from the spindle and the pinion wheel, into which gears the second cog wheel. This pinion wheel is driven by means of a vertical shaft and bevel wheels connected with the handle, the speed being from twenty-six to thirty turns a minute. Owing to the belt pulley being mounted on a loose arm, when power is applied to its pinion by means of the cog wheel, it tends to rotate round the same, and thus slipping of the belt is prevented ; and another advantage obtained is that the winch handle and gearing do not rotate unless power is applied. The drum, which is stamped from sheet steel $\frac{3}{16}$in. thick, is flat, 12in. in diameter and 3in. high, with an aperture of 6in. in the top. The internal fittings of the drum comprise a vane to carry the milk round, and the skim milk exit, a combination of two tubes and valve, which is regulated to pass the correct amount of skim milk for the speed at which the drum runs. The cream is removed by means of a tube projecting from the external casing and reaching into the drum, the tube being provided with a steel nipple. At a speed of 3000 this machine extracts the fat from twenty gallons of milk in an hour.

There is nothing new in the well-tried machines for

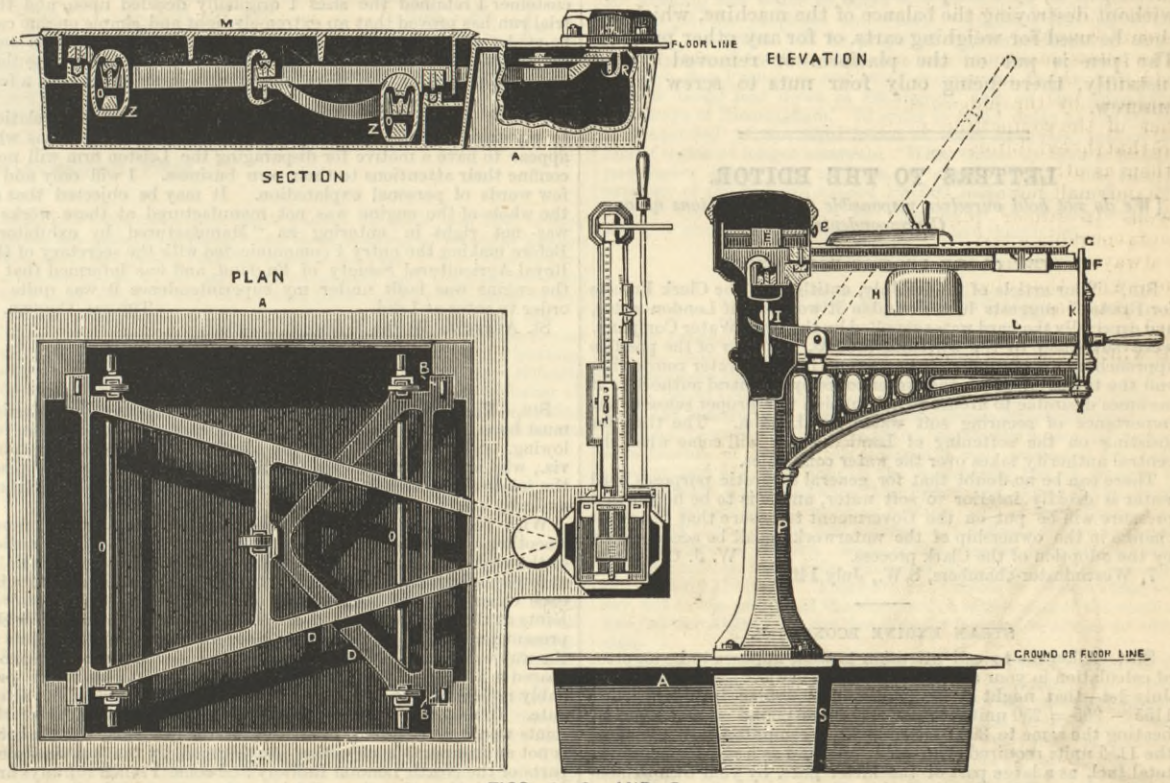


HART'S WEIGHING MACHINE STANDARD, FIG. 4

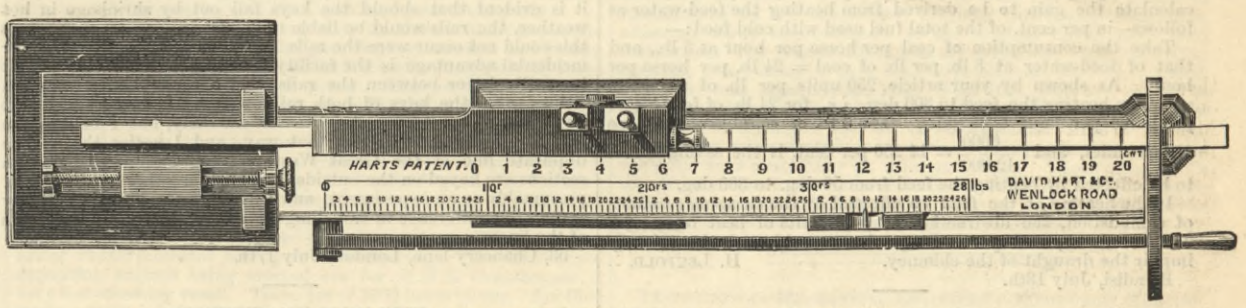
weighing live stock and farm produce generally, entered by Messrs. Hart and Co. Their machines are self-indicating and have no loose weights; the frames have solid bottoms cast on to exclude damp, and all centres work in cups of oil. We give a drawing of the machine of medium size for weighing cattle and horses up to 21 cwt. The pen is of forged wrought iron, and has a gate at either end to facilitate the entrance and exit of animals. The front of the pen and the gates can be removed when the machine is required for ordinary farm produce, and the balance of the machine is not affected. The machine can be mounted on wheels, stand on the ground or floor, or be sunk either wholly or partially. The steelyard is automatically unhooked when the machine is thrown out of gear, and may be taken out for safety and to preserve it from rust. The other entries consist of a smaller machine, for sheep and pigs, weighing up to 6¼ cwt., and a larger one which weighs up to 3 tons. This last machine is so arranged that the pen can be entirely removed in order to weigh carts. The judges awarded the prize of £25 to the machine for weighing cattle and horses, and £20 to the smaller machine for sheep and pigs. In these machines, to the makers of which were awarded the two prizes, of £20 for the best machine for weighing sheep, pigs, calves, and £25 for the best machine for weighing cattle and horses, the frame A, Fig. 2, has a solid bottom cast in, to exclude damp. The four corner blocks B are drilled to receive the hardened steel V blocks for the main centres of the levers to rest in. They also form stops for the platform to rest on when the machine is out of gear, and receptacles for oil, as one of the advantages claimed is that every centre in these machine works in a cup of oil, to protect it from rust. The levers D D are fitted with hardened steel centres. The long lever passes through the neck S of the frame, and—see section, Fig. 1—lies in a recessed hook R, Fig. 1, attached to the rod I, Fig. 4, which passes down the pillar P, connecting the long lever with the steelyard or beam when the machine is in gear. The two levers D D are coupled together in the centre, as shown, with a sling or strap, a steel block or universal joint being interposed, to give

HART'S PRIZE CATTLE WEIGHING MACHINE.

freedom of motion. On each of the four fulcrum centres of the levers D D is placed a universal joint, on which hang the four straps or slings Z which support the two swing bars O, which pass through them and have cups formed in their ends to receive the feet of the platform M, which can thus move freely in either direction without causing any grinding or wearing action on the centres



FIGS. 1, 2, AND 3



DETAILS OF HART'S SELF-INDICATING WEIGHING MACHINE.

—the levers always remaining stationary when the machine is in gear. The fulcrum centres of the steelyard rest in two steel V blocks fitted in the pillar P—Fig. 3. On the back centres of the steelyard hangs a double hook or shackle W—Fig. 4—to which the hooked upper end of the pillar-rod I is attached when the machine is thrown into gear, and from which it is detached when it is thrown out of gear by the action of the relieving apparatus. A guard plate K—Fig. 3—is fitted to the end of the arm of the pillar. This performs several functions. It has an elongated opening in it at F, in which the end of the steelyard oscillates when at a balance, the top or bottom of which control it when it is out of balance, and the bottom of which forms a rest for it when the machine is thrown out of gear. The guard plate K has also a rest formed in it for the striker lever L to lie in when the machine is in gear. Its form also is such as to act as a guide to the strike lever L in throwing the machine into and out of gear. This lever works in a swivel rest in the pillar, as shown. The end of the lever farthest from the guard-plate works in a loop in the pillar rod I. When the machine is out of gear the lever L is in the upright or dotted position. The action of bringing it down in front of the guard-plate K, passing it under the front of the latter, and up into the rest in it, furnishes—by its form—the necessary motion to its other end to raise the levers D D, by means of the pillar rod I, passing the hooked upper end of the rod I up behind the shackle W, then moving it forward and attaching it to it, thus throwing the machine into gear, the end of the lever J finally remaining free in the loop of the rod I, not touching anything. The reverse action of moving the strike lever from the horizontal to the dotted position detaches the rod I from the shackle W, and lowers the levers to the bottom of the frame, and the platform on to the stops B in the corners of it. No centres in the machine can then be affected by any amount of weight placed on the platform, and traffic may be taken over it, if fixed in the floor, without any injury to them. The steelyard being now entirely disconnected from the remainder of the machine, may be taken out, if required, and put in a place of safety. The arrangement of the steelyard is shown in the plan of one of 21 cwt. capacity, which we illustrate. No loose weights whatever are used. There are two sliding weights, the one representing cwts., the other qrs. and lbs., or any other weight desired. When both weights are at zero, the steelyard balances with an oscillation similar to that of a beam scale. The cwt. divisions are notches cut in the steelyard. The divisions for qrs. and lbs., and all the figures, are engraved on a zinc plate, and will therefore not rust. On the front of the large weight H is a centre which rests in the notches, and forms the

indicator to show the weight. This weight has two handles, as shown, the one fixed, the other hinged, and having a cranked end carrying a roller, which runs along a groove in the steelyard. Pressing the handles together brings the roller on to this groove, and lifts the front of the weight until the indicating centre is lifted clear of the notch, and the weight can be moved easily along the steelyard without wearing the notches, it being supported by and running on the roller. E—Fig. 3—is a tare weight, moved by a screw, actuated by the button-head *e*, to balance dirt on the platform, &c. To ascertain the weight of a load on the platform, the large weight is moved along the steelyard into the nearest notch short of the correct weight. The small weight is then moved along it until an exact balance is obtained. The weight of the load on the platform is now indicated in figures on a plainly engraved scale by the positions of the two sliding weights. For instance, in the plan of steelyard now given the positions of the sliding weights indicate that the weight of goods is 7 cwt. 3 qrs. 10 lb. Among the advantages of this system of sliding weights, never removed from the steelyard, are the following:—It is almost impossible to make a mistake in reading off the weight after weighing. The weights, never being removed, cannot be lost or mixed with those of other machines, nor can they become heavier through picking up dirt or sticky matter from objects on which they may be placed, nor lighter through getting wet and rusting. Any increase or decrease here is magnified about 100 times on the platform, consequently in the weight of the goods. One important advantage is this: in the ordinary weighing-machines with loose weights, the steelyard or beam balances at zero, without any weights on it. Therefore if the weights have been tampered with, or have become heavier or lighter from any cause, or if they have become mixed with those of other machines, there is no means of detecting it, and a serious mistake may occur; but with this system the weights form part of the balance of the steelyard at zero, so in case of any alteration in their weight through tampering or from any cause, the machine, through the leverage, would be thrown out of balance so much at zero that it ought to be detected. We give an engraving of a machine for weighing carts and cattle, exhibited by Messrs. David Hart and Co., at the Royal Agricultural Society's Show at Newcastle last week. The cattle-pen is, by a simple arrangement, made removable without destroying the balance of the machine, which can then be used for weighing carts, or for any other purpose. The pen is put on the platform or removed almost instantly, there being only four nuts to screw up or unscrew.

LETTERS TO THE EDITOR.

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

THE CLARK PROCESS FOR LONDON.

SIR,—Your article of the 1st July, entitled, "The Clark Process for Bristol," suggests how desirable it would be if London water, and especially the hard water supplied by the Kent Water Company, were subjected to the softening process. In view of the possible approaching dissolution of the existing London water companies, and the taking over of the waterworks by a central authority, it becomes desirable to arouse public opinion to a proper sense of the importance of securing soft water for London. The time for insisting on the softening of London water will come when the central authority takes over the water companies.

There can be no doubt that for general domestic purposes hard water is greatly inferior to soft water, and it is to be hoped that pressure will be put on the Government to ensure that the great change in the ownership of the waterworks shall be accompanied by the adoption of the Clark process. W. J. COOPER.

7, Westminster-chambers, S.W., July 14th.

STEAM ENGINE ECONOMIES.

SIR,—Allow me to call attention to what appears to be an error of calculation in your article on the above subject—THE ENGINEER, July 1st—that might seriously mislead sanguine inventors. The 1155 – 905 = 250 units of heat saved per pound of feed-water by heating the same to 300 deg. cannot be computed in per cent. of the 1155 units required with cold feed, and as a net saving on the total fuel, as a large part of the latter goes, by your own demonstration, towards heating the fuel itself and the air for combustion, and a large part is lost altogether by irradiation, &c. I would calculate the gain to be derived from heating the feed-water as follows—in per cent. of the total fuel used with cold feed:—

Take the consumption of coal per horse per hour at 3 lb., and that of feed-water at 8 lb. per lb. of coal = 24 lb. per horse per hour. As shown by your article, 250 units per lb. of water are saved by heating the feed to 300 deg., *i.e.*, for 24 lb. of feed-water per horse per hour 6000 units. The 3 lb. of coal burnt develope 42,000 units, and $\frac{6000}{42{,}000} = 14{\cdot}286$ per cent. is the saving in fuel to be effected by heating the feed from 50 deg. to 300 deg.

If the heating of the feed be effected by the escaping products of combustion, the abstraction of 6000 units of heat from each 54 lb. of air required per horse per hour would no doubt seriously impair the draught of the chimney. H. LEUPOLD.

Brindisi, July 13th.

SIR,—Your article in THE ENGINEER of July 1st, on "Steam Engine Economies," opens up the question in such a way as must convince steam users generally that they have not arrived at the state which justifies any in saying they possess the best possible arrangements in their engines and boilers for economical working. Some time ago you honoured me by a reference to my patent furnace bars, and as the circumstances which led to the development of the idea may be of interest, I would venture to detail them, especially as the conditions under which the bars were first tried are common to many steam boilers.

Several of my clients—chiefly millowners—were very much pressed for steam and troubled by the smoke, but having been previously induced to try numberless patent furnaces, without obtaining relief, it was with the greatest difficulty I persuaded them to think the remedy could be found in a new arrangement of furnace bars. Hollow bars had been tried, and these answered for the smoke, but as they "saved" so much fuel that it was impossible to raise sufficient steam—the air spaces being necessarily so much reduced that enough coal could not be consumed in the grate for the purpose—they were abandoned. Heating the air was tried, but without the means of producing a forced draught, this was useless, the air being rarefied to such a degree that little more than half the usual amount passed through the furnace; and though the economy was manifest when comparing the water evaporated per lb. of coal consumed, the results were unsatisfactory, inasmuch as the lack of steam rendered a stoppage inevitable.

With common bars which would maintain steam the smoke could be overcome by opening the furnace door slightly, but this also had the effect of reducing the pressure of steam, and therefore demonstrated that the admission of cold air to the flame in the furnace, although combination with the free carbon in the flame took place, left the resulting temperature lower than before. It is one thing for free carbon to combine with the air pure and simple—or the oxygen of it—and quite another thing when the same carbon is intermixed, say, with one hundred times its weight of carbonic anhydride, nitrogen, and steam. A burning candle will illustrate the first, and the "human furnace" more imperfectly the latter. Combustion does not necessarily imply a large increase in temperature, hence the difficulty with the smoke, or rather the economical consumption of it. Contemplating these facts forced me to the conclusion that a combination of the characteristic features of the two classes of furnaces would be the most likely to succeed, and on putting this combination into practice, both on land and at sea, the results have far exceeded my most sanguine expectations. I do not mean to suggest that my plan should be adopted in preference to the one so strikingly outlined by you, but merely to indicate a stepping-stone in the river of prejudice and doubt, which it would be to the interest of many to cross.

Kettering, July 13th. CHAS. WHITFIELD.

THE NEWCASTLE ENGINE TRIALS.

SIR,—In spite of repeated contradiction, it has been so persistently asserted during the past week that Messrs. Richard Garrett and Sons were partly responsible for the design of the engine I exhibited at Newcastle, that in justice to their reputation I beg for a little of your valuable space to state as distinctly and unreservedly as possible that from beginning to end neither Messrs. Garrett nor any one else had anything to do with designing my engine.

The facts are:—The latter end of last year I wanted for a particular district a very light and narrow traction engine, and having had for some years a most satisfactory experience of Messrs. Garrett's corrugated fire-boxes, I determined to use one for the engine I intended building, and on the first day of last Smithfield Show I arranged with them to make a boiler for me on their principle to my dimensions. Some time afterwards, when I had completed the main features of the design and decided upon entering for trial at Newcastle, I further arranged with them to do *part* of the engine work to my drawings and under my own personal superintendence.

When Mr. Garrett knew that I contemplated entering for trial he strongly urged me not to do so, and gave reasons which, I must admit, events have proved to be entirely accurate. However, I preferred to take my own course, and entered my engine for trial some time before a certain memorial was made public. It is only fair to Mr. Garrett to add that when he saw the drawings for my cylinders he was good enough to advise me that the proportions of areas and the capacity of receiver were not such as would give the best results; but being desirous of working in an ordinary way at a pressure not exceeding 100 lb., in order to meet the views of my customer I retained the sizes I originally decided upon, and the trial run has proved that an extremely light and simple engine can be made, which for a farmer's use is economical enough in coal consumption for all practical purposes, economy in first outlay and repairs being a far more important consideration than a few coals.

I think I have now made Messrs. Garrett's position in relation to my engine perfectly clear, and trust that some persons who appear to have a motive for disparaging the Leiston firm will now confine their attentions to their own business. I will only add a few words of personal explanation. It may be objected that as the whole of the engine was not manufactured at these works I was not right in entering as "Manufactured by exhibitor." Before making the entry I communicated with the secretary of the Royal Agricultural Society of England, and was informed that if the engine was built under my superintendence it was quite in order to enter as I did. THOMAS COOPER.

St. Andrew's Works, Ryburgh, Norfolk.

RAIL JOINTS.

SIR,—The fact that I am not a railway engineer by profession must be my excuse for asking, with your permission, the two following, perhaps simple, questions relating to railway construction, viz., why is it the almost universal practice in England to place the joints of the two rails of a line of railway opposite one another, and why are the rails almost always keyed on the outside?

With regard to the first point, travelling would be much smoother and easier, and there would be a very great diminution of the rhythmical bumping so unpleasantly observable, especially at low speeds, were the joints of the two rails to alternate with each other, so that both wheels of a pair should not pass over joints at the same instant. I can think of no good reason for the present practice, as it would cost no more to arrange the joints in the way referred to. It is true that the sleepers are sometimes spaced a little closer where the joints occur, but this would probably no longer be necessary were the joints of the rails to alternate. It may be objected that an alternate arrangement of the joints would cause lateral oscillation of the carriages, but that this is not an insuperable objection is evidenced by the fact that some parts of the North London Railway and some French railways are, I believe, laid so that the rail joints alternate.

With regard to the second point, keying the rails on the outside, it is evident that should the keys fall out by shrinkage in hot weather, the rails would be liable to spread under a train, whereas this could not occur were the rails keyed on the inside. Another incidental advantage is the facility for examination, as the ballast is usually lower between the rails, and a man walking between them can see the keys of both rails at once. It may be said that keying on the outside gives greater elasticity, but I believe the Midland Railway is laid in that way, and I notice that on the duplicate line of the Great Western, near Paddington, certain sections are keyed on the outside and certain other on the inside, presumably as an experiment, and I do not know that there is any perceptible difference in travelling over these differently laid parts of the line. A. M. CLARK.

53, Chancery-lane, London, July 17th.

EDUCATION OF ENGINEERS.

SIR,—Even if a coaching accident did not at present forbid much use of my right hand, I should doubt the propriety of adding more words just now to embarrass thinkers over a difficult problem, on the grounds urged by "Via Media"—ENGINEER, p. 56, July 15th. Surely "Via Media" will admit "vague words and letters of an enigmatical nature" are sometimes hung up on the peg of controversy to fructify, or does he think all new discoveries are thrust on an astonished world without centuries of talk? "Via Media's" argument puts him in one dilemma out of three. If "Via Media" be of the latter opinion, it might account for why he imagines I am fishing for the ring which college professors have lost and cannot re-find, or that I wish to convince him that he is labouring under a mistake which exists not on the other side of the cloudy pillar, or that my motives are only concerned about the hiatus in the dividing line between darkness and light; whereas, I hold with most others that railway directors and steamship owners ought to understand their own business sufficiently not to require inventors or practical mechanicians to push goods, like German manufacturing firms, at any price, but, on the contrary, both corporations, with the assistance of the Board of Trade, should be in a position not only to please the shareholders, but also their customers the public. As an example, it seems by no means improbable a few years' warfare at sea would upset all present notions about warships, and recall to mind lessons learned in a sterner school, and facts which at present would seem to be nearly forgotten alike in logomachic controversy and untried and seemingly untriable specialities connected with bird flight, whether of the pelican, bat, or humming bird moth order of naval architecture. SLOW COACH.

July 18th.

TORPEDO BOAT CASUALTIES.

SIR,—My friend, Mr. McDougall, manager of the Boiler Insurance and Steam Power Company, has called my attention to an extract from a leader on the above subject in one of your contemporaries. In endeavouring to account for the disappearance of the water from the boiler of No. 47 boat, your contemporary says:—"Very little is known of the action of steam of a much higher temperature than that due to the corresponding pressure normal to saturated steam. It is possible that the component gases may become dissociated, and in such a case . . . they would escape into the atmosphere, never returning to the aqueous condition."

As this is a renovation of an old and useless theory of boiler explosions, it is worth while perhaps once more to show the fallacy of that theory. This matter is not by any means the mystery which the above quotation would lead one to believe. It is well known that water or steam cannot be dissociated by the highest temperature of our blast furnaces, because the heat produced by the combination of oxygen and hydrogen to form water is much higher, consequently it would require at least an equally intense heat to dissociate it. In other words, if it be assumed that the steam were dissociated into its component elements, every chemist knows that a red heat would ignite them, and make them combine with explosive violence to produce water. Any of your readers who wish to convince themselves of the accuracy of this, may do so by performing the following simple experiment, which I carried out in Mr. McDougall's presence. I put a coil of iron tube, ¼in. interna diameter, into a furnace, with the lower end of the tube dipping into a trough of water. The coil was heated to whiteness, and steam was passed through it. A large inverted test tube, filled with water, was held over the outlet, and a certain amount of gas was soon collected in it. On bringing a lighted taper in contact with this gas, it was found to burn slowly away, with the characteristic blue flame of hydrogen. It is needless to say that had it been a mixture of oxygen and hydrogen produced by dissociation, this mixture of these gases would have exploded violently. The tube was afterwards cut to show a section of it, and there was found on the inside a black coating of the magnetic oxide of iron. The steam was decomposed by the white-hot iron, the oxygen going to the iron to form the oxide, and liberating the hydrogen which we collected in the tube. As a grain of water will produce upwards of 1000 grains measure of hydrogen, the quantity of hydrogen we collected was quite inappreciable compared with the quantity of steam passed through the white-hot tube, and it was all accounted for by the incrustation of black oxide of iron which we found in the tube.

I understand that no appreciable scale of black oxide of iron was found on the tubes or furnace of the boiler to which the accident happened, and consequently the temperature could not have been sufficiently high, or the time of the exposure of the plate and tubes to the fire was not sufficient to decompose any appreciable quantity of water in the manner above described. It is therefore impossible that a sufficiently high temperature to dissociate the water could have been obtained.

WILLIAM THOMSON, F.R.S. Ed., F.I.C., F.C.S., &c.

Royal Institution Laboratory, Manchester, July 19th.

PORTLAND CEMENT CONCRETE.

SIR,—"Our confidence in this material we must admit to have been rudely shaken of late." These words, in your able article to-day, will be echoed by many readers, who, perhaps like myself, will hope that your reference to the failures of concrete works may lead to the true causes being ascertained and published.

Will you allow me to suggest—(1) That too many authorities have demanded that the assumed excellence of Portland cement shall be measured only by its ascertained tensile strength, 500 lb. and more per square inch being frequently insisted upon. (2) That such tensile excellence is only obtainable by adulteration. (3) That this adulteration—excess of lime, or whatever it may be—is acted upon by moisture after the cement is set, and produces disintegration. (4) That, varying with the character of the ingredients, a certain proportionate and moderate quantity of cement will, if well mixed, thoroughly bed every particle of the material with which the concrete is to be made. Any greater amount of cement is not only wasted, but increases risk of failure. (5) That pure, properly made and weathered Portland cement, having its natural tensile strength, is after all a material as thoroughly trustworthy as it is useful.

May I add, in reference to the paragraph *re* Mr. Houda's concrete work under water, that Mr. Teasdel, of Great Yarmouth, effectually used a sort of big trouser-leg of canvas for the same purpose? The foot end of the leg was first closed by a cord having a slip knot, the leg filled with concrete, and lowered to touch the bottom; the knot was then let go, and the deposit made. This seems a more handy thing than the iron box.

Millwall Docks, E., July 15th. F. E. DUCKHAM.

INJECTORS FOR PORTABLE ENGINES.

SIR,—While so many injectors are now before the public, if merely as a result of natural selection, we trust it may interest your readers to learn that at the Royal Agricultural Show at Newcastle last week the only injectors at work on agricultural engines were the "Influx" injectors of our make. They were fitted, amongst others, by Messrs. Burrell, Sons, and Co., and in one case this injector was the only means of feed on a portable engine.

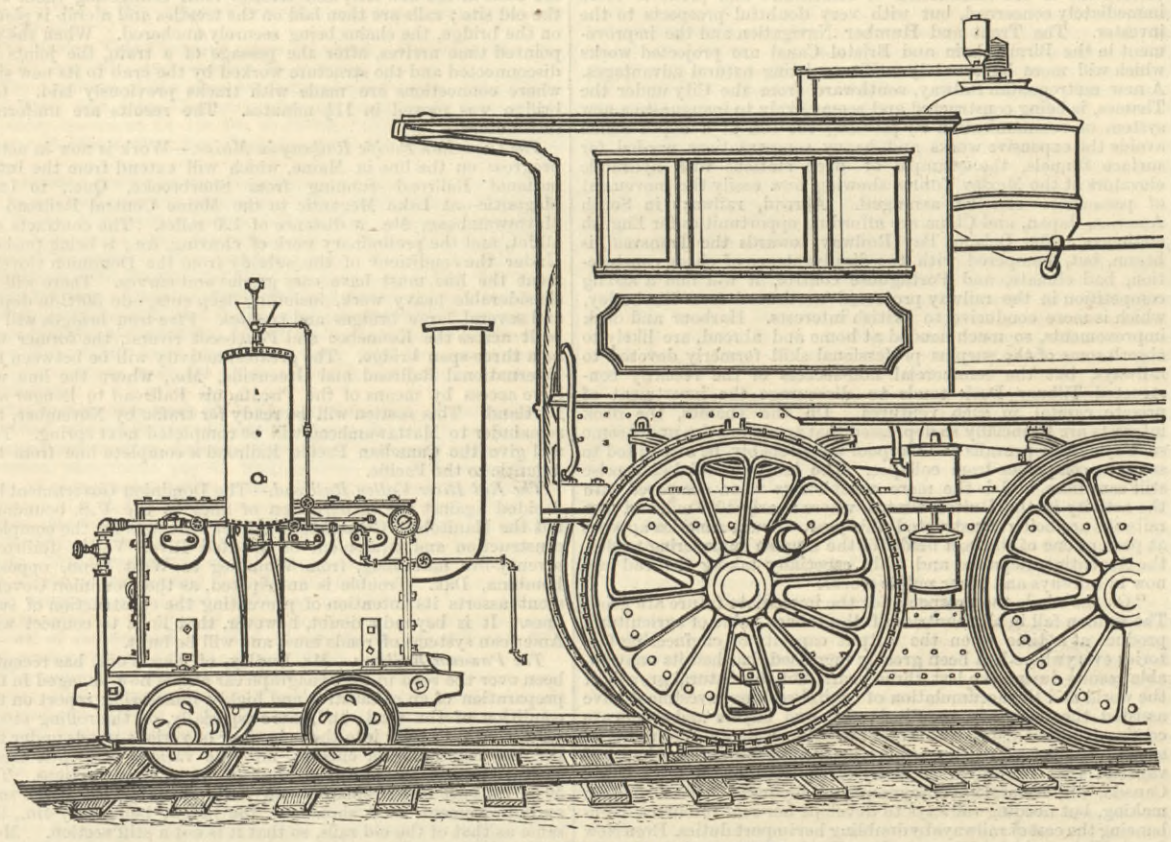
HOLDEN AND BROOKE, Limited.
GEO. F. HOOPER.

St. Simon's Works, Salford, July 19th.

ELECTRIC LIGHT *v.* GAS FOR GLASGOW PUBLIC BUILDINGS.—A report on the lighting of the Glasgow City Hall and bazaar, which are adjacent to each other, and of the new municipal buildings in George-square, which is some little distance away, came up for approval in the Town Council on the 14th inst. The committee having charge of the matter had received the report of Mr. W. A. Bryson, electrical engineer, which recommended that the City Hall and bazaar should be lighted by two circuits, on the series system, of 13-15 arc lamps on each, driven by two small engines. He estimated the cost of generating plant for the City Hall and bazaar installation at £1800. As regards the municipal buildings, Mr. Bryson assumed that the power required was to be obtained from engines and boilers placed either at the bazaar or some other site away from the buildings, and recommended that the arc system should to a large extent be adopted except in the smaller rooms and corridors, when incandescent lamps would be necessary. The committee were of opinion that the incandescent system should be adopted, except as regards the quadrangle, and that accommodation should be found for the necessary generating plant on property adjacent to the buildings, and not at the bazaar. Commenting on the entire separation of the installation for the municipal buildings from that of the City Hall and bazaar, which was a departure from the original intention, some members took exception to the matter being proceeded with until after further consideration. In the opinion of some, gas lighting had been so much improved of late that before coming to any decision on the matter it would be advisable to consider whether it would not be better to adopt some of those regenerative burners which, as well as lighting efficiently and economically, acted also as ventilators. The committee agreed to take the matter back for consideration.

APPARATUS FOR HEATING, SETTING, AND REMOVING TIRES.

MR. T. W. GENTRY, master mechanic, and Mr. George W. O'Brien, general foreman, shops of the Richmond and Danville Railroad Company, have recently been granted a patent on an "Apparatus for Heating, Setting, and Removing Tires," and arrangements have been made with Messrs. Pedrick and Ayer, proprietors of L. B. Flanders' Machine Works, Philadelphia, Pa., for its manufacture and sale. It can be arranged either as a stationary or portable plant. The cut shows general arrangement of the latter. The old process requires the wheels to be taken from under the engine and then run out to some safe place, where fires are built around them until they are hot enough to come off. This injures the paint and finish of the centre, consumes much valuable time, and requires a good force of men, except where city gas can be introduced, and when this is possible, it is very slow, costly, and unreliable; and in order to get sufficient pressure, not less than a 3in. pipe can be used, and then very little or no blast can be applied. The jets burn slowly and irregularly, and the consumption of gas is very heavy. The inventors have a patent on the hoop or burning pipe without jets or burners, and cover the heating by gas. With this apparatus and system of doing the work less than one-tenth of the time is consumed, a great saving in labour effected, and the wheel centres are not injured in any way. In case of a loose tire, it is not necessary to take down the connections. In taking off or putting on new tires, the connections are taken down. In all cases the engine is jacked up so that the wheels will clear the rails about 2½in. to allow the burning hoop to be placed around the tire. This hoop is not a continuous ring of pipe; the ends are plugged up and are left a little space apart, so that they can be placed on the wheels while the connections remain on them. One of the main features is the generator, in which are four retorts, which are heated by fire of coke, coal, or wood. Into one of these retorts oil is fed through a very small opening and needle-point valve. This generates gas, which passes into another retort. The other two retorts are for heating the air that is used with the gas, workings of which will be explained later on.



GAS APPARATUS FOR REMOVING TIRES.

In close proximity is a tank containing about ten gallons of common kerosine oil, and at any desired place is an air compressor that supplies air to the device. A very convenient arrangement is an air-brake pump, used for testing brakes, &c. Attachments are made to this oil tank, on top, so that an equal air-pressure is on the oil that is operating on any part of the plant. This is controlled by a valve at the will of the operator. A larger connection is made with the two air retorts in the generator, so that the air and gas are about the same temperature and are propelled by the same force through the generator. From the generator to the burning hoop is made a connection through pipes of which the gas flows, and in a fitting with an injector nozzle the air mingles with the gas and forces both through the burning hoop that has been placed around the wheel. On the inner side of this hoop small holes are made, about 1½in. apart. This hoop is held off from the tire about 1in. by small studs placed in hoop. After the furnace has been fired up and retorts are hot, air is admitted to them; also the oil through the needle-point valve, and in a few seconds gas can be admitted into the burning hoop and fired. The amount of flame is regulated by the needle-point valve, and when tire is hot enough, shut off valve, the flame stops and the generator also. The gas is made only as fast as used, and is under absolute control. There is no waste and no danger. The points of pressure all have gauges and can be seen by operator. The flame that strikes the tire is a blue one and intensely hot, penetrating the tire very quickly. By placing generator out of doors, along a wall or any convenient place, no more danger need be apprehended than from an ordinary stove. The oil tank, manipulating valves, gauges, &c., are inside, close by the track that engine is run in on.

From a private letter from Mr. Gentry to the manufacturers, we make the following extract: "The Richmond and Danville Railway Company have, on their western North Carolina division, a number of ten-wheel freight engines, whose general condition is very good, with the exception of their tires. Driver brakes having been applied to all of them when last overhauled, their tires, which were about getting their last re-turning or truing-up at that time, have all proved too thin to stand; the friction and the heat thus generated have loosened up all of their tires. We find ourselves compelled to give all of these engines new tires, while the running gear and machinery is in first-rate order, and does not need coming down or being worked upon. It occurred to us that it would be an excellent opportunity to give our gas tire heater a good trial, so the new tires were ordered and specified to be of uniform outside diameters and free of flats, &c., with a view of being run without turning off on outsides. They came to hand, and we found them very nearly perfect, and as soon as the first engine arrived for her new tires, we chucked two tires on each of our double driving-wheel lathes, and while tires were being bored out to fit wheel centres, we slipped off connecting rods, wheel covers, and driver brake clogs or heads—nothing else was removed—jacked up engine until wheels swung over rails just enough to allow flange of new tires to slip over top of rail, and in from ten to fifteen minutes each we dropped off the old tires, and, by the time the wheel centres had cooled off, the new tires were nearly ready to be applied. We had a suitable frame or heavy trestle, with a running hook and lever, which was placed in position in front of the wheel on which the new tire was to be placed; the tire was suspended in this, and the gas pipe arranged on it, and tires expanded and set in place on wheel centres on an average of less than twenty minutes each; or, in other words, the old tires were removed from six wheels and the six new tires put on, and the engine that came in in the morning to get an entire set of new tires, was ready for service that same evening. We consumed, in all, about nine hours time, and employed one machinist and six labourers in the gang. I wish to add, however, that the tires had only one light cut taken through them, and that I did not take into consideration the men who bore the tires, as this would have had to be done, no matter how tires were applied. This was our first attempt at removing and replacing whole sets of tires without removing the wheels from the engine, and we desired to show that it could be done successfully and with great economy. We measured the oil consumed during the whole operation, and it averaged about half a gallon to an old tire, or three gallons for the six old tires, and little more than three quarts for each new tire, or say, about five gallons for the six new tires, making in all eight gallons at 8 cents per gallon, making 64 cents for fuel. It is possible that a little more oil would have been consumed had the old tires been very tight, but it is safe to say that 1 dol. worth of kerosine oil will remove and replace six tires, no matter how tight they are. I might add that we find our apparatus so very convenient and cheap that it is now doing all the work connected with tire heating, setting, removing, shimmering, and replacing, and makes a hitherto disagreeable and uncomfortable job a picnic for the boys, being all indoors and under perfect and easy control, and we can do any kind of work connected with tires, either under the engine or out on the floor."—*The Age of Steel.*

THE SOCIETY OF ENGINEERS.

THE Society of Engineers visited, in the course of one of their summer excursions on Wednesday, the 13th inst., the works of Messrs. Maudslay, Sons, and Field, Lambeth, and the City of London and Southwark Subway. Professor Henry Robinson, President; Mr. A. T. Walmisley, Vice-President; Messrs. Arthur Rigg, Henry Adams, and W. Newby Colam, members of Council; Messrs. W. MacGeorge, B. D. Kershaw, Henry Davey, J. Quick, jun., G. Anderson, W. Hack, R. Sutcliffe, J. W. Restler, C. Anderson, B. P. Ellis, P. F. Tarbutt, R. Mansfield, J. H. Cunningham, G. B. Cutler, J. S. Tamburini, C. J. Light, secretary; R. E. Middleton, and Mr. J. S. Jeans, were present as visitors. They were received at Maudslay's by Mr. Timme, manager, and at the subway by Mr. J. H. Greathead, the engineer to the works. In the evening at dinner at the Guildhall Tavern Mr. Alfred Williams, hon. sec. and treasurer, and Mr. Greathead joined the party.

On entering the first erecting shop at Messrs. Maudslay's, the first object of interest was the port engine, erected and nearly complete, for the Italian ironclad Re Umberto, the power of these engines alone being 9750-horse power. The port and starboard engines are capable of working up to 19,500-horse power collectively, or, when necessary, as low as 800-horse power. When working to their greatest power, forced draught is used, and seventy-two large furnaces are required to raise the necessary steam. The valves are worked by Joy's patent gear. In the next shop was to be seen the few remaining parts of a pair of compound engines made for the Austrian navy, the condenser being the only part of any consequence not packed and sent away. These engines are of 11,000 indicated horse-power collectively. The small triple expansion engines being erected are for H.M.S. Grasshopper, a very fast-steaming vessel. These are of 3000-horse power. Another set in a more advanced state will be seen in another part of the works, while another set has just been sent away for H.M.S. Sandfly. Passing to the turnery, a large boring and wall planing machine amongst other tools deserved notice; steel connecting rods for the Re Umberto were being turned, also those for H.M.S. Nile, cast steel frames and standards were being worked upon, the slide jacket cover being planed, and many other parts belonging to the same vessel. The Nile's engines are triple expansion, to work up to 12,000 collective indicated horse-power. Both cast and wrought steel are largely used in these engines, and are fast taking the place of cast and wrought iron. In the next erecting shop were seen the starboard engines of the Re Umberto, being exactly the same as those before seen; by the side were some of the gun-metal propeller blades and bosses for the same vessel. The bed here is being prepared for erecting the Nile's engines. The cylinders, frames, stern shaft, stern tube, and many other parts belonging to the same engines are lying about; the cylinders are lined with Whitworth's compressed steel. The steel propellers of the Spider were also seen here. The triple expansion engines of H.M.S. Spider are the same as those of the Grasshopper, but in a more advanced state, twin screws of 3000 indicated horse-power collective, the steam pressure 150 lb., and are to run at 350 revolutions per minute. The greatest importance is attached to the weight of these engines, every part being made as light as possible consistent with safety, the engines being almost entirely made of steel and gun-metal, and no expense being spared where weight could be saved; the weight will be as low as 28 tons when finished. In the fitting shops are a number of the small auxiliary engine, being fitted. They vary in size from 18in. diameter to 4½in. diameter, and are used for circulating the water through condenserss fire, pumping bilge, feeding boilers, turning engines, ventilating engine room, forced draught fans, and for ash raising hoist. For different vessels there are about 215 of these being made; each large ironclad, such as the Austrian, just sent away, has from forty-five to sixty auxiliary engines. A long screw shaft lying in the yard, 67ft. long, hollow, and made of Whitworth's compressed steel, 16½in. diameter, was also worthy of notice; it is for the Nile.

The primary object of the City of London and Southwark Double-Tunnel Subway is to give increased facilities for passenger traffic between the north and south sides of the river Thames in the vicinity of London Bridge, where the existing facilities are notoriously quite inadequate. London Bridge and its approaches are probably the most densely-crowded thoroughfares in the world, and this line has been laid out to accommodate the great stream of passenger traffic between the City and the Borough, Newington, Kennington, &c., enabling it to avoid the bridge entirely without deviating appreciably from its present course. This line is, in effect, an underground railway, but distinguished from the existing metropolitan railways in construction and in mode of working. The mode of construction is exceedingly simple and expeditious. A steel shield, overlapping—like the cap of a telescope—the forward end of the iron tunnel, is driven forward by hydraulic power as the material is excavated from before it, and the segments of the iron lining are built up inside and under cover of the shield into successive rings about 1ft. 7in. long. Six of these rings can be erected daily, representing a progress of about 9ft. 6in. at each face. As the shield is moved forward, the annular space outside the iron tunnel, left by the advance of the overlapping steel plate of the shield, is filled up by hydraulic cement ejected from the inside of the tunnel by air pressure. Thus all chance of settlement is avoided, and the iron tunnel is protected on the outside by an impervious coating. Already both of the tunnels have thus been driven from a shaft at the Old Swan Pier, on the north side, across and under the river, and for a considerable distance on the south side. The main contract for the construction of the subway is being carried out by Mr. Gabbutt, who has executed important works for the London and North-Western, Great Western, and other railway companies, and the Liverpool Corporation. The line is being constructed with unique economy. Its total cost, including land, equipment, and every charge, will be little more than one-fourth the capital cost of the underground portions of the metropolitan railways.

At each of the stations, in addition to the stairs, there will be powerful hydraulic lifts for raising and lowering the passengers direct between the street level and the platforms. The working of the Mersey Railway, where the lifts are much deeper than they will be upon this line, has shown how readily the public avail themselves of these appliances for saving time and fatigue. The lifts will be of the most approved construction, and the hydraulic power for working the whole of them will be derived from the engine station at the Elephant and Castle. Avoiding the use of locomotives, the trains will be propelled by the well-known endless cable system of traction which has long been in successful use in Chicago, San Francisco, and other commercial centres, and which is now being laid down in Edinburgh, and on the Corporation tramways of Birmingham. In order to avoid delay at the stations it is intended to run light trains at short intervals, rather than heavy trains at longer intervals. With trains to take a hundred passengers every two minutes, as contemplated, the carrying capacity of the line will exceed 100,000 passengers per day. The average speed will be about the same as on the underground rail ways, or about double that of tramcars and omnibuses.

AMERICAN WARSHIPS.

THE American Government appointed a Board to consider plans for the new cruisers, for which, as we have already announced, tenders were asked.

The Board reports that none of those submitted are available, but that the design submitted by the Barrow Shipbuilding Co., of England, promised well. The plan presents the somewhat remarkable feature of having the water line well protected by heavy armour, and also the guns on the upper deck, but of leaving the intermediate space between the upper and lower decks wholly without protection, there being nothing there of importance. The buoyancy of the ship is well assured by a deflective deck at the top of the water-line armour. Some of the recently-built Italian battle ships embody this principle, which has given rise to much discussion in professional circles. There are two turrets *en echelon*—that is to say, not in the middle of the ship, but on either side of the medium line, so that their guns can fire directly forward or aft, or to either side.

The Board came to no decision in the selection of a design for the armoured cruiser. To provide for such an emergency, the Bureau of Construction of the Navy Department had prepared original plans for both the armoured battle-ship and the cruiser. These designs were not submitted for competition, but were held in reserve in case no suitable designs were received from private sources. "As the Board has failed to find a design suitable for the cruisers, the Bureau plans for that vessel will, says the *Mechanical Engineer*, doubtless be used." The plan of this craft has many points of resemblance to the celebrated Brazilian turret-ship Riachuelo, although many improvements in the original model have been introduced. The general dimensions are as follows:—Length, 310ft.; breadth, 54ft.; draught, 21ft. 6in.; displacement, 6600 tons; speed, 17 knots; coal capacity, 800 tons. Four 10in. guns are carried in turrets *en echelon*, and six 6in. guns are mounted in central pivot carriages, so arranged that all of the 10in. and three of the 6in. guns can be concentrated on one point of fire, while thirteen rapid fire guns have practically an all-round range. The armour belt is seventeen inches in thickness and six feet in breadth. The vessel is fitted with torpedo tubes for the discharge of fish torpedoes, carries two steam torpedo boats, and is rigged as a barque.

INSTITUTION OF MECHANICAL ENGINEERS.—EDINBURGH MEETING 1887.—The summer meeting of this Institution will be held in Edinburgh, and will commence on Tuesday, August 2nd. The following papers are announced:—"On the Structure and Progress of the Forth Bridge," by E. Malcolm Wood, of London; "Notes on the Machinery Employed at the Forth Bridge Works," by Mr. William Arroll, of Glasgow; "On the Paraffin Oil Industry in Scotland," by Mr. St. John V. Day, honorary local secretary; "Description of the Electric Light on the Isle of May," by Mr. David A. Stevenson, of Edinburgh; "Description of the New Tay Viaduct," by Mr. Fletcher F. S. Kelsey, resident engineer; "On Electro-Magnetic Machine Tools," by Mr. Frederick John Rowan, of Glasgow; "On the Dredging of the Lower Estuary of the Clyde," by Mr. Charles A. Stevenson, of Edinburgh; "On the Position and Prospects of Electricity as Applied to Engineering,' by Mr. William Geipel, of Edinburgh. The meeting commences on August 2nd and ends on Friday, August 5th. On Tuesday, the 2nd, the programme includes reception in University Hall, reading of papers, excursions to engineering works and Forth Bridge, and Institution dinner. Wednesday: Papers, excursions to iron and engineering works, *conversazione*. Thursday: Visit to Dundee and Tay Bridge works. Friday: Excursion to waterworks, paper mills, lighthouse, and Newcastle Exhibition. Numerous engineering works open for visitation.

ENGINEERING TRADES.

MESSRS. MATHESON and GRANT'S half-yearly engineering trades report says, "There has been a decided amelioration of trade during the last six months, and new enterprises of various kinds continue to absorb capital which has been lying idle, and as there is hardly any sort of commercial venture which does not give employment directly or indirectly to engineers, a growing activity may be looked for.

"Coal has advance in price. At South Wales ports the shipping facilities are strained to the utmost, and steamers can obtain cargo only after several weeks' notice. At Newcastle prices advanced in the spring owing to strikes among the colliers which restricted the output, but though the strikes have ended prices have not receded. There is not at present any marked advance in coal for metallurgical purposes at home, but increased activity in the iron and steel trades would tell immediately on the prices obtainable for coal. In Belgium there is considerable activity, but colliery owners feel keenly the competition of German coal, which is allowed to enter the country at favourable carriage rates; and although Belgian and French colliers are working for miserably low wages, the capital of the masters is hardly earning more than enough to pay current expenses.

"Iron of all kinds is at almost the same prices as in January, the slight speculative rise due to hopes of an American demand having been only temporary. The manufacture of finished iron allows no real profit if the deterioration of plant be considered; puddling furnaces continue to diminish in number; and the prospects for the future even if general trade improve are clouded by the growing use of steel. For smithing purposes high-class Yorkshire iron is still deemed necessary, and for many important uses is considered safer than steel.

"Steel makers are busier and altogether more hopeful than at the beginning of the year, although the large productive power of the principal works and new economies in manufacture together keep prices low. Plates, and the various forms of sectional steel used by bridge builders are obtainable at prices lower than would have been deemed possible two years ago, this being partly due to the slackened demand for shipbuilding, and partly to the competition of new works. The rail mills are fairly occupied with orders, and it is not unlikely that there may be a revival of an export trade to the United States. Owing to the peculiar operation of the customs tariff, exports thither have mainly been confined to partly manufactured steel, such as blooms and billets, of which there have been large shipments. But orders for rails have also been coming forward lately. Nothwithstanding the enormous power of production in America, exceeding two million tons per annum, the present price there of 40 dols. per ton is about equal to the price of English rails delivered duty paid at an American port. Primarily, therefore, the competition is determined by the situation of the place of inland delivery, which, as regards transport, is in some cases more favourable to the imported than to the home-made rail. The conditions of quality have also to be considered, and in this respect some of the American railroad engineers consider that they can get better value for their money here than at home. It is not that rails as good cannot be made there, but owing to the rapidity of manufacture, the combinations of makers and other circumstances, the terms of American specifications are less favourable to the buyers than those enforced here.

"*Mechanical Engineers.*—The numerous branches of trade included under this heading have for the most part felt a decided though moderate improvement during the last six months, and the very diversity of the causes for this revival is a sign that the improvement is widespread. Among marine engineers there is as yet no indication of a return to the activity of 1883, and though there are signs that the demand is growing, yet even if to the large ocean and war steamers on hand be added the special craft of various kinds which are building, such as river steamers, torpedo boats, and dredgers, the aggregate does not show any marked improvement on the trade of last year. Invention in mining machinery has been stimulated by the gold discoveries in the Transvaal, where the ore demands special appliances. Machine tool makers are already feeling the renewed inclination and power to purchase of their customers the engineers, and are offering various automatic and labour-saving novelties, the present Exhibitions at Newcastle and Manchester showing that in these respects this country retains the lead against foreign competition. Economy in fuel has evidently not reached its final stage. The use of high-pressure steam leads to various alterations of old methods. There are improvements in corrugated boiler flues which allow the minimum thickness of steel plates. The utilisation of waste heat studied and accomplished in various novel ways, and the economic combustion of coal is stimulated by the increasing rivalry of gas and oil fuel. Not only are gas engines being improved and cheapened, but petroleum engines are likely to afford an alternative source of power in England where gas is cheap, and to supply a long-needed want in places where gas is dear or unattainable. Arsenal machines and plant have been much improved, and have been in considerable demand. Improvements in milling machinery will retain in this country a trade that was fast leaving it for Germany and the United States. Cold storage for frozen meat is in increased demand, as well as artificial refrigeration for various manufacturing purposes, and it is evident that the expensive process of producing cold by the cooling and re-expansion of compressed air has had its day, and though likely to survive a little longer on board ship, it will even in such cases soon be superseded by the best of the ammonia systems, which are not only theoretically more perfect, but much more certain and economical in practice.

"Agricultural engineers still suffer from the continued depression of the farming interest; the makers of portable engines, thrashing machines, and implements are not fully employed, but it is questionable whether the forced reduction in prices much exceeds the saving in the cost of manufacture. Increased attention is given to the export trade; portable engines and machinery of English make still hold the first position in foreign markets where customs duties allow their entry, but protective tariffs greatly impede trade in Russia, France, and other countries, which formerly bought largely of English goods. The recent exhibition at Frankfort shows considerable advance among continental manufacturers, much of it being evidently due to imitation of English designs. Compound engines are receiving wider attention here than formerly; recent trials seeming to show that this system can be practised with advantage in engines of not less than 20 effective horse-power, the improvement lying not merely in economy of fuel in generating a certain indicated power, but in a steadiness of running that diminishes the difference between the indicated and effective force.

"Engine builders are still unable to obtain remunerative prices for locomotives and rolling stock, and at present the prospects of improvement are not very good, as the orders from India and the Colonies are insufficient to make up for the deficiency at home, where so many engines are made in the railway workshops. In the United States there is great activity, and manufacturers are less eager than a year ago to compete at low prices in foreign countries with English firms. Various adaptations of the compound system are being tried in England and elsewhere, but except on the London and North-Western Railway, where an increasing number of such engines are at work, these new methods are only in an experimental stage. The automatic vacuum brake seems likely to be generally adopted, for in addition to the merits it possesses, the fact that so many leading lines are using it will, from the advantages of uniformity, discourage any other kind. Railway carriage builders are more hopeful than at the beginning of the year; inquiries seem to be more numerous and to rest on a sounder basis, but competition is still severe, and the power of supply in excess of the actual demand.

"Bridge builders have continued busy since January, though at very low prices. Large contracts for steel bridges are in course of execution for Japan, India, and South America, and a fresh demand from Australasia may be anticipated as one of the first signs of revived trade there. Besides new enterprises requiring bridges, there is an increasing demand for renewals both in this country and abroad. In the United States the bridge builders are busier with railway work than they have been for years, and the re-building of the frail structures of iron and wood erected in past years cannot much longer be postponed under the exigencies of modern heavy traffic. In Canada also the time is not distant when the earlier bridges must be strengthened or re-constructed. The choice between steel and iron is no longer an open question. For bridges it is settled in favour of steel, but for roofs it is only in very large spans that steel is as yet adopted.

"There is a growing demand for Portland cement for export, which, if it continues, will raise this trade out of the severe depression which has characterised it during the last twelve months. At present, however, there is no increase in the consumption at home nor any evident sign of alteration in the prevailing prices, which are unprecedentedly low.

"Public works at home do not at present promise much to engineers. The Manchester Ship Canal seems now likely to be carried out to the satisfaction of Lancashire and profit to those immediately concerned, but with very doubtful prospects to the investor. The Trent and Humber Navigation and the improvement in the Birmingham and Bristol Canal are projected works which will more legitimately utilise existing natural advantages. A new metropolitan railway, southward from the City under the Thames, is being constructed and seems likely to inaugurate a new system of communication by piercing the soil at a depth which avoids the expensive works and heavy compensations needed for surface tunnels, the example of deep stations with hydraulic elevators at the Mersey Tunnel showing how easily the movement of passengers can be arranged. Abroad, railways in South America, Japan, and China are affording opportunities for English engineers. The Delagoa Bay Railway, towards the Transvaal, is begun, but, hampered with the disadvantages of cheap construction, bad climate, and Portuguese control, it will find a strong competition in the railway projected northward from Kimberley, which is more conducive to British interests. Harbour and dock improvements, so much needed at home and abroad, are likely to absorb some of the surplus professional skill formerly devoted to railways, but the commercial non-success of the recently constructed Tilbury Dock tends to discourage the investment of private capital in such ventures. On the Thames, the dock interests are financially so depressed that amalgamation under some such system as prevails at Liverpool will probably be attempted to save the companies from collapse. The lull in colonial enterprise still continues, and is the more conspicuous when compared with the activity in the United States, where nearly 4000 miles of new railways are being constructed this year. South America appears at present one of the best fields for the English engineering trades, the Argentine Republic and Chili especially taking the lead just now in railways and other public works.

"On the whole the prospects for the immediate future are good. The sudden fall in all countries of the money value of agricultural produce at a time when the output capacity of engineering factories everywhere had been greatly increased, has had its unavoidable results during the last three years, but the natural growth of the world and the accumulation of capital seeking investment have assisted the necessary re-adjustment, and buyers and sellers are coming together again. India and the Colonies may still be relied on as safe outlets for British manufactures, notwithstanding the tariff vagaries that prevail in so many of the self-governing Colonies. Canada, with natural advantages quite inadequate for steel and iron making, but needing railways to develope her real resources, is enhancing the cost of railways by doubling her import duties. Even New South Wales, which believes in Free Trade when purchases by the people's money are concerned, is, when the expenditure of borrowed money is in question, enforcing under the voting of the working men the manufacture in the colony at high prices of railway material. Every increase of duty or other artificial restraint so raises the cost of local manufacture that, in one shape or another, as by the purchase from us of separate parts, if not of the complete article, this country is still able to retain its trade by offering terms better than our rivals can afford, and possibly only where, as here, absolute freedom allows unimpeded scope to the inventive and manufacturing interests of the people."

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Hydraulic dock.—A large hydraulic dock has recently been completed at San Francisco, California, by the Union Ironworks, from the designs of G. W. Dickie, one of the proprietors of the works. The platform is 450ft. long and 66ft. wide, composed of thirty-six transverse steel girders, 6ft. 4in. deep, connected with five longitudinal girders. This platform is planted and provided with heel and bilge blocks of laurel, and all necessary appliances. The platform is raised by thirty-six hydraulic cylinders, eighteen on each side, the plungers having a stroke of 15ft., and the total lifting power being 8000 lb. These cylinders are supported on pile piers with a steel caisson, and on the piers are cast iron caps carrying the girders of the frame supporting the cylinders. On the plunger is a 76in. sheave grooved for eight steel ropes. There are 288 of these ropes, 2in. diameter and 44ft. long; one end of each is attached to the castings of the cylinder supporting frame and the other to the transverse girders of the platform. The water pressure is maintained by a pair of vertical steam engines, cylinders 12in. by 16in., geared to four 4½in. pumps with a stroke of 36in., making twenty revolutions per minute. The weights on the accumulator are graduated according to the weight of vessel to be lifted, and when in place seventy-two steel chocks are forced into place by hydraulic power to obviate any danger from the breakage of the ropes. In the test made, the steamer Arago was placed on the dock and raised in two hours and five minutes, and lowered in one hour and three minutes. The result was entirely satisfactory. This will add greatly to the importance and prospects of the Pacific and shipping interests.

Manufacture of sugar.—A new diffusion battery has been built for the United States Government, for experimental purposes, at New York, and is to be sent to the plantation of Governor Warmouth, in Louisiana. The battery is used for extracting the saccharine matter from sugar cane, and it is claimed to produce more satisfactory results than those by the old method of crushing between rollers. Under the roller process, even with double pressure, 75 per cent. only of the saccharine matter can be extracted; while the new process is claimed to be capable of extracting 88 per cent. It is this process which has made the beet sugar industry of Germany so successful. In the experimental battery there are twelve iron cylinders arranged in a circle, each capable of holding 65 cubic feet of cut canes; to these cylinders are attached beaters through which steam is passed. The cane is cut up in a chopping machine and fed into the cylinders; water is then introduced and forced through the cane, passing through each of the cylinders in turn, after which it is passed to the defecators and then treated in the same manner as the juice expressed by the ordinary roller mill. At the same time an experiment will be made with the new Yargan system of evaporation, for the purpose of evaporating the solution resulting from the above process. The evaporation is performed within coils of pipe surrounded by steam or other heating medium, and the material is forced continuously through the coils. The main advantage of the system is in economy of fuel. There is a London company operating the foreign patents of the Yargan system.

Change of gauge.—On June 26th the Toledo division of the Toledo St. Louis, and Kansas City Railroad, from Toledo, O., to Frankfort, Ind., 206 miles, was widened to the standard gauge, and the same day the first standard gauge train started from Delphos, O., to Toledo. Every preparation had been made by partially driving the new spikes, organising the gangs, &c., and the 2500 men performed the work completely and satisfactorily, the most difficult work being at the frogs and switches. The St. Louis division, from East St. Louis, Ill., to Frankfort, 245 miles, is being prepared, and the gauge will be changed in the Fall. The original gauge was 3ft. The road was originally intended to form a part of a transcontinental narrow-gauge system, but the tendency is now to bring every road to the standard gauge. Last year the greater portion of the southern system of railroads, with the southern gauge of 5ft., was reduced to the Pennsylvania Railroad gauge of 4ft. 9in. The Cincinnati and Eastern Railroad, between Cincinnati and Portsmouth, O., 106 miles, is to be widened from the 3ft. to standard gauge. The work has been delayed by the failure of the rolling mills to supply the new rails by June 23rd, as contracted for. The rails cannot be delivered before August, and the widening will be carried out in the Fall.

Moving railroad bridges.—The Pennsylvania Railroad Company is building a number of stone arch bridges to replace iron structures, and the latter are being shifted up or down stream to allow of the new work being constructed. Timber abutments and piers are built at the new site, and trestles built connecting them with the old site; rails are then laid on the trestles and a crab is placed on the bridge, the chains being securely anchored. When the appointed time arrives, after the passage of a train, the joints are disconnected and the structure worked by the crab to its new site, where connections are made with tracks previously laid. One bridge was moved in 11½ minutes. The results are uniformly satisfactory.

The Canadian Pacific Railway in Maine.—Work is now in active progress on the line in Maine, which will extend from the International Railroad—running from Sherbrooke, Que., to Lake Megantic—at Lake Megantic to the Maine Central Railroad at Mattawamheag, Me., a distance of 120 miles. The contracts are all let, and the preliminary work of clearing, &c., is being pushed. Under the conditions of the subsidy from the Dominion Government the line must have easy grades and curves. There will be considerable heavy work, including deep cuts, one 50ft. in depth, and several large bridges and trestles. Five iron bridges will be built across the Kennebec and Penobscot rivers; the former will be a three-span bridge. The greatest activity will be between the International Railroad and Greenville, Me., where the line will have access by means of the Piscataquis Railroad to Bangor and Portland. This section will be ready for traffic by November, the remainder to Mattawamheag will be completed next spring. This will give the Canadian Pacific Railroad a complete line from the Atlantic to the Pacific.

The Red River Valley Railroad.—The Dominion Government has decided against the construction of lines to the U.S. boundary, but the Manitobian Government has let contracts for the complete construction and equipment of the Red River Valley Railroad, seventy-five miles long, from Winnipeg to West Lynn, opposite Pembina, Dak. Trouble is anticipated, as the Dominion Government asserts its intention of preventing the construction of such lines. It is beyond a doubt, however, that lines to connect with American systems of roads must and will be built.

The Panama Railway.—Mr. Dudley, of New York, has recently been over the road in his dynagraph car and is now engaged in the preparation of an exhaustive and highly interesting report on the condition of the road, and, more especially, on the rolling stock. He enters very fully into the behaviour of various woods under the peculiar conditions of climate, into the various antiseptic treatments, and has some instructive drawings of wood sections. The 56 lb. rails are being replaced with 70 lb. rails, but this is not such an improvement as it should be, the height being only 4in., the same as that of the old rails, so that it is not a stiff section. Most of the ties are of lignum vitæ; the spike holes are bored and the spikes cannot be withdrawn, the heads are knocked off when necessary to release the rail. There is a considerable traffic due to the canal work, and of the thirty-two engines only three or four are in the shops at a time; there are thirty-two locomotives to forty-seven miles of road. The mechanics in the shops get 6 dols. per day.

Heavy rails.—The New York Central and Hudson River Railroad is replacing its 65 lb. rails with an 80 lb. section, specially designed for the road by Mr. Dudley. It is 5in. wide on the flange, 4⅜in. high, with head 2⅜in wide. The radius of the top of the head is 12in.

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

(*From our own Correspondent.*)

ON 'Change in Wolverhampton yesterday, and in Birmingham to-day—Thursday—the deductions drawn from the condition of the quarterly meetings imparted a repetition of the previous favourable tone, and justified makers in expressing some confidence in the future. This opinion, however, applies mainly to sheets, for which there is now, in the case of galvanised qualities, an almost unprecedented demand.

The shipping demand is beginning to emerge from the state of lassitude into which it has in part been thrown by a disorganisation of the foreign currency markets. With India business has been seriously checked by the indisposition of merchants to grant credit, but now that the rupee is recovering its normal value this stumbling block has been removed. Indian orders are now arriving with freedom. There is likewise some recovery of the South American markets—particularly Brazil—which promise in the early future to have an important bearing upon British trade.

A few of the best bar makers are in receipt of good orders, which are keeping some works in full operation; while there is likewise a better tendency in the medium branches, the price of best bars remaining at £7, and second quality at £6. The New British Iron Company occupies a somewhat exceptional position as follows:—Best Congreave's bars, £6 5s.; composite bars, £8 15s.; best Congreave's rods, £6; best Congreave's plates, £7 15s.; tank plates, £7; best Congreave's tees, £6 15s.; and best Congreave's hoops, £6 15s. per ton. The list of Messrs. W. Millington and Co., Summerhill Ironworks, stands at:—Bars, £7; small rounds and squares, £7 10s.; $\frac{5}{16}$in. bars, £8; ¼in., £8 10s.; No. 5, £9; $\frac{3}{16}$in. £9 10s.; No. 7, £10 10s.; No. 8, £11 10s.; and No. 9, £13. Best bars they quote, £8; double best, £9; and treble best, £11. Plating bars and cable iron, £7 10s.; best ditto, £8 10s.; with double best, £9 10s.; rivet iron, £7 10s.; best, £8 5s.; double best, £9 15s.; angles, £8 to £8 10s., and on to £9 10s., according to quality. Boiler plates and sheets, £8 10s.; best, £9; double best, £10; and treble best boiler plates, £12.

Merchant bars remain at £5 5s. to £5 10s.; and common £4 15s. to £5. At the £4 15s. quotation shoeing bars may be obtained, and hurdle bars may be had at £4 10s. at makers' works. Hoops for export purposes are £5; superior hoops, £5 5s. to £5 10s.; and gas tube strip, £4 15s. upwards.

The advance in sheets of from 2s. 6d. to 5s. per ton, which was announced by some firms a fortnight ago, is well maintained for prompt delivery business. A few firms, who are booked well forward, and do not desire further orders at present, quote 7s. 6d. advance this week. Galvanising doubles are quoted £6 5s. to £6 7s. 6d. as the maximum, but business with less favoured firms could be done at £6 2s. 6d. Lattens are, at the advanced rates, quoted £7 2s. 6d. to £7 7s. 6d. Merchant singles remain at £5 17s. 6d. to £6, and galvanising singles are this week a maximum of £6 2s. 6d. per ton. Makers are busy all round.

No abatement is on the open market allowed on the 10s. advance declared last Thursday by the associated galvanisers, who feel themselves still further justified in the course which they have taken by the improving tone of the Australian market. Actual business is, however, going on at 5s. to 7s. 6d. advance. For some time Australia has been congested with heavy consignments, but

these are now fortunately beginning to move off. Prices vary greatly from £10 2s. 6d. to £10 5s. and on to £10 10s. for 24 gauge, packed in bundles, f.o.b. Mersey. Spelter having advanced 15s. to 20s. per ton, the price is now £15 5s.

Good orders for best thin sheets for stamping and working-up purposes are being received largely on account of South Australia, North America, Italy, Germany, France, and other distant markets. Some makers reported on Thursday larger orders for France and Germany than they have booked for a considerable time past. Prices are well maintained.

Makers of pigs having upon their books good orders for forward delivery are strong in price. The Spring Vale Company has contracts on its books for 40,000 tons. Prices are maintained at 36s. to 37s. for Northamptons delivered to consumers' works, 37s. to 38s. for Derbyshires, and 41s. to 41s. 6d. for Lincolnshires at stations.

The Lilleshall Company, Shropshire, quotes its No. 3 hot-blast all-mines at 50s. to 52s. 6d., with 5s. extra for Nos. 1 and 2. Cold-blast are 75s. for No. 3, 5s. extra for No. 2, and 10s. extra for No. 1. Ordinary Staffordshire medium pigs are 37s. 6d. to 40s., and common 29s. to 30s. Barrow hematites are quoted 55s., with only a small sale.

The Spring Vale Company quote this week—Hydrates, 47s. 6d.; B.F.M. iron, 40s., and common 30s. per ton.

The condition of the steel trade keeps satisfactory. The Lilleshall Steel and Iron Company, who are particularly busy, quote ordinary blooms at £4 12s. 6d. to £4 15s.; while for some superior classes of billets they are obtaining as much as £7 17s. 6d. per ton.

Basic steel continues to obtain increased favour at the hands of engineers and general consumers. The Staffordshire Steel and Ingot Iron Company, which is full of work, is sending away bars and plates to be used in bridgework for Japan, India, and other foreign countries. It is also supplying bars up to 6in. diameter and 35ft. lengths for piles for pier supports to the Indian State Railways. Bars for shafting in engineering shops is becoming an important branch, and the sizes at present rolled have a maximum diameter of about 6½in. In addition to plates, sheets, tube strip, bars, and billets, basic steel is now being used for a great variety of light machine work for which malleable cast iron was formerly employed.

The starting this week of an 8-ton steel furnace, at the works of the Staffordshire Steel and Ingot Company, Bilston, upon the open hearth basic system, deserves more than a passing notice. The common phosphoric pig of Staffordshire, which contains 2 per cent. of manganese, will be used. The manufactured product will command 5s. to 10s. per ton more than the basic steel. The output at the works will be more increased, according to the method of working ultimately decided on, by from 100 to 200 tons per week. The furnace is served by three vertical gas producers, and the admixture of gas and air enters the furnace at the enormously high temperature of from 3000 deg. to 4000 deg. An ordinary charge consists of 6 tons of pigs, 1 ton 10 cwt. of steel plate scrap, 15 cwt. of red Spanish ore, and 10 cwt. to 15 cwt. of lime. This will produce 6 tons 8 cwt. to 6 tons 10 cwt. of ingot steel.

The young Earl of Dudley, who attains his majority next year, made a tour of inspection, on Tuesday, through his collieries and ironworks at Brierley Hill. He was met by Mr. Charles Tylden Wright, his principal agent, and Mr. R. Smith Casson, general manager of the Round Oak Works. After visiting the blast furnaces, his lordship viewed the mills and forges in detail. The machinery, which was in full swing, having been stopped, the men gave a hearty welcome to Lord Dudley, and in replying, he said that he should do everything he could to promote the prosperity of the works; he hoped that by working together they might be able to weather the present depression.

The ironworkers' wages question is again cropping up. The masters are not prepared to allow to lie dormant their recent agitation upon the subject of the "extras" paid in the Staffordshire mills and forges, over and above the prices paid to ironworkers in other districts. A preliminary meeting of the officials on each side has just been held, and next month it is anticipated that a meeting of the joint committee of masters and men that has been appointed to deal with the subject will take place, with the view, if possible, of arranging some mutual scale.

The demand for coal is dull alike for manufacturing and house sorts, and the pits are only making two or three days a week. Best thick coal mined in the Tipton district used for blast furnace purposes is 6s. 6d. to 7s. 6d. per ton; Staffordshire mill coal, 6s. to 5s. 6d.; and forge coal, 5s. to 6s. On the Cannock Chase slightly lower prices are being accepted. House coal on the Chase is selling at lower prices than have ever previously been known. The prices at the West collieries are as here:—Shallow kibbles, 5s.; shallow one-way, 5s. 6d.; shallow hand-picked, 6s. 6d.; deep kibbles, 5s. 6d.; deep one-way, 6s.; deep hand-picked, 7s. Second and third-class collieries on the Chase are selling at 6d. per ton less than these prices.

Some fair Indian orders are now on the market—one for fishbolts and wagon ironwork for the Indian State Railways, and another for wrought iron, galvanised iron, switches, and crossings, for the South Indian Railway Company. A supply of cast iron pipes is required for the Baroda State Waterworks.

Electrical machinery engineers in Birmingham and Wolverhampton are very busy. So rapidly is the demand increasing for this class of machinery for power transmission and for employment at chemical works, that at some shops the current demand for dynamos and accumulators for lighting purposes is by no means of most account. Trade with the colonies and India is fast extending, and so, too, is the home business. Messrs. W. and J. Player, Birmingham, are actively engaged, chiefly as agents of the Gulcher Company, and the Elwell-Parker Engineering Company, Wolverhampton, whose working staff has now increased to something like 250 hands, is full up with orders.

Steam pump engineers who do a colliery business are hardly so active as two or three months ago on new orders, but they are nevertheless fairly steadily engaged an account of collieries in the North of England, South Yorkshire, and South Wales. Messrs. Joseph Evans and Sons, of the Culwell Foundry, Wolverhampton, give a steady report on the above. Pumps for hand and wind power, for irrigation purposes, are in large demand at date for the River Plate and the Brazils, South Africa, and South Australia. American competition continues severe, and the Germans are also coming to the front as makers.

Birmingham machinists and engineers, though not quite so fully engaged as earlier in the year, are yet experiencing a brisk export demand for most descriptions of machinery and machine tools. The Indian Empire and Burmah are proving capital markets at date, not only in consequence of railway extension work, but from other causes likewise. Orders are coming forward from China, and big things are hoped for in this direction as the country increasingly adopts Western civilisation. Spain and some other of the European markets are buying encouragingly, but German and Belgian competition is on the increase, particularly in engineers' machine tools. The extended employment of gas engines and of the compressed air system, is operating against the business in steam engines, but makers must turn their attention into new channels.

Messrs. Tangyes and Messrs. Causer and Co. are executing orders for hydraulic machinery, lifting jacks, winches, and the like for India and the colonies in good numbers. Certain other firms are experiencing a capital demand from India, Australia, and South America for screwing tackle, lathes, and other engineers' tools. Dockyard and arsenal requirements, though hardly so brisk as recently, are affording work to Messrs. Archdale and Co., Messrs. G. G. Belliss and Co., and other firms. The first-named concern has recently completed an important line for cartridge drawing machines for Messrs. Kynoch and Co. Spiel's petroleum engines are in increased demand from Messrs. A. Shirlaw and Co. To facilitate the execution of their recent magnificent order for coining presses for China, Messrs. Heaton and Sons are sub-letting some of the business to other local firms of repute.

The directors of the Patent Nut and Bolt Company, at their last board meeting, resolved upon the payment of an interim dividend for the past half-year at the rate of 5 per cent. per annum on the preference shares, and 10 per cent. per annum on the ordinary shares.

The operatives in the Birmingham malleable nail trade are determined to strenuously resist the attempt of the employers to enforce a reduction of 10 per cent. in wages. It is thought that the matter can be amicably arranged.

Preliminary arrangements are being made for holding in North Staffordshire in 1888 an Exhibition of the industrial products and appliances of the Pottery district. An executive was formed last week at Stoke-on-Trent.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—The condition of the iron trade in this district does not get any worse, and this seems to be about all that can really be said in its favour. Any sign of appreciable improvement is still absent, and so far as the prospects of better trade are concerned the outlook for the future continues discouraging. There is a moderate amount of business doing, with an occasional spurt of buying, which while it keeps things moving is still too small in volume generally to give the much needed strength to the market which would help it on to a substantial improvement. The result is that prices are kept on the low, unsatisfactory basis that has prevailed for so long past, and where orders have to be competed for in the open market they are in most cases only secured on terms, which, from the makers' and sellers' point of view, very often renders it questionable whether the business is worth having at all. If the constantly reiterated complaints that the prices at which business is done are below the actual cost of production are only true, in fact, to a moderately proportionate extent, it must simply be a question with many producers how much longer they can stand this persistent leakage of their resources. It is of course out of the question to suppose that all, or even nearly all, the business in the iron trade is now being done at a loss to the producer, but there is no reason to doubt that in very many cases where makers are in any way unfavourably situated, either as regards their plant for production or the position of their works, in obtaining supplies of the raw material or the delivery of the manufactured article to their customers, the keen competition of favourably situated works fitted up with modern plant is driving them into a position the only solution of which will be the survival of the fittest, and the inevitable closing of many of the present struggling concerns. Trade may perhaps then take a turn for the better.

At the Manchester iron market on Tuesday there was only a slow business doing, and the same remark will summarise trade generally during the past week. Prices have remained without material change. This, however, is not so much an indication that the market is actually strong, as that iron makers and manufacturers have got down to the lowest possible point. In pig iron there have been some moderate transactions at the low prices that have been ruling recently. Lancashire makers, however, who have contracts still running that are pretty well taking off their present limited productions, still abstain from competing with the low figures at which district brands can be bought in this market, and are content with the occasional small orders they are able to book at about their list rates to regular customers, where they have an advantage in the rate of carriage. For delivery equal to Manchester, local makers still quote 38s. 6d. for forge and 39s. 6d. for foundry, less 2½ per cent., but at these figures they are practically out of the open market. Small sales of Lincolnshire iron have been made at about 36s. 6d. for forge and 37s. to 37s. 6d. for foundry, less 2½ per cent., delivered equal to Manchester, but even at these low figures orders are difficult to get, and although makers generally are firm, there are sellers who would take a little less. The rather weaker tone which has been reported during the past week in Scotch and Middlesbrough warrants does not appreciably affect makers' prices for outside brands offering here, and good-named brands of foundry Middlesbrough remain steady at about 43s. 4d. net cash, delivered equal to Manchester.

There has been very little doing in hematites, and the tendency is towards flatness; quoted prices, however, remain without alteration, and except for quantities it would be difficult to place orders at under 53s. to 53s. 6d., less 2½, for good No. 3 foundry qualities delivered into the Manchester district.

Business generally in the manufactured iron trade is very dull. In sheets there is a fair amount doing, but bars and hoops are in very slow demand. Prices remain without alteration, although it can scarcely be said that they are in all cases firm at late rates. One or two makers still hold to £5 per ton for bars delivered into the Manchester district, but £4 17s. 6d. represents the full average price generally; hoops can be got at £5 2s. 6d. to £5 5s., and local made sheets remain at about £6 5s. per ton delivered.

With regard to the condition of the engineering trades, works in this district seem to be irregularly supplied with orders. In some cases they are getting decidedly busier, in others the weight of actually new work coming forward is reported to be falling off. Taking trade generally, there is a moderate weight of inquiry stirring, and, judging by the returns of the trades union organisations, the Amalgamated Society of Engineers again reporting a decrease in the number of members in receipt of out-of-work support, there would certainly seem to be more actual business doing. The competition to secure orders continues, however, as keen as ever, and in some instances I hear it reported that the prices at which work is taken are, if anything, getting even lower.

The strike in the Bolton engineering trades continues, and there is no sign of giving way on either side. The employers are determined in their efforts to fill the places of the men who have gone out on strike with workmen obtained from other districts, whilst the Bolton strike committee is resorting to every possible means to prevent the outsiders being brought into the works. Gradually, however, men are being got, and a deputation from the Bolton strike committee which attended before the Manchester and Salford Trades Council on Monday reported that twenty-five men had been got into the works of Messrs. Hick, Hargreaves, and Co., thirty into Messrs. Dobson and Barlow's works, eighteen into the works of Messrs. J. and E. Woods, and some few in other establishments. Since then further additions have been made, and but for the terrorism which prevails in the town, the employers would have no difficulty in filling their works many times over. Liberal contributions are still coming to hand from various outside sources in support of the strike. The balance in the hands of the committee, after paying all expenses, has week after week steadily increased, and for the week ending July 12th amounted to £476. This is, of course, quite independent of the grants made by the trades union organisations to their members for which a special levy is being raised both by the Amalgamated Society of Engineers and the Steam Engine Makers' Society. The employers, on the other hand, are backed up by the full strength of the Iron Trades Employers' Association. It is therefore evident that the dispute is not likely to be brought to any early end by lack of funds, and there is every indication that it will be a very protracted struggle. There has been an attempt by the men's representatives to make capital out of the fact that a very small firm in Manchester, which happens to be pressed to complete orders in hand, has given back the 7½ per cent. to the men it employs so as to ensure them working overtime; but this is altogether too insignificant a circumstance to have any value whatever, and is only an illustration how even the most trivial circumstance is eagerly seized hold of to bolster up the position of the men out on strike.

On Saturday last the members of the Manchester Association of Engineers to the number of about 150 paid a visit to the Manchester Royal Exhibition, and were entertained at tea in the Palm House dining-room by Alderman W. H. Bailey, the president, who afterwards delivered a brief address on the achievements of science during the Queen's reign, of which he said they had a splendid representation in the building in which they were then assembled which contained the finest and largest collection of machinery ever brought together under one exhibition roof. Mr. Bailey added that he saw her Majesty's Government intended to devote some attention to the promotion of technical education, and he would suggest that if it should be the good fortune of the executive committee, when that exhibition terminated, to have a surplus in hand, it might not be an improper thing to indulge the hope that some portion of the building and the profits might be used to promote technical education, and that as a survival they might have a permanent exhibition in the interests of utility and beauty. The suggestion which Mr. Bailey has so happily thrown out will unquestionably receive general assent in this district, and it is only to be hoped the committee of the exhibition will have a sufficient surplus to enable them to carry it out.

A melancholy incident in connection with the exhibition during the past week has been the rather sudden death of Mr. Herbert Mead, superintendent of exhibits, who, after a very short illness, expired on Monday night. The announcement was received with general and deep regret by the exhibitors, amongst whom Mr. Mead was universally and highly respected.

The Manchester Ship Canal project is making very encouraging progress. Upwards of £3,300,000 ordinary share capital has now been taken up, and at a meeting of the Manchester Consolidated Bank on Wednesday, the chairman, Mr. Frederick A. Hankey, M.P., remarked that he had made inquiries in London, and it was gratifying to know that the applications for preference shares were coming forward in a satisfactory way.

An excessively quick demand for all descriptions of fuel is still the general report throughout the coal trade of this district. Pits are not working more than three to four days a week, but even this restricted output is considerably in excess of requirements, and stocks of round coal are accumulating heavily, slack, of which very little is now being screened, being the only description of fuel that is not a drug upon the market. Where stocks are pressed for sale it is of course impossible to say what prices are being taken, but there are sellers at very low figures. The current market rates, however, remain without change, and at the pit mouth average 8s. to 8s. 6d. for best coals, 6s. 6d. to 7s. seconds, 5s. to 5s. 6d. common coal, 4s. 6d. to 4s. 9d. burgy, 3s. 6d. to 3s. 9d. good qualities of slack, and 2s. 6d. to 3s. per ton for common sorts.

The shipping trade is only dull. North Wales is competing keenly with Liverpool, and Scotch and Whitehaven coal at the Irish ports, much to the detriment of Lancashire coal. Delivered at the high level, Liverpool, or the Garston Docks, Lancashire steam coal can be got at about 6s. 6d. to 7s. per ton.

Barrow.—Mr. H. W. Schneider, on the occasion of opening the new Town Hall at Barrow last week, a ceremony which was performed by the Marquis of Hartington, spoke very encouragingly of the future of Barrow in its reference to the steel trade. He said that during the past few weeks the Barrow Hematite Iron and Steel Company had rejected more orders for steel than would keep their gigantic works fully employed up to the end of June next. But they were on the one hand so fully employed, and the prices offered, like current quotations, so low, that they were not in a position to accept them. At the same time, he expressed the belief that within twelve months the commercial and industrial position of Barrow would be such as to show activity in all departments of local industry. The Marquis of Hartington, who has accepted the post of chairman of the three Barrow companies—the Furness Railway Company, the Barrow Hematite Steel Company and the Barrow Shipbuilding Company, said his family had been very greatly identified with the great industries of Barrow, and now that he had been called upon to fulfil the positions his father had resigned owing to failing health and advancing age, he would promise to do all he could for the town. There is a steady and improving tone in the hematite pig iron trade, and the demand for Bessemer samples is much more active than it has been. Prices are steady at 45s. 6d. per ton, net, f.o.b., for Bessemer samples in parcels of mixed numbers, and 44s. 6d. per ton for forge and foundry iron No. 3, while white and mottled samples are quoted at 43s. 6d. per ton. There is no change to note in the activity of the steel trade. Orders for steel are brisk, and the trade doing in rails is especially strong both on home and on foreign account. Prices are steady at £4 3s. per ton, and any amount of business could be accepted at these prices. There is not much doing in other departments of the steel trade, although makers are fairly well employed on bars, plates, angles, &c. The shipbuilding trade is very quiet, and none of the orders which were expected a short time ago have been secured. Engineers are fairly well employed in the marine department. Iron ore is in steady demand at late values—8s. 6d. to 11s. per ton. The coal trade is brisk, and there is a good consumption of coke. Shipping is fairly employed in the importation of iron and steel to foreign and colonial ports.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

RAILWAY material continues to be very largely ordered, both on home and foreign account. Messrs. Craven Brothers, Darnall Carriage and Wagon Works, are fully employed in every department of their business. They have just booked 365 wagons for the Hull and Barnsley Railway; a large quantity of wheels for the North British, Lancashire and Yorkshire, Great Northern, and Great Eastern railways; and they have work in hand for the same class of material for the Cheshire lines, as well as for carriages. Among foreign orders recently taken is one for wheels for the Tasmanian Government. This is a good order. Other work is in course of completion. One or two firms employed in railroad material of general description are also working full time, and some of the orders are urgently called for.

Some years ago, when doubt was expressed as to the future of the steel trade, I remember hearing the chairman of Charles Cammell and Co., Mr. George Wilson—since deceased—predict a development of the steel industry in steel sleepers. His prediction has come true, but the work has not come Sheffield way, as he thought it would. Large orders are just now on offer for steel sleepers, the most important of which is for an Indian line, and is exciting a good deal of interest. Prices are stated at £5 to £6 per ton. A Welsh firm is said to have carried off a contract for nearly 300,000 sleepers for the East India State Railway.

A largely-attended demonstration of Yorkshire miners took place at Wakefield on Monday. It is estimated that 15,000 persons were present. A resolution was passed recording the good done by the Yorkshire Miners' Association, and urging all miners to join it, "So that greater benefits in the matter of fair wages and contracts may be obtained in the future than has been done in the past." The resolution further reiterated the desire of the miners that the Yorkshire colliery owners would meet the men and agree to form a joint committee of owners and workmen, "in order that all disputes may be decided amicably without having recourse to strikes and lock-outs both on local and general questions." Among other resolutions passed was one in favour of the Government being pressed to deal with the Employers' Liability Bill and other questions affecting the interests of the working classes "in a more prompt and practical manner than has hitherto marked their action since they came into office." The miners, it is understood, intend to add to their representatives in the House when they feel financially strong enough.

Two old-established collieries have recently been closed—West Melton, where coal has been got for over half a century, and Newhill pit, which at one time produced a fine quality of house coal which was in repute for the Southern markets. A number of miners have thus been deprived of employment.

Metal tubing is at present in excellent request, chiefly on home

account. Messrs. Howell and Co., of the Sheffield Tube Works, Wincobank, report that business is very brisk with them in all their specialities. They are also full of work in steel, files, and similar goods. Generally, the steel, file, and saw trades, and edge and mining tools, are in a gratifying condition, though complaints are made of the lowness of price and the keenness of competition.

Lead mining in Derbyshire is almost a lost industry. Companies which at one time paid magnificent dividends find it impossible to carry on at a profit, and mine after mine is being closed. On Tuesday, the mines and mineral possessions of the Eyam Mining Company, situate in the manor or mineral liberty of Stoney Middleton and Eyam, Derbyshire, was sold for £131 15s.! One portion of the property—the Dusty Pits and Glebe Mines—were for years very rich. The shares have been as high as £60 and £70, and dividends of £1 per share per month have been paid. These pits, with several other mines, sold for £120. Three other mines—the Fielding Gate Mine, the Shining Cliff Mine, and a moiety of the Burr Mine—fetched 10s.; and 648 shares in the Water Grave United Mines, situate near Foolow and Middleton Dale, sold for 25s.! Very few of the many prosperous mining concerns of twenty years ago are now being worked. The capital of the Egam, Magpie, Milldam, and most of the mines is held in Sheffield. In times of war, and before Spain and America became sources of supply, the lead mining industry of Derbyshire afforded employment for thousands of worthy workers, and returned good dividends to Sheffield capitalists. Mr. Wass's mines in Darley Dale are still being profitably worked.

Sheffield has lost a noted citizen in the death of Alderman W. Hutchinson, formerly senior partner in the firm of W. and H. Hutchinson, surgical instrument makers, Matilda-street. At one time in the scissor trade, Mr. Hutchinson, failing to book any orders in London, was asked why he did not offer something that would sell, and a Strand merchant mentioned to him that he could not procure scarificators, even though he sent his asssistant with cash in hand for them, neither would the market back an order. Mr. Hutchinson borrowed a pattern, returned to Sheffield and made a dozen or two. These were sent to London and formed the beginning of a great business and the introduction to Sheffield of the new industry. He showed inventive genius in other directions, and in course of time became a leading manufacturer, amassing a large fortune. He was Master Cutler in 1857-8, and has been an alderman for many years. The business is now carried on by his nephew, Mr. George Tomlinson, under the old style.

Messrs. J. G. Lowood and Co., of Sheffield and Deepcar, have just booked an order for nearly 100,000 of their "Lowood" bricks for the armour-plate furnaces at Kolpino, St. Petersburg. They report business as exceedingly brisk.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE Cleveland pig iron trade continues in a quiescent condition, and prices are slightly lower than a week ago. There was a good attendance at the market held at Middlesbrough on Tuesday last, but consumers could not make up their minds to purchase, and only small quantities changed hands. Makers have made no reduction in the quotations, but those merchants who hold iron in quantity are now mostly willing to take 34s. 4½d. for No. 3 G.M.B. for prompt delivery, and 34s. 7½d. for delivery to the end of August. Some sales were reported at 34s. 3d. per ton, but they were not many, and for small lots only. Forge iron is in poor request, manufacturers preferring not to buy whilst the outlook of the finished iron trade remains so unsatisfactory. The usual quotation is 33s. per ton, but 32s. 9d. has been accepted by some sellers.

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

The price current of warrants was on Tuesday last 34s. 3d. per ton, but 1½d. less was reported as their value at Glasgow. Buyers are, however, difficult to meet with at any price.

Messrs. Connal and Co.'s stock of pig iron at Middlesbrough amounted on Monday last to 335,904 tons, being a reduction of 55 tons for the week.

Pig iron shipments from Middlesbrough have been but small during the last few days, owing probably to holiday-making at Glasgow. The quantity exported up to Monday night had only reached 35,590 tons, or about 7000 tons less than in June.

The finished ironworks are in more continuous operation as the result of somewhat cooler weather, bnt orders are being rapidly worked off, and the prospect of fresh ones to take their places is not very encouraging. Quotations remain unaltered; common bars and ship plates being offered at £4 10s., and angles at £4 5s. per ton, less 2½ per cent. discount, free on trucks at makers' works. But orders can usually be placed at somewhat less, owing to the sharp competition among producers.

The steel works are fairly well occupied, and enquiries are numerous. Prices are as follows:—Rails, £4 2s. 6d. per ton: ship plates, £6; and angles, £5 2s. 6d., free on trucks at works. Payments net cash.

The workmen connected with the iron and steel trades of the Cleveland district seem to be in an uneasy condition. In view of the long-continued depression of trade, and the ample supply of labour in every market, it might have been thought that they would have been contented, and even thankful, to have an opportunity of working on quietly, at the best wages obtainable. That is not so, however. Whether spontaneously, or under pressure from professional agitators, is not clear. At any rate, the Northern workmen seem ever ready to quarrel with their bread and butter, and throw it recklessly away, however scarce it may be. At a recent meeting of the blast-furnace men, their officials were instructed to arrange for a conference between representatives of the steel workers, the blast-furnace men, and the miners, with the object of federating them all into one Union. A hope was expressed that their operations might be extended to wherever there are blast furnaces in the United Kingdom. But the principal object of the meeting was to take measures to get the hours of labour reduced to eight per day. Whether there is to be a proportionate diminution of wages or not was not stated, but there is little doubt that the same wages will be expected for eight hours as for the present working day. The meeting also decided to ask its parliamentary committee to do their best to have blast furnaces placed under Government inspection. It would be well if if could be brought home to these blast furnacemen that we have lost the Mediterranean trade in hematite pig iron. It is now being carried on almost entirely by Spanish firms, and this is largely due to the longer hours and lower wages at which Spanish miners, blast furnacemen, and sailors work in comparison with the English. If the English iron and steel trades are handicapped still further in the same way, other markets, less distant than the Mediterranean ports, will be given over into the hands of our competitors, and further depression will probably ensue.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE past week has been devoted to holidays in the manufacturing districts of the West of Scotland, as well as in some other parts of the country, and in Glasgow and neighbourhood probably another week will elapse before work is completely resumed.

The Glasgow pig iron market was closed from Thursday till Tuesday, and the tone of business has been quiet since the opening, with comparatively little doing, and not much alteration in prices. Very little speculative business has taken place. The past week's pig iron shipments were fair for a holiday time, amounting to about 7000 tons. There were eighty-three furnaces in blast, against eighty-six twelve months ago. Less pig iron than usual has been sent into Messrs. Connal and Co.'s Glasgow stores this week.

The current values of makers' pig iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 49s. 6d.; No. 3, 44s. 6d.; Coltness, 54s. 6d. and 45s.; Langloan, 50s. 6d. and 46s.; Summerlee, 52s. 6d. and 43s. 6d.; Calder, 49s. 6d. and 42s. 6d.; Carnbroe, 44s. and 40s. 6d.; Clyde, 46s. 6d. and 41s. 6d.; Monkland, 43s. 6d. and 39s.; Govan at Broomielaw, 43s. 6d. and 39s.; Shotts at Leith, 49s. 6d. and 45s. 6d.; Carron at Grangemouth, 52s. and 44s. 6d.; Glengarnock at Ardrossan, 48s. 6d. and 41s. 6d.; Eglinton, 43s. 3d. and 39s. 3d.; Dalmellington, 44s. and 40s. 6d.

During the week ending Saturday last 2920 tons of Cleveland pig iron were imported at Grangemouth against 4705 in the same week of 1886. The total import of these pigs to date for the present year is 185,073 tons, being 15,479 more than at the same date last year.

The coal trade is quiet, many of the colliers being on holiday, but the week's shipments have nevertheless been fairly good. At Glasgow, 29,563 tons were despatched; Greenock, 811; Irvine, 2393; Troon, 6496; Ayr, 8307; Granton, 5655; Leith, 3000; Burntisland, 7326; Bo'ness, 7463; and Grangemouth, 11,875 tons. There is no change in prices this week, although it is not very easy to maintain quotations.

Miners' wages are being reduced all round, and the prospect is that in some places the men will offer active opposition. Indeed, strikes of the shale miners have already occurred in certain districts. These will be futile, so far as the men are concerned, because the whole of the oil companies are agreed in making the reduction as an absolute necessity of the present unremunerative state of the trade. The oil companies have also confirmed an agreement for increasing the price of burning oils.

The Fairfield Shipbuilding Company, of Glasgow, has received an order from the Government for the construction of the hulls of two wood-sheathed protected cruisers of about 2950 tons displacement, and having a speed of twenty knots an hour. The engines for the vessels, which are to be built by Messrs. Hawthorn, Leslie, and Co., on the Tyne, are to be 10,000-horse power.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE cutting of the sod for a new steel works at Cwmavon took place this week, and the expectations are favourable. The district has long been an industrial one, from the palmy days of the copper works, and being favourably situated for the seaboard, may rival some of the inland ones.

It is considered that the prospects of the steel trade are favourable, efforts at a restart being probable in several directions, notably at Treforest. The proprietors include several leading men in the steel trade, and thus the augury is a good one. I regret to find that Dowlais Works continue in a dormant state. Very little is doing there for lack of water, and total stoppage seems not far removed. The works not requiring coal, colliers in turn are not required, except those who work the sale coal, and thus the distress is intensified. But for the drought, a good business would be doing in all directions, as orders for steel sleepers, rails, and tin bar are in hand in sufficient numbers to keep things moderately brisk. The little that is done by works better situated than Dowlais for water is at firm, if not advancing, rates. Cyfarthfa is going on well, being favourably placed with regard to water, though great economy is practised, the hydraulics requiring large quantities. The coke ovens of the Evance Copper Co. are progressing well, and a new contingent of Belgians came in this week to construct.

The only iron and steel cargoes of any note of late have been one of rails for San Francisco, from Cardiff, and another of steel sleepers from Newport, Mon.

The multiplication of the uses of steel promise, as I have stated of late, well for the future of the steel works. The exhibition of plates from Landore now being used at Pembroke Dock in naval construction, and of steel "tissue paper," for such is the best description, made at Cyfarthfa, yield the two extremes, and show what steel is capable of being transformed into.

A fine steel vessel is now loading at Penarth, Cardiff. It is regarded as a fine example of the Clyde build. She carries 3600 tons, and is strongly and handsomely constructed, engined on the triple-expansion principle, the diameter of the cylinders being 21in., 33in., and 54in. Her length is 285ft., beam 37ft., and depth of hold 18ft. 6in.

Several fine vessels have been cleared this week, notably the Star of Victoria for Bombay with 4000 tons steam coal. Large cargoes are going to India and China, and the coal trade continues to sustain the hopes aroused of late. Coalowners are, however, complaining that too favourable an opinion is at present held of prices, and insist that the high prices quoted of late, as obtained at Cardiff, have been given under exceptional circumstances. This may be, but it cannot be denied that prices are higher at all the ports, generally, for steam coal. At Cardiff, owners of the best steam coal have been able to command pretty well their own rate, which is 9s. 6d. per ton. Inferior sorts are selling at various figures ranging from 7s. 9d. to 8s. 6d. Rhondda coal has not quite recovered its form, and 8s. is about the highest price obtainable.

Colliers are beginning to get expectant at an advance of wage, but this is still in the distance. The fact is that though the coal trade is undoubtedly better, the grave evil still remains that the capacity of yield is too great for demand. Jubilee week told well on the coal trade, because the colliers worked less. Coalowners say that directly the output slackened, and buyers found it difficult to complete cargoes, prices went up. If the colliers went in thousands for holidays to the wells and the coast towns, it would have an excellent influence on the trade.

The drive at the large collieries is excessive: Clydach—Thomas and Riches—may be instanced, which sends up 1400 to 1500 tons daily. This is so managed that the operations are incessant, three tons of coal coming up every time, and as rapidly as the engine can act. The "high-pressure" exercised at other collieries, not so well engined as this—three being employed—is shown by a complaint of an engineer "that he has not time to eat a meal during the eight hours working." He can only take "surreptitious bites."

An accident in connection with one of the Rhondda pits is reported this week. Some derangement of the valves of the engine caused the cage with ten men to descend at too rapid a rate, and all were more or less injured at the bottom of the pit.

The export of coal from Cardiff last week was over 150,000 tons; from Swansea close upon 26,000 tons; and Newport coasting trade showed a total of 25,000 tons. Swansea quotations, steam coal, were 8s. to 8s. 6d. House coal is weak all round. Steam coal is now beginning to flood the market again, but prices still keep at 5s. to 5s. 3d. Pitwood, best, 15s.

Patent fuel is getting more brisk. Swansea last week sent away over 6000 tons. This is scarcely, though, half the capacity of the manufacturers. The quality is excellent, and I should only be too glad to record some of the old totals of 10,000 to 12,000 tons.

In tin-plate there has been a considerable exportation. Swansea exported last week tin-plates to the value of £80,000. America is still the principal customer, as note the items of last exports:—Baltimore and Philadelphia, 2200 tons, New Orleans 750 tons, New York 1600 tons, Lisbon took 185 tons, Hamburg 250 tons, Batoum 1660 tons.

The total shipments from Swansea were next to the highest on record, amounting to over 92,000 boxes.

There is a little hesitation amongst buyers this week, and not so much business doing, as makers are firm in resisting any reduction from late quotations, namely, Bessemer steels, 13s. 6d. to 14s. Siemens, 14s. to 14s. 6d. In face of the fact that makers are greatly backward in deliveries owing to the drought, as regards their own works, and the works supplying them with steel bar, and that stocks are down to 36,000 boxes instead of 90,000 the previous week, the tendency of things at Swansea especially is to an advance above present figures.

The Monmouthshire works are going along satisfactorily.

Five colliers of Plymouth were each fined on Monday 10s. and costs for reckless contravention of the colliery rules, by which their own lives were endangered and three horses killed.

NOTES FROM GERMANY.

(From our own Correspondent.)

THE Rhenish-Wesphalian iron market has in general assumed a firmer attitude, at any rate as concerns wrought iron manufactures, and to all appearance there is an improvement approaching in the condition of the crude iron trade as well, judging from the reports coming to hand. The South-west group of works are now discussing a common sales syndicate, it appears, and when this is arranged the present idea is to establish a joint central sales bureau at Berlin for merchant iron for all the four groups or syndicates. It may then be that the physiognomy of the iron business will be changed for the better, which is very desirable, but there are still a number of works, though the less important ones which are and will probably remain without the pale of the combination, which is a bad prognostic for a continued, steady, remunerative trade. Beyond this, again, it will require careful watching to see that one group does not try to overreach the other, and so bring the trade into the same condition it was placed in before by individual competition. The reports from Silesia are, on the whole, satisfactory, although the demand for crude iron has shrunk considerably for some sorts. Latterly the reports from the Siegerland, too, have been more cheerful, and since the sudden drop in forge pig a short time back, made by one works for no easily reconcileable reason, it has decidedly become quite firm, for although the greater part of the output for the quarter has been sold, still there is a steady demand not only for it, but for the other sorts as well, and new sales are only done at M. 1 to 2 advance on last quotations. Ores also have improved in price a little and the mines are able to maintain the slight advance, which, however, unfortunately for them, took place after the Westphalian and Rhenish smelting works had made large contracts for roasted steel-stone at the former ruling lower prices. On the whole, at the present moment the Rhenish-Westphalian crude iron trade is, relatively, in the worst position as prices cannot be got to rise; but this is not to be wondered at when the disproportion between stocks and present output on the one hand is considered in relation to demand on the other. Nevertheless, prices have not receded during the week, and if not in every case, still the condition of the market may be pronounced to be an improving one, and if a common sales syndicate can be established for the Siegerland, which is now in embryo, it will materially aid in steadying prices and sales in all quarters. America is again in the market for spiegeleisen, and considerable export contracts have been entered into with that and other countries. There is nothing new to mention concerning Bessemer and basic pig, further than that prices fixed by the Rhenish-Westphalian convention are being strictly upheld. As regards the rolling mill branch, it has improved, as was expected, for no sooner were buyers once satisfied that the sales syndicates were realities, than they emerged from their waiting attitudes, and concluded large contracts at the prices fixed by the combination. Now the works are fully engaged, and some of them already for the next five or six months, not only that, but the present base price of M. 112 for bars leaves a small margin of profit. All that the works now desire is a demand for exportation. The mills rolling girders can scarcely get through the work fast enough for the demand at this season, consequently the prices are exceedingly firm, and have risen again. The plate trade has also lately been a little brisker, and the convention price of M. 150 well sustained. Although the consumption of sheets has somewhat increased, the business is unsatisfactory, as prices have been sinking for weeks past; still, within the last fortnight they seem to have found bottom. In order to improve this state of things, an arrangement is being concocted between the Rhenish-Westphalian and Seigerland works to fix upon minimum selling prices, which in the course of the month is to come into operation. Iron wire rods have gone down a few marks per ton in consequence of the late weaker state of the pig market; added to this is the cheapness of mild steel rods, which influences them unfavourably, but still the price of steel billets keeps up. The diminished demand from America is doing the mischief. In steel there is little that is new to note. At Strasburg on the 13th inst. 142,000m. of steel rails were awarded in part to de Wendel et Cie., at M. 107·50, and in part to the Rothe Erde Company, at M. 107 p.t., no foreign firms tendering. Then it was definitively settled, at a general meeting of the Bochum Steel Company that it should associate itself with the firm of Tardy and Benech, of Savona, in Italy, with 4,000,000f., and with the firm of Portilla, White, and Co., of Sevilla, in Spain, with M. 300,000, in order to improve and extend the works of these firms for producing steel of all sorts by all the different new systems now in vogue in all first-class works. But as such works already exist in these countries, as detailed from time to time in these "Notes," notably that at Terni, capable of making all the requirements of Italy, for instance, how long will it be before there is the same competition there as there is here and elsewhere? Foreign competition, again, can always keep the prices so moderate—not to say low—that it seems a bold speculation, although propped up by protective duties and other advantages. At last the constructive workshops can no more complain of want of work, which appears of satisfactory bulk just at present, as more demand from abroad has set in, but the prices are as depressed as ever and do not pay; however, workpeople and workshop tools get employment, and that is something at any rate.

On the 14th inst. the well known Alfred Krupp, head of the firm Fried. Krupp, of Essen, died at his residence, near Bredeny, in the seventy-sixth year of his age. In 1848 the management of the exceedingly small ironworks at that date was given into his hands, and, through his restless activity during forty years, has culminated in the largest steel works now existing.

The situation of the French iron market is at present a most cheerless one. The ever sinking tendency continues, and for some time past the cost price of the articles has not been realised. Nominally, girders are still quoted at 125f., and merchant iron at 135 p.t. It appears, however, now to have come to such a pass that efforts must be made to improve the position of the trade, and meetings were held on the 7th and 8th insts. at Paris for the purpose of forming conventions for each group of works, with the ultimate object of uniting them into one, in order to regulate the prices, sales, and output for the whole country in the future, for at first, bar, sectional iron, and plates, to be afterwards extended to rails, tin-plates, and wire nails. It is said that the French Syndicate in China has secured orders for material for the Pekin-Tientsin Railway. With the object of competing with foreign, especially English, imports of coal, the Nord Railway has lowered the freight from 7·40f. to 6·00f. for one year for the Pas de Calais Department.

The long continued firmness in the Belgian market has increased if anything. Pig iron is in great demand and the production is less than the requirements. Forge pig is 42f. up to 50f. for special sorts. The export of rails has increased, girders and construction iron are in great request. The coal trade is also firm for most sorts. In 1886 280 mines were at work against 285 in 1885 and 100,282 miners were engaged against 103,095 the year before, 2 p.c. of which were women. The average wages were in 1886 783f. in 1885 813f. The average cost price of the coal was in 1886 7·95f. against 8·47f. in 1885. The output was in 1886 142,542,003t. against 154,618,235 in 1885, and the average selling price in the two years 8·25f. against 8·87. The whole profit realised was last year 5,151,101 against 6,929,055f. the year before, or a difference of 1,777,954f.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, July 8th.

THE importers of tin and tin-plate are counting upon a very heavy autumn demand, and already orders are arriving for tin-plate from the canning interests, which indicate that the demand will be of very large proportions. So far this year, our importations foot up about 180,000 boxes behind last year; but arrangements have been made for early and large shipments from abroad. The demand for tin is improving, and lead and spelter are selling more freely. The inquiries for Bessemer pig, spiegel, and billets have not resulted in much business. Brokers handling foreign rails are now negotiating for large importations on the Gulf and Pacific Coasts. One order was sent abroad this week for 10,000 tons, to be delivered at New Orleans. There will be no strike in the rolling mills, as the employers have yielded to the demands of the workmen, and will pay the 10 per cent. advance. The Connelsville coke strike is still on, and the coke production has now reached 35,000 tons per week. Furnaces are banked up in Western Pennsylvania and in Ohio. Foundry irons are stronger everywhere, especially among the finer brands. American Bessemer is in very active demand. American steelmakers declare themselves able to supply all legitimate demands for steel, and are endeavouring to bring about an understanding by which they can secure some of the business which has heretofore been going abroad.

There is great activity in material entering into the construction of ships for coastwise service, and boats and barges for river and lake service. The new railroad law has greatly stimulated traffic where the hauls are for short distances. Valuable iron ore beds are being developed in Canada, Michigan, Virginia, Kentucky, and Missouri. The Lake Superior iron region will increase its output this year over last by fully 25 per cent. The bar mills throughout the country are booking heavy orders for car work, and for all purposes for which finished iron is used. There will be a general improvement in the demand for iron and steel, based upon the heavy activity in railway building. The mileage for the first six months foots up nearly 4000 miles, and these figures will probably be doubled during the last six months of the year. Reports from all the bridge-builders up to June 30th show an unprecedented activity, and a good many railroad bridge-builders are in the market this week to ascertain the probability of having orders filled during October. The nail mills throughout the country are in bad plight. The producing capacity is so far beyond the present consumption that there are no probabilities of any improvement in prices. The sheet mills are fairly busy. The output of pig iron is absorbed about as fast as it cools. The new furnaces under construction are being hurried forward as fast as possible. Several new railroad lines have been projected within thirty days. One line is 800 miles long, intended to develope the mineral and timber regions contributory to Chicago. Several short lines are to be constructed in the Gulf States, to develope the territory controlled by New Orleans and Savannah. The industrial and labour outlook is quite pleasing to both employers and employed.

NEW COMPANIES.

THE following companies have just been registered:—

Acme Filter Co., Limited.

On the 7th inst. this company was registered, with a capital of £10,000, in £1 shares, to purchase and work the letters patent, No. 5407, dated 13th November, 1882, granted to Jasper Wetter for the manufacture and sale of the Grant Revolving Bull Water Filter. The subscribers are:—

	Shares.
*S. G. Mason, Moseley, Worcester, manufacturer	100
*J. F. Pearson, Moseley, Worcester, agent	100
H. Wood, Balsall-heath, Worcester, surgeon	50
*J. R. Hands, Alexandra Hotel, Liverpool	50
B. Hands, Bootle, Liverpool, wine and ale merchant	50
O. Essex, Birmingham, architect	50
H. Hodgkinson, Aston, secretary	25

The number of directors is not to be less than two, nor more than five; qualification, 100 shares; the subscribers denoted by an asterisk are the first.

Hecla Engineering Works, Limited.

This company was registered on the 7th inst., with a capital of £5000, in £1 shares, to carry on business as engineers, millwrights, boilermakers, &c. The subscribers are:—

	Shares.
T. McLaughlin, Bumber Bridge, Lancaster, boilermaker	1
E. McLaughlin, Bumber Bridge, Lancaster, rivetter	1
C. Norman, Bumber Bridge, Lancaster, smith	1
J. J. Roberts, Liverpool, bookkeeper	1
J. S. Howden, Liverpool, printer	1
W. Jennings, Preston, joiner	1
H. Holland, Preston, moulder	1

Registered without special articles.

Hobbs, Hart, and Co., Limited.

This is the conversion to a company of the business of lock and safe manufacturer, carried on by the above-named firm. It was registered on the 8th inst., with a capital of £100,000, in £1 shares, with the following as first subscribers:—

	Shares.
*Major-General W. Nassau Lees, 64, Grosvenor-street	1000
*The Earl of Wharncliffe, Curzon-street	1000
*J. Ramsay L'Amy, 107, Cromwell-road	1000
*General Sir John St. George, 22, Cornwall-gardens, S.W.	1000
Lord Claude J. Hamilton, M.P., 23, Lowndes-square	1000
S. Lovelock, 19, Coleman-street, chartered accountant	500
H. J. Whiffin, 19, Coleman-street, chartered accountant	500
R. Jehu, 33, Mark-lane, solicitor	500
T. Purvis, 48, Eagle Wharf-road, Hoxton, engineer	1200

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; remuneration, £750 per annum.

Bute Dock Club Company, Limited.

This company was registered on the 8th inst., as a company, limited by guarantee to 10s. each member, the following being the first directors and managers:—Messrs. J. Morgan, T. Sheridan, T. Patter, D. Williams, T. Mahoney, E. W. White, E. McCarthy, and C. Mason, all of Cardiff.

Holmes' Lights Company, Limited.

Registered on the 7th inst., with a capital of £2500, in £10 shares, to purchase and work the letters patent, No. 3490, dated 18th February, 1884, for "improvements in extinguishable signal lights." The subscribers are:—

	Shares.
J. W. Howard, Harlesden, engineer	1
*D. R. Comyn, 37, Cornwall-road, W., nautical assessor	1
D. Wallis, 15, Billiter-street, merchant	1
J. Bernie, 25, Belmont Park, Lee, naval architect	1
J. W. Atkins, 121, Fenchurch-street, contractor	1
T. R. Ord, 28, Sunnyside-road, Hornsey-rise	1
*W. W. Mutter, Glasgow, merchant	1

The subscribers denoted by an asterisk, and Mr. J. R. Holmes, of Adam-street, are the first directors.

Marriage, Neave, and Company, Limited.

This company was constituted by articles of association on the 30th ult., and was registered as a limited company on the 9th inst. It proposes to take over the business of Marriage, Neave, and Company, of the Albert Bridge Flour Mills, Battersea. The capital is £150,000, divided into 3750 preference shares of £20 each, and 7500 ordinary shares of £10 each. The shares taken up are 1560 preference shares, and 3130 ordinary shares upon which the full amount has been paid.

Metropolitan Mineral Water Company, Limited.

On the 8th inst. this company was registered, with a capital of £100,000, in £1 shares, to enter into an agreement of the 6th inst. with John Thomas Law, for the acquisition of a mineral water manufactory. The subscribers are:—

	Shares.
*Major J. H. Prenderville, 44, Gloucester-crescent, W.	1
J. T. Law, Lynwood, Southport, corn miller	1
*J. Heyworth, 74, St. John-street, E.C., curled hair manufacturer	1
*H. Roe, 6, Melbourne-square, Brixton, water manufacturer	1
W. H. Bibby, 98, Stamford street, Lambeth, secretary	1
T. B. Ward, Rhyl, quarry owner	1
N. Warwick, 33, Old Broad-street, accountant	1

The number of directors is not to be less than three, nor more than twelve, the first being the subscribers denoted by an asterisk, and Lieut.-Col. F. Weymyss; qualification, 250 shares; remuneration, chairman, £150 per annum; each ordinary director, £100 per annum. The first managing director will be entitled to £200 per annum, to be increased to £400 in any year in which 10 per cent. dividend is paid.

Mid-Kent Building and Contracting Works, Limited.

This company was registered on the 11th inst., with a capital of £20,000 in £5 shares, to trade as builders and contractors. The subscribers are:—

	Shares.
*John Cox, Beckenham, surveyor	1
*J. B. Cox, Beckenham, clerk	1
A. Cox, Beckenham, architects' pupil	1
H. Heathfield, Beckenham, clerk	1
*S. Robinson, Beckenham, builders' foreman	1
A. Turner, Hitchin, clerk of works	1
A. Beavis, 5, Fenchurch-street, chartered accountant	1

The number of directors is not to be less than three, nor more than six; the first are the subscribers denoted by an asterisk.

Salterforth Shed Co., Limited.

This company was registered on the 7th inst., with a capital of £6000, in £10 shares, to erect a cotton mill at Salterforth, parish of Barnoldswick, York. There are 14 subscribers, who take amongst them 104 shares. The first directors are Messrs. Henry Widdup, J. Widdup, A. Brown, W. Brown, R. Hodgson, J. Marsden, J. Pelty, and Robinson Sutcliffe.

LOCOMOTIVE CYLINDER PRACTICE IN AMERICA.—At a recent meeting of the American Master Mechanics' Association, the report of a committee on the best proportion of locomotive cylinders was read. They stated that though they had sent out a large number of circulars, they had only received replies from Messrs. Barnett, Meehan, Sinclair, and Mr. J. McGrayel, of the Des Moines and Fort Dodge; Thos. Twombley, of the Chicago, Rock Island, and Pacific; Mr. S. G. Copestake, of the Glasgow Locomotive Works, Scotland, and from Mr. F. W. Webb, of the London and North-Western. Most of the gentlemen gave rules which they used for proportioning the diameter of cylinders and stroke to the diameter of the driving wheel, the boiler pressure and the weight on the drivers. These rules gave very varying results, as shown below. For a passenger engine with 26in. stroke of piston, 61in. mean diameter of driving wheels, 160 lb. boiler pressure, and 60,000 lb. weight on drivers, the rules given by the following gentlemen gave the following results:—

	Inches.		Inches.
Barnett	14·5	Copestake	16·9
McGrayel	16·6	Webb	15·7
Meehan	16·2	Rule proposed by the Committee	16·1
Twombley	16·9		

The committee proposed a rule in which the mean effective cylinder pressure was taken at 85 per cent. of the boiler pressure, and that the tractive force thus given should be one-fourth of the adhesive weight for passenger engines, 1 divided by 4½ for freight engines, and 1 divided by 4½ for switching engines. The report was accompanied by an interesting table, showing the variation from the committee's rule found in a large number of engines actually running and designed by both American, British, and continental engineers. Many of the passenger engines appeared to possess considerable excess of weight, while many of the freight engines and all the switching engines were deficient in adhesive weight.

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.

12th July, 1887.

9719. STEAM ENGINES, R. Creuzbaur, London.
9720. DYEING SKINS, C. Meadowcroft and P. Denanhouer, London.
9721. PROPELLING VESSELS, W. P. Thompson.—(*R. A. C. von Schlieben, Berlin.*)
9722. CLEANING COTTON, W. P. Thompson.—(*J. Meikle, United States.*)
9723. GLOBULAR, &c., STEAM ENGINES, T. Mudd, Liverpool.
9724. STOPPERS for AERATED WATER BOTTLES, O. Weslau, Liverpool.
9725. DYNAMO-ELECTRIC MACHINES, W. P. Thompson.—(*G. Westinghouse, United States.*)
9726. ARMATURES, W. P. Thompson.—(*G. Westinghouse, United States.*)
9727. COMMUTATORS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9728. CONVERTERS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9729. CONVERTERS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9730. VOLTMETERS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9731. AMMETERS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9732. INDICATORS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9733. REGULATING CIRCUITS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9734. TRANSMISSION of ELECTRICITY, W. P. Thompson.—(*G. Westinghouse, United States.*)
9735. ELECTRICAL DISTRIBUTION, W. P. Thompson.—(*G. Westinghouse, United States.*)
9736. GENERATORS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9737. ELECTRICAL DISTRIBUTION, W. P. Thompson.—(*G. Westinghouse, United States.*)
9738. ELECTRICAL DISTRIBUTION, W. P. Thompson.—(*G. Westinghouse, United States.*)
9739. CIRCUITS, W. P. Thompson,—(*G. Westinghouse, United States.*)
9740. ELECTRICAL DISTRIBUTION, W. P. Thompson.—(*G. Westinghouse, United States.*)
9741. ELECTRICAL DISTRIBUTION, W. P. Thompson.—(*G. Westinghouse, United States.*)
9742. CIRCUITS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9743. LAMP SOCKETS, W. P. Thompson.—(*G. Westinghouse United States.*)
9744. CABLES, W. P. Thompson.—(*G. Westinghouse, United States.*)
9745. CONVERTING ELECTRIC CURRENTS, W. P. Thompson.—(*G. Westinghouse, United States.*)
9746. REGULATING the FLOW of FLUIDS, M. Vinning, London.
9747. MATTING, G. J. Bicknell, London.
9748. ASH-GUARD, C. Forrest and A. Spon, Bradford.
9749. CORK-SCREW, W. Hartmann, Paris.
9750. MATCH BOXES, W. Cook, Redditch.
9751. MILKY JUICES, E. J. P. Robet, Paris.
9752. EARTHENWARE TOPS for TABLES, F. J. McMinn and H. Jackson, Longport.
9753. SPINNING TOPS, J. E. Hayward, Birmingham.
9754. ADVERTISING, F. D. Tippetts, Birmingham.
9755. TREATING SEWAGE, &c., MATTERS, R. Weaver, London.
9756. BREECH-LOADING SMALL-ARMS, G. A. Mills, London.
9757. EXPLOSIVE ALARMS for PROTECTING WINDOWS, &c., J. Turner, Birmingham.
9758. SWITCHES for ELECTRIC CIRCUITS, A. C. Cockburn and E. Thomas, London.
9759. WATER TAP or STEAM VALVE, W. Preston, Leeds.
9760. SULPHATES of SODA and POTASH, &c., A. Walker, Glasgow.
9761. INSULATOR, &c., of TELEGRAPH WIRES, F. Bishop, Bristol.
9762. HEATING, &c., AIR, J. H. R. Dinsmore, Liverpool.
9763. GRAVITY RAILWAYS, R. Mansell and E. S. Samuel, Manchester.
9764. BUSTLES, C. C. Carpenter, London.
9765. DOFFING or STRIPPING FIBRES from ROTARY SURFACES, J. and T. Scott, Halifax.
9766. CIGARETTES, &c., G. H. Jones, London.
9767. REPAIRING ELECTRIC LAMPS, J. B. Duncan, Newcastle-upon-Tyne.
9768. ELECTRICAL CONDUCTORS, J. Hewitson, Monkwearmouth.
9769. DRILL PRESSES, U. Eberhardt, London.
9770. CARRIAGES for RAILWAYS, F. B. Welch, Manchester.
9771. INTERNALLY STOPPERED BOTTLES, D. Rylands, Barnsley.
9772. LINK COUPLER, J. Farnsworth, Manchester.
9773. SIGNALLING, E. Restieaux, Llanelly.
9774. CIGAR-HOLDERS, H. Lintott and H. T. Tallack, London.
9775. FLUID PRESSURE PACKING, J. T. Williamson, London.
9776. MUSKETRY INSTRUCTION, A. N. Tucker, Sheffield.
9777. ROAD VEHICLES, B. Jones, Lynton.
9778. GAS-HEATED IRONS, R. B. Sanson, London.
9779. WEIGHING, &c., W. T. Whiteman.—(*The United States Machine and Inventions Company, United States.*)
9780. WEIGHING, &c., W. T. Whiteman.—(*The United States Machine and Inventions Company, United States.*)
9781. MEASURING, &c., W. T. Whiteman.—(*The United States Machine and Inventions Company, United States.*)
9782. HARDENING, &c., METALS, R. K. Boyle, London.
9783. CRAMP for WOODWORK, A. S. Bayer and C. F. Mott, London.
9784. COVERED BUTTONS, J. N. Gotendorf, jun., London.
9785. COAL-BREAKING, W. Pegge, Stoke-on-Trent.
9786. DUST-PANS, W. Hardy, jun., and J. W. Willcocks, London.
9787. HARVESTERS, La V. W. Noyer, London.
9788. SINGLE TRANSFER PAPERS, T. S. Skelton, London.
9789. LEVER-DRIVEN MACHINE, E. Scholey, Colchester.
9790. TRIMMING APPARATUS, F. Wilkinson, J. Hall, and P. Pearson, London.
9791. VEHICLE AXLES, J. M. Brosius, T. H. Jones, and H. Krouse, London.
9792. TYPE-WRITERS, E. Fitch, London.
9793. GATES and WINDOW-GUARDS, W. W. Bostwick, London.
9794. SPRINGS for SUPPORTING the SEATS of VELOCIPEDES, J. K. Starley, London.
9795. MOULDS for CASTING METAL ARTICLES, H. J. Smith, Glasgow.
9796. MAGAZINE GUNS, P. Jensen.—(*M. Hartley, United States.*)
9797. GRATES for FURNACES, T. Kirkwood, London.
9798. PRODUCING SCENIC EFFECTS, J. Buatier, London.
9799. HANDLING AMMUNITION, P. A. Newton.—(*S. Seabury and C. L. Bruns, United States.*)
9800. WINDOW FASTENERS, A. J. Boult.—(*R. Clarke and W. F. Munro, Canada.*)
9801. SIGNALLING APPARATUS, A. J. Boult.—(*J. M. Fischer, Dresden.*)
9802. CUTTING CARTRIDGE CASES, &c., A. J. Boult.—(*B. Gruhl, Dresden.*)
9803. BUTTON-HOLE ATTACHMENTS for SEWING MACHINES, A. J. Boult.—(*J. W. Blodgett, United States.*)
9804. PROTECTING the HULLS of VESSELS, A. J. Boult.—(*F. Cuervas-Mons,* ———.)
9805. DELIVERY APPARATUS, H. P. Tucker, London.
9806. INFANTS' FEEDING BOTTLES, A. R. Stocker, London.
9807. APPARATUS for EXHIBITING ADVERTISEMENTS, F. Schoyer, Paris.
9808. COOLING BEVERAGE, H. Eschwege, London.
9809. APPLIANCES for SEWING MACHINES, R. Reader, London.
9810. BLEACHING by ELECTROLYSIS, B. J. B. Mills.—(*W. E. Smith, Russia.*)
9811. CIGARETTE-MAKING MACHINES, H. H. L. Lewis, London.
9812. INDICATING the SPEED of VELOCIPEDES, &c., H. H. Lake.—(*H. B. Beach, United States.*)
9813. BREECH-LOADING ORDNANCE, A. Sauvée.—(*J. B. G. A. Canet, France.*)
9814. BINOCULAR TELESCOPES and STEREOSCOPES, A. H. Douglas-Hamilton, London.
9815. COWLS or WIND GUARDS, A. H. Douglas-Hamilton, London.
9816. COMBINED SWITCH and TURNTABLE for RAILWAYS, O. Bertrand-Bocandé, London.
9817. MATERIAL for COVERING WALLS, FLOORS, &c., O. Imray.—(*W. A. Simmons, United States.*)
9818. COMBINATION EASEL DESK, P. T. W. Parry, Woolwich.

13th July, 1887.

9819. SHEAF-BINDING HARVESTING MACHINES, J. Hornsby, J. Innocent, and I. Trolley, Grantham.
9820. FILTERING APPARATUS for DRAWING-OFF LIQUIDS, T. T. Edwards, Birmingham.
9821. BICYCLES and TRICYCLES, W. Andrews, Birmingham.
9822. PISTON SPRINGS, R. Tonge. Manchester.
9823. RIVET for BOOTS, &c., M. Yoxon, Leicester.
9824. RAILWAY SLEEPERS, S. A. Croft and G. Trenbath, Manchester.
9825. BOLSTER BEARINGS of SPINDLES, S. Tweedale, Halifax.
9826. DENTAL VALVE, J. G. Yemen, Glasgow.
9827. FOLDING SHIPS' BERTHS, W. P. Hoskins, Birmingham.
9828. PENCIL-SHARPENING, T. Crossley, Blackburn.
9829. DYNAMO-ELECTRIC MACHINES, T. Stanley, London.
9830. APPARATUS for MEASURING the FOOT, C. Müller, London.
9831. FASTENING SHEET METAL ROOFS, W. Orr and P. S. Brown, Glasgow.
9832. DRYING AIR, G. Shepherd, Cardiff.
9833. TREATMENT of ZINC SURFACES, R. H. W. Biggs and W. Duxbury, London.
9834. EXTINGUISHING FIRE, J. C. Merryweather, London.
9835. CARTRIDGES, G. A. Farini, London.
9836. ADVERTISING, T. M. Potter and T. Allen, London.
9837. PERMANENT WAY of RAILWAYS, G. A. Farini, London.
9838. CORD FASTENINGS for BLINDS, C. R. Redfearn, London.
9839. WASHING MACHINE, M. Leeb, London.
9840. STOPPERS for BOTTLES, W. Fox, London.
9841. FASTENING TOGETHER SHEETS of PAPER, G. F. Whittle, London.
9842. FORMING METAL STRIPS into TUBES, D. Smith, jun., London.
9843. COMPENSATING ELECTRIC MEASURING INSTRUMENTS, W. T. Goolden and S. Evershed, Westminster.
9844. STOPPING and STARTING APPARATUS for RAILWAY CARRIAGES, T. Martin, London.
9845. STRAP FASTENER or BUCKLE, W. H. Hall, London.
9846. FASTENING WINDOW SASHES, P. J. Bishop, London.
9847. STOPPERS for BOTTLES, W. Wootton, Surrey.
9848. INDICATOR of FLUID PRESSURE, J. G. Jourdon, London.
9849. WASHING MACHINES, D. Ehrlich, London.
9850. COMPOSITION for COATING of PASTEBOARD, &c., M. Strasser and P. Hosemann, London.
9851. SEWING MACHINES, T. Vogel, London.
9852. BRUSHING DEVICE applicable as a TOOTH-BRUSH, R. Mische, London.
9853. DYNAMO-ELECTRIC MACHINES, H. Watt, London.
9854. LUBRICATING the BEARINGS of SCREW PROPELLER SHAFTS, &c., F. R. Cedervale, London.
9855. HORSE-RAKES, J. Howard and E. T. Bousfield, London.
9856. TRAIN-PIPE COUPLINGS of CONTINUOUS RAILWAY BRAKES, B. E. Popowski, London.
9857. TOOTHED DRIVING BELT and WHEELS therefor, H. Dalgety, London.
9858. HORSE-SHOE NAIL MACHINERY, S. Hansen, London.
9859. TELEPHONES, L. N. Loeb.—(*H. Hanneman, Germany.*)
9860. PUMPS for LIFE-BOATS, &c., E. J. Preston, London.

14th July, 1887.

9861. SEWING and EMBROIDERING MACHINES, W. von Pittler, London.
9862. BRAKE WHEEL, T. Palmer and C. Rrookes, Tipton.
9863. VELOCIPEDES, T. Redman, Bradford.
9864. HORSE CLIPPERS, &c., M. G. Gillette, London.
9865. REGISTERING the NUMBER of PERSONS ENTERING or LEAVING TRAMCARS, &c., W. H. Gittins, Liverpool.
9866. STAKE for PLANTS, D. J. S. M. C. Kemp, London.
9867. TREATING PULVERULENT IRON, L. A. Brode, Glasgow.
9868. MANUFACTURE of GALVANISED IRON, A. G. Greenway, West Derby.
9869. BRAKE APPLIANCES, E. H. Molyneux-Seel, London.
9870. HEATING, &c., FLUIDS, H. Wilson, Stockton-on-Tees.
9871. ELECTRO-DYNAMO MACHINES, J. Gibson, Glasgow.
9872. DOUBLE SPRING RUPTURE TRUSS, J. Andrew, Ashton-under-Lyne.
9873. PRODUCTION of SULPHURETTED HYDROGEN, E. W. Parnell and J. Simpson, Liverpool.
9874. POLES for TENTS, B. Gibbons and G. Glydon, Birmingham.
9875. CUTLERY SCOURER, D. Appleton, Manchester.
9876. DYNAMO-ELECTRIC MACHINES, R. Dick and R. Kennedy, Glasgow.
9877. DISTRIBUTING MANURE, F. Schlor, London.
9878. GUILLOTINES, F. Payne, Halifax.
9879. GAS BURNERS, F. Bosshardt.—(*F. G. Dispot, France.*)
9880. INCREASE of POWER on a BICYCLE CRANK, J. J. Morse, Hailsham.
9881. WARP TRAVERSE, H. Hadden and A. Cooke, Nottingham.
9882. VALVE GEAR, W. S. Bancroft and J. Horsfall, Halifax.
9883. GEARING, T. Schofield and F. Barker, Manchester.
9884. TOYS, G. Fischer, Berlin.
9885. FLOOR PLATE for KILNS, J. Milne, Glasgow.
9886. COLLAPSIBLE BOXES, A. B. McIlvride, Glasgow.
9887. COLOURING PAINTS, &c., J. Rust, London.
9888. FASTENING WINDOW SASHES, &c., J. Savage, London.
9889. LASTING BOOTS and SHOES, A. Hannibal, London.
9890. TIE, &c., FASTENER, M. J. Bianco, Manchester.
9891. VELOCIPEDES, W. Clegg, London.
9892. MUSIC TURNER, J. A. Messenger, London.
9893. STEAM ENGINES, S. H. James, London.
9894. RAILWAY SIGNALLING, C. T. Jones, London.
9895. DISH-WASHING MACHINES, J. Cochran, London.
9896. BOILERS, J. Wadsworth, London.
9897. SEWING MACHINES, I. Nasch, London.
9898. CARRIAGES, A. Mackenzie, London.
9899. ETCHING, A. J. Boult.—(*F. Kraupa and L. Moser, Austria.*)
9900. MICROTOMES, H. F. Dale, London.
9901. SUPPLYING CARRIAGES with GAS, C. D. Abel.—(*M. M. Rotten, Germany.*)
9902. OIL DISTRIBUTORS, S. P. Wilding.—(*C. J. Boye, Denmark.*)

9903. FIRE-ARMS, P. T. Godsal, London.
9904. INSULATING COATINGS, L. Grabau, London.
9905. CONDUCTORS of ELECTRICITY, R. E. B. Crompton, Chelmsford.
9906. SHIELDS, A. H. Fryer, London.
9907. CUTTING TOBACCO LEAVES, P. Elkan, London.
9908. COWL, H. F. Henry, London.
9909. SCREEN BOTTOM, A. Gaukroger, London.
9910. TABLE for GUILLOTINE MACHINES, H. H. Leigh.—(*— Simoulin, jun., France.*)
9911. GUARD for CARVING FORKS, H. H. Leigh.—(*H. E. Parry, Western Australia.*)
9912. DRIVING GEAR for BICYCLES, T. R. Marriott and F. Cooper, London.

15*th July*, 1887.

9913. WEAVING and COP WINDING COMBINED, J. Baxter, Dundee.
9914. FORCE PUMPS, A. G. Melhuish, London.
9915. CLOTHES-HORSES, W. Leggott, Bradford.
9916. JACQUARD MACHINES, J. and T. Wilkinson, Bradford.
9917. MASHING POTATOES, R. Ford, Birmingham.
9918. BURNERS for HYDROCARBON OIL LAMPS, J. C. C. Read and G. F. A. Griffin, Mansfield.
9919. AERATING WATER and other LIQUIDS, J. Mumford, Manchester.
9920. WAKING, &c., SLEEPERS from OUTSIDE their ROOMS, G. Quarrie, Birmingham.
9921. CONTINUOUS AIR BRAKES for RAILWAY VEHICLES, W. Fürst, Manchester.
9922. BUTTONS, C. A. Pfenning, Manchester.
9923. RINGS for use in RING-SPINNING and RING-DOUBLING MACHINES, P., R., and J. Eadie, Manchester.
9924. HOOKS, S. Harris, Birmingham.
9925. SHOW-CARD, J. Hall and Sons, Bury.
9926. LOOKING-GLASS MOVEMENTS, F. R. Baker, Birmingham.
9927. SANITARY FLOAT MILK CANISTER, W. T. Steer, Cornwall.
9928. VALVES for STEAM ENGINES, J. Lang, Glasgow.
9929. FLOWER HOLDER, J. H. Lamprey and J. M. Burnup, London.
9930. MEASURING and REGISTERING TAPS, E. G. Matthewson, Upper Norwood.
9931. SIZE BOILING, T. Singleton, London.
9932. AXLE-BOXES, T. F. N. Finch, London.
9933. CONSUMING LIQUID HYDRO-CARBONS, J. J. Harries, London.
9934. MOUNTING SEATS or SADDLES of VELOCIPEDES, C. T. Austen, London.
9935. GRAB DREDGER FITTINGS, J. R. Bell, London.
9936. REGULATING the PRESSURE FLOW of GAS, C. H. McEuen.—(*J. C. Alexander and W. F. Maddox, New South Wales.*)
9937. HOSE and PIPE COUPLING, W. E. Gedge.—(*P. J. O'Connor, United States.*)
9938. CASE PROJECTILES, A. Mieg and H. Bischoff, London.
9939. COOLING AIR in ROOMS, &c., P. Born.—(*L. Maring, Switzerland.*)
9940. AUTOMATIC DELIVERY BOXES, R. W. Vining, London.
9941. DOLLS, W. P. Thompson.—(*O. J. Schmidt, Sonneberg.*)
9942. STERN POSTS, E. F. Wailes, London.
9943. PURIFYING VEGETABLE OILS, W. A. Mitchell.—(*M. V. Schmidt, Austria.*)
9944. PURIFYING, &c., OILS, W. M. Riddell, London.
9945. WASHING APPARATUS, M. Hopkins, London.
9946. CABINETS, W. H. Pearse, London.
9947. STOPPERS for BOTTLES, G. A. Wilkins, London.
9948. SPRING FASTENERS for SHUTTERS of SLIDES of PHOTOGRAPHIC CAMERAS, T. P. Watson, London.
9949. GELATINISED CLOTH, E. A. Sengel and L. F. Dobler, London.
9950. PRESERVING FRUIT, &c., L. and C. Stollwerck, London.
9951. BILLIARD RESTS, G. R. Short, London.
9952. COMPRESSING APPARATUS, F. Weldon, London.
9953. REFINING VEGETABLE OILS for ILLUMINATING, T. H. Gray, London.
9954. PHOTOGRAPHIC CAMERAS, &c., A. Rayment, London.
9955. HOLDING STEREOTYPE PLATES for PRINTING, E. Edwards.—(*F. A Bureau, France.*)
9956. EVAPORATING or BOILING MILK, &c., A. C. Drenkhan, London.
9957. THIN PLATES and other ARTICLES of GLASS, J. Trassl and H. Lindner, London.
9958. SCARF ATTACHMENT, W. P. Clarke, London.
9959. BARGE adapted to be used in SUBMARINE MINING OPERATIONS, J. T. Bucknill and A. J. Day, London.
9960. PACKING for the STUFFING-BOXES of STEAM ENGINES, &c., A. C. Dewies, London.

16*th July*, 1887.

9961. CYLINDER BRAKES of LITHOGRAPHIC and LETTER-PRESS PRINTING MACHINES, C. Pollard, Leeds.
9962. WAYS for TRAVELLING designed to CARRY SUSPENDED LOADS, A. and A. Goodwin, London.
9963. TYPE WRITERS, G. H. Cawthorn, Halifax.
9964. AUTOMATIC BALANCES, C. M. Otto, Australia.
9965. EGG WHISK and UNIVERSAL MIXER, W. Garthwaite, Grimsby.
9966. SAFETY BOLTS, A. E. Earl, London.
9967. FASTENER for BOOT BUTTONS, &c., R. Barlow, London.
9968. GLAZED WATERPROOF PAPER CANISTERS, P. Cook, Glasgow.
9969. MILLS for CRUSHING GRAIN, &c., R. G. Morton, Glasgow.
9970. STOCKINETTE, E. A. Lupton, Bradford.
9971. MACHINERY for PLANING WOOD, S. S. Hazeland, Cornwall.
9972. COMBINED BATH, &c., G. Royston, Birmingham.
9973. SPEAKING TUBES, S. Gratrix, Manchester.
9974. SHADES for PROTECTING the EYESIGHT, C. W. Woosnam, Cefullysgwynne.
9975. PROPELLING VESSELS, C. L. Tweedale, Manchester.
9976. LOCKS for CARRIAGE DOORS, S. and J. Wilkes, Bloxwich.
9977. ELECTRIC RAILWAYS, J. Munro, Croydon.
9978. HORSESHOES, R. McDougall, Glasgow.
9979. CIRCULATION of ELECTROLYTE, R. E. B. Crompton, Chelmsford, and J. C. Howell, Llanelly.
9980. CLASPS for BAGS, J. Frankenburg, Glasgow.
9981. PRESSING TOBACCO LEAF into PLUGS, J. Macdonald, Glasgow.
9982. SCREW OAR, J. H. Martin, Bridport.
9983. FLEXIBLE HOSE, I. B. Harris, Glasgow.
9984. HEADSTONE, &c., G. Parkinson, London.
9985. HELIX SCREW FEEDER for FURNACES, T. Andrews, Sheffield.
9986. TUBES for BOILERS, S. E. Howell, Sheffield.
9987. STEERING APPLIANCES for TORPEDOES, J. T. Shipman, Sheffield.
9988. CLOSING LADDER for FIRE-ESCAPES, R. Middleton, Leeds.
9989. DRAWING OFF FIBRES in COMBING MACHINERY, I. Holden, London.
9990. SHOWING PASSENGERS in a TRAIN the NEXT STATION at which the TRAIN will STOP, N. Briggs, London.
9991. WHITE LETTER TYPE, W. de Little.—(*R. D. de Little, Victoria.*)
9992. GRAIN BINDERS, W. P. Thompson.—(*C. H. McCormick, jun, United States.*)
9993. METALLIC PACKINGS for PISTON-RODS, T. Downie, Liverpool.
9994. IMPREGNATING WATER with CARBONIC ACID, T. R. Shillito.—(*C. G. Rommenhöller and O. Brünler, Holland.*)
9995. SOLE SEWING MACHINE, L. Bonneville, London.
9996. HOPPER TUBS for WEIGHING COAL, &c., W. Stephenson, London.
9997. METAL STUD for the SOLES and HEELS of BOOTS, C. Allsop and W. J. Gale, London.
9998. RAPID REPEATING RIFLE, R. C. Romanel, London.
9999. FIRE-ESCAPE, T. Walters and A. Pell, London.
10,000. PREVENTING FRAUD in AUTOMATIC MACHINES operated by the ACTION of a COIN, E. P. Appleyard and J. Johnson, London.
10,001. VEHICLE WHEELS whereby JAR or SHOCK is DIMINISHED, T. Bolas and J. B. Bright, London.
10,002. CASKS for COOLING or WARMING LIQUIDS, W. S. Hogg, London.
10,003. BRACES, G. C. Reddick, London.
10,004. PRODUCING BRILLIANT EFFECT in or from GLASS, &c., E. and F. Smith, London.
10,005. USING STEAM for PRODUCING ROTARY MOTION in ENGINES, J. Richardson, London.
10,006. PAPER, &c., for GEOMETRIC MODELS, G. R. Gill, London.
10,007. COAL VASES or BOXES, P. Everitt and R. Edwards, London.
10,008. FORMING SHEET METAL LATHING, J. Weichhart, London.
10,009. DANGER SIGNALS, G. H. Wright, London.
10,010. HARVESTING MACHINES, J. Howard and G. Gibbs, London.
10,011. FLASKS, J. F. Spong, London.
10,012. CARTRIDGE MAGAZINES, Gustavus, Baron de Overbeck, London.
10,013. TESTING PENETRATION, P. H. B. Bedingfeld, London.
10,014. PIPE JOINTS, H. Lane and J. S. Fairfax, London.

18*th July*, 1887.

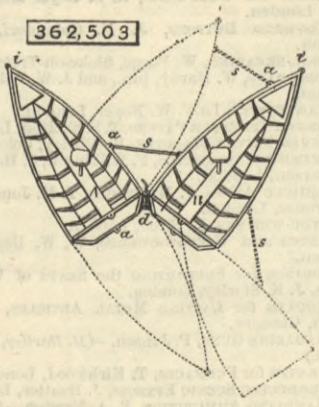
10,015. FEEDING of MOTORS, A. Fehlen, London.
10,016. CREEL FRAMES, A. Fidkin, Kidderminster.
10,017. PRINTING, F. W. Hayward, Norwich.
10,018. TUBE STOPPER, C. Vincent, Liverpool.
10,019. LUBRICATING, J. S. Marsland, Halifax.
10,020. SPLINTS, I. A. Best, Birmingham.
10,021. BICYCLES, &c., E. Warwick, Birmingham.
10,022. PICTURES, &c., W. Greenwood, Manchester.
10,023. WATER SOFTENING, W. Tapp, Bristol.
10,024. PREVENTING HORSES from KICKING, W. Sharp, Glossop.
10,025. SPINDLES, &c., of SPINNING FRAMES, W. C. Burton, Rochdale.
10,026. PENCIL, J. H. Wüster, Lower Austria.
10,027. WRITING SLATES, G. Challenger, D. D. Rees, and E. Jones, Swansea.
10,028. ANCHORS, J., E., and J. Ford, Birmingham.
10,029. CUTTER BAR, D. B. Detweiler, Hamilton.
10,030. SURGICAL INSTRUMENT, A. W. Walker, London.
10,031. CHAIRS, S. S. Bromhead.—(*J. F. Sargent, United States.*)
10,032. EXTRACTING SALIVA, S. S. Bromhead.—(*H. W. Parsons, United States.*)
10,033. LAMP, C. Kempton, London.
10,034. CHIMNEY POTS, R. Smith, Bristol.
10,035. DRYING TEA, H. Thompson, London.
10,036. BEVERAGES, A. McDougall, London.
10,037. BICYCLES, A. M. Markham and G. Shann, London.
10,038. LAMPS, J. J. Phillips, London.
10,039. BOX-IRONS, G. Woolliscroft, London.
10,040. CIGAR CUTTERS, A. J. Boult.—(*C. J. Wilson, United States.*)
10,041. RENDERING SCENERY UNINFLAMMABLE, J. Wybauw, Liverpool.
10,042. ROOFS, A. J. Boult.—(*La Progresiva Joint Stock Company,—*)
10,043. ALUMINIUM ALLOYS, W. P. Thompson.—(*— Faurie, France.*)
10,044. LOOMS, J. and J. Nightingale, London.
10,045. KNITTING MACHINES, E. Attenborough and J. W. Kent, London.
10,046. COLOURING MATTERS, &c., C. A. Bennert, London.
10,047. HOES, SPADES, &c., J. Perks and W. C. Salmon, London.
10,048. DIFFUSION of BATHING INGREDIENTS, E. Mack, London.
10,049. TURFING or BRAIDING MACHINE, S. S. Bromhead.—(*C. C. Harris, United States.*)
10,050. STONE-SAWING MACHINE, S. S. Bromhead.—(*T. A. Jackson, United States.*)
10,051. TOOLS, J. Edmonds, Birmingham.
10,052. LAWN TENNIS NETS, G. Hookham and W. H. Tonks, London.
10,053. FIXING PAPERS, T. P. Owen, London.
10,054. DOOR, &c., FASTENINGS, G. Lundberry, London.
10,055. LOCK ESCUTCHEONS and KEYS, C. Dresser, London.
10,056. CONTACT APPARATUS, W. Walker, London.
10,057. EXTRACTION of ALUMINIUM, E. de Pass.—(*M. and E. Bernard, France.*)
10,058. GAME or PASTIME, A. H. Williams and E. L. White, London.
10,059. SLEEVE-HOLDER, L. N. Loeb, London.
10,060. MANURE, T. Roxburgh, London.
10,061. HEATING, R. Warner and S. B. Goslin, London.
10,062. CARPETS, H. Fawcett, London.
10,063. DESIGNS upon MARBLE, &c., H. H. Lake.—(*A. Macairio, ——.*)
10,064. GRAVITY RAILWAYS, T. H. Lambert and H. Etherington.
10,065. POSTAL and other WRAPPERS, J. J. Coleman, London.
10,066. ALBUMINIMETERS, &c., A. C. Christensen, London.
10,067. LAMPS, E. Patterson, London.
10,068. LIGHTING FIRES, E. Patterson and W. H. Strype, London.
10,069. BISCUIT, W. H. Gilruth, London.

SELECTED AMERICAN PATENTS.

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

362,503. SECTIONAL BOAT, *J. L. Gribble, Macomb, Ill.—Filed June 28th, 1886.*

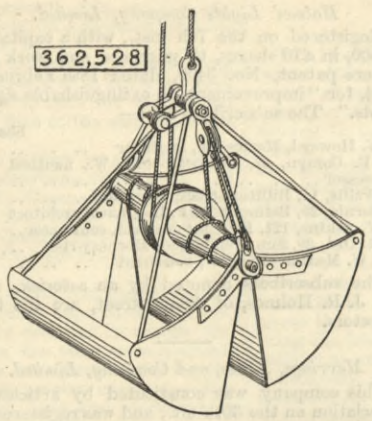
Claim.—A sportsman's boat constructed in two half parts A and B, each part having firmly attached on the side rail the stay-rod eyes *a a* and eyes *i i* at their outer ends, in combination with the hinge *d*, which hinges the two parts A and B together on one side at



their inner ends, said hinge being constructed so as to allow the boat to be placed in different forms or positions, and the stay-rod *s*, for holding the two parts A and B firmly in the different positions that they may be placed in, substantially as shown and described, for the purpose set forth.

362,528. HOISTING BUCKET, *G. E. Newell, Pawtucket, R.I.—Filed March 9th, 1886.*

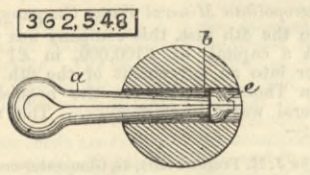
Claim.—(1) The combination of the opening and closing jaws with the upwardly converging rods, the tapered or conically formed drum and its wheel or enlargement, the bucket-operating ropes or chains, the sheave attached to the pivot of the converging rods, the sheave attached to the pivot of the bucket jaws, and the rope or chain secured to the drum and passing around the sheaves, substantially as described. (2) In a hoisting bucket, the combination of the opening and closing jaws with the tapering or conically-formed drum, its wheel or enlargement, the attached operating



chain, and the rope or chain secured to the tapering drum and operatively connected with the bucket jaws, whereby a gradually accelerated closing movement will be imparted to the jaws of the bucket, substantially as described.

362,548. SPRING KEYS, *O. Smith, Bridgeton, N.J.—Filed August 11th, 1886.*

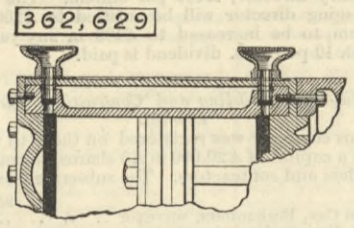
Claim.—A barbed spring key or cotter having when closed similar and approximately equal cross sections



at *a* and *e*, and a smaller cross section at *b* than at *a* and *e*, substantially as shown and described.

362,629. WATER ESCAPE DEVICE for ENGINE CYLINDERS, *A. L. Ide, Springfield, Ill.—Filed December 29th, 1885.*

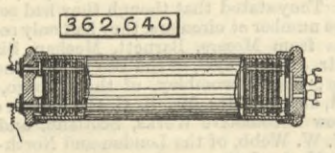
Claim.—(1) A metal relief chamber consisting of an integral casting provided with a neck or orifice for attachment to an engine cylinder or other inclosure subject to interior pressure, said relief chamber being constructed to yield or burst under an excess of pressure in said inclosure, substantially as described. (2) The combination, with an engine cylinder or other inclosure subject to interior pressure, of a detachable relief chamber formed of an integral casting, and the



walls of which comprise one or more flat plates, which are thinner than the other parts of said walls substantially as described. (3) The combination, with an engine cylinder, of a relief chamber having a narrow neck or orifice for attachment to the cylinder, and formed of an integral casting, said chamber being provided with an outlet in its lower part, having a valve or cock which remains normally closed, and is adapted to be opened by hand to allow the escape of water from the chamber, substantially as described.

362,640. SECONDARY or STORAGE BATTERY, *W. I. Ludlow, Cleveland, Ohio.—Filed November 29th, 1886.*

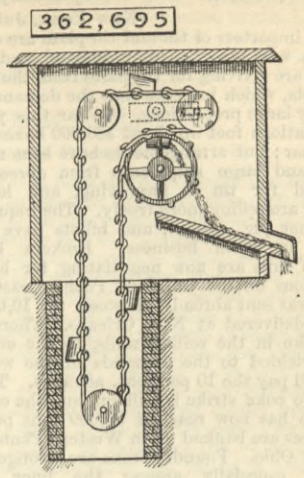
Claim.—(1) The combination with a secondary battery comprising an open-ended shell or cylinder, detachable end heads, and interior elements or electrodes filling the space between the end heads, of means, substantially as described, for exerting pressure upon the electrolyte, said means being arranged outside the battery and detachably connected thereto, for the object herein stated. (2) A secondary or storage battery comprising an open-ended shell or cylinder, an end cap having tubes for the attachment of appliances for producing a vacuum or pressure and admitting the electrolyte, and leading in wires connected with the interior electrodes, substantially as described. (3) A secondary or storage battery comprising an open-ended shell or cylinder having screw



threads, two detachable end caps provided with screw threads and tubes having stop-cocks, and the electrodes or secondary pile filling the space within the open-ended shell between its end caps, substantially as described. (4) The combination, with a secondary battery comprising a hermetically-sealed shell or cylinder, a detachable end cap, interior electrodes, and conducting wires passing through the end cap, of means, substantially as shown, for creating a vacuum within the electrode chamber, and exerting pressure upon the electrolyte after the discontinuance of the vacuum and admission of said electrolyte, substantially as described. (5) A secondary or storage battery consisting of a shell or cylinder, a series of disc-shaped elements, separating and insulating sheets or discs, conducting rods upon which said elements and insulating discs are piled and secured, and a detachable end cap, substantially as described. (6) A secondary or storage battery consisting of a shell or cylinder, detachable end caps having tubes and openings, a pile of disc-shaped elements and separating discs or plates, and conducting rods having screw threads, end nuts, and collars, and projecting through one of the end heads, substantially as described.

362,695. CHAIN PUMP, *T. Wortmann, Chamberlain, Dak.—Filed February 19th, 1887.*

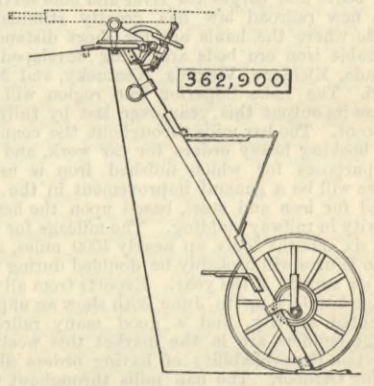
Claim.—In a chain pump, the combination, with the chain, buckets, and delivery spout, all constructed substantially as described, of the chain wheels secured to a shaft having bearings in the sides of the casing or housing and the roller journalled in bearings in the casing on the side of the said wheels opposite the well at a suitable distance from the wheels, and with its lower surface about on the same level with the upper edge of the wheels, so that the buckets will turn



between the wheels and said roller and discharge their contents into the spout, substantially as specified.

362,900. PORTABLE PARAPET MOUNTING for GUNS, *T. Nordenfelt, Westminster, England.—Filed February 1st, 1887.*

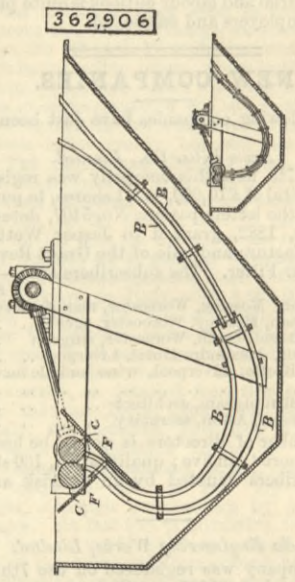
Claim.—A parapet mounting for guns of small calibre, composed of a tube or pole with a gun carriage at one end and a foot at the other end, and near the gun carriage end a socket for a pole to be



passed through for men to lift and carry the gun, and near the foot end a pair of wheels, which can be raised or lowered by excentrics, so as to allow of the foot end being lowered on to the ground or raised from it, substantially as described.

362,906. APPARATUS for the MANUFACTURE of GALVANISED IRON, *W. B. Spear, Philadelphia, Pa.—Filed September 10th, 1886.*

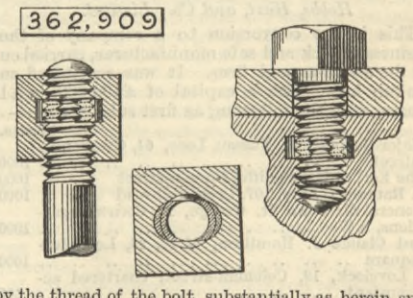
Claim.—(1) In an apparatus for coating sheet iron with zinc and other metals, the combination of the delivery rolls C C with the curved guides B B, the latter extending to a point beyond the vertical plane of the line of contact of delivery rolls, and then curved back to present the sheet to the said rolls, substan-



tially as set forth. (2) In an apparatus for coating sheet iron with zinc and other metals, the combination of the delivery rolls C C with the curved guides B B, the latter extending to a point beyond the vertical plane of the line of contact of delivery rolls, and then curved back to present the sheet to said rolls, and two or more deflectors F F1, substantially as set forth.

362,909. NUT and BOLT LOCK, *W. Tucker, East Brookfield.—Filed March 26th, 1886.*

Claim.—(1) The combination, with a bolt, of a counterpart having its threaded bore provided with a lune-shaped lateral recess excentric to the axis of the bolt, and a brake block, of wood or the like, tightly filling such recess and compressed within the same



by the thread of the bolt, substantially as herein specified, for the purposes set forth. (2) A nut for screw bolts, provided internally with lune-shaped brake blocks, of wood or the like, which tightly fill excentric lateral recesses in the walls of its threaded bore, having their greatest width at said bore and originally project to the inner circumference of its thread, said brake blocks being adapted in form and size to be inserted through said bore, and said recess communicating only with said bore, so as to be tightly closed on all sides when the nut is applied to a bolt, substantially as herein specified.