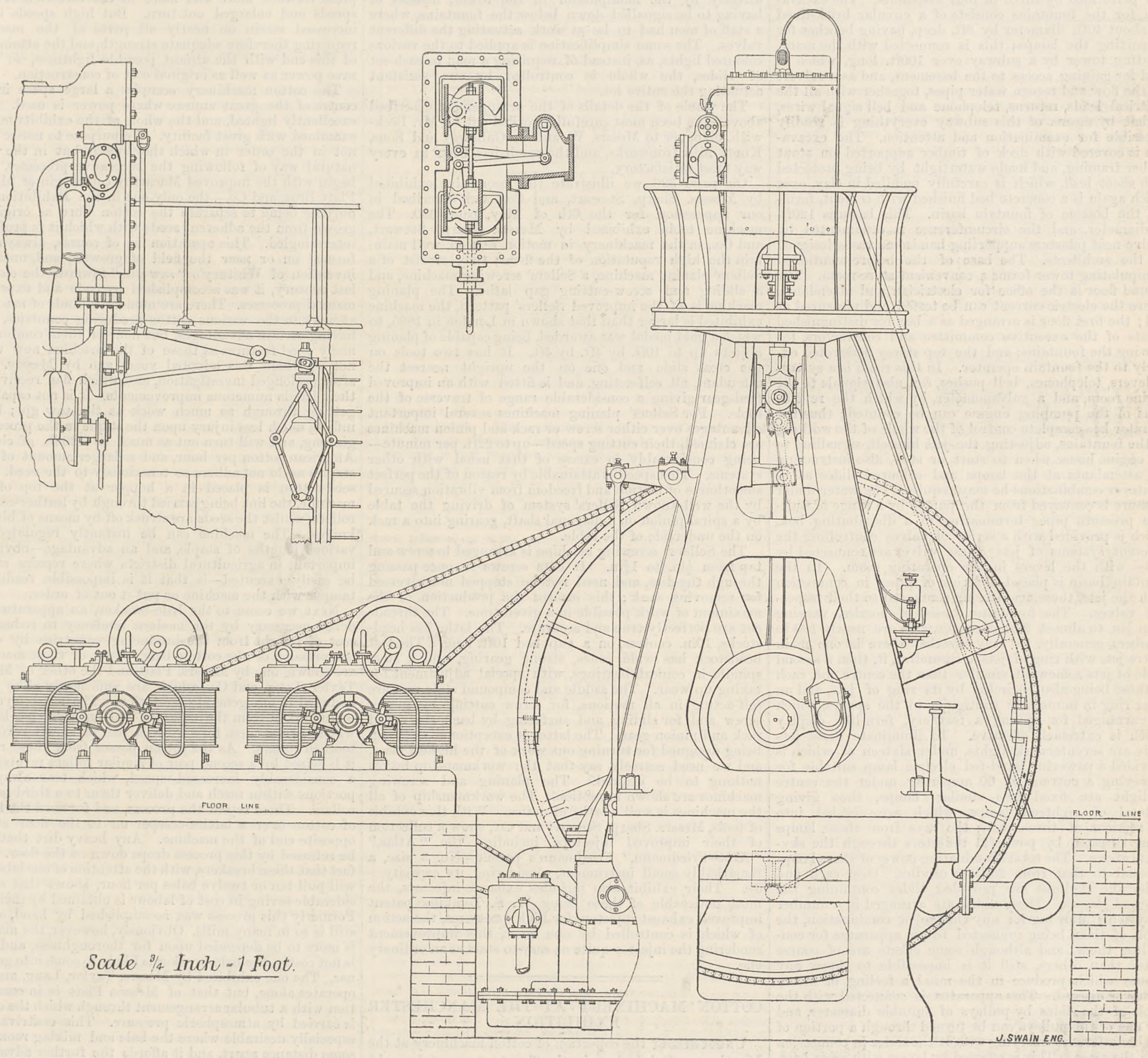
THE MANCHESTER EXHIBITION.

THE portion of the electric lighting department adjoining the machinery in motion section has been reserved for the electrical plant for lighting the Fine Art galleries, fourteen in number, which are situated on the north side of the eastern nave. Both engines and dynamos have been constructed by Messrs. Mather and Platt, of the Salford Ironworks, Manchester. The engines have been specially designed for electric lighting work, and embody several interesting and novel features. In their general arrangement, and in the method of driving, Messrs. Mather and Platt have specially held in view the requirements of a central station installation, or a large mill installation, where economy of floor space is usually of primary importance. When the engines are worked to their full power, and the dynamos replaced by the next standard larger size, the whole plant would be capable of supplying current for 4000 lamps of 16-candle power, while the total floor space occupied does not exceed 30ft. passages are obliquely directed within the block of the valve, so that the ports on the off side are curved, the edges being circular. The main valves are worked in the usual way with an excentric on the crank shaft. The cut-off valves work on the back of main valves, with a reciprocating motion also derived from an excentric on the crank shaft. These valves have curved edges corresponding to the curvature of the ports of the main valves, and are carried on pivots fixed in the slide block. The cut-off valves can thus turn about an axis at right angles to the axis of the cylinder, in addition to their rectilinear reciprocating motion. The point of the stroke at which the steam is cut off depends upon the angular position of the cut-off valve, which is regulated directly by the governor through a suitable series of levers. This form of cut-off has given exceedingly good results on smaller engines. Applied to an ordinary horizontal engine indicating 20-horse power, it was found that when 50 per cent. of the whole load was suddenly thrown off the momentary variation in speed valve only. The air-pump and condenser are of the ordinary vertical type, fixed below the floor. The pump is single-acting, 12in. diameter, and 15in. stroke, and is worked by a beam from the engine crosshead. Throughout all the threads on the bolts are of fine pitch or gas threads, and in working parts have a nut of ordinary depth, locked with a thin one, and in addition have a split cotter through the end of the bolt. The left-hand engine drives two Edison-Hopkinson dynamos, both shunt-wound for an output of 105 volts, 320 ampères, at a speed of 750 revolutions per minute, equivalent to 500 lamps of 16-candle power. These machines have a commercial efficiency of 93·3 per cent., and an electrical efficiency of over 95 per cent. The improvement made in these dynamos by Dr. John Hopkinson and Messrs. Mather and Platt since the original Edison type is effectively shown by comparing the two smaller Edison-Hopkinson dynamos with the four Edison dynamos of the type which are at work close by. Although only about one-third the weight of the Edison dynamos, the Edison-



MESSRS. MATHER AND PLATT'S ELECTRIC LIGHT ENGINES.

by 20ft. Another essential condition of electric lighting engines is a sensitive, quick-acting, automatic cut-off. This is accomplished by an entirely new form of cut-off valve, recently patented by Messrs. Mather and Holgate, which is described below.

The engines are of the vertical high-pressure condensing type, with a single inverted cylinder, 20in. diameter and 30in. stroke, intended to run at 120 revolutions per minute, and to work with a boiler pressure of 100 lb., and under these conditions will each indicate about 200-horse power. The two engines are entirely independent, each having a separate fly-wheel and independent outer bearings, but they are connected together by a bridge to give access to the cylinders and valves. The cylinders, cylinder slides, and crank bearing pedestal are cast in one piece with the trunk or frame, which is of a box section closed entirely back and front, but open at the sides. The form is very rigid, and looks massive and substantial in design; at the same time, as the frame casting is only ⅝in. thick, it is actually not so heavy as it appears. The cylinder is fitted with a liner, which forms the steam jacket. The valve-box is bolted on separately, and has double slide valves, so as to get straight ports from the valve-box to the cylinder. In the main slide valves the ports are straight on the cylinder side, but the did not exceed 4 per cent., which was immediately reduced to 1¼ per cent., and that with the whole load suddenly thrown off the rise in speed was 2½ per cent. only. The piston-rod and crank-pin are steel, and the connecting-rod best hammered scrap. At the crosshead end the connecting-rod is forked, and the wear taken up by a wedge and screw. Its length is three times the stroke. The crank is of steel, and balanced and covered with a cast iron shield. It is shrunk and keyed on to the shaft. The crank-pin is also shrunk in. The shaft is 8in. diameter, bossed up to 8½in. for the fly-wheel, and at the crank end is carried in a bearing 15in. long, and at the off end in an angle pedestal, 12in. long and 6½in. diameter. The main bearing is adjustable both top and bottom, and at the sides by wedges and screws, so that the brasses can be fixed in any way while the engine is at work. The fly-wheel is 12ft. diameter and 30in. wide, and is prepared for two 13in. belts. It was cast whole, split, and bolted together at the rim, and held with bolts and shrunk hoops at the boss; its finished weight is 5¾ tons. All the bearings, the excentrics, crank pins, &c., are lubricated from one oil tank, to which the oil is pumped from a tank at a lower level, into which it collects from the drippers. The cylinder is lubricated by Mather and Platt's improved sight-feed lubricator, requiring one plug Hopkinson dynamos give a larger output and have a higher efficiency. The right-hand engine drives two "Manchester" dynamos, compound-wound, for an output of 100 volts, 400 ampères, at a speed of 750 revolutions per minute, equivalent to 700 incandescent lamps of 16-candle power. The efficiency of the Manchester dynamo is also very high. With the full load the electrical efficiency is 94·8 per cent. and the commercial efficiency 92·8 per cent. These dynamos, as also the Edison-Hopkinson, are driven direct from the fly-wheels of the engines with link belts, as shown by the accompanying engraving. In order to increase the lap of the belt on the driving pulley of the dynamo, it is bent on the slack side under a loose pulley riding on a stud carried on an arm projecting from the dynamo bed. This system of using a jockey pulley instead of a large belt is very effective when it is desirable to economise floor space. It was introduced by Messrs. Mather and Platt some years ago for dynamo driving, and has given good results. Careful experiments show that there is very little friction in the arrangement and no undue wear of the belt. The belts employed for driving the dynamo are worthy of notice, as instead of having flat faces, as is usual with link belts, the section is double concave, so that the pins are not bent as the belt is bent over the convex surface of the pulleys. At the side of the vertical engines is a small double cylinder diagonal engine driving a 20-horse power "Manchester" dynamo. This is employed for generating the current which is conveyed by cable to Messrs. Mather and Platt's exhibit in the machinery-in-motion section, where a large ten-colour calico printing machine and an electrical singeing machine are driven by "Manchester" motors, concerning which we shall have more to say.

The work in connection with the illuminated fountains has been designed and carried out by Messrs. W. and J. Galloway and Sons, of Manchester, and it is by far the most complete and effective installation of the kind that has yet been erected. This firm had the contract for somewhat similar fountains at the South Kensington Exhibition last year, but a patent has since been taken out by Messrs. Galloway and Beckwith which embodies many important improvements, making the fountains more effective and simplifying the arrangement to such an extent that instead of requiring about eighteen or twenty men for displaying the various effects, this is now performed by three or four assistants. The excavation for the fountains consists of a circular brick-lined pit about 40ft. diameter by 8ft. deep, having benches for supporting the lamps; this is connected with the manipulating tower by a subway over 100ft. long, which is used for gaining access to the basement, and as a culvert for the flow and return water pipes, together with all the electrical leads, returns, telephone and bell signal wires, so that by means of this subway everything is readily accessible for examination and attention. The excavation is covered with deck of timber supported on stout timber framing, and made watertight by being protected with sheet lead, which is carefully puddled in clay, over which again is a concrete bed finished with cement, forming the bottom of fountain basin. This basin is 120ft. in diameter, and the circumference is ornamented by twelve neat pilasters supporting handsome vases designed by the architects. The base of the before-mentioned manipulating tower forms a convenient store-room. The ground floor is the office for electrician and attendants, where the electric current can be tested and measured at will; the first floor is arranged as a box for distinguished guests of the executive committee and contractors, for viewing the fountains; and the top storey is devoted entirely to the fountain operator. In this room is a system of levers, telephones, bell pushes, &c., also signals to the engine room, and a galvanometer, by which the revolutions of the pumping engine can be counted; thus the operator has complete control of the whole of the working of the fountains, adjusting the jets himself, signalling to the engine house when to start or stop, also instructing the attendants at the lamps and coloured slides as to whatever combinations he may require. The water under pressure is conveyed from the pumps by a range of suitable pressure pipes terminating in a distributing box, which is provided with a series of valves controlling the different systems of jets; these valves are connected by wires with the levers in the operating room. In the fountain basin is placed a series of pipes in connection with the jets, these again being connected to their respective valves. The fountains consist of nozzles, varying from ¼in. to almost 2in. diameter, and are nearly 100 in number; generally, we may say that there is one main centre jet, with ring of jets surrounding it, then a second circle of jets somewhat smaller than the centre one, each of these being also encircled by its ring of jets, and an outer ring in immediate contiguity to the sprays, which are arranged for giving a feathery, fern-like display which is extremely effective. To illuminate these jets there are seventeen skylights, under sixteen of which is provided a powerful hand-fed electric lamp suitable for conveying a current of 60 ampères; under the centre skylight are fixed two similar lamps, thus giving a total of eighteen lamps, which are divided into six sections of three each; the rays from these lamps being directed by powerful reflectors through the skylights above. The total illuminating power of these lamps is equal to that from 250,000 candles. Over each and under the skylight are provided slides containing the coloured glasses. These slides are arranged in a number of systems allowing for any change or combination, the whole of them being connected to an apparatus for controlling them; and although some effects are of course better than others, still it is impossible to throw any colours which produce in the mind a feeling of incongruity or discord. This apparatus is connected with the whole of the slides by pulleys of suitable diameter, and any one of the pulleys can be turned through a portion of its circumference, carrying with it the slides in connection with the same. This is effected by levers with cross-bars, on which slide movable stops, so arranged that when any series of slides has been put on the bar automatically revolves, and the previous set of stops that was used comes into operation for taking off the slides previously on.

The pumps and electric machinery are situated on the other side of Talbot-road, a distance of some 800ft. The former consist of a double set of three-throw pumps, capable of delivering 200,000 gallons of water per hour, worked at either side of a three-throw shaft, the shaft being connected without the intervention of gearing to the crank or fly-wheel shaft of the engine. It was not considered desirable to attach an air-vessel to the delivery, as pressures varying with great rapidity from 10 lb. to 100 lb. to the square inch had to be dealt with. This is met by having a ram of similar proportions to one of the pump rams loaded by two powerful laminated springs, which meet any inequality that may be incidental to the pumping arrangements. These pumps are driven by one of Messrs. Galloway's recently improved horizontal compound superposed engines, with 14in. and 24in. cylinders, by 3ft. 6in. stroke, suitable for indicating 180-horse power. This engine is fitted with trip gear for cutting off the steam instantaneously at any point of the stroke, the admission being controlled directly by the governor. The electric current for the lights under the fountains is furnished by two of Messrs. Siemens' latest design of dynamos, B 13 size, each equal to a current of 450 ampères, with an electromotive force of 250 volts when running at 300 revolutions. These dynamos are driven by horizontal twin engines of 200 indicated horse-power, having the cylinders side by side, 15in. and 26in. diameter respectively, with a stroke of 2ft. 6in. This engine is made in the highest style in every way, and is suitable for running at very high speed for giving the regular current to the lights. It has every appliance for continuous lubrication whilst in motion, being one of the three engines which drove the outdoor lighting and fountains at the Colonial Exhibition, where the electric lights gave such satisfaction. Both these engines are non-condensing, as is general in exhibition work, on account of the difficulty in providing water for condensing, and the steam for driving them comes from the range of ten Galloway boilers, which supply all steam throughout the Exhibition.

One of the important improvements consists in so arranging the apparatus for controlling the water and levers for working the same, that they are handled directly by the manipulator in the tower, instead of having to be signalled down below the fountains, where a staff of men had to be at work actuating the different valves. The same simplification is applied to the various coloured lights, as, instead of requiring a man to each set of slides, the whole is controlled by one assistant actuating the entire lot.

The whole of the details of the arrangement described above have been most carefully worked out by Mr. Beckwith, manager to Messrs. W. and J. Galloway and Sons, Knott Mill Ironworks, and the result has been in every way most satisfactory.

On page 396 we illustrate the locomotive exhibited by Messrs. Sharp, Stewart, and Co., and described in our impression for the 6th of May, page 350. The machine tools exhibited by Messrs. Sharp, Stewart, and Co., in the machinery in motion section, well maintain the high reputation of the firm; they consist of a Sellers' planing machine, a Sellers' screwing machine, and a sliding and screw-cutting gap lathe. The planing machine is of the improved Sellers' pattern, the machine exhibited is larger than that shown in London in 1885, to which a gold medal was awarded, being capable of planing objects up to 10ft. by 4ft. by 4ft. It has two tools on the cross slide and one on the upright nearest the attendant, all self-acting, and is fitted with an improved feed-gear giving a considerable range of traverse of the tools. For Sellers' planing machines several important advantages over either screw or rack and pinion machines are claimed, their cutting speed—up to 22ft. per minute—being considerably in excess of that usual with other systems. This speed is attainable by reason of the perfect smoothness of motion and freedom from vibration secured by the well-known Sellers' system of driving the table by a spiral pinion on a diagonal shaft, gearing into a rack on the underside of the table.

The Sellers' screwing machine is arranged to screw and tap from ½in. to 1¾in. It cuts screws in once passing through the dies, and need not be stopped nor reversed for removing work; this insures the production of the maximum of work possible in a given time. The threads cut are perfectly true and accurate. The lathe has headstocks, 10in. centres, on a gap bed 10ft. long. The fast headstock has wide cones, strong gearing, and a steel spindle in conical bearings, with special adjustment for taking up wear. The saddle and compound slide rest are self-acting in all motions, for screw cutting by guide-screw and for sliding and surfacing by back shaft and rack and pinion gear. The latter is exceptionally strong, being designed for turning out work of the highest class, and we need scarcely say that the workmanship leaves nothing to be desired. The planing and screwing machines are shown in motion. The workmanship of all the machines is well worthy of notice. With this exhibit of tools, Messrs. Sharp, Stewart and Co., show a collection of their improved injectors, including the "Atlas," "Atlas-Friedmann," Friedmann's patent—No. 3 size, a remarkably small instrument, considering its capacity—&c. Their exhibit also includes exhaust injectors, the most noticeable of these being W. S. Tomkins' patent improved exhaust injectors for high pressures, the action of which is controlled by one lever, this improvement rendering the injector quite as easy to start as an ordinary one.

COTTON MACHINERY AT THE MANCHESTER EXHIBITION.

UNDOUBTEDLY the collection of cotton machinery at the Manchester Exhibition is the finest ever yet brought together. The abundance, perfection, and orderly arrangement of the exhibits leave little to be desired. The primary purpose of the section is, of course, the instruction not so much of those who are unacquainted with the processes of the cotton industry, as of those who desire to familiarise themselves with the most recent improvements in construction, and in the methods of treating the staple. Still the machinery supplied by a multitude of makers is so well grouped, and so easily inspected, that no person with the most elementary knowledge would have any difficulty in carrying away a clear impression of the high degree of efficiency which automatic instruments have now reached in every department of the industry. From the bale-breaker to the fine ten-colour printing machine of Messrs. Mather and Platt, every principal operation is illustrated, and the interest shown by all classes of visitors in the whole of this section testifies to the thoroughness and excellence of the representation.

There are a few specific novelties in some of the exhibits to which we shall have occasion to refer more carefully in later notices; but in a preliminary survey that which strikes the observer most is the numberless small improvements in construction which have been gradually adopted in recent years. These occur sometimes in the form of more solid and durable construction, as, for example, when framework is cast in a solid piece which used to be made up of segments. This is no small advantage where machinery is subject to much constant strain and vibration, liable to cause slight looseness or displacement. For not only is bad work frequently the result of such apparently trivial disarrangement, but breakages of the machine itself are also occasioned by it, and consequent expense in repairs as well as loss of work through stoppage. A further general improvement is the use of the most suitable kinds of metal and other material for the details of machinery, and although the advantage may seem of little importance in many cases, the whole effect of this better adaptation of means to ends is surprisingly great in practice. The high value, and, indeed, the necessity for the progress accomplished under these two heads become clearer when the fact is borne in mind that in recent years the stress of competition and the extreme narrowness of the margin between the prices of the raw material and of the manufactured product, have compelled spinners and manufacturers to press forward more and more in the direction of high speeds and enlarged out-turn. But high speeds imply increased strain on nearly all parts of the machine, requiring therefore adequate strength, and the attainment of this end with the utmost possible lightness, so as to save power as well as original cost of construction.

The cotton machinery occupies a large space in the centre of the great annexe where power is used. It is excellently lighted, and the whole of the exhibits may be examined with great facility. We purpose to notice them not in the order in which they stand, but in the more natural way of following the successive processes. We begin with the improved Macarthy cotton gin of Messrs. Platt Bros. and Co.—the only one in the Exhibition—its purpose being to separate the cotton fibre as originally grown from the adherent seeds with which it is profusely intermingled. This operation is, of course, always performed on or near the field of growth; and, until the invention of Whitney's "saw gin," towards the close of last century, it was accomplished by rude and expensive manual processes. There are numerous kinds of machines at work in the various cotton-producing countries, each having certain advantages, but none of them combines so many good features as those of the machine now under notice, which was adopted years ago by Messrs. Platt after prolonged investigation, and which has received at their hands numerous improvements. It is not capable of getting through so much work as the saw gin; but it inflicts much less injury upon the staple in the process of ginning, and will turn out as much as 120 lb. of cleaned American cotton per hour, and a larger amount of such staples as do not adhere so tenaciously to the seed. The seed-cotton is placed in a hopper at the top of the machine, the lint being carried through by leather-covered rollers, whilst the seeds are struck off by means of blunted knives. The machine can be instantly regulated for various lengths of staple, and an advantage—obviously important in agricultural districts where repairs cannot be easily executed—is that it is impossible readily to tamper with the machine or put it out of order.

Next we come to the bale-breaker, an apparatus rendered necessary by the modern tendency to reduce the cost of freight from the producing countries by closer compression of the cotton bale. Two of these machines are shown, one by Messrs. Platt and the other by Messrs. Tayler, Lang, and Co., which are sufficiently alike to be included in one general description. The solid layers of cotton taken from the bale are laid on a creeper-lattice, which carries them forward to a pair of slowly revolving toothed rollers. As the cotton passes from these rollers it is seized by a second pair of similar rollers revolving at a considerably increased speed, which tear away the portions within reach and deliver them to a third pair of rollers. These repeat the process, and forward the lumps of cotton over a lattice-creeper on to the floor at the opposite end of the machine. Any heavy dirt that may be released by this process drops down on the floor. The fact that these breakers, with the attention of one labourer, will pull ten or twelve bales per hour, shows that a considerable saving in cost of labour is obtained by their use. Formerly this process was accomplished by hand, and it still is so in many mills. Obviously, however, the machine is more to be depended upon for thoroughness, and as it is not costly, the bale-breaker is likely to come into general use. The one exhibited by Messrs. Taylor, Lang, and Co., operates alone, but that of Messrs. Platt is in combination with a tubular arrangement through which the cotton is carried by atmospheric pressure. This contrivance is especially desirable where the bale and mixing rooms are some distance apart, and it affords the further advantage that, being drawn through long tubes by means of an exhaust fan, opportunity is given of providing for the deposit during the passage of heavy foreign matter, which is thus abstracted from the cotton without the slightest injury to the staple. Indeed, generally, it may be observed that a primary object of the machinist in designing and constructing apparatus for the preparatory stages of cotton spinning is to free the fibre from every kind of impurity, whilst preserving as far as possible the original length of the staple. With the aid of two men, the bale-breaker will pull 90,000 lb. of cotton per week.

The next process is that of opening. Machines for this purpose are shown by Messrs. Curtis, Son, and Co., Messrs. Platt, and Messrs. Taylor, Lang, and Co. The first of these is a double Crighton opener, with two vertical conical beaters, which may be used separately or together, and special arrangements are made for oiling the bearings and for keeping the footsteps cool. This class of machine, which is specially adapted to the dirtier kinds of cotton, is so well known as to require no minute description. In Messrs. Platt's opener the ordinary horizontal beater is adopted, and it is capable of getting through 30,000 lb. of cotton per week. The lint is taken from the stack or mixing prepared in the usual way after the cotton has passed through the bale-breaker and spread upon the feeder lattice of the opener, passing then through two pairs of feed rollers into the cylinders, and delivered then to the dust trunks, over which it is drawn by the action of the exhaust fan into the cylinder of the opener proper, leaving behind it, as in the case of the bale-breaker already described, many impurities on the floors of the trunks. In this cylinder, after passing through the ordinary cages and feed rollers, the cotton is subjected to the action of a three-winged beater, and is then made into laps. In order that the thickness of these may not vary through accumulation of cotton in the trunks and pipes, whenever the machine is brought to a stand, the rollers at the feeder end are started a short time before the beater and lap portion, and of course a similar interval of time is allowed between the stoppage of the rear and fore portions. Messrs. Taylor, Lang, and Co.'s opener is a very efficient machine, one of its advantages being that the cotton is struck not by the ordinary knife-beater, but by a succession of dull blades radiating from a horizontal axis and revolving between similar blades, which are fixed; and very little injury is inflicted upon the staple, whilst the opening and cleaning appear to be perfectly satisfactory.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Colombia—Trade of Carthagena.—Foreign commerce with this country is carried on mostly by steamers, nine-tenths of which are British. The trade with the United States is entirely in the hands of a British line of steamers. Last year the importations from England amounted in value to 45 per cent. of the total importation of this port. Considerable increase in the foreign trade of this port took place during the year, the imports being £265,570, against £167,105 in 1885, and the exports £410,627 against £194,168. Formerly Carthagena was the only port of entry for this part of the country, all exports and imports passing through a canal called the Dieque, connecting the river Magdalena with the bay of Carthagena. When through the silting up of this canal navigation became obstructed, a railway was built from Savanilla to Barranquilla and commerce changed to that port. Now the Deque has been reopened and two lines of steamers established from Carthagena to Hondu, commerce is again resuming its old channel, and the trade of this port is increasing every month, the delay, expense, and risk consequent upon the transfer from steamboat to railway at Barranquilla, and the lighterage in the open roadstead of Savanilla being saved. Besides the above-mentioned traffic, all the foreign trade of the Atrao and Sinu rivers is from necessity obliged to pass through this port. The valleys of these rivers want only capital and immigration to make them the gardens of the world, while their mountains abound in mineral wealth. The present Government is doing all in its power to develope the country, opening new and improving the old turnpikes, railroads, &c., granting subsidies to lines of steamers, &c., paying the greatest attention to gold and silver mines, of which the country is full.

Ecuador—Trade of Guayaquil.—The light dues on ships have been decreased to 1½d. per ton register, or in all, 5d. per ton register for every sailing vessel entering Guayaquil, the duties on steamers being one half of the above. During 1886 the Quito Railway has been advanced beyond the bridge of Chimbo. Cuttings through the mountains for about 5·5 miles have been made and the road prepared for laying the rails; also the whole of the road to Sibumbo has been surveyed. An iron bridge imported from France has been erected over the river Chimbo. Waterworks are proposed, to convey the water from Agua Clara, near Chimbo Bridge, on the railroad, a distance of sixty miles to Guayaquil, by pipes along the railroad to Yagnachi, and thence to Guayaquil, crossing the river in front of the city by pipes laid on the river's bed. The latter work has been contracted for in the United States; but the whole of the piping, &c., for the land line and for the distribution of the water throughout the city has been contracted for in Scotland. The work has to be provided for by the issue of municipal bonds to the amount of £151,500; but up to the present date none of these bonds have been taken up by the public, and the project is consequently in suspense. The telegraphic lines of the republic have been augmented by one to Bodegas or Babayhoyo, the head of river navigation on the present road to Quito.

Russia—Trade of Kertch in 1886.—The imports to this place have always been very small, and those of English goods especially are hardly worth mentioning. The want of agricultural implements and machinery had just begun to be felt, and the English plough and locomobile were being freely imported when the Russian protective import duties turned everything in favour of the Moscow and Warsaw manufactures. Ironware, especially wrought iron tubes for petroleum boring, which are not made in Russia, have hitherto been supplied by German firms at about 20 per cent. less than English prices, but the tariff has pressed even on the Germans, and tubing is now ordered from the borders of Poland, where the Germans have established more than one ironfoundry and machinery factory on Russian soil under Russian names, and thus getting over the tariff difficulty.

Trade of Nicolaeiff in 1886.—The imports of 1886 compare very favourably with the previous year, but the principal items were armour-plates and machinery for the Russian Government. It is believed that the dredging of the Ochakoff bar, so as to give a minimum depth of 22ft. between Nicolaieff and the Black Sea, will beneficially affect the import trade, since many goods which have hitherto gone to the commercial centres of Charkoff, Poltava, and even Moscow, through other channels, will now be received at this port. The great benefits which were expected to be derived from fostering and protecting home trades have not yet been felt, the consumer paying almost as much for an inferior article of Russian manufacture as for a superior article of foreign make. Great progress has been made in the manufacture of certain goods, such as cotton, linen, and woollen fabrics, but other branches of trade are monopolised by men who produce nothing but goods of the commonest description, charge the highest prices, and stamp their goods with the trade marks of well-known foreign makers.

Trade of Odessa in 1886.—There was a considerable falling off both in exports and imports, though the tonnage of British shipping was still 57 per cent. of the whole. In coal an augmentation of the duty has taken place, which has been the means of considerably increasing the trade in Russian coal in the Black Sea ports. This added to the high rates of exchange, as well as the outward heavy freights during the past, rendered the importation of English coal almost an impossibility except at a loss. The effect of the increased duty is shown by the fact that the importation of English coal decreased from 309,275 tons in 1884 to 117,853 tons in 1886, a reduction of 62 per cent. The Russian Government continues to increase the duties on imports, and has brought into force several stringent measures in connection with vessels arriving at Russian Black Sea ports with cargoes. The harbour has in many places been deepened to 22ft., and further operations will be carried on in the spring. A project is on foot for constructing a separate harbour at the back of the Pratique Port for coal and petroleum. The railway line has been carried on the Platonofsky Mole, where the Russian Steam Navigation and Trading Company has erected a new building where the luggage of passengers travelling by their vessels is inspected instead of being transported to the Custom House for examination.

Spain—Trade in Barcelona—Competition.—Notwithstanding the admission of English goods to the most-favoured nation clauses in all treaties between Spain and European nations, competition is still severe, and to succeed England must produce goods as good and cheaper than she does now. In Barcelona the shops display so-called English wares imported from Belgium and Germany, so that superior English goods cannot be sold at the prices asked. There does not appear to be any new trade carried on with success. The standing trade meets all the necessities of the place, and all that is required is to attempt competition with the foreign local trade in those articles which are British productions, distinguished by the superiority of work, and better quality, and cheapness. The Catalian purchaser prefers to give 5s. for two German pocket-knives of inferior make than the same price for an English one which is of superior finish and material. It is even said that dry goods manufactured in Barcelona are exported to England and reimported with British labels and marks. Severe as foreign competition is, its power is becoming lessened, and British success by no means depends on custom-house tariffs enabling other foreigners to enjoy advantages denied to British traders, but on the commercial attainments of British agents in opposition to French and German. In view of the late tariffs, firms in Barcelona worked with Spanish material and have not imported metal from England, while they could get it two-thirds cheaper from Bilbao. The present condition of credit is uncertain, but the customary terms are from six to nine months without security. Though British trade is no longer affected by customs duties, shorter distances, as in the case of Austria, France, and Italy, and lower freights in foreign bottoms favour goods from those countries. English package, and the package of machinery and other goods are much superior to those of other nations, being packed with care and in such a way that the portions come easily to hand, and thus facilitate the putting together of the articles. "I strongly advise the increased introduction of British manufactured goods into Barcelona, and I can almost promise a success in the speculation, being better and cheaper than native goods, if the country's wants are duly considered and studied." Very few goods are imported from foreign countries into Barcelona that could not be so from England except spirits, sugar, glucose. The countries which compete with England are Belgium, France, Germany and Italy, and they compete strongly in coal, ironware, and machinery. France competes in coal and is a rival not to be despised, our imports in coal in 1886 being 335,000 tons, while those from France by land and sea were 99,774 tons. Italy imports charcoal only, which during the past year amounted to 27,000 tons. British coal is used chiefly for domestic cooking and heating. A great improvement has taken place in the manufacture of bolts, locks, &c., for safes and strong boxes, which appear to be inviolable by any manner of forcing or picking. They are made with much skill and beautifully finished. British traders are beginning to understand the situation if "I may judge by the flood of correspondence received by me daily from seekers for information from all parts of England and Scotland, and which is most difficult to reply to from want of time."

Turkey—Trade of Damascus.—The import trade of Damascus shows a falling off in 1886, the total amount of the imports £625,218, against £711,883 for 1885, a decrease of £85,665. The falling off is most conspicuous in British manufactures, which diminished to the extent of £123,172, though in iron, tin, and zinc there was an increase. The decrease is attributable to the stocking of the market during the previous year, and also to the competition of other European countries, whose imports show an increase, but the amount of goods imported from England is so far ahead of that from other countries that there is little fear of British manufacturers ceasing to maintain their position. As regards foreign competition, efforts must not be neglected on the part of British manufacturing firms to promote their interests in the East in the same way as other foreigners. Costly and elaborately got-up circulars are sent out to this country by every post from England, and no opportunity is missed by the Consulate to bring them to the notice of native merchants and traders, but much more could be done in the interest of British trade by the periodical visit of commercial travellers. "Inquiries are frequently made at this office as to whether there is any likelihood of such travellers coming out to the country who would be able to do business in some particular article required, which shows the desire to trade with British firms; and it is needless to say that any representation of a firm in England would receive very proper assistance and action from that Consulate." As an instance of the efforts of other nations in promoting their trade, during the whole of last spring and summer there was in Damascus a German representing an engineering firm in Berlin who endeavoured to introduce agricultural machinery into Syria, and doubtless would have succeeded if the thrashing machines, &c., had not broken down during trial. He had at the same time the offer of the contract by the municipality of Damascus for running a tramway in the city, and may still make arrangements for carrying out the project as soon as it is finally decided on. A few days ago, a French gentleman from one of the manufacturing firms in Lyons signed an agreement for setting up a cotton and silk factory in this city, and had returned to France for the requisite machinery. Commercial travellers representing different firms in England, and knowing one or two foreign languages, might occasionally visit the East with beneficial results to their employers.

United States—Trade of Boston in 1886.—Considerable increase took place both in the export and import trade. The shipping entering the port shows an increase over 1885 of 116,146 tons, 90,491 of which were British. Although prices continued low, and numerous and prolonged strikes, also heavy defalcations and failures, arrested business development and revival of confidence, a progressive gain was perceptible in the volume of domestic industry and trade, which are now in an improving and sound condition throughout this consular district. A small advance in the price of iron at the close of 1885, added to the conviction that a large supply would soon be required, led to a large increase of production early in the year. Though sales were active from the beginning, prices did not materially improve until the close of the autumn. At the close of the year American pig iron was quoted at £4 6s.; Scotch pig at £4 12s.; and steel rails at £7 12s. per ton; the market was firm with an upward tendency. Copper and pig tin followed a similar course; but pig lead was lower at the end than early in the year. As to the practicability of promoting an increased trade with the United Kingdom, it is the opinion of merchants here that the existing system is the most efficient and the most conducive to permanently sound and profitable business that can be devised. The system is:—Having carefully studied the wants of the home market, the prevailing fashions and tastes, and the prices at which certain articles can compete with domestic manufacture, each importer sends to Europe periodically—and occasionally to other parts—a competent representative who visits the manufacturing establishments in his line of business, both on the Continent and in Great Britain, and who, after a careful and full inspection, decides for himself where he can obtain the best adapted goods, or have his orders most satisfactorily executed at the lowest cost. By this method alone can importing merchants succeed in supplying themselves with the most desirable and profitable selections, and in securing themselves against competition, whilst manufacturers are relieved from the alternative of publicly exhibiting abroad by means of travelling agents or sample rooms, either inappropriate or new and popular goods, with the chance of the former being unsaleable and the latter being closely imitated before advantage can be taken of a favourable market, and they reap the benefit of effecting large sales directly to a limited number of customers of established credit in lieu of selling abroad, at greater risk and expenses in collecting debts, to small traders whose liability may be more easily evaded. Exporting manufacturers and merchants are of opinion that this system is not equally applicable to all countries, and they establish agencies or send representatives in various parts, and avail themselves of the reliable information acquired through them to ascertain the precise class of goods that are in demand at any particular place, and to judge whether they can be produced and exported at a profit. In this way, in addition to frequent shipments elsewhere, a well-established and growing export trade—supplemented to a certain extent by imports—has for many years been carried on with Australia, the principal articles of export being agricultural implements, carriages, carts, hardware—including all kinds of tools, locomotives, machinery, railway cars, ranges, and stoves. Some of the goods are such as are not produced in the United Kingdom, but it is admitted that others sell readily though not able to compete in price with those of British manufacture, owing to greater attention having been paid to their adaptation in quality and value to the requirements of the markets to which they are exported.

THE NEW HAMMERSMITH BRIDGE.

IN our impression of the 22nd ult. we gave a two-page engraving showing the new bridge which is now being constructed from the design of Sir Joseph Bazalgette and Mr. Edward Bazalgette. We then also gave enlarged views of the piers and towers and abutments above water. In our impression of the 29th ult. we gave further engravings—page 330—showing the construction of the wrought iron towers with their ornamental cast iron casing; and on page 331 engravings showing the anchor chambers, saddles, saddle beds, tightening keys, and other details. With the present impression we give, on page 356, sections and plan of one of the piers and of one of the anchor chambers complete; details of the chains, suspenders, and longitudinal girders, and details of the wrought ironwork of one tower. The works as commenced were known as the Hammersmith Bridge alterations; but as only the lower parts of the abutments and piers are being used again, and as even these have to be to a large extent rebuilt and strengthened, it is much more correct to call it a new bridge. Part of the work consisted in building a temporary bridge, but of this we need not speak. In describing the new bridge we shall draw largely from the contract specification. After the removal of the old superstructure, the first work consisted in

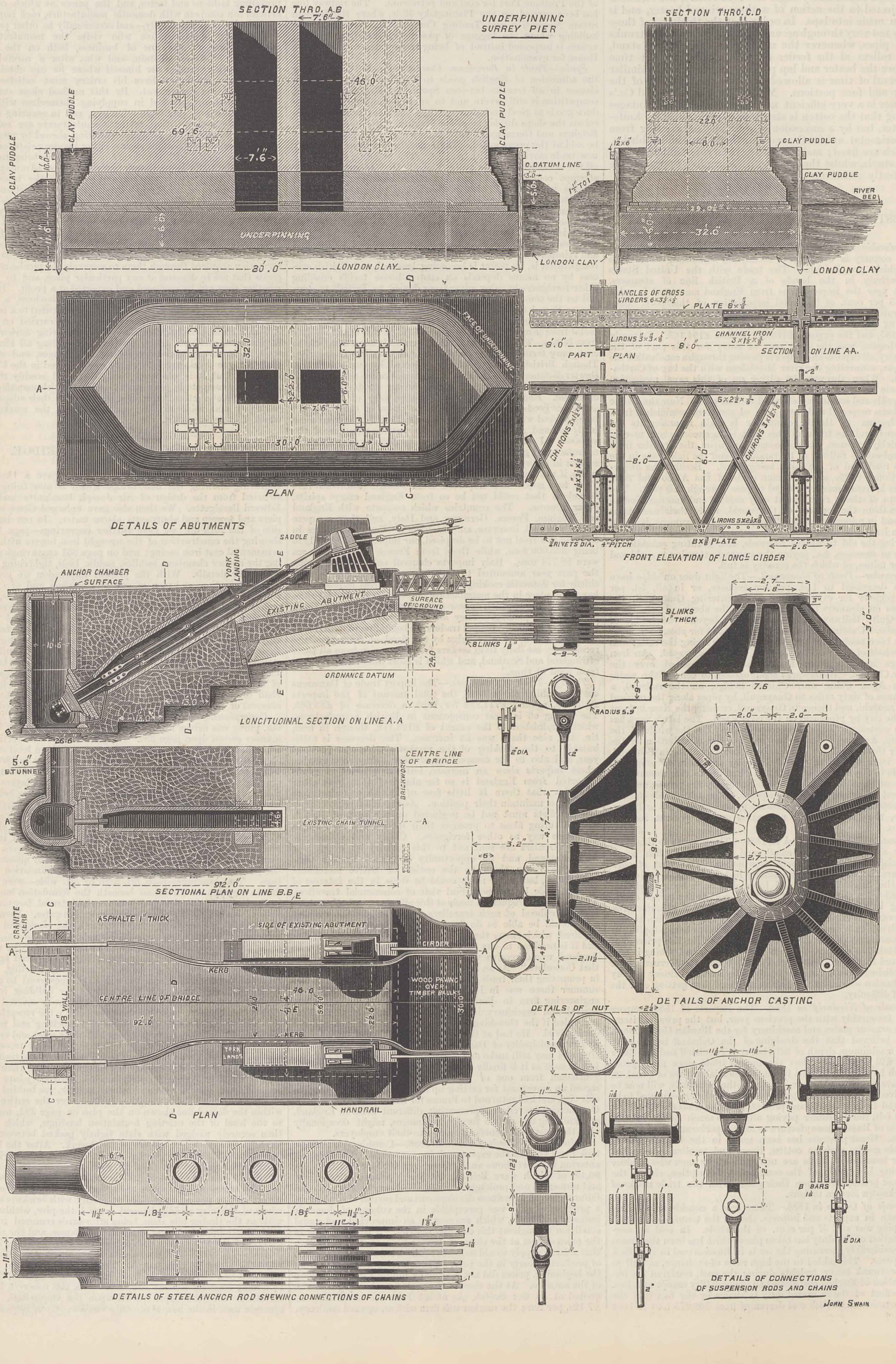
Underpinning the Surrey pier.—A single line of close 12in. by 6in. piling was driven around the Surrey pier to enclose it in the manner shown upon page 392. The piles were driven vertically, with their heads in the finished dam at a uniform level of 3ft. above Ordnance datum, and the points of the shoes to 18ft. 6in. below Ordnance datum, or 4ft. below the level of the underpinning. Clay puddle was then solidly punned in layers 12in. thick, into the whole space enclosed around the pier or between its external faces and the pile dam, and level with the surface of the pile heads. Against the external faces of the piles, and reposing upon the bed of the river, was also placed two shafts, each measuring about 7ft. 6in. long by 6ft. wide, and in the positions indicated upon the engraving, page 392, were then excavated through the depth of the brickwork and masonry of the pier, to a level of 6ft. below the existing foundation landings. Two headings—each 6ft. high by 5ft. wide—were then driven in opposite directions beneath the foundation landings in the length of the pier, and as far as the internal faces of the extremities of the pile dam adjoining its cutwater. From the longitudinal gallery thus formed beneath the piers, and commencing at the ends most remote from the working shafts, cross galleries of similar dimensions were also driven under the width of the pier. The process of underpinning commenced against the face of the pile dam at the end of each cross heading. The intended clay foundation surface was kept unexposed to atmospheric influence until the time arrived for building in the brickwork; it was then levelled and immediately covered over with a 3in. layer of neat Portland cement for the reception of the brickwork. During the process of tunnelling and underpinning, the whole of the galleries had their sides and crowns strongly timbered with 6in. by 6in. side and head trees, the latter supported on footblocks. The galleries were also timbered so as to resist any tendency to lateral movement of their clay sides. Stock brickwork, properly bonded, with all joints fully and solidly grouted in Portland cement mortar, was bedded upon and built up from the foundation surface over the entire area within the dotted line shown on the plan on page 392, and up to the level of the existing foundation landings, which were then securely wedged with slate tightly packed between the landings and the upper course of brickwork. After the headings in the width of the pier had been filled with brickwork, the longitudinal gallery was filled in with brickwork in a similar manner. Upon the completion of the underpinning of the Surrey pier the two working shafts, to the formation level of the new wood roadway paving, were filled up solidly with brickwork, the whole of the clay puddle deposed around the pier, within and without the timber pile dam, being afterwards removed to the original adjoining bed level of the river Thames, and the upper portion of the timber pile dam cut off to a corresponding level.

Abutments.—The old abutments were about 41ft. 4in. in width by about 46ft. in length. These abutments have been increased to a total width of 56ft., and a total length of 92ft., by adding concrete to their sides and backs, the concrete being carried down to the depth shown upon the engravings. The concrete used in the new abutments consists of one measure of

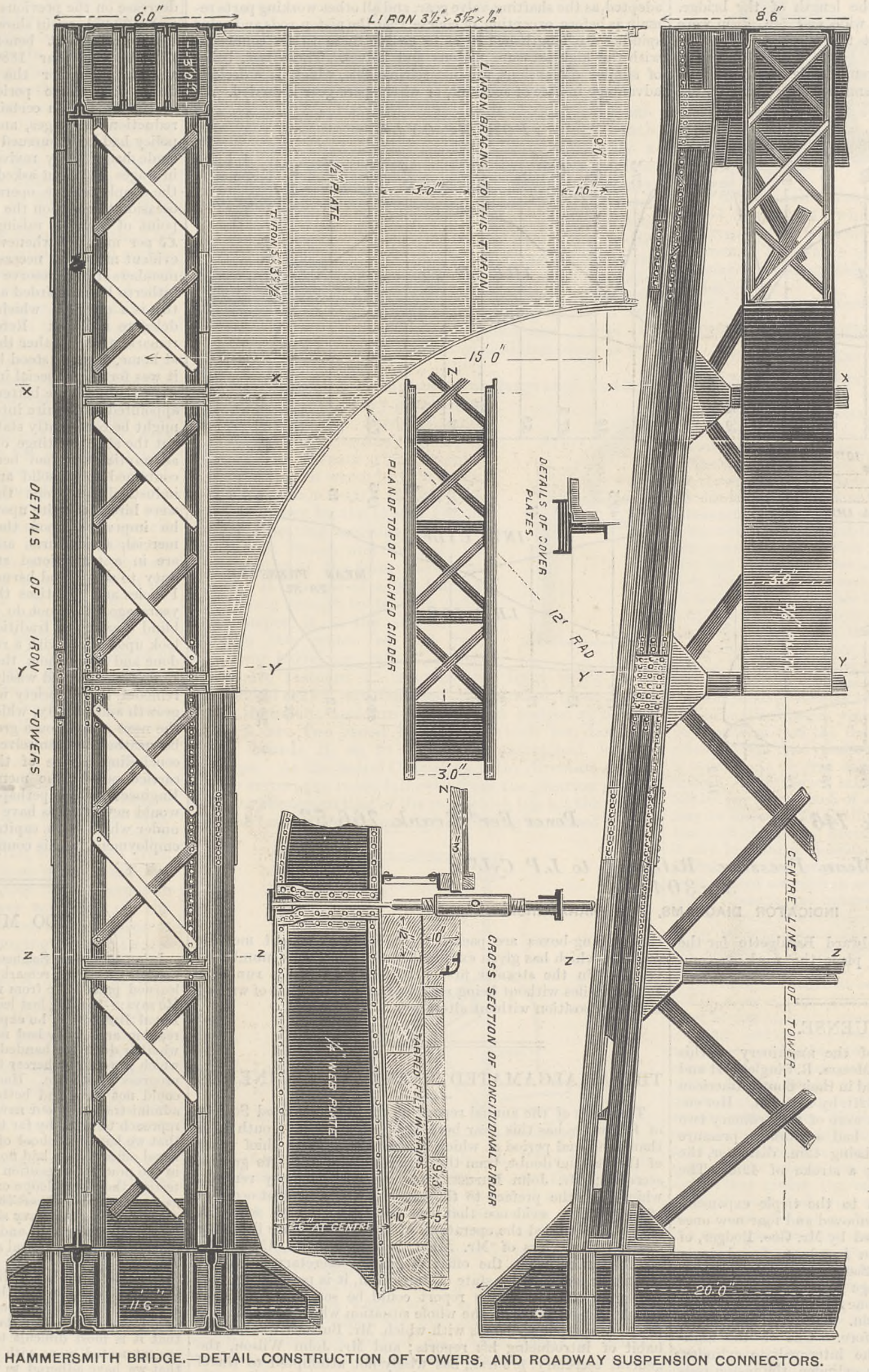
THE NEW HAMMERSMITH BRIDGE.—DETAILS OF PIER FOUNDATIONS, CHAINS, AND ANCHORAGE

SIR JOSEPH BAZALGETTE AND MR. EDWARD BAZALGETTE, MM. INST. C.E., ENGINEERS.

(*For description see page 391.*)



Portland cement to six measures of thoroughly clean and sorted Thames ballast. It was placed in the excavations in layers not exceeding 12in. in thickness. The old chain tunnels were completely filled and made perfectly solid with Portland cement concrete. The masonry underneath the ends of these tunnels at the back of the existing abutments was cut away so as to form a bond between the old abutments and the new concrete placed at the back of them. Vertical chases, 3ft. wide by 3ft. high by 1ft. deep, were cut in the sides of the old abutments so as to form a bond for the new work, these chases not being less than one-twelfth the area of the sides of the existing abutments. The tops of the old abutments were entirely stripped of all macadam and other materials, cleansed, and the whole surface covered with Portland cement concrete, brought up to the underside of the new wood block paving and asphalted footways. In front of the concrete forming the additions at each side of the existing abutments, whole piles 12in. by 12in. of rock elm timber were driven in a line with and joining on to the old piling in front of the abutments. The new concrete was brought up to the back of these piles. This piling was anchored with wrought iron rods—each 2in. diameter—to anchor plates bedded in the new concrete additions, as shown in the engravings. The inclined concrete beds immediately in contact with the 12in. York landings, against which the anchor castings bear, were for a thickness of about 6in. formed of fine ballast and Portland cement mixed in the proportion of three to one. Chain tunnels 6ft. 6in. high by 4ft. 6in. wide, inclining at an angle of 30 deg. to the horizon, have been formed with a 9in. brick in cement lining, round which the concrete has been placed. Adjoining the shoulders of the steel forgings the dimensions of the chain tunnels are gradually reduced by means of cast iron taper tubes of ¾in. metal, each tube being 5ft. long. Their internal dimensions at the large ends are 4ft. by 1ft., tapering to 3ft. 2in. by 1ft. internal dimensions at their smaller ends. The tubes are built into the concrete with their axes inclining at an angle of 30 deg. to the horizon, and affording a perfect clearance round the shanks of the forgings. Each of the three courses of York landings are pinned up and solidly built into position with the surrounding work, their beds being dressed smooth and at right angles to the pull of the anchor chains. Upon the whole bearing surfaces of the York landings and anchor castings are laid sheets of lead ⅛in. thick. Two anchor chambers are formed to each abutment, and each pair connected by circular brick tunnels 5ft. 6in. diameter. The chambers and tunnels are formed of brickwork in Portland cement, and the tops of the chambers covered with 9in. York landings supported on cast iron girders. Upon these landings are laid the concrete and wood carriage-way paving and asphalted footways. Access to the anchor chambers is provided by iron gratings 2ft. 6in. by 2ft. 6in., their frames being built into the brickwork over each anchor chamber. The lower ends of each chain tunnel are drained into the anchor chambers by a 3in. cast iron pipe built into the concrete. To form an access to the chain tunnels, 4in. York landings rest at one end upon the brick arch at the mouth of the tunnel, and at the other extremity upon the projecting bases of the ornamental saddle casings. The saddle castings shown on page 331 are bedded on and bolted to the two courses of Darley Dale stone, these courses of stone being carefully dressed, and bedded one on the other and on the abutments, to form a perfectly solid and true bearing, and to prevent after movement. The abutment saddles and chains are covered with ornamental cast iron covers, as shown on the double page engraving published on the 22nd ult. These covers extend back 43ft. 6in. from the front faces of the abutments, and partly cover the upper ends of the chain tunnels.



HAMMERSMITH BRIDGE.—DETAIL CONSTRUCTION OF TOWERS, AND ROADWAY SUSPENSION CONNECTORS.

Towers, tower saddles, &c.—After the masonry towers had been removed, the old piers were prepared for the new towers by removing part of the masonry from the upper surfaces of the piers, and forming solid and level beds to receive the bases of the new towers. The level of these beds is about 22ft. 8in. above Ordnance datum, the top surfaces of these parts of the piers being finished off at a level of about 23ft. above Ordnance datum. The stone faces shall correspond with the existing work in the piers. Provision was made for anchoring down the iron towers by cutting chambers in the masonry, at the lower ends of the holding-down bolts, and boring holes from the top surface through the masonry or brickwork of the piers down into hese chambers. Eight of these chambers, 36in. high by 30in. wide by 36in. deep, were cut in the side faces of each pier, and their top surfaces dressed to a level bed 5ft. above Ordnance datum, to receive the bearing of the cast iron anchor plates shown at page 392. Sixteen other chambers were cut in each pier, and similar anchor plates fixed in them, with their bearing surfaces at a level of 11ft. above Ordnance datum. Each of these castings was connected to the bases of the wrought iron towers by two wrought iron bolts 1¾in. diameter, passed through the holes bored in the masonry, and secured with nuts at the under sides of the castings. After the castings were in place and bolted up, all the chambers were built in solid with brickwork, and faced with stone to correspond with adjoining work. In order to give a fair bearing to the wrought iron bases of the towers, cruciform cast iron bed-plates—eight in number on each pier—are bolted to the wrought iron bases, and bedded in cement at the required level. The tops of these bed-plates are planed and fitted to the wrought iron work. The rollers are of hard steel, and are fitted in stiff wrought iron frames, of 5in. by 1in. bars. The upper cast iron roller plates are planed on the under side and edges. Each saddle is made with ten steel plates, built up with wrought iron packing pieces, angle pieces, and gussets. The links are secured between the steel plates, the packings being $\frac{1}{16}$in. thicker than the links, so as to give sufficient clearance for the links to be inserted when the saddle is bolted up tight. The gibs and keys are steel, placed in the slots in a position to allow an equal amount of adjustment of the chains in either direction. After the chains were finally fixed in position the keys were cut off.

Ornamental cast iron casings for abutment saddles and towers.—The general design of the tower and abutment ornamental cast iron casings is shown upon the double page (THE ENGINEER, April 22nd). The average thickness varies from ¾in. at the bottom to ⅜in. at top. The cast iron casings rest upon their bases, and are self-supporting, except that they are stayed laterally from, but not fixed to the wrought iron towers.

Cast iron columns for piers.—The old stone caps were removed from the cutwaters at the ends of the piers, and a level bed made to receive a group of cast iron columns of the form shown on the same double page. The tops of the castings have an inclination of 1 in 50, to suit the gradient of the bridge platform. When in place the castings were filled in solid with Portland cement concrete, mixed in the proportion of one of cement to seven of fine ballast. The stanchions to support the parapet to the footways are fixed to these castings.

Steel chains, &c.—There are four sets of steel links forming the suspension chains of the bridge. Each set consists alternately of eight links 9in. by 1⅛in. and nine links 9in. by 1in., giving an uniform sectional area throughout the whole length of the bridge. The upper set of links at each side of the carriage-way—see page 309—is kept at an uniform vertical distance of 24in. above the lower sets—centre to centre. The versed sine of the chain curves of the centre span, at a temperature of 60 deg. Fah., is 35ft., measured from the intersections of the centre lines of the chains on the centre lines of the towers, to the centre lines of the chains at the centre of the span. The curves of the chains of both the side spans correspond with the curves of the chains of the centre spans, so that at equa distances from the piers the levels of the chains in the centre and side spans are the same. The link bars are rolled of mild steel. The swelled ends are formed to the dimensions shown on page 392. It was prescribed in the specification that all link bars which are to be placed side by side in the structure of the chain shall be bored at the same temperature, and of such equal length that upon being piled upon each other the pins shall pass through the holes at both ends without driving. The bars shall be bored to exact lengths, and the pin-holes shall be $\frac{1}{50}$th inch larger than the diameter of the pin. Pin-holes shall be bored exactly perpendicular to a vertical plane passing through the centre line of each member when placed in a position similar to that it is to occupy in the finished structure. The link pins shall be of steel 6in. diameter, and turned straight and smooth to gauge, and shall fit the links within $\frac{1}{50}$th inch. Whenever necessary for the protection of pin threads during erection of the chains, precautions shall be taken accordingly. The part of the suspension rods which is below the screw couplings is 8¼in. wide by ⅝in. thick, and turned up at the bottom, so as to form a flat stirrup 12¼in. long by 8¼in. wide by ⅝in. thick. The platform has an inclination of 1 in 50, and the suspension rods hang vertically. The expanded forging at the lower ends of the suspension rods is rivetted to the angle irons of the wrought iron plate-cross girders and of the wrought iron plate cantilevers. The top flanges of the cross girders are neatly curved to give the carriage-way a camber of 3in. The cross girders and cantilevers are spaced at an uniform distance of 8ft. from the centre to centre.

Erection of steel chains and girders.—The steel anchorage links for connecting the abutment saddles with the anchor forgings having been first completely erected, the method of connecting up the links of the new chains across the several spans of the bridge was as follows, as directed by the engineer's specification:—From the towers and abutments shall be suspended four lines of steel wires, each line to be capable of safely resisting a pull of 90 tons. Should the contractor, however, prefer to make use of the existing links, which would form a more rigid combination than the wire lines—but probably less economical—the system hereafter described may be adopted. The temporary chains to be composed of a sufficient number of the original links as will complete two distinct pairs of catenary chain curves, each to extend throughout the length of the bridge, and on each side of the saddles, and placed vertically at from 12in. to 18in. beneath the intended positions of the lowest steel chain. Each pair of chains to be suspended from the towers by means of suitable wire rope attachments, and to be maintained at a distance of about 18in. apart by means of hollow struts. Each line of chains to be separately connected, raised, and suspended from the temporary apparatus connected with the towers for that purpose. After their complete erection, the four lines of temporary chain shall be stiffened and braced together throughout the width of the new bridge by means of a horizontal and diagonal system of scaffold poles, attached across the under edges of the temporary link chains. The steel links which form the under lines of permanent chains shall be laid upon timber packings piled at suitable intervals along the erecting chains, and shall be gradually connected to and from the tower saddles downwards. Each line of the permanent lower chains to be simultaneously built downwards from each of the tower saddles, and likewise brought up from the abutment saddles and connected midway in the various spans. It is proposed to connect the links for the temporary erecting chains upon a suitable barge platform. The chains to be thereon disposed in such manner that when moored midway between the saddles, each chain may be separately and gradually hauled from each of its extremities to its destined position. The hauling tackle to be securely attached at the towers and abutments. Following the complete erection of the lower permanent chains and the removal of the temporary erecting chains, the under permanent steel chains shall be similarly used for the complete erection of the upper lines of steel chains. Upon the completion of the upper and lower lines of chains, the contractor shall suspend therefrom a suitable platform, and at the correct levels for the erection of the longitudinal and cross girders.

Formation of roadway platform.—The longitudinal timbers for the formation of the carriage platform—excepting the end timbers in each course—are 40ft. long by 12in. wide by 10in. deep. With the exception of certain portions of the carriage-way above the piers of the bridge, the platform timbers extend longitudinally between the abutments, and cover the entire width of that portion of the bridge included between the suspending rods. These timbers are disposed in the width of the bridge, as shown upon drawings, page 309. Each timber is secured to the top flange of every transverse girder, which it crosses by a ⅝in. bolt, passing through its centre. The several heading joints of the longitudinal timbers upon the upper flanges of the cross-girders are in every case specially connected with ⅝in. bolts, ⅝in. wrought iron junction plates—10in. by 12in.—sunk flush into the surface of the timbers, and central with the cross joints of the timber balks, thus forming an overlap of 5in. across each joint in the length of the timber. The whole of the plates, bolts, and nuts for holding down and connecting the longitudinal balks were thoroughly tarred on all surfaces previous to their insertion in the work. The whole of the timber used in the formation of the road and footways of the bridge is Memel and Dantzic fir, and, excepting the paving blocks, is creosoted by Bethel's process, so as to be increased in weight to the extent of 8 lb. for every cubic foot of timber by the absorption of the creosote; but no timber was creosoted until after its inspection and approval by the authorised officer of the Board. The whole surface of the creosoted timber of the roadway platform, after the timber balks were laid, was coated with hot tar, and while the tar was still hot strips of felt, well saturated with tar, were evenly and closely laid over their whole upper surfaces, throughout the length of the bridge. Wood paving setts 9in. long by 3in. wide and 5in. deep were laid upon the tarred felt throughout the whole carriage-way area of the bridge described.

It will have been seen that some remarkable work has been done in the renewal of the Hammersmith Bridge, and we are indebted to Sir Joseph and Mr. Edward Bazalgette for the drawings which have enabled us to place the work so completely before our readers.

THE S.S. MANAUENSE.

We publish this week drawings of the machinery of this steamer, which belongs to the fleet of Messrs. R. Singlehurst and Co., of Liverpool, and which is employed in their South American trade. Her dimensions are 281ft. by 32ft. by 15ft. 6in. Her engines up to the time of their alteration were of the ordinary two cylinder inverted compound type, and had a working pressure of 75 lb., the high-pressure cylinder being 42in. diameter, the low pressure 78in., and both having a stroke of 42in. The indicated horse-power was about 1000.

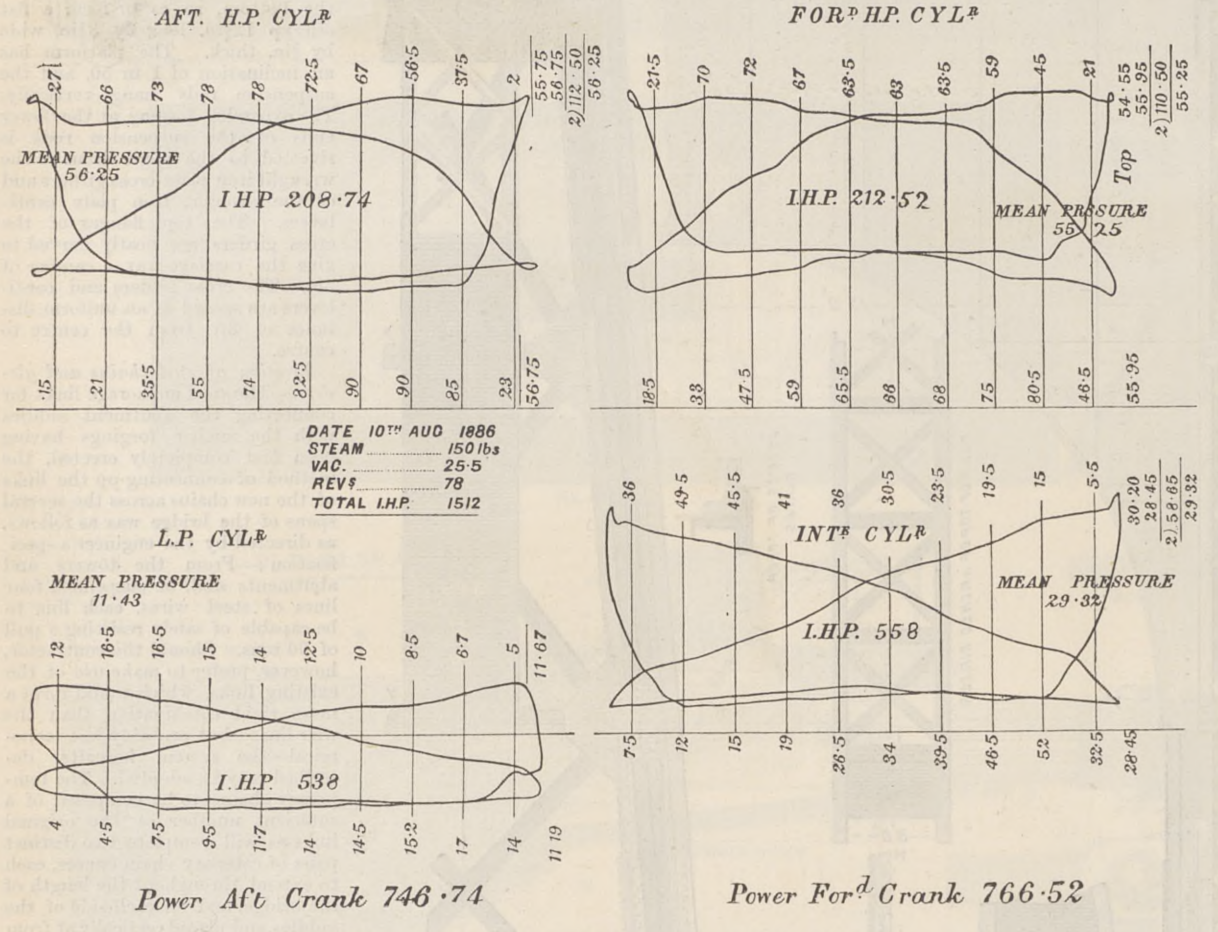
In order to effect their conversion to the triple expansion arrangement, the old cylinders were removed and four new ones were substituted, on the plan patented by Mr. Geo. Rodger, of Queen Victoria-street, whose system has been found in a number of instances to give most satisfactory results. The new cylinders—Figs. 1, 2, 3, and 4, page 397—are two high-pressure, each 17in. diameter, one intermediate, 38in. diameter, and one low pressure, 60in. diameter, the stroke of all being, of course, 42in., as before. One of the high-pressure cylinders is placed over the intermediate cylinder, and the other over the low-pressure cylinder, the piston-rods being prolonged upwards, as is usual in the tandem arrangement. The whole design, both in general arrangement and in detail, is clearly shown in the drawings which we publish, and for which we are indebted to Messrs. David Rollo and Son, of Liverpool, who carried out the work to the specification, and under the supervision of Mr. Geo. Hepburn, consulting engineer to the owners. On account of the small space occupied by the high-pressure cylinders, and from their position in the skylight, no alteration was required in any of the bunker or bulkheads, while at the same time every part of the engines is thoroughly accessible for examination and repair. No change was made in the propeller at the time of recompounding, but experience has shown that the surface of the blades may be increased with advantage, the power now being considerably greater than before the alteration of the machinery.

The subjoined table gives the mean results of the last seven voyages with the old, and first four voyages with the improved, arrangements; the figures being taken from the official logs:—

	7 last voyages before alteration.	4 first voyages after alteration.	difference.
Average speed per hour, knots ..	.. 10·428	.. 11·42	.. ·992 increase.
Average coal per day, tons ..	.. 22·82	.. 21·63	.. 1·19 decrease.
Distance run per ton of coal, knots ..	10·96	.. 12·67	.. 1·76 increase.

From these figures it will be seen that while the speed has been increased 9½ per cent., the coal has been reduced nearly 5 per cent. The distance through which one ton of coal will propel the loaded ship—and this, not mere indicated horse-power, is the test—has been increased 15½ per cent. It is to be noted that the vessel is now running regularly about one knot faster than before. This, according to the well-known laws, which require the horse-power to increase at least as the cube of the speed, calls for a very material increase in the quantity of coal consumed. Had the ship been driven at the old speed, the daily consumption of coal would have been 17 tons or under, and the saving would thus have been over 25 per cent.

Returning for a moment to the drawings, it will be observed that there are two high-pressure cylinders of equal diameters, and that steam at boiler pressure is admitted to both of these direct. Both exhaust in turn to the intermediate cylinder, whence the steam passes in the ordinary way to the low-pressure cylinder, and thence to the condenser. From this it will be seen that the conversion or "tripling" of a set of ordinary compound engines is a very simple matter when this method is adopted, as the shafting, valve gear, and all other working parts remain as before, excepting, of course, that the piston-rods and valve spindles are lengthened so as to enable them to be connected with the high-pressure pistons and valves. These last, being of similar dimensions, are interchangeable, which is a decided advantage in case of accident, or when spare gear is carried. All the stuffing-boxes are packed with Rodger's patent metallic packing, which has given excellent results in a large number of vessels. In the steamer first fitted in 1884 it has run over 100,000 miles without being repacked, and at the time of writing is still in position without alteration.



Mean Pressure Referred to L.P Cylr 32·304 lbs.

INDICATOR DIAGRAMS, S.S. MANAUENSE.

THE AMALGAMATED SOCIETY OF ENGINEERS.

The issue of the annual report of the Amalgamated Society of Engineers has this year been delayed about a month later than the usual period at which it is sent out. The chief cause of this has, no doubt, been the resignation of the late general secretary, Mr. John Burnett; and the introductory remarks which form the preface to the report on the present occasion afford further evidence that the hand which with so much ability has guided the operations of the Society since it lost by death the services of Mr. Allen, is now absent. Under the circumstances, when the office of general secretary is still in what may be termed a state of transition, it is perhaps scarcely to be expected that the report could be set forth with that comprehensive grasp of the whole situation which characterised the ably written addresses with which Mr. Burnett was in the habit of introducing his reports; and Mr. John Wilson, the general secretary, *pro tem.*, has wisely not attempted to travel much beyond a summary of the Society's operations during the past year, and its present membership and financial position. He gives, however, a number of facts which are sufficiently significant in themselves, and will be of interest to our readers. In compiling this, their thirty-sixth annual report, Mr. Wilson states that their feelings had been those of regret and satisfaction; regret at the heavy strain upon their reserve balance of income, and satisfaction to know that all their liabilities, heavy as they were, had been met, and left them at the end of the year with a reserve of £111,678. This balance, however, shows a decrease on the previous year of £7451, and it may be added that during the last ten years the decrease in the Society's reserve balance has amounted to no less a sum than £163,592. These are facts which of course may well cause feelings of regret, and the problem before the society, and which Mr. Wilson seems to recognise in some of his later remarks, is, how this ruinous drain upon their resources is to be effectively arrested. Mr. Wilson has, however, one cheering fact to chronicle; the Society is still increasing in members and branches. At the beginning of the year they started with 433 branches and 51,689 members, and at the close of 1886 they had 439 branches and 52,019 members, thus giving a gain of six branches and 330 members. With regard to their financial position, they had at the close of 1885 a reserve balance of £119,130, and at the close of December, 1886, £111,678, showing, as already stated, a decrease of £7451. Mr. Wilson points out, however, that this decrease occurred in the two first quarters of the year, the balance at the end of the June quarter standing as low as £104,811, so that during the September and December quarters their income had actually exceeded their expenditure by £6866, which saving was still going on up to date, and to all appearance would continue. The total income of the Society from all sources during the year had been £173,687, and the total expenditure £180,964, which was equal to £3 19s. 5¼d. per member. The chief items of their income had been contributions, fines, and levies, £166,638; entrances, £1898; and bank interest, £2842. With regard to expenditure, the chief item had again been in out-of-work and contingent benefit, which had absorbed the large sum of £86,460, equal to a cost of £1 17s. 11⅝d. per member, which was considerably in excess of the previous year, notwithstanding that this was regarded as an exceptionally heavy one, involving the outlay of £78,669 on the above benefits; but even the heavy expenditure of 1885 was less by £7791 than the demands which the Society had to meet in 1886. For sick benefit the expenditure during 1886 stood at £30,462, a slight decrease on the previous year, but superannuation benefit, which cost £33,951, again showed an increase. Funeral benefit cost £8881; accident benefit, £1450; and benevolent grants, £3361. The year 1886, Mr. Wilson points out, had been a costly one for the Society. It opened in gloom, and during its whole period taxed the judgment and temper of the Council in certain places to prevent strikes in resisting reductions in wages, and up to the present date the same policy had been pursued even in exercising caution, now when trade had slightly revived, in those districts where an advance in wages had been asked for. In dealing with matters outside the simple routine operations of the Society, Mr. Wilson takes occasion to question the soundness of the policy from a financial point of view of raising the reserve balance of the Society to £3 per member whenever it fell below this figure, which it is evident must now necessitate a considerable extra levy upon the members if the reserve balance is to be placed upon what has hitherto been regarded as its minimum basis, and he urges that this is a question which may very well be discussed at some delegate meeting. Referring to the depression in trade, he remarks that whether this was absence of orders from abroad or at home, the fact stood before them that it was somewhere, and it was for their special interest that the sooner the actual cause was discovered the better. The report of the Royal Commission appointed to inquire into the depression of trade, and which it might be confidently stated appeared to have been got up without the slightest tinge of class feeling, for ever disposed of the assumption that had been made against trades' unionists, and contained more solid and truthful information on trade and industrial questions than would be got from parties who were hired to write upon any particular view. In conclusion, he impresses upon the members the fact that the commercial, agricultural, and industrial conditions of the country are in a transitional state, and that therefore it is their duty to shape and harmonise their Society with such changes. Policies and practices that suited the condition of things fifty years ago would not do so now, and instead of clinging with a blind tenacity to traditions as a present rule of life, let them look upon them with a respectful veneration of what they had done and with whom they had been associated, but no more. If they would read wisely the signs of the times they would so remodel their Society where such was required as to give it growth and solidity, which would enable them to hand down to the next generation a greater inheritance than what had been bequeathed to themselves. There are many ways in which this concluding advice of the general secretary might be wisely carried out by the members of the Amalgamated Society of Engineers, which perhaps he does not contemplate, but which would nevertheless have beneficial results upon the conditions under which both capital and labour have at present to seek employment in this country.

TOO MUCH EDUCATION.

In an article on Science and Gunnery in *Nature* the author commences with some remarks on the effect of cramming with what is learned parrot-like from what teachers have learned before them. He says:—"In the last lecture which Prof. Tyndall delivered at the Royal Institution, he expressed a doubt as to whether extensive reading and study had not a tendency to hamper original genius, whether doctrines handed down for generations as articles of faith, which it would be heresy to dispute, had not materially checked the progress of science. Had he wished to illustrate his theory, he could not have had better examples than are to be found in the administration of our naval and military systems. It has been a reproach to us, as by far the greatest maritime nation of the world, that we have no School of Shipbuilding, that, until quite recently, naval officers have had no instruction except such as they could get in the practical execution of their duties, and no method existed of testing their knowledge except such rough-and-ready examinations as their superior officers could administer. Yet under these seeming disadvantages the Navy and the merchant service have kept in the forefront of progress, and have adopted all the newest discoveries of science, or of practical skill, as fast as they have been brought to light.

"On the other hand, the officers of Artillery and Engineers have long been considered as belonging to the scientific branches of the service; they have been regularly trained in schools in which theory and history have been taught, and the consequence seems to be that it is most difficult to make the departments with which they are connected move with the times. How else can it be explained that we have adhered to wrought iron as a material for guns, and to muzzle-loaders, long after nations esteemed semi-barbarous have used steel and constructed breech-loaders? or how can we explain the waste of millions in constructing fortifications of patterns long obsolete, and which show no more originality than that exhibited in using in some places iron instead of stone to resist the greater energy of modern projectiles? Not but that there have been many men both in the Artillery and Engineers who have seen the unfitness of what we have been doing, and have energetically protested against it, but they have not had force enough at the War-office to overcome the inertia due to the complacency derived from, perhaps, just pride in a profound knowledge of books. We do not, says our contemporary, go quite the length of Dr. Tyndall's opinions, though we admit that there is much truth in them; we recognise the difficulty of teaching in advance, if we may use the expression; but there can be no doubt that precedent and routine have much to answer for, and account for the reluctance of professors to admit that many of the old methods of fortification and artillery are as dead and useless as the matchlock or the old castle. Besides these considerations derived from experience of the services, we have the fact that most of the original inventions in the construction of guns and carriages have been the work of civil engineers and mechanics, who have been unhampered by precedent and unchecked by authority, and this circumstance must be our apology, as a non-professional paper, for devoting some space to a discussion of the present state of the science of fortification, especially with regard to our own coast defences."

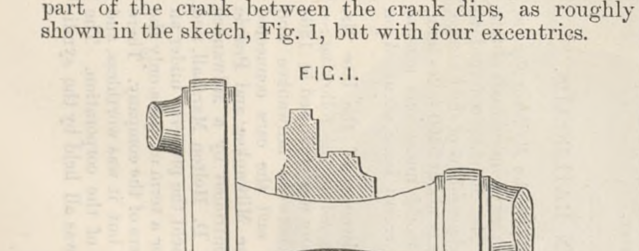
THE SALTAIRE EXHIBITION.

To complete the educational institutions of the modern and almost phenomenal community at Saltaire, a place which owes its origin and growth to the inventive and business capacity of the late Sir Titus Salt, schools of art were deemed necessary. The work of a school of art was carried on in the Salt Schools, founded and endowed by Sir Titus Salt in 1877, but in later years under difficulties through want of space, and the governors of the various bequests and endowments decided to build the art and science schools as a memorial to the late Sir Titus Salt, Bart. These schools were completed last year, and the Saltaire Exhibition was projected with a view to paying for them from expected profits. The Exhibition was, however, postponed until the present year, and was opened on the 6th inst. by Princess Beatrice and Prince Henry of Battenburg.

The buildings are entirely of a temporary character, and of wood, occupying four acres out of twelve acres devoted to the Exhibition. The main building is 475ft. in length, and from one side of this branch eight courts of 100ft., all being 50ft. in width. Outside these buildings are others, in which are the working dairy, nail-making and wool-combing by the old hand method. There are also buildings containing a fine loan collection of pictures, Japanese village, toboggan slide, refreshments, and one of Stewart's rapid cupolas, by Messrs. Thwaites Bros. The buildings are judiciously laid out, though the inequalities of the ground made this difficult. It would be difficult in the Saltaire Valley to find a level area big enough for a cricket-field of good size. In the office of the secretary, Mr. W. Fry, may be seen the method by which the disposition of the various buildings and stands was arranged—an operation sometimes occupying a good deal of time. Upon a large sheet, or a number of connected sheets of square ruled scale paper, the outline of the ground is first plotted, the position of the main gallery settled by reference to the best position for an entrance, and the general position of the main courts set out. Pieces of paper are then cut out of similar scale paper and of the size representing all except the largest of the spaces applied for. By pins these may be now moved from place to place on the plan until all are arranged within the area devoted to the buildings, and thus in the process of tentative arrangement no applicants for space can be overlooked, as they may be when the re-arrangements necessary to a final settlement are made by drawing in, rubbing out, and re-drawing the plans of arrangement with pencil. Moreover, the pieces representing the areas of stands, on which gas or water, or both, or steam, are required, may be coloured differently, and the final arrangement of all the exhibits thus greatly facilitated. Within the Exhibition are many objects and machines of much interest to engineers and mechanicians, though there are few novelties. Machinery of different kinds for the treatment of wool and manufacture of woollen and worsted fabrics occupy more space than any other class, and, on the whole, the collection may be said to be very varied, instructive, and interesting to the public generally, even when the art collections and many old acquaintances from the Colonial Exhibition, and amusements are not included.

The most striking object in the main gallery is a well-finished Midland passenger engine, from the designs of Mr. S. W. Johnson, Derby, and like the engine illustrated by a double-page engraving in THE ENGINEER, February 6th, 1885, a splendid engine, which seen from the ground level and mounted as it is on planed rails laid upon polished sleepers on the Exhibition floor, conveys an impression of the tremendous power and size of the modern express monsters, which does not seem to present itself in the ordinary way. The engine has cylinders 18in. diameter, 26in. stroke, and 7ft. coupled wheels. The boiler has a total of 1260 square feet of heating surface, 110 square feet in the fire-box and 1150 square feet in the tubes, and works at a pressure of 160 lb. The tender carries 3250 gallons of water, or 14·5 tons, and 4 tons of coal. The engine is No. 1757, and is named Beatrice. A crank is also shown with the cast iron excentric sheaves cast on by Mr. F. Holt's method, as adopted by Mr. Johnson. The excentrics have been cut through, and show how sound a job is made of them, though, of course, in the ordinary way there would be much tendency to blowing when making a comparatively small casting round a large piece of iron. There are several advantages, as well as economy, resulting from this method of casting excentrics whole on shafts, not the least of which is the strong form which is given to the part of the crank between the crank dips, as roughly shown in the sketch, Fig. 1, but with four excentrics.

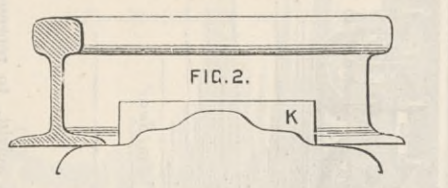
FIG. 1.



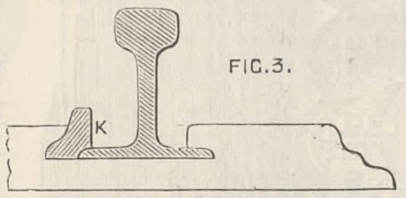
Near this engine is a sample collection of Howard's new sleepers, as made both for light and heavy standard gauge railways. For the larger sleepers the section is as roughly shown in the sketch at Figs. 2 and 3, the upward corrugation being cut through for permitting the rail to sit upon the main flat parts of the back of the sleeper. The corrugation is under-cut, so that the foot of the rail is held on one side and a wedge or key on the other, the outer edge of the key being corrugated, so that with the slight spring of the sleeper it is held tight.

Messrs. Perkins, Son, and Barrett make a fine display of pulleys, split pulleys, and shafting requirements, and Mackey's split pulleys are near by.

The Leeds Forge Company shows, amongst other fine pieces of pressed plate and tube work, a pressed flanged side frame for a North-Eastern Railway standard tender, horns and openings and edges being all flanged at one pressing by special presses now forming part of the plant

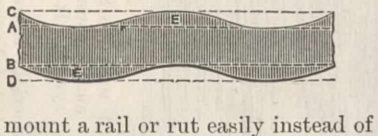


of this company. The company also exhibits Mr. W. Fox's wave line steel tire bars for cart and carriage wheels, the object being to make a tire which in effect has



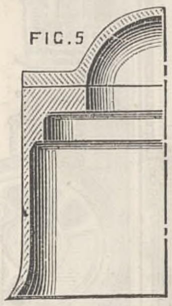
—as concerns freedom from entering the grooves of tramways and ease of getting out of ruts—a width much greater than the ordinary straight tire, with only a part of the extra weight. Thus an ordinary plain tire being of the width A B, Fig. 4, has its efficiency in a tramway town much increased by the wave line form which gives the tire in effect the width C D with a comparatively small increase of weight. The projecting parts E enable the wheel to mount a rail or rut easily instead of skidding along as the plain tire usually does.

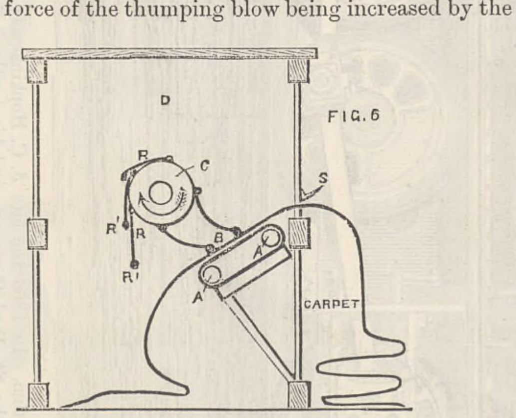
FIG. 4



The Bowling Iron Company shows large steel castings and cylinders, and heavy gearing, as well as forgings and furnaces; and the Lowmoor Company exhibits, with cranks, furnace rings, cranks and axles, a new wrought iron dome rolled to section from a thick-edged plate, as shown by the sketch Fig. 5. A carpet beating machine is shown by Messrs. Simon and Tullige; it is somewhat of the form shown in Fig. 6. It consists of a big-framed box D long enough to take an ordinary carpet in at the slot at S; through the centre of the box is a long barrel or roll C, upon which are fastened at intervals the light ropes R, to the ends of which are fastened the parallel ropes which act as thumpers, and are only seen in section at R' R'. At A A are two wood beams, to which are fastened spring boards B, on to which are stretched leather in strips. As the barrel C revolves in the direction shown by the arrow, the ropes fall over from the position of the one near the top, to that of the rope which has hit the carpet at B, the force of the thumping blow being increased by the

FIG. 5

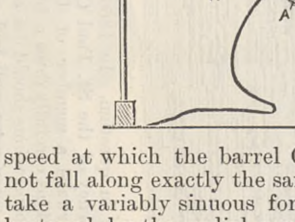




speed at which the barrel C is driven. The thumps do not fall along exactly the same line, because the ropes R' take a variably sinuous form as they fall over, and are hastened by the radial ropes R; and after the blow is delivered, the ropes R' slide down over the carpet. The machine is simple, and appears to be effectual without injuring the carpets.

A machine making cut tacks is shown at work by Mr. J. Grimshaw, upon whose stand is also shown samples of stamped goods, which he manufactures for loom and woollen machinery makers and users, many of which would be useful to makers of other machinery, but by whom they are made at from treble to tenfold the cost. The names of many of them are not much suggestive of their purpose. For instance, in Fig. 7 A is a "monkey joint," and B a cranked monkey joint; C is a pedal plate, and D and E are clasps. Let us hope the name reformer will not visit these northern Exhibitions much, or he will soon find a return southward good for his personal comfort. He would be puzzled to find that the piece which slides along two rods and gives motion to a shuttle is called a picker, and the lever with which motion is conveyed to the cord or lash that moves the picker, called the picking stick; while some springs are called either pickers or fallers, and others are known as a swell, or a pig's foot; one form of stud is called a pap, and screws have various names that are probably the right names, though they don't accord

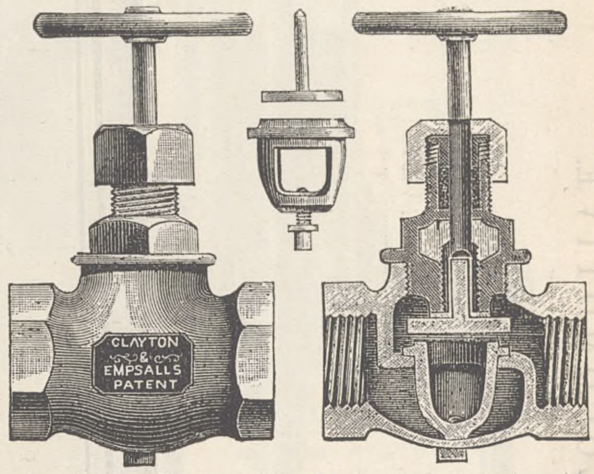
FIG. 7.



with uninitiated expectations. For instance, the thirsty reformer would be very wrath if, when he wanted a cork-screw, he was handed a thing very much like an ordinary wood or coach screw. These, however, are the names which would have to be used by anyone who, wanting any of the many forms of springs or other articles exhibited by Mr. W. B. White, of Colne.

Mr. John C. Willis exhibits, amongst other things, the

Fig. 8. Fig. 9.



valve which is illustrated by the annexed engravings, the special feature of which is the seat being removable and renewable without removing the case from its connections. The valve is shown in section in Fig. 9, and the seating is separately shown in between the two views of the valves.

PORTLAND CEMENT—TESTS AT LONG DATES.

By REGINALD EMPSON MIDDLETON, M. Inst. C.E.

THE accompanying data, derived from the breaking of some 200 briquettes at dates varying from the original seven days' test to 410 days, and from that to 2019 days after gauging, are offered very tentatively, especially as regards the deductions drawn from them, but may not be altogether without interest.

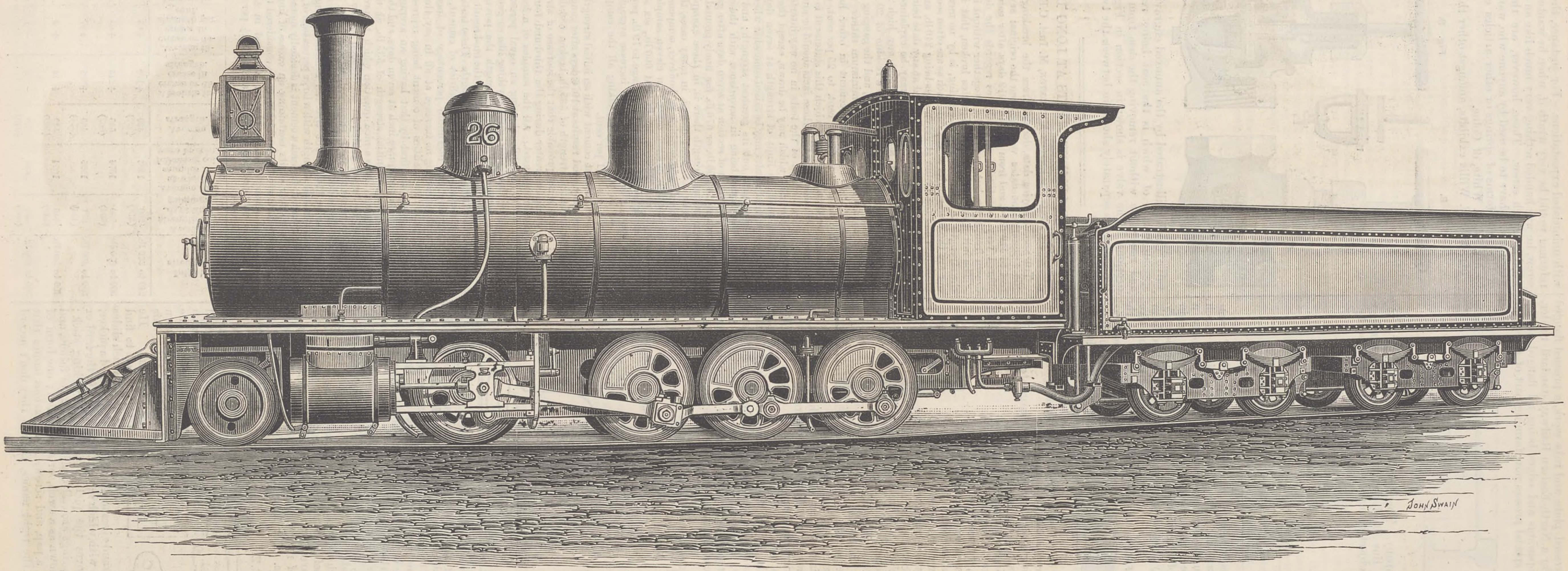
The initial strength of the briquettes broken, that is to say, the strength at seven days after gauging, is by no means high; nor are the final results at any date such as are often secured, the minimum and maximum at seven days being 240 lb. and 563 lb. respectively, the greatest test obtained at any date being 700 lb. per square inch of section; but this may be explained by the fact that the cement was not made to meet any high specification, the grinding was such as to leave a residue of 20 per cent. on a sieve of fifty meshes to the inch, and the gauging was done purposely so as to arrive at the minimum rather than the maximum result; and the same cement in other hands has always given tests from 20 per cent. to 25 per cent. or thereabouts, higher than those from which this statement is deduced. But though it is desirable that these facts should be understood, the comparative lowness of the tests in no way interferes with the general inferences which may be drawn, except that it may be considered that the limit of strength at seven days which gives the best final results may be raised somewhat when cement is tested so as to give out its greatest strength; and perhaps, instead of this figure being in accordance with these results, 538 lb. per square inch of section at seven days after gauging, it may be increased to 650 lb. or 670 lb. for finely ground cement. But with this initial strength there is, in these examples, little if any increase in cohesion; indeed, in many cases, there is a falling off in this respect—which is, however, compensated for by increased strength in some cases. In eleven samples whose initial strength was between 500 lb. and 600 lb., six showed a loss of strength amounting on the average to 79 lb. per sample, or 15 per cent.; while five showed an increase averaging 85 lb. per sample, or 16 per cent.; or, taking all the samples into consideration, a loss of 1 per cent.

It will be noticed that cement with an initial strength of only 350 lb. gives equally good results at 1076 days after gauging with that having an initial strength of 535 lb. broken 686 days after gauging; and it is not probable that the increase of strength of any cement would be greater during the third and fourth year after it was made and used. All the samples of a less initial strength than 300 lb. while showing an equal percentage of increase of strength, do not give anything like so good a final result; while above 350 lb. initial strength the percentage of increase falls off rapidly, so rapidly that the final result is not so good as that having a lower initial strength. These tests seem to point to the use of one of two qualities of cement, namely, either that giving the maximum percentage of increase in strength, or that showing no increase at all in say three years in each case, the two qualities of cement being represented in the above samples; the first by that having an average initial strength of 330 lb. per square inch at seven days, and the second by a cement having an initial strength of 535 lb. at the same date after gauging. It is a nice question which to prefer, and the user must be largely guided in his decision by the purpose for which the cement is to be employed, whether the material can wait for the added strength to accrue. If this be the case, there seems to be little doubt that the cement having a comparatively low initial strength with a large percentage of increase should be preferred, for such a cement is decidedly more reliable, and there is no fear of its containing an excess of lime. The figures in brackets are those which may be considered to represent the full strength of the cement if tested in the most advantageous way, and are found by adding 22½ per cent. to the original figures.

Initial strength.	Average strength at 7 days after gauging.	Average date at which samples in following col. were broken.	Average strength.	Absolute increase or decrease in strength.	Average increase or decrease in strength per cent.	Average increase or decrease in strength per c. per mensem.
240 to 300 lb.	260 (318)	1463	430 (527)	+170	+65	+1·33
300 to 350 lb	330 (404)	1076	545 (667)	+215	+65	+1·80
350 to 400 lb.	371 (454)	1595	469 (574)	+ 98	+27	+ ·51
400 to 500 lb.	446 (546)	1054	459 (562)	+ 13	+ 3	+ ·09
500 to 600 lb.	535 (655)	686	530 (649)	− 5	− 1	− ·04

MANCHESTER EXHIBITION—CONSOLIDATION NARROW GAUGE LOCOMOTIVE.

MESSRS. SHARP STEWART, AND CO. ATLAS WORKS, MANCHESTER, ENGINEERS.



NARROW GAUGE LOCOMOTIVE.

WE illustrate above the metre-gauge colonial engine exhibited by Messrs. Sharp, Stewart, and Co., at Manchester, already described on page 350. The cylinders are 15¼in. diameter, 18in. stroke. The driving wheels are 3ft. in diameter. The total weight 27¾ tons. The smoke-box is extended to act as a spark arrester.

THE FINANCE OF AMERICAN RAILROADS.

THE following extract from an American paper, the *Railway Review*, throws some light on the method by which cliques or individuals obtain control of vast systems of railroads. The Mr. Mitchell referred to was for many years a banker at Milwaukee, and president of the Chicago, Milwaukee, and St. Paul Railroad. This line is about 5300 miles long, and is said to be the longest railway in the world under one general manager. The Rio accident, referred to in a recent issue, occurred on this line.

"From the numerous stories and reminiscences of the late Mr. Alexander Mitchell, now floating about, we select the following:—The Milwaukee and St. Paul Railway Company was organised in 1864 or 1865, but included only broken lines between Milwaukee and La Crosse. These breaks were soon filled, and the cars connected at La Crosse with boats for St. Paul. The Milwaukee and Prairie du Chien Railroad was a separate affair, controlled by a Milwaukee syndicate composed of E. H. Brodhead, E. D. Holton Marshall, and Ilsley, and some smaller capitalists. They held the property under an act of incorporation, which provided that for a term of years only the owners of preferred stock should vote for officers of the company. There was a vast mass of the common stock out, but it was worthless, and its holders had no voice in the management of the corporation. The preferred stock was small in amount, and was all held by the syndicate in question. In 1866 the late J. C. Hopkins was the Madison attorney of the St. Paul Company, and his brother, B. F. Hopkins, afterward a member of Congress, was in the Legislature. J. C. Hopkins carefully drew a bill providing that all classes of stockholders in corporations should be entitled to vote for directors for the same. The ropes were well laid. B. F. Hopkins introduced the bill, moved that it be not printed, and said that it was 'purely local' in its character, and was intended to facilitate the operations of the Madison Gas Company (of which he was the owner), or perhaps 'other corporations which needed the relief provided in the bill.' He asked to have the rules suspended, which was conceded, and the bill passed. It went through the other House in the same disguise, was rapidly enrolled, and was signed by Governor Fairchild without examination all in less than three-quarters of an hour after it was introduced. By proper care the new law did not get into print till after the Legislature had adjourned.

"No attention was paid to it till June, when the annual election of the Prairie du Chien Company was called to be held at Marshall and Ilsley's bank. At the hour named for the meeting the few holders of preferred stock were surprised to see Mitchell, S. S. Merrill, and other St. Paul men enter, but had no suspicion of the object for which they came. Mitchell had a copy of the session laws under his arm, and remarked in a pleasant voice that they had 'come in to see how their friends managed a railroad election,' or something of the kind. This pretext was as pleasantly accepted, and the election proceeded. After the preferred fellows had voted, and when it was announced that the polls were about to close, Mr. Mitchell advanced and offered to vote on two or three millions of common stock. Merrill did the same, and the others followed. They were sharply informed that the common stock 'could not vote.' 'I think ye haven't read the law,' said Mitchell, opening the volume which he held at the 'common stock' chapter above described. It was decisive. Mitchell and his associates elected themselves directors of the Prairie du Chien Company, and it was soon afterwards consolidated with the St. Paul. With the Prairie du Chien followed the Iowa and Minnesota lines, which form so important a part of the St. Paul system. It was the shrewdest railroad *coup* ever made in the West."

It will be noticed as significant that our American contemporary speaks approvingly of the affair as being a piece of Yankee smartness, and fails to perceive any deviation from honourable conduct in the transaction. Investors in American securities should make a note of this.

TRIAL OF THE FASTEST TORPEDO BOAT IN HER MAJESTY'S NAVY.

MESSRS. YARROW AND CO., of Poplar, have just completed for the British Government a torpedo boat of the Falke type, which is the largest, and has proved itself the fastest torpedo boat in the Navy. The official trial took place last week with the following results:—

	Steam.	Vacuum.	Revs. per min.	Time on knot.	Speed.	Means.	2nd Means.
	lbs.	in.			Knots per hour.	Knots per hour.	Knots per hour.
1	160	26	380⅔	2-31	23·841		
						22·896	
2	160	26	383	2-44	21·951		22·896
						22·896	
3	160	26	381½	2-31	23·841		22·963
						23·031	
4	160	26	381⅘	2-42	22·222		22·992
						22·953	
5	160	26	380½	2-32	23·684		23·057
						23·162	
6	160	26	384½	2-39	22·641		
Means.	160	26	382½				22·977

The above speed of 22·977 knots is the mean of two hours' continuous run, loaded with over 15 tons weight, to represent armament, fuel, &c., and the contract stipulated speed was 22 knots. After the trial for speed, experiments were made to test the turning power of the boat, and it was found that a circle to port was made in 65 seconds, and to starboard in 60 seconds, the size of the circles being 110 yards and 90 yards in diameter respectively.

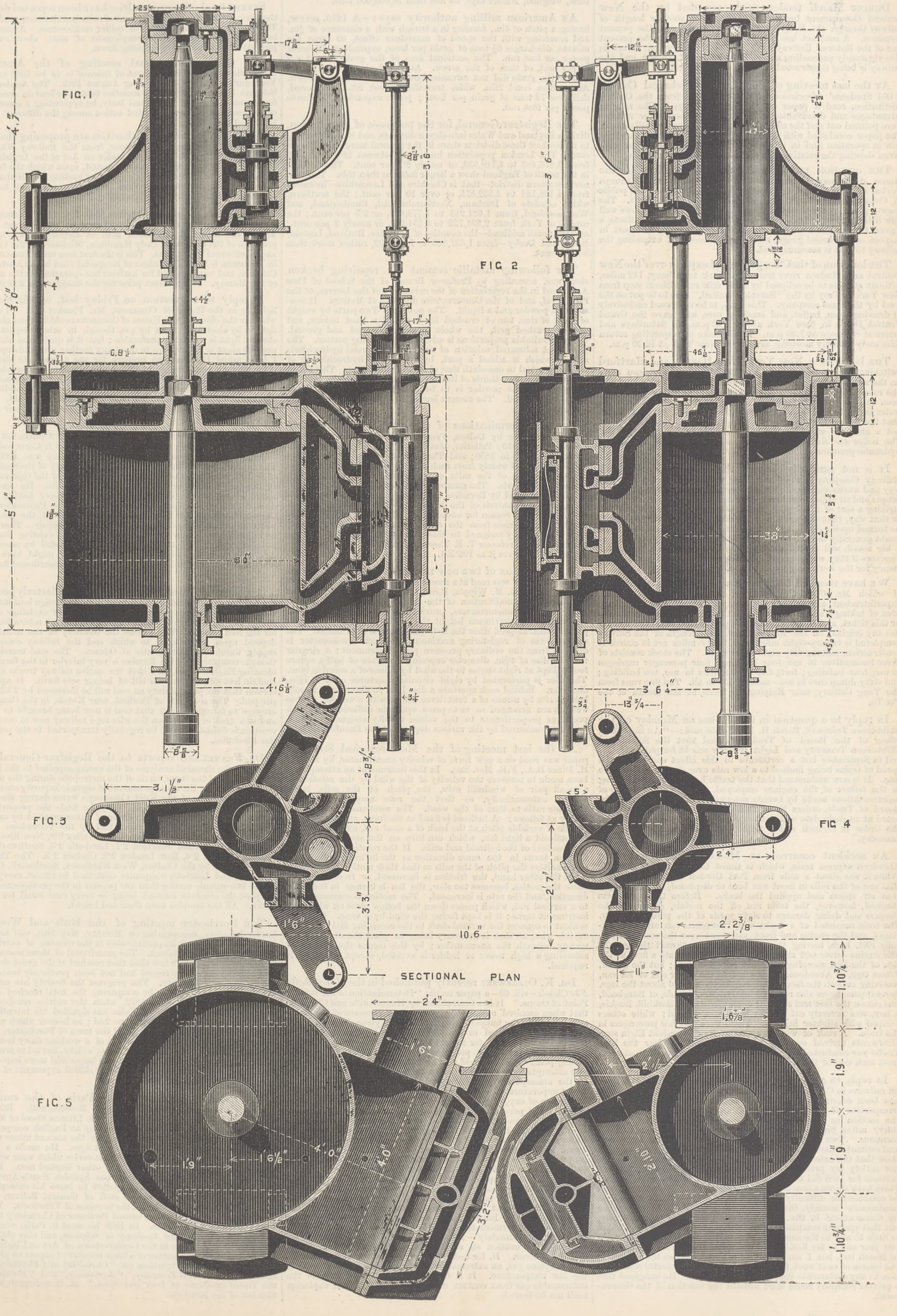
The dimensions of the boat are 135ft. in length by 14ft. beam, and it is to be noted that the construction of the hull is far stronger than is customary in boats of this class. The boiler is fitted with Yarrow's patent arrangement, by which means, if the stokehole is damaged by shot or collision, and water gains access to the compartment, the air supply shall not be cut off; and consequently the boat retains its steaming capabilities for a considerable time. This system is considered of great importance by naval authorities, as otherwise in case of damage to the large compartment in which the boiler is placed and water finding its way in, the steaming power of the boat would be almost instantly crippled, and the boat would become powerless. This torpedo boat differs from the smaller ones, of which a great number have been constructed, in regard to the armament, there being only one bow tube, which is placed under a turtle back, and two revolving torpedo guns aft.

The steersman is well elevated above the water-line, and gets a good all-round view, the steering-tower being placed at the after end of the turtle back, which is a form of construction first introduced by Messrs. Yarrow and Co., in the torpedo boat Batoum, built many years since for the Russian Government. The engines are on the triple expansion principle, supplied with steam from a single boiler. The machinery throughout the trial worked to the perfect satisfaction of the Admiralty inspectors, and the speed abovenamed was obtained with the engines partly linked up, so that it will be seen there was still a reserve of power, and during the preliminary runs of this boat in its loaded condition a speed of over 24 knots was obtained.

COMPOUND ENGINES, S.S. MANAUENSE.—DETAILS.

MESSRS. ROLLO AND SONS, LIVERPOOL, ENGINEERS.

(*For description see page 394.*)



RAILWAY MATTERS.

FOR the four months of the current year there is a total decrease of 23,000 tons in the quantity of coal brought into London by rail and canal, but there is an increase of 903 tons in the quantity brought by sea in that period.

DURING March tenders were accepted by the New Zealand Government for the construction of another length of railway through the King Country from Otorohanga, the present terminus. A contract has also been let to continue the present line of the Rotorua Railway from Lichfield to Ngatira. Work is also vigorously proceeding at the Rotorua end of the line, and the railway is being constructed from the Lake to Ngatira.

AT the last meeting of the Finsbury Technical College "Old Students' Association" Mr. John Rance, from the Central Institution, read a paper on "Electric Railways." The relative advantages and disadvantages of battery and conductor systems were pointed out and the efficiency of reversible batteries discussed. The paper concluded with a short description of the various lines now in operation and in process of construction, and tables were given showing the relative cost of electric and horse traction.

THE question put by Sir Roper Lethbridge, in the House of Commons, some time back, relative to the Nanuoya Ceylon Railway extension, has attracted the attention of the public in Colombo, and few, if any, were surprised at the result. The answer given by Sir Henry Holland, it is remarked, "shows well how little a change in the office of Secretary of State affects a Crown Colony like Ceylon." As the people are out of heart in respect of the broad gauge, some cheaper mode of extending the railway to Uva is recommended.

THE long run of the Chicago limited express over the New Central and Hudson river from New York to Albany, 142 miles, without stop, is to be eclipsed by a 148 mile run without stop from New York to Troy by the "Saratoga limited," soon to be put on the road by the same company. This train, to be composed exclusively of drawing-room, buffet, and smoking cars, will leave the Grand Central Depôt in New York about 2.50 p.m. on Saturdays and arrive at Saratoga at 7.30 p.m. It will make corresponding return time early Monday morning, arriving at New York at 12.30 p.m.

THE boiler of a New York, New Haven, and Hartford switching engine exploded in the Belle Dock roundhouse early on the morning of the 3rd inst. Seven men were badly hurt and the roundhouse was wrecked. The explosion is supposed to have been caused by the carelessness of the engineer in allowing the water in his boiler to get too low. The fireman, however, states that there were four gauges—they apparently use gauge cocks and not a glass—of water in the boiler shortly before the explosion. The boiler was six years old, and had been recently tested by a hydraulic pressure of 170 lb. per square inch.

IT is not generally known that the Great Western Railway Company is wriggling along without a chief permanent way and works engineer. The directors hear the notions of various people and sit in judgment on many important questions, and, after striking a sort of average, vote that work shall be carried out this or that way, that sleepers are or are not required, that they should be turned upside down, or that structures are safe or unsafe, no doubt generally safe. It may be hoped that nothing in the way of a big smash will occur, because it would be rather hard on the directors if they were convicted of negligence and culpable inefficiency for the work they took in hand.

WE have received from the Kaiping Railway Company, of which Mr. Claude W. Kinder, M.I.C.E., is engineer and superintendent, a pass over the Company's line. We have some idea of taking a special excursion to China, with a view to the use of this ticket, and to see whether the pretty view engraved upon it has any original on the Kaiping line. The length of the railway completed is twenty-eight miles, and thirty miles are in course of construction, making fifty-eight miles in all. The stock consists of three locomotives in use, four building; four passenger carriages in use, four building; forty-five 10-ton cars in use, ten building; and sixty dump cars in use—making 135 in all. The line runs from the Tong Colliery, near Kaiping, to Taku, at the mouth of the Pei To.

IN reply to a question in the House on Monday on the Skibbereen Tramway, Baron H. De Worms said:—"An inspecting officer of the Board of Trade reported that the Schull and Skibbereen Tramway and Light Railway was fit for public traffic, and in September last a certificate to this effect was issued, the speed of trains being limited to a low rate over certain parts of the line. It is now understood that the traffic has been stopped owing to the failure of the engines employed. But in consequence of representations made by twenty ratepayers of the district to the Board of Trade, orders have been given that an inquiry shall be heard at an early date under the provisions of the 45th section of the Order in Council which authorised the construction of the tramway."

AN accident occurred on Monday afternoon to the Aberdeen express train, which is timed to pass Buckie at 12.25. When it was about a mile from Port Gordon the driver noticed that one of the rails in front was bent or displaced, and he at once shut off steam and applied the brake. Before the speed was checked, however, the train ran off the metals, shattering the sleepers and doing damage to sixty yards of the permanent way. The train consisted of a brake van, Post-office van, and two carriages, and the engine and front van went over the embankment, fully 10ft. high, leaving the other carriages athwart the metals. The engine driver and stoker were precipitated into a field at the side of the line, escaping with but slight bruises; but the guard, James Ogg, of Aberdeen, was dashed to the other end of his van, receiving cuts on the face and being badly bruised about the legs. Several passengers also received injury. Mrs. Rennie, of Burghead, was cut on the face and shaken; John Christie, of Barkhill, Buckie, a boy, was severely cut on the back of the head; while others escaped with slighter injuries. There were but few passengers in the train. A staff of workmen under Superintendent Elgin soon afterwards arrived on the scene and began to clear the line. Traffic was conducted by trains which exchanged their passengers from each side of the wrecked express.

IN reply to a question in the House on the 13th inst. on railways in Ceylon, Sir H. Holland said: "The line to Nannaya has been constructed, but it was sanctioned by the Government irrespective of any further extension. In the event, however, of the section to Nannaya justifying expectations, Badulla, some thirty miles beyond Haputale, was looked to as the ultimate terminus. Two successive Governors recommended the extension, and estimates have been furnished from time to time purporting to show that the extension would be profitable, but the data given did not satisfy my predecessors. In the face of the fact that the revenue for 1886 did not reach the estimate, and that the last few years have shown a constantly growing burden of debt, there would be considerable difficulty in varying the decision of my immediate predecessor—namely, that the extension could not be undertaken by Government in the present financial condition of the colony, but that a private company would be at liberty to take it up. There is little to add to the answers given to the hon. member in April last year and to my hon. friend the member for North Kensington in March last, but I am to receive a deputation on the subject in the course of next week and shall, of course, give careful consideration to any statements they bring before me." He imagined that a private company could start without the sanction of the Government.

NOTES AND MEMORANDA.

A GERMAN mathematician has, from certain measurements effected, calculated that the quantity of snow which fell in Central Germany from December 19th to 23rd, between 50 deg. and 52·5 deg. N. latitude and between 7 deg. and 18 deg. E. longitude, weighed, *Nature* says, no less than 10,000,000 tons.

AN American milling authority says:—A 12in. screw, having a pitch of 4in., turning in a trough with a clearance of ¼in. and revolving with the speed of maximum effect, 60 turns per minute, discharges 6¼ tons of grain per hour, expending ·04-horse power per foot run. The sectional area of the grain moved was 49 per cent. of that of the screw. At speed above 60 turns per minute the grain did not advance, but revolved with the screw. An endless band 28in. wide, travelling about 9ft. per second, delivered 70 tons of grain per hour; power expended, ·014-horse power per foot run.

THE Registrar-General, for the purposes of registration, divides England and Wales into eleven districts, and it is interesting to notice how these districts share in the general increase of 7·3 per cent. The London population increased between 1881 and 1886 from 3,816,483 to 4,149,533, or nearly 8·7 per cent. The districts in the north of England show a larger increase than this. Thus the north-western district—that is Cheshire and Lancashire—increases from 4,108,184 to 4,532,875, or over 10 per cent.; the northern, which consists of Durham, Northumberland, Cumberland, and Westmoreland, from 1,624,213 to 1,778,028, or 9·5 per cent.; the county of York from 2,894,759 to 3,154,349, or nearly 9 per cent.; and the north midland—the counties of Leicester, Rutland, Lincoln, Notts, and Derby—from 1,637,865 to 1,771,093, rather more than 8·1 per cent.

THE following metallic cement for repairing broken stone was, according to Professor Brune, of the School of Fine Arts, used in the restoration of the colonnade of the Louvre, of the Pont Neuf, and of the Conservatoire des Arts et Metiers. It consists of a powder and a liquid. The powder.—Two parts by weight of oxide of zinc, two of crushed limestone of a hard nature, and one of crushed grit, the whole intimately mixed and ground. Ochre in suitable proportions is added as a colouring matter. The liquid.—A saturated solution of zinc in commercial hydrochloric acid, to which is added a part, by weight, of hydrochlorate of ammonia equal to one-sixth that of the dissolved zinc. This liquid is diluted with two-thirds of its bulk of water. To use the cement, one pound of the powder is to be mixed with two and one-half pints of the liquid. The cement hardens very quickly, and is very strong.

FORMER determinations of the atomic weight of gold have been made by Dalton, Proust, and Oberkampf, in 1806; Berzelius, in 1813; Pelletier, Javal, and again by Berzelius, in 1844; by Levol, in 1850; and Thomsen, in 1876. The numbers obtained differed widely from each other, partly owing to the unstable character of the salts of gold, and partly to imperfect methods of analysis. The number usually accepted is 196·2, being the value obtained by Berzelius in his second series of determinations, from the analysis of the double chloride of gold and potassium. A special reason for undertaking a revision of the atomic weight of gold arises from the circumstance that a higher value than that usually assigned to this element is demanded by the periodic law. Professor T. E. Thorpe, F.R.S,, has made the determination, and gives it as 196·594.

A DESCRIPTION of two new maximum pressure registering anemometers was read at a recent meeting of the Meteorological Society by Mr. G. M. Wipple, B.Sc., F.R. Met. Soc. The simplest instrument is a modification of the Lind's, Hageman's, or Pitot's water pressure anemometers, provided with an apparatus for registering the maximum height the water attained during the period which elapsed since the last setting of the instrument. The second form of registering maximum pressure anemometer is derived from the ordinary pressure plate instrument; a circular metallic disc of 9⅝in. diameter exposing a surface of half a square foot is kept at right angles to the wind by means of a suitable vane. This disc is perforated by eight circular apertures each of 1⅝in. diameter. Behind each aperture a disc 1¾in. in diameter is loosely held *in situ* by means of a bent lever loaded with a weight. These weights are arranged so as to press upon the different discs with pressures proportionate to the values usually assigned to wind pressures measured by the various degrees of the Beaufort scale.

AT the last meeting of the Meteorological Society a paper was read on a new form of velocity anemometer, by Mr. W. H. Dines B.A., F.R. Met. Soc. In this instrument an attempt has been made to measure the velocity of the wind by the rotation of a small pair of windmill sails, the pitch of the sails, being altered automatically, so that the rate may always bear the same ratio to that of the wind. The mechanical details are briefly as follows:—A helicoid is fixed at the front, and a small pair of sails of variable pitch at the back of a steel rod, and just behind the helicoid a light fan, which can turn on the same axis, but is independent of the helicoid and sails. If the rotation be too rapid the fan turns in the same direction as the helicoid, and by its motion alters the pitch of the sails so that their motion is retarded; if, on the other hand, the friction is increased, or from any other cause the motion becomes too slow, the fan is turned in the other direction, and the rate is increased. The motion is communicated to a vertical rod, which passes down the hollow pivot on which the instrument turns; it is kept facing the wind by a vane. It is convenient to connect the vertical shaft to the recording dial by a light flexible wire, all that is necessary being to place the dial approximately beneath the anemometer; by this means the trouble of ascending a high tower or ladder is avoided, except where oil is required.

DR. K. OLSZEWSKI recently published in the *Monatshefte Für Chemie*—viii. 69—a paper on the "Determination of the Boiling Point of Ozone." It has been shown by Hautefeuille and Chappuis that when ozonised oxygen is exposed to a pressure of 125 atmospheres and to the temperature of boiling ethylene (−102·5 deg.), the ozone is obtained in the form of a dark blue liquid which retains the liquid form for a short time at the above temperature, after the removal of the pressure. It seemed therefore that the boiling point of ozone could not be much below that of ethylene, and attempts were therefore made by Olszewski to liquefy ozone at the atmospheric pressure merely by the application of cold. At a temperature of − 150 deg. no liquid was obtained, the large proportion of oxygen present probably hindering the condensation of the small percentage of ozone. When a lower temperature (−181·4 deg.) was employed—that of boiling oxygen—the ozone readily condensed to a dark blue liquid. At this temperature it is transparent in very thin layers, but is almost opaque in layers 2 mm. thick. In order to determine its boiling point, the tube containing it was introduced into a vessel containing liquid ethylene cooled to about −140 deg. The ozone still retained the liquid form, and only began to vaporise when the temperature of the ethylene had risen to near its boiling point. The temperature of the ethylene was determined by means of a carbon bisulphide thermometer, which at the moment of incipient ebullition of the ozone indicated a temperature of −109 deg., this corresponding to − 106 deg. of the hydrogen thermometer. The boiling point of pure ozone is therefore approximately −106 deg. Experiments with liquid ozone require great caution on account of the readiness with which explosions occur. If, for instance, liquid ozone comes into contact with ethylene gas, an extremely violent explosion occurs in spite of the low temperature. It is therefore necessary to exclude the inflammable gas from contact with the ozone, and then explosion need not be feared.

MISCELLANEA.

THE authorities of Swansea are acting the wise part. After an effort to get the Government to give a harbour of refuge, they are going to make one themselves. The Mumbles is to be the point chosen.

SEVERE fatal colliery casualties have been reported during the week. One case of infringement of rules has also been punished. This was another illustration of collier recklessness. A cage was being lowered with its full complement of men, when another jumped in and insisted upon going down.

THE thirty-sixth annual meeting of the American Association for the Advancement of Science is to be held in New York during the week beginning August 10th. The Academy of Sciences has among the local societies taken the lead in arranging for the reception of the national body, by appointing a committee of conference to secure concerted action among the different institutions of the city.

THE Jamaica Harbour authorities are proposing that the whole foreshore of Kingston harbour, from the Railway Wharf to East-street, should be bought up under an Act of the Legislature, and a sea-wall, in deep water, constructed, upon which the freight trains could run alongside the shipping for loading and discharging cargoes. Harbour facilities are absolutely necessary to any improvement in the trade of the country.

THE steam dredger constructed for the Tasmanian Government by Messrs. Kennedy and Sons, of the Derwent Ironworks, was launched on March 26th at Battery Point, in the presence of the Governor, Lady Hamilton, Ministers of the Crown, and Members of Parliament. This is the first iron vessel constructed in Tasmania, is the only dredger of its special kind in the Australian Colonies, and was designed for harbour bar operations at the mouth of the Mersey. The contract price for the dredger was £11,000.

IN reply to a question on Friday last, on the electric lighting in the House of Commons, Mr. Plunket said, "I doubt whether the offices of the House of Commons could be more cheaply lighted by electricity than by gas, though in other respects the electric light is certainly preferable; but it is quite true that the present plant is inadequate to meet any further demands upon it. I have asked Dr. Percy to prepare for me a complete plan and estimate for a considerably increased plan for lighting the whole of the Palace with electricity, on the chance that I may some day find the House in a sufficiently generous mood to vote the additional expense; but small additions from time to time would, I am advised, be very expensive and I could not recommend their adoption."

IN reply to a question in the House of Commons last Friday on the floating iron dock at Bombay, Sir J. Gorst said the original cost of the iron floating dock at Bombay was £307,000. The expenditure was incurred in 1868 by authority of the Secretary of State for India in Council, and by the advice of the Government of Bombay backed by the Government of India. He was not aware of any of the ships of her Majesty's Navy having been docked there. The dock had been leased to the Peninsular and Oriental Company for five years at a nominal rent, the company being under the obligation to keep it in proper repair. There was no information to show that the enlargement of existing docks in the Government yard at Bombay, as recommended by successive Admirals in command of the Indian station, might have been carried out at one-third of the cost of the afore-mentioned floating dock.

ACCORDING to Russian accounts, there has latterly been an extraordinary falling off in the importation of foreign coal into the country. The reasons given are the low course of exchange of the rouble and high freights, caused by there beng no return loading for the coal vessels. This causes the industry of the country to depend upon native coal, to which end the railway companies supply warehouse room gratis at Odessa. The coal merchants, though, complain that the Russian is very inferior to the foreign—meaning English—coal, and that the native railway trucks always contain less weight than the bill of lading sets forth. It appears certain that the present duty on coal will be increased by 2 kopecks per pud. The coal beds of Tkwibul, near Kutais, in the Caucasus, are now so far opened out that coal is now being brought to bank, and in a week or two, when the wire rope railway now in course of erection is finished, it will be regularly transported to the ports on the Black Sea.

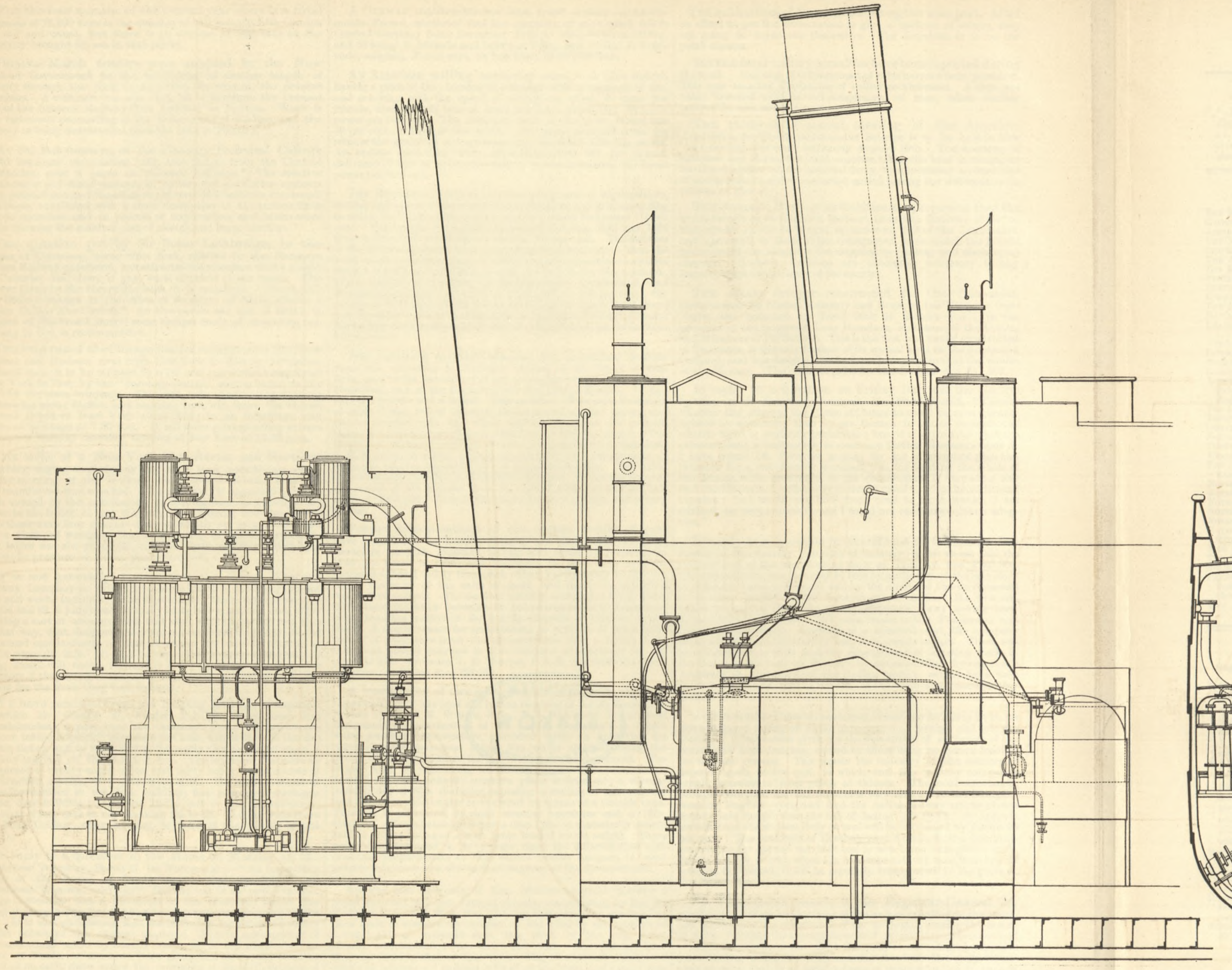
DR. FRANKLAND reports to the Registrar-General the results of the chemical analyses of the waters supplied to the inner, and portions of the outer, circle of the metropolis during the month of April. Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, he finds the proportional amount contained in an equal volume of water supplied by each of the metropolitan water companies, and by the Tottenham Local Board of Health was:—Kent 0·5, Colne Valley 0·9, New River 0·9, Tottenham 1·5, Grand Junction 2·1, Lambeth 2·3, Southwark 2·4, West Middlesex 2·4, East London 2·5, Chelsea 2·5. The Thames water sent out by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth companies contained in almost every case rather less organic matter than was present in the previous month's samples, the absolute amount being in every case small for river water. All the samples were clear and bright.

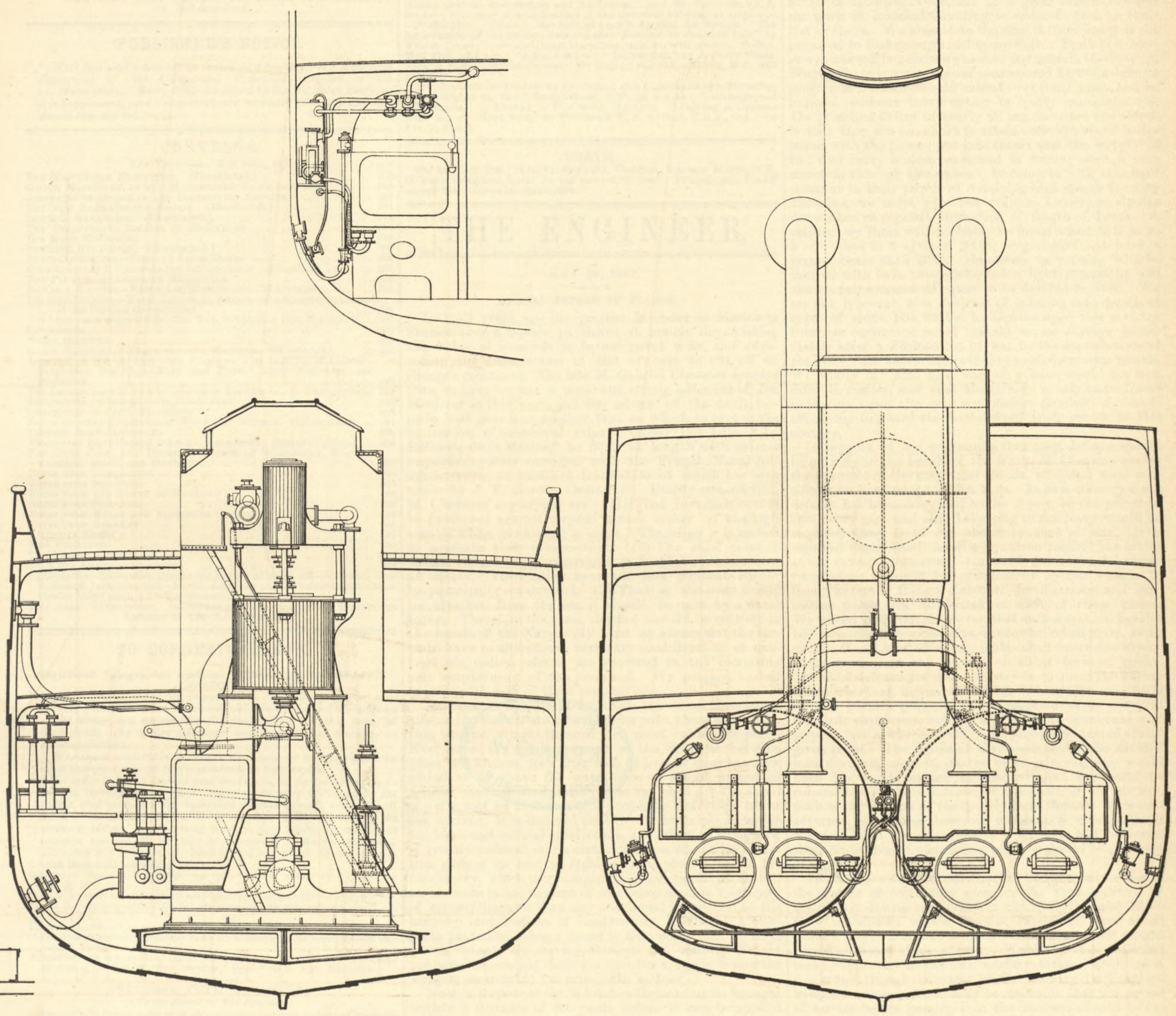
THE Dorchester meeting of the Bath and West of England Society, commencing on Monday, May 30th, will be surpassed by only one of its predecessors in the number of entries of live stock and dairy produce. The grand total of these mounts up to 1538, which is but 79 less than that reached at the great show at Bristol last year, whose record had not been previously beaten in the history of the Society. The progress the Society has made is evidenced in some degree by comparing the total reached at its last visit to Dorchester, in 1872, when the entries reached the figure of 1121. The Prince of Wales has signified his intention of visiting the show on Thursday, June 2nd; an honour which will be appreciated alike by the Society and the town of Dorchester. The success which attended the exhibition of a working dairy last year at the Bath and West of England Society's Show, has led to arrangements being made for one this year on a larger and more important scale. The services of some of the most skilful exponents of dairy operations have been secured.

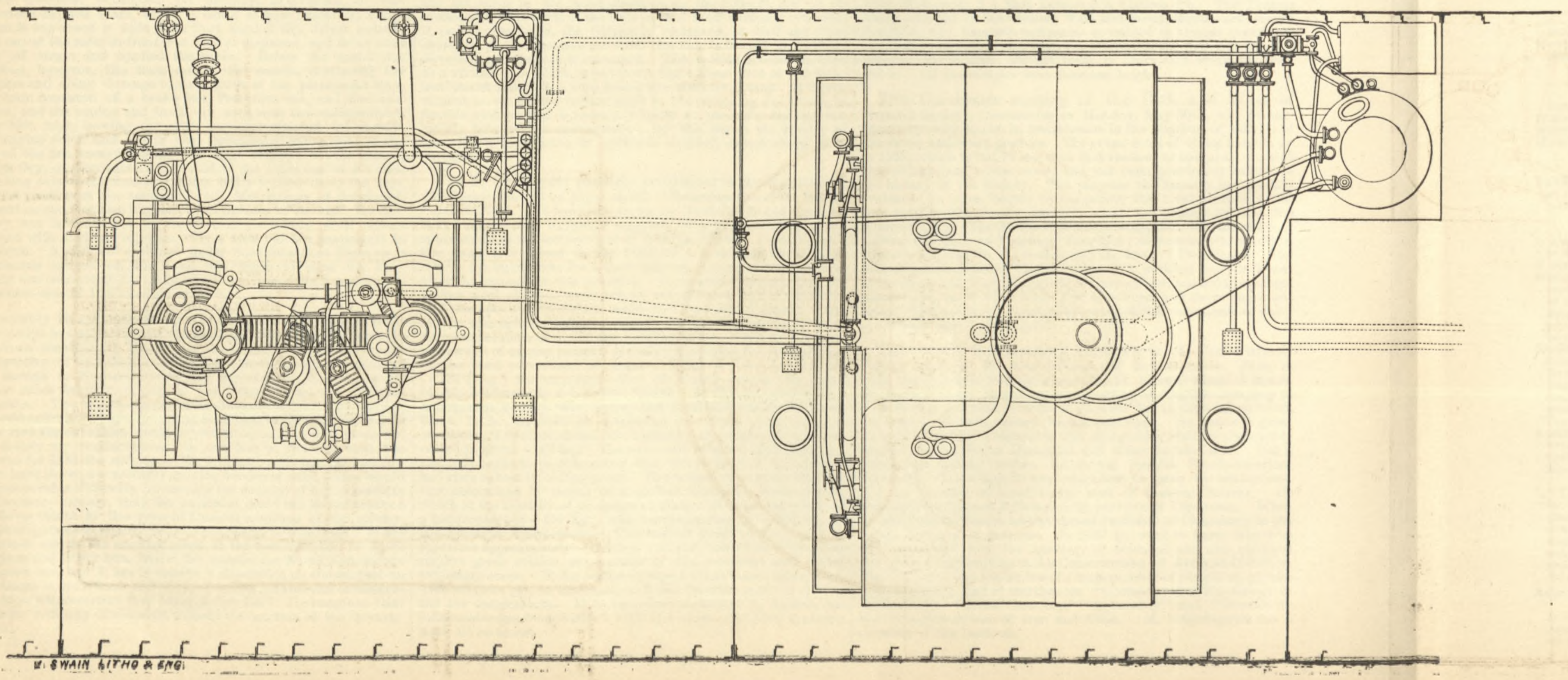
THE death is announced from Paris of the eminent French chemist, M. Joseph-Dieudonné Boussingault. Born in 1802, the deceased was educated at the St. Etienne Shool of Mines. On leaving there he was commissioned by an English company to go to South America in order to discover the ancient mines which are known to have existed there in past ages. He made a great number of valuable researches and discoveries which were warmly appreciated by Baron Humboldt and other learned men. But a revolution having broken out in the Spanish South-American colonies M. Boussingault was compelled to leave his enterprises, and he became attached to the staff of General Bolivar. He thoroughly explored Bolivia and the province of Venezuela. When he returned to France he was named Professor of Chemistry to the Lyons Faculty of Sciences. In 1839 he went to Paris, where he was associated with the Academy of Sciences, and also obtained the chair of agriculture in the Conservatoire of Art and Industry. The deceased was the author of a large number of papers on physics and chemistry, and of treatises on "Chemistry and Physiology in Agriculture," "Rural Economy," "Agronomy," and "Studies on the Transformations of Iron and Steel." M. Boussingault was a member of the Institute.

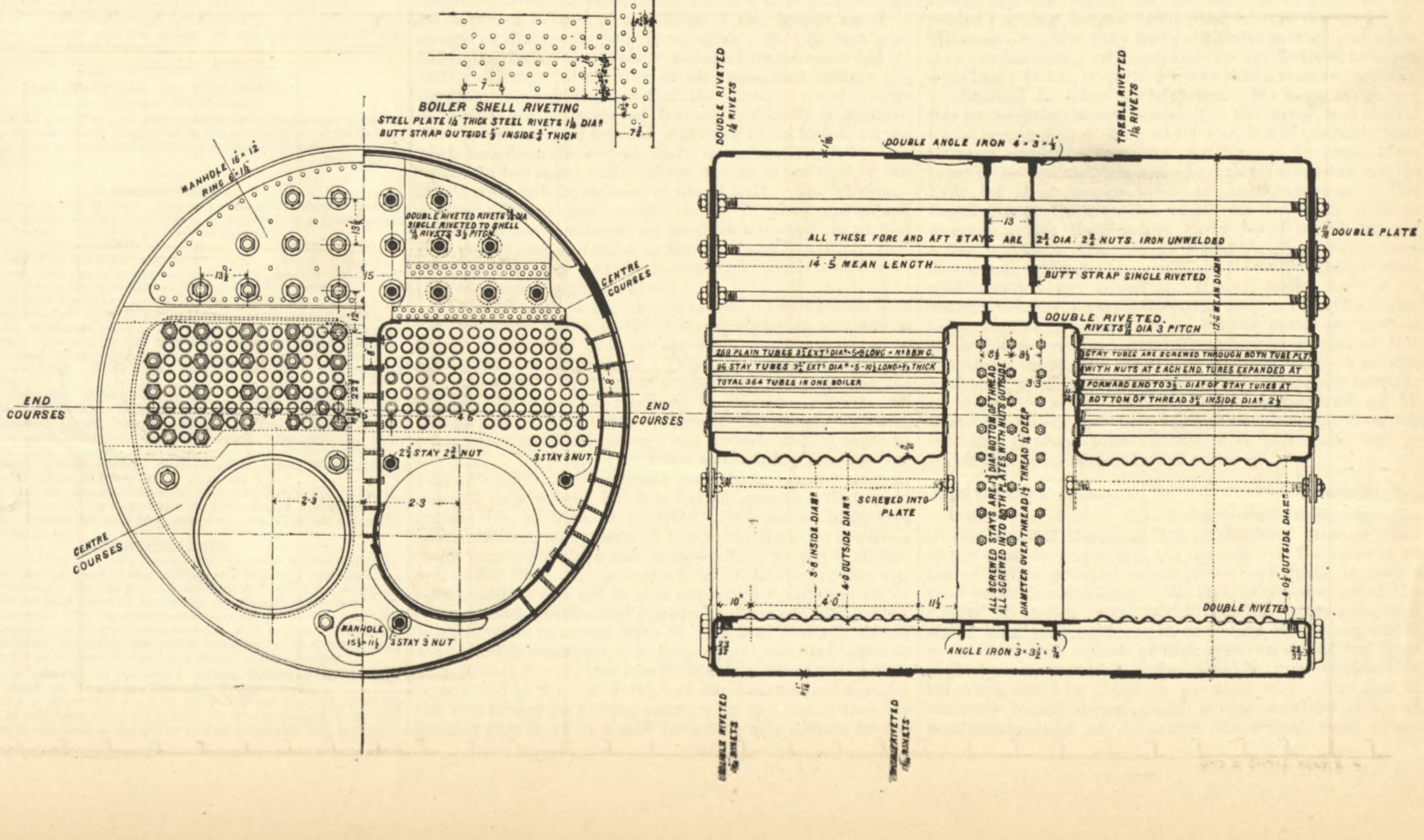
COMPOUND CONVERTED ENGINES OF THE S.S. MANAUENSE.

MESSRS. D. ROLLO AND SONS, LIVERPOOL, ENGINEERS.









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CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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BLUE TRACINGS.—*You can get the tracings you require made from your own drawings or ordinary tracings from T. R. Saxton, Lyndhurst, Townshend-road, S. Tottenham.*

ERRATUM.—*In our report of the proceedings of the Institution of Municipal Engineers, for "E. W. Rich, Poplar," read "E. W. Rich, Hounslow."*

CHENEILLE CUTTING MACHINES.

(To the Editor of The Engineer.)

SIR,—Would any of your readers give names of best makers of cheneille cutting machines?—and oblige, OLD SUBSCRIBER.
May 17th.

DIFFERENTIAL SELF-FEEDING RATCHET BRACES.

(To the Editor of The Engineer.)

SIR,—Can any of your readers oblige by naming makers of differential self-feeding ratchet braces? RATCHET.
May 18th.

MANUFACTURE OF PILL-BOXES.

(To the Editor of The Engineer.)

SIR,—I should be glad if any of your readers could supply any information regarding the machinery employed in the manufacture of pill-boxes, paper cartridge cases and articles of that class—the address of any makers of such machinery. PILL-BOX.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, May 24th, at 8 p.m.: Ordinary meeting. Paper to be read:—"Accidents in Mines" (Part I.), by Sir Frederick Abel, C.B., F.R.S., Hon. M. Inst. C.E.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C. — Monday, May 23rd, at 8 p.m.: Cantor Lectures: "The Chemistry of Substances taking part in Putrefaction and Antisepsis," by J. M. Thomson, F.C.S. Lecture IV.—Special consideration of the chemical substances employed —Antiseptics. Tuesday, May 24th, at 8 p.m.: Applied Art Section: "The Importance of the Applied Arts and their Relation to Common Life," by Walter Crane; Professor Hubert Herkomer, A.R.A., will preside. Friday, May 27th, at 8 p.m.: Indian Section: "Indian Tea," by J. Berry White, Bengal Medical Service (retired); Sir Roper Lethbridge, C.I.E., M.P., will preside.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, May 26th, at 25, Great George-street, S.W., at 8 p.m.: "Underground Telegraphs," by Charles J. Fleetwood, Member. "Driving a Dynamo with a very Short Belt," by Professors W. E. Ayrton, F.R.S., and John Perry, F.R.S.

DEATH.

On the 11th inst., at 65, Studley-road, Clapham, THOMAS MASON, C.E., of East Bridgford, Notts, in his sixty-fifth year. Friends will kindly accept this—the only—intimation.

THE ENGINEER.

MAY 20, 1887.

NAVAL REFORM IN FRANCE.

TWELVE years ago the present Minister of Marine in France, then a captain, published an article depreciating the value of ironclads in future naval wars, and advocating the construction of fast cruisers to cut off an enemy's commerce. The late M. Gabriel Charmes appears then to have become a pupil and strong adherent of the Minister in this view, and the advent of the swift torpedo boat gave him another text on which to preach the extinction of armoured ships. Under the title, "La Réforme de la Marine," he deals at length with several important points connected with the French Naval Administration, an excellent translation of which has been made by J. E. Gordon Cumming. Briefly summarised, M. Charmes' arguments are:—(1) That ironclads cannot be protected against torpedo attack either on the high seas or when blockading a coast. Therefore it is useless to continue their construction. (2) The chief point of attack should be the commerce and unfortified towns of an enemy. Therefore cruisers and fast gunboats should be principally constructed. (3) That as the coast would be attacked from the sea, it should be met by a naval force. Therefore the coast defence should be entirely in the hands of the Navy. (4) That as steam and the torpedo have so altered the necessary qualifications of nautical life, radical reforms are required in the recruiting and employment of the *personnel*. We propose to deal briefly with each of these propositions.

As regards the extent to which armoured vessels are affected by the introduction of the torpedo, there is no doubt this weapon attacks them in their most vulnerable point. Ever since the commencement of the struggle between guns and armour, inch after inch of iron or steel has been added at or above the water line, to afford protection against shot and shell; while little has been done to annul the effect of an explosion of a projectile travelling below the surface. It is believed that by the principle of double bottoms, and cellular subdivision, the effect of a torpedo is greatly reduced over a certain portion of the hull; but this cannot be said as regards an explosion under the machinery, which now occupies so much space. Moreover, an increase in the amount of explosive used is more easy of accomplishment than any additional protection to the hull by modifications of construction. Nets are a complete protection when a vessel is stationary, but of little or no value when moving through the water. We are prepared to concede therefore that the torpedo is now the weapon an ironclad has principally to fear.

Now, a torpedo of the Whitehead type must be brought within a distance of 400 yards before it can be applied with any certainty; and the point is, whether when carried in the swift small craft, of which so many have been acquired of recent years by all nations, this position can be attained in spite of all efforts of the larger vessel to escape or destroy its puny antagonist. M. Charmes considers the destruction of the ironclad a foregone conclusion; but we cannot allow this in all cases, and believe the danger is diminishing now that the value of speed in large as well as small vessels has become generally recognised. The seventeen knot ironclad will have little to fear on the high seas from the torpedo boat, because she will be able to retain her speed under circumstances when that of the small craft will be reduced to about half. The efficiency of our Admiral class consists chiefly in their speed, and we should have preferred to sacrifice a certain amount of gun power and protection in the Nile and Trafalgar, that they might have had an increase of motive power to propel them at eighteen knots.

If the ironclad is superior in speed to the torpedo boat the principal value of the latter disappears, and she is only dangerous if able to approach unobserved and to attain the desired position. This might occur in the case of a blockade, a condition of warfare which steam and the torpedo have almost rendered impossible. Taking all things into consideration, we believe the danger to which ironclads are subject through the torpedo should cause us to consider the propriety or not of abandoning the construction of vessels carrying either very thick armour or guns over 20 tons weight, but it is beyond question that speed should be as high as possible. We have important interests in so many parts of the world that we require a large number of ships and cannot afford to pay a million apiece for them. It is quite evident, however, that our requirements will not be met entirely by any number of torpedo boat flotillas and squadrons of unprotected ships. We are quite in accord with M. Charmes that any nation with a large commerce is in these days peculiarly open to attack, and it is curious how little this seems to have been considered in the construction of our unarmoured fleet for the last fifteen or twenty years, with the result that the greater portion of it would be practically useless for the protection of our ocean trade. Every unarmoured vessel of 1000 tons and upwards whose speed is less than 15 knots should be practically condemned; that is to say, not a penny more should be spent on their repair and refitment, but all money put into new fast ships. France, under the advice of Admiral Aube, has to a great extent stopped the work on ironclad building in order to push on their fast cruisers. We should do the same if the country is not prepared to find enough money for both. Probably, however, a war will be necessary to show our needs in this respect. We require to reconstruct our unarmoured fleet on a definite programme, which should extend over some years and be pursued without interruption by party considerations. The principal defect of nearly all our corvettes and sloops is that they are too short to attain sufficient speed under steam with the power put into them; and the supply of fuel they carry is soon consumed in forcing such a construction through the water. To compete with merchant steamers in their power of retaining high speeds for long distances, we must give our cruisers somewhat similar dimensions as regards proportion of length of beam. A satisfactory limit will probably be found when this is as 8 : 1; that is, a cruiser 280ft. long should not have a greater beam than 35ft. Handiness in turning will be insured with twin propellers, and a light armament will allow a fair amount of space to be devoted to fuel. We are not, however, now desirous of entering into details of types of ships, but rather to impress upon this country that our commerce could sustain severe damage immediately after a declaration of war by the depredations of not more than two cruisers if they evaded our own vessels. We would say also that such an evasion would not be a difficult matter, and that the remedy is only to be found in placing upon the seas a sufficient number of vessels effectively to guard the well-defined trade routes to this country.

In support of his contention that coast defence should be entirely in the hands of the Navy, M. Charmes quotes the example of Germany and Russia, who after some consideration have adopted this step. In this country coast defence has been relegated to the Army, on the principle that every man and ship belonging to the Navy would be required away from our shores in time of war. It is assumed that a small hostile squadron might then arrive at one of our commercial ports and cause great destruction before it could be encountered by our vessels in home waters. Hence elaborate fortifications and submarine mines are advocated at each of these places. We would point out, however, that such a system, besides being enormously expensive, cannot be relied upon, as an enemy, if unmolested afloat, could inflict enormous injury without visiting the regions of either forts or mines. The chief defence for this country is to meet the enemy at sea wherever he may be found. In reserve we should have at certain ports a force composed of a powerful ironclad, supplemented by a few swift gunboats and torpedo boats, which could be rapidly concentrated at any given point. The whole of the coast should be divided into districts, each in charge of an admiral, who would have his headquarters at the principal port, and be responsible for the defence of the coast in his district. Such is the outline of the purely local defence we would advocate, but space does not enable us to enter into all the details of its organisation. We may add, however, that the defence of our coaling stations should be similarly arranged.

In reference to the reforms M. Charmes advocates in the system of recruiting men for the French Navy, he apparently desires to modify, if not to abolish, the Maritime Inscription which enables France to have at all times a large reserve of seamen who have served a certain period on board ships of war. We doubt if he will find many supporters in his own country as far as abolition is concerned, though in view of the training that modern weapons necessitate, it may be desirable that the period of service before passing into the Reserve should be extended. At present in the French Navy it is four years, but as the seamen are recruited direct from the merchant service and the shore, they all have to undergo an extended training before being drafted into the fleet. M. Charmes considers they leave the active service just when they are becoming efficient, and we are inclined to agree with him; but it is quite obvious that a reserve can only be obtained by some such system. We have recognised this by adopting short service for the army, and should we be engaged in a long naval war, it will probably lead to some similar system for the Navy. At present we boast of our reliance upon a reserve of Volunteers, but do little for their organisation or encouragement. The Royal Naval Reserve are mostly drilled with obsolete weapons which they would never see if called out for active service. The Royal Naval Artillery Volunteers find equal difficulty in making themselves acquainted with modern war material. If such bodies have not a distinct value in a possible contingency, it would be better to say so plainly; but if, as we believe, under our present system of providing armed forces for the defence of this Empire, a Volunteer Reserve could render good service in time of need, it should receive every assistance towards efficiency. We may not be able to agree with all M. Charmes' ideas, but his work contains much food for reflection to those who endeavour to pierce the veil in which future naval warfare is wrapped.

THE STEAMER SUBSIDIES OF THE GERMAN GOVERNMENT.

WHEN describing the arrangements made by the Government of Germany for establishing steamer lines to the East, we expressed the opinion that the amount of the subsidies granted must prove inadequate to insure their profitable working. We on that occasion cited the results of known cases within English experience, and stated that, judging from those results, it was impossible to run first-class vessels of high speed on any of the lines of Eastern trade which, unless aided by very considerable subsidies, could be made to pay their way. Any line of steamers bound down under severe penalties to strict punctuality, both of departure and arrival, must necessarily be severely handicapped in any competition for the carrying of cargo. It is almost impossible to guarantee that on a fixed day there shall always be cargo ready to be taken on board a ship the stay of which at any particular port is, under the regulations of a subsidised convention, limited probably to a few hours only. It follows that those vessels which can await a freight must possess great advantages over those circumstanced as we have above indicated. Then, again, owners of goods, unless they are of a particularly perishable nature, care but little whether they reach their destination a few days sooner or later, and they will not pay enhanced freight rates to send such cargo by boats steaming seventeen knots in preference to those whose speed is the normal commercial rate of about nine knots only. Now, we know what is the enhanced cost of driving steamships at the greater of those two speeds. And this means that while the slower ships can and do carry goods at a profit, such profit is entirely lost in the case of the faster vessels. Add to these factors of disability the present low rates of freight ruling in our Eastern trade—rates which we can scarcely expect in these days of fierce competition to see materially increased—and it is easy at once to realise why, as we have insisted is the case, vessels bound to keep regular time, and to maintain high speed, are worsted in the contest with ships not under such restrictions.

The Germans, we observe, are beginning to be alive to these facts—facts which have long been known to Englishmen as the outcome of their own far wider experience. In the attempt which Germany has of late been making to compete with the foreign trade of Great Britain, and in the endeavour to stimulate the formation of a rival mercantile marine, her Government has of late introduced a system of subsidies to the owners of all vessels fulfilling certain conditions. As we have stated above, we early in the course of that arrangement drew attention to the fallaciousness of much of the data upon which the Berlin authorities appeared to have based their offers. These last were, however, alluring enough in the eyes of German shipowners to induce them to enter largely into the building of ships to compete with our own marine. It has not taken long to prove to these the soundness of the contention by which we strove to demonstrate that failure must surely follow the attempt. The subsidies granted no doubt appeared liberal to those who had had but little opportunity of becoming acquainted with all the details of steamship working, and with the very heavy cost at which speed can alone be kept up. Stimulated by the offers of the Government, our German friends rushed with a considerable amount of haste into the jaws of the difficulty set for them, and they are now finding to their cost how little compensatory are the sums paid to them for doing so. A Hamburg paper writes that there are numerous complaints throughout Germany about the failure of the system of such subsidies. It specifically says that:—"The Vulcan Shipbuilding Company, in Stettin, which built the steamers, complain of very great losses; and the North German Lloyd Company have not only spent their whole subsidy, but have also suffered heavy loss. The shipowners complain that the expected advantages have not been gained, and that German goods were often left behind in German ports to make room for English emigrants." We are well aware of the fact that the passage money of emigrants is not upon a high scale. How low, then, must be the rates which German shippers are willing, or can afford, to pay for the transport of their goods! It is very certain that they must be on an exceedingly low scale if it is found to pay better to carry emigrants to the exclusion of cargo—quite too low to ensure to the working of fast steamships anything like a profitable issue.

We do not know as yet how far these complaints which reach us through the German press are entertained by those who have undertaken the running of the steamers now competing with ourselves in the Eastern trade. It may be assumed that, as these have been running but for a few months, time has either not sufficed to bring the unpleasant conviction home to the minds of those who have entered on the enterprise, or that, sanguine of improvement after a further period of trial in the scale of freights, they are maintaining a wise reticence as to results as yet obtained. Yet we may be certain, for the reasons we set forth in our former article, that sooner or later the difficulties which are evoking so much complaint among those who have invested in German steam shipping must press heavily upon the but recently inaugurated enterprise of the same nationality. It is a matter of public knowledge how great has been the difficulty experienced by British owners working the Eastern trade under high Government subventions to realise any profit. That they have succeeded in doing so to the limited extent that they have done is solely due to the great practical knowledge they have brought to bear on the subject, and to their prior occupation of the trade routes. How, then, can Germany hope to successfully compete? The passenger trade of the East is practically almost entirely of British nationality, and national prejudice will maintain it so. To secure freight against our own steamers it must be carried by the Germans at lower rates. But we know that these are down already to the minimum which affords a possible paying return. To force them still lower must but hasten the catastrophe which the German press seems to indicate must be imminent, and in time the weight of it must be felt more heavily by associated enterprise than it is now by the individual owners whose complaints are already so strongly expressed.

SOLINGEN AS A COMPETITOR.

As bearing on the question of bayonets and swords for the British army, the following facts are worth special notice. The Solingen Chamber of Commerce reports that "the war alarm at the beginning of the year, though bad for other trades, was good for our specialities in arms, and that so many orders came to hand that part of them had to be given out to manufacturers in neighbouring towns. An officer of the Prussian army has been for some time in the town, inspecting the large quantities of side-arms and officers' swords, with signalling-whistles in them, being made for the Government. Orders for arms are still coming briskly to hand, especially as the competition of Sheffield has just experienced a signal defeat. It is now no longer the 'German Sheffield,' but now it is 'Solingen in England.' The trade in fire-arms, even those of luxury also increased. Pocket-knives suffered severely from the political crisis at the beginning of the quarter. The domestic demand was as small as the foreign, and was particularly felt as regards the commoner sorts. At this moment the demand is increasing, and our market is being sought after again by North America, but the work is being so distributed that, while one manufacturer has too much, the other has too little to do. The North American houses send buyers over here who certainly make large purchases, but at such low prices that our industry would in a short time be almost ruined if it lasted, and energetic steps must be taken against such a danger, which is a matter for our Commercial Union to look to. Table cutlery, which was very dull a few months ago, is improving and satisfactory. The knife-blade forgers are well employed, but the scissors business is still very bad—the orders come in slowly, and the stocks are large." "Solingen in England" probably means the wretched little office a few feet square established at Sheffield, with the object of invoicing direct from there the cheap cutlery with that unrivalled finish which alone Solingen is able to produce, but nevertheless stamped with the Sheffield mark, in order to take in the unwary and ignorant purchaser.

THE NEW SUBMARINE BOAT NORDENFELT.

THE submarine steam torpedo vessel Nordenfelt has just completed what may be considered a most crucial trial trip as a surface boat in making the voyage, through at times heavy seas, from Barrow-in-Furness—where she was built—to Southampton, in the neighbourhood of which she is shortly to prove her use and enormous offensive capabilities. She was during the voyage tested by her commander in every wind and condition of wave and sea, and by her behaviour therein she has shown that she will be capable of being manœuvred in any possible weather, however bad; an advantage possessed by no other torpedo boat. During the trip no attempt was made to test the speed of the new vessel, only one boiler being used, and that without forced draught. The object aimed at was rather to show how far she could be driven at a fair speed on a small consumption; and on the result, namely 100 miles on just over 1½ tons of coal, Mr. Nordenfelt is to be congratulated. A higher economy than this will, beyond doubt, be obtained with higher pressures than it was convenient to use during this her maiden trip, and when we mention that she is capable of carrying on board upwards of 20 tons of coal, it will be seen how wide her operations may be. The vessel is now in Southampton Docks, having such upper gear as was found necessary for the voyage—such as masts, side lights, bridge railings, winches, &c.—taken off her, and is being made to look like what she is, a submarine boat. She is then to be taken out for speed, progressive, and other trials, the results of which will be given in our columns.

LITERATURE.

The Origin of Mountain Ranges considered Experimentally, Structurally, Dynamically, and in Relation to their Geological History. By T. MELLARD READE, C.E., F.G.S. London: Taylor and Francis. 350 pp. 1886.

MR. READE has collected together in this book so much that is interesting and useful, that it is not perhaps essential to its appreciation that the reader should agree with him as to the validity of the theory of mountain building, which it is apparently the sole object of the book to announce. The collated information which may be referred to is comprised in the chapters which give the coefficients of expansion of different kinds of rock materials, the rates of increase of temperature at numerous localities, the physical features of the mountain ranges of many parts of the world—partly from observation and partly by quotation from numerous authors—and in a large number of excellently illustrative lithographs of mountain elevations, normal and abnormal contorted strata, natural and conventional. Mr. Reade has evidently spread his reading over a very large area, with the object of learning as much as possible from all those who have written on this subject, or to find all he could, if any, that was favourable to the hypothesis with which he evidently approached the work. He has apparently been struck by the observation that mountains are to a great extent built of the sedimentary rocks, and having some years since in his writings on chemical denudation, seen that the sedimentary building of strata now going on is enormous, he has appealed for an explanation of mountain building to that which has been suggested by others before him—namely, the possible rise of isogeotherms below these thickened sedimentary areas, and their consequent radial and local expansion. He has consequently been led to inquire into the expansion of rock materials, and although he has not apparently added to existing knowledge on this subject, he has made a number of experiments upon it. From these he has satisfied himself as to the amount of the probable vertical expansion of a given heated area of the earth's crust, assuming its temperature to be increased 100 deg. or 1000 deg. Fah. Having postulated this local rise of temperature, Mr. Reade next discovers that the writers who have preceded him have assumed that thermal increase or decrease in the earth's crust has only been productive of tangential pressures by expansion of area, and that they have overlooked the expansion in vertical or radial direction. He has omitted to see that the great physicists who have dealt with this subject with so much real ability have not written for readers to whom it would be necessary to mention that cubical expansion is as much a reality as linear expansion, and they have not, moreover, found it necessary to appeal to cubical expansion as apart from the linear expansion, or to expansion in a radial direction alone. Moreover, they have not supposed that any noteworthy expansion has taken place from arbitrary and causeless change of level locally of a supposed 3000 deg. plane in a thirty-five mile crust. They have, on the contrary, assumed that these things do not and have not taken place, and that, with certain exceptions, the physical changes which have resulted from thermal causes have been chiefly due to contraction as the common result of thermal degradation. Mr. Reade has evidently taken great pains to make himself acquainted with the physical concepts of those who have dealt with the causes of the changes in the earth's crust, but he has equally evidently worked very much in the dark for want of thermodynamic light on many of the problems with which he attempts to deal. He has most completely failed to understand the bearing of the writings of Mallet and others, as is shown by numerous remarks throughout his book. For instance, speaking of Mallet's theory of the origin of volcanic energy, he remarks that "It is evident that a collapsing crust cannot develope more heat than is due to the distance it falls through; hence, taking the crust as a whole, and supposing the entire mechanical effect to be converted into heat for every contraction of the radius of the earth of 772ft., only sufficient heat would be generated to raise the mass of falling crust five deg. Fah." Inasmuch as Mallet calculated that the radial contraction of the earth amounted to less than seven inches in 5000 years,[1] and yet showed that the heat developed by the descending crust was vastly in excess of that necessary to account for all volcanic activity, Mr. Reade has very strangely failed to obtain that knowledge of the subject which most physical geologists would consider necessary before announcing "Mallet's View of the Origin of Volcanic Heat Controverted."

For his calculations Mr. Reade assumed a co-efficient of expansion for all temperatures concerned, but as the expansion of the materials forming the earth's crust is, at the high temperature he deals with, namely, 3000 deg., about double the co-efficient at 500 deg.,[2] as found by experiments on a very large scale, his estimates are not worth much. This alteration would, however, tell in favour of his argument, but he has nowhere given any facts or suggestions which have the slightest semblance of an explanation of the origin of the supplies of heat he wishes to call upon for local operation. Small or large, therefore, the accuracy of the co-efficient he uses is of no importance. There is one notion which is perhaps more misleading than any other in Mr. Reade's not very well collected elements of his hypothesis. He assumes a constant supply of heat always available, but takes no notice of heat losses. For his chief source of elevation of any isogeothermal he appeals to increased thickness of the crust. The sedimentary areas having been deposited, and, as he pictures them, finished, he supposes the elevation of the isogeothermal, and with it the increase of elevation of the crust over the area so heated. He does not apparently see that the isogeothermal would take its new position gradually—that is to say, it would rise gradually with the deposition of the sedimentary strata—and that any increase of temperature would take place *pari passu* with the sedimentation. There would thus be an earlier cessation of the sedimentary operations; the depressed area would become evanescent, and there would be no such elevation by expansion as he assumes.

Mr. Reade describes and illustrates many experiments with lead plates and with stone bars, and refers to the effects of heat on iron and steel plates, but none of these have any direct bearing on the questions under consideration. In all of them there is a definite source and application of heat, and there are mechanical conditions which have no analogue in the origin of the forces which may have had existence in the crust of the earth. We must not, however, be led into following Mr. Reade up point by point. A discussion of those which have been marked in reading his book would occupy many columns of space which we cannot afford. We must therefore conclude with the remark that the theory of mountain building does not appear to have received any advancing help in these pages, but that the publisher's part of the work has been excellently done.

BOOKS RECEIVED.

An Elementary Treatise on the Mathematical Theory of Perfectl: Elastic Solids; with a Short Account of Viscous Fluids. London: Macmillan and Co. 1887.

The Electrician's Directory, with Handbook for 1887, *containing Useful Tabulated Information Relating to Dynamos, Formulæ, Electro-Chemical Equivalents, Lost of Potential, Resistances and Weights, Candle-powers, Cableography, Directories of Electricians, Electrical Engineers, &c. &c.* London: The *Electrician* Office. 1887.

L'Année Electrique ou Exposé Annuel de Travaux Scientifiques des Inventions et de Principales Applications de l'Electricité a l'Industrie et aux Arts. Par Ph. Delahaye. Paris: Baudry and Cie. 1887.

Factory Accounts: their Principles and Practice. A Handbook for Accountants and Manufacturers. By Emile Garcke and J. M. Fells. London: Crosby Lockwood and Co. 1887.

Minutes of Proceedings of the Institution of Civil Engineers, with other Selected and Abstracted Papers. Vol. lxxxviii. Edited by James Forrest, Assoc. Inst. C.E., secretary. London: The Institution. 1887.

Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland; comprising Lists of the Papers Read during 1886 *before Societies Engaged in Fourteen Departments of Research, with Names of Authors.* Fourth annual issue. London: Griffin and Co. 1887.

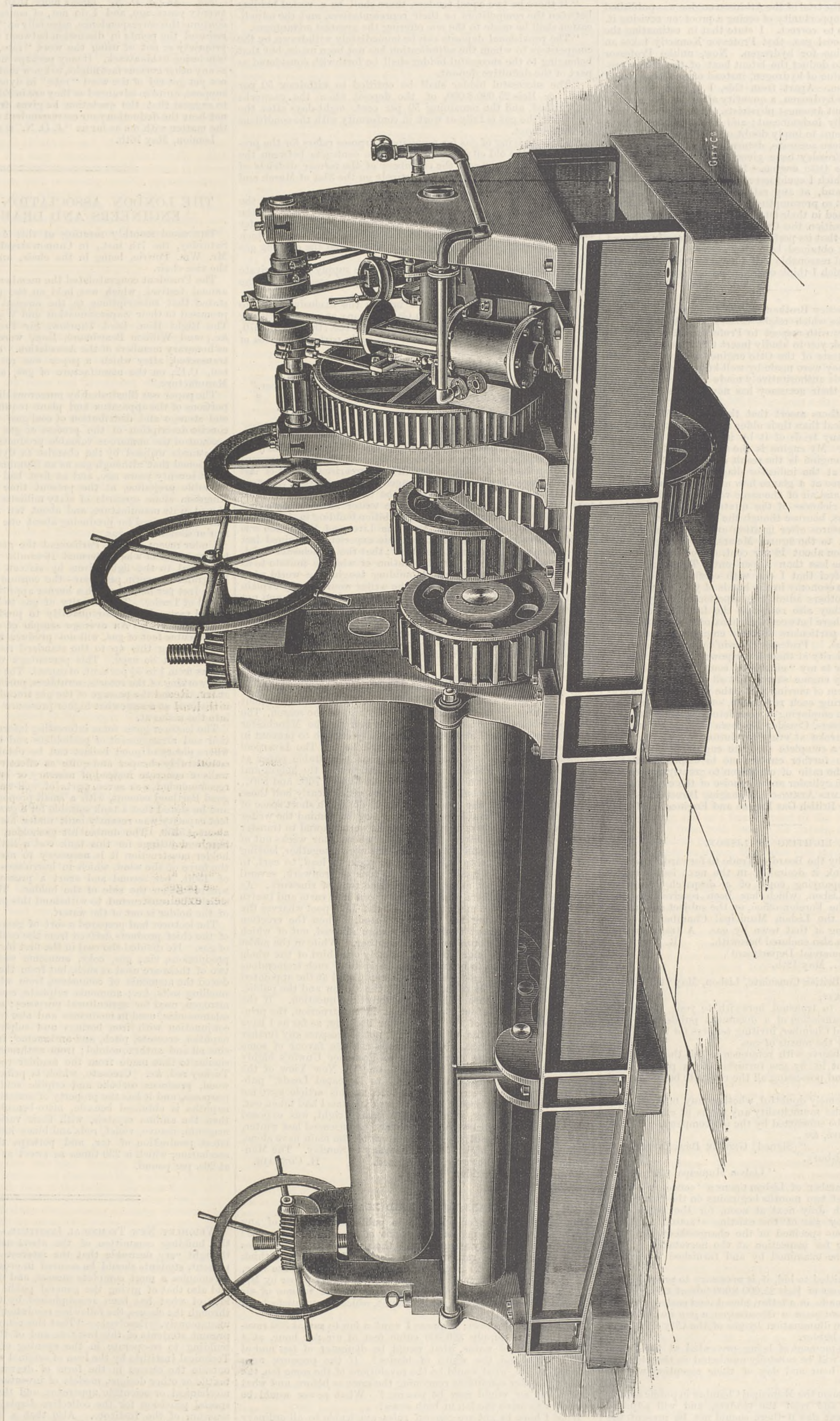
COLLAPSIBLE BERTHS FOR EMIGRANT SHIPS.—There has been on exhibition, at the show-rooms of Messrs. Barnard, Bishop, and Barnards, Queen Victoria-street, the collapsible passenger berths for emigrant vessels which have been invented by Messrs. F. H. Street and C. Ellis, of Hull. Amongst the gentlemen who inspected the berths were representatives of the New South Wales, New Zealand, and Queensland Governments, of the New Zealand Shipping Company and the Orient Line, and other gentlemen interested in shipping matters. The berths, which are made of wrought iron throughout, economise room, and the small space which, when folded up, they occupy on a vessel, is a great recommendation. The separate bed parts are interchangeable, and the berths are easily put together and taken to pieces. They can be stowed away in less than half the space usually taken up by other berths; they can be fitted to the ship's side if required, or can be laid on the deck, and cargo placed on the top of them without fear of breakage or damage to cargo. Being rivetted with copper, they will corrode. The system is also adapted to cattle fittings and pens, and is an improvement on the old wooden pens now in use, being easily fixed and stowed away.

[1] *Phil. Trans.*, vol. clxv., Part I. [2] *Phil. Trans*, 1878.

LARGE HORIZONTAL PLATE BENDING MACHINE.

MESSRS. FRANCIS BERRY AND SONS, SOWERBY BRIDGE, ENGINEERS

(*For description see page 403.*)



LETTERS TO THE EDITOR.

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

GAS ENGINES.

SIR,—The report of the trial of the Atkinson engine was published without my having an opportunity of seeing a proof or revising it. One word I should like to correct. I state that in estimating the heat value of London coal gas, that Professor Kennedy takes an "erroneous" heat value for hydrogen. Now, unlike Professor Kennedy, I do prefer to deduct the latent heat of the steam produced from the heat value of hydrogen, instead of correcting for it later in the calculation. Apart from this, I take a somewhat different heat value for hydrogen, a quantity about which there is not at present agreement amongst physicists. But the difference between us is practically insignificant; and I ought not to have used a phrase which seems to imply doubt of Professor Kennedy's very careful, and I believe accurate, determination.

I am glad Messrs. Crossley have given later data of the consumption of gas in the Otto engine. I am not aware that any independent tests to which I could have referred have been made in the last two years, and, at any rate, I gave the authority for those quoted. I was not so presumptuous as to imply that no better results had been obtained in their latest engines. It is simply due to the commanding position the Otto engine has so long and so deservedly maintained that its performance is necessarily referred to in examining results obtained by a new motor. Messrs. Crossley's letter is so fair and reasonable that I will not even complain of an adjective or two, which I think could have been spared.

May 16th. W. C. UNWIN.

SIR,—As Messrs. Crossley Brothers' letter in your issue of the 13st inst. makes remarks which might cause some misunderstanding among your readers with respect to Professor Unwin's report of my engine, may I ask you to kindly insert this letter.

With respect to the tests of the Otto engines used as references by Professor Unwin, they were made by well-known scientific men, they are the best records authoritatively made public, and though very widely published, their accuracy has never been questioned before.

Messrs. Crossley Brothers assert that their new 4-horse power engine is more economical than their older engines, but there is no published account of any trials of it by independent experts of acknowledged position. My engine is the first of its kind, while Messrs. Crossley's new engine is the result of ten years' working. Any engineer looking at the indicator diagrams you were good enough to publish can see at a glance how much more power I get out of a charge of gas and air of the same volume, and if there be any difference in the richness of the mixture that of the Otto diagram shows more gas, because though the compression is higher in my engine, the pressures after ignition are about the same in both. Referring again to the figures Messrs. Crossley give, their engine absorbs in friction about 16 per cent. out of the total indicated horse-power, mine less than 10 per cent. Taking these two facts in conjunction, I feel that I can with confidence leave the judgment as to relative economy in the hands of your readers.

Messrs. Crossley Brothers admit the superior economy of my engine at full power; they also recognise the fact that most gas engines work at somewhere between their maximum and minimum loads, yet they give no particulars of their engine's performances at intermediate powers. Professor Unwin's report shows my engine's greatest superiority at these lower powers.

Messrs. Crossley refer to my "cumbrous contrivance." I think the small friction of my engine shows that all its parts are highly effective. By my system of moving parts, the pumping and working are performed during each revolution, surely a less cumbersome arrangement than employing a complete separate revolution for each function. Messrs. Crossley Brothers recognise the value of having a working stroke at every revolution by building their twin engines, involving a complete separate engine, to obtain this advantage. My system further enables me to dispense with the use of a slide, and by the ratio of expansion to greatly reduce the terminal pressure in the cylinder and the noise of the exhaust.

JAMES ATKINSON, Managing Director.
(For the British Gas Engine and Engineering Co.)
London, May 18th.

THE LIGHTING OF LISBON.

SIR,—I am directed by the Board of Trade to forward to you for publication, if you think it desirable, in the next issue of THE ENGINEER, the accompanying copy of a despatch from her Majesty's Consul at Lisbon, which has been received in this Department through the Foreign-office, on the subject of a notice recently published by the Lisbon Municipal Chamber, inviting contracts for the lighting of that town by gas. A translation of the notice referred to is also enclosed herewith. R. GIFFEN.

Board of Trade (Commercial Department),
London, S.W., May 18th.

"British Consulate, Lisbon, May 7th, 1887.

"MY LORD MARQUIS,

"I have the honour to transmit herewith to your Lordship a printed copy and a translation of a document published to-day by the Lisbon Municipal Chamber, inviting tenders for the lighting of the city of Lisbon by the means of gas.

"It is necessary to observe with reference to this that Lisbon is at the present moment lit by gas furnished by a powerful and prosperous company, and possessing all the requisite buildings and plant for the purpose.

"It is therefore extremely doubtful whether any new company would be able to offer the municipality any terms at all as favourable as those likely to be submitted by the old company.

"I have, &c.,
"(Signed) GEORGE BRACKENBURY.
"The Marquis of Salisbury."

"Lisbon Municipal Chamber.

"The Municipal Chamber of Lisbon opens a 'concours'—competition—for a period of two months beginning on the 9th of May and ending on the 9th July next at noon, for the public and private illumination by gas of the existing—'actual'—City of Lisbon on the conditions specified in the charge-sheet—*cahier de charges*—which is lying for inspection at the Secretariat of the Chamber in order to be examined by and furnished to persons interested.

"In order to be admitted to bid, it is necessary to prove having made a provisional deposit of Reis 25,000 $000 (about £5555).

"Tenders must be made in a letter, closed and sealed, bearing the inscription, '*Proposta para a illuminaçao a gay da Cidade de Lisboa*'—tender for the illumination by gas of the City of Lisbon—and the name of the bidder.

"The tenders at the moment of being presented at the Secretariat of the Chamber will be carefully numbered in the order of their arrival, and the hour and day of their reception will be registered.

"On the 9th July at noon the Municipal Chamber in public session will proceed to open and read the tenders, and will adjudge immediately, or the next day if there should not be present the legal number of town councillors to deliberate, the supply of gas to whosoever shall offer the greatest advantages, of which the Secretary of the Chamber will draw up the proper official record—*termo*—which shall be signed by the town councillors present as well as by the bidder who has been preferred.

"This official record—*termo*—shall be binding forthwith on the contracting parties as if it were a public deed until the contract shall have been converted into such a deed.

"The tender must contain a declaration that the bidder conforms to all the conditions and clauses of the *cahier de charges*, as the bidding will only turn on the reduction in the price of gas for municipal purposes.

"When the supply is adjudged, the bidder shall make within a period of eight days the definitive deposit of Reis 50,000 $000 (about £11,110) in cash or securities of the public debt, the provisional deposit being taken into account towards the definitive one.

"If there be two equal tenders, there shall be a verbal bidding between the competitors or their representatives, and the adjudication shall be made to the one offering the greatest advantages.

"The provisional deposits can be immediately withdrawn by the competitors to whom the adjudication has not been made, but that belonging to the successful bidder shall be forthwith considered as part of the definitive deposit.

"The successful bidder shall be entitled to withdraw 50 per cent., or Reis 25,000 $000, of the deposit when the gasworks are finished, and the remaining 50 per cent. eight days after the supplying the gas is fully at work in conformity with the conditions of the contract.

"The supplying of gas for municipal purposes refers for the present only to the old city, inasmuch as the contracts between the present gas company and the chambers of the former districts of Belem and Olivaes terminate respectively on the 31st of March and the 1st of October, 1889.

"Notwithstanding, all the works, whether gasworks or the general network of pipes, shall be established for the supply of the whole present area, the whole of which will remain entirely under the charge of the contractor, as soon as the contracts expire which bind the districts recently annexed to the city and the existing gas company.

"The contractor will be entitled at once to supply gas to private persons, whether in the old or in the recently annexed part of the city of Lisbon.

"This concession by no means implies the exclusive right to make gas, inasmuch as the Lisbon Gas Company at present existing is entitled by Condition 17 of the contract of the 7th March, 1870, to continue to furnish gas to private persons in part of the area of the old city.

"Town Hall, May 6th, 1887.
(Signed) "JOAS AUGUSTO MARQUEZ,
"Secretary to the Chamber."
[Translated by—(Signed) George Brackenbury.]

EXHIBITION BUILDINGS.

SIR,—I must beg to ask you the favour of some space in your honourable paper in reference to some observations made in regard to the Manchester Exhibition, and in its comparison to that of last year at Liverpool, where I was engaged from the start at Antwerp until lately. I refer at present to the leaders in your valuable paper of April 29th and May 6th. The writer seems to state that the completion of the Manchester Exhibition building in six months was somewhat extraordinary; that the Liverpool Exhibition was mostly in wood, and that the disastrous experience obtained last year at Liverpool has borne good fruit; that the Manchester building will probably serve as an illustration of what to imitate to as great an extent as the Liverpool building taught the world what to avoid. I should feel obliged if the writer would kindly explain in what respect. I refer only to the structural ironwork and not to the show itself, with which I had nothing whatever to do. The Liverpool papers, as well as your honourable paper, pointed out at the time the defects of the show and its management during its first period, but as far as I am aware the same management has been entirely transferred to Manchester. In regard to the building, I visited it when nearly complete, and my impression was, in reference to the exhibitors and the public, that the whole building is composed of a series of hothouse compartments, far too low to permit thousands of visitors to circulate at the same time without being, perhaps, injuriously affected by the heat of the season. The Liverpool building, which is, in comparison to the Manchester building, lofty, was, I am told, still not lofty enough to prevent in hot weather cases of indisposition through heat. The Liverpool Exhibition building was illustrated in your honourable paper at the time, and I wish therefore only to mention that the height and breadth of the galleries ranged from about 33ft. to 70ft. and 80ft., while the Manchester building does not approach nearly half these dimensions. As to the amount of work done in a short space of time and its considerable difficulties, I beg to remind the writer that, as to the ironwork, about nine weeks were allowed to transfer it from Antwerp to Liverpool. During about four weeks out of the nine, winds, ice, and snow stopped the work altogether, leaving not quite five weeks to take down, to pack, to load, to cart, to unload, and to ship again about 2000 tons of ironwork, several hundred tons of glass, and several hundred tons of zincwork. As means of transport there were required about 1000 carts and twelve steamers. When the materials were at the Liverpool wharves the unloading and carting had to be repeated. Then the erection began, for which about twelve weeks were allowed, out of which two were lost on account of severe weather. While in the midst of the work the steamer sank with nearly one-third of the whole ironwork, which had to be renewed. In spite of such tremendous calamities, the work got on and was completed at the appointed time for the reception of her Majesty the Queen and the public. But besides this, there is another interesting question. If the Liverpool building is found to be light in construction, the principal nave and dome of the Manchester building, as far as I have seen, are also light. As to this point, not to trespass any further on your valuable space, I may perhaps ask the favour of some space at another time in reference to Professor Unwin's highly interesting and most valuable article on "A New View of the Nature of the Resistance of Material to Repeated Loads," published in yours of December 10th, 1886, as this article gave me some assurance in reference to the stress diagrams I had taken out. The Liverpool building, standing at a great height, was exposed to severe gales and heavy snowstorms, as I experienced last winter, where there were about 200 tons of snow on the main nave alone, having fallen in one night, from a Saturday to Sunday. The Manchester building is, however, less exposed. H. CONRADI.

13, Soho-square, London, May 9th.

FANS FOR FORCED BLAST.

SIR,—Can any reader refer me to published accounts of any experiments as to the proper dimensions of fans for this purpose? I believe it is generally assumed that the pressure produced varies as the square of the revolutions of the fan, but I do not think practice bears this out. Mr. Kinnear Clark adopts the above view, and gives a table of sizes for various pressures from a paper by Mr. Buckle. These appear to be independent of the volume of air required. Molesworth, too, gives formulæ, which are unsatisfactory, I think.

To put a definite case: Suppose I want a fan to run at 800 revolutions, and to supply 360,000 cubic feet of air per hour, at a pressure of 3in. of water, what would be diameter of fan and of suction pipe and the width of blades? If the pressure were reduced to 2in., what would be the revolutions of the same fan, the boiler and other conditions remaining the same as before, and what quantity of air would now be passing? What power would be necessary to drive the fan in both cases?

What I hope to get are general rules applicable to all ordinary cases, and based on experimental proof. What pressure is required to pass a given weight or volume of air through a boiler of fixed dimensions? How does the size of outlet affect the speed of the fan for a given air pressure? FAN.

May 17th.

PROFESSORS AND ENGINEERS.

SIR,—I am not surprised that "J. D. N." does not understand the fact that pure dynamics and kinetics take no cognisance of matter, but only of mass. It forms no part of my duties to teach him but I will refer him to a tolerably well-known book, the "Dynamics of a Particle," which may enlighten him on this subject, if he can read the higher mathematics. W. SHAIRP.

Edinburgh, May 17th.

SIR,—As "J. D. N." knows more than Professor Rankine did twenty years ago, and I do not, of course it is useless for me to continue this correspondence, especially as "J. D. N." has ingeniously reduced the points in discussion between us to one concerning the propriety or not of using the word "rate," a lame and impotent conclusion to his attack. It may perhaps interest him, however, just as any other curious fact might, to know that at Cambridge they have not yet got rid of the word "rate" in dynamics. They are not, I suppose, quite so advanced as they are in Edinburgh. May I venture to suggest that the quotation he gives from Clerk-Maxwell does not bear the deduction your correspondent draws from it. This ends the matter with me as far as "J. D. N." is concerned. J.

London, May 16th.

THE LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.

THE usual monthly meeting of this Association was held on Saturday, the 7th inst., in Cannon-street Hotel; the President, Mr. Wm. Powrie, being in the chair, and Mr. W. P. Heath, in the vice-chair.

The President congratulated the members on the success of their annual festival, which was held on the previous Saturday, and stated that subscriptions to the amount of over £90 had been promised to their Superannuation and Widow and Orphan funds. The Right Hon. Lord Thurlow, Sir Fred Abel, C.B., D.C.L., &c., and William Beardmore, Esq., were proposed and elected as honorary members of the Association. Some other business was transacted, after which a paper was read by Mr. F. Darlington, C.E., on the manufacture of gas, entitled "Notes on Gas Manufacture."

The paper was illustrated by numerous diagrams showing various portions of the apparatus and plant required for the manufacture and storage and distribution of coal gas. Mr. Darlington gave a concise description of the process of gas manufacture and some account of the numerous valuable products of the coal, which are afterwards utilised by the chemist as dyes, scents, oils, &c. He mentioned that although gas as an illuminant was only introduced about seventy years ago, and at first had to contend against considerable prejudice, at the present time there is in the United Kingdom alone upwards of sixty millions pounds of capital employed in its manufacture, and about ten million tons of coal are annually required for producing about one hundred million cubic feet of illuminating gas.

Under recent Acts of Parliament the gas companies undertake to supply gas of what is termed 16-candle power—that is to say, gas equal to the light given by sixteen sperm candles burning 120 grains of sperm per hour—the consumption of gas being five cubic feet per hour through a burner approved and stamped by the Board of Trade. The quantity of gas to be extracted from a ton of coal varies, but a fair quantity to produce is 10,000 cubic feet per ton of coal. An average sample of common coal, yielding 10,000 cubic feet of gas, will not produce more than 13½ candles, and to bring this up to the standard required a percentage of cannel must be used. This percentage varies in different companies from ¼ to 3¼ per cent. of cannel. The structure, arrangement, and working of the retorts, scrubbers, purifiers, &c., were described at length, and the passage of the gas traced into the holders, where it is stored at a somewhat higher presssure than it is delivered out into the mains at.

The lecturer gave some interesting information on the construction and arrangement of gasholders and tanks, and stated that where plenty of good ballast can be obtained it was found to be considerably cheaper and quite as effective to line the tank with walls of concrete instead of masonry or brickwork. The mixture recommended was seven parts of well-washed ballast to one of good Portland cement, with a small proportion of fine clean sand, and he stated that a tank suitable for a gasholder of 800,000 cubic feet capacity was recently built under his supervision at a cost of about £5350. The double lift gasholder, with its columns, bracings, and fittings for this tank cost a little over £6000. In gasholder construction it is necessary to make ample allowance for the force of the wind, which in hurricanes may attain a velocity of 150ft. per second and exert a pressure of about 25 lb. per square foot on the side of the holder. The standards therefore should be constructed to withstand this pressure when the whole of the holder is out of the water.

The lecturer had prepared a sort of genealogical sketch of some of the chief products derived from the coal during the distillation of gas. He divided the coal in the first instance into four primary productions, viz., gas, coke, ammonia water, and tar. The first two of these are used as such, but from the ammonia water is produced the ammonia of commerce, from which is made the ladies' smelling salts, &c.; ammonia sulphate, containing 25 per cent. of nitrogen, used for agricultural purposes; muriate of ammonia or salammoniac, used in medicines and also for making rust joints in conjunction with iron borings and sulphur. From tar we get naphtha, creosote, pitch, and anthracine; from anthracine, anthracine oil and anthraquoiniol; from anthracine alizarin is produced similar to that made from the madder root and used for dyeing Turkey red, &c. Creosote, which is principally used for pickling wood, produces carbolic and cripilic acid, used for disinfecting purposes, and it has the property of arresting putrefaction. From naphtha is obtained benzole, nitro-benzole, and aniline oil, and then the aniline crystals, with their various brilliant colours of magenta, mauve, violet, reds and blues innumerable almost. The latest production of tar, and perhaps the most wonderful, is saccharine, which is 230 times as sweet as sugar cane, and is sold at 26s. per pound.

WEIGHLEY NEW TECHNICAL INSTITUTE.—At the last meeting of the building committee of the above-named Institute, it was thought very desirable that the interest of all past, as well as present, students should be secured in order to make the opening ceremonies a most complete success, and with this object in view, and also that of giving the general public at the same time some idea of what has been accomplished by those who have passed through the classes, the following resolution was moved and carried unanimously. Resolved:—"That this committee invite all past or present students of this Institute and of the classes in the earlier building to co-operate in the opening of the new wing of the Technical Institute by the loan of original works executed by them outside the classes in the form of drawings, paintings, carvings, textile or other designs, models of inventions, or improvements in mechanical or scientific apparatus, and that the committee make special provision for the collective display of such works in the museum of the Institute. Also that a list be prepared of the students who have distinguished themselves as teachers or otherwise, and that such as do not contribute works be asked to make a report, setting forth the advantages they have derived from their association as students at this Institute." All students who are willing to comply with this request are desired to communicate with the secretary, Mr. J. A. L. Robson, who, we are given to understand, will be ready to answer any enquiries relating thereto, and to receive information as to the address and success of any student who has left the town and district.

LARGE HORIZONTAL PLATE BENDING MACHINE.

We illustrate on page 401 a large horizontal plate bending machine, made by Messrs. Francis Berry and Sons, of Sowerby Bridge, Yorkshire. This machine is capable of bending steel plates 18ft. 6in. wide and up to 1in. thick, cold. The rollers are of cast iron, with wrought iron shafts running through their centres, the top roller being 27in. diameter, and the two bottom rollers 21in. diameter. The top roller is balanced by weights and levers underneath the machine, and is raised and lowered by a large fly-wheel, and worm and worm wheel, so arranged that this object is easily effected. The bottom rollers are fluted from end to end, that they may secure a better grip of the plates, and have supporting rollers fitted underneath them, carried in a strong framing, which is bolted to the large girders, enabling them to resist the greatest strain. As will be seen from the illustration, the gearing is all at one end, thus leaving the other end entirely clear for the easy removal of cylindrically rolled plates. This very powerful and massive machine, which is driven by a pair of steam engines, with reversing motion, approximately weighs 50 tons, and is well adapted for the work its design indicates its power to perform. This machine was made for the Flensburger Schiffsbau-Gesellschaft, Flensburgh, and similar machines have been supplied to her Majesty's dockyards at Sheerness and Devonport.

THE INSTITUTION OF MECHANICAL ENGINEERS.

The spring meeting of the Institution of Mechanical Engineers took place in the theatre of the Institution of Civil Engineers on Monday evening and Tuesday afternoon last. The president, Mr. E. H. Carbutt, gave an interesting inaugural address, in which he reviewed the changes and improvements that have occurred in the construction and use of ordnance and armament during the past fifty years. As showing the importance of these to England and her colonies, he mentioned that the value of British ships, and of the freight they carry annually was estimated in 1881 to be not less than £900,000,000, and must now be £1,000,000,000, of which it is estimated that in the direct trade of the United Kingdom alone £144,000,000 is afloat at any one time; but British interests in sea-borne commerce are really larger, for much of what appears to be foreign trade is either British property, or security for British advances. He then mentioned that except in the superior composition of the metal, cannon cast in the reigns of the Georges exhibited little improvement upon those of the time of Elizabeth. The want of accuracy in shooting is well illustrated by the fact that in 1812, at the battle of Salamanca, 3½ million cartridges and 6000 cannon balls were fired, with the result of only 8000 men being put *hors de combat*. And as late as 1857, during the Kaffir war, 80,000 cartridges were fired in a single engagement, in which only twenty-five of the enemy were killed. The Crimean war directed attention to the fact that our guns must be improved, and a great amount of inventive talent was brought into the field. He then referred to the gun of to-day, made entirely of steel, which is provided with mechanical appliances for every movement in forts, in turrets, or on shipboard, and said that while the ability of many inventors has rendered all this progress possible, a good deal of it is due to the genius and energy of Sir William Armstrong and the late Sir Joseph Whitworth. In 1854 Sir William Armstrong obtained leave from the Duke of Newcastle to make six rifled guns. In these the general principle of construction was nearly the same as at present, namely, a central barrel of steel strengthened by hoops. In 1854 Lord Hardinge applied to Sir Joseph Whitworth to make the machinery for the production of the barrels for the Enfield rifle. This he declined to do until he could make experiments with a view to determine the proper form of rifling and the length of barrel and of shot. The Government agreed he should build a shooting gallery, in which an exhaustive set of experiments was carried out. These showed what was the best pitch of rifling, what was the best form or method of rifling, what was the best length of projectile, what shape of projectile afforded the greatest power of penetration, and a variety of similar matters; all these things were removed from the region of speculation. The experiments proved, moreover, that what was true of small-arms was equally true, *mutatis mutandis*, of cannon.

In 1856 France used some rifled field guns in the Italian campaign, and this was the signal for the re-construction of artillery in Europe. In 1858 the English Government appointed a committee to examine and report on rifled field guns. Seven different designs were submitted, and eventually the committee reported that it was expedient to continue the experiments on two, namely, the Armstrong and Whitworth guns. The Government became thoroughly committed to the Armstrong system, firstly by appointing Sir William Armstrong as head of Woolwich, and secondly by giving a guarantee to a private firm at Elswick to manufacture his guns. This was in the year 1859; but in 1862 Sir William gave up his appointment at Woolwich, and the Government gave up their guarantee to Elswick, which has ever since been conducted as a private firm. In 1868 Sir Joseph Whitworth advocated the use of flat-headed projectiles for penetrating armour under water and at angles. From the first he also advocated the adoption of long projectiles, even five and six diameters in length. This theory is now accepted to a certain extent, the length of the service projectiles having increased from 1·5 and 1·8 calibres up to nearly 4 calibres long. The flat head has never been adopted; but in these days of compound hard armour the racking effect of flat-headed projectiles may be worth trial.

In 1882 four breech-loading Whitworth guns of 9in. calibre were made for the Brazilian ironclad Riachuelo, which were adapted to fire the modern slow-burning powder. The weight of the charge was 200 lb., and the projectile weighed 400 lb. A steel shell from one of these guns was fired through 18in. of wrought iron armour with heavy timber and steel backing, and was dug out of the sand 17ft. behind the face of the target, the shell being still intact. This is the greatest recorded penetration from any 9in. gun.

Major Moncrieff invented the disappearing carriage, utilising the recoil of the gun, originally by means of a heavy counterweight, and now by means of a hydro-pneumatic cylinder, to bring the gun back into the position for firing after it has been loaded underground. In a new fort on the south bank of the Tyne Mr. Maxim is trying a new plan of disappearing gun by mounting it on a kind of gasometer, which is raised by air-pressure and sinks by its own weight.

At the fort at Dover the turret carries two 80-ton muzzle-loading guns, and is rotated by steam power. It is the only fort of the kind on our shores; we ought to have more. At Elswick much larger turrets are being constructed for the Italian Government to carry a pair of 120-ton guns, which are to be worked and loaded by hydraulic machinery; the turrets are to be rotated by hydraulic power, and the magazine cranes to be worked in the same way.

Mr. Longridge's wire gun is coming into favour. Mr. Vavasseur has greatly improved the naval gun-carriage, and utilised the hydraulic buffer with a water cataract to take up the recoil of the gun. After Sir William Armstrong left Woolwich, the Government pushed on with the manufacture of the wrought iron coil guns. A large number of new tools were designed by our best toolmakers, aided by Sir John Anderson, who had been appointed inspector of machinery. To give an idea of the amount of work turned out, I may say that, since the introduction of rifled guns in 1859-60 down to the present time, upwards of 11,000 rifled guns have been issued from the Royal Gun Factory, varying from the 7-pounder of 150 lb. weight to the 17¾in. muzzle-loading gun, and from the 6-pounder rifled breech-loader to the 13½in. breech-loading 69-ton gun. For fifteen years Woolwich was practically the only manufactory in the country making guns for the nation, as the guns ordered from outsiders did not amount to more than £1500 a year thoroughout that period. The threatened war in 1878, the year of the £6,000,000 vote of credit, made the Government review their position, and apply to our private manufacturers.

As typical of the two ends of the period reviewed, we have—year 1837, muzzle-loading cast iron gun, weighing 65 cwt., and firing a 68 lb. shot with 10 lb. of powder, taking ten men to fire one shot per minute, each shot fired costing 11s. 9d.; 1887, breech-loading steel gun with a total length of 44ft., weighing 110 tons, and firing a shot 16¼in. diameter weighing 1800 lb., which is calculated to penetrate a 34in. iron armour-plate. This gun can be trained and fired by one man with the aid of hydraulic power; and the cost of every shot fired is £190.

Our largest ironclad, costing some £600,000 or £700,000, carries only two of these 110-ton guns; but in addition it has a large number of quick-firing machine-guns. The Benbow has an armament consisting of two 110-ton guns, twelve rapid-firing guns, and fourteen machine-guns. There are also four torpedo ports on the broadside, and one at the stern, all above water. The armament of the Colossus comprises four 43-ton breech-loading rifled guns, two in each turret, firing projectiles of 714 lb. weight with a charge of 295 lb. of powder, and penetrating 20½in. of iron at 1000 yards.; also five 6in. breech-loading guns, weing 89 cwt., and firing a projectile of 100 lb. with 42 lb. of powder, and penetrating 9·7in. of iron at 1000 yards; also four 6-pounder Hotchkiss quick-firing guns of oil-hardened steel, weighing 7·3 cwt.; ten four-barrelled 1in. Nordenfelt guns of 4 cwt.; one two-barrelled Nordenfelt of 181 lb.; two 9-pounder muzzle-loading guns of 8 cwt.; two 7-pounder muzzle-loading guns of 200 lb.; and four five-barrelled Gardners of 280 lb., firing 330 shots in half a minute.

Reference was also made to the various quick-firing machine-guns, and then to our means of supply. "First we have the arsenal at Woolwich, then we have practically two other arsenals, which, although private works, would in case of war be at the disposal of the Government. Fortunately they are separated by long distances. Should an enemy destroy Woolwich, we should still have Elswick left on the east, close to the seaboard, and an inland arsenal at Manchester—namely, the Whitworth works—communicating with the west coast."

Mr. Carbut concluded with remarks on the production of satisfactory steel ingots and forgings, and by reference to the relative value of the steam hammer and press methods of producing the main parts of big guns.

The first paper read was by Mr. F. R. F. Brown, of Montreal, on the construction of Canadian locomotives. A discussion upon this was continued on Tuesday afternoon, and a second paper, by Major Thomas English, R.E., was read on some experiments on the distribution of heat in a stationary steam engine. The discussion upon this was adjourned to the next meeting, and a third paper, namely, one by Mr. John Richards, of San Francisco, on irrigating machinery on the Pacific coast, was not reached. On Tuesday evening the annual dinner of the Institution was held at the Criterion, the Duke of Cambridge being among the guests, and the president in the chair.

THE INSTITUTION OF CIVIL ENGINEERS.

WATER SUPPLY FROM WELLS.

At the meeting on Tuesday, the 19th of April, Mr. Edward Woods, President, in the chair, four papers were read on the subject of obtaining Water-Supply from Wells, namely, "Chalk Springs in the London Basin," by Mr. J. W. Grover, M. Inst. C.E.; "Borings in the Chalk at Bushey, Herts," by Mr. William Fox, M. Inst. C.E.; "On a Borehole in Leicestershire," by Mr. T. S. Stooke, Assoc. M. Inst. C.E.; and "The Wells and Borings of the Southampton Waterworks," by Mr. William Matthews, Assoc. M. Inst. C.E.

In the first paper, Mr. Grover began by pointing out what a large and rapidly-increasing water-supply was required for London, and that the Upper and Lower Greensands did not yield water in any quantity, and therefore were not available, as Professor Prestwich had hoped, for furnishing a supplemental source of supply for the metropolis. He showed that the chalk was the true source, but that care must be exercised in selecting a site for sinking a well into it; and that whilst only a moderate supply of water could be obtained where the chalk was overlaid with a thick bed of clay, owing to the compression of the fissures by the superincumbent weight, and the distance the water had to travel underground, a large supply might be secured by sinking a well at the outcrop of the chalk, at a point near a river, which indicated a subterranean flow of water. Consequently, there was no prospect that any large volume of water could be obtained from the chalk under London, or from the Upper or Lower Greensands, owing to the immense pressure upon them. The author then proceeded to describe in detail the various works carried out for supplying the Newbury, Wokingham, Leatherhead, and Rickmansworth districts with water. A plentiful supply was readily obtained for the Newbury district by sinking a 7ft. well, 13ft. deep, in the valley of the Kennet, on the west side of the town. The chalk spring struck there proved of excellent quality, and the water was raised by pumps into two reservoirs, at a high level, each having a capacity of 110,000 gallons, and commanding the whole of the town. The cost of the works had not exceeded £20,000. Two wells had been previously sunk in the Wokingham district to depths of 336ft. and 734ft., through the Bagshot Sands, London clay, and Woolwich and Reading beds, into the chalk, which failed to give an adequate supply of water, owing, in the author's opinion, to the flowing in of the fine running sand of the Woolwich and Reading beds. By sinking another well down into the chalk, which was reached at a depth of 345ft., and carefully excluding the fine sands of the Woolwich and Reading beds in its descent, a fine chalk spring was struck at 405ft., which rose to 30ft. from the surface. The well was sunk in twelve months; and several trials were made of the yield of the well, which proved that the spring flowed more freely after pumping, owing doubtless to the fissures, giving passage to the water, being cleared out and enlarged. A lower set of pumps drew the water from 123ft. below the surface. The upper pumps, capable of pumping 10,000 gallons an hour, lifted the water into reservoirs 144ft. above the engine-house floor, having a capacity of 220,000 gallons; and a constant service was afforded at a capital cost of under £20,000. The Leatherhead district included eight parishes in Surrey, having an area of 24 square miles; but it would be possible to extend its limits, and to afford a supplemental supply to South London from the Leatherhead springs, for which no other at all equally available source of supply existed. A 12in. boring was sunk to a depth of 200ft. in the chalk, through flint beds containing powerful chalk springs; and the yield of water at the depth reached far exceeded any possible requirements, the flints being continuous for the last 40ft., and forming a natural reservoir, from which the water rose to the surface when liberated by the borehole. The catchment area embraced the whole basin of the Mole above Leatherhead, over 100 square miles in extent; the water in the well kept at a level of 2ft. to 3ft. above the river Mole, and maintained an even temperature of about 53 deg. all the year round. From trials made with the pumps drawing 15,000 gallons an hour, it appeared that 1,000,000 gallons a day could be raised by the pumps from the surface, and by enlarging the borehole down to the great reservoir of flints below the 97ft. level, a minimum daily supply of 4,000,000 to 5,000,000 gallons could probably be obtained. A constant supply was provided from a reservoir, containing 125,000 gallons, the level of which would command South London with a high service. The collecting basin above Rickmansworth was 234 square miles in extent; and the water rose in many places bright and pure from the flint beds in the chalk. The subterranean flow had been estimated at 70,000,000 gallons a day at Rickmansworth; and from 5,000,000 to 10,000,000 gallons might probably be intercepted. A well was sunk near the river Colne, at a bend in the valley, where the chalk spring broke out with the greatest volume, to a depth of 300ft., through chalk and flint beds. The water rose in the well to a level of about 3ft. above the adjacent river Colne; and the volume of water obtained from the well was much augmented by enlarging the borehole and further sinking. Trials were made, during the operations, of the effects produced on the water level by pumping 21,600 gallons an hour, when the water soon regained its original level on stopping the pumps.

Mr. Fox described, in his paper, the works carried out, in the valley of the Colne, for supplying a large district lying between Watford and London. A well and boring were commenced in 1874, and completed in 1876, to a depth of 212ft., having pierced 20ft. of hard rock chalk, where it was stopped, owing to no greater supply of water being anticipated from further sinking. Trials of the yield of the well showed that it had decreased from 820,000 gallons in twenty-four hours in 1876, to 650,000 gallons in 1881; but by lowering the pumps 20ft., the yield was raised from 900,000 to 1,000,000 gallons, which was found to have been maintained on testing it again in 1885. Observations of the amount of water pumped, the level of the water in the well, and the rainfull, showed that the well and adjacent strata acted as a storage reservoir supplied by the rainfall. In order to increase the supply for an enlarged demand, a new well was sunk, in 1885, down to the gault, 700ft. from the surface, at an average rate of 16ft. a day. No increase of water was obtained in the last 200ft. The flow of water from the top of the borehole, 43ft. below the surface, into the well had diminished from 656,000 gallons to 555,000 gallons in twenty-four hours, at which rate it flowed steadily. The water in the new well was conveyed through a tunnel into the old well, from which it was pumped. When the communication was closed by a valve, the water-level in the old well was lowered by pumping without affecting the level in the other well, showing that the sources of supply of the two wells were separate. From the results obtained in sinking the new well, it would appear that a much larger supply of water could have been obtained from the old well by sinking the borehole 300ft. more. The supply was now 1,500,000 gallons a day; but some new pumps could be arranged to draw 15ft. below the present level of the old well; and by lowering the well this amount, and modifying the pumps, the yield could be increased to from 2,000,000 to 3,000,000 gallons a day.

A borehole was sunk, in 1880, to a depth of 754ft., by the local board of Hinckley, in Leicestershire, acting under the advice of Mr. Plant, for seeking a supply of water from the "Waterstones" of the Triassic formation, at the base of the Keuper Marls. The water-line was met with 80ft. below the surface; and, in 1883, Mr. Stooke advised that pumping should be effected with easily available plant. Boring rods, 3in. in diameter, and 450ft. long, served for suction pipes; and boring rods, provided with rubbers, were used as pumping rods to a depth of 300ft. The pump was worked with a stroke of 18in.; and 400,000 gallons of water were pumped out of the bore-hole in April and May, 1883. The water contained about 500 grains of solids, and 40 grains of chlorine, to the gallon. A 3in. bore-hole was then carried 51ft. lower, and gave evidence of more favourable water-bearing strata. A plug was obtained to separate the upper from the lower water, as the tubing had not been carried below 476ft. from the surface, and the pump was arranged for the plug to act at a depth of 690ft. The quality of the water, however, was no better, the solids ranging from 425 to 395 grains per gallon. The plug was then placed at a depth of 731ft., and afterwards as near the base of the original bore-hole as practicable, without any better quality of water being obtained. On the plug being raised, it did not appear that any water could have passed it, and the water from the upper strata must therefore have passed to the pump through fissures in the rock.

Mr. Matthews, after explaining the hydrographical conditions of the district round Southampton, proceeded to describe the several steps taken to obtain a water supply of 3,000,000 gallons a day for the borough, at a cost of £60,000. A small 3in. boring was first sunk 105ft. in the chalk, just above its outcrop at Otterbourne, where a remarkable convergence of water gradients, as obtained from ninety wells, had been found, with the object of ascertaining the actual presence of water before executing further works. Water was found in the chalk in good quantity at a depth of 20ft. Two 12in. borings were then sunk in eleven days, each 50ft. from the small boring, and in a line parallel to the outcrop. On pumping continuously from both borings for sixteen days, a mean discharge of 20,960 gallons per hour was obtained with a loss of head of 9⅜ft.; and on ceasing to pump, the water rose rapidly to its normal level, which is very constant there at all seasons. An adequate yield having thus been proved, the regular works were proceeded with. As the trial borings had been sunk so easily and rapidly by the ordinary "chisel-and-shell" method, the author determined to sink two bored wells, each 6ft. in diameter, instead of one large well sunk by hand in the usual manner, thereby gaining the advantage of having two independent wells, and saving the cost of temporary pumping machinery. After executing the foundations of the engine-house, and forming a strong working floor, the wells were bored to a depth of 100ft. from the surface by breaking up the chalk and flints by dropping down the iron 3in. boring rods, furnished with three steel-pointed chisels, and raising the *débris* by the "miser" to the surface. The chisels and the miser were given a rotary motion by manual labour, and the miser usually came up about two-thirds full. The first well was bored in thirty-three days, having been delayed by accidents; but the second well was completed, with slightly altered tools, without mishap, in fourteen days—a rate of over 5ft. per day. The wells were lined with ½in. mild steel tubes, 5ft. 11in. in diameter, in 6ft. lengths, with twenty-four 6in. holes in each length, to allow the free ingress of water. The cost of the bored wells was under £1700, whereas the author estimated that a single large well, lined with 18in. brick-work, would have cost between £2000 and £2500. The two wells being distinct, with independent pumps, any accident to one would not interfere with pumping in the other, and any deepening could be easily effected in one without affecting the clearness of the water in the other. The author added a short account of the deep well on Southampton Common, bored between 1838 and 1851 to a depth of 1317ft., when it only yielded 130,000 gallons a day. It traversed 850ft. of chalk, but did not reach the Upper Greensand; and an attempt in 1882 to deepen it being frustrated by a broken tool lying at the bottom, it was finally abandoned, having involved a cost of £20,000.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—George Harding, chief engineer, to the Thalia, to date May 12th; Richard S. Ham and E. J. Rattenbury, engineers, to the Thalia, to date May 12th, and to the Carysfort when recommissioned; John E. Chase, engineer, to the Seahorse, to date May 12th; George J. Ross, engineer, to the Thalia, to date May 12th; and to the Albacore when recommissioned; and Charles G. Taylor, assistant engineer, to the Thalia, to date May 12th, and to the Carysfort when recommissioned.

The Manchester Ship Canal.—This project, our Manchester correspondent says, is being pushed forward with great energy, and the amount of promised capital in its district is now well over three million pounds, but the promoters are not resting until they have capital promised to the amount of about four millions before they attempt to raise the remaining capital in London. The prospects of the final carrying out of the project may be described as very healthy, and although it was a great disappointment that the scheme had not been sufficiently advanced to enable the Prince of Wales during his recent visit to Manchester to turn the first sod, there is a very general feeling of expectation that this ceremony will eventually be performed by her Majesty the Queen, and that it will form the central incident of the jubilee year in this district.

NOTES ON SOME ENGINEERING WORKS AT BOMBAY.

By KILLINGWORTH HEDGES, M.I.C.E.

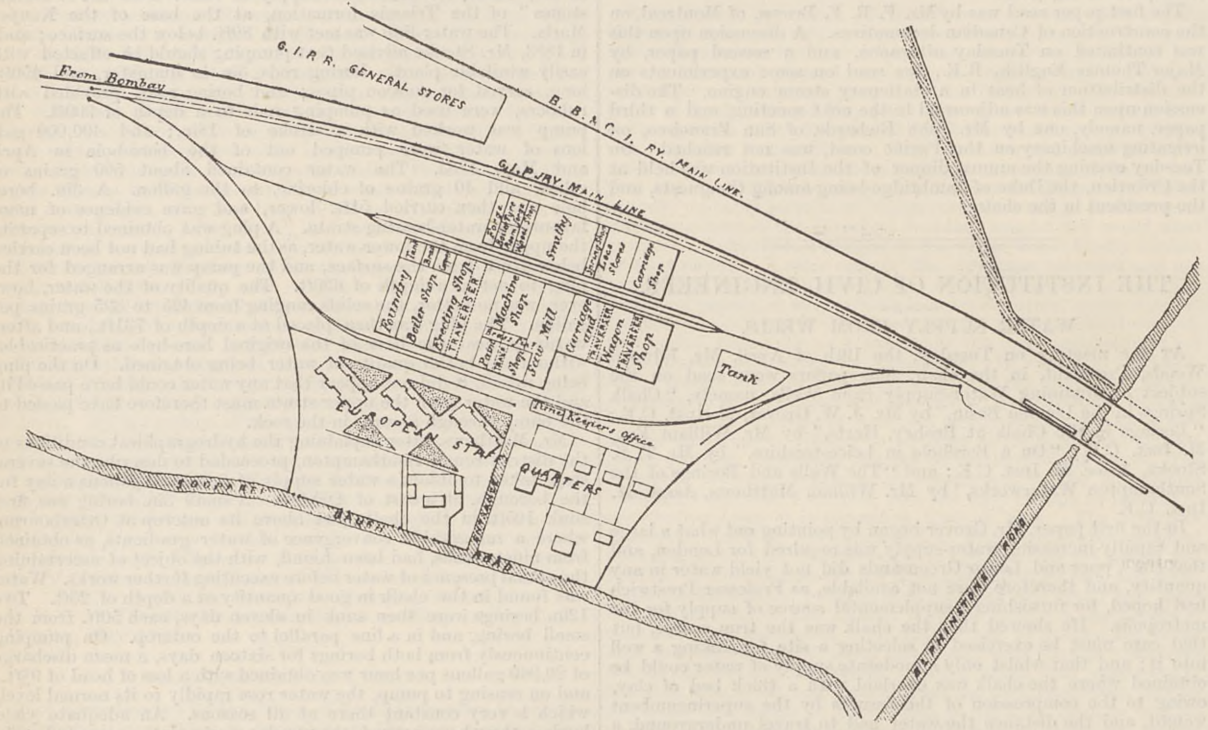
THE Prince's Dock is being greatly extended, and is the most important work in the city; also there are several extensive engineering works in active progress in the neighbourhood of Bombay. Of these, the new water supply of the city, which is anticipated to deliver thirty-three million gallons daily, in addition to the present supply, is the most important, the waters having to be led in conduits and pipes a distance of 53½ miles from the artificial lake which is now being formed. Through the courtesy of the executive engineer, Mr. W. Clerke, the writer was not only given every facility of inspecting the whole of the work, but also has been furnished with the particulars and details of the novel features which will be described in a future article. A brief account of the journey and the method adopted for securing the necessary amount of coolie labourers may be of interest to those who are not acquainted with engineering work in India.

The magnificence of the new terminus of the Great Indian Peninsular Railway impresses the visitor to Bombay. In outward appearance there is some resemblance to the Caledonian-station at Glasgow, except that the area covered by the Great Indian Peninsular terminus and offices is much larger, and after passing through the magnificent booking-hall with its vaulted roof and marble columns, one is surprised to find the platforms of the station cramped as to accommodation, and covered by a very low roof with very deficient lighting. The railway carriages are designed for coolness, having double roofs and sides; the gauge of the line, 5ft. 6in., admits of considerable interior room and ample accommodation for five persons to lie full length at night, the top berths folding up during the daytime; there is also a lavatory for each carriage, with an ample supply of water, and in some cases a shower-bath. In fact, the long journeys which passengers have to take in India necessitate sleeping accommodation to be afforded without extra charge. On the Great Indian Peninsular Railway there are three classes, a proportional charge per mile being made, so that first-class is 12 pies, or about 1½d. per mile; twice the amount of second, and four times the price of third-class; the exact fare is always marked on the ticket, and for the third-class both in English and Persian figures; the latter class is doubtless the paying factor of Indian railways. Unimpeded with luggage, the natives throng at every station, taking up positions on the platforms hours before the departure of the train, and complacently squatting until the arrival of the next train, if, as it frequently happens, there is no room.

Instead of at once proceeding to Atgaon station, which is the nearest to Tansa, the site of the artificial lake and headworks of the Bombay scheme, it was suggested that a visit should be paid to the workshops of the Great Indian Peninsular Company which are situated at Parell, a small station about five miles out of Bombay. The general arrangements of these workshops are shown by the accompanying plan. Repair work is only carried on in the locomotive department, but the carriages and wagons are constructed at Parell. Teak wood is exclusively used for the bodies, the frames being made of iron, which is also extensively employed for the covered goods wagons, the sides and roof being made of iron plates fastened to a wooden frame. There are 3000 men in the locomotive and 2000 in the carriage department, who are all natives, the European staff consisting of fifty who are foremen or draughtsmen. It is curious to see how the various trades are exclusively taken up by certain classes; thus the fitters are all Parsees, the carpenters mostly Jews, the tin-smiths Mahometans, and the copper-smiths and blacksmiths are all Hindoos. Time did not allow more than a cursory inspection of the shops, which are low and inconveniently designed, but at the same time have the reputation of efficiently meeting the requirements of the company. Indian railway travelling is slow, a great deal of time being lost at stations by reason of the apparent helplessness of the natives in getting in and out of the carriages; there is much, however, to interest the engineer. At one station we see large quantities of old pot sleepers discarded for the more practical Vignoles rail; at another, in order to save a turntable, two lines run off so as to form an inverted λ, the locomotive running up one siding and back on to the main line by the other. A temporary road has been made from Atgaon station to Tansa; a continuous string of country bullock carts being met during the seven miles of drive; these carts are owned by the contractors for the dam works, Messrs. Glover and Co., and fetch the lime from the station. The method of driving the bullocks is primitive, and simply consists of screwing their tails, the driver sitting on the pole with a tail in each hand. The animals seem little worse for this treatment, but many die in the dry season, therefore bullock transport is not so cheap as is generally imagined

The limit of what is to be the artificial lake is marked out with stones painted red; these are worshipped by the natives, whether on account of the red colour or the engineer fetish I cannot say; but we were treated to the singular spectacle of a native praying and making offerings to what appeared to be a very ordinary bench mark. The area, at present occupied by a teak forest, which is to be flooded, is eight square miles; the catchment area, from which the rainfall will be collected, is over 52 square miles, from which every source of contamination will be removed. The water will be impounded by means of a dam across the river Tansa, which will be built to a height of 109ft. above the river bed. At the time of my visit, only a small portion had been completed, to store sufficient water for the work. The total length of the dam at top when finished will be 8700ft.; and excavations for the foundations are being rapidly completed along the whole length. The ashlar work will be bonded on to the solid rock, which is only met with at a depth varying from 20ft. to 50ft., on account of the trap formation, which, cropping up to the surface in places, is full of fissures. Some 4000 men and women are at work on these foundations, the men either excavating the earth or drilling holes for blasting, the women taking away the spoil in baskets. With the exception of the tramway which brings stone from a quarry that has been opened up down the river, all the labour of removing the spoil is performed by women, who are simply provided with shallow baskets which they balance on their heads. This method is nearly always practised in India, and in the opinion of many engineers is far more efficient than barrows, trollies, or carts, and has the great merit of enabling any number of coolies to be set to work on a given spot where it is desirable to move a large quantity of spoil. For instance, on the Jhansi section of the Indian Midland Railway I found Mr. Walter Merivale, the executive engineer, had concentrated about 700 men, women, and children in a small area consisting of a depression and a slightly rising ground which was immediately required for a store yard. The method adopted was as follows:—Fifty or sixty men were told off with picks and large hoes to dig up the earth and fill the baskets. At the place where the earth was to be deposited stood six chuprassies, or foremen, with bags of tin tickets, and close to the work a responsible clerk sat with an assistant, having spread before him 50 rupees' worth of money in copper and small silver. The coolies, or cowrie wallahs, as they are termed, carry a basket-load of earth on their heads, and as they deposit it receive one or more tickets, according to the load and the fulness of their basket; half empty baskets are thrown down and not paid for, but they are generally full. As soon as a coolie has a few coppers' worth of tickets, he or she goes to the table and changes them for their value in money, and this constitutes the popularity of the system, as they can come and go as they like, and they can work fast or slow. Mr. Merivale informed me that one will often see a man ploughing in the next field leave his plough, borrow a basket, and as soon as he has earned an anna, or the equivalent of 1½d., run back to his plough. The value of the tickets is arranged so that the coolies can earn about twenty per cent more than their usual pay, which is for men about 3 annas to 4 annas a day, women, 2½ annas, and children, 1 anna to 1½ anna; this increase pays well, as a good deal more than a usual day's work is obtained. The excavation of the foundations of the dam necessitates a great deal of blasting, which is done by native labour. The contractor has one Maclean's steam drills at work; but it is doubtful whether its use is more economical than ordinary "jumping." The powder is all made quite close to the work in a most primitive manner by a native who employs women to grind it in the ordinary flour mills which are found in every native hut. The proportion is as follows:—Nitre, 2; sulphur, 2; and charcoal, 3, to which, after the paste has been dried and ground, a small portion of sharp sand is added. The cost on the ground is 16s. 6d. per cwt., and the efficiency is said to be equal to the ordinary imported powder, which would come to very much more.

In this and many other districts in India, limestone in the shape of small nodules, known as "kunkah," is found in large quantities; from it most excellent lime is made which is moderately hydraulic. The burning of the lime and the preparation of mortar is carried out at Tansa on a large scale; kilns have been erected on the plan which admits of charging and withdrawing going on at once. The lime and sand are mixed in the proper proportion by filling boxes having removable sides, allowing the whole mass to be turned with a spade and removed to the mortar mills, which are erected in batches of four edge-runners to one portable engine. The charge is ground for thirteen minutes, which is a great improvement on the native method, still adopted by the Indian Government, of mixing mortar in a shallow circular trench dug in the ground by means of a millstone pulled round by a bullock yoked to a pole, which works on a pivot in the centre of the circle. An unaccountable accident has occurred to all the portable engines employed on this work at Tansa, which, perhaps, the makers, Messrs. Clayton and Shuttleworth, may be able to explain. After working some little time, the regulator valve appears to be of little use for stopping the engine. This was accomplished at the time of my visit by the primitive method of applying a brake to the fly-wheel by means of a chain. I was informed that "the valve had been carefully inspected and was in good repair," and that up to the present time "the brake and chain was the only solution of the difficulty." The extensive character of the Tansa works may be gathered from the amount of the contract for the dam alone, which is 30 lakhs of rupees, or, roughly, £300,000, the contract time for finishing the work being six years, but it will be probably finished in less. Payment to the contractor is made monthly on the engineer's certificate, and 50 per cent. advance is made on the value of materials on the ground. Of the total payment, 10 per cent. is deducted and reserved for contingencies, and a lakh of rupees has been deposited on commencement.



GREAT INDIAN PENINSULAR RAILWAY WORKSHOPS, BOMBAY.

TORPEDO BOAT CASUALTIES.

THE following extracts speak for themselves. An inquiry is pending, and it would, of course, be premature to express any opinion on the subject until this inquiry has been concluded. Under the circumstances we feel that we shall best discharge our duty to our readers by placing before them what has been said by contemporaries presumed to be well informed on the subject.

"The torpedo boat manœuvres off Portland have unfortunately resulted in two disasters. On Monday Nos. 43 and 66 collided. The former was much knocked about in the bows, the latter, a stronger built Yarrow craft, being but slightly damaged. . . . . The second and more serious catastrophe was caused by the bursting of the boiler of No. 47 during the full-speed trials from Portland to Torquay and back. Unfortunately this accident has been attended with loss of life. The boat was towed to Plymouth by the Rattlesnake, and the five injured men were sent to hospital. Two of them succumbed during the night—H. T. Platt, engine-room artificer, and Henry Hawkins, leading stoker. Another stoker, John Abinett, is not expected to live; but the other men, Henry Ferriss, engine-room artificer, and James Bickham, stoker, will probably recover. This has been a sad event in a series of operations which were badly wanted to give both officers and men experience and practice. The results of the trial upon which the ill-fated No. 47 was engaged at the moment of the accident are, however, sure to be valuable. A Yarrow boat won the race."—*Army and Navy Gazette*, May 14th.

"Besides Hawkins and Platt, another stoker, named John Abinett, died at the Royal Naval Hospital, Plymouth, yesterday morning, from injuries received by the explosion on board No. 47 torpedo boat. Henry Ferriss and James Bickham, the other two men injured, are expected to recover. The inquest on Hawkins and Platt has been opened and adjourned until June 1st. The Admiralty have, however, ordered an inquiry into the disaster to be opened to-morrow morning on board the Royal Adelaide. Singularly enough, news of a very narrow escape from explosion on No. 57 torpedo boat was brought by the Seahorse special service tug, which arrived at Plymouth on Saturday. This boat was also one of the fleet running between Portland and the Ore Stone. After the accident to No. 47, the rest of the fleet at once returned to Portland, and on arriving there the engine-room artificer of No. 57 reported to Commander Harford that the boiler was leaking. An examination showed that not only had the top of the boiler fallen in, but that seven stays had been drawn out by the pressure of steam, and eleven others were partially drawn from the plate. Commander Harford immediately had the fires drawn; otherwise a serious explosion must have occurred. This is a very grave occurrence, and will probably lead to the boilers of all these torpedo boats being examined."—*Daily Chronicle*, May 16th.

So that our readers may be aware of the torpedo boats engaged in the present manœuvres, we annex a list of them, together with their numbers, the builder's name, and the officer-in-charge, T. meaning Thorneycroft; Y., Yarrow; and W., White. No. 81, W., Com. Egerton; No. 48, T., Lieut. Miller; No. 49, T., Lieut. Ravenhill; No. 50, T., Lieut. Greville; No. 57, T., Lieut. Harford; No. 55, T., Lieut. Carey; No. 56, T., Lieut. Austen; No. 27, T., Lieut. Coxon; No. 26, T., Lieut. Carr; No. 66, Y., Lieut. Madden; No. 70, Y., Lieut. Duff; No. 72, Y., Mr. Barrett; No. 41, T., Lieut. Colmore; No. 47, T., Lieut. Tower; No. 44, T., Lieut. Nicholson; No. 31, Y., Lieut. Hewitt; No. 35, W., Lieut. Hamilton; No. 36, W., Lieut. Heath; No. 42, T., Lieut. Armstrong; No. 58, T., Lieut. Bridson; No. 43, T., Lieut. Harvey; No. 46, T., Lieut. Grant; No. 45, T., Lieut. Thursby; No. 34, W., Mr. Jeffery.

"G. H. Y." writes to the *Times* from Devonport, May 14th:—"The calm heroism and unselfish devotion of the late George Platt, engine-room artificer in charge of No. 47 torpedo boat, deserves to be recorded. He was in the stokehold at the time of the accident, and made his escape through the water-tight door into the engine-room, and thence on deck. Almost blinded and frightfully burnt and scalded, his first thought was for others. 'Turn fire-extinguisher cock,' he gasped to the deck hands, who were assisting up the ladder. This cock can be worked from the deck, and his motive was to save the boat. When the surgeon arrived, he first turned his attention to Platt, who nobly asked to be left until his groaning companions were attended to. After nearly six hours of intense suffering, borne without a murmur or complaint, he was about to be removed to the hospital, when he asked the surgeon to allow him to remain for a few minutes as 'he felt faint.' At 5 a.m. the following morning his sufferings ended, and his gallant spirit passed away."

It is certainly a remarkable fact that during the recent manœuvres two boilers, built by the same firm, should have given way in an exactly similar manner, and it is indeed fortunate that the failure of the second did not result in loss of life. We presume the authorities will have a searching inquiry made into the cause, which is but just to Messrs. Thorneycroft, the builders, to the reputations of the men whose lives have been sacrificed, and to the country possessing no less than twenty-four similar vessels of identical construction. We shall therefore anxiously await the evidence given at the inquest, which is adjourned till the 1st of June, in hopes that the survivors of No. 47 will have so far recovered as to be able to attend. There is some consolation in the fact that it is better that these accidents, whether due to unskilful handling or to defects in design, should occur in times of peace rather than in times of war, when the consequences would be far more serious.

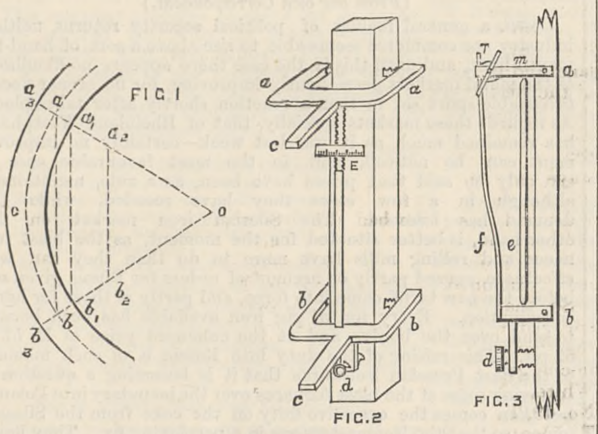
THE Bath and West of England Society's Show, which this year will be held at Dorchester, opens on the 30th inst., and remains open until Friday, 3rd June, inclusive. The programme is a very full one, especially for the working dairy department.

MEASURING INSTRUMENTS USED IN MECHANICAL TESTING.[1]

By Professor W. C. UNWIN, F.R.S.

THE determination of the exact distance between two fine marks on a standard of length is an operation of some difficulty, as is well known to physicists. But that operation is free from many of the difficulties which attend the measurements which have to be made in the engineering laboratory. Among these the determination of the modulus of elasticity—Young's modulus—of a bar by measuring its change of length by stress, is one of the most important. Now the bars subjected to test are usually, in the part which can be measured, not more than 10in. in length; and the whole elastic extension of such a bar is generally only about 0·007in. It is obvious therefore that measurements must be made with considerable accuracy and refinement to be of any value. But the bar cannot be placed in a position convenient for measurement; and the attachments to the testing machine are more or less in the way of the measuring apparatus to be applied. The bar itself is a somewhat rough bar, the form of which must not be interfered with to facilitate the measurements. Then also bars of very different forms have to be tested, flat and round, of various widths and diameters; and the measuring apparatus must be applicable to all these with equal readiness. Last, but not least, the work of an engineering laboratory is pressing, and measurements must be carried out with rapidity. In some cases, two diamond scratches have been made on the bar, and the distance between these measured by two micrometer microscopes. Apparatus of this kind is awkward to apply on the testing machine, and tedious to adjust and read. A cathetometer has been used. But then two adjustments have to be made, and two readings taken for each elongation. Also the limit of accuracy of the cathetometer is hardly sufficient for the purpose. Very often mechanical magnification by a lever is adopted. But there are some difficulties in satisfactorily attaching a lever apparatus to the bar: if a leverage of 100 to 1 is adopted, the fulcrum distance becomes very short and the range of the apparatus is limited. There is also some difficulty in the calibration of the instrument to determine the value of the readings. A micrometer screw is sometimes used as a means of mechanical magnification. With this there is, again, the difficulty of suitable attachment to the bar; and, as generally used, it is difficult to ascertain when exact contact of the screw is obtained without excessive pressure.

There is a special difficulty in measuring the elongation of ordinary test bars which has been overlooked in the construction of most of the apparatus of this kind. It is difficult to get test bars which are rigidly straight. Even if the test bar is strictly straight it is difficult to hold it in the testing machine, so that the resultant of the stress on any cross section passes strictly through the centre of figure of the section. Now if this condition is not satisfied, the bar becomes curved during the test. The straightening of an initially curved bar, or the curving of an initially straight one, introduce errors in the measurements of very considerable amount. If the measurements could be made at the axis of the bar, the errors of this kind with any amount of curvature likely to occur would not be very serious; but this is of course impossible. The best that can be done is to measure at the surface of the test bar. But, in straightening, the surface of the bar on one side lengthens and on the other shortens, and thus introduces a not inconsiderable error of measurement. If, as in many forms of elongation measuring apparatus, the measuring points are 2in. or more from the axis of the bar, the errors become very large relatively to the elongations to be measured.



Let Fig. 1 represent a bar bent in the plane of the paper, the centre of curvature being O. Then, if measurements could be made on the axis of the bar, between the points a b, the straightening of the bar would introduce an error equal to the difference of the length of the chord a b and arc a c b. With any amount of curvature likely to occur in a test bar, this error would not be very serious. Generally, however, the best that can be done is to measure the distance between points a_1 b_1 on the surface of the bar. Then, since by straightening the lines a O, b O become parallel, the error introduced is the difference between a_1 b_1 and the arc a c b; and this is much more serious. Most commonly, however, measurements are made between points on clips fastened to the bar at 1in. or 2in. distance from its surface, such as a_2 b_2. Then the error introduced by straightening is the difference between a_2 b_2 and the arc a c b; and this may be a serious error, even with a very small amount of initial curvature. If simultaneous measurements are taken of a_1 b_1 and a_3 b_3, the mean of these will have no greater error than the measurement of a b. That is, the mean of measurements on two sides of the bar reduces the error due to initial or induced curvature to the same amount as a measurement actually made at the axis of the bar.

Professor Bauschinger, of Munich, appears to have been the first to recognise the importance of this double measurement symmetrically on the two sides of the bar. He has always used apparatus in which a finger, or touch piece, attached to one end of the bar, presses on a roller attached to the other end. As the bar extends, the roller rotates by friction against the finger. A mirror is attached to the roller; and the amount of rotation is observed by noting the image of a scale in the mirror through a reading-telescope. In this way measurements to $\frac{1}{125000}$ of an inch can be taken. To eliminate errors due to curvature, two rollers are placed, one on each side of the bar, and two sets of readings are taken. This involves the adjustment of two instruments and the taking of two sets of readings. But the principle is perfect; and no more accurate measurements than Bauschinger's have probably been made.

Touch-micrometer extensometer.—The first instrument used by the author was a kind of callipers. Two bars, one sliding in the other, could be set by touch to the distance between two fixed clips on the test-bar. A scale was engraved on silver on one bar; and the distance of the nearest division from a fixed zero-mark on the other was taken by a microscope-micrometer. Readings could be taken to $\frac{1}{10000}$ of an inch. The instrument is easy and rapid to use. Readings can be taken on both sides of the test-bar; and the readings are direct on to a carefully graduated scale, so that no calibration of the instrument is necessary.

Screw-micrometer extensometer.—This aims at obtaining the extension along the axis of the bar by a single reading. Two clips are fixed on the bar, each by a pair of steel points, one on each side, gripping the bar in a plane through its axis. If, then, these clips can be made to preserve the same relative position to the bar, the middle points of the clips will move in the same way as points on the axis of the bar. Fig. 2 is a diagrammatic sketch of the apparatus; a a and b b are the clips on the test bar, fixed to it by points in its middle plane; c c are projections on the clips, to which are fixed delicate spirit levels; d is a small screw which just touches the test bar; e is a micrometer screw with graduated head, which supports the upper clip on the lower clip. In use the lower clip is first levelled by the screw d; then the upper clip is levelled by the micrometer screw, and a reading taken. The clips being always accurately levelled, in a plane perpendicular to that in which the four points attaching the clips to the test bar lie, the micrometer readings are the distances between the middle points of the two parallel clips; and their differences are the mean of the elongations on the two sides of the test bar, or virtually are readings at the axis of the test bar. Readings to $\frac{1}{10000}$ of an inch can be taken.

Roller and mirror extensometer.—Fig. 3 is a diagrammatic sketch of another instrument on the same principle; a and b are two clips similar to those in Fig. 2; the lower clip is supported on the test bar by a screw d; the upper clip is supported on the lower by a stay bar with knife edges, e. At r and m are the roller and mirror, the axis of these being at the same distance from the knife edge of the stay bar as the set screw of the clip. A touch piece or finger f attached to the lower clip presses on the roller. If the bar extends, the roller approaches the lower clip by an equal amount; it turns against the finger f; and the amount of rotation is read by a telescope and scale. This instrument will easily read to $\frac{1}{100000}$ of an inch. The roller being at the centre of the clip, its movement is the mean of the elongations on the two sides of the test bar. The author showed a third instrument on the same principle, for obtaining the compression of small blocks of stone.

[1] Read before the Physical Society.

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

(*From our own Correspondent.*)

THE better condition of the Scotch and North of England markets imparts to the Staffordshire market anticipations of a slightly brighter character. The summer weather, too, is assisting to improve the home demand. Fresh examples, however, which have occurred this week of the heavy losses occasioned by the long depression, have a sobering effect.

The mills and forges are rather better employed than earlier in the month, and specifications are somewhat more numerous.

Black sheet makers are going along pretty steadily. Specifications are, however, of a hand-to-mouth sort, and makers can see a very short distance ahead. Happily order-books have several months' work upon them, and less difficulty will be by-and-bye experienced in getting purchasers to accept deliveries. Messrs. Jno. Lysaght are running both their Swan Garden and Osier Bed Works at Wolverhampton briskly, and are producing a larger outturn of sheets than any other one firm in the entire trade.

Hard singles are quoted this week £5 17s. 6d. per ton; doubles, £6; and lattens, £6 17s. 6d. to £7. Galvanised corrugated sheets are about £9 15s. to £9 17s. 6d. delivered in the Mersey from this district. Last month's exports reached 11,828 tons, which is regarded as a capital total.

A new galvanising works has this week been started at Tipton by Mr. Edward Bailey, of the Crown Ironworks, who has long been engaged in the black sheet trade. The firm are beginning upon a modest scale, but their machinery is of sufficient size to treat sheets 4ft. wide, and in the ordinary sizes 12ft. lengths can be treated. The plant has been laid down by Messrs. Thomas Bridges and Sons, engineers, Wolverhampton, and is driven by two engines, one vertical, and one of the horizontal type. The new works are so arranged as to enable the sheets to pass rapidly from hand to hand through the various processes.

Orders are being placed by Staffordshire brokers with North of England firms at much less than Staffordshire prices. Tank plates, guaranteed to flange cold, are being bought, delivered into the Thames, at £5 12s. 6d. per ton, while the minimum price which Staffordshire makers can accept is £6 15s. For steel plates of Northern make £1 per ton additional upon the price of iron is paid. Local plate makers have also to meet Belgian competition. The Belgians are delivering tank plates, guaranteed quality, into London at £5 17s. 6d. per ton. The demand for Staffordshire boiler plates continues quiet, and makers quote £7 upwards. Superior qualities go up to £9 and £10.

Steel is selling in increasing quantities. Formerly the output of plating bars in Staffordshire was something like 2000 tons per week. This demand is now being rapidly monopolised by the steelmasters, particularly those of South Wales. Steel plating bars are being delivered here at £4 15s. to £5 per ton, which is £1 per ton less than is demanded for local iron bars.

The facilities which modern steel works possess for rolling every class of manufactured product direct from the ingot are enabling them to supply steel bars at prices scarcely more than blooms and billets. Blooms delivered from outside districts are quoted this week, £4 10s. to £4 15s. per ton; while the price demanded for tin bars is only £4 15s.

Pig iron is changing hands in moderate lots. Buyers of hematites from the west coast express intention of remaining off the market until, if possible, 52s. 6d. is again touched. Sellers give them no encouragement. Ores are still 2s. per ton dearer than before hematites went up, which means an increase of 4s. per ton in the cost of production, so that there is no room for lower prices. 57s. 6d. to 60s. is this week quoted by good west-coast firms, but Welsh hematites may be had at 52s. 6d. for Nos. 3 and 4, and 55s. for No. 1. Blaenavon hematites are quoted 55s. for forge, and for No. 6 cold blast iron for chilled roll purposes as high a figure as £6 into trucks at Blaenavon, or £6 10s. delivered, is being realised. Staffordshire all-mine pigs are nominal at 52s. 6d.

Lincolnshire pigs are quoted 39s. to 40s. delivered, Derbyshires are 37s. upwards, and Northamptons 36s. and on, Staffordshire part mines are 40s. to 45s. according to mixture, and common 30s. easy.

Messrs. Brown, Marshalls, & Co., of the Britannia Railway Carriage and Wagon Works, Birmingham, have sufficient work in hand to keep them busy for some time yet. Among the contracts which they have just received is one for the carriages and wagons required for the new Delagoa Bay and East African Company. The firm have also secured from the Indian Midland Railway Company the largest order for rolling stock which has been placed in England for many years. It consists of 205 carriages and fifteen horse-boxes, and carriage trucks.

Among the contracts for railway material now on the market is one on account of the Indian State Railways for the supply of cast ironwork for bridge piers, ironwork for roofing, and the like; and for the Bengal-Nagpur line there are required 12,000 tons of steel Vignoles rails, 180,000 steel transverse sleepers, 750 tons of steel fish-plates, and 180 tons of steel fish-bolts and nuts.

The industrial portion of a Jubilee Exhibition, opened at Dudley on Wednesday by the Countess of Dudley, contains a number of scientific appliances, models relating to mining, and a variety of machinery in motion.

The precarious position in which the Birmingham glass trade has been placed by the severe competition from Germany has led to the consideration between the masters and men of alterations in the labour system. At present these alterations have not taken a definite shape. The men declare that no opposition shall be given to new modes or systems of work provided that wages are not reduced.

A deputation of directors of the Manchester Ship Canal attended at a special meeting of the North Staffordshire Chamber of Commerce held on Tuesday at Hanley. Mr. L. Williams, engineer of the company, explained the course of the proposed canal, and Sir J. C. Lee addressed himself to the financial part of the subject. Mr. J. K. Bethell, who followed, asserted that when the canal was cut materials might be brought into the Potteries from Liverpool at 3s. per ton less than the present rate of carriage.

NOTES FROM LANCASHIRE.

From our own Correspondent.)

Manchester.—Although it can scarcely be said that trade itself shows any really appreciable improvement, the iron market shows, if anything, a tendency towards a stronger tone. The reports which have come to hand of an improvement in the Glasgow and Middlesbrough markets have tended somewhat to relieve the feeling of depression prevailing here, whilst rumours of the probable stoppage of one of the large pig iron making concerns in the district, and the consequent withdrawal of some of the low-priced pig iron from the market, have helped to strengthen the hands of makers. This has resulted in buyers who have been holding back manifesting more disposition to place out their orders, whilst makers have shown less inclination to entertain the very low prices which have been recently current. One or two moderate transactions have been put through which perhaps would not yet have come upon the market, and there are inquiries stirring which are an indication that buyers are now watching pretty closely the course of events, with a view to business when they are satisfied that prices have got down to their lowest point. There is, however, still so much iron in the market that buyers generally feel themselves relieved of any real anxiety as to the future, and business of any weight is only practicable where makers are prepared to take very low figures.

There was a moderate attendance on the Manchester iron market on Tuesday, with rather more inquiry stirring, and in some instances a fair business being done. Generally, however, trade was still only dull, and for both common pig iron and hematites prices were very irregular, quoted list rates, as a rule, being little more than nominal. For Lancashire pig iron makers' quoted prices remained at about 38s. 6d. to 39s., less 2½, for forge and foundry qualities, delivered equal to Manchester, but in the open market they would have to come considerably below these figures to secure orders, although on occasional special sales they are being obtained, and local makers are not anxious sellers at much under their list rates. For district brands 36s. to 37s., less 2½, delivered here, represent the prices which makers of Lincolnshire iron would in most cases be prepared to accept; but in some instances 1s. per ton above these figures is being held for, and there is if anything less eagerness to press sales. Outside brands, such as Scotch and Middlesbrough iron, were not to be got at quite such low figures as would have been taken last week.

Hematites are at present so very irregular in price that it is scarcely possible to get at any really fixed quotation, the actual selling price being apparently determined by the special conditions of each separate transaction. As an indication of the wide margin there is between the prices current in the market, I may mention that there are some local makers offering at as low as 47s. 6d., less 2½, delivered into the Manchester district, whilst other brands are quoted at 53s. 6d., less 2½, and the really selling price may be almost said to range anywhere between these two figures.

In the manufactured iron trade the general tendency seems to be to quiet down. A few works are still kept busy, but most of them are only indifferently employed, and orders are running out faster than they are being replaced. This is naturally causing makers to be more eager to secure what new work there is giving out, and although £5 per ton is still the quoted basis for good qualities of bars delivered into the Manchester district, with hoops averaging £5 5s. to £5 7s. 6d., and sheets £6 5s. to £6 10s. per ton, there is an increasing disposition to meet buyers where they have actual specifications to give out.

The condition of the engineering trades in this district remains without improvement. There are a few firms who have special orders in hand who are fairly employed, but others have very little to do; and taking general engineers, locomotive builders, and boilermakers, all through the district, they are but very indifferently off for work, and in these trades the outlook for the future is anything but encouraging. Machine makers and toolmakers are perhaps better off than other branches, and in some instances they are fairly busy with work on hand, but this is not being followed up with new orders of any weight. The monthly report of the Amalgamated Society of Engineers again shows a slight reduction in the number of members out of employment, but pattern makers are not in as good demand as they were two or three weeks back, and the reports as to the actual condition of trade in the various districts can scarcely be said to show much real improvement, as it is still only in exceptional cases that trade is returned as really good.

As I anticipated last week, the overtime question in the engineering trade of the Bolton district has resulted in a strike on the part of the men. Before the notices requiring the men to work overtime when necessary had expired, they decided that unless these notices were withdrawn they would cease work, and they further resolved to demand an advance of wages equal to about 7½ per cent., being the amount which was taken off at the commencement of last year. The matter, consequently, has now resolved itself into a question of wages, and the men are receiving the full support of their respective trade union organisations in the action they have taken. On both sides a most determined attitude is being shown, and the employers, who are thoroughly unanimous in their refusal to accede to the demands of their men, feel no apprehension about being able to readily fill their shops with any workmen they may require to take the place of those who have gone out on strike. The struggle has only commenced this week, and it is difficult to foresee what further development it may assume, or whether it may not result in much wider disturbance of the relations between employers and their men with regard to wages. As I pointed out last week, there is a very unsettled feeling amongst the men in other districts, but the present impoverished condition of the various trades union societies' funds may possibly prove a sufficiently powerful restraint against any widespread strike being entered upon.

So far as the promoters of the Rating of Machinery Bill—of which full details have previously been given in THE ENGINEER—are concerned, they have now closed the evidence they have to give in favour of the measure, and they appear to be confident of success; but while they have received the active support of the Manchester Corporation, they are meeting with opposition from the Board of Guardians at Sunderland, which strikingly illustrates the different points of view from which the question is regarded in two important engineering centres. Of course, in the Manchester district, where the proposed Bill originated, there is a large quantity of loose machinery with regard to which it is being sought to obtain relief from rating; but in the Sunderland district, where the bulk of the engineering plant consists almost exclusively of heavy tools and other fixtures, the necessity of the measure is not appreciated, and hence the decision to oppose it.

In the coal trade business has quieted down very considerably during the past week, and it is not only that house fire coals meet with a slow sale, but steam and forge coals and engine classes of fuel are also in poor demand, and plentiful in the market. Stocks of round coal are beginning to accumulate, and pits generally are not working more than four and a-half to five days a week. Prices, although not quotably lower, are easier, and at the pit mouth average 8s. 6d. for best coals, 7s. seconds, 5s. 6d. to 6s. common house coals, 5s. to 5s. 6d. steam and forge coals, 4s. 3d. to 4s. 9d. burgy, 3s. 6d. to 3s. 9d. best slack, and 2s. 3d. to 2s. 6d. common sorts.

The shipping trade is quiet, with steam coal delivered at the high level, Liverpool, or the Garston Docks to be got at 6s. 9d. to 7s. per ton.

Barrow.—A quiet tone is still reported in connection with the hematite pig iron trade of the Furness and Cumberland district.

The sales which are made are mainly at low rates, but buyers of special brands pay the full prices asked by makers. The demand is, however, good, if makers would make same concession in prices; this they are not disposed to do. The selling price of second-hand parcels during this week has been at about 42s. per ton net, but makers are asking 44s. per ton, and for the iron they sell they are getting this money. This price, however, shows a drop on the week of from 1s. to 2s. per ton. Makers are busy on old orders, and the work already in hand will furnish them with full employment during the remainder of the season. It is probable that prices will advance before they again decline, and the enquiry from America and the colonies is in itself proof that large orders are shortly to be placed if buyers and sellers can agree as to prices. It is rather remarkable that the price of iron should go down in the same week that the price of steel advances. The price of rails this week is quoted at £4 2s. 6d. to £4 5s. per ton, net, f.o.b. at makers' works. There is an improving demand for rails both for home and the American markets, and in all probability some considerable contracts will be booked at an early date for delivery during the season. There is considerable activity at the steel mills, which are all working full time night and day. Merchant mills are not, however, fully employed. There is a good demand for blooms, especially from America. Prices are quoted for samples 7in. by 7in., £3 15s. to £3 17s. 6d. per ton net f.o.b. There is still a good demand for billets, and a full inquiry for steel shipbuilding material. There is not much doing industrially in the latter department, but it is expected at Barrow that a large plant recently laid down for the manufacture of all kinds of steel shipbuilding material will be put in early operation. Shipbuilders in the locality are indifferently supplied with orders. No new contracts have been booked lately, but it is certain that more inquiries are offering, and some of these are likely to lead to important contracts. The finished iron trade is quiet. Prices show no variation, but they are considered to be very unremunerative. Bars are quoted at from £5 to £7 per ton, and angles from £5 2s. 6d. to £7 5s. per ton. The iron ore trade is not so active as it has been, and prices are again a trifle lower, ranging from 8s. to 11s. per ton net at mines for good average qualities. The coal and coke trades are steady. Shipping is again more briskly employed. The steamer Carmona, which took out over 6000 tons of pig iron from Barrow for New York eleven weeks ago, is given up as lost, with her crew of thirty-nine men.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

IN both the light and heavy industries there is a perceptible diminution in the orders received of late. Some classes of heavy work are well in request, but others are not called for to anything like the extent anticipated. In the lighter trades, particularly of cutlery and plated goods, the business, both on home and foreign account, is much quieter. The continuance of cold weather is not encouraging the seaside people to order new goods, and hotel requirements are not at all heavy. Edge tools, saws, files, &c., with certain classes of mining and entrenching tools, have been very active during the whole season, and the demand, both on Colonial and Continental account, is maintained.

The enterprising preparations at several of our large firms to meet the increasing demands of the Government in war material are rapidly approaching completion. Messrs. Vickers, Sons, and Co. have had their forging press in operation for some time; Messrs. Thos. Firth and Sons, who have devoted their attention to adding to their hammer power, are also in work with their new machinery; Messrs. John Brown and Co. expect to have their press ready in a few days; and Messrs. Charles Cammell and Co. will follow shortly. In connection with these and other works, specialities are being made by neighbouring firms. A large anvil block, to be utilised as a powerful hydraulic ram, has been manufactured by Messrs. Watson, Moorwood, and Co., of the Harleston Ironworks, Harleston-street. The block weighs thirty-five tons, and has been constructed to withstand an enormous pressure. A second anvil block has been made by the same firm.

Messrs. Craven Brothers and Co., of the Darnall Carriage and Wagon Works, Sheffield, have despatched to London this week a pattern train, which they have completed for the Metropolitan Railway Company. The train, which has been designed by the builders, is composed of nine coaches, including three first-class carriages. Each coach is made of Indian teak wood; the tops are rounded to avoid striking the tunnels, and there is a contrivance by which fresh air is admitted—with closed windows—while at the same time smuts and dirt are excluded. All the coaches rest on Mansell's carriage wheels, and are provided with central buffing and draw gear, arranged in such a manner that when the automatic brake is applied, the train can be pulled up with safety, and without rudely jolting the passengers. The gear has been adjusted to admit of the train taking sharp curves safely. Attached to each wheel is a patent axle-box supplied with a door, by opening which the guard can at once ascertain while the train is in traffic whether the axle-box is heated. The upholstering and fittings for the carriages—first-class, second-class, and third-class—are far more luxurious than anything yet provided on the Underground.

Messrs. J. G. Lowood and Co., of Sheffield and Deepcar, who have a wide reputation for fire resisting goods connected with the iron and steel industries, have in their possession a piece of brickwork, taken from a Siemens-Martin open hearth furnace, which is particularly noteworthy. It had been working in the establishment of Messrs. Bolckow, Vaughan and Co., of Middlesbrough-on-Tees, for nearly twelve months, and had run 462 casts, and produced 6056 tons of Siemens mild steel without rebuilding, the sample having been at work the whole time. This firm have sent to the Newcastle Exhibition a collection of their manufactures, including working samples of the silica bricks, built up in the form of the back end of a Siemens-Martin furnace, showing the gas and air ports, the parts subjected in this kind of furnace to the most intense heat. Samples of bricks are shown after having been in use in almost every description of furnace where great heat is needed. Some of these samples have undergone the ordeal of fire to the extent of 2000 tons and upwards of steel being melted in front of them. The example mentioned is the most extraordinary. Messrs. Lowood also exhibit a specimen taken from the roof of a copper refinery after being at work six months. It shows, in an interesting way, how certain chemical properties eliminated from the copper in a refinery furnace act upon the construction of the brickwork. The firm also include samples of their different manufactures for the Bessemer steel process, such as converter tuyeres, ladle bricks, nozzles, stoppers, and other goods required by the iron and steel industries throughout.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was a good attendance at the Cleveland iron market held at Middlesbrough on Tuesday last, and the tone was decidedly more cheerful than it has been for some weeks. Buyers are beginning once again to show a disposition to operate, and prices are stiffening accordingly. Last week, No. 3 g.m.b. was bought at 33s. 6d. per ton, but on Tuesday last 33s. 9d. was the lowest at which it could be obtained, and it was only certain of the merchants who would accept that figure. Most of the others asked as much as 34s. For delivery over the next three months some sellers are prepared to take 34s. for No. 3, but in face of the improved feeling the majority will not commit themselves so far ahead. Makers are still fairly well off for orders and continue to keep out of the market. A steady demand has sprung up for forge iron, and the price is firm at 32s. 9d. per ton.

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

Warrants, which were 33s. 4½d. per ton last week, were on Tuesday sold at 34s. and 34s. 1½d.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s Middlesbrough store amounted on Monday last to 328,743 tons, or 730 tons less than on the previous Monday.

The pig iron shipments from the Tees continue to be very satisfactory. Up to Monday night last 39,673 tons had left the port of Middlesbrough since the 1st inst., as against 35,249 tons during the corresponding portion of April.

Finished iron makers have begun to speak somewhat more cheerfully of their future prospects. Inquiries have been more numerous during the last fortnight. The amount of business actually transacted has, however, not been large, as the prices offered by consumers are too low. Makers maintain their quotations at the figures last quoted, on the ground that they cannot accept less without incurring loss.

During the last few days salt has again been reached in the neighbourhood of Middlesbrough. It is only a few weeks since that the Middlesbrough owners, a company of gentlemen mainly consisting of members of the Pease family, who own a considerable landed property in and about the great iron city, determined to try their fortune by boring for salt at a point near the North Ormsby toll-bar. Success has crowned their efforts. The seam reached is the same as that which is being worked by the various other salt companies in the district. It is expected that no time will be lost in putting up the necessary buildings, machinery, and salt pans, and that soon a busy industry will spring up in this particular locality. Judging by the rate at which new borings are being made and others projected, there seems to be considerable danger that the salt industry will soon be overdone. The present total output of the salt works on both sides of the river is about 2800 tons per week, which, valued at 10s. per ton, represents a weekly turnover of £1400. There is said to be about 4s. per ton profit out of this. But it is clear that competition will tend to reduce this margin, and that before very long the salt trade, like many others, may not be worth doing. If people were wise, they would wait for a time in order to see the effect of the new-made bore holes upon the market. But they seldom or never are wise in these matters, and they are now pretty certain to go on without much consideration of consequences until the profit has disappeared from all producers alike. The general public will be the only gainers in the long run.

Among the exhibits at the Newcastle Exhibition worthy of special notice is that of Messrs. Crewdson, Hardy, and Co., of the Yorkshire Tube-works, Middlesbrough. It consists of two upright tubes of wrought iron, tapered gradually from 3in. to 1½in. in diameter, joined at the top with wrought iron cross-pieces and a cross-bar of 1½in. tube. Below are various lengths of butt-welded steam and galvanised tubes from ⅛in. to 6in. in diameter, screwed and socketted. Below and in front of these there is a profusion of crosses, tees, round elbows, square elbows, back nuts, diminishing sockets, flanges, eight, six, and five-way pieces, and cast iron main cocks, ranging from ⅛in. to 4in. in diameter. In another place are samples of strong hydraulic tubes, square oval, and fire-bar section tubes. On one side of the stand is a tubular coil made from a length of 70ft. without joint, and two tubular pyramids formed by placing one tube inside the other, these varying from ⅛in. to 6in. in diameter. On the other side are three blast furnace tuyere coils and a set of cast iron flanged gland and plug cocks from 2½in. to 4in. in diameter; and in front of the whole is a barrier formed by a galvanised square-sectioned tube twisted throughout its length and carried upon tapered tubular stanchions to which it is united by wrought iron cross-pieces.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been comparatively firm during the greater part of the present week, and the prices of warrants have been tending upwards. The shipments were a little larger than in the corresponding week of last year, but not to such an extent as to influence the market. The firmness is attributed to a scarcity of warrants at the moment, and likewise to the strikes on the Continent and in America. Warrants have ranged about 41s. to 41s. 5d. cash. The past week's pig iron shipments were 2372 coastwise and 6015 abroad, the total of 8387 tons corresponding with 7993 last year. There is no change in the number of furnaces in blast—eighty-one against ninety at the corresponding date. Additions continue to be made to the stocks of pigs in Messrs. Connal and Co.'s Glasgow stores to the extent of about 2000 tons a week.

The current values of makers' pigs are as follows:—Gartsherrie, f.o.b. at Glasgow, No. 1, 48s., No. 3, 44s.; Coltness, 54s. and 44s. 6d.; Langloan, 50s. 6d. and 46s.; Summerlee, 52s. and 43s.; Calder, 49s. 6d. and 42s.; Carnbroe, 43s. 6d. and 40s.; Clyde, 46s. 6d and 41s. 6d.; Monkland, 43s. and 39s.; Govan, at Broomielaw, 43s. and 39s.; Shotts, at Leith, 48s. 6d. and 45s. 6d.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 47s. and 41s.; Eglinton, 42s. 6d. and 38s. 6d.; Dalmellington, 43s. 6d. and 40s.

The proposal to increase the Canadian import duties on pig iron and steel, which is expected to take effect without delay, has taken the iron trade here by surprise. Such a thing has only been spoken of as probable for a short time; but from the tenor of the telegraphic advices to private firms received this week from Canada it appears that the increased duty is either already in force or is expected to be so without delay. The amount of the rate on pig iron is to be doubled, which will bring it up to 4 dol. 48c., or about 18s. a ton. Such a change cannot fail to be an inconvenience, at least at first, and it may possibly reduce materially the amount of pigs sent to Canada. The shipping season has only just opened with the re-opening of navigation, and so far there has been despatched from Scotland 4273 tons to Canada, as compared with 5046 in the same period of last year. An order for 1000 tons was received in Glasgow this week, and it is just possible that others may follow, although this will depend altogether upon the pressure of the demand in Canada. Our exports of iron and steel goods, either partially or wholly manufactured, is somewhat extensive to the Dominion, and some anxiety is felt as to how these may be effected; particularly is this the case with orders now in progress of manufacture.

The West of Scotland Steel makers, as I anticipated last week, have obtained orders for about 10,000 tons of shipbuilding steel for large orders recently placed with Clyde builders. The prices have been somewhat reduced from those formerly quoted, on condition, it is said, that specifications be at once supplied to the makers.

There is a brisk demand for ell coal for shipment, but main coals are not so much required, or rather, the supply is so great that individual coalmasters are not able to get their output fully disposed of. Steam coals are in steady request, and the prices of this quality are well maintained. The quotations of ell and splint coals are somewhat easier.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE coal export from Cardiff last week to foreign destinations was one of the highest on record—190,000 tons. This enormous total caused a great deal of activity in the Rhondda collieries, and indeed in the Taff and Aberdare Valleys full time has been the rule of late.

Newport shared somewhat in the pressure, and the coasting total was increased, but Swansea only retained its average. There has been no change in quotations, and the only result of the increased demand has been to keep prices firm, 8s. 6d. f.o.b. now being the ruling figure, instead of fluctuating about and receding to 8s. 3d.

It may now be regarded as a certainty that a fair part of the summer trade is secure, as substantial orders are being put in which will take some time to execute. This will give the colliers ample work, even if it does not increase their wages, and this cannot be expected until an advance takes place. If coalowners could get 7s. at pit for their coals an advance of wages would soon follow. The next declaration of audit will, I expect, be "No alteration."

I find on inquiry that a good deal of difference still exists in the cutting price of coal. The Rhondda collieries pay better than the ironwork collieries. Such is the statement, while buyers are, of course, dependent upon the character of the seam, and while in one place colliers get 1s. 3d. per ton for cutting, another will be 1s. 10d. About the best results attained by colliers at present are 5s. a day wages. Colliers having a boy just passed the standard with them, with full time, get £2 per week. This is in striking contrast to the ironwork labourers, who rarely get more than 2s. a day. I am not surprised, seeing that the colliers are now fully employed, that they have ceased from "meetings." They are now benefitting by their peaceful resolve not to follow the "Tyne lead."

The only meeting of importance lately was held by the associated and non-associated coalowners at Cardiff, on Saturday, A. Hood in the chair, when the Mine Regulation Bill was thoroughly discussed and amendments formulated which will be at once brought under official notice.

I am sorry to note that tin-plate workers are beginning to "sow the wind" again. Meetings have been held in the Swansea and Monmouthshire district, and the basis of a wide organisation has been laid which means mischief. Gloucestershire is to be included, and the weekly subscription of members are so arranged as to admit of as much as £1 being paid to men on strike. This is one of the strongest temptations to strike I have seen. Few men can resist the temptation of idleness, coupled with a pound sterling per week. There has been a good deal of business done of late at the old prices. These are—coke wasters, 12s. 3d. to 12s. 4½d.; best wasters, 12s. 6d. to 12s. 9d.; cokes, up to 13s.; Bessemer steel to 13s. 6d.; Siemens, which command most attention, vary from 13s. 6d. to 14s.

There was not such a large export from Swansea last week, but business is tolerably good and prospects substantial. There is a rumour in circulation that a tin-plate works at Briton Ferry are to be started, and this has given great satisfaction.

In rails some works are doing a good deal of business, though prices are not remunerative at £4 2s. 6d. to £4 7s. 6d. Dowlais keeps one mill going pretty exclusively for rails, which are run off in lengths of three. Cyfarthfa is more fully occupied with tin bar; as for steel sleepers I hear little about them; though from a large quantity stocked in the neighbourhood of one of the large Welsh works it does not appear that prospects are good. American business is looking up, but Canadian has re-awakened anxiety. Ironmasters are contending that reciprocal trade arrangements should be legalised. These restrictive tariffs are doing great injury. In respect of steel, Wales is now sending a fair make of blooms, which, but for the tariff, would, to the greater satisfaction, I am told, of the American buyers, be converted into steel rails before leaving the works.

The Treharris Colliery the men have begun to agitate for a concession of reduction of rents from landlords—quite a new movement.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

UNTIL a general feeling of political security returns, neither industry nor commerce seems able to rise above a sort of hand-to-mouth limit, and until this is the case there appears no likelihood of the metal markets permanently improving, for no sooner does a favourable spurt set in than a reaction shortly after takes place. As regards these markets specially, that of Rheinland-Westphalia has remained much as it was last week—certainly no improvement can be noticed, and in the most favourable case it can only be said that prices have been, as a rule, maintained, although in a few cases they have receded, while the demand has lessened. The Silesian iron market, on the other hand, is better situated for the moment, as the blast furnaces and rolling mills have more to do than they can well effectuate, caused partly on account of orders for Russia given out before the new tariff came into force, and partly of those for home consumption. Every ton of pig iron available has been bought to send over the border, and at the enhanced price of M. 51 to 52 p.t. This raising of the duty into Russia is of such moment to the East Prussian ironworks that it is becoming a question of removing some of the blast furnaces over the boundary into Poland; but then comes the excessive duty on the coke from the Silesian mines, so that the ironmasters are in a perplexing fix. They have, however, now thoroughly established in working order their common bureau at Berlin, and from this their inland and export business will now be vigorously pushed. The wire rod mills and the wire-working industries are also so well employed that further orders are only taken when there is no obligation as to time of delivery.

The Belgian iron market is still very firm, and pig iron maintains its price well at 40f. to 46f. p.t., and common bars are noted 100. The talked-of rise in girders has been abandoned. The export of rolled iron in 1886 was 470,000 t.

The French iron market is slowly improving, and prices are advancing, except at Paris.

There is little change in the prices of ores here. On the Siegen Exchange the prices varied for red, brown, and steel stone from M. 8·20 to 11·80 p.t. The pig iron prices are also unchanged, and are quiet. Endeavours are being made to cheapen production by the substitution of brick hot-air stoves, on the Cowper system mostly, for the old-fashioned iron ones, by heightening the blast furnaces, and erecting cogging mills at the steel works. At the same time, the State has also just reduced the railway frieghts on iron and steel, and their manufactures by 25 to 30 per cent. Spiegel is not quite so well called for for export, but the price has kept up. Forge pig is in moderately good and regular demand in Westphalia, and prices could therefore be maintained, which, however, was not the case in the Siegerland. The pig iron combination decided at their last meeting to continue the minimum base-price as last noted. The consumption of pig iron has not decreased, and the lowering of prices has never, in this country at least, led to more business. On the contrary, it gives buyers a hint to hold back any orders they have to place, in the hope of cheaper prices coming eventually. Most of the rolling mills have still work enough to keep them moderately busy, and in nearly every case the prices have been upheld. The bar mills are most busy, but some are inconvenienced waiting for specifications, though the contracts for delivery have been made. On the whole, however, the demand may be said to have slackened. The convention price of M. 110 p.t. cannot always be obtained, as dealers come in at cheaper rates, but even the convention price scarcely leaves a margin at present price of pigs. In heavy plates no change has taken place. Thin sheets are cheaper, and are now quoted at M. 130 p.t. base price. The works, generally speaking, have enough orders in the books, only a few complaining of their absence. Stocks are not large, and during the summer, the usual busy time, they will soon be cleared off. There is nothing new in the wire rod department, and the same may be said of railway material. The foundries and machine shops are in the same condition as last week, except that an order for eight six-wheeled locomotives has just been given out, the lowest tender being M. 15,000 a-piece at the works. The brass founders were better off last month. Sufficient orders came in from home and foreign customers to keep them well employed, and hopes of higher prices than the last noted are entertained, as till now they have been anything but remunerative.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, May 5th.

TO-DAY's advices from interior industrial centres indicate that there is an improving demand for material for railway building shop and agricultural purposes. Manufacturers of all kinds have begun to order more liberally, finding that bottom prices have been reached, and that labour organisations are not likely to make trouble. Disputes in Chicago have been settled, arbitration has been established at several points, and there is a general disposition among employers and *employés* to avoid any serious trouble. At this time 100,000 anthracite miners threaten to strike for a 10 per cent. advance, but they are willing to arbitrate, and will probably be met in a friendly spirit. The Delaware River shipyards are well off with orders, and there is a great deal of inquiry for coastwise and river tonnage. The new freight law is stimulating Lake craft building to supply facilities for carrying wheat, coal, ore, lumber, and other heavy products between Buffalo and extreme north-western points.

The industries throughout the country are generally in a healthy condition. The iron trade is improving. The steel makers have practically as much business as they can safely handle. A large amount of foreign material is arriving in the shape of tin-plates, iron and steel rods, and crude steel. Very few orders are going abroad for material. The lumber trade is very active, on account of the heavy demand for building purposes in all of the larger cities and towns; an excellent season is in sight. Values will be steady, and shop and mill capacity will be uninterruptedly engaged.

The anthracite coal combination has practically fixed prices for the season. During the past week contracts have been placed for 500,000 tons of bituminous coal by the New England and Eastern Railroad Companies, and manufacturers are now placing their orders for coal which costs at Atlantic Coast delivery points 2·50 dols. per ton. 3000 coke ovens are being built in Pennsylvania, in addition to 17,000 already in operation.

To-day's selling prices are 21 dols. for average No. 1; 39 dols. at mill for steel rails; 22 dols. for old rails. Furnace production is 136,000 tons per week. Heavy machinery contracts have been placed this week for manufacturing establishments in the Southern States. The builders are overcrowded with building contracts, and this year's work will far exceed any former year. A number of petty strikes are in progress in the city. The tendency is in the direction of greater activity.

NEW COMPANIES.

THE following companies have just been registered:—

Cast Steel Foundry Company, Limited.

This company proposes to carry out an agreement entered into with Sir Joseph Whitwell Pease, Bart., M.P., and William Fowler, Esq., for the purchase of the Roseberry Steel Works, Middlesbrough. The company was registered on the 9th inst., with a capital of £24,000, in £20 shares. The subscribers are:—

	Shares.
Sir Joseph W. Pease, Bart., M.P., Gisborough ..	1
D. Dale, Darlington, colliery owner	1
*J. Walton, Saltburn-by-Sea, colliery owner ..	1
*T. D. Ridley, Middlesbrough, contractor ..	1
*J. Featherstone, Middlesbrough, agent ..	1
*J. A. Pease, Darlington	1
W. Shaw, Wolsingham, steel works manager ..	1

The number of directors is not to be less than three, nor more than six; qualification, 25 ordinary shares or corresponding stock; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Edwin Foden, Sons, and Co., Limited.

This is the conversion to a company of the business of general engineer, ironfounder, thrashing machine maker, and coal dealer, carried on by Mr. Edwin Foden, at Elworth Foundry, Sandbach, Chester. It was registered on the 11th inst., with a capital of £25,000, in £5 shares. The subscribers are:—

	Shares.
*T. Cliffe, Crewe, farmer	40
*R. Stubbs, Winsford, salt proprietor	80
*J. Stubbs, Winsford, salt proprietor	100
*W. Stubbs, Winsford, salt proprietor	100
*J. Stubbs, Winsford, salt proprietor	100
*R. Stubbs, Winsford, salt proprietor	100
A. Ryder, Sandbach, mechanical engineer ..	20

The number of directors is not to be less than three, nor more than seven; the first are the first six subscribers. The company in general meeting will determine remuneration.

Effer's Patent Automatic Gas Lighter Co., Limited.

This company proposes to purchase and utilise the invention of Mr. Wilhelm Effer, of Berlin, engineer, for an automatic gas lighter, the purchase to be inclusive of all patent rights. It was registered on the 11th inst., with a capital of £25,000, in £25 shares. The subscribers are:—

	Shares.
M. A. Ashurne, 12, Palace-rd., Hornsey, accountant	16
J. Zacharias, Berlin, electrical engineer	10
A. Zoern, 5, Wood-street-square, merchant ..	2
O. Rewinley, 64, Gresham-street, agent.. ..	2
J. R. Heeley, 31, Surrey-street, agent	8
G. Pitt, 15, Scylla-terrace, Peckham	1
H. Quistorp, West-end, Berlin, director.. ..	546

The council is to consist of not less than three, nor more than five members; the first to be appointed by the subscribers; qualification, £200 of fully-paid shares. Mr. H. Quistorp is appointed managing director.

Leadenhall Market Cold Storage Co., Limited.

Registered on the 11th inst., with a capital of £25,000, in 50 shares of £500 each, to carry on the business of storing commodities of all kinds. The subscribers are:—

	Shares.
Hy. Abbott, 66, Queen-street, E.C., merchant ..	1
H. Chapman, C.E., 113, Victoria-st., Westminster	1
Louis Sterne, 2, Victoria-mansions, S.W., engineer	1
J. S. Beale, 28, Great George-street, solicitor ..	1
G. F. Brooke, Leadenhall Market, salesman ..	1
J. Loden, 14, Lawn-road, Hampstead	1
T. O. Hutton, Merlewood, Chislehurst	1

Registered without special articles.

Metropolitan Carriage Company, Limited.

This company was registered on the 11th inst., with a capital of £100,000, in £1 shares, to carry on the business of carriage builders, omnibus and hackney carriage proprietors, livery stable keepers, &c. The subscribers are:—

	Shares.
A. F. Stokes, 5, Birchin-lane, printer	1
J. Woolley, 14, Bridge-ter., Paddington, auctioneer	1
S. Buttanshaw, 14, Queen Victoria-st., accountant	1
J. Walton, 11, Jamaica-road, S.E., clerk ..	1
S. Banning, 143, Cannon-street, accountant.. ..	1
J. R. Morriss, 17, Adam-street, Rotherhithe, clerk	1
J. R. Clifford, 158, Strand, surveyor	1

The number of directors is not to be less than three, nor more than seven; remuneration, £1000 per annum, with an additional £150 for every 1 per cent. dividend in excess of 8 per cent. per annum. In the event of the number of directors being reduced, the remuneration will be reduced by £150 per annum for each director retiring. Most of the regulations of Table A apply.

J. G. Statter and Company, Limited.

This is the conversion to a company of the business of Messrs. John Grice Statter and Sydney Linton Brunton, of the Alliance Engineering Works, West Drayton, and of Middleton-road, Dalston, electric light and general and consulting engineers. It was registered on the 9th inst., with a capital of £20,000, in £10 shares. The purchase consideration is £6400 in fully-paid shares. The subscribers are:—

	Shares.
*W. Statter, Snapethorpe, near Wakefield, surgeon	100
Mrs. Statter, Snapethorpe, near Wakefield ..	50
*H. B. Statter, Snapethorpe, near Wakefield ..	20
Miss M. B. Statter, Snapethorpe, near Wakefield	1
E. Ablett, M.D., Whitehaven	50
Mrs. M. E. Horsfall, Leamington	100
W. A. Statter, Wakefield, physician	20

Director's qualification, 20 shares; the first are the subscribers denoted by an asterisk; remuneration, £60 per annum. Mr. John Grice Statter is appointed managing director, and Mr. Sydney Linton Brunton secretary and joint manager, at a salary of £250 per annum respectively.

Patent Letter and Enamel Company, Limited.

This company was registered on the 6th inst., with a capital of £9000, in £10 shares, to acquire and work the letters patent granted to William Norman Sears, for improvements in the manufacture of letters and figures designed for attachment to glass and other surfaces—No. 10,038, dated 5th August, 1886. The subscribers are:—

	Shares.
Colin G. Ross, Carlton Club	1
R. B. B. Clayton, 88, Bishopsgate-street Within, merchant	1
Major C. Ross, Army and Navy Club	1
H. Weld, Blundell, Mount-street, brewer	1
Lord Kilcoursie, M.P., 47, Duke-st., St. James'..	1
W. Norman Sears, 144, High Holborn, enameller	1
Colonel Vincent, United Service Club	1

The number and names of the first directors will be determined by the subscribers, who act *ad interim.* The company in general meeting will appoint remuneration.

THERMOMETERS.—At a recent meeting of the Physical Society a paper was read "On Delicate Calorimetrical Thermometers and on Expansion of Thermometer Bulbs under Pressure," by Professor Pickering. The reading of a delicate mercurial thermometer, when placed in a bath at constant temperature, is found to depend on whether the thermometer was at a higher or lower temperature than the bath before immersion. Capillarity was suggested as an explanation, but experiment showed that the effect was not always greatest at the narrow parts of the tube, and hence this idea was discarded. By using the same tubes with different bulbs attached the differences varied, and eventually the effect was found to be caused by exposing the inside of the tube to air and moisture, for when bulbs were attached to new tubes without being so exposed, the differences between the rising and falling readings disappear. Hence for very delicate thermometers great care should be taken not to expose the bore of the tube, and calibration of a tube before attaching the bulb must not be attempted. Even in the best tubes, after every possible precaution has been taken, the author finds some parts about which the mercury appears to stick, and in delicate observations these parts of the tube are to be avoided. He also finds it necessary to gently tap the top of the tube to relieve any friction, and has devised a clockwork arrangement for performing the operation uniformly. In the second part of the paper the author describes the want of concordance between two thermometers which have been compared with the same standard, and finds it due to the expansion of the bulbs not being in all cases proportional to the difference of pressure between the inside and outside. Thermometers with large thin bulbs show greatest discrepancies, and the remedy is found to be in making the bulbs more rigid. This is done by having a double bulb, making them from cylindrical tube instead of by blowing, and increasing the thickness of the walls of the bulb. A knife-edge arrangement in the upper part of a thermometer is described, by which the same part of the graduated tube can be used, whatever the temperature—about which small changes are to be observed—may be. The proper amount of the mercury column can be cut off with the greatest nicety by its use. Mr. Whipple remarked that phenomena similar to those described in the paper were constantly coming under his notice, and mentioned the pressure corrections they were applying to thermometers used in vacuo during some pendulum experiments at present being carried out. He also described the Kew method of determining the pressure correction in deep-sea thermometers, which are protected by an outer glass jacket filled with alcohol. Mr. Lant Carpenter described the first comparison experiments made at sea with protected and unprotected bulb thermometers. In answer to questions, Prof. Pickering said the range of pressure used was from 0 to 3 atmos., and in his most delicate thermometer, where 200 mm. correspond to 1 deg. Cent., the difference between readings taken in horizontal and vertical positions amounts to 30 mm.

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.

10th May, 1887.

6805. ELECTRICAL SECONDARY GENERATOR, C. Philpott and M. C. Stapylton, Brighton.
6806. MONUMENTS, A. and W. S. McCreary, London.
6807. WATER PURIFIER and FILTER for STEAM BOILERS, J. W. Hyatt, London.
6808. PRODUCING AERATED BEVERAGES, S. R. Divine and G. F. Morgan, London.
6809. ELECTRIC BELL INDICATORS, J. and E. Eshelby, Dublin.
6810. HYDRAULIC LOADING and UNLOADING APPARATUS for SHIPS, A. B. Brown, Glasgow.
6811. TIES, &c., to be STAMPED with FIGURES, F. E. Reading and H. Arnold, Luton.
6812. PNEUMATIC MECHANISM of ORGANS, C. Brindley, Sheffield.
6813. PHOTOGRAPHIC CAMERAS, &c., J. V. Robinson, Dublin.
6814. HOISTING, &c., MACHINERY, E. Shaw, Bristol.
6815. STAYS, &c., W. Anderson, Manchester.
6816. REGULATING and CONTROLLING the SPEED of GAS-MOTOR ENGINES, H. Williams, Stockport.
6817. CENTRIFUGAL PERCUSSION FUZE, J. H. Burke, Southsea.
6818. GENERATING INFLAMMABLE GASEOUS VAPOUR for HEATING, H. Williams, Stockport.
6819. GAS-MOTOR ENGINES, H. Williams, Stockport.
6820. EAVES PLATE, W. Gwinett, Wolverhampton.
6821. VESSELS for HOLDING, &c., LIQUIDS, J. Parish, Leicester.
6822. JOINTS of MALLEABLE METALLIC TUBES, &c., T. Henderson, Gosforth.
6823. GUIDES for HEALD SHAFTS or FRAMES, E. Smith, J. Aspinall, and A. B. Barlow, Manchester.
6824. PORTABLE HARMONIUM, M. Concanen, Manchester.
6825. GAS-MOTOR ENGINES, H. Williams, Stockport.
6826. TOBACCO PIPE CLEANERS, T. J. Porter, Fleetwood.
6827. BOOT FASTENER, S. May, London.
6828. DYNAMO-ELECTRIC MACHINES, E. T. and D. Higham, London.
6829. ELECTRIC BATTERIES, P. Jensen.—(*O. Lugo, United States.*)
6830. PURGATIVE and SYRINGE for SAME, C. Schedl.—(*A. Oidtmann, Holland.*)
6831. ARTIFICIAL BIRDS for SHOOTING PRACTICE, E. R. Day and C. H. Colt, London.
6832. WHEELS for BICYCLES, &c., E. Evans and T. H. D. Davies, London.
6833. PREPARING, &c., TEA and COFFEE, H. Freeman, London.
6834. WIRE, A. Mannesmann, Brixton.
6835. STEAM TRAPS, C. and A. Edmeston, London.
6836. WEAPON of ATTACK and DEFENCE, A. J. Myzoule, London.
6837. STRETCHING TROUSERS, &c., J. E. Kearne, London.
6838. STEAM BOILER COMPOSITION INJECTOR, R. Chambers, Handsworth.
6839. HUB LAMPS used on TRICYCLES, R. V. Ash, London.
6840. TYPE-SETTING or COMPOSING MACHINES, A. J. Boult.—(*A. Lagermann, Sweden.*)
6841. TOOLS, W. J. Murgatroyd and J. Green, London.
6842. GAS-TRAP COVERS, A. J. Boult.—(*N. Schwab, United States.*)
6843. ENRICHING SEED PLANTS with ALIMENTARY SUBSTANCES, F. Knauer, London.
6844. ELECTRIC ARC LAMPS, A. J. Boult.—(*C. M. Noble, United States.*)
6845. BRAKES, T. S. Brown, Liverpool.
6846. TYPE-WRITING MACHINES, F. Myers, Liverpool.
6847. TOYS, S. Bennett, Liverpool.
6848. SQUEEZING WATER from "MOPS," W. David, London.
6849. SHOT CARTRIDGES, J. Joyce, London.
6850. HANDLE for LAWN TENNIS BATS, &c., D. Allport, London.
6851. ELECTRIC GLOW LAMPS, A. F. St. George and S. E. Robinson, Redhill.
6852. SIGHTING GUNS at NIGHT, A. Slatter, London.
6853. ELECTRIC CABLES, R. W. Eddison.—(*Tatham and Brothers and D. Brooks, United States.*)
6854. DISAPPEARING GUN MOUNTINGS, J. Y. Johnson.—(*La Société Schneider et Cie., France.*)
6855. TOILET PAPER-HOLDING FIXTURE, W. W. Colley, London.
6856. COMMUNICATING between DRIVERS and RIDERS, C. H. Burgess, London.
6857. PERMANENT WAY of RAILWAYS, J. C. Caillé, London.
6858. STEAM BOILERS, G. Kingsley, London.
6859. BEARINGS of WASHING, &c., MACHINES, T. T. Mercer and T. Woolfall, London.
6860. FILTERING WATER, &c., P. Sedlák, London.
6861. FASTENINGS for GLOVES, P. A. Newton.—(*C. W. Stuart, United States.*)
6862. KILN for DRYING TEA, A. S. Tomkins, F. A. Cracknall, and A. G. Courage, London.
6863. SUBMARINE TELEGRAPHY, B. A. Collins, London.
6864. COLLAR STUDS and SOLITAIRES, C. E. Revill, London.
6865. STEAM BOILERS, T. Hipkins, London.
6866. WORKING the SLIDE VALVES of ENGINES, W. Allan, London.
6867. LEAF-TURNING MECHANISM, A. J. Boult.—(*L. Maas, France.*)
6868. MOWING MACHINES, H. H. Lake.—(*B. Arnold, United States.*)
6869. PRIMARY BATTERIES, H. H. Lake.—(*W. I. Ludlow, United States.*)
6870. MOULDING, H. H. Lake.—(*E. N. Todd, United States.*)
6871. TROUSER-STRETCHERS, H. H. Lake.—(*R. Cromer, United States.*)
6872. PULLEY BOXES, H. H. Lake.—(*T. L. Johnson, United States.*)
6873. BAGGAGE CHECKS, C. M. Drinker, London.
6874. COUPLINGS, F. Broughton, London.
6875. TREATMENT of INDIA-RUBBER, &c., A. M. Wood, London.
6876. LIFTING FURNITURE, E. Graetz and E. F. Reinhold, London.
6877. MECHANISM, H. H. Lake.—(*T. L. Johnson, United States.*)
6878. CABLE RAILWAY, H. H. Lake.—(*T. L. Johnson, United States.*)
6879. BANJOS, S. Scuderi, London.
6880. CIRCULAR KNITTING MACHINES, S. P. Kittle and J. J. Adgate, London.
6881. WINDOW FRAMES, H. H. Lake.—(*S. S. Bradshaw, United States.*)
6882. WIRE BELTING, J. E. Emerson and T. Midgley, London.
6883. SHIPPING COAL, P. G. B. Westmacott, London.
6884. NAIL, F. Chapman.—(*W. J. C. Stokes, New Zealand.*)
6885. ELECTRO LOCOMOTIVES for TRAM-CARS, G. Forbes, London.

11th May, 1887.

6886. FINISHING, &c., BOOTS and SHOES, G. Hurdle, London.
6887. WATER WASTE PREVENTING SYPHON CISTERNS, J. Jackson, Chorlton-cum-Hardy.
6888. CAISSON HYDRAULIC LIFT, W. Henman, Birmingham.
6889. DAMPER ACTUATING APPARATUS for STEAM BOILER FURNACES, T. White and W. Carson, Glasgow.
6890. ELECTRIC DISTRIBUTION, R. Dick and R. Kennedy, Glasgow.
6891. APPLICATION of FLEXIBLE SPINDLES to GLASS-CUTTING, &c., W. O. Bowen, Brierley Hill.
6892. BUCKLES for BRACES, &c., A. W. Patching, Birmingham.
6893. COPYING PRESSES, T. Downie, Glasgow.
6894. BOOT CLEANERS, G. Tabberer, Birmingham.
6895. DUPLEX STEAM PUMPS, W. Walker and W. Norris, Birmingham.
6896. WORSTED and YARNS, A. Goldthorp, Wakefield.
6897. STRAINING PAPER PULP, G. Hibbert, Gateshead-on-Tyne.
6898. MAINTAINING BEER in CASKS, G. Macaulay-Cruikshank.—(*H. Reichard, Germany.*)
6899. DRILLING RIVET-HOLES in BOILERS, G. Booth and G. Pickersgill, Halifax.
6900. ARMOUR-PLATES, &c., J. Willis, Sheffield.
6901. FORMING LAPS of COTTON, G. Ashworth and E. Ashworth, Manchester.
6902. POULTRY COOPS, J. Andrew and T. Shiels, Maybole.
6903. LIFEBOATS, C. W. Pater, Manchester.
6904. SPINNING, &c., H. Stevenson, J. Webb, and S. Hallam, Manchester.
6905. MOULDING PIPES, J. Barker, Manchester.
6906. CRICKETING STUMPS, J. C. Richmond, Rotherham.
6907. BAROMETERS, W. P. Thompson.—(*A. E. Lebret, France.*)
6908. AUTOMATICALLY STOPPING INJECTING APPARATUS, A. Horne, Liverpool.
6909. OBTAINING SULPHUR from IRON PYRITES, C. F. Claus, South Wimbledon.
6910. WATCHES, E. P. Wells, London.
6911. MACHINES for PUNCHING, A. Beaudry, London.
6912. FORGING BOLTS, T., R., G., and A. Parker, London.
6913. HEADS for MOULDING MACHINES, S. Bastow, London.
6914. TREATMENT of HIDES for LEATHER, J. S. Hooper.—(*J. W. Darrow, United States.*)
6915. SUPERHEATING, &c., GAS, G. K. Cooke, London.
6916. MINERS' SAFETY LAMPS, W. Baker and J. Barton, London.
6917. RESISTANCE COILS, W. M. Mordey and C. E. Webber, London.
6918. TELEGRAPHY, W. E. Gedge.—(*A. Claude, France*)
6919. WATER-CLOSETS, A. H. Ward, Elm.
6920. CLOSING CAPSULED BOTTLES and JARS, C. Laurent, London.
6921. MARKING the FRAMES of UMBRELLAS, J. Willis, Deepcar.
6922. GUN-MOUNTINGS for MACHINE GUNS, T. Nordenfelt, London.
6923. STOVES, &c., J. Nicholas and H. H. Fanshawe, London.
6924. SCREW STEAM VESSELS, J. Nicholas and H. H. Fanshawe, London.
6925. ENDLESS WIRE WAYS for TRANSPORTING GOODS, T. Obach, London.
6926. SEWING MACHINES, R. Otto, London.
6927. COMPOUND for COVERING ELECTRIC WIRES, H. W. Merritt, London.
6928. COMPOUND for COVERING ELECTRIC WIRES, H. W. Merritt, London.
6929. SIGN and SHOW CARDS, J. P. Scott, London.
6930. DRESSING WOUNDS, O. Schlatter, H. Burtscher, and A. Schmid, London.
6931. STUDS, C. F. Veit, London.
6932. MOUNTING and WORKING TURRET GUNS, J. Fielding, London.
6933. INSULATING ELECTRICAL CONDUCTORS, D. Nicoll, London.
6934. FIRE-ARMS, J. A. Longridge, London.
6935. MAKING SCREWS from ROD WIRE, J. K. Starley, London.

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6936. SATURATING SUGAR SOLUTIONS, P. J. E. Heffter, Germany.
6937. PAINT for STUCCO, R. Ripley, Liverpool.
6938. PUMPS, J. Garvie, jun., London.
6939 WORKING CARDING ENGINES, J. Heginbottom, Oldham.
6940. GAS LAMPS, R. W. Pugh, Manchester.
6941. LAMPS, R. W. Pugh, Manchester.
6942. DRAWING WIRE, M. F. Roberts, Manchester.
6943. MAGNETO-ELECTRIC MACHINES, M. Settle, Manchester.
6944. SEWING MACHINES, H. Hyndman.—(*J. Forbes, United States.*)
6945. SUCTION BOXES for PAPER MAKING MACHINES, G Bird, Glasgow.
6946. PAPER MACHINE STRAINER CLEANSING, G. Stewart and J. Reid, Fisherrow.
6947. FORGING MACHINE, G. Weston, Sheffield.
6948. SHIRTS, J. D. Macarthur, Glasgow.
6949. BOTTLES, T. W. Grant, Glasgow.
6950. POCKET INSTRUMENT, I. Watts, Manchester.
6951. GRINDING HARD SUBSTANCES, J. F. Brinjes, London.
6952. SAFETY BABY TRAINER, J. McHardy, Dollar, N.B.
6953. LAMPS, &c., H. O. A. E. Grünbaum, Stratford.
6954. SECURING BRACKETS to BEARINGS, A. Yates, London.
6955. UNDER CLEARERS for DRAWING FRAMES, J. Butler and T. Howard, London.
6956. SPRINGS for VEHICLES, T. H. Heard, Sheffield.
6957. TELEPHONIC APPARATUS, C. L. W. Fitz-Gerald, London.
6958. MAKING GLUE, J. Campbell, Glasgow.
6959. BEARING for SHAFTS of SCREW PROPELLERS, M. P. Baxter, London.
6960. KETTLES, W. B. Quelch, London.
6961. KEYBOARD for PLAYING the BANJO, G. Finniear, London.
6962. POLISHING MACHINES, S. Bellotti, London.
6963. BRACKET for HOLDING SHELVES, &c., A. M. Hart, London.
6964. FACING POINTS, F. R. Francis, London.
6965. TUBULAR SPRINGS, R. Gradenwits, London.
6966. REFLECTORS, F. C. Phillips and H. E. Harrison, Westminster.
6967. MAGAZINE FIRE-ARM, H. A. Schlund, London.
6968. PROPELLING VELOCIPEDES, &c., J. Bramall, London.
6969. FRAMES for LOOKING-GLASSES, &c., G. F. Redfern.—(*G. F. Lebrun, France*)
6970. KILN DUMPING FLOORS, F. Kohler and W. A. Chambers, London.
6971. MASHERS for POTATOES, &c., A. N. Hopkins, London.
6972. OBTAINING DERIVED CURRENTS from a MAIN ELECTRIC CURRENT, J. C. Mewburn.—(*La Société Anonyme pour la Transmission de la Force par l'Electricité, France.*)
6973. MACHINES for MAKING CASKS, J. H. Hall and D. Parry, London.
6974. STARTING, &c., RACES, R. E. Phillips, London.
6975. VELOCIPEDES, H. T. Davis and C. W. Dawson, London.
6976. STOP-COCKS, F. H. Josten, F. G. Berndt, and F. Westip, London.
6977. TERRA-COTTA STOVES, T. Roberts, London.
6978. RAILWAY BUFFERS, W. Boucher, London.
6979. LIGHTING by GAS, D. W. Sugg, London.
6980. STUFFING-BOXES, J. C. Swash, London.
6981. TYPE-WRITING MACHINES, R. C. Thompson and W. Spence, London.
6982. HATCHES for VESSELS, F. Edwards, London.
6983. VESSELS, F. Edwards, London.
6984. UMBRELLA FURNITURE, F. A. Ellis, London.
6985. SEPARATING SOLID IMPURITIES from the WATER of STEAM BOILERS, A. Pottier, London.
6986. DISTILLING FATTY ACIDS, W. Sanzenbacher and S. Tanatar, London.
6987. ELECTRIC ARC LAMPS, A. Siemens, London.
6988. CONVEYING ELECTRICITY to MOVABLE VEHICLES, R. Laurence, London.
6989. MUFF, &c., J. Greenbaum, London.
6990. WATER-CLOSETS, L. E. Sunter, London.
6991. COATING of WOOD, &c., H. Trautmann, London.
6992. LAMPS or LANTERNS, R. B. Evered, London.

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6993. SIGNALLING by ELECTRICITY, H. H. Slater and A. S. Newman, London.
6994. BEDSTEADS and COTS, J. T. Softly, London.

6995. WASHING BARLEY, &c., R. C. Catling, Manchester.
6996. MACHINES for SCOURING WOOLLEN, &c., FABRICS, C. H. Hopps and W. G. Bywater, Leeds.
6997. SADDLE BAR, G. Salter and J. Hughes, Birmingham.
6998. "POCKET" SEWING MACHINES, A. Schofield and F. McIlvenna, London.
6999. CONNECTING WARP to BEAMS, G. D. Sykes, Huddersfield.
7000. SPINNING and TWISTING WOOL, &c., S. B. Barker.—(*R. Gill, United States.*)
7001. RUNNERS for UMBRELLAS, &c., C. W. Bremshey, Paris.
7002. GUN CARRIAGES, J. T. Williamson, London.
7003. "RAISING" CLOTHS, &c., J. Booth, Halifax.
7004. LOOMS for WEAVING, L. F. Gaillard and A. Remy, London.
7005. COMBINATION TUBE, VICE, and CUTTER, J. Hammond, Birmingham.
7006. PROPELLERS for SHIPS, O. E. Pohl, Liverpool.
7007. FASTENINGS for BRUSH HEADS, &c., C. Stuart, Bletchley.
7008. SKIMMING YEAST from ALE, &c., W. Smith and W. Bagshaw, Dudley.
7009. WIRING EDGES of SHEET METAL, H. H. Chilton, London.
7010. EXTRACTING CARTRIDGE CASES after FIRING, I. Bullock, Birmingham.
7011. VALVE for LIQUID CARBONIC ACID, J. Fleischer and C. Mühlich, Paris.
7012. AUTOMATIC CASH-RECEIVING APPARATUS for GAS-METERS, R. W. Brownhill, Birmingham.
7013. ELECTRO-PLATING ROLLERS, &c., D. Appleton and F. A. Binney, Manchester.
7014. WATER-WASTE PREVENTERS, R. D. Russell, Glasgow.
7015. BOOTS and SHOES, T. Horton, Birmingham.
7016. CARTRIDGE BOX, A. J. Lyon, Cambridge.
7017. PROTECTORS for the BOTTOMS of BOOTS, &c., J. Brown, Manchester.
7018. CONTROLLING the SUPPLY of GAS, T. Fletcher and A. Clare, Manchester.
7019. LOCKS, J. Burdon, Glasgow.
7020. AIR-TIGHT MAGAZINES, N. J. Holmes, Lewisham.
7021. ELECTRO-DYNAMIC and DYNAMO-ELECTRIC MACHINES, G. Scarlett, Liverpool.
7022. STRUCTURES for RETAINING TIDAL WATER, E. Lightowler, Liverpool.
7023. MACHINERY for LOZENGES, &c., J. Hounsell, Birmingham.
7024. PRODUCING PATTERNS on CLOTH, &c., C. H. Behnisch, Berlin.
7025. ADJUSTING the TABLES of SAW BENCHES, &c., C. Redman, London.
7026. MECHANICAL CRYPTOGRAPH, C. Hight, London, and J. Howard, Erith.
7027. ATTACHING KNOBS to their SPINDLES, G. A. Bateman, London.
7028. CLEANING KNIVES, &c., F. R. Morgan, Westminster.
7029. HOT or COLD-WATER PAD, T. O. Clark, Addlestone.
7030. PLATES with COMPOSITION for ELECTRIC BATTERIES, C. Maltby-Newton, near High Wycombe.
7031. BOOTS and SHOES, J. H. S. Evans, London.
7032. HORSESHOE, R. Gumm, London.
7033. SEWING MACHINES, C. W. Vosper, London.
7034. CARBURETTING APPARATUS, O. W. Bennett and S. O. Hemenway, London.
7035. MAGNESIUM LIGHT for PHOTOGRAPHIC PURPOSES, J. Gaedicke and A. Meithe, London.
7036. STONE-WORKING MACHINES, F. Trier, London.
7037. LAMP-POSTS for SIGNALLING PURPOSES, H. J. Haddan.—(*W. C. Smith, United States.*)
7038. FURNACES for BURNING POTTERY, L. Boissonnett, London.
7039. REGULATING the SPEED of WINDMILLS, H. Sykes, London.
7040. COMBINED ELECTRICAL and PNEUMATIC TRANSMISSION, &c., E. Guthrie, London.
7041. FIRE-ESCAPES, J. Hicks, Hastings; and H. Hurd, London.
7042. ELECTRIC ARC LAMPS, F. G. Chapman and F. M. Dearing, London.
7043. LABEL CABINET, H. Poths, London.
7044. PULLEYS, G. W. H. Brogden, London.
7045. HOLDING CARTRIDGES, A. Greenwood.—(*Schweizerische Industrie-Gesellschaft, Switzerland.*)
7046. LENSES and REFLECTORS for LAMPS, J. Thorne and E. B. Burr, London.
7047. METALLIC ALLOYS, A. P. Vivian, London.
7048. CHURNS, P. Scharff, London.

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7049. LAMPS, J. Gilchrist, Glasgow.
7050. BREAKING and CLEANING FLAX, W. S. Johnston, Liverpool.
7051. CRICKET BATS, H. Hibbard, Liverpool.
7052. PAPER SHEETS, W. O. A. Lowe, Liverpool.
7053. FOLDING TABLES, T. F. Clasen, Liverpool.
7054. SIGHTS, T. Bland, London.
7055. HORSESHOE BARS, J. Blackstock, Lenton.
7056. SOLITAIRES, W. E. Patterson, Birmingham.
7057. VENTILATOR for BUILDINGS, T. Boothroyd and S. Brooke, Halifax.
7058. GAS-BURNERS, C. H. Green, New York.
7059. PRIMARY BATTERIES, R. W. Paul, London.
7060. SELF-DISCHARGING SEWAGE BARGE, F. Jordan, Barrow-in-Furness.
7061. FRICTIONAL GEARING for VELOCIPEDES, S. Currie, Birmingham.
7062. BOTTLE STOPPER, W. T. Morton, London.
7063. SPOOL, A. Stannard, Leek.
7064. BANK CHEQUES, J. T. Steen.—(*J. J. Macky, New Zealand.*)
7065. BLINDS, W. Fraser, London.
7066. TRANSPARENT OIL DRIPPER, W. Butterworth, London.
7067. CARBURETTED AIR GAS, W. H. Beck.—(*A. Krieger, France.*)
7068. SELF-HARDENING STEEL, J., H. P., and J. P. Marsh, Sheffield.
7069. PANORAMIC ALBUMS, C. Deschler, London.
7070. GAS COOKING APPARATUS, J. F. and G. E. Wright, Birmingham.
7071. STEAM GENERATORS, J. Birchall, London.
7072. EXTRACTING GAS from SEWAGE SLUDGE, W. J. Lomax and M. Guthrie, London.
7073. BLUE PACKAGES, W. Edge, London.
7074. SCREW STOPPER, The Aire and Calder Glass Bottle Works, E. Breffit and Co., and W. Walker, London.
7075. SAFETY SWIMMING COLLAR, E. Chevallot, London.
7076. STRETCHING TROUSERS, W. H. Young, London.
7077. SPINNING COTTON, J. Dodd, Manchester.
7078. WATER LEVEL APPARATUS, P. Williams and W. Powles, London.
7079. DYNAMO-ELECTRICAL MACHINES, E. Wilson, London.
7080. LOOM PICKERS, Y. and L. Helliwell, Halifax.
7081. EXCAVATORS, J. Garvie, jun., London.
7082. HEELS of BOOTS and SHOES, F. Lebacq, London.
7083. FASTENING TOGETHER the ENDS of BELTS or BANDS, R. Bruce, London.
7084. CUTTING RAGS, J. A. Gregory, London.
7085. MOVABLE PRIMERS for CARTRIDGES, &c., T. R. Bayliss, London.
7086. BLINDS of CORRUGATED SHEET METAL, P. Haddan.—(*M. G. Mitter, Germany.*)
7087. SUGAR, W. R. Watson.—(*A. Young, Hawaiian Islands.*)
7088. AUTOMATICALLY EXTINGUISHING OIL LAMPS, A. Rettich, London.
7089. LOCK-STITCH SEWING MACHINES, W. S. Lockhart and J. G. Bellamy, London.
7090. POTTERY TISSUE PAPER, T. Phœnix, Newcastle; and G. Kirk, Uttoxeter.
7091. DRESSING FLAX, &c., T. Robinson, London.
7092. REPEATING FIRE-ARMS, H. Pieper, London.

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7093. JARS or CELLS of PRIMARY or SECONDARY BATTERIES, W. G. Spurgeon, London.
7094. IMPROVEMENTS in DRIVING BELTS, W. Tatham, Manchester.
7095. BICYCLE, J. T. Ford, Southsea.
7096. TELEPHONE INSTRUMENTS, A. A. Campbell-Swinton, London.
7097. VALVE GEAR, E. Latham, Liverpool.
7098. DRIVING NAILS, J. M., J. A., J., and S. A. Gimson, Leicester.
7099. LAMPS, W. H. Pasley, Birmingham.
7100. ENGINES, J. H. Dewhirst, Sheffield.
7101. WINDOW FRAMES, A. Lever, London.
7102. STEAM TRAP, J. H. Kidd, Wrexham.
7103. WATCHES, S. Walker, Liverpool.
7104. FENCE, T. Miller, Glasgow.
7105. CARTRIDGE EXTRACTORS, H. I. Dixon and W. Beaumont, Sheffield.
7106. SEPARATING CINDERS, W. Pegge, Stoke-on-Trent.
7107. FLOWER HOLDER, B. T. Ffinch and J. F. T. Wittkugel, Karachi.
7108. RAILS, W. Borrmann, London.
7109. CLOTHES WASHER, E. Faull, London.
7110. TUBE STOPPERS, T. Dixon and J. Dykes, London.
7111. WINDMILLS, J. F. Kilburn, London.
7112. COCOA, D. Ker, London.
7113. WARMING, &c., BUILDINGS, J. Horne and S. Hollyman, London.
7114. FENDERS, P. J. Webb, London.
7115. DIALS of WATCHES and CLOCKS, C. Humbert, London.
7116. OBTAINING PRODUCTS of CONDENSATION from ALDEHYDES, &c., A. Ewer and P. Pick, London.
7117. COMPOSITION of MERCURIAL SOAPS, J. Thomson, London.
7118. INHALING AMMONIUM CHLORIDE, C. S. S. Webster, London.
7119. LIXIVIATING RAW SUGAR, C. Steffen, London.
7120. LAMPS and LAMP-BURNERS, C. Asbury, London.
7121. FOCUSSING the OBJECT GLASSES of CAMERAS, G. Downing.—(*L. M. Berthon, France.*)
7122. TAKING SOUNDINGS, A. J. Cooper and E. E. Wigzell, London.
7123. DISTRIBUTING MANURE to TREES, J. Farrell, London.
7124. GLAZING GLASS WINDOWS and BLINDS, H. J. Snell, London.
7125. IGNITING FIREWORKS, &c., A. Brock and G. J. Mayer, London.
7126. ILLUMINATION or BUCKET LAMPS, A. Brock, London.
7127. MOULDS for CASTING PIPES or TUBES, M. and J. Cornthwaite, London.
7128. GRANULATING MILL, G. F. Redfern.—(*Messrs. Wirth and Co., Germany.*)
7129. SERVING ROPE for the RIGGING of SHIPS, T. Johnson, London.
7130. CUTTING WORM WHEELS, J. A. Nordstedt, London.
7131. HORSESHOES, R. G. Dixon, London.
7132. SPEED INDICATOR for VESSELS, J. Michel, London.
7133. WATER-BORNE VEHICLE, G. P. Bidder, London.
7134. ASPHALTE, &c., STRUCTURES, W. Gürtler, London.
7135. CASH MAT, H. J. Haddan.—(*E. Sears, United States.*)

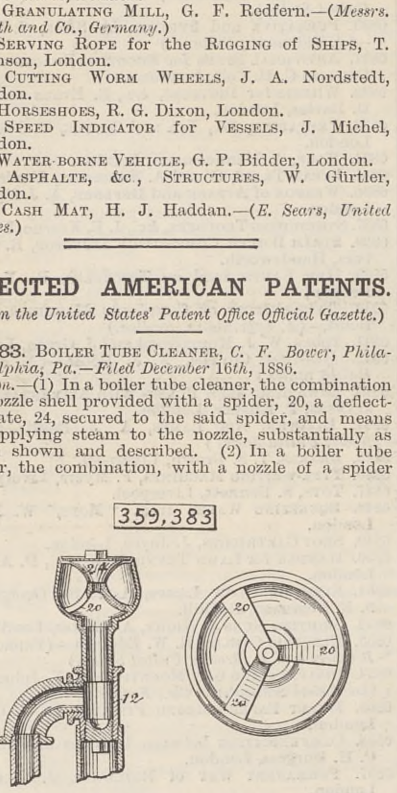
SELECTED AMERICAN PATENTS.

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

359,383. BOILER TUBE CLEANER, *C. F. Bower, Philadelphia, Pa.—Filed December 16th*, 1886.

Claim.—(1) In a boiler tube cleaner, the combination of a nozzle shell provided with a spider, 20, a deflecting plate, 24, secured to the said spider, and means for supplying steam to the nozzle, substantially as herein shown and described. (2) In a boiler tube cleaner, the combination, with a nozzle of a spider

359,383

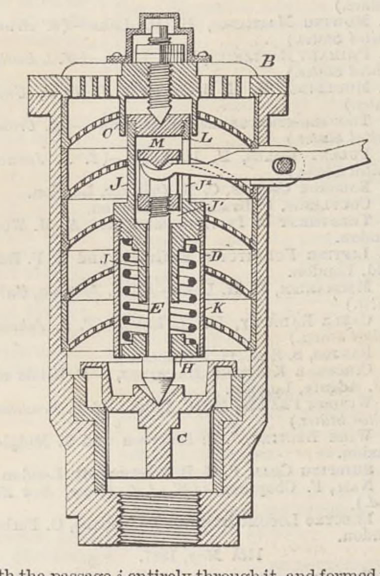


made integral therewith, a deflecting plate connected to the spider and provided with an external head, a coupling 12, a steam supply pipe connected to a flexible pipe that is provided with a coupling, a coupling connected to the end of the flexible pipe, and a handle connected to the coupling 12, substantially as described.

359,389. MUFFLER, *T. F. Hill, Rahway, N.J.—Filed November 16th*, 1886.

Claim.—(1) In a muffler, the inner shell J, formed

359,389

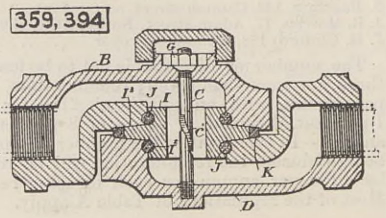


with the passage *j* entirely through it, and formed with the chamber j^1 and slot j^2, in combination with the casing K for the valve spring, and into which casing the casing J is screwed, substantially as shown and described. (2) The top plate B, formed with the gland O, in combination with the shell J, spring D, spindle E, plate H, and valve C, substantially as described. (3) In a muffler, the shell J, formed with the passage *j* and chamber j^1, in combination with the spring D, plate H, spindle E, tube K, and yoke M, attached to the upper end of the spindle, substantially as described. (4) In a muffler, the shell J, formed with the passage *j*, chamber j^1, and slot j^2, and closed at its upper end with the plug L, substantially as described.

359,394. PIPE CONNECTION, *W. E. Jones and H. Winniatt, El Paso, Tex.—Filed July 13th*, 1886.

Claim.—(1) In a pipe connection, the heads B and D, in combination with the spring bolt C, substantially as shown and described. (2) In a pipe connection, the heads B and D, in combination with the bolt C, having the spring C^1 and the nut G, substantially as shown and described. (3) In a pipe connection, the heads B and D, in combination with the metal ring I and the rubber gaskets J and the spring bolt C, substantially as shown and described. (4) In a pipe connection, the

359,394

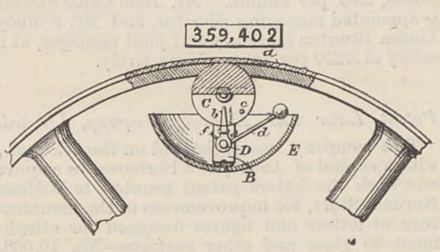


heads B and D, the metal ring I, having the grooves I^2, and the annular projection I^3, in combination with the gaskets J and K, substantially as shown and described. (5) In a pipe connection, the heads B and D, in combination with the metal ring I and the gaskets K and the spring bolt C, substantially as shown and described. (6) In a pipe connection, the heads B and D, the spring bolt C, provided with the spring C^1, and the nut G, in combination with the metal ring I and the gaskets J and K, substantially as shown and described.

359,402. LOOSE BELT ALARM, *J. Paff, Amboy, Minn.—Filed June 17th*, 1886.

Claim.—(1) The combination, with a pulley, of a friction wheel journalled on the same, with its periphery projecting beyond the periphery of the pulley, and an alarm, also mounted on the pulley and constructed to be operated by the said wheel, substantially as set forth. (2) The combination, with a pulley having a slot in its periphery, of a wheel mounted on the pulley and projecting through said slot and having a pin on one side of the wheel, a bell on the pulley adjacent to said wheel, and a bell hammer

359,402

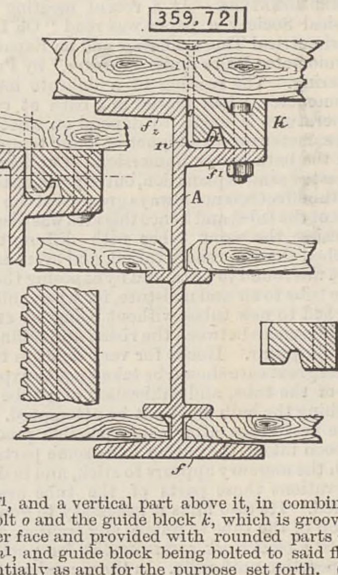


having an arm extending into the path of the said pin. (3) The combination, with a pulley having a slot in its periphery and a frame secured to the rim under the slot, of a wheel journalled in the frame and provided with a pin on one side, a spring-operated rock shaft, also journalled in said frame and provided with a bell hammer operated by the said pin, and a bell secured to said frame, substantially as set forth. (4) The combination, with a pulley provided with an aperture, *a*, in the rim thereof, of a loose belt alarm formed of the friction wheel C, provided with the pin *c*, the rock shaft D, arms *b d*, spring *f*, gong E, and the supporting frame B, substantially as shown and described.

359,721. IRON BEAM AND NAIL-HOLDING DEVICE THEREOF, *R. Gocht, Zittau, Saxony, Germany.—Filed August 26th*, 1886.

Claim.—(1) The flanged beam A, having a horizontal

359,721



flange f^1, and a vertical part above it, in combination with bolt *o* and the guide block *k*, which is grooved on its inner face and provided with rounded parts *n* and recess n^1, and guide block being bolted to said flange, substantially as and for the purpose set forth. (2) In combination with beam A, having on one side, at its top, the flange f^2, and on the other side, below its top, the flange f^1, the guide block *k* fastened to the latter flange and having ribs *r*, alternative grooves r^1, rounded part *n*, and recess n^1, all substantially as and for the purpose set forth.

359,735. BUSHING MOULD, *W. Messerle, Cincinnati, Ohio.—Filed January 17th*, 1887.

Claim.—A mould for casting soft metal screw-threaded bushings for the faucet holes of beer kegs, &c., which mould consists of the bottom plate A, having a curb B, pit C, socket D, and pins E E′, and

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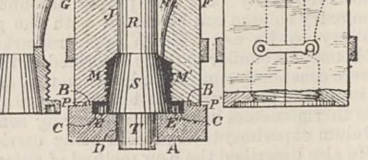
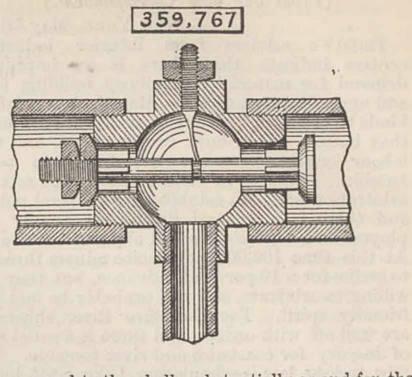


the hinged flasks F G H, provided with semi-cylindrical bores I J, threaded matrix M M′, gate N, and counter-bores P P′, in combination with the detachable mandrel R, having a conical portion S, and shank T, substantially as described.

359,767. DEVICE FOR DRAINING THE CYLINDERS OF ENGINES, *J. Briscoe, Custer City, Pa.—Filed August 9th*, 1886.

Claim.—In a check and relief valve for draining the cylinder of an engine or pump, the combination, with a shell or case having a drainage outlet and valve seats and two valves connected by a valve stem, of a spring engaging the valve stem between said valves and provided with a screw plug, by which it is detachably secured to the shell, substantially as and for the purposes described.

359,767



359,780. CULTIVATOR ATTACHMENT, *H. H. Fulton, Indianapolis, Ind.—Filed January 3rd*, 1887.

Claim.—(1) An attachment for cultivators comprising, in combination, a head provided with an arm having jaws to receive a plate having an open socket upon its outer face, whose sides provide bearings for the shank of the tooth along their entire length, this socket plate pivotted in the jaws of the arm at a point near the bottom and further secured therein near the top by a frangible pin and fastened to the socket plate

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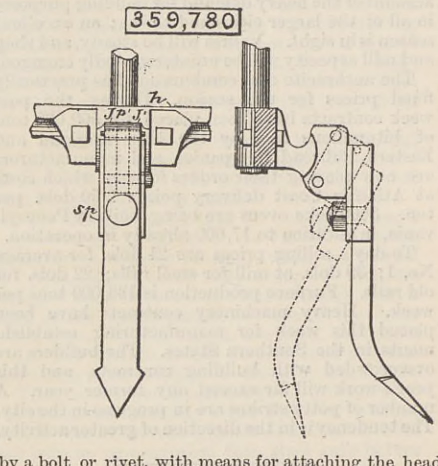
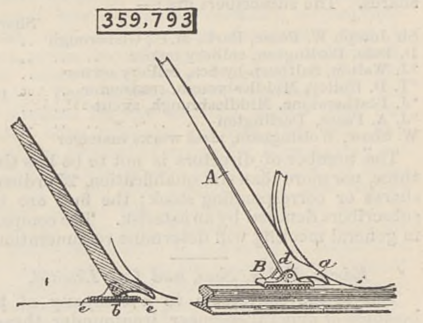


by a bolt or rivet, with means for attaching the head to the cultivator shank, all combined substantially as described. (2) In a cultivator attachment, the socket plate *sp*, having rear projection, p^1, with openings at adjacent corners to receive the pivot and brake pin, the head *h*, having jaws *j* and j^1, to receive the projection of the socket plate, the parts united by pivotal and flangible pins, and the tooth connected to the socket plate, all combined substantially as described.

359,793. PINCH BAR, *C. E. Letts, Detroit, Mich.—Filed November 24th*, 1886.

Claim.—The combination, in a device for the purpose described, of a lever A, having a toe, *a*, and a rounded heel, *b*, bearing upon the shoe, and a metallic shoe, B,

359,793



having ears *d*, for attachment of the shoe to the lever, and flanges *e* at each end, and a removable friction surface attached to the bottom of the shoe, substantially as set forth.

360,030. ARMATURE FOR DYNAMO-ELECTRIC MACHINES, *W. A. Leipner, Lynn, Mass.—Filed February 24th*, 1886.

Claim.—(1) The combination, with the plate or frame provided with wedge-shaped radial recesses, the larger part of said recesses extending toward the centre of the frame, of division pieces having their inner ends constructed to fit snugly in said recesses and their outer portions from the edge of the frame to their outer ends of gradually and regularly expanded width, whereby the spaces formed between said pieces beyond the edge of the frame are made wider at said edge than at the ends of said pieces, and wire-wound bobbins constructed to fit snugly in said recesses, as set forth. (2) The combination, with the circular frame composed

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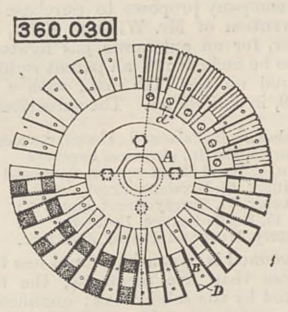

of insulating material, of the radiating spacing pieces secured thereto at regular intervals therearound, the construction and arrangement of said spacing pieces being such as that the spaces therebetween will be wider at the edge of the frame than at the end of the pieces, and wire-wound bobbins having discs or sides composed of insulating material, constructed to fit snugly in said spaces, as set forth. (3) The combination, with the circular frame, of the spacing pieces insulated from each other and the wire-wound bobbins having iron cores and sides or discs composed of insulating material, said bobbins being arranged between the outer ends of said spacing pieces, as set forth. (4) The combination, with the circular frame A, of the spacing pieces B, bobbins D, and plates d^4, as set forth. (5) The combination, with the circular frame A, of the spacing pieces B, insulated from each other, and the wire-wound bobbins D, insulated from each other and from the spacing pieces, as set forth.