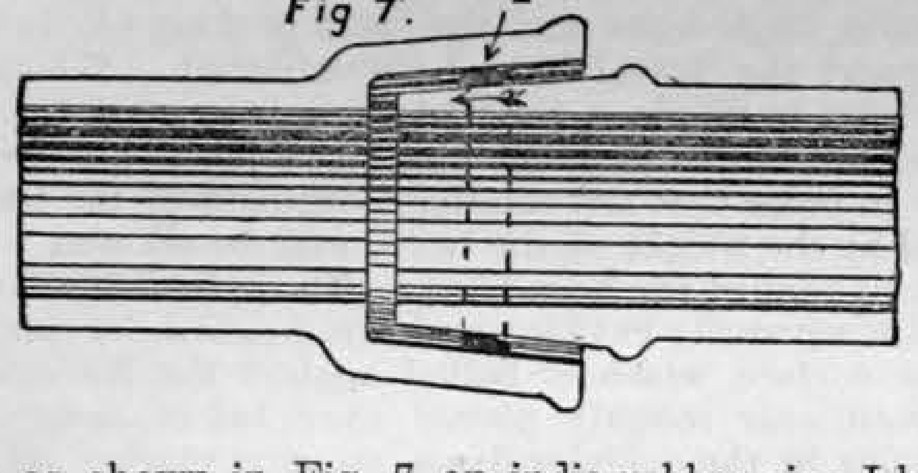
STEAM PUMPING ARRANGEMENTS IN SCREW STEAMERS.

No. II.

It seems to be a well-established principle that all bilge suction pipes may be made of lead, whereas such pipes which will at times be in open communication with the sea, such as the donkey sea suctions and the ballast tank filling and emptying pipes must be made of stronger material. Copper is used for the one purpose and cast iron for the other, the only exception being that the bends of the ballast pipes are frequently made of lead—copper or wrought iron would be still better—for it has been found that they sometimes fracture if made of cast iron. Flanges are generally cast on the ends of these pipes, and the bolted joints of the rough metal are made water-tight by india-rubber insertions. The ends are rarely machined or recessed, as is done for hydraulic pressure pipes on shore, but as the number of bolts to be used could be reduced the slight extra labour might lead to a saving. Some years ago a practice had crept in of making socket

Fig 7.



joints as shown in Fig. 7, an india-rubber ring I being slipped over the end of the right-hand pipe, which was then forced into the left-hand pipe, as shown by the arrow, making a perfectly water-tight, and at the same time elastic joint. The objectionable feature of this system is that it is impossible to remove any one length of pipe without disturbing the others, and trouble is also said to have been experienced due to the "working" of the joints, all the pipes travelling slowly in one direction, generally towards the aft end of the vessel, until one of the forward joints opened and led to leakages of water into the hold while filling the tank, and it also admitted air while emptying the tanks. This could, of course, only happen when the ends of the various pipes did not butt properly. Lead fillings as used for water-mains, are still more objectionable than india-rubber rings, and do not appear to have been used.

In small steamers wrought iron pipes—gas pipes—have sometimes been fitted with the ordinary thimble screw joint, but these are almost as objectionable as socket joints; besides, all such pipes have to be bent hot, which adds greatly to the expense of such a system. Copper pipes are so expensive that they are rarely used, except in men-of-war or in small vessels, when the diameters are small, say less than 2in. They are much lighter than lead pipes, and are not so easily injured. Flanges are brazed on their ends, and the joints are made water-tight, either with india-rubber or red lead insertions. The pipes are bent cold, which should be done after filling them with pitch, so as to preserve the round section; but as this is a somewhat expensive process, the bending is frequently done without any filling, and the oval shape at the bend is converted into a round one by judicious hammering.

Lead pipes are, as has been said, almost exclusively used for the bilge pumping arrangement; they are bent without being filled, the sections rounded, as has just been described for copper pipes, and lead flanges are then soldered on their ends; but as these are far too plastic to withstand the pressure of the bolt heads and nuts which draw them together, a pair of iron rings, having four or six bolt-holes forged into them, are slipped over each pipe before the flanges are soldered on. When in place, bolt holes are cut into the lead flanges exactly under the holes in the iron rings, and bolts are then inserted, as shown in Fig. 8. The lead and solder is shown white in section, and the iron rings are shown shaded. The lead of the flanges being sufficiently plastic to make a water-tight joint when the bolts are screwed up hard, it is not necessary to introduce any insertions. Instead of these flanges, plumbers' joints are sometimes made, but they are very objectionable, for the pipes would have to

Fig 8.

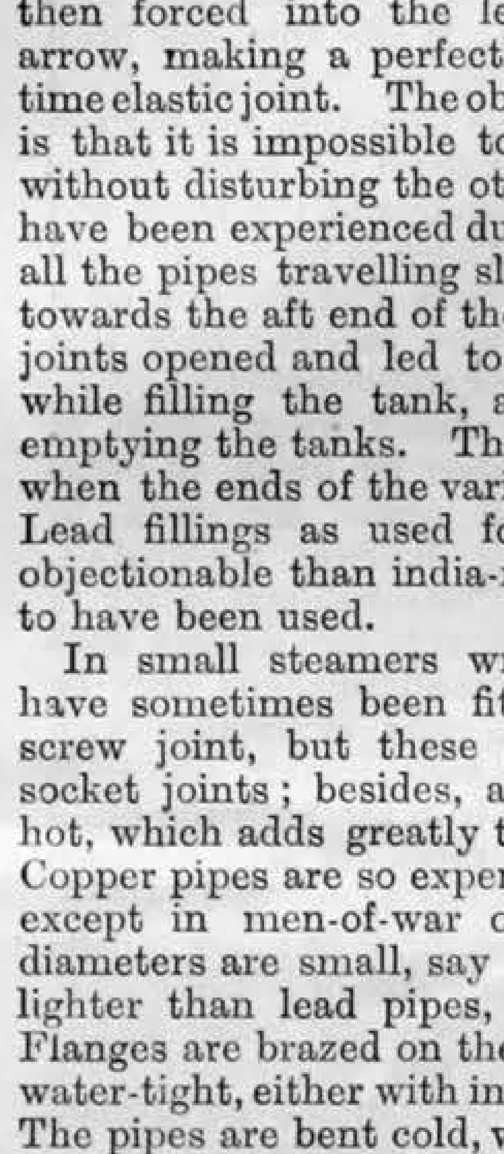


Fig 9

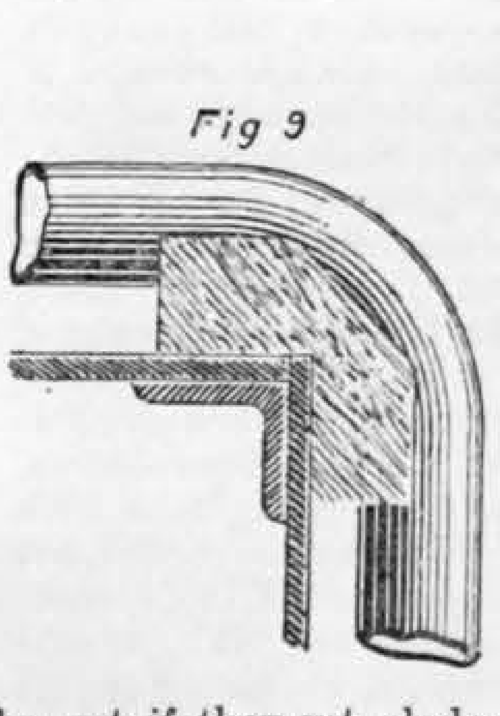
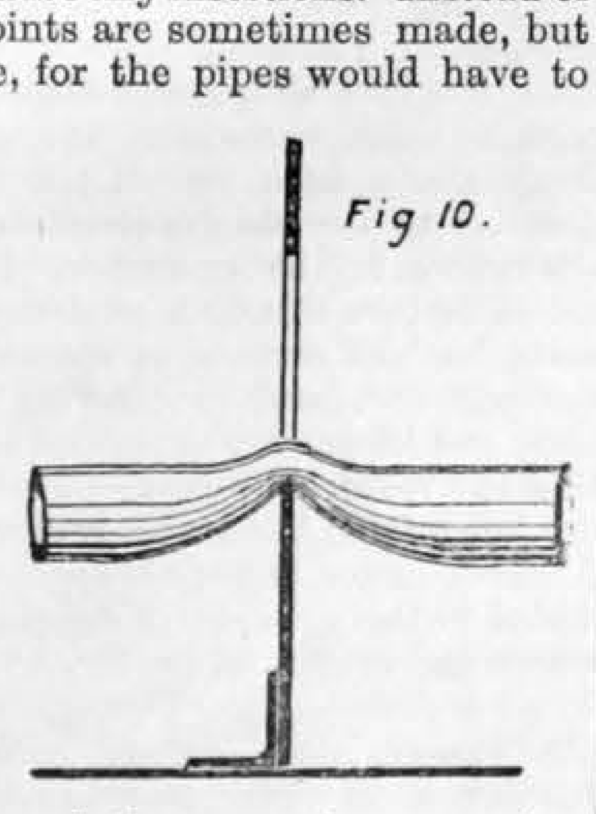


Fig 10.



be cut if they get choked, and there are few sea-going engineers who could re-make such a joint. One of the worst troubles with lead pipes is that they are so easily damaged, nor are sufficient precautions taken, particularly in the engine room, to guard them from injury. They ought, if possible, to be encased in wood, as is frequently done in the holds, but in the engine-room it is thought sufficient to hide them away under the lower platform. Wherever they pass over a sharp corner a rounded wooden channel piece, as shown in Fig. 9, ought to be fitted, but ships' plumbers generally content themselves in such cases with interposing a thin sheet of lead. In many vessels even such provisions are entirely wanting, which after a time results in the section of the pipes being partially or entirely closed up, as shown in Fig. 10, which represents a lead pipe carried through the floors and resting on the sharp edges of their web plates.

The ends of the bilge suction pipes are provided with strums; these used to be of lead, but are now made of galvanised cast iron. They consist—as shown in Figs. 11 and 12—of a box with perforated sides and top. In

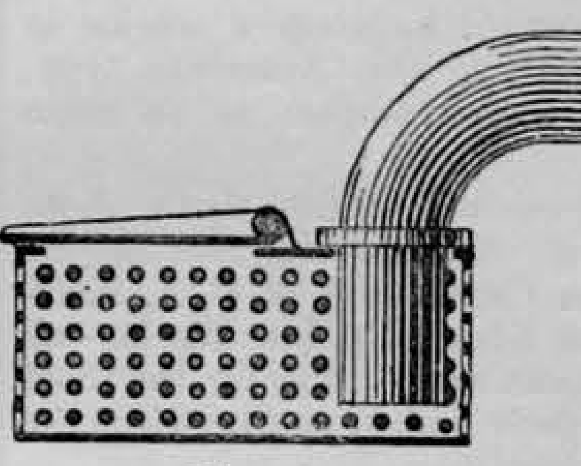


Fig 11.

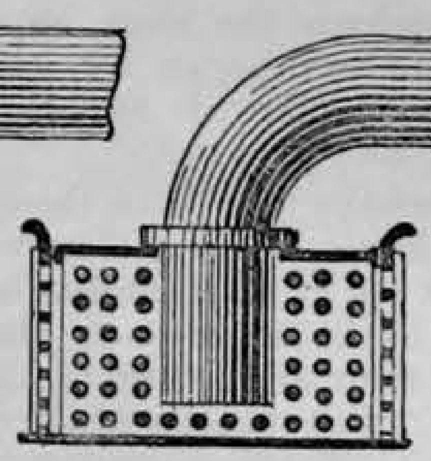


Fig 12.

the one pattern the top has a hinged lid, which permits of the bottom of the pipe being cleared if it should be choked. In the other pattern the sides can be lifted out and cleaned. The latter arrangement has the disadvantage that the pipe cannot be cleared while the pump is at work; for if any one side is removed, waste and other obstructions which float about will at once be drawn in; whereas if only the top of the box is opened, as in Fig. 11, when the water is low enough, there is no danger. The advantage of clearing the suction while the pump is drawing is that the objectionable matter is just then collected around the strum, and can be removed in a compact body, instead of having to be "fished" for in the moving bilge waters. On the other hand, it is easier to clean the holes in the sides of the suction boxes if these can be lifted out. The bottoms of these boxes need not be perforated, because they rest on the cement. Near the end of the bilge pipe, where it enters the box, a flange is soldered on—as shown in Figs. 11 and 12—on which it rests, while its lower end is one-quarter of its diameter above the bottom of the strum, the section of the pipe and of the open circumference being equal. With large pipes, such as are used for ballast tanks, which may be 6in. or even 8in. in diameter, the height of the pipe above the cement would have to be about 2in., and as this is considered too much, the ends of these pipes are sometimes made trumpet-shaped, which allows them to be lowered to within 1in. of the bottom, and yet to retain the full sectional area of the pipe. Strums are rarely fitted to ballast pipes.

It is very essential that those suctions which are situated in the engine-room should be quite accessible; yet on account of the number of auxiliary engines on the lower platform, and on account of bunkers and store rooms, there is generally so little floor space for convenient trap doors over the strums, that these are almost out of reach when the engines are at work. Thus in Fig. 13, which represents the thrust block, aft bulkhead, and engine bed-plate and seating; the aft centre strum is placed underneath the main engine turning wheel, and cannot be cleaned by hand except by someone who has courage enough to descend bodily into a small pit, bounded at one side by the revolving turning wheel and the half-dozen projecting nuts of a shaft coupling. But even then, if the water has gained on the pumps, which is the only reason for trying to clean a strum at sea, the engineer will be half immersed in water before he can turn to do his work. If the suction is placed in such a position the longitudinal vertical plates of the engine seating ought to have large manholes cut into them, at least over that frame space where the suction is to be found, so that it can be reached by crawling through this hole. Now that most steamers are built with double bottoms, which extend over their whole lengths, only wing suctions are fitted, which are of course quite accessible. For some inexplicable reason—it cannot be for cheapness—some of these tanks are separated by so-called wells, in which a centre suction is placed, the water reaching it by running along the gutters, and then into the well. When, as is almost invariably the case, this well is close to the aft engine-room bulkhead, it is quite impossible to clear the suction if the bilge water is at all high, for it is even less accessible than the one shown in Fig. 13, because of the tank top which extends over the well; and though there are manholes at the sides nobody dare venture in if the water has risen, which it does very quickly when once the suction is closed, as the well is comparatively small, and cannot hold much water. Some builders put both the centre and the two wing suctions into this confined space, and were it not for the available auxiliary pumping power, many a ship arranged on this plan would have foundered.

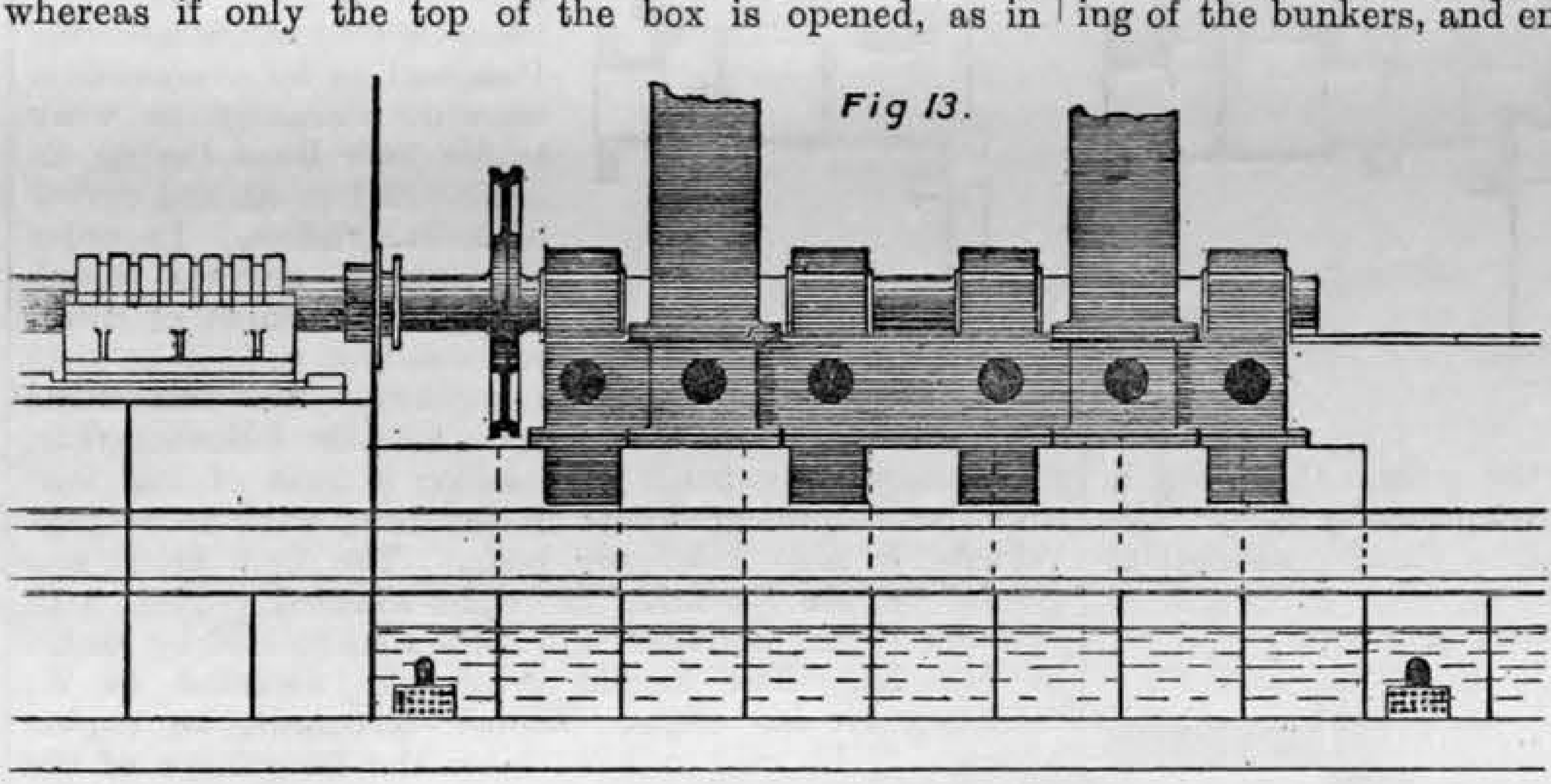
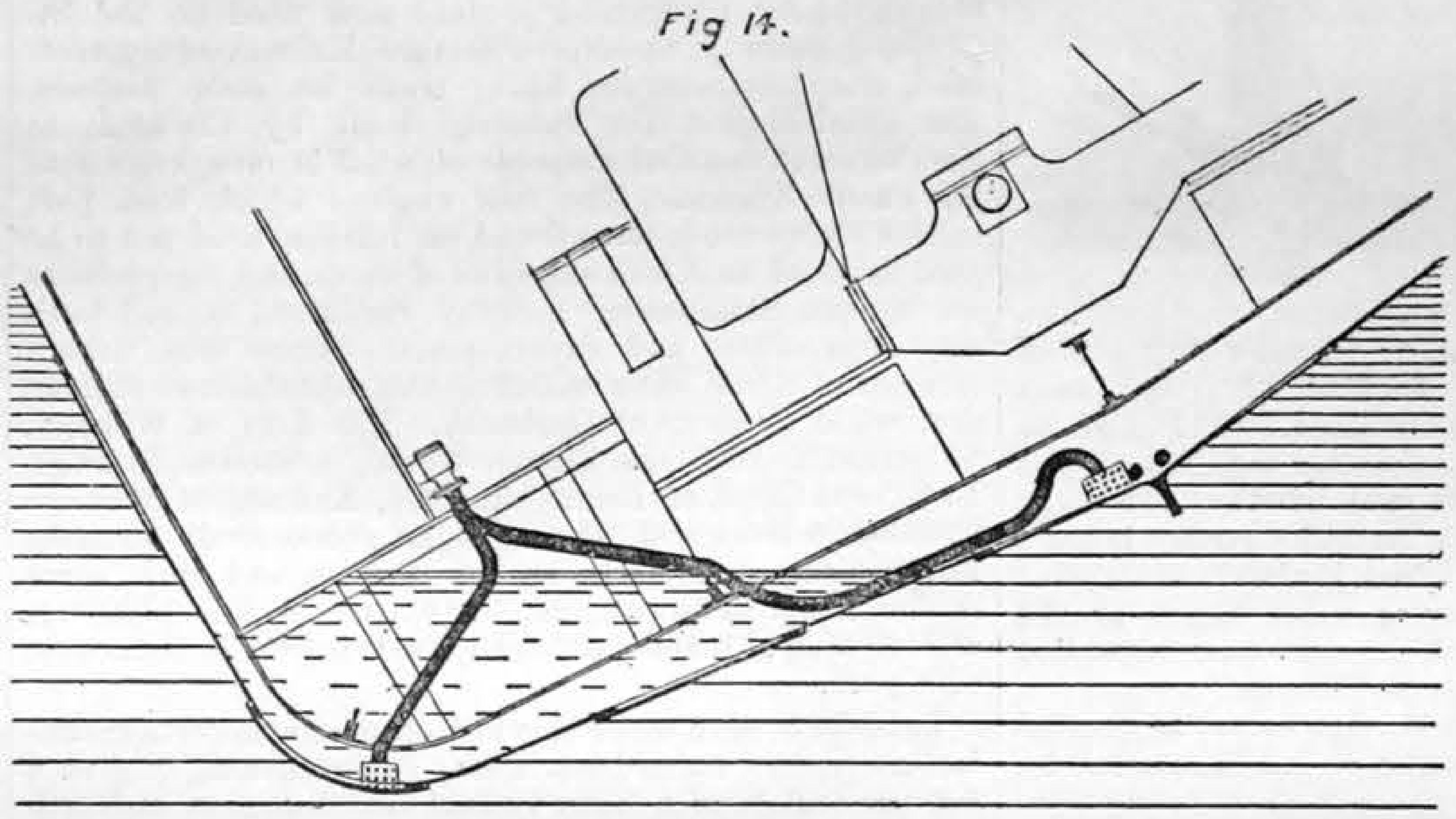


Fig 13.

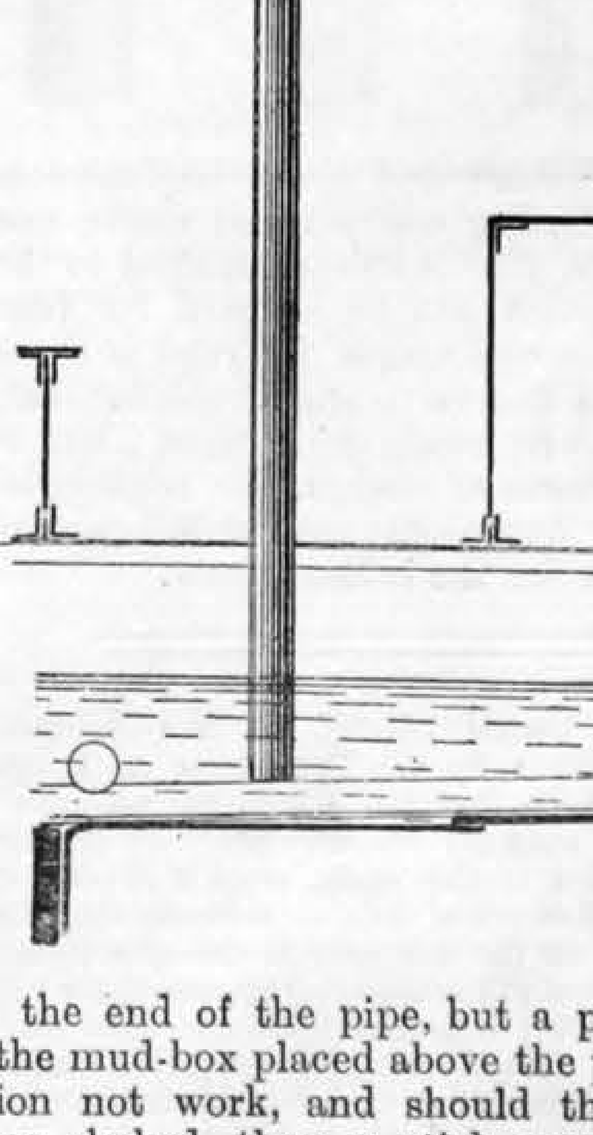
Fig 14.



Wells are sometimes, but very rarely, fitted in the holds of vessels with double bottoms, the object being to provide a larger and deeper reservoir for the bilge water than is to be found at the two gutters, whereby the risk of partially damaging the cargo is reduced.

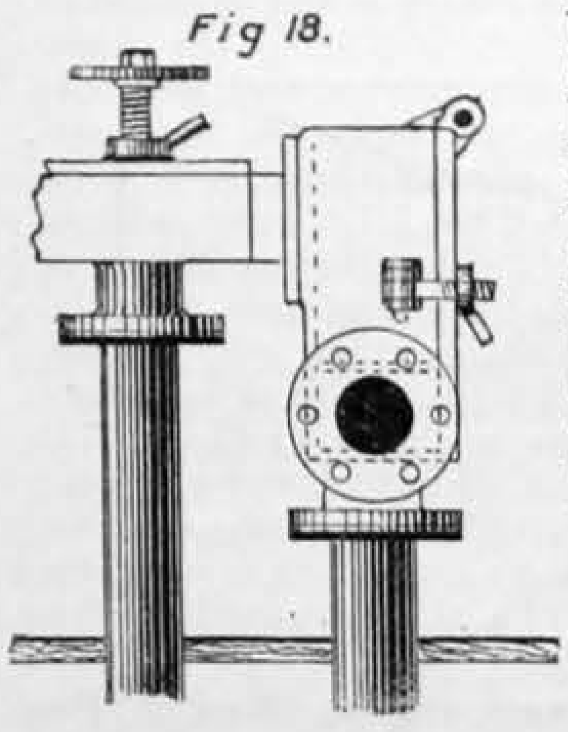
Another inaccessible position for a strum is in the wings under a bunker or storeroom. If the vessel has a list, and this suction should get choked, the water accumulates as shown in Fig. 14, and if the ship is rolling heavily this water will most probably knock up the ceiling of the bunkers, and empty the coal into the bilges. Such an accident would entail the most serious consequences, and no effort should be spared to prevent it, for not only is the floating coal capable of choking all the bilge pipes, but, being gradually ground down into a fine powder, or paste, it accumulates in the most inaccessible corners, from which it has afterwards to be removed at great expense. Vessels which have suffered in this way were found on examination to have the hollows of the bed-plate filled up solid with small coal, and in one case, where the manholes in the tank tops of the engine-room had been opened so as to utilise the ballast pump for removing the water, it was found, when the vessel ultimately reached port, that the whole tank was filled with small coal to the top. Amongst the devices which have been used for cleaning the insides of bilge pipes may be mentioned a hose connection to the boiler. The high pressure removed every obstruction, and the hot water washed and scoured away the dirty coating of the inside. With modern high-pressures this practice has been discontinued for fear of bursting the valve chests, but where cocks only are used the plan might still be adopted. These pipes might perhaps also be cleared by forcing cold water into them, but such a connection, if accidentally left open, would flood the engine-room or holds, and should therefore not be used. Another plan for clearing the pipes is to make them straight and accessible. Thus in Fig. 15 there is no

Fig 15.



strum at the end of the pipe, but a perforated plate is fitted in the mud-box placed above the platform. Should the suction not work, and should this be due to the pipe being choked, then a stick would easily clear a passage; while if the perforated plate is closed up, one can easily remove the obstruction by hand. The projection of the upper end of the vertical pipe high up into the mud-box is necessary, as otherwise the obstructing objects—small coal, wood chips, waste, &c., which have been carried up by the suction would fall back again into the bilges as soon as the mud-box is opened. This is a defect from which the combined valve chest and mud-box—Fig. 16—suffers. A better design is shown in Fig. 17, in which an overflow weir is added, and the dirt which is drawn up collects between this weir and the perforated plate, and can be lifted out by hand. The outside view of a still more convenient mud-box is shown in Fig. 18. The perforated plate is placed horizontally, as shown in dotted lines, while the door hangs vertically, and on opening it, the dirt falls into a bucket placed below, or can easily be raked out.

Fig 18.



The mud-box door joints consist of india-rubber bands, which are let into recesses running round the edge of the boxes, the hinged screws press the lid down, and when a suction is produced by the pumps this joint is still further compressed and becomes perfectly tight. The valve spindles are made air-tight by gland packings, as in Fig. 19. A cheaper plan is shown in Fig. 16, and in section in Fig. 20. A tight-fitting leather washer shown black in section, surrounds the screw, and is pressed down by a nut. As this arrangement is practically air-tight and cheap, it is now frequently adopted, but it is objectionable because of the trouble it gives when the engineer is not certain as to which of his valves is open, or whether any one of the valves is partially open. Instead of trying each wheel, as he would do if glands were fitted, as in Fig. 19, he has first to unscrew each nut, and then try each wheel; but even then he can never be quite sure whether the valve itself is down on its seat, because its under surface is lined with india-rubber—see Fig. 16—which is always somewhat yielding, and if a chip of wood or other object should have got caught at the lip, and thus prevent a perfect closing, its detection might be very difficult.

Fig 16.

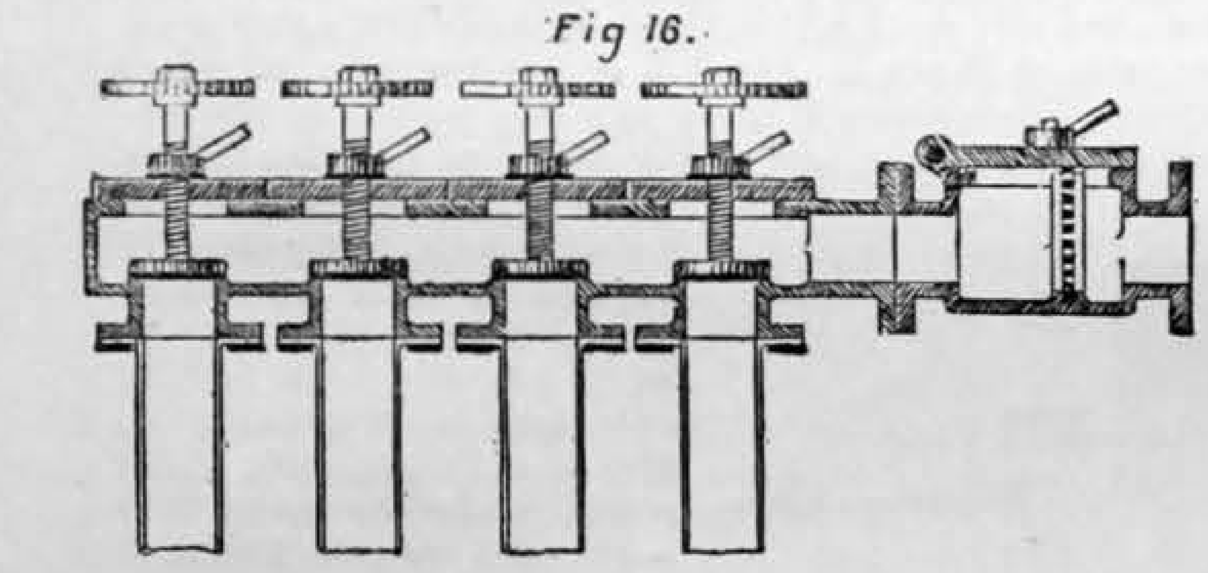
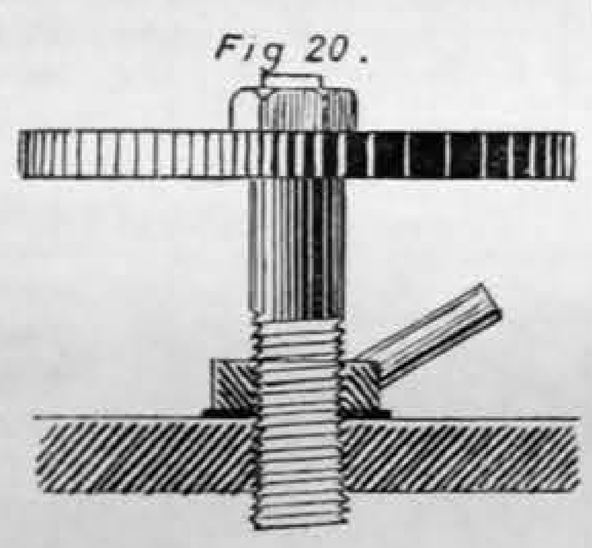
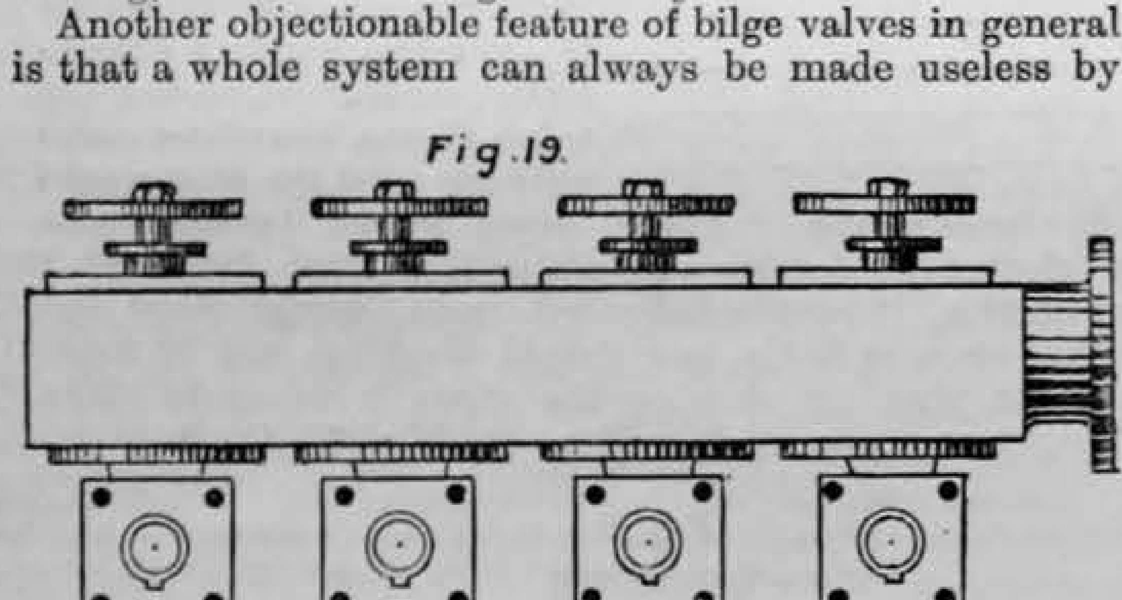


Fig 20.



Another objectionable feature of bilge valves in general is that a whole system can always be made useless by leakage past one valve; and some engineers go to the extra expense of having cocks fitted under each valve, as shown in Fig. 19, guards being attached to the glands, so that the key which has to be used for turning the plugs cannot be removed unless the cock is closed. The reason for having both a valve and a cock for each suction is that the latter are rarely quite tight; but as this is largely due to lightness of design, the remedy is not far to seek, and on the East Coast substantial cast iron cocks are being used even for the ballast pipes.

Fig. 19.



The Nicaragua Canal report to the United States House of Representatives by the Committee on Interstate and Foreign Commerce, states that the committee believes the canal entirely feasible, and strongly recommends that the Government assist in the completion of the work, even if it costs more than £30,000,000. The difference of opinion between the engineers for the Government and for the company is thought to affect in no wise the practicability of the project. The committee believes that the main question now is: Who shall build the canal and who shall control it when built? *Engineering News* says the committee feels justified in recommending that Congress should take immediate action to give such aid to the enterprise as may be necessary to obtain the funds which are requisite to complete the work.

LOCOMOTIVE BUILDING IN GERMANY.

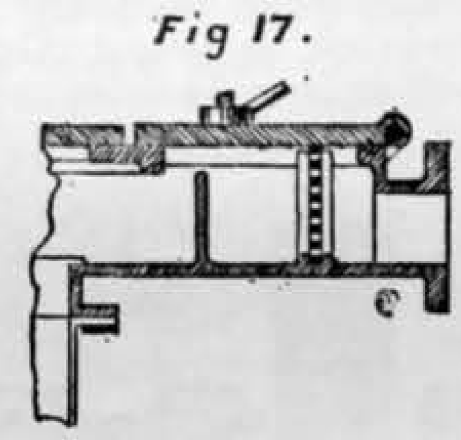
The earliest German railways—of which the first of any length was that from Leipzig to Dresden, opened in 1837—were supplied with locomotives built in English workshops. These English engines were copied by one or two enterprising German engineers between the years 1838 and 1841.

In 1841 several continental firms, which have since become well-known, began to make locomotives, amongst these must be mentioned the firms of Maffei of Munich, and Kessler of Karlsruhe, which copied exactly the English models, and of A. Borsig of Berlin. The latter are now perhaps the most important locomotive works in Europe, and began by imitating the American type, but soon followed the English examples as to main principles.

About the year 1845, three other important firms, those of G. Egestorff, near Hanover—now the Hanover Engine Works—of C. A. Henschel in Cassel, and of C. A. Hartmann in Chemnitz—now the Saxon Engine Works—all began the manufacture of locomotives, using for the most part English machinery in their shops, and copying the English locomotives pretty closely.

The year 1851 may be looked upon as the year in which continental engineers really began to form original types of locomotives suited to their own peculiar requirements, and not borrowed from English or American designs. In 1849, as the railway joining Vienna and Trieste neared its completion, and the enormous difficulties of the section between Gloggnitz and Mürzzuschlag over the Semmering Pass had to be overcome, it became necessary to work traffic over lines having an incline of 1 in 40, and curves of 935ft. radius. In order to procure engines which should be capable of working this line, in 1850 an open competition was announced to be held the following year, for locomotives capable of drawing a train of 125 tons over the steepest gradients on the line, with an average velocity of nine miles per hour. The first prize was gained by the Bavaria, an eight-wheeled engine with cylinder 19½in. diameter, and 29in. stroke, built by Maffei of Munich. The second prize was awarded to W. Günther, for his engine Wiener-Neustadt, an engine which may be said to have been the forerunner of the four-cylinder compound engines now used on the St. Gothard Railway, the North-eastern Railway of Switzerland, and elsewhere, for heavy traffic on steep inclines. The third engine, the Seraing, built by Cockerill at Seraing, was the first example of what is now known as the Fairlie System. The four engines which took part in this competition were found on further trial not to be able to do all that was expected of them, and the problem set by the Semmering Railway continued to call forth new suggestions and experiments. Since that time a number of firms have taken up the manufacture of locomotives in all parts of Germany. The firm of Wöhlert, in Berlin, in 1850, the Vulcan Works, in Stettin, in 1859, L. Schwarzkopff of Berlin, in 1867, Krauss, of Munich, founded in 1866, and others, began successively to make locomotives, and there are at the present time some fifteen firms of importance employed in this industry, and capable of turning out over 2000 engines in the course of a year.

Fig 17.



In order to give some idea of German locomotive manufacture as now carried on, it may be interesting to give a few particulars of a fairly typical establishment in North Germany. This firm gives employment to over 2000 workmen, and is one of the oldest and largest of its kind; and, although not possessing all the newest improvements, shows itself to be well able to maintain a prominent place in the competition for both home and foreign orders. Although locomotive building occupies the greater part of the works, there is also a department for making stationary and pumping engines. To begin with the machine shop, the older machine tools are of English manufacture; but those added within recent years, with very few exceptions, bear the names of German makers, and come mostly from the shops of Chemnitz, Karlsruhe, or Berlin. Their relatively high price appears to be fatal to the English tools, which are, however—even in Germany—generally looked upon as superior to the home-made ones. The majority of the machines have been in use for many years, and it is evident that in the past very little money has been spent in renewing them. It is, however, also evident that steps are being now actively taken to introduce new machinery and appliances, and so to remove this reproach. All the planing machines are driven by a straight rack and pinion under the bed, instead of by the more exact and modern screw. Amongst the tools recently introduced is a cylinder boring machine, which is furnished with three cutting tools; one for boring the cylinder barrel, and the other two for facing simultaneously the ends of the cylinder.

Next to the machine shop are the smithy and forge. The steam hammers are of old-fashioned design, most of the smaller ones being fitted with an automatic valve action, which makes it more difficult to regulate the blows than is the case with valves moved directly by a simple hand lever. Amongst the interesting operations to be seen in the forge may be mentioned the forging of the wrought iron axle-boxes, which are fitted to almost all German engines. The wrought iron cross-heads for outside cylinder engines also form rather complicated pieces to forge. There was formerly a very fine wheel forge, fitted up with specially designed English steam hammers, for the production of iron wheels, for which the firm was noted. This is now entirely dismantled, and is only used as a storage room, the use of steel wheels being now universal in Germany. A department not usually found in English locomotive works is the file-cutting shop. The new files are all bought from the file makers, but they are re-cut in this shop after being used. This shop is also found to be advantageous in enabling special files to be made at short notice for special work.

Taking the shops in the order in which they stand, the erecting shop comes next. The erecting pits are situated at right angles to and on both sides of the line of rails traversed by a movable platform, on which the engines are moved when finished to the trial-siding and paint shop. The locomotive frames and tenders are put together over the pits on one side and the engines are erected over the pits on the other, there being about twelve pits on either side. There is, however, another similar set of pits at the far end of the erecting shop, which is now only occasionally used for repairs.

The system of erecting is, in outline, as follows:—The frames, cross-stays, and stretchers are riveted together in one part of the shop and then transferred to the erecting pit. The boiler is then at once placed between the frames, but is at first supported on trestles until the expansion angle-irons and the brass packing pieces used to support the barrel have been adjusted. When the boiler rests in its place, the first thing is to mark the face of the horn-blocks for machining; this has not been done before in order that any relative movement of the frames caused by the weight of the boiler may be allowed for in the machining of the horn-blocks. The cylinders are then bolted temporarily in place and are marked for planing on the surface, which is bolted against the frames and has been only roughly planed over beforehand. The bolt-holes in the cylinder-flange are next marked off and bored. After the cylinder has been finally bolted in place the slide-bars and slide-bar bracket are put up, bored out, and the packing-pieces adjusted. While this has been going on the clothing and cab-fitting "squads" have been doing their work. During the time that the motion is being put in place and the valves set the brake-fitters and pipe-men are putting on the brake and the pipes and cylinder cock gear respectively. There is no single man responsible for the erecting of each engine, but each operation has a gang of fitters, who perform only this one kind of work on all the engines successively.

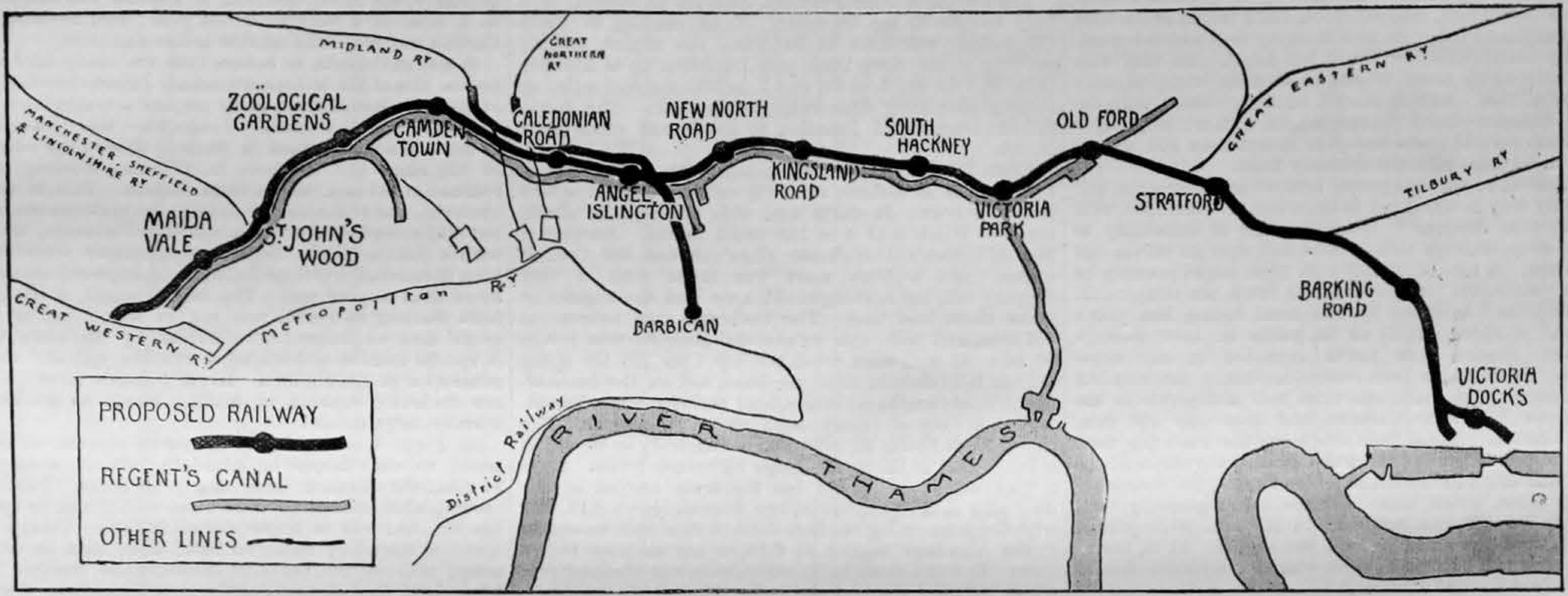
It is worth noticing that all steam joints, both of pipes and boiler mountings, are made by means of brass rings of triangular section, and made according to standard tables issued by the State Railway authorities. By this means much labour in adjustment and facing is saved, as a slight want of parallelism in two flanges does not signify, and the flanges themselves need only be roughly turned. Another saving—and in engines with outside steam chests this is a considerable one—is effected by the use of malleable iron for both the main steam and exhaust pipes. These pipes are ordered from special makers, bent accurately to the drawings supplied, and all that has to be done in erecting is to braze on the flanges made to suit the appropriate size of jointing ring. Behind the erecting shop are the tank and boiler shops, where little of any special interest is to be seen. All riveting is done by hand, and all rivet holes are drilled. Fire-box roofs are almost invariably supported by stays screwed into the outer fire-box shell, which is usually made of thicker plate at the top, in order to give it the requisite stiffness; roof bars are scarcely ever used. The copper fire-box stays have the thread turned off on the length between the plates, and are drilled with a 3 millimetre hole for a depth rather greater than the length of the thread left at each end. The stay ends are hammered to form a conical head, care being taken not to rivet over the holes. Short pieces of tube are afterwards riveted into the clothing opposite each stay, so that a fracture in the stay can at once be detected. Plate flanging is at present done entirely by hand; but a hydraulic press will probably be shortly set up, which will greatly lessen the amount of labour now expended. The foundry is very large as heavy castings for stationary engines are also made there. The locomotive cylinder patterns are usually divided into three transverse sections, the mould being made and cast vertically in three boxes. A heavy ring of metal is cast on to the upper end, to aid in producing a sound casting.

The shop containing the fine machine-tools used in making milling-cutters, twist drills, taps, and other fine work, deserves special notice. It is fitted with new machinery specially designed for this kind of work, and made mostly by Loewe of Berlin. Almost all the twist drills and taps used in the works are made here, and a considerable saving in cost is the result.

In conclusion it may be worth while to allude to one or two points which affect the price of locomotives made in Germany. The State railways purchase all their engines from contract shops, and although the different sections require some variations, the comparative uniformity in the engines used on all the State railways renders it possible to use old drawings and patterns with but few alterations in the execution of any fresh orders. Considerable care is taken in designing to use the cheapest materials and method of manufacture which will answer the purpose, and in carrying out the design, no more time and labour are expended than is sufficient to ensure that the result will work. Thus as few pieces as possible are left bright, handrails, reversing-rods, &c., are painted. Another factor in the cheapness of German locomotives, added to the lowness of wages, is the thoroughness with which the system of payment by piecework is carried out in all departments. Through the pressure of this system the turners and planers have each to work several machines, in order to make sufficient wages to support themselves with. By these and other means, the German locomotive manufacturers must now be considered to have rendered themselves strong competitors with us in securing foreign contracts. This is proved by the fact that within the last few months German firms have received orders for the Wladikawkas Railway of Russia, amounting to several hundreds of thousands of pounds, for which English engineers had tendered in vain.

THE REGENT'S CANAL, CITY, AND DOCKS RAILWAY.

IN THE ENGINEER of July 10th, we referred, in passing, to the railway of the above company. Now, however, that a portion of the company's Parliamentary powers is about to lapse, and as it is understood that the directors of the project have an application to Parliament for renewal under consideration, it becomes of interest to review the past history of this railway project, which attracted so much attention in the engineering world and so little support from the public, and to set forth its present prospects. The project had so dropped out of public notice during the last few years that many otherwise well-informed people were under the impression that its scheme had been definitely abandoned. This, however, appears to be very far from the truth, and although, as has just been said, a portion of the power—the Compulsory Purchase clauses—granted in 1881-2 has just lapsed, the construction powers have yet two years to run, and those two years may bring forth a great deal in this respect. Sooner or later, and probably sooner rather than later, the unchartered wilderness of houses through which the proposed line has been surveyed must have the railway facilities which it has always sorely lacked, and never so urgently as now, when the great terminus of the Manchester, Sheffield, and Lincolnshire Extension to London is being rapidly pushed forward, to bring in the near future a working-class population on this route, as dense as that which crowds the huddled streets behind the other great termini of Euston, King's Cross, and St. Pancras.



The Regent's Canal, City, and Docks Railway Bill was introduced to Parliament in the Session of 1881-82. The map above will show the course it was proposed to take. By it, it will be seen that the bank of the Regent's Canal was followed very closely all the way from Paddington as far as Victoria Park, where it continued beside the Hertford Union Canal to Old Ford, taking its way thence across the levels of West Ham to Victoria Docks. Stations were proposed at Maida Vale, St. John's Wood-road, Zoological Gardens, Camden Town, Caledonian-road, the Angel, Islington, New North-road, Kingsland-road, South Hackney, Victoria Park, Old Ford, Stratford, Barking-road, and Victoria Docks; while a spur line was proposed from St. Pancras to the Barbican, City, giving direct communication with the Midland Railway at St. Pancras and the Great Northern at King's Cross.

The Bill was hotly contested in Committee, no fewer than seventy-six petitions being presented against it by railway companies, public bodies, and private individuals, who considered their interests prejudicially affected. The South-Eastern and Metropolitan Railways were especially active against the scheme.

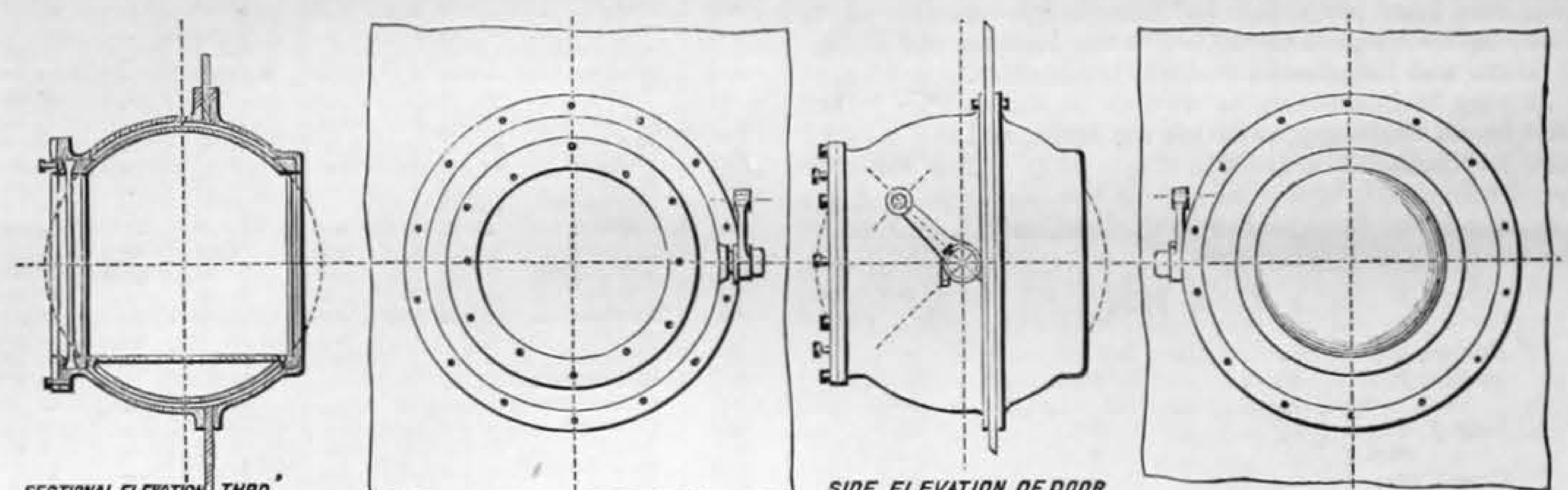
Yet it was one calculated to be peculiarly useful, both as a passenger and a heavy goods and mineral line. It joined the great trunk systems of the Great Western, the Midland, and the Great Northern Railways with the City and the Docks, and provided direct communication between the South Wales coalfields and the Port of London, *viâ* the Great Western. Coal could, with the construction of this line, be shipped direct, instead of, as at present, being brought along the Great Western line to Southall and Brentford, there to be transferred to barges, and thence to come, by the tortuous course of the Thames, to the Docks. A similarly large traffic would have come from the Midland and the Great Northern Railways; while those lines, serving as they do, the vast northern suburbs of London, wherein lives a population largely clerkly, and desirous of journeying between their homes and the City on six days of every week, would have welcomed this outlet for their congested traffic, already straining to their utmost the carrying capacities of both lines. The Regent's Canal, City, and Docks Railway would thus, in fine, have performed the office of a railway truly metropolitan, and the directors were well advised when they recently altered the title of their projected line to that of the "North Metropolitan Railway and Canal Company."

The extent of the proposed line is rather over twelve miles. For its construction a capital of £5,722,400 was authorised by the Acts the company obtained, and renewed in the Sessions of 1882 and 1892. The Acts provided for the formation of the company and for the purchase of the existing canal from the Regent's Canal Company. Thus the present company have in view two undertakings—the proposed railway, and the canal which was taken over, and is a concern paying interest at the rate of 2¾ per cent. per annum. The capital of the canal part of the company, already created, including loans amounting to £425,000, is £1,783,100. The railway capital has not, however, been issued, for investors, made shy perhaps by the story of the District and the East London Railways, have not responded to the prospectus issued by the promoters, although the prospects of such a line have always seemed to be good.

It is interesting, in connection with this railway, to note that in the works now in progress on the Manchester, Sheffield, and Lincolnshire London terminus, the engineers have constructed a space on the north side of the Regent's canal for the North Metropolitan line to run in, whenever its building shall be begun. The Manchester, Sheffield, and Lincolnshire crosses the canal on girders at a height of 16ft. above the towing path. Here a new retaining wall has been put in on the outer side of the path, and the girder supports rising from the water are filled in between with lattice work. The space thus left beneath the Manchester, Sheffield, and Lincolnshire will allow for one up and one down line.

CASEY'S SPHERICAL WATER-TIGHT BULKHEAD DOORS.

NUMEROUS as have been the attempts to devise a simple and thoroughly effective door for closing the compartments of ships separated by bulkheads, it is a matter for regret that few, if any, of these have fulfilled the most essential requirements, namely, that of being readily closed in case of emergency, and any meritorious attempt to supply the means to effect this end will be sure to meet with encouragement from steamship owners. The latest aspirant to favour is a globular device invented by a marine engineer of considerable experience, Mr. James Casey, 10, Philpot-lane, London, E.C., and certainly has the merit of being entirely original. The accompanying illustrations will enable the construction and action of this door to be readily understood. It is spherical in form, fitted in a casing formed in two parts bolted to the bulkhead, and is provided with a through opening corresponding with similar openings in the casing, thus forming a double-seated door. The globe is accurately fitted, and works in fixed and adjustable seatings, upon which a packing is fitted, and covered by a packing ring. The packing and rings being independent of the bulkhead, prevent the globe from becoming jambed, should the bulkhead be twisted or buckled during a collision. The globe is mounted upon a spindle or trunnions, on one side of which is secured a handle or lever for rotating it; so that by moving the lever in one direction the passage is opened, while a movement in the reverse direction closes the connection between the two compartments. This handle or lever may be connected to another lever on deck, in the chart-room, or on the bridge of the vessel by means of a rod, so as to be in easy reach in case of emergency. This arrangement has one important advantage over the rack and worm arrangement so largely used at present, namely, that the passage can be closed almost instantaneously by a simple movement of the lever through the arc of a circle.



SECTIONAL ELEVATION THRO' BULKHEAD DOOR AND BULKHEAD. BACK VIEW OF BULKHEAD DOOR. SIDE ELEVATION OF DOOR CONNECTED TO BULKHEAD. FRONT VIEW OF BULKHEAD DOOR.

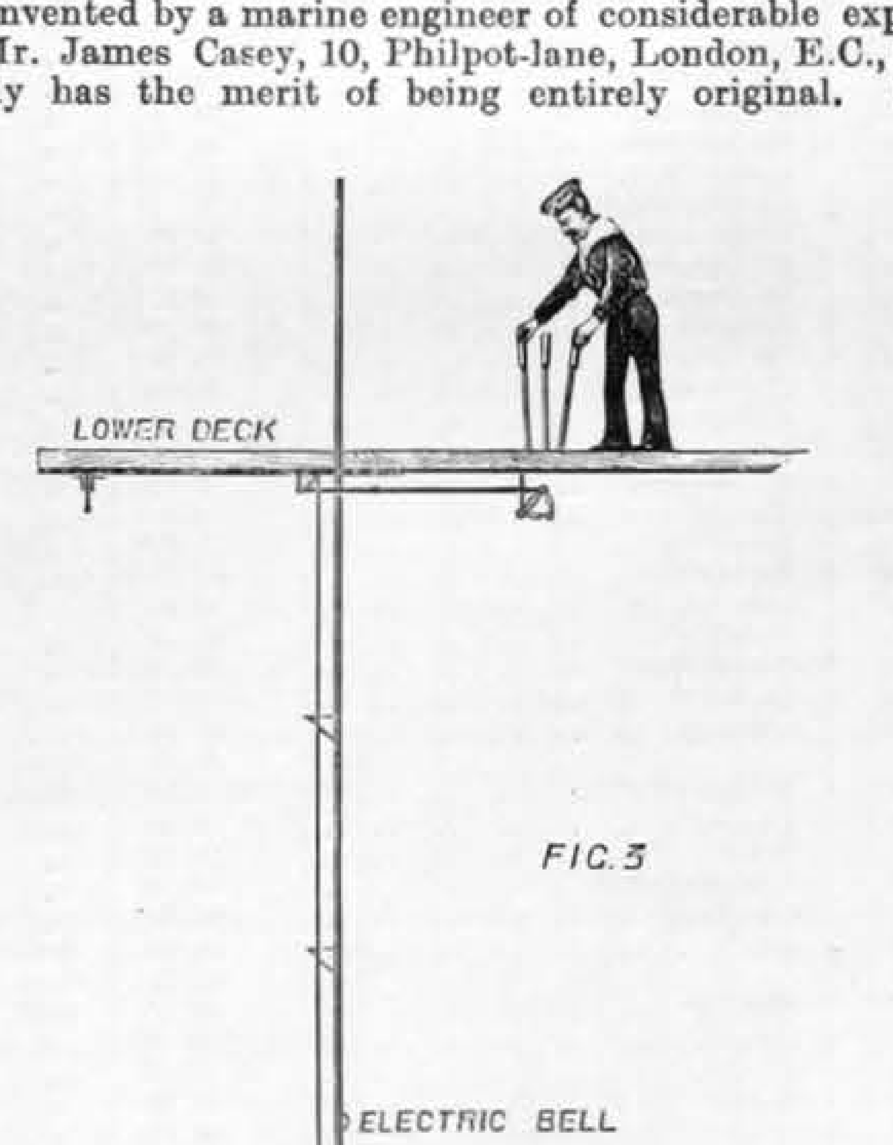


FIG. 5

We recently witnessed the operation of one of these doors fitted in the engine-room of the Carron Company's steamship Thames. The door was operated by a lever on deck, and an electric bell arrangement was provided whereby the operator could give an audible signal to any person who might be in either of the communicating compartments below that the passage was about to be closed. A return signal sent from below informed the operator that all was clear before pulling over the lever and closing the door. The whole proceedings occupied only a very brief period, certainly much less than that required for operating an ordinary bulkhead door working by means of a worm and rack in vertical slides. It was also shown that the operation of the globe was not impeded by placing a block of coal in the opening of the casing, several blocks being sheared completely through by the closing of the door. Although some slight objection may be raised to the system of audible signalling fitted with the apparatus on the Thames, on the ground that this might be productive of delay in closing the door at a precarious moment should the return signal not be given, this does not affect the general principle underlying the invention, and it must be stated that at the time of our visit the working of the door was perfectly satisfactory.

A further important advantage which Mr. Casey claims for his globular door is that it can readily be operated, should the ship be suddenly thrown into darkness owing to the lights going out, which is usual with electrically-lighted ships upon a collision occurring. Under these circumstances the officers and crew might experience much difficulty owing to the darkness in finding the gear for closing the doors from the 'tween decks, whereas with the present apparatus it would be a comparatively simple matter to put the hand on the levers in the chart room, or on the bridge, and upon the receipt of the "all clear" signal from below, close the passages communicating with the compartment or compartments whence the danger arises. This form of door may also be fitted to deck openings for bunkers, transit, or ventilation.

THE effect of electricity on projectiles while in flight has been illustrated by some recent trials of the Swiss army rifle. The *Journal de Genève* states that during this trial strange deflections of the bullets were noticed that could not be accounted for until it was discovered that an electric line paralleled the range. Experiments were made by building a line of four steel cables the full length of the range, 780ft., and about 120ft. from it. When these cables carried a heavy current of electricity the lateral deflection for this distance was about 70ft. For a longer range the deflection was much increased; with artillery, and a range of 9000ft., the deflection from the true line is claimed to reach the enormous amount of 14 deg. It is not stated whether the deviation is toward or away from the electrical cables.

WITH THE WEST COAST "FLYER."

By Charles Rous-Marten.

A great deal of mischievous nonsense has been written in the daily papers about the lamentable accident which occurred at Preston on the 12th inst. to the West Coast "Flyer." There has been the usual ignorant assumption without proof that "excessive speed" was the cause of the mishap. Much reference has been made to the run made by the same train in the previous week of 105 miles in 105 min., and it has been taken for granted that this was abnormal and perilous. No idea could be more absurd. As a matter of fact, that same run, from Wigan to Carlisle, was surpassed a day or two later by one which a trustworthy friend timed for me in full detail. In that case the 105¼ miles from Wigan to Carlisle occupied only 103 min. net. And it should be remembered that the same distance—from passing Wigan without stopping—was done several times last year in less than 100 min.—once in 94 min. with the ordinary train.

Excess as to speed is purely relative in these cases, and the only way in which the point arises in connection with the Preston disaster is from the view of suitability to the passage through that station and over its curves and crossings. A rate of 40 miles an hour might possibly be more "excessive" there than 80 down the Shap bank. But often as I travelled by that train during last year's "race," a speed of 20 to 25 miles an hour through Preston Station was never exceeded in my experience. It has also been asserted, without the smallest foundation, that sufficient time was not given to the run from Wigan to Carlisle, and that only 105 min. were allowed. So far from this being the case, the time allowed was 112 min., and when the mishap occurred the train had still 94 min. left in which to run the remaining ninety miles, which same distance had repeatedly been done in 85 to 89 min., and once in 80½ min. with perfect safety, and with a similar load per engine. It is, therefore, clear that in no respect was the accident due to insufficient time allowance.

Another mistatement which has been published is to the effect that the London and North-Western Company had admitted their error in timing by allowing "19 min. additional to Carlisle." No extra time has been allowed, but the Bletchley, Rugby, and Wigan stops have been taken out, a course which had become necessary, and had been resolved upon, before the accident happened.

With a view of ascertaining authoritatively what was actually done on the fastest lengths of the West Coast journey, I recently made a special trip to Aberdeen and back expressly to observe and investigate. This, I may add, was done with the full knowledge—except as to *date*—and courteous assistance of the London and North-Western and Caledonian Railway authorities.

It may be interesting to explain *in limine* that it had been found necessary to divide the train, and run the first part to Carlisle with only a single stop. The schedule speed was consequently higher on the earlier part of the way, but lower from Crewe to Carlisle, as will be seen by the following comparison:—

Former Time.

		Speed.
Euston, dep.	8.0	—
Bletchley, arr.	8.59	47·5
,, dep.	9.1	—
Rugby, arr.	9.45	48·9
,, dep.	9.49	—
Crewe, arr.	11.10	56·0
,, dep.	11.15	—
Wigan, arr.	11.54	55·1
,, dep.	11.58	—
Carlisle, arr.	1.50	56·4

New Time.

		Speed.
Euston, dep.	8.0	—
Crewe, arr.	10.55	54·2
,, dep.	11.0	—
Carlisle, arr.	1.50	49·8

Starting from Euston we had a train of seven vehicles, viz., two sleeping cars, 4 eight-wheel W. C. J. S. coaches, and a van, the total weight being about 161 tons, exclusive of engine and tender. The engine was one of Mr. F. W. Webb's splendid eight-wheeled compounds, of the Greater Britain class, having two high-pressure cylinders, 15in. by 24in.; one high-pressure cylinder, 30in. by 24in.; and four driving wheels, not coupled, 7ft. 1in. diameter.

The weather was fine and calm throughout, and the rail dry—except on the Caledonian in the early morning after a heavy dew and mist. Excellent work was done by the big compound, which ascended the bank to Tring (31¾) in 36 min. 5 sec., covered 57¼ miles in the first hour, passed Rugby (82½ miles) in 86 min. 40 secs., Nuneaton (97) in 1 h. 44 min. 10 sec., and Tamworth (110) in 1 h. 57 min. Then being in advance of time the driver eased down, and Crewe was easily reached three minutes early. Here a 6ft. 6in. coupled engine, of the same class as the racing celebrities Hardwicke and Vulcan, came on. A very smart beginning was made, Warrington (24¼) being passed in 24½ minutes, and Wigan (36) in 37¼. Then this driver, too, eased down, having plenty of time on hand. At Preston Station there was almost an excess of caution. It took fully five minutes to pass through the station and yard, including two stops. There was, however, abundance of spare time, and the driver went along easily nearly all the way to Carlisle. The speed did not fall below thirty miles an hour up the bank to Grayrigg averaging 1 in 130, and the five and a-half mile length from Tebay to Shap Summit, including the steep bank of 1 in 75, was done in 10¼ min. The descent of 31¼ miles to Carlisle occupied 32 min., going easily, with a frequent touch of the brake, and Carlisle was reached a minute early, in just under 2 hours 47 min. from Crewe.

Here the real stress of the journey began, the Caledonian timing on to Forfar being of a most severe character, averaging 56·8 m.h., with two stops and a change of engines. One of Mr. J. F. M'Intosh's superb locomotives of the Dunalastair class—6ft. 6in. coupled, with cylinders 18¼in. by 26in.—came on, and it soon became evident that the driver meant to keep time. The run to Stirling was certainly most remarkable. The distance of 117¾ miles was covered in 116 min. 53 sec. from start to stop with a load of 161 tons. Beattock (39¾) was passed in 37 min. 50 sec., the Summit (49¾) in 53½ min., and Carstairs (73½) in 72¾ min., the lowest speed up the long stretch of 1 in 75 being 36 miles an hour. The downhill speed from the Summit to passing Carstairs was very high, the 23¾ miles being run in 19 min. 13 sec.

The 68 miles from Beattock Summit to Stirling took only 63 min. 20 sec. to cover. From Stirling to Perth (33 miles) was done in 34¾ min., the engine making nothing of the steep bank past Dunblane up to Kinbuck (1 in 78, 1 in 84, 1 in 88, and 1 in 90), the five miles up these grades being done in little over 6 min. The downhill run from Crieff Junction to Perth was exceedingly smart.

From Perth to Forfar the timing is by far the fastest ever seen in Bradshaw, viz., 32½ miles in 32 min. = 60·9 miles per hour. It starts too, with a nine mile climb, much of which is at 1 in 123 and 1 in 125. Another of Mr. M'Intosh's Dunalastair class relieved the Carlisle engine, and a fresh start was made with a very slippery rail, but nothing could keep back the engines or make them lose time. The load was now reduced to 101 tons, and with this weight the distance was run in 30 min. 51 sec. start to stop. Up 1 in 123 the speed did not fall below 50 miles per hour, and on the descending or level lengths no exceptional velocity was attained. It was a case of evenly rapid work throughout. The timing from Forfar to Aberdeen is relatively so slow that it is not easy to fill up the large allowance given. After a very steady and even run the train arrived at the Aberdeen ticket platform a few seconds before 6.12, and with the intervening needless delay, a final halt was made in the Aberdeen Station at 6.15, or ten minutes before time. It was a remarkably rapid, safe, and pleasant run, which reflected the highest credit alike on the company, their officers, their road, and their rolling stock, nothing could be smoother or more easy than the travelling of the train at the highest speeds attained.

The following are the "logs" of this remarkable run, and of a subsequent one by the same train:—

Miles ex Euston.	Stations.	No. 1. Actual times.	No. 2. Actual times.
—	Euston .. .. dep.	8 0 44	dep. 8 0 32
5½	Willesden .. .. pass	9 11	,, 9 5
17½	Watford .. .. ,,	21 45	,, 22 10
31¾	Tring .. .. ,,	36 49	,, 37 44
46¾	Bletchley .. .. ,,	50 41	,, 51 11
52¼	Wolverton .. .. ,,	56 4	,, 56 33
59¾	Roade .. .. ,,	9 3 45	,, 9 4 40
82½	Rugby .. .. ,,	27 24	,, 30 22
97	Nuneaton .. .. ,,	41 54	,, 47 52
110	Tamworth .. .. ,,	57 45	,, 10 0 0
116½	Lichfield .. .. ,,	10 3 53	,, 6 26
133¼	Stafford .. .. ,,	22 45	,, 24 46
147½	Whitmore .. .. ,,	40 47	,, 43 10
158	Crewe .. .. arr.	52 40	arr. 54 56
	dep.	11 2 4	dep. 11 1 54
182¼	Warrington .. .. pass	26 30	pass 26 50
184	Wigan .. .. ,,	39 18	,, 40 59
209	*Preston .. .. arr.	57 52	arr. 58 30
	dep.	12 2 2	dep. 12 1 24
230	Lancaster .. .. pass	26 31	pass 25 45
236¼	Carnforth .. .. ,,	32 24	,, 31 47
249	Oxenholme .. .. ,,	47 33	,, 47 0
256¼	Grayrigg .. .. ,,	59 48	,, 59 0
262	Tebay .. .. ,,	1 6 28	,, 1 5 35
267½	Shap Summit .. .. ,,	16 42	,, 15 57
277	Clifton .. .. ,,	26 8	,, 25 22
281¼	Penrith .. .. ,,	30 0	,, 29 17
294¼	Wreay .. .. ,,	42 4	,, 42 58
299¼	Carlisle .. .. arr.	48 54	arr. 49 12
ex Carlisle.			
	Carlisle .. .. dep.	55 47	dep. 1 56 1
4	Rockcliffe .. .. pass	2 0 50	,, 2 1 0
6	Floriston .. .. ,,	2 36	,, 2 43
8½	Gretna .. .. ,,	4 45	,, 4 54
13	Kirkpatrick .. .. ,,	9 16	,, 9 30
16¾	Kirtlebridge .. .. ,,	13 8	,, 13 18
20	Ecclefechan .. .. ,,	16 23	,, 16 32
25¾	Lockerbie .. .. ,,	21 46	,, 21 51
28¾	Nethercleugh .. .. ,,	24 7	,, 24 16
31¾	Dinwoodie .. .. ,,	26 32	,, 26 47
34½	Wamphray .. .. ,,	28 59	,, 29 20
39¾	Beattock .. .. ,,	33 37	,, 34 24
49¾	Summit .. .. ,,	49 20	,, 49 31
52¼	Elvanfoot .. .. ,,	52 10	,, 53 0
55¼	Crawford .. .. ,,	54 23	,, 54 58
57¾	Abington .. .. ,,	56 23	,, 56 58
63¼	Lamington .. .. ,,	3 0 31	,, 3 1 13
67	Symington .. .. ,,	3 31	,, 4 25
68¼	Thankerton .. .. ,,	4 50	,, 5 47
73½	Carstairs .. .. ,,	8 33	,, 9 41
81½	Braidwood .. .. ,,	16 47	,, 17 41
84	Law .. .. ,,	19 36	,, 20 30
89¾	Holytown .. .. ,,	25 4	,, 25 47
94	Coatbridge .. .. ,,	30 0	,, 30 30
109¼	Larbert .. .. ,,	45 9	,, 46 12
117¾	Stirling .. .. arr.	52 40	arr. 53 41
	dep.	57 2	dep. 59 50
120¾	Bridge of Allan .. .. .. pass	4 1 55	pass 4 4 0
125¼	Kinbuck .. .. ,,	8 19	,, 10 16
134¾	Crieff .. .. ,,	18 14	,, 20 35
137	Auchterarder .. .. ,,	20 0	,, 22 17
141¼	Dunning .. .. ,,	23 29	,, 25 37
150¾	Perth .. .. arr.	31 46	arr. 34 36
	dep.	40 31	dep. 6 9 19
158	Stanley .. .. pass	49 12	pass 18 10
162¼	Cargill .. .. ,,	53 0	,, 22 15
171¼	Alyth .. .. ,,	5 1 9	,, 30 50
183¼	Forfar .. .. arr.	11 22	,, 42 3
	dep	13 11	
190¼	Guthrie .. .. pass	20 56	,, 49 48
201¼	Dubton .. .. ,,	31 58	,, 7 1 59
217¼	Drumlithie .. .. ,,	47 49	,, 18 30
224¼	Stonehaven .. .. ,,	55 0	,, 26 7
240¾	Aberdeen Ticket Platform .. arr.	6 11 41	,, 43 0
	Aberdeen Station .. .. .. arr.	6 15 0	arr. 7 44 15

* Time from entrance of station to exit.

A second experimental journey by the same train as far as Perth gave curiously similar results. The load was slightly—perhaps nine tons—heavier, and the time of each inter-stational run was slightly longer. Substantially the locomotive work accomplished, allowing for difference of weight, was identical in its excellence.

From Euston to Crewe the train was taken without stop, and with only a partial slack at Rugby, by one of Mr. Webb's 6ft. 6in. coupled engines. On reference to the "log" it will be observed that with a load of 170 tons behind the tender, the Tring summit was passed in 37 min. 12 sec., Rugby in 89 min. 50 sec., and Tamworth in 1 h. 59½ min., Crewe being reached a few seconds early.

From Crewe, one of Mr. Webb's 8-wheeled compounds brought the train on to Carlisle. The schedule allowance—2 h. 50 min.—is quite excessive on this length, and the drivers must be hard put to it to fill up the time. Preston Station was passed through at a slow walking pace, the passage occupying 3 min. The speed fell to 36 miles an hour up the Grayrigg bank and to 25 miles an hour up the Shap incline, there being no object to be gained by pushing the engine, as the train was in ample time. Similarly, the falling gradient to Carlisle was descended, as a rule, at a very moderate pace; but, nevertheless, Carlisle was reached a minute before due time.

It was at Carlisle, as before, that the really hard work began. One of Mr. M'Intosh's already-famous new engines, of the Dunalastair class, came on, and a magnificent performance again ensued. Lockerbie was gained in 25 min. 50 sec., Beattock in 38 min. 23 sec., the Summit in 53½ min., and Carstairs in 73¾ min., Stirling being reached in 117 min. 40 sec. from Carlisle. This, it will be observed, was 47 sec. slower than on the previous occasion, but still exceeded the "mile-a-minute" average, though with a heavier load. Such a performance would have been deemed utterly improbable, if not impracticable, little more than a year ago. The heavy length of 33 miles from Stirling to Perth, was run in almost exactly the same time as before, notwithstanding the extra load. A special feature of both trips was the splendid steam generation of the engines. Mr. M'Intosh's large boilers are evidently capable of making steam to an exceptionally large extent.

At Perth I changed into the postal express, which is timed to run thence to Aberdeen without a stop in 97 min., the distance being nearly 90 miles. This was accomplished with the utmost ease, with 2 min. to spare, but the feat was in no respect remarkable—though the speed averaged 57 miles an hour from start to stop—seeing that on the previous occasion the distance had been done in 89¼ min., with an intermediate stop at Forfar. In this case, however, the load was somewhat heavier, consisting of three bogie postal vans, one bogie coach, two six-wheeled coaches, and a brake = about 130 tons. I may mention incidentally that on the return trip by the corridor train another of Mr. M'Intosh's Dunalastairs ran with a load of 233 tons from Forfar to Perth, start to stop, 32½ miles, in exactly 32½ min.

Apart from their general excellence of design and construction, the special merit about these fine engines, which enables them to perform with ease such admirable work, is their ample boiler power. This is the great secret of success in express engines. With abundant means and reasonably judicious design success is certain. With insufficient boiler power the most skilful, and even perfect construction in other respects, will not avail to avert failure.

As before, the running throughout was perfectly smooth, steady, easy, and safe, whether the speed were low or high.

Notes.

(1) Bad slacks, two stops passing Preston, slight slacks passing Rugby, Stafford, Carstairs, Law, Holytown and Guthrie Junctions. Engines: London and North-Western, eight-wheeled compound—Greater Britain class—to Crewe; 6ft. 6in. coupled—Precedent class—to Carlisle. Caledonian, 6ft. 6in. coupled—Dunalastair class—throughout. Weather fine and calm, a little mist in Scotland and heavy dew; rails wet during latter part of journey.

(2) Very slow—three miles an hour—through Preston Station and round curve. Slight slacks through Rugby, Carstairs, Law, Coatbridge, and Guthrie Junctions. Engines: London and North-Western 6ft. 6in. coupled to Crewe; 8-wheeled compound thence to Carlisle. Caledonian, Dunalastair class. Weather fine and calm; dry rail throughout.

MR. PICKARD'S NEW PROPOSALS TO THE COAL-OWNERS.

Once a year Mr. Benjamin Pickard, M.P., in his capacity as secretary of the Yorkshire Miners' Association, addresses the country on the subject of the coal trade. As Mr. Pickard is also the president of the Miners' Federation for Great Britain, his pronouncements possess an importance and an interest beyond the district of its production. The member for the Normanton Division means that it should do so. It is, in fact, not so much the report of the Yorkshire Miners' Association, extensive as that would be in its bearing, but a formal statement of the position taken up by the whole body of colliers within the Federated area. On these occasions, when Mr. Pickard "rises," he rises like the Nile, overflowing the newspapers as the Egyptian river does its banks. A mere abstract of it is given in the Yorkshire press, spreading over about a page of space. Mr. Pickard, the most prominent and powerful personalty of miners' leaders in the British coalfield, has won his way to his present position by sheer dogged force. In the report before us that quality is again in evidence. He has insisted all along that the troubles of the English coalowner were troubles of his own creation. He insists upon that still. The low values ruling for coal, he urges once more, are owing to ruinous competition and the underselling of coalowners amongst themselves. They have, he says, permitted the gas and railway companies to be the dictators of the coal market, with the result that the coalowners have been literally giving away their output. "If you give away your coal," he tells the employers, "that is no reason why we should give away our labour." That has been the contention of Mr. Pickard for years, ever since the high-water mark which followed 1888 began to be "left high" and dry by drooping business. He nails his colours to the mast for what he calls "a minimum living wage," not merely for his clients the colliers, but for the sake of the coalowners themselves. "I have come to the conclusion," he says, "that when we once get on the down grade, unless we have something to stop reductions in wages, the gas companies and the other trading companies would literally pull the owners to pieces, so far as any concession that we might give them is concerned; and instead of any real benefit accruing to the workmen or the miner, we would remain in exactly the same condition, so far

GREAT EASTERN RAILWAY WIDENING WORKS—THE PRIMROSE-STREET BRIDGE

MR. J. WILSON, M. INST. C.E., LONDON, ENGINEER

(For description see page 186)

as trade is concerned, at the end of 1896, as we are at the end of June, 1896." Controverting the statement that trade is going to other localities, Mr. Pickard attributes the reduced output in the federated area to the fact that several large firms have not been working, and that thousands upon thousands of men have been laid idle by the month, six weeks, two months, and even three months together, which has had a tendency to limit the output in the federated area. Here Mr. Pickard is in rather shallow water. He is too shrewd a man not to know that there is a reason for the men being idle. If the coalowners could make a profit by employing these men they would do so. The fact that they cannot do so accounts for their being idle. He admits one cause of the reduced employment, and ignores the other. The cause he admits is the nearness of the Northern coalfields to the seaboard, which gives the coalowners in Durham, Northumberland, South Wales, and Scotland, easier facilities for commanding an export trade than there is in the Midlands. That cause he concedes—he could not well do otherwise—for there is getting round that awkward corner; but, he asked, are the miners in the Midlands to be bound by results arising from that condition? "Are they to work two or three days a week for nothing, in order to counterbalance the geographical and geological condition connected with a particular class of mines?" This is clever, but it is not convincing. The fact that these distant coalowners can get their coal to market so much more cheaply than their competitors in the Midlands simply tells in their favour, and enables them to take the trade. The one thing explains the other. Mr. Pickard's impeachment of certain coalowners for not employing "thousands upon thousands of men" is sheer nonsense, because these men are idle through no fault of the coalowner. He cannot compel the foreign or the metropolitan consumer to give him 1s. a ton extra for his coal; neither can he keep his pits going when he loses 1s. on every ton of coal he brings to bank. If it is absurd to ask the coal-getter "to work for two or three days a week for nothing"—which nobody is foolish enough to ask him to do—it is surely equally absurd to rail at the coalowner for not working pits for less than nothing, for a positive loss, which Mr. Pickard appears to expect them to do. So much for the first case. Now for the second, that of wages. Is it not a fact that the men in the other districts—those outside the federated area—get from 12 to 20 per cent. less than those within the federated area? When to that is added the facilities of cheaper transit, which Mr. Pickard admits, surely there is no marvel in trade going to other localities. The marvel would be if it did not go. There is no sentiment in business. People buy where they can get best value, and the Yorkshire coalowner, doubly handicapped by distance from the seaboard and higher wages, loses his trade, which naturally fails into the hands of those more favourably circumstanced. Nor does Mr. Pickard make mention of another vital point. His anxiety for a minimum living wage is admitted; but does his policy get it? What is wage? Is it the amount a miner receives per ton or per day, or the amount he takes home at the week-end? Of course it is the latter. Tested by that standard, the miner who has not had Mr. Pickard to fight for him, and to give him the minimum wage, is better off than the miner who has. "To the victor belong the spoils." But though Mr. Pickard is the victor, his followers have not the spoils. The spoils are with the men in the North and the South, everywhere except in the Midland counties. The employers outside the federated area have the work; the employed outside the federated area have the wages. Is the victory which leaves the victors worse off than those who did not fight at all not suspiciously akin to that of which the winner exclaimed, "Another such victory, and I am undone?" How long will men find comfort in a doctrine, even with such a tempting name as the "minimum living wage," when it brings the Dead Sea fruit of miserable wages, getting gradually less through business drifting to other districts?

It is impossible to deal with all the points raised in Mr. Pickard's voluminous documents; but his paragraph declaring what the workmen propose is worth notice. Wages he finds to be between 10s. and 15s. per week, which is no glowing testimony to the value of the campaign which has this for its practical outcome. We will go further than Mr. Pickard, and say that the collier ought to earn double that amount and more. Seeing that 10s. to 15s. a week is all that his efforts have brought his constituents, he does well to prepare another plan. He puts forth as the basis of an agreement for five years both a minimum and a maximum wage. That conceded, he would have wages regulated thus:—"(*a*) The output of coal to determine the rate of wages once in every six months, 5 per cent. either up or down, as the case may be. (*b*) Take the output of coal within the federated area on December 31st, 1895—viz.: (*c*) When the output decreases 1 per cent. then wages shall be reduced 5 per cent. from the minimum. (*d*) and for every other decrease or increase of 1 per cent., wages shall be raised or lowered 5 per cent., between the minimum and maximum rates agreed upon by the owners and workmen." Although Mr. Pickard uses the word "minimum," he possibly means "basis." Of course, a *minimum* wage once settled cannot be reduced, unless the whole principle of an irreducible minimum is surrendered, and that would be giving up everything from Mr. Pickard's point of view. It will be interesting to see what the employers think of this scheme. Its essence, it will be noted, is restriction of output, the logical effect of which would be raising of values. But, then, all the new collieries recently opened out, or being opened out, in the virgin coalfields of Yorkshire, Derbyshire, Nottinghamshire, and elsewhere, are on the principle of a great output to lessen the cost per ton. Only in that way, with the double disadvantages already noted—distance from the seaboard and dearer labour—can coal-getting be made to pay. Mr. Pickard's plan puts a premium upon restricted output. Precisely as the coalowner gets less coal, the coal-getter is to receive less for getting it. But the business of the colliery proprietor is to do a large trade, and that is exactly what is being done in the Yorkshire and other coalfields, with the result that many old pits are being set down. Mr. Pickard's principle is directly in the teeth of the economic law that the price of an article shall govern the cost of its production—or, to put it shortly, in the formula so frequently heard and everywhere else enforced, that values shall govern wages. Can he reasonably expect his innovation to be taken *au serieux*, or, if so, that it would solve the problem—the protracted and perplexing problem—of capital and labour in England's coalfields? But whatever *his* expectation, the coalowners should put forth their objections to it, if they have any, and not let judgment go by default. The miners are signally loyal to their leaders; through many a conflict which has brought them untold privation they have exhibited an astounding docility. But there are many amongst them who do not have their thinking done by deputy; that is a growing class with whom chiefly rests the hope for the future. Even if there were no independent minds amongst the miners, there remains that great body, the general community, who are so little consulted in the disasters of the coal industry. They have a right to know what is the owners' answer to the new plan of campaign. Their feeling, if it could be got at, would probably be that of the dying Mercutio, "A plague on both your houses," for those who suffer most from coal war are the people who have no voice in the making or the ending of them. But the moral right to be considered remains, and the owners would do well to make known as soon as possible their views of Mr. Pickard's latest proposals.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

RE BARKER'S GRAPHICAL CALCULUS.

SIR,—Professor Greenhill's letter on this subject seems to make some further reply from your reviewer desirable. In Mr. Barker's letter he complains that the review "speaks of the glaring error of his method of graphic integration." What it did criticise was not this at all, but, on the contrary, Mr. Barker's special method of avoiding glaring error. To speak of the "glaring error" of any skilled workman would be simple rudeness, of which your reviewer trusts he is incapable. "Glaring" error is well understood to mean error of such large amount as to be inadmissible in the special work in hand. The error spoken of may be expressed as that due to calculating in your equation the increment of rise in a short length of a curve from the tangent at the beginning of the short length instead of from the mean tangent throughout that length. In the theoretical treatment when the short length treated goes down to—or towards—the limit zero, this error also goes down to—or towards—zero. Thus in the theoretical analytical treatment no difference results from the use of the one in place of the other tangent; although I, along with many others, think that the difference is a most important one in principle. But in the graphic construction on paper the short length does not go down to, or even near, the limit zero; and, therefore, everyone who uses graphic integration, including Mr. Barker, is forced to adopt some method of avoiding the "glaring" or "gross" error that would arise from using the uncorrected tangent at the beginning of the curve. It would be wholly and accurately avoided by using the true mean tangent throughout the short length dealt with, but in general one has no means of finding this true mean until after the drawing of the curve has been effected.

Mr. Barker's method of avoiding this "gross" error is to halve the angular difference between the curve directions at beginning and end of the short length; otherwise expressed, to use the arithmetic mean of the two angular directions at the two ends of this short length. To carry out this a construction is employed which your reviewer characterised as tedious and as favouring the insinuation of draughting error.

The method advocated by your reviewer was to halve the difference of the tangents of inclination at beginning and end of the short length; that is, to use the arithmetic mean between these two tangents of inclination at the two ends, or else to use the tangent at mid-length of the dx projection of the short arc. It is not, of course, stated that this arithmetic mean is accurately coincident with the true mean, which latter would get rid of even minute error, except that due to draughtsmanship. But, in the first place, it is contended that this is a more rational method—and this is particularly important in leading students to become familiar with the true fundamental meaning of the whole proceeding; secondly, in the great bulk of actual cases it gives a closer approximation to the exact true result; and thirdly, it is in a very great degree simpler, easier, more rapid, and in especial does not favour draughting error.

In the familiar graphostatic constructions of "moment curves," "deflection curves," &c., in, let us say, 90 per cent. of the integration curves actually and frequently drawn out in the engineer's drawing-office, this arithmetic mean agrees exactly with the true mean; and, therefore, it is always used in these constructions wherever they are made intelligently. These are parabolic curves, and draughtsmen accustomed to these constructions will naturally, and quite properly, follow the same method in dealing on the drawing board with curves not parabolic. When the curve is parabolic the "short lengths" taken may be as long as you like by this method without any inexactness in the construction. The more the nature of the curve differs from the parabolic characteristic the shorter must be the lengths used in the integration in order to avoid gross or glaring error.

The superiority or, if you like, the greater convenience, of the parabolic approximation to the short incremental length of the integral curve is, of course, due to the fact that the second differential co-efficient is constant. Prof. Greenhill's remarks lead one to suspect that he either did not read the review or else did not read the part in question of the book criticised. His remarks deal with the relative advantages of circular and parabolic arcs as approximative means of drawing in long lengths of complex curves; and they have therefore no bearing on the point under discussion, which is the building up of long lengths by successive short steps.

The reviewer has studied closely the methods of facilitating the good drawing of mathematical and experimental curves, and would be the last to depreciate the value of Mr. C. V. Boys' and other aids in this direction. His somewhat extensive experience has proved, to his complete satisfaction, that neither circular nor parabolic templates are those that give most aid in this way. The circular arc is, of course, favoured in workshop construction for excellent and weighty reasons.

Professor Greenhill misses the point that the draught neither on the loco. drawbar, nor on "the couplings between any pair of carriages," can be given as a function of velocity independently of the load running in front of the coupling in question. For a given locomotive worked in a given way, its indicated power and its driving effort may no doubt be given as a tolerably complicated function of the velocity, independently of all loads; but the portion of that driving effort transmitted back to any such coupling as above depends not only on the velocity, but also upon the acceleration of velocity and upon the load in front of the coupling.

Professor Greenhill's closing remark that the "freshness and novelty" of Mr. Barker's treatment has evidently, as shown by my review, "stirred up the prejudices of supporters of old-fashioned routine," amply justifies the suspicion that he has not read the review in question, as it throughout denounces this "old-fashioned routine." YOUR REVIEWER.

August 17th, 1896.

LONDON AND NORTH-WESTERN RAILWAY ENGINES.

SIR,—Your note added to "Teutonic's" letter on this subject as to the Chatham and Dover and Brighton Companies using engines with no bogies is a little misleading. Unless my eyes deceive me, the Chatham and Dover were running their expresses with bogie engines ten years ago, if not more, and the Brighton have adopted bogie engines as their standard. In any case neither of these lines can be said to run expresses in the modern sense of the word, and I doubt whether they have curves in their main lines like the Preston one. The Great Eastern and the London and North-Western are the only companies still constructing non-bogie engines.

Till the Board of Trade report is out I do not wish to refer to the Preston smash, but much experience of riding on the engines of different companies, especially on express and "racing" trains, enables me to say two things: (1) that to say that a radial axle can compare with a bogie is sheer humbug; and (2) that Mr. Worsdell's North-Eastern cabs are the only ones which protect the men from rain and cold properly, and therefore the only ones designed for comfort and health. NORMAN D. MACDONALD.

15, Abercromby-place, Edinburgh, August 17th.

[The Brighton Company has only within the last year built some bogie engines; all the Stroudley engines are without them. The London, Chatham, and Dover has thirty-nine single leading axle engines still running in general service, and the Kirtley bogie engines running number thirty-seven, and others are building. The double curves at Strood and Rochester are amongst the most severe in the country.—ED. E.]

SIR,—In your remarks on "Teutonic's" letter in your last issue, No. 2120, August 14th, *re* "London and North-Western Railway Engines," it is stated that nearly all the express engines on the Brighton and Chatham and Dover lines are without bogies. Since the present locomotive engineer, Mr. Kirtley, came here in 1874, no single leading-wheel engines have been built to his design. At present we have thirty-seven bogie express engines running, and four more new ones being built, which makes forty-one bogie engines, against thirty-nine single leading-wheel engines of the older type; and very soon twelve of the latter will be replaced by bogie engines of the latest design. I would remind you that as far back as January 24th, 1879, you published working drawings and specification of our standard type of bogie express engine, designed by Mr. Kirtley and built by Neilson and Co. in 1877. It is, however, only very lately—the latter end of last year, I think—the Brighton line has built some bogie express engines.

London, Chatham, and Dover Railway, Locomotive Department, Wandsworth-road, S.W., August 17th. R. R. SURTEES, Chief Draughtsman.

[The figures given by Mr. Surtees confirm our remarks as to single leading-axle engines, although the company has now also a large number of Mr. Kirtley's bogie engines.—Ed. E.]

ROPE-DRIVING GEAR.

SIR,—In your report of the meeting of the Institution of Mechanical Engineers, which appeared in the columns of THE ENGINEER of the 7th inst., there is a rather startling claim, viz., that the introduction of rope-driving is due to Mr. James Combe, in the year 1856 or 1858—or, even prior to that date, to Mr. Wise.

Now, if any of your readers interested in this question will refer to the "Annales des Ponts et Chaussées," for the year 1859, he will see that Hirn, of Mulhouse, after fruitless attempts to drive pulleys by means of iron bands, succeeded in driving grooved pulleys by means of iron wire ropes—about 1850.

Hirn's attempt to use bands before trying ropes would perhaps suggest the idea that leather straps were in use before ropes. If, however, your readers will look at the early copying lathe on page 92 of THE ENGINEER of this year they will get a proof that rope-driving was in common use in workshops nearly a century before Mr. Combe's or Mr. Wise's introduction, the "Encyclopédie des Arts et Métiers," from which the lathe has been reproduced, bearing the date of 1771. S. D. B.

Turin, August 12th, Via Beaumont, 2.

A SUBSTITUTE FOR STEAMERS' ROPES.

SIR,—The use of ropes in mooring steamers at piers seems rather an awkward arrangement. Why not have a couple of small screw propellers working in recesses on either side of the hull? When a steamer drew up at a pier the outer propellers might be set in motion to force the steamer towards the pier and keep it there as long as required. A. B. M.

London, August 18th.

H.M.S. DREADNOUGHT.—This battleship is to have all her thirteen boilers replaced. Ten of them will be made at Chatham, where it is probable her refit will be carried out. It is estimated that her refit will cost over £50,000, and that she will be in dockyard hands for at least twelve months.

TRADE AND BUSINESS ANNOUNCEMENTS.—Sir Christopher Furness, Westgarth, and Co. announce that they have acquired the businesses of Westgarth, English, and Co., and of the Tees Side Iron and Engine Works Company—except so far as the bridge building and blast furnaces are concerned—from July 1st, 1896. The new company takes over all current trade contracts, and will carry on the business.—Messrs. H. E. Lockhart, A.M.I.C.E., and G. D. Seaton announce that they have taken over the business of the Lion Engineering Works, Abergavenny, from Mr. George Davies as from August 1st, 1896, and it will in future be carried on under the style of George Davies and Co.—Messrs. Bohler Bros. and Co., of the Styrian Steel Works, Sheffield, inform us that they have started an agency in London, under the management of Mr. A. J. Henderson, at 2, Lombard-court, Gracechurch-street.—Messrs. McKie and Baxter, Govan, have recently completed new engineering and shipbuilding works in convenient proximity to the 130-ton crane in the Cessnock Docks, Govan, as well as the graving and wet docks of the Clyde Trustees. The works have been built by Sir William Arrol and Co., of Glasgow, and embrace all the best modern practice in construction. The columns, girders, roof couples, and ties, forming the main buildings are built entirely of mild steel; the columns are throughout spaced 25ft. apart, giving the maximum of floor and head room between the various shops, and the roofs are entirely of glass, the shops being as light inside as if they were in the open air. Special ventilation arrangements have been adopted, and the comfort of the workmen has been particularly studied. Most of the machines have been specially constructed under the directions of the principals, and are from the best makers. The works are specially laid out for the building of the smaller class of passenger and cargo steamers, yachts and fast launches, and a high class of marine machinery for shipment abroad, engines for factories, pumping engines, high-speed engines, and McKie's patent water-tube boilers. We understand that the firm have in hand a set of engines for Burmah, and another set for a Clyde yacht.—We are informed that the Acetylene Illuminating Company, London, have concluded arrangements with the British Aluminium Company by which they will be able to erect works of several thousand horse-power for the manufacture of calcium carbide, using water-power. Temporary carbide plant is now being erected at Foyers, which, it is expected, will be in full work during the month of October next. It appears that the Acetylene Company has been making calcium carbide in this country on a fairly large experimental scale since the early part of 1895, but as so much had to be learned in the details of manufacture and as to the behaviour of acetylene gas under various conditions, it has not until now felt justified in erecting large works. The company has now succeeded, we are told, in regularly making a crystalline metallic carbide, free from dangerous impurities, such as exist in some specimens of foreign carbide which found their way to this country.—Notice is given that the transfer books of the first debenture stock of the Brush Electrical Engineering Company, will—in view of interest payable on the 1st September, 1896—be closed from August 19th, 1896 to September 1st, 1896 both inclusive.—The Tees-side Bridge and Engineering Works announce that they have acquired the business of the Tees-side Iron and Engine Works Company, so far as relates to the Bridge and Constructional Engineering Works, from the first day of July, 1896.—Mr. Perry F. Nursey has, we understand, undertaken the editorship of *Inventions.*

RAILWAY MATTERS.

THE half-yearly statement of train mileage of the North London Railway shows that the passenger trains have run 928,148 miles, and goods and mineral trains 138,702 miles, a total of 1,066,850 miles. The coal account amounted to £17,808, and the renewal of locomotive stock £1500.

AT the half-yearly general meeting of the proprietors of the London and North-Western Railway, the mileage of passenger trains for the half year was given as 10,774,503, and goods and mineral trains 9,886,576, as against 10,278,073 and 9,510,925 miles respectively in the corresponding period last year.

THE extension passenger line through West Durham, *viâ* Consett, completing the circuit to Newcastle, a distance of seven and a-half miles, was opened on the North-Eastern Railway system this week. The new railway serves several important collieries and affords extra travelling facilities for a large mining and steel-working community.

AT the Midland station, Nottingham, on Tuesday night, an engine which was engaged in shunting operations in connection with the fish traffic, fouled the points and came into contact with one of the iron columns supporting the roof. The foundation of the structure covering the passenger platform being partially disturbed, a heavy mass of ironwork and glass fell, a rent being caused in the roof to the extent of about 60ft. Several very narrow escapes are reported.

THE following table shows the total export of German rails into Russia for the single years since 1886:—

	Tons.	Millions of marks.		Tons.	Millions of marks.
1886	163,222	15·2	1891	142,846	14·3
1887	174,226	16·0	1892	113,712	10·2
1888	114,946	10·9	1893	87,360	7·4
1889	110,949	12·2	1894	149,310	9·9
1890	130,837	15·0	1895	166,627	10·2

THE following list in order of the sixteen leading systems of railways in the United States has been printed in the *Railway Age*, with their mileage:—(1) Pennsylvania system, 8882; (2) Chicago and North-Western, 7931; (3) Atchison, 7555; (4) Burlington, 7304; (5) Canadian Pacific, 7103; (6) Southern Pacific, 6717; (7) St. Paul, 6169; (8) Missouri Pacific, 5326; (9) Southern Railway, 4644; (10) Union Pacific, 4459; (11) Northern Pacific, 4362; (12) Illinois Central, 4332; (13) Great Northern, 4256; (14) Rock Island, 3573; (15) Grand Trunk, 3512; (16) Louisville and Nashville, 3163.

PRINCE KHILKOFF, the Russian Minister of Ways of Communication, has been specially deputed by the Tsar to make an official tour in the United States, and will probably meet the Emperor in England, says the *Times*, before returning to Russia in November. The object of the Minister's trip round the world is to secure the best information as to American and English railway practice, to inspect the latest development in machinery and manufacture pertaining to railways, and to study the navigation of inland waterways. Prince Khilkoff had a varied experience in the capacity of blacksmith and fitter in his early years in South America.

HER MAJESTY'S Secretary of State for Foreign Affairs has received a despatch from her Majesty's Agent and Consul-General at Sofia stating that tenders are invited by the Bulgarian Ministry of Public Works before October 19th next for the Rustchuk-Nova Zagora Railway, and before November 5th for the Saramby-Nova Zagora Railway. It appears that the respective "cahiers de charges" are open to inspection at the Ministry in question, and that copies may be bought there for 20f. each. Such particulars as her Majesty's Government has received on the subject may be viewed at the Commercial Department of the Foreign-office between the hours of 11 a.m. and 6 p.m daily.

ON the line from Paris to Saint Germain, founded more than fifty years ago by Sir Edward Blount as the beginning of the Great Western system, there has been running since Tuesday a carriage which, says the *Daily News* Paris correspondent, has been nicknamed the "Bistro Car," Paris and Saint Germain. "Bistro" belongs to the language of "argot," and renders the English slang or rather abridged expression of "Pub." The "pub.-car" is designed to allow business men to take their *café au lait*, with perhaps a boiled egg—a Frenchman never has anything more in the morning—on their way up to town. There is accommodation for first and second class passengers and a bar for the use of persons who are ordered by their doctor to take stimulants. The Western of France Railway, which serves nearly all the race-courses and all the fashionable places around Paris, is building refreshment cars to put on all its suburban lines, to run to all places within forty miles of Paris.

THE vast blocks of artisans' dwellings erected by the Manchester, Sheffield and Lincolnshire Railway Company near the site of their great London terminus are now nearly completed. Situated at the junction of Grove-road, Grove End-road, and St. John's Wood-road, they cover an area of not less than four and a-half acres, and will cost, from first to last, a sum of £250,000. They are in six blocks of about 375ft. long each, and are five storeys in height, being built of yellow stock bricks with red-brick facings. The roofs are finished off with flat asphalted spaces, for use as drying grounds. An item of engineering interest is found in the arduous work which went towards building the extremely heavy retaining wall bordering Regent's Canal for a length of 550ft. Constructed of concrete, it is 35ft. high, and broadly based on an 11ft. foundation. Accommodation will be provided in these buildings for 2690 persons displaced by the Lisson-grove and Princess-street clearances, and a new Lisson-grove will thus be formed in the near future amid the groves and secluded villas of St. John's Wood.

LIEUT.-COLONEL G. W. ADDISON, R.E., has reported to the Board of Trade the result of his inquiry into the accident that occurred on June 27th, at York, on the North-Eastern Railway. It will be remembered that as a Lancashire and Yorkshire Company's excursion train from Todmorden to Scarborough was standing at Waterworks cabin advance signal, at about 9.13 a.m., it was run into in the rear by a pilot engine with eight empty carriages and two vans attached. No one was killed, but four passengers complained of slight injuries. Lieut.-Colonel Addison finds it impossible to acquit the driver of the pilot engine of great carelessness. The driver admitted that he saw the excursion train before it came to a stand, and when it must have been at least 220 yards away from him, but, thinking it was going right away, he evidently failed to keep a careful look-out ahead. On the other hand, Lieut.-Colonel Addison thinks it must be admitted there are extenuating circumstances, as the driver ought not to have been allowed to go past the signal cabin without being warned that the excursion train was standing at the advance signal. Lieut.-Colonel Addison further says:—"Another matter to which I must call attention is the way in which the excursion train left the station, on the wrong road, through facing-points and a cross-over road, with no fixed signal to protect the operation or to ensure the points being properly set, &c. I understand that this is an exceptional occurrence, but it is somewhat astonishing to find such a mode of working allowed at a place like York, where the traffic arrangements are under the immediate superintendence of high officials, and where everything might be expected to be thoroughly up to date. An additional starting signal, properly interlocked with the other signals and with the points, should be provided with as little delay as possible."

NOTES AND MEMORANDA.

MR. R. FORBES CARPENTER, Chief Inspector of Alkali Works, in his first annual report, gives the following figures relating to the production of sulphate of ammonia in the United Kingdom in 1895:—Gasworks, 119,645 tons; ironworks, 14,588 tons; shale works, 38,335 tons; producer-gas, coke, and carbonising works, 7083 tons; total, 179,651 tons.

SOME time ago, says the *Electrical Engineer*, we noted that some American firemen received electric shocks which they believed were communicated through the jet from a fire engine hose. Considering what a particularly good earth a fire engine must have in its suction pipe, it seemed unlikely; but it appears that, so far as alternating currents are concerned, the matter has been already determined experimentally by Professor Slaby, of Berlin. The overhead conductors of a 10,000-volt power transmission line were used for the experiment. A voltmeter was connected between the metal mouthpiece of the water-hose and the earth. On turning the water on to the live conductors no flow of current to earth was noticeable.

THE refractive indices of a number of substances for electric waves of very small length have been determined by Dr. A. Lampa. The experiments, which form the subject of a communication to the *Wiener Sitzungsberichte*, were made with electro-magnetic radiations of 8 mm. wave-length; this number being ascertained both from the dimensions of the exciter and by diffraction observations. The wave-length in question corresponds to the frequency $N = 37 \cdot 500 \times 10^6$, and Dr. Lampa gives the following values for the index n: Paraffin, 1·524; ebonite, 1·739; crown glass, 2·381; flint glass, 2·899; sulphur, 1·802; benzole, 1·767; glycerine, 1·843; oil of turpentine, 1·782; oil of vaseline, 1·626; oil of almonds, 1·734; absolute alcohol, 2·568; and distilled water, 8·972.

IN the June number of the *Annalen der Hydrographie* there is an interesting discussion, by H. Haltermann, of the occurrence of St. Elmo's Fire at sea, based upon observations in the log-books received at the Deutsche Seewarte. The tables contain full details as to position, conditions of weather, &c. During more than 77,000 days of observation the phenomenon was observed 164 times, eighty-seven times in north and seventy-seven times in south latitude. Its occurrence differs very considerably in different parts of the ocean, *e.g.*, in the 10 deg. square lying between the equator and 10 deg. N. lat., and between 20 deg. and 30 deg. W. long., St. Elmo's Fire was observed three times per 1000 days, while in the two squares lying between 50 deg. and 60 deg. S lat. and 60 deg. and 80 deg. W. long. it occurred six times per 1000 days. The more frequent occurrence at sea than on land is attributed to the fact that the accumulating electricity is more easily conducted by the numerous objects projecting into the air over the land.

MR. A. J. ROSSI has contributed to the *Engineering and Mining Journal* the results of experiments made by him to ascertain the effect of additions of titaniferous ores to phosphoric iron ores in the blast furnace, more particularly to find out if the weakening influences of the phosphorus on the metal, when obtained from the latter ore alone, might in any way be counteracted. With phosphoric ore a grey metal was obtained containing 2·862 per cent. of phosphorus, and which broke easily, whereas with the mixed ores a grey large-grained metal containing 3·98 per cent. of carbon, nearly all graphitic, 3·229 per cent. of phosphorus, and 0·4 per cent. of titanium, was produced, which withstood several blows before breakage. It would also appear from these experiments that whilst titanium in an iron ore has a tendency to throw the carbon in the metal produced therefrom into the combined state, the united effect of phosphorus and titanium is to produce a metal in which nearly all the carbon is in the graphitic state, this effect being the greater as the quantities of phosphorus and titanium in the mixtures increase.

IN the *Journal* of the Society of Chemical Industry, a process is described for the extraction of precious metals from calcined ores by bringing them into contact with molten lead, and it is stated that a plant has been set up at Amador City capable of working ten tons per day, and giving yields of over 90 per cent. extraction with gold-bearing sulphides and base ores. The fine ore, after roasting to get rid of sulphur, arsenic, antimony, &c., whilst at a temperature above the melting point of lead, is automatically fed in a steady stream to the bottom of the bath well. It at once attempts to rise through the bath of molten lead of over five tons, but is met in its upward course by circular perforated plates with arms between, by which it is caught and thrown on to another set of stirrers, and so on five times. When it reaches the surface it is discharged automatically by a rapidly revolving disc, and passed into a trap box of running water, by which it is cooled before passing to the concentrator. The gold and silver will have alloyed with the lead in the wells, and the freed ore, which carries about 44 per cent. of lead with it, is treated for the recovery of the lead in the concentrators.

A RAPID and sufficiently accurate volumetric method of estimating the quantity of lime in raw Portland cement, consists in calcining 2 grms. of the raw material under examination—powdered so fine that 85 per cent. will pass through a 5000 mesh sieve—in a smooth platinum crucible for ten minutes in the full flame of a Paquelin blowpipe. After cooling for five minutes and weighing, the mass is emptied into a beaker containing 50 c.c. of hot distilled water and is boiled therein for one minute, 40 c.c. of suphuric acid —of $\frac{20}{34}$ normal strength—being thereupon run in, and the boiling continued for a minute longer. After washing the crucible thoroughly with 50 c.c. of distilled water at room temperature, the titration is effected by means of potassium hydroxide solution—also of $\frac{20}{34}$ normal strength—with twenty drops of phenolphthalein — 0·5 per cent. solution — as indicator. The volume of acid consumed in the primary reaction, calculated to the weight of calcined substance gives a co-efficient for determining the lime, varying with different raw materials on account of the different proportions of alkalis in the total alkaline matter, but constant for each. *The Journal of the Society of Chemical Industry* says the co-efficient will in each case have to be established by previous experiments.

DEATH has just deprived Yale University of the services of Professor Hubert A. Newton, the well-known mathematician. Professor Newton, says the *Times*, was born at Sherburne, New York, in 1830. He graduated at Yale in 1850, after which he studied higher mathematics. In 1852 he was appointed tutor, and was elected professor three years afterwards, though then only twenty-five years of age. His scientific work in pure mathematics included papers on "The Construction of Certain Curves by Points," "Certain Transcendental Curves," and kindred subjects. His most valuable investigations, however, were made concerning meteors and like bodies, and in 1864 he published a work on sporadic meteors, in which he determined their numbers, their frequency in the space traversed by the earth, and the fact that most of them moved in long orbits like the comets. Much of his work was in the direction of examining results that had been obtained by others, and deducing therefrom the laws or general principles applicable to meteors. On this particular subject he came to be regarded as one of the leading authorities of the day. In 1864 he secured the introduction in the arithmetics of the United States of an adequate presentation of the metric system. He was a member of various learned societies, and in 1872 was elected an Associate of the Royal Astronomical Society of London, while in 1886 he became a Fellow of the Royal Philosophical Society of Edinburgh. He had also held the post of president of the Connecticut Academy of Arts and Sciences, and had been a member since 1850 of the American Association for the Advancement of Science, being vice-president in 1875 and president in 1885.

MISCELLANEA

THE approximate traffic return on the Manchester Ship Canal for July states that the total receipts were £16,602, against £12,504.

THE Secretary of State for Foreign Affairs has received a despatch from her Majesty's Minister at Bucharest stating that tenders are invited by the Roumanian Government for the construction and delivery of steam vessels for the commercial and maritime service of that country. Such particulars as her Majesty's Government have received on the subject may be viewed at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

HEAVY ordnance is being placed in position to command the entrance to New York harbour. At Willit's Point, Long Island, the work of mounting two of these large guns is in progress. They are 30ft. long, 10in. bore, and weigh 30 tons each. The steel projectile weighs 575 lb., and requires 250 lb. powder. Each gun can be fired at intervals of three minutes. After the discharge the guns disappear behind the parapet for reloading. In practice shooting, the target is to be set six miles away.

THE *Bulletin* of the Société d'Encouragement pour l'Industrie Nationale contains a list of the medals and prizes to be awarded in 1897 and 1898. Amongst these, the following prizes are proposed for 1897. In the mechanical arts, for improved methods in milling of grain—2000f.; for a motor weighing less than 50 kilos. per horse-power developed for use in aërial navigation—2000f.; for a study of the coefficients necessary for the calculations of an aërial machine—2000f.; for a small motor suitable for domestic use—2000f.; for improvements in machine tools—2000f.

MR. CHARLES M. TURRELL, of 40, Holborn-viaduct, has the distinction of being the last to be prosecuted under the old obstructive Road Locomotives Acts. He was summoned before the borough justices at Margate, on the 19th inst., to answer two charges of driving a motor-car in the public streets of Margate at a greater speed than regulated by the Highway Act. Police evidence was given that on July 31st the defendant had been driving at more than two miles an hour. A telegram was put in addressed to Mr. Turrell from Mr. Chaplin, President of the Local Government Board, to the effect that the Bill had received the Royal Assent. The magistrates thought it as well to dismiss the summons, and the chief constable seems to have concluded that he must withdraw the second summons.

THE Secretary of State for Foreign Affairs has received despatches from her Majesty's Consul at Cadiz, stating that preliminary tenders for a supply of electric lighting apparatus for the illumination, on the most approved modern plan, of the private houses, &c., in the town of Cadiz, are invited by the "Sociedad Co-operativa Gaditano de Fabricacion de Gas." It appears that the tenders should be sent in by September 15th to the above-named company, whose offices are San José, 25, 27, and 29, Cadiz. Firms wishing to obtain the contract for the supply of plant are advised by the Consul to send representatives to treat personally with the company. Such additional particulars as have reached her Majesty's Government on the subject may be viewed at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

REPLYING to a question asked in the House of Commons on Thursday, the 13th inst., Mr. Goschen, the First Lord of the Admiralty, said: No accident had occurred to H.M. ship Terrible. During the run preliminary to the commencement of the second of the contractors' trials, it became evident that certain adjustments were necessary to the slide valves of some of the cylinders. The contractors were in charge of the machinery, and at their request the vessel entered Plymouth Sound in order that an examination might be made. As the result of that examination, and at the request of the contractors, the Terrible has returned to Portsmouth, where the necessary defects will be made good by the contractors before the trials are resumed. Under the circumstances explained, no question arose as to the sufficiency of the mechanical appliances at Devonport Dockyard.

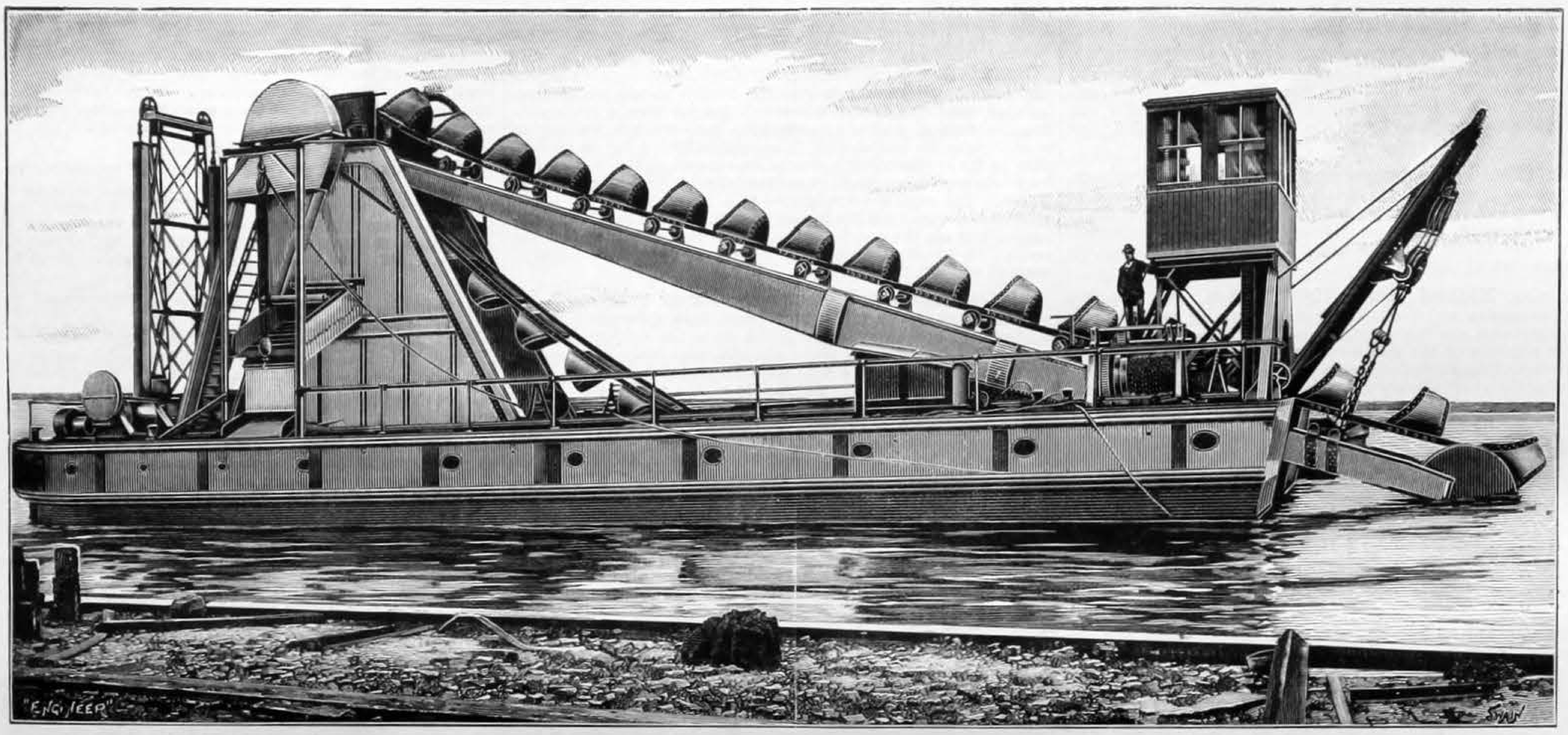
THE Admiralty have ordered the stern torpedo tubes to be taken out of all ships of the Royal Sovereign class, and these vessels will now carry only the submerged tubes. There are two very substantial reasons for this course. Experiments have been made which have demonstrated the possibility of hitting the whiskers of a torpedo by means of quick-firing guns while the weapon is in the tube, and thus hoisting the engineer with his own petard. Then, says the *Naval and Military Record*, it has been found on the China station that where the stern tube is reasonably near the water-line, the seas in rough weather fill the tube, and if the torpedo is there collapse the balance chamber. The trials of the Eclipse were especially directed to elucidate this point, but though no accident occurred in that cruiser, owing to her tube being well out of the water, an immunity from accident is not guaranteed to ships less favourably constructed. Hence the necessity that has arisen for removing the tubes.

IN our impression of May 15th last we published an illustrated description of the rolling or wheel steamer designed by M. Bazin. This remarkable boat was launched at St. Denis on Wednesday. It is called a *bateau rouleur*, and M. Bazin claims for his new boat complete seaworthiness, and contends that sea-sickness on board will be reduced considerably by its comparative stability. Others think the opposite to this will occur. The drum wheels, which are convex-sided, and are 3 metres 60 centimetres thick at their axis, being hollow, naturally act as buoys and will, when laden with the superstructure, engines, coal, &c., be immersed in the water about 3 metres 30 centimetres. The motive power of the vessel is 750-horse power. Each of the three pairs of wheels is to be driven by a separate engine, as is also the screw. An ordinary vessel of the same tonnage, with the same motive power, would steam at the rate of about 10 knots an hour, whereas M. Bazin calculates his rolling boat will attain a speed of between 18 and 22 knots. About 550-horse power will be employed to propel the screw and the remaining 200-horse power for the rotation of the wheels. According to M. Bazin, his rolling boat will be able to steam at the same speed as the quickest Channel boats at less than half the cost in coal, and by consuming the same quantity of coal the speed will be doubled. He proposes to cross the Channel shortly with it.

THE new tariff of tolls for the North Sea and Baltic Canal, which comes into force on September 1st next, provides that laden vessels of not more than 400 tons register passing through the canal will be taxed at the rate of 60pfgs. per ton, those between 400 and 600 tons 40pfgs., those between 600 and 800 tons 30pfgs., and those exceeding 800 tons 20pfgs. The present rate is 60pfgs. per ton for vessels not exceeding 600 tons register, and 40pfgs. for all those above that amount. The minimum charge is fixed at ten marks as before. The tax on small German coasting vessels of not more than 50 tons remains unaltered at the rate of 40pfgs. per ton. An important reduction is made in the case of empty vessels and of those carrying ballast, which, instead of paying as at present 40pfgs. per ton, will be allowed a 20 per cent. rebate on the scale of dues for laden vessels. The minimum charge for this class and for the coasting vessels will be six marks instead of ten. The towing dues remain unaltered. The original tariff provided that during the six winter months all rates should be subject to a 25 per cent. increase. This clause was regarded as a special hardship, and the Government have wisely yielded to public feeling, and have reduced the increase to 10 per cent. Finally, it is enacted that for vessels engaged in the North Sea traffic the above rates shall include pilot fees from the North Sea to Brunsbüttel, the southern end of the canal.

AN ELECTRICALLY WORKED DREDGER

MR. A. F. SMULDERS, ROTTERDAM, ENGINEER



AN ELECTRIC DREDGER.

The accompanying engraving represents a dredger of novel construction, which has recently been built by Mr. A. F. Smulders, Rotterdam, to the designs of M. Bunau Varilla, and is intended for use on the river Esla, in Spain. The principal feature in connection with this dredger is that the motive force, in the form of electrical energy of high tension, may be generated on shore by any convenient means, the current being distributed either by overhead wires or cables laid under the water. In the particular installation under notice the central station is situated on the river bank, and furnishes current not only to the dredger, but also to work an elevator which returns the material dredged into lighters and ballast wagons. All the motions are controlled by one man in the cabin, shown. When once in position a heavy metallic pile situated on the central line abaft the chain is allowed to fall, and penetrates by its own weight the bed of the river, forming a pivot around which the dredger can be made to describe circles, the movement being effected by two screws situated near the bow, and operated by electric motors in such a manner that the boat may be rotated in either direction. When all the material lying in the circle of operations, of which the fixed pile is the centre and the end of the bucket chain the radius, has been removed, a second pile at the stern, but not on the centre line of the dredger, is allowed to fall, and the first one is raised. The second pile now forms the pivot around which operations are conducted, and it will be readily understood that when the necessary depth has been dredged by dropping the first pile again when the boat has reached a pre-determined position, a new area for dredging is reached. The winches for operating the bucket chain and raising the piles are operated by electric motors controlled in the cabin. The motor for operating the bucket chain is capable of developing 45-horse power when making 600 revolutions per minute, the reduction of speed being effected by intermediate pulleys and belting in the usual way. The average power required to work the dredger is equal to about fifteen horses, and as the motor is equal to 45-horse power in normal working, a good margin is left for emergency.

The dynamo machines chosen by M. Varilla are of the three-phase alternating type, giving 2000 volts, which pressure is transformed on the dredger to 200 volts. Besides operating the motors for driving the screws, driving the dredge chain, raising the dredge frame, and lifting the piles by electrical energy, there is also a centrifugal pump, which is worked by electric motor.

HOLE GRINDING MACHINE.

The machine illustrated by the above engraving has recently been designed by Messrs. Neilson and Co., Hyde Park Locomotive Works, Glasgow, for grinding or lapping round holes or eyes in valve motion gearing, brake gear, and coupling rods for locomotives, and making them true after the eyes have been case-hardened.

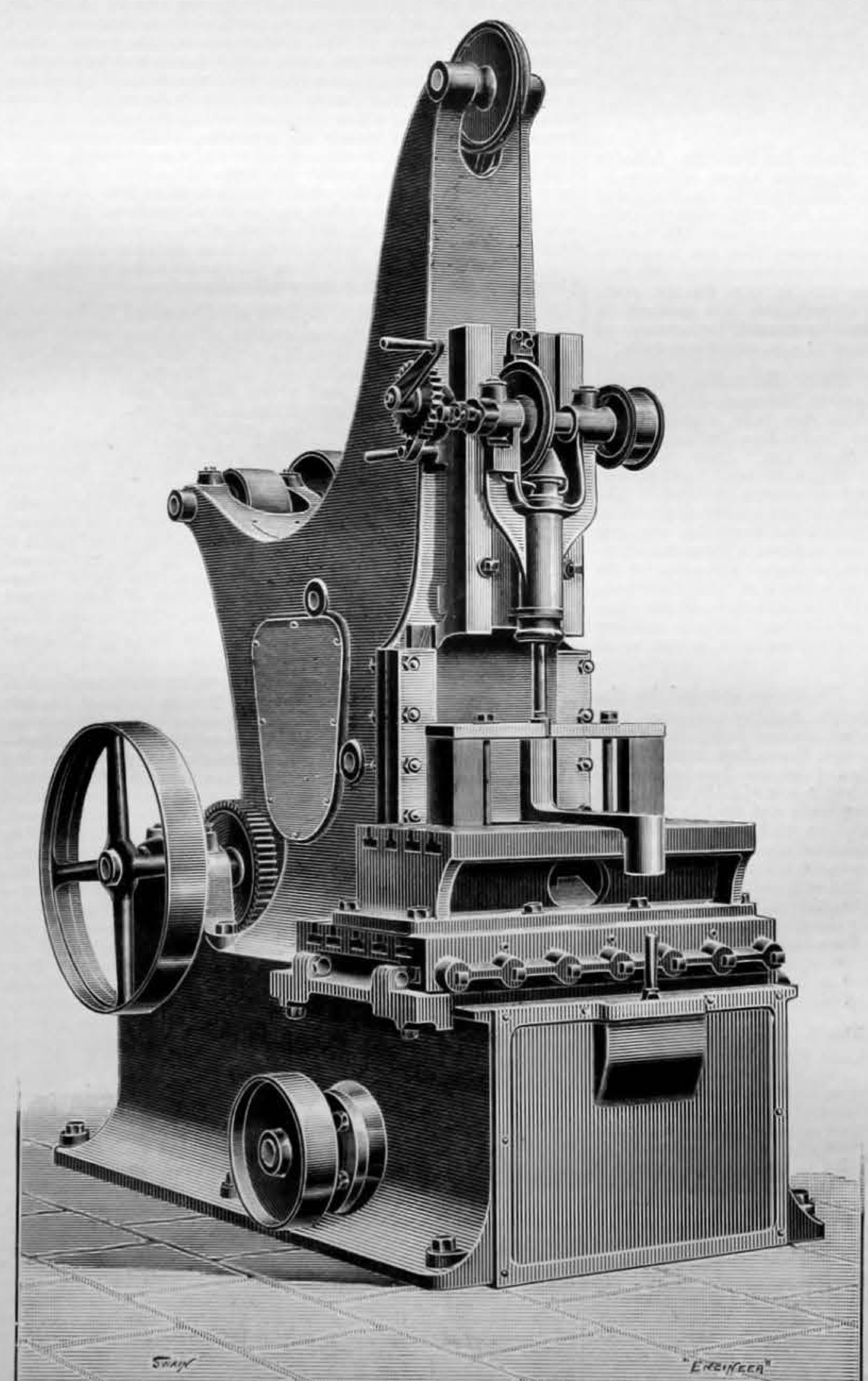
The grinder spindle has a combined rotary and vertical reciprocating motion. The rotary motion is conveyed to the spindle by bevelled friction wheels driven by belting, and the frame or slide carrying the spindle receives its reciprocating motion from a lever worked by a crank, variable in throw, to suit different depths of eyes. It is driven by a shaft fitted with elliptical wheels to accelerate the speed of the crank at the dead centres, and thus give an approximately constant rate of reciprocating speed. Top and bottom bearings are provided for the spindle, so that there is no overhang of the grinder when lapping the deepest eyes the machine is capable of dealing with. Efficient means are provided for quickly withdrawing the spindle when desired, for the purpose of gauging the hole which is being lapped.

The work to be operated on is fixed to the upper bed of a compound slide, carried on the table of the machine, and is moved in a circular path, so as to bring every part of the circumference of the hole in successive contact with the grinder which passes through it; the speed being such that the revolutions of this circular path do not synchronise with the reciprocations of the grinder spindle, so that the grinder passes successively over every part of the surface of the hole.

The circular movement of the upper slide referred to is effected by a revolving upright spindle, driven by a worm and wheel under the table of the machine, the centre of which is concentric with that of the grinder spindle, and which carries a hollow pin or driver on a slide at the top.

This hollow pin works in a bearing on the bottom of the upper slide of the compound slide, and it is by moving the centre of this pin excentric to that of the revolving worm wheel spindle above mentioned that the circular motion is given to the upper slide, and the work fixed to it, and the surface of the hole brought in contact with the grinder.

The adjustment of this eccentricity, that is, giving more or less feed to the grinder, is effected by a centre spindle—within the worm-wheel spindle—and mitre-wheels turning a screw, which acts on the slide carrying the hollow pin or driver.



NEILSON'S HOLE GRINDING MACHINE

This centre spindle revolves with the worm-wheel spindle, but is accelerated or retarded by differential gearing brought into action by a handle, and clutches driven by mitre wheels on the bottom of the worm-wheel spindle.

The machine is now at work, and, we are informed, giving great satisfaction, the work produced by it being very superior in character, owing to the steadiness of the grinder spindle in having top and bottom bearings. A heavier feed can also be given than would be desirable, or even possible, with the grinder overhung on the spindle.

LIVERPOOL - STREET STATION WIDENING.

EXTENSION OF PRIMROSE STREET BRIDGE.

Wherever public road bridges existed over the tracks running into the terminus at Liverpool-street, it is obvious that in the lateral extension of the same station it became necessary to lengthen or add new spans to those structures. The bridge over the Great Eastern line at Primrose-street, represented in the accompanying elevations and sections, is an example of a work of this description. It will be seen from the general plan of the bridge in Fig. 1, that the line of thoroughfare of the extension or new part intersects both abutments on the street, forming angles of 64 deg. and 83 deg. respectively with each face, which is inclined towards the other. As a result, the faces of the abutments are not parallel, and the spans of the two principal girders are different, the north one being 94ft., and that on the south side 118ft., and their respective total lengths 105ft. 4in. and 131ft. For the purposes of description and illustration it will be sufficient to restrict our attention to the longer of the main girders, as the design and construction of both are similar. These trusses are virtually of the Pratt type, although the end panel lengths are designed a little differently. There are twelve cross girders placed 9ft. apart, of the plate type, resting at both extremities on the main girders, which are 39ft. apart from centres, and one short cross girder resting at one end on the abutment of the old bridge.

The width of the bridge between the parapets, or rather screens—for the former are not supposed etymologically to be more than breast high—is 35ft. 2in., and the rolled longitudinal steel joint runners connecting the cross girders, Fig. 1, are spaced at distances of 4ft. 4in. to 4ft. 8½in.

An elevation of the south or longer main girder is given in Fig. 2, and is of the form which is also known as the N truss,

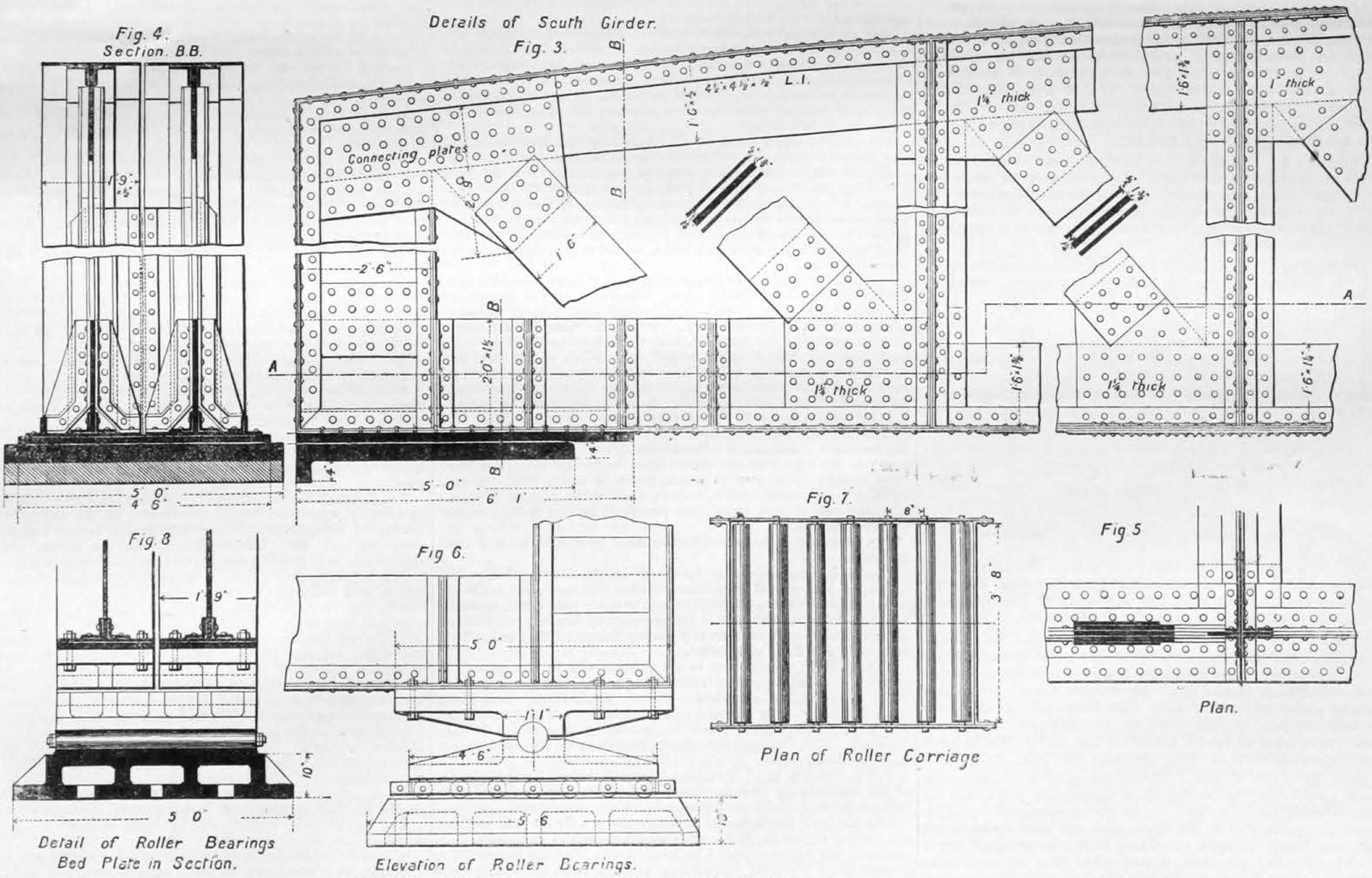
LIVERPOOL-STREET STATION WIDENING—PRIMROSE-STREET BRIDGE

MR. JOHN WILSON, M. INST. C.E., ENGINEER

although the designation strictly applies to only the left half of the elevation. Similarly to the girders of the Worship-street bridge, described and illustrated in our impression of April 24th last, the upper boom is curved, but the truss is of a different character. There is but one set of diagonal bars, which are ties in this instance, and the vertical members are struts, although this disposition of the members composing the web is sometimes reversed, not, however, in our opinion to advantage, when the girder is constructed wholly of steel or iron. American engineers, who, it may be fairly stated, are *facile princeps* in every matter relating to the design and construction of open web or trussed girders, prefer in similar instances to make the vertical members struts, and the diagonal bars ties. It is true that in the Howe truss these conditions are reversed, but then that truss is a composite one, and partly of iron or steel, and partly of timber. The girder, Fig. 2, is divided into fourteen bays or panels, all of which are 9ft. in length between the centres of the vertical members, except the last bays at the ends of the girder, which are 11ft. 6in. long each. Consequently the girder is symmetrical in elevation, about a centre line drawn vertically through the axis of the strut separating the two middle bays, which are both counterbraced, that is provided with an additional diagonal tie bar each, to suit the requirements of a rolling load. Theoretically one of these counter braces is redundant, as the central panels are indeformable with one of them, but practically both are required. The plates composing the upper flanges are eight in all, 1ft. 9in. broad by ½in. thick, including the outside cover plate, and their greatest length is 30ft. 2in., thus bringing up the weight of a single plate to half a ton. The angle irons in the flanges are 4½in. by 4½in. by ½in., covered with wrappers at the joints 3ft. 4in. in length, of angle iron 4in. by 4in. by ½in. A similar number of horizontal plates and angle irons of the same scantlings compose the lower boom. The cross girders are placed at the lower apices, that is at every point of intersection of the lower boom, and the vertical and diagonal bracing of the web.

In Figs. 3, 4, and 5 are given details of the construction of the main girders, from which it will be seen they are built up of twin girders, as was the case with respect to the bridge at Worship-street. At the centre the girders are 12ft. in depth from inside to inside of the plates, forming the booms. In addition to these plates and angle irons, the upper and lower booms of each of the twin girders have a vertical plate riveted in between the angle irons, with rivets 1in. in diameter, with a pitch of 4in. These vertical plates—Figs. 3-5—have a uniform depth of 1ft. 6in., and a thickness varying from ½in. at the central bays to 1⅜in. towards the end. The depth and thickness of these vertical plates are increased in the last or end panel lengths, and their scantlings are 2ft. by 1½in. Corresponding to the same longitudinal positions in the main girders the dimensions of the diagonal tie bars vary from 10in. to 1ft. 6in. by 1½in., and they all terminate flush with the vertical plates of the booms. The struts are composed—Figs. 3-5—of four vertical plates, two of which are placed transversely to the main girders, and two in the same longitudinal plane, and terminate like the diagonal tie bars flush with the vertical plate of the booms. Where the two former plates, which are uniform in thickness, in each twin girder nearly meet at the centre space of 1in. between them, a couple of plates are riveted along the vertical joint, and the double struts thus united form a complete diaphragm between the twin girders, as shown in Fig. 4. The two other vertical plates at right angles to these are 5in. by ½in. at the central panel of the main girders, and increase in the end ones to 7in. by 1½in. Four vertical angle irons, each 3in. by 3in. by ½in., rivet up the component parts of the struts with rivets ¾in. in diameter. The attachment of the struts and ties of the web to the booms are effected by strong gusset and connecting plates, the dimensions and thicknesses of which are proportioned to those of the members forming each apex or junction, as shown in Figs. 3 and 4.

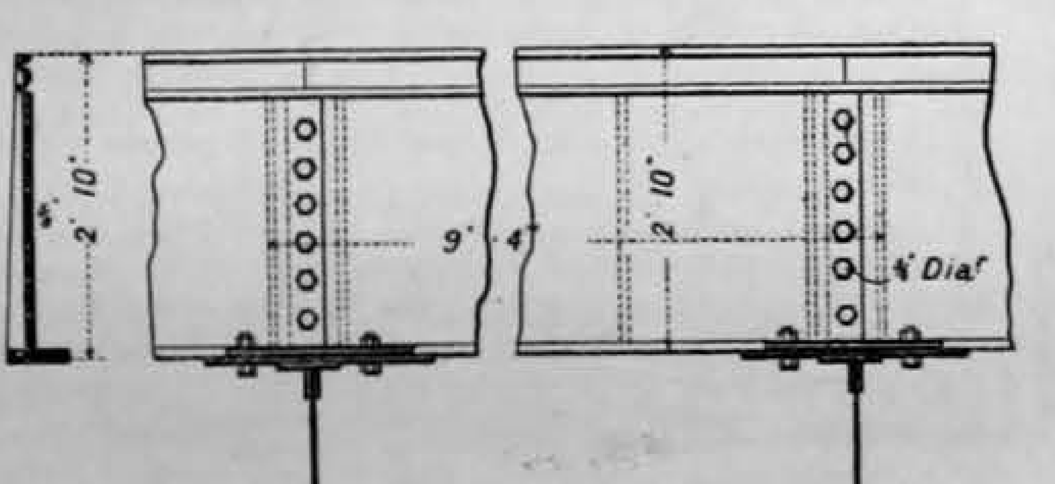
The bearings of the main girders are adjusted upon the combined rocker and roller system. One end of each of



GREAT EASTERN RAILWAY WIDENING WORKS—PRIMROSE-STREET BRIDGE—DETAILS the main girders is fixed and the other free to move—Figs. 6-8—on rollers arranged as follows. Beneath the bearing area of the girder and to the underside of the lower booms is riveted by countersunk rivets passing through the end plates and angle irons a wrought iron plate 1⅝in. thick, 5ft. in length, and 4ft. 6in. in width. This bearing plate is bolted down to the upper half of a pivoting block or rocker—Figs. 6 and 8—by sixteen bolts 1⅛in. in diameter, the heads of which dip under the top flange 3in. thick of the rocker, and the nuts are tightened up over the longitudinal end plate of the lower boom. The upper half of the rocker, which is exactly similar to the lower, rests upon a steel pin 6in. in diameter, which bears in its turn upon the lower half. Underneath the rocket, which is 4ft. 6in. long, 3ft. 6in. broad, and 1ft. 5in. deep, is placed the roller frame of wrought iron bars ⅞in. thick, 5ft. long, by 3ft. 8in. wide, and 2¼in. deep. Seven rollers, spaced 8in. apart from centres, and each 4in. in diameter, work in this frame on bearings 1in. in diameter. These rollers are free to move on a partly hollow cast iron bed plate 5ft. 6in. in length, 5ft. in breadth, and 10in. in height, of which an elevation and section are shown in Figs. 6 and 8.

The general cross section of the bridge on the square is given in Fig. 9, which includes a roadway 20ft. in width and two footpaths 7ft. 7in. wide each. A substratum of concrete 1ft. in depth carries the asphalt surface of both road and footways, that material being used in place of the wooden setts laid down over Worship-street bridge. Arched plates of cast iron support the concrete, and rest upon small longitudinal wrought iron plate girders running between the cross girders and riveted to brackets connected to the webs. The depth of the cross girders is 3ft. between the flange plates, and each flange is built up of three plates as follows:—One, 28ft. 8in. in length, 2ft. in breadth, and ½in. in thickness; a second, 26ft. long, 1ft. 6in. in breadth, and also ½in. thick; and a third, 23ft. in length, and with the other dimensions the same as the second plate. A pair of ∠ irons 3½in. by 3½in. by ½in. are riveted to the main girders and the strut diaphragms, as shown in Figs. 9 and 10. The details of the manner in which the connection of the principal and cross girders, that of the cross girder and of the longitudinal stringers, and the whole of the arrangement of the iron platform of the bridge is effected, is shown in Figs. 10 and 11. The junction of the cross girders with the main girders is accomplished by extending the web of the former for its full depth through the whole cross section of the twin girders. In this position it constitutes the lower portion of the vertical diaphragm between the struts in the web of the main girders already described. The necessity for this strong vertical attachment of the cross girders arises from the fact that the cross girders have but a very small bearing on the main girders. This is inevitably the case in all "through" bridges in which the cross girders rest upon the inner edge of the lower flange of the main girders. The strong vertical attachment serves to render nugatory the objection that has been raised against the one or lop-sided bearing of the cross girders upon the main girders. The horizontal joints between it and the upper part of the diaphragm are covered by wrappers, 8in. broad by ⅜in. thick—see Figs. 10 and 11. This extended part of the web of the cross girder is riveted to the vertical angle irons of the strut diaphragms, both of which are bent over at the extremity to form a connection with the lower flange of the cross girders to which they are riveted. In addition to this compact and substantial mode of attachment to the main girders, the cross girder is provided with a bed or bearing. A short plate, 1ft. long and ½in. in thickness, is riveted to the inner edge of the lower flange outside the longitudinal angle iron. To this bed-plate, which is of the same width as that of the flange resting upon it, is bolted by eight rivets the lower flange of the cross girders.

The material of which the footpaths are composed is retained in position at the sides by cast iron earth plates, or iron ballast boards, as they might be termed, indicated in Figs. 9 and 10 by the letter B, and shown in elevation, section, and detail in Fig. 12. The plates are of a length of



Elevation of Cast Iron Earth Plate
Fig. 12.

9ft. 4in., of a depth of 2ft. 10in., and ⅝in. in thickness, with a moulded upper edge and stiffening fillet pieces on the outside; they are lap-jointed in the thickness of the material, and bolted together by six bolts ⅝in. in diameter.

It will be seen, on referring to Fig. 13, that the web of the longitudinal wrought iron bearers is prolonged to the extent of 4in. beyond the angle irons which form the upper flange, and that the sides of the cast iron arched plates are bolted to these prolongations by bolts ⅝in. diameter, so that the web, which is ⅜in. in thickness, fits in between the arched plates. A camber of 2in. is given to the plates, which have a uniform thickness of ⅝in., and are 4ft. 3½in. long, and 3ft. 8⅝in. broad. Over the longitudinal bearers the cast iron arched plates are connected by a simple lap joint 3in. in width, and fillets are cast on to strengthen them. The longitudinal bearers are 1ft. deep, and are built up of equal upper and lower flanges consisting of a pair of angle irons 3½in. by 3½in. by ½in., and a web plate ⅜in. in thickness. Where the upper flange of the bearer meets that of the cross girder, as shown in Fig. 14, the angle irons constituting the former are discontinued, and the cast iron arched plates bolted down to the horizontal through plate of the cross girder, which is 2ft. by ½in., and has already been referred to. The bearers themselves are carried on small angle iron brackets 6in. by 6in. by ½in., riveted to the web of the cross girders. It will be observed that in Fig. 13 the side flanges of the cast iron arched plates do not touch the protruding webs of the longitudinal bearers. The open space on each side of the web is ½in. in width, and is filled up with rust cement, as shown in Fig. 15.

We are indebted for the drawings accompanying our article to the courtesy of Mr. John Wilson, M. Inst. C.E., Engineer-in-Chief of the Great Eastern Railway, and for the photograph which represents one of the girders in course of erection, and for some further particulars to Mr. H. A. G. Sherlock, M. Inst. C.E., who acted as resident engineer to the company during the construction of the works. The contracts were carried out for this bridge by the same firms whose names we have mentioned in connection with our description of Worship-street bridge, and also in our previous articles relating to the general widening and extension of the metropolitan terminus of the Great Eastern Railway.

THE AIMS OF TECHNICAL COLLEGES.

The following abstract of an address by one of the very foremost of Germany's professors of engineering, and at the same time an engineer practising with distinction, and by this means in constant touch with the practical working requirements of engineers and of manufacturers, will interest many of our readers. England is waking up to the fact that the modern craze for mixing up colleges and workshops is a dangerous one, and Germany is finding that the more she grows in practical commercial engineering the more the real workshop becomes the most important training ground. Consequently, she is reverting more to the old British practice. The German technical colleges have developed in the three last decades remarkably quickly, but quicker still has been the progress in the technical arts, and consequently also the growth of the demands made on technical education. If these demands are to be met, a reform of technical instruction is unavoidable.

"Knowledge of reality is the basis of technics, and with this, knowledge of nature, insight into physical things, not however mathematics, the true element of the engineer. This does not always receive due consideration in our colleges. All instruction, even in the highest grades, must be objective and yet combined with scientific accuracy. Here the prevailing school fails. How much the scholar has to learn in words and conceptions, how much is described to him in words, how much he has to describe, and how little is shown to him that he can see and observe, that he must himself represent in drawings or sketches!

Such way of instruction deceives as to the difficulties of reality, and the consequence is fear and flight from reality. The school must develope the sense of observing accurately; exercise in this respect, the developed powers of observation and imagination must be brought to college just as the knowledge of languages, mathematics, and drawing.

But for technical activity knowledge alone without the capacity to put it into use is not sufficient. The practical application is necessary to complete the theoretical knowledge: it is the higher step in knowledge, general theoretical knowledge being the first.

Knowledge without practical application is the cause of the growing disinclination of youth to do detail work, and at the same time of the increasing uselessness of those who have only scientific, *i.e.*, one-sided theoretical education. Another result is the decrease in self-education by independent work. The formal doing of the full amount of school work and passing the necessary examinations contributes its quota in keeping back youth from self-education.

The consequences are known: the mere acquiring of privileges, a mighty crowding, especially of the most talented, to get high positions where there is little work, to get an office attractive on account of the support and social position which it affords, holy horror of the struggle for existence, of productive work, of responsibility and of all "uncertain future."

Less serious persons are conceited, consider what they have learned sufficient for all active life, confuse self-made suppositions with reality, and so superficiality, contempt of experience, over-estimation of what they have learned, flourish. All their mental energy is expended in fruitless criticism, and they boast of superiority over all who have not reached the same rank in the same way of advancing.

The entire rearing must be permeated by the practical spirit. The Germans tend by nature to the dogmatical, to dreaming; while the Anglo-Saxons take hold of everything from the very beginning practically and technically. Impractical sense is a German hereditary and educational mistake. On this account we must avoid excess of learned training; for this reason we need before all other things technical training, which teaches to think practically and put into use, which trains a practical and not a learned youth.

The point of view of economy must receive more attention than heretofore in technical instruction. The knowledge of economics, of one's own country as well as of foreign countries, is becoming to-day more and more necessary. We live in a time when mistakes in economy weigh the heaviest, and when nations bleed to death more easily by them than on battlefields. With us the state and its officials exercise an unhealthful influence on the practical and economical sense, because all higher studies are arranged specially for the training of state officials. A great hindrance is the age that our students reach before they enter into active life. The gymnasial examination, f. i., occurs often in the twentieth year, the builder's examination (*Bauführerprüfung*) in the twenty-fifth year; in the meantime our competitors in foreign countries have been already from five to seven years in active life. Since a military year is unavoidable, a shorter and more suitable preparation, and only a three years', but practical, fruitful college course must be the aim.

The reform of technical education must be sought for in several directions.

The training previous to technical instruction must also lay stress on the special capacities needed for technical activity; power of observation, of imagination for space and form, capacity of representing the objects of imagination by drawing, and before all else the capacity of correctly seeing things as they are. This demand is not filled at present.

The scientific preparation in the colleges should not consist in abstract doctrine, but must from the beginning show the difficulties which arise in actual experience, and the application which alone leads to the complete mastery of the elements. The scholar can only put into use that of which he is master, that which he has digested. This demands the utmost limitation of the matter, and time for assimilation.

The instruction in all the sciences must therefore for the average of the students be brought down to the necessary minimum, but this minimum be fully mastered and put into use.

The study of the technical sciences has not for its aim to turn out perfect engineers, but it must so develope the capacities that practical life will seem only a natural growth from the instruction; it must train practical, responsible helpers, teach the varied conditions of reality, the practical application and execution for the special case.

Also the technical sciences have to teach for the average of the students only the fundamental principles, the amount that is absolutely necessary, but to demand complete mastery of that. The particular learning of engineering begins in practice. Necessary are: more thorough knowledge by means of practical application, and teachers who understand such application and work in the spirit of true practice and economy.

The teachers of the technical sciences must be acquainted with the actual facts from their personal activity and must be masters of, and know how to put into practice, the art which they undertake to teach.

On the other hand, opportunity for the highest special scientific training must be guaranteed, which is indispensable for the solution of numerous technical questions; such training, however, ought to be offered only to select students.

Arrangements for examinations are necessary, which shall be of equal value with those for public service, but which correspond to technical activity, admit of the development of individuality, and prevent the abnormal crowding into state offices and the privileged course of education.

In the technical colleges a lively mental competition of the teachers ought to be produced by parallel 'professorships, and by attracting teachers from practical life. The success of the colleges and of the national productive activity is dependent upon this. The damaging of an entire generation and nation by a single college teacher who is not capable of doing his work, or whom a false or outlived reputation surrounds, is much greater than the damage which dozens of dismissed army officers would have been able to do.

Professor Riedler elsewhere draws attention to the mistaken appreciation in which some British talkers speak of German technical college training, such as the remarks of Lord Rosebery at Epsom. Germany sees her error, but our scholastics clamour only for more subscriptions for more colleges and harmful scholarships and enticements to underrate workshop hard work.

CATALOGUES.

La Manufacture Française d'Armes, St. Etienne, Loire. Guns and all manners of sporting outfits.—This book contains nearly 600 pages, and is illustrated by many hundreds of engravings and some excellent specimens of the colour printer's art.

Holden and Brooke, Limited, Manchester. Anti-primers and Steam Dryers.—Contains useful information for steam users.

The D. P. Battery Company, Limited, 66, Victoria-street, London, S.W.—Storage batteries and accessories.

Green and Boulding, London. The Buffalo injector, Shipman engine, metallic packing, valves, cocks, &c.—This catalogue commends itself to us on account of its handy size, and clearness of arrangement.

C. D. Mominger, London.—Machines, tools, and wood-working appliances.

T. Cooke and Sons, London and York.—An illustrated catalogue of theodolites, tacheometers, levels, sextants, planimeters, and other surveying instruments. The book is well printed and is provided with a stiff cover.

J. Bagshaw and Sons, Limited, Batley.—Besides being an illustrated price list of wrought iron pulleys, shafting, and friction couplings, this book contains useful rules and tables for engineers and architects, and is, moreover, of convenient size and bound in cloth cover.

C. W. Burton, Griffiths, and Co., London.—A number of separate lists with illustrations and particulars of tools useful to bicycle makers. The tools are the manufacture of the Garvin Machine Company, New York.

Hayward-Tyler and Co., London.—This is an illustrated catalogue of pumps and pumping machinery and pump specialties, and has as an appendix a section devoted to useful notes and tables. In point of get up the book is worthy of a place in any engineer's book-case.

William Rose and Co., Manchester.—Messrs. Rose's catalogue contains every imaginable requisite for fire-stations, from steam fire-engines to firemen's belts. It is well printed on good paper.

C. Challenger, traffic manager to the Bristol Tramways and Carriage Company, Limited, sends us a treatise written by himself on self-acting rain-proof seats for tramcars and 'buses. A tramway seat should not be difficult to describe, but we have read Mr. Challenger's treatise and are still ignorant of the general construction of this seat, nor is there an illustration of it from which some idea can be gleaned.

The I. E. S. Accumulator Company, Limited, Westminster.—Price list of accumulators.

Darling, Brown, and Sharpe, Providence, U.S.A.—Steel rules.

Hardy and Padmore, Limited, Worcester.—The "Ideal" gas engine.

A. B. Pescatore, Manchester.—This is a price list of the Tudor accumulators, with instructions for charging, discharging, and supervision.

John and Henry Gwynne, Hammersmith, London.—This is a well illustrated pamphlet describing the "Invincible" centrifugal salvage pumping plant. The illustrations are half-tone reproductions of photographs of wrecks and stranded vessels which have been floated again by the use of Messrs. Gwynne's plant. The book is worthy of a better cover.

Fairburn and Hall, Manchester.—Injectors, water elevators, blowers, silent heaters, valves, fittings, &c.

Frank Pearn and Co., Limited, Manchester. Pumping machinery.—Considerable taste is displayed in the get up of this handy catalogue. The engravings and typography are alike excellent.

Bolling and Lowe, London.—Portable railway plant, weigh-bridges, locomotives, and trucks.

The Safety Tread Syndicate, Limited, London.—Non-slipping stair treads, hydrant and man-hole covers.

John Abbot and Co., Limited, Gateshead-on-Tyne.—A nicely arranged catalogue of brass and metal work, sections of iron, engineers' and blacksmiths' tools, &c.

The Union Gas Engine Company, San Francisco.—This catalogue comprises some forty pages of illustrations and particulars of the Union oil engines and launches. The engravings are particularly good.

The General Electric Company, Limited, London.—This is a very excellently appointed book, containing in its thousand pages illustrated particulars of every conceivable device useful to the electrical engineer. The section devoted to motors and their application is interesting and up to date. There is in this section a very full explanatory text, in which the principle, construction, action, and efficiency of the electric motor, of both direct and alternating current types, are amply explained by the aid of excellent diagrams and tables. The constructive portion also includes graphic directions for installing electro-motor plant, and estimating for it. Direct current, alternating, three-phase and polyphase motors of various powers are shown applied to fans, launches, drilling machines, lifts, cranes, coal cutters, tram cars, autocars, factory equipments, lifts, and domestic machinery. The catalogue is well bound, but would be improved if the firm's name were printed on the back.

John J. Royle, Manchester.—This is a sectional catalogue devoted to the "Row" tube and its applications. The "Row" tube is formed by indenting or flattening a circular tube in such a manner that the indentations so formed intersect each other at right angles, so that a column of liquid passing through is broken up and diverted into contact with a large amount of impinging surface.

William Allchin, Northampton.—Illustrated catalogue of traction, portable, and stationary engines, road rollers, and sawing machinery.

The Mannesmann Tube Company, Limited, Landore.—Weldless steel tubes for all purposes. The book contains useful information regarding tests of tubes, &c.

The Salvage Patent Appliances Syndicate, Liverpool.—Salvage appliances, consisting of pontoons and machinery for raising sunken vessels.

The United Asbestos Company, Limited, London.—A complete catalogue of the manufactures of this firm, interspersed with illustrations showing the processes through which the material passes in the works.

Dorman, Long, and Co., Limited, Middlesbrough.—Catalogue of steel sections. This book is a nice size, nicely bound, well printed, and contains quite a fund of useful information concerning beams and girders.

THE EFFECT OF RETARDERS IN FIRE TUBES OF STEAM BOILERS.*

By JAY M. WHITHAM, M. Am. Soc. M. E.

THE trials were conducted on a 100-horse power horizontal tubular boiler at the Sutherland Avenue Station of the Philadelphia Traction Company, Philadelphia. The purpose of the trials was to ascertain under what condition, if any, retarders in the fire tubes would add to the efficiency of the boiler.

Dimensions and Proportions of Boilers and Setting.

Boiler shell	60in. by 20ft.
Tubes, 44	4in. by 20ft.
Grate surface	26·7 square feet
Water heating surface	1137 square feet
Ratio of heating surface to grate area	42·6 to 1
Steam drying surface in top of shell	150 square feet

Boiler set with a return pass over the top. Ten such boilers are connected to a brick stack 10ft. diameter by 175ft. high. During the tests from four to seven of these boilers were run in connection with the boiler tested. On certain tests retarders were used in the tubes. These were made of loosely fitting strips of No. 10 sheet iron, running the whole length of the tubes, and twisted to a pitch of 10ft., or making two entire convolutions in the length of the tube.

The tests were conducted according to the methods advised by this society, and all instruments used were standardised. L. Kennedy, a careful and skilful fireman, fired on all the tests. The boiler tubes were clean at the beginning of each test, while the boiler was fairly clean on the water side. Several of the tests were duplicated in order to make sure that no error existed.

RESULTS OF THE TRIAL.

Coal.—The coal was practically uniform in quality on all the tests. The percentage of ash and refuse varied from 8·72 to 4·25 per cent.

Draughts.—The draught was measured in the furnace, in the front connection, and in front of the damper at the rear end of the return pass over the top of the boiler. The damper was manipulated so that the draught would be just sufficient to burn coal for the power desired to be developed on each test.

Table I. compiled from the results obtained in the tests should be valuable in predicting the draughts needed for any rate of combustion from 5 lb. to 40 lb. an hour per square foot of grate with bituminous coal, natural draught and horizontal tubular boilers, while it should be of use also with water-tube boilers

TABLE I.—*Draught Required for Boiler with Various Rates of Combustion.*

Pounds of dry coal burned an hour per sq. ft. of grate.	Resistance due to. Furnace draught.	Pass under boilers and thro'gh tubes; no retarders.	Retarders in tubes.	Pass over top of boilers.	Total draught. No retarders; no return pass.	With retarders; no return pass.	Top pass; no retarders.	With top pass and retarders.
	inch.	inch.	inch.	inch.	inch.	inch.	inch.	inch.
5	0·04	0·04	—	0·04	0·08	0·08	0·12	0·12
8	0·11	0·05	0·02	0·04	0·16	0·18	0·20	0·22
10	0·13	0·07	0·03	0·05	0·20	0·23	0·25	0·28
12	0·17	0·07	0·04	0·05	0·24	0·28	0·29	0·33
14	0·19	0·10	0·03	0·05	0·29	0·32	0·34	0·37
15	0·20	0·11	0·03	0·05	0·31	0·34	0·36	0·39
16	0·21	0·12	0·03	0·05	0·33	0·36	0·38	0·41
18	0·23	0·13	0·06	0·05	0·36	0·42	0·42	0·48
20	0·24	0·16	0·08	0·06	0·40	0·48	0·46	0·54
22	0·26	0·18	0·12	0·06	0·44	0·56	0·50	0·62
25	0·27	0·22	0·19	0·06	0·49	0·68	0·55	0·74
28	0·29	0·24	0·27	0·07	0·53	0·80	0·60	0·87
30	0·30	0·27	0·31	0·07	0·53	0·88	0·64	0·95
34	0·32	0·31	0·38	0·08	0·63	1·01	0·71	1·09
36	0·33	0·34	0·40	0·08	0·67	1·07	0·75	1·15
40	0·36	0·38	0·46	0·08	0·74	1·20	0·82	1·28

Quality of steam.—The steam was practically dry for every condition of the tests, however much the boiler was pushed in capacity. This is due to the large liberating surface in boiler and the use of dry pipes.

Economic evaporation.—Table II. shows tests with and without the use of retarders. The advantage due to retarders is as high as 18 per cent. when the boiler is greatly forced. The temperature of the waste gases is always less when retarders are used. economic workings of the boiler when run at from 50 per cent. below to 70 per cent. above its rating, *i.e.*, when making a horse-power an hour on anywhere from 21·7 to 6·7 square feet of heating surface. The cost of fuel per horse-power was as follows, for the tests made with retarders in the tubes:—

Boiler, horse-power :—	52·4	77·3	104·2	127·5	148·6	169·1	197·3	226·1
Dry coal per horse-power, lb. :—	3·30	3·21	3·15	3·18	3·14	3·11	3·23	3·23

It is, therefore, evident that retarders enable a boiler to be run as economically on five square feet of heating surface to the horse-power as on 21·7 square feet, or, practically, as on any number of square feet between these limits.

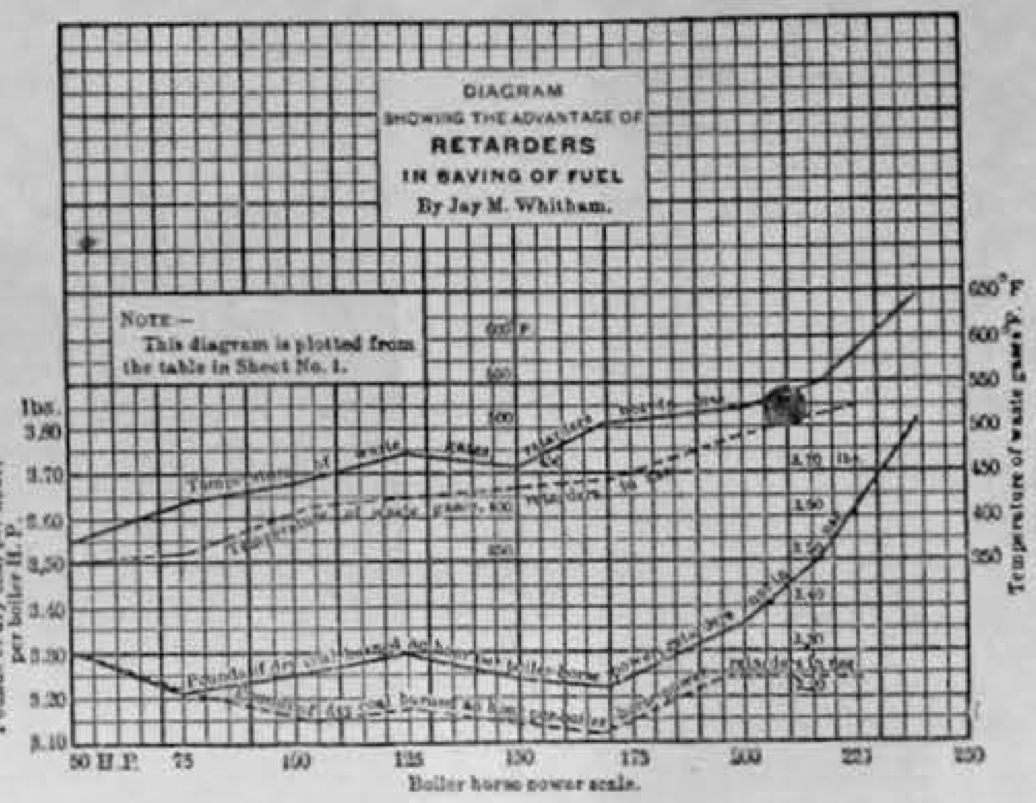


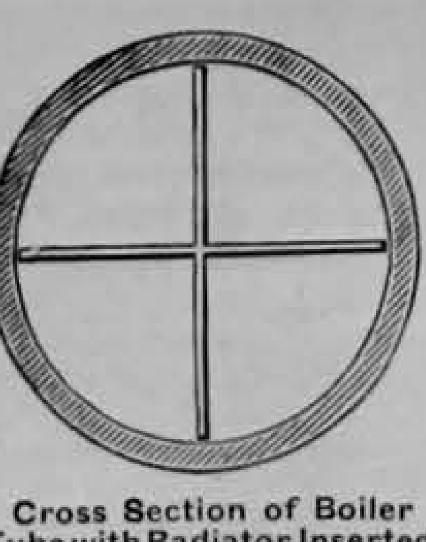
Diagram Showing Fuel Saving due to the Use of Retarders in Steam Boiler Tubes.

Conclusions.—(1) Retarders in fire tubes of a boiler interpose a resistance varying with the rate of combustion. (2) Retarders result in reducing the temperature of the waste gases, and in increasing the effectiveness of the heating surface of the tubes. (3) Retarders show an economic advantage when the boiler is pushed, varying in the tests from 3 per cent. to 18 per cent. (4) Retarders should not be used when boilers are run very gently, and when the stack draught is small. (5) It is probable that retarders can be used with advantage in plants using a fan or steam blast under the fire, or a strong natural or induced chimney draught, when burning either anthracite or bituminous coals. (6) Retarders may often prove to be as economical as are economisers, and will not, in general, interpose as much resistance to the draught. (7) Retarders can be used only with fire tubular boilers. (8) The economic results obtained on the boiler tested are ideal, showing that it was clean, the coal good in quality, and the firing skilful. With retarders the tubes are more effectively cleaned than without their use. (9) The tests prove that the marine practice of using retarders is good, and that the claim, often advanced, that they show from 5 per cent. to 10 per cent. advantage, holds, whenever the boiler plant is pushed and the draught is strong.

DISCUSSION.

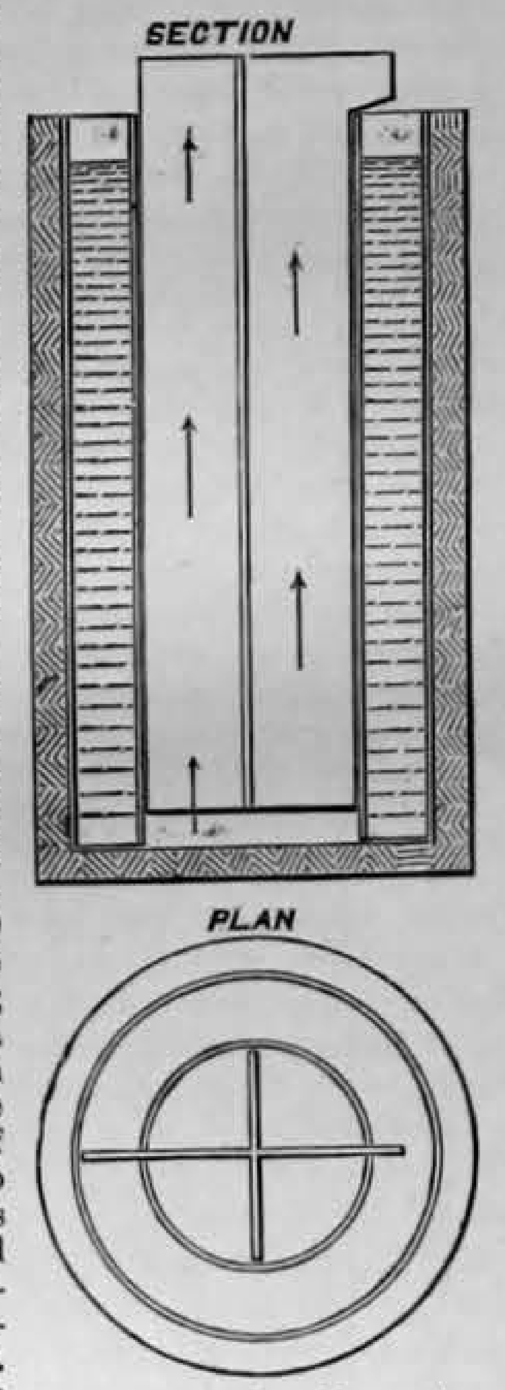
Charles Whiting Baker: It is rather a curious fact that while "retarders," as they are called, have been used more or less for several years, and in some instances with very notable advantage, Mr. Whitham's paper, so far as I am aware, is the first extended account of their use and their advantages which has appeared in technical literature, although of course allusions to their use in connection with various steam plants have been made in various papers. Another curious fact is that the action of retarders in the flue has been generally misunderstood, as is indicated by their name. The retarder does, of course, obstruct and retard the flow of gas through the flue, but this is by no means the purpose for which it is placed there. If it were desired simply to make the hot gases flow more slowly through the tubes, the simplest and best way is to check the draught by dampers in the chimney or at the ash pit. What the so-called retarder does that is beneficial is to increase the amount of heat transmitted to the tube surface from the hot gases, and it does it in two ways. First, by a mixing action upon the gas in the tube. The friction upon the surface of the retarder aids in stirring up the gas in its passage through the tube and mixing the hot gas at the centre with the cold film next the surface of the tube. Also in every horizontal tube there is a

of radiating surface and on the difference in temperature between the radiating surface and the surface of the tube. A radiator of cross shape, like that shown in the accompanying cross section of a tube, has a radiating surface nearly $1\frac{1}{2}$ times as great as the inner surface of the tube, and experiment shows it to radiate nearly twice as much heat in a given time as a flat strip of a width equal to the tube diameter.



Cross Section of Boiler Tube with Radiator Inserted.

I have made numerous experiments to test the efficiency of radiators with the apparatus shown in the accompanying sketch. It represents a section of a single tube of a vertical boiler. The water space surrounding it is well protected by a non-conductor, so that the loss of heat is very small. Through the tube a current of hot gas is caused to flow from a lamp, gas jet, or other suitable source, and the amount of heat transmitted to the water in a given time is measured. The test is then repeated under identical conditions, except that a radiator of the form shown above is placed in the tube. The increased amount of heat transmitted to the water is taken as the amount due to the radiation from the internal piece. Experiments with this apparatus show the following general results:—(1) That the percentage of increase in heat transmitted due to radiation increases with increase in temperature of the gases passing through the tube. (2) That the percentage of increase in heat transmitted due to radiation is larger in vertical tubes than in horizontal, on account of the fact that a given area of heating surface in a horizontal tube absorbs heat faster by direct contact with the gases than the same area in a vertical tube. In general, the experiments showed that with vertical tube heating surface and gas passing through the tubes at a temperature sufficient for the tube to transmit 1000 to 3000 B. T. U. per square foot per hour, the insertion of a radiator would cause an increased heat transmission of 200 B. T. U. to 1200 B. T. U. per square foot of radiating surface per hour; or, in other words, the insertion of a radiator in that part of a tube in which the gas is of high temperature appears to increase the amount of heat absorbed from 20 deg. to 40 deg. These experimental figures for the amount of heat transmitted by a radiator in a tube are corroborated by the figures for relative radiation and convection given by D. K. Clark in his treatise on the steam engine, page 68, et seq. The radiators possess the advantage over the spiral retarders described by Professor Whitham, that they do not obstruct the draught to so great an extent, and they interfere less with the cleaning of tubes with the steam jet blower.



Apparatus for Measuring Increase in Transmission of Heat to the Tube Surface due to Radiation.

Experiments on actual boilers indicate that either device is most useful on boilers with short tubes of not too small diameter, and with an abundance of draught. With either device the tube surface must be kept clean, otherwise the increased efficiency will soon disappear, as is the case with the Serve ribbed tubes when care is not taken in this respect. It appears likely that either of these devices may be used with especial advantage, therefore, where a clear fuel like gas or oil is used. Another application of these devices which appears to have promise is to the tubes of vertical boilers of the Corliss or Manning type. An objection t these otherwise excellent types of boilers is the very high hea room that is required to get in tubes long enough to extract the heat from the gases with reasonable completeness. By the use of some device to increase the tube-heating surface efficiency, shorter tube should be permissible, with a consequent reduction in the height of the boiler.

TABLE II.—*Results of a Series of Trials on a 100-H.P. Horizontal Tubular Boiler, to Determine the Value of Retarders in the Tubes.*

Duration of trial, hours	9	9	9	9	9	9	9	9	9·1	9	9	9	9	9	9
With or without retarders in tubes	Without.	With.	Without.	With.	Without.	With.	Without.	With.	Without.	With.	Without.	With.	Without.	With.	Without.
Absolute steam pressure in boiler, lb.	135·20	133·16	135·45	133·35	137·17	134·90	138·30	133·90	136·70	132·80	136·23	133·52	136·90	133·56	136·59	133·53	135·66
Draught in pass over boiler at damper, inches	0·16	0·15	0·21	0·28	0·33	0·31	0·36	0·38	0·42	0·49	0·51	0·53	0·65	0·71	0·62	0·86	0·67
Draught in furnace over top of fire, inches..	0·07	0·07	0·13	0·13	0·17	0·17	0·19	0·20	0·24	0·23	0·25	0·24	0·36	0·24	0·30	0·34	0·32
Temperature of fire-room, deg. Fah.	103	70	94	67	104	70	112	75	110	76	87	76	102	78	99	80	89
Temperature of escaping gases, deg. Fah.	371	351	414	361	444	412	470	424	455	426	506	447	526	490	551	523	646
Percentage of ash and refuse in dry coal	8·33	8·72	6·04	7·42	6·15	5·55	4·93	5·81	4·93	5·06	4·96	5·76	4·63	5·49	4·43	4·53	4·25
Quality of steam, dry steam taken as unity	0·99	0·99	0·99	0·99	1·00	0·99	0·99	0·99	0·99	0·99	0·99	0·99	0·99	0·99	0·99	1·00	0·99
Water evaporated* per lb. of dry coal, lb.	10·43	10·44	10·70	10·72	10·58	10·92	10·44	10·86	10·65	11·00	10·70	11·09	10·26	10·68	9·84	10·69	9·03
Water evaporated* per lb. of combustible, lb.	11·38	11·43	11·38	11·57	11·29	11·56	10·99	11·53	11·20	11·60	11·27	11·53	10·76	11·20	10·29	11·19	9·43
Saving in dry coal by use of retarders, per cent.					3·22		4·02		3·29		3·55		4·09		8·64		18·39
Water* per hour per sq. ft. of heating surface, lb.	1·59	1·59	2·25	2·34	3·03	3·16	3·80	3·87	4·55	4·51	5·25	5·13	6·06	5·99	6·59	6·86	7·26
Dry coal burned per hour per sq. ft. grate surface, lb.	6·49	6·49	8·89	9·33	12·13	12·30	16·35	15·18	19·20	17·45	20·87	19·73	26·55	23·86	30·10	27·32	34·10
Boiler H.P., basis $34\frac{1}{2}$ lb. water, 212 deg. Fah., per hour, H.P.	52·4	52·4	74·6	77·3	99·7	104·2	125·3	127·5	150·0	148·6	169·6	169·1	199·7	197·3	217·4	226·1	239·0
Heating surface per H.P. developed, sq. ft..	21·7	21·7	15·24	14·71	11·37	10·91	9·09	8·92	7·58	7·65	6·70	6·72	5·68	5·76	5·23	5·03	4·76

* From and at 212 deg. Fah.

Herein lies the advantage of retarders. Their use renders more efficient the heating surface of the tubes, enabling the gases to be reduced in temperature, and the same capacity of boiler to be developed with a less expenditure of fuel.

The accompanying cut shows at a glance the usefulness of retarders. A reduction in temperature of the waste gases shows at once a decrease in the coal consumption, as follows:—

52-H.P.,	gases reduced	20 deg. Fah.,	fuel saving	0·0 per cent.
75-H.P.,	,,	53 deg. Fah.,	,,	0·0 per cent.
100-H.P.,	,,	32 deg. Fah.,	,,	3·2 per cent.
125-H.P.,	,,	46 deg. Fah.,	,,	4·0 per cent.
150-H.P.,	,,	19 deg. Fah.,	,,	3·3 per cent.
170-H.P.,	,,	59 deg. Fah.,	,,	3·6 per cent.
200-H.P.,	,,	36 deg. Fah.,	,,	4·1 per cent.
225-H.P.,	,,	26 deg. Fah.,	,,	8·6 per cent.
239-H.P.,	,,	123 deg. Fah.,	,,	18·4 per cent.

Variation of economy with capacity.—By Table II. we see that the 100-horse power boiler, rated on 11·37 square feet of water-heating surface to the horse-power could easily develope over 200-horse power. At its rated power 3·03 lb. of water, from and at 212 deg. Fah., were evaporated per hour, yet there was no difficulty in evaporating 7·26 lb. to 1 square foot, or in getting a horse-power on 4·76 square feet of heating surface. The cost in fuel of a horse-power was as follows for the tests made without the use of retarders:—

Boiler, horse-power :—	52·4	74·6	99·7	125·3	150·0	169·6	199·7	217·4	239·0
Dry coal per horse-power, lb. :—	3·30	3·21	3·25	3·30	3·24	3·22	3·3	3·51	3·82

These results show that there is practically no change in the

*Condensed by *Engineering News* from a pape presented a the St. Louis meeting of the American Society o Mechanica Engineers.

tendency for the gases to be cooler in the upper part of the tube and hotter in the lower, for the upper half of the tube extracts heat far more readily from the tube than the lower half. The twist of the retarder has the effect of repeatedly "turning over" the gas in the tube as it flows along.

In the second place the retarder acts by direct radiation of heat to the tube surface. While this action may not be apparent at first sight, it is of such importance that it should be clearly understood. To this end the fact should first be realised that the temperature of the tube surface exposed to the fire in any steam boiler is practically the same as that of the water in contact with it, no matter what the temperature of the gases on the other side. We, of course, suppose the tube surface to be clean. The reason is that water absorbs heat many times as rapidly as gas. As experimental proof I may add that in a boiler filled with cold water I have often seen dew collect and stand in beads upon the fire side of the tube when a current of gas at a temperature of over 1000 deg. Fah. was passing through the tube.

The rate of absorption of heat by boiler heating surface, then, depends almost entirely on how much heat we can impart to this surface on the fire side. In the ordinary boiler tube heat is imparted to the surface of the tube only by the contact of the hot gases. Now, suppose we place in the tube any solid body, of any shape whatever, manifestly, as it is surrounded and bathed on all sides by gases at a temperature of, say, 1000 deg., it will, if it loses no heat, soon become of the same temperature as the hot gases. Suppose the surface of the tube is at a temperature of 300 deg. Fah. Then we shall have these two surfaces only an inch or two apart, and a difference of temperature between them seven times as great as exists between a very cold winter day and the maximum heat of summer. Under these circumstances, of course, the hot body at the centre of the tube will energetically radiate heat to the walls of the tube, and will materially increase the rate of heat transmission.

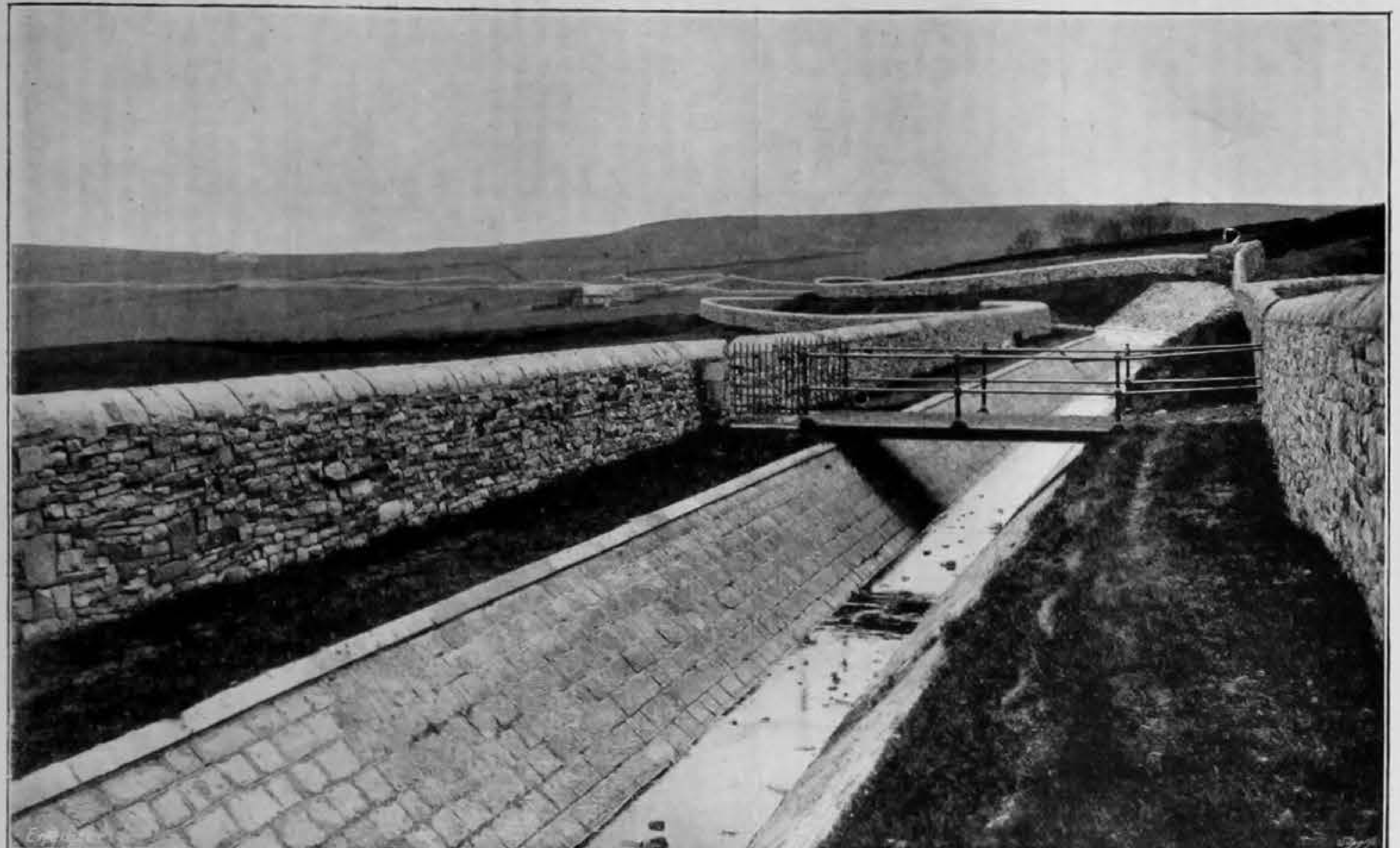
The amount of radiation in any given tube depends on the area

The economic gain by the use of either radiators or retarders depends entirely on the temperature at which the boiler is discharging its hot gases. In general it may be assumed that every 100 deg. reduction in the temperature of the waste gases represents from 5 per cent. to 10 per cent. saving in fuel. In general it will not usually be found worth while to introduce either retarders or radiators in the tubes of any boiler unless the thermometer shows its hot gases to be discharging at a temperature of over 550 deg. Fah. I notice among Mr. Whitham's conclusions the statement that:—"Retarders can be used only with fire-tube boilers." This doubtless refers to the proposition to place retarders inside the water tubes, which is absurd on its face to any one correctly understanding the action of the retarders. The use of radiating bodies of extended surface, however, in the gas passages between the tubes of a water-tube boiler, should in theory at least give the same advantage as in the case of fire tubes. Two methods fo effecting this radiating action devised by the writer may be found by reference to United States patents Nos. 529,997 and 559,021.

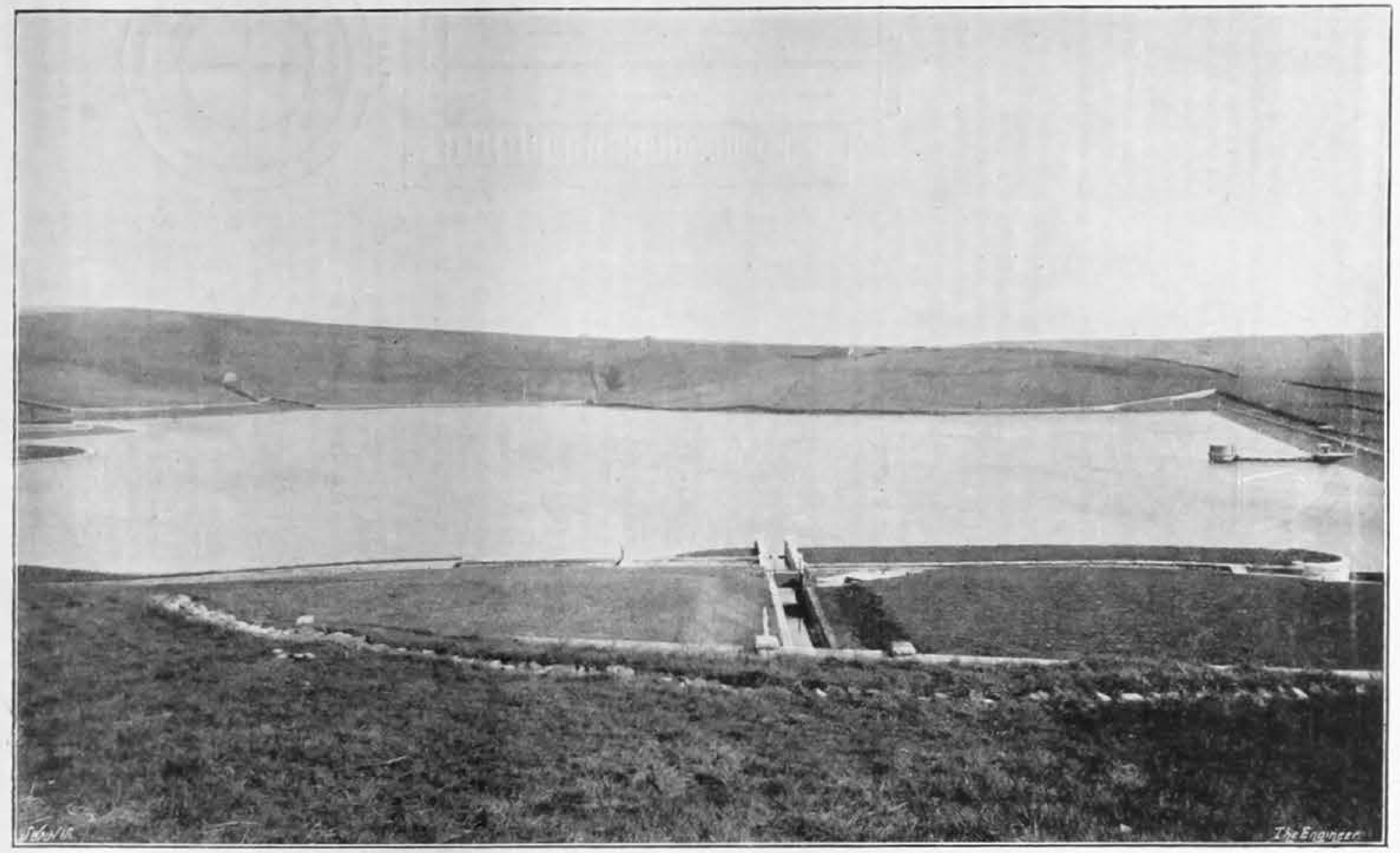
DEATH OF A MIDLAND ENGINEER.—Mr. J. W. Gray, M. Inst. C.E., M.I.M.E., late engineer of the Birmingham Waterworks, died at his residence, Leamington, on the 17th inst., in his 68th year. Mr. Gray was at one time employed in London, first in the service of the New River Company, and subsequently in that of the East London Waterworks Company. In 1865 he obtained the post of engineer to the Birmingham Waterworks Company, which was taken over by the Birmingham Corporation in 1876. The growth of the city was so rapid that the question of the wate supply was always a source of anxiety to the committee, and finally it was decided to seek additional supplies in North Wales at a cost of several millions. Mr. Gray was to have taken charge of the section of the work between Birmingham and Hagley, but his health failed, and in the autumn of 1894 he sent in his resignation. This was accepted, and he was granted a retiring allowance of £600 a year.

THE BURY WATER WORKS

MR. J. CARTWRIGHT, M. INST. C.E., BURY, ENGINEER

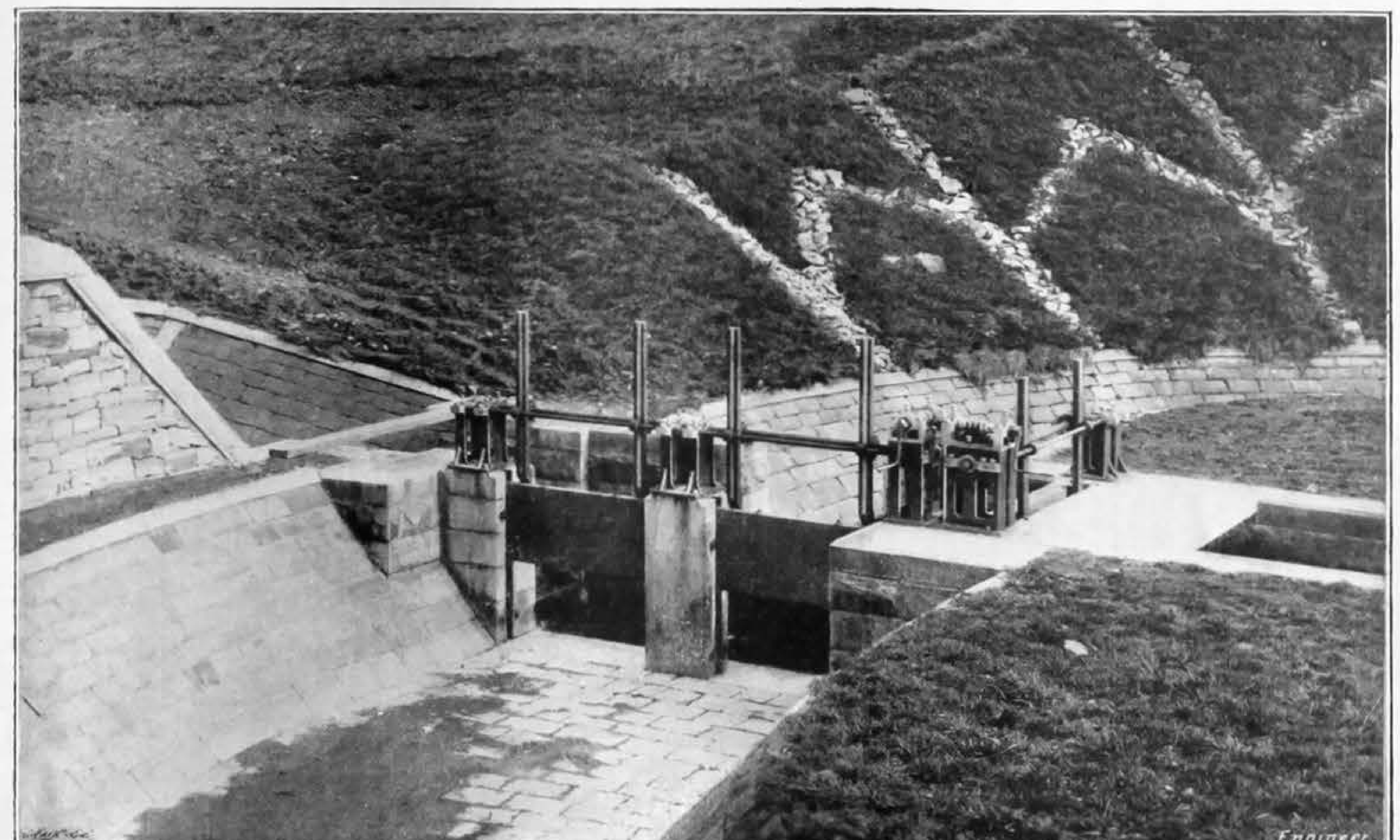


CATCHWATER, LOOKING WEST



GENERAL VIEW OF RESERVOIR

TUNNEL OUTLET, LOWER BYE-WASH, AND GAUGE BASIN



SHUTTLES ON BYE-CHANNEL—INTAKE No. 2

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Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of THE ENGINEER.

Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

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TO CORRESPONDENTS.

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

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

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

REPLIES.

J. R. T. (Hereford.)—We cannot publish any part of your communication.

A. W. (Elgin.)—A horse could just do it for a short distance, but not if wheel flanges were rubbing or binding in a dirty groove of a tram rail.

M. B. (Hebden Bridge.)—There are several in this country and at Douglas in the Isle of Man. The most recent is that recently opened at Aberystwyth.

H. C.—You can apply to the Scottish Vulcanite Company, 57, Fore-street, E.C.; or the Rhenish Rubber Celluloid Company, 65, Basinghall-street; or the British Zylonite Company, Ltd., Homerton, London, N.E.; or the Corruganza Manufacturing Company, Ltd., Brewhouse-yard, 173, St. John-street, E C.

BONA FIDE (Ashton-under-Lyne.).—Your best course is to appeal to the results of experiments. See "Chromienne's Etude sur les Marteaux-Pilons." In this it is recorded that steel blocks 100 mm. high were reduced to 82·5 mm. by a 3½ ton hammer falling 0·5 metre or 42 tons hydraulic pressure, to 73·5 mm. by 3½ tons falling 1 metre or 59 tons pressure, and to 65·5 mm. by 3½ tons falling 1½ metre or 80 tons pressure.

$$\frac{42{,}000}{3{\cdot}500 \times 0{\cdot}5} = 24$$

$$\frac{59{,}000}{3{\cdot}500 \times 1{\cdot}0} = 16{\cdot}9$$

$$\frac{80{,}000}{3{\cdot}500 \times 1{\cdot}5} = 15{\cdot}2$$

Or the pressure required is from 16 to 24 times the momentum of impact in metre kilograms. 20,120 foot-pounds = 9 foot-tons = 2·8 metre tons. 2·8 × 16 = 44·8 tons. 2·8 × 24 = 67·2 tons. According to this the 108 tons you propose would be a liberal equivalent. These seem to be the only directly comparative experiments. See also Tweddell, "Proceedings" Institution of Civil Engineers, vol. cxvii.

H. R. S.—The following is a list of some of the books you ask for:—(1) "The Treatment and Utilisation of Sewage," by W. H. Corfield: published by McMillan and Co. (2) "Sanitary Engineering," by Baldwin Latham: published by E. and F. N. Spon. (3) "The Municipal and Sanitary Engineers' Handbook," by H. P. Boulnois: published by E. and F. N. Spon. (4) "Accounts of the Sewerage of Buenos Ayres, by Parsons; can only be found in the "Proceedings" of the Institution of Civil Engineers. (5) "Practical Building Construction," by J. P. Allen: published by Crosby Lockwood and Son. (6) "Harbours and Docks and Rivers and Canals," by Harcourt: published by the Clarendon Press. (7) "Harbours and Waterways," by W. H. Wheeler: published by E. and F. N. Spon. (8) "Stress Diagrams," by W. H. Bidder: published by Gale and Polden. (9) "The Practical Engineers' Handbook," by Hutton: published by Crosby Lockwood and Son. (10) "Hydraulic Power and Hydraulic Machinery," by Robinson: published by Griffin and Co., London. (11) "Sewerage and Drainage of Towns," by Robinson: published by E. and F. N. Spon. (12) "Sewage Disposal Works," by W. Santo Crimp: published by C. Griffin and Co. (13) "The Steam Engine," by D. K. Clark: published by Crosby Lockwood and Son. (14) "Oil and Gas Engine," by Bryan Donkin: published by Griffin and Co. (15) "The Steam Engine," by Rigg: published by E. and F. N. Spon. (16) "Modern Mechanism, General and Popular," by Park Benjamin: published by McMillan and Co. (17) "Hydraulic Motors and Turbines," by Bodmer: published by Whittaker and Co. (18) "Tramways: their Construction and Working," by D. K. Clark: published by Crosby Lockwood and Son. (19) "Stresses in Girders, Bridges, and Roofs, by B. B. Stoney: published by Longmans and Co.

INQUIRIES.

SCALING LANCASHIRE BOILERS.

SIR,—Can any reader give us any information of any machine for removing the scale from the tubes of a Lancashire boiler at those places to which a man cannot get with a chipping hammer? We understand that there is a machine made for working by air or water which acts as a hammer, chisel, or caulking tool. Probably the same firm might make a tool like that which we require. Or is there anything in the way of a rapidly revolving cutter which would do our work? The places are between the shell and the outside of the furnace tubes from which we wish the scale removed.

H. O. M.

August 17th.

THE ENGINEER.

AUGUST 21, 1896.

THE LOCOMOTIVES ON HIGHWAYS ACT.

IT is with unfeigned satisfaction that we write the above title; we are, at last, able to substitute "Act" for "Bill." We rejoice that the efforts we have made during the past few years to procure the removal of the restrictions on the use of light road locomotives have been successful, and we cannot refrain from congratulating the vast number of engineers, manufacturers, and others throughout the country, who, by signing our memorial to the President of the Local Government Board, strengthened the hands of the Government and contributed so largely to the success with which our efforts have been crowned. The Act differs in some respects from the Bill as originally introduced. It was intended that a locomotive within the purview of the Act should not weigh more than two tons, and should not draw another vehicle. Now it may not exceed a weight of three tons, and may draw one vehicle—the two together not to exceed four tons unladen. Originally it was proposed absolutely to prohibit the emission of smoke or visible vapour; now the words of qualification, "except from any temporary or accidental cause," are added. Such a locomotive is to be subject to the usual carriage duties plus an additional duty, the whole varying from £2 2s. to £4 4s. per annum according to weight. The penalty for breach of the Petroleum Acts, or the regulations to be framed presently, is raised from £2 to £10. These are the principal changes which have been made during the passage of the Bill through Parliament. It only remains now for our designers and builders to turn out vehicles which will at once commend themselves to the public. If they do their best, we are satisfied that they will be abundantly rewarded by the growth of a new and most important industry.

PROPOSED WHARFAGE IN THE LOWER THAMES.

IN our issue of June 12th last we dealt with the aspects of the question in dispute between the London dock companies and the shipping trade. When doing so, we pointed out that, did the former insist upon their unquestioned right to terminate the existing agreement with the latter as to the conditions of berthing and cargo discharge, there was a probability that measures of a retaliatory character would be adopted. For some time past it has been known that these were in contemplation, and we have now learned that, no offers in the direction of compromise having been made by the dock companies, the Peninsular and Oriental Company has concluded its arrangements for the acquirement of land on the Thames bank between the Albert Docks and Tilbury, on the Essex shore.

These arrangements at present affect, we believe, only the company named; but we understand that they form but a part of a general scheme to serve a much wider interest in the shipping trade. We are informed that negotiations have been concluded for the acquirement of some 13,000 lineal feet of river bank at the locality above named. Of these, 8000ft. are on the Essex shore, the remaining 5000ft. facing them on the Kentish side. If we are rightly informed, the requirements of the Peninsular and Oriental Company will extend to a frontage of 5000ft. only, the balance of 8000ft. being available for other steamer lines. The intention is to build wharves throughout the entire length stated, the river bottom being dredged to admit of vessels of large tonnage lying alongside of them. At the time of our writing no particulars as to the full scheme have been made generally public; but the land having been secured, it only needs the co-operation of the shipping trade to secure its realisation. In this the directors of the Peninsular and Oriental Company have taken the lead, and, we presume, have fully committed themselves to the new line of action. It is certain that the Docks Association has for some time been aware that some such measure as that we have described was in contemplation. At the meeting lately held of one of the dock companies, its chairman made reference to this scheme. He, however, appeared to regard the threat it held out as *brutum fulmen* solely, as being designed only with the view of bringing pressure upon them to induce retirement from the position they had taken up with respect to the shipping interest. He regarded the cost of constructing wharves and quays in the river as certain to be quite prohibitory. As to this, the speaker had evidently reckoned without his host. No more capable judge of what can or cannot be afforded could be found, perhaps, than Sir Thomas Sutherland, the chairman and chief managing director of the Peninsular and Oriental Company. That gentleman has, we are informed, gone thoroughly into the question in all its aspects; and, having convinced himself of the entire practicability of the proposal, has been the first to enter upon the breach.

Into the effects of this new departure upon the London docking interest it is unnecessary that we should here enter. We named in our former article what the result of a wholesale withdrawal of the greater shipping lines must be to this. It may be computed with a sufficient degree of accuracy that 13,000ft. of wharf frontage would afford accommodation for an average of twenty-six steamers of from 3000 to 10,000 tons burthen. If two rows could be accommodated, as is often the case at dock wharfage, a maximum of fifty-two vessels of such a class would be provided for. What the withdrawal of such an amount of tonnage would mean to the several Thames docks will be readily realised; and should this take place, the last financial state of the companies owning these must prove to be greatly worse than the first.

We are not yet in a position to give any details as to the character of the work proposed, but we are assured that it is to be of a very permanent description. Experience in several large rivers, and especially in some of those on the Continent, has amply demonstrated the feasibility of such arrangements as those now proposed for the Thames. The width of that river in the reaches of it that it is proposed to occupy, is so great that there will be more than ample space for even four lines of vessels, two on each bank, to find berthage without injurious interference with the customary navigation of the river or its channels. The area that will be occupied is now entirely a muddy foreshore that is exposed at low water. Nothing, therefore, is to be abstracted from the present navigable area of the river. We have understood that for some time past all arrangements have been made for bringing out a company to undertake the construction of the required work, and we presume that now the Peninsular and Oriental Company has taken the initiatory plunge that must separate its future proceedings from all connection with the dock companies, no time will be lost in developing it.

It is asserted that other large steamship lines are only withheld by one consideration from immediately following the lead now given them. "What," they ask, "is to be done during the lengthy interim before these new wharves can be made ready for our ships?" Perhaps, we should think, they dread the vengeance that the dock companies might propose to take while yet retaining power to inflict it. Or perhaps they deem that the single pronounced withdrawal now made may suffice to induce the dock companies to submit to all their demands. Anyway we may be sure that, should it hereafter be proved that the Curtius of the movement has obtained considerable financial benefit by its action, this last will not long remain without its imitators. When we last wrote on the subject of this dispute we referred to the possibility of some of the lines removing their headquarters to Southampton or to other outports. As regards the Peninsular and Oriental Company, however, we learn that the advantages it possesses in the Thames could not be obtained for it elsewhere. It is for this reason, doubtless, that it has been the first to give support to the new proposals, the effect of which, if fully carried out, must prove momentous.

THE SOUTH WALES SLIDING SCALE.

AT a time when the Northern miners have discarded the Sliding Scale arrangement, and while the Conciliation Board appears to have been abandoned in the English part of the coalfield, it is pleasant, and almost encouraging, to read that the Joint-Committee of masters and men in the South Wales district are making preparations to celebrate the twenty-first anniversary of their pact of peace by a dinner after the festive if formal manner. It is a moot point whether South Wales was the first to experiment in an automatic adjustment of colliers' wages according to the selling prices of coal at the ports. Some efforts were made as long ago as 1871 to bring coalowner and collier closer together in what was then a discontented and occasionally turbulent district; but it was not until four years later that a basis of agreement could be settled. The historical fact is that in 1875 a Board of Conciliation was established, which has survived all the changes of the subsequent years; and from this Board proceeded the existing Sliding Scale Agreement adopted in 1879. The agreement was that there should be a periodical examination of the coalowners' books by auditors representing both parties; and that the two auditors were to report on the percentage the fluctuations in selling prices represented to the colliers' wage-rate as measured by a common and accepted standard, which is the frequently quoted, but ill-understood, standard of 1879. The periods of the audit have been more than once altered. The men have naturally asked for a more frequent audit when they thought the market was improving, and it is at their request that the joint auditors now make their reports at two months' intervals, although by the turn of events the market has, until a month or so ago, been declining. These and kindred questions involved disputes which for a while threatened to be critical; but, nevertheless, it stands on record that since 1879 the majority of the South Wales colliers have said and done nothing to challenge or impeach the principle of a Sliding Scale.

For a moment it is worth while recalling the condition of things prevailing before the Board of Conciliation came into existence. Less than a quarter of a century ago the men in the ironworks formed a larger and better organised labour factor than the more numerous body of miners. The ironworkers — puddlers, or rollers, or furnacemen, it scarcely matters—had a dispute with the manager, and forthwith struck. At Dowlais, or Ebbw Vale, or at Plymouth Works, the temporary stoppage of the ironworks—it was before steel manufacture had been so generally resorted to in South Wales—really compelled a cessation of labour at the pits which kept the works supplied with fuel. The miners got into an utterly unsettled and disaffected mood, and followed the example of the ironworkers, and indeed improved upon it from their own point of view. Strikes were frequent in all the coal valleys. There was no Coalowners' Association; there was no semblance, nor, indeed, is there now, of a general Colliers' Union. There was nothing but universal rivalry and jealousy, pit by pit, valley by valley, and alike among masters and men. Did the rumour reach them that higher wages had been granted for working a similar seam in the Rhondda Valley, the Aberdare or Merthyr colliers would threaten to bring up their tools unless they were recompensed at an equal rate. A general strike the coalowners would probably have known how to deal with. The only general strike they had experience of before the institution of the Sliding Scale, they met with a lock-out. The chief source of irritation was, to colliery proprietors, to the colliers, to railway shareholders whose interests were concentered in the continuity of traffic, the all-round grievance was the uncertainty of affairs. A colliery manager might be on excellent terms with the workmen one day; the next he would be told of a successful strike in an adjoining pit, and that his miners must have the same terms before they descended the shaft.

This retrospect will remind many colliery managers, north and west, of some of their early troubles and anxieties. From 1879 most of them would admit that, to use the French phrase, we have changed all that. There have been schisms on proposed amendments of the 1879 agreement; they seemed threatening for a time; possibly they meant nothing; at any rate, they ended in nothing. The only serious labour dislocation we remember of recent years was caused by the hauliers. They struck work, and thus threw the colliers out of work, not so much for higher wages as for the acknowledgment of an equal status. The underground haulier claimed to be as good and as necessary a man as the hewer of coal. The trained collier, who is an underground aristocrat in his way, said the idea was preposterous. The haulier, notwithstanding, proved his power; and his power of mischief is curtailed, if it is not extinguished, by the admission of a member of his order to the delegation which meets the coalowners' representatives on the Joint Committee. It is in this way, by reasonable compromise on both sides, that the South Wales Conciliation Board, with its Sliding Scale arrangement, has pursued its peaceful way to the age of a man's majority. A compromise involves two parties, and it may be as well just now to emphasise the fact that the admirable influence of the Conciliation Board in Glamorganshire and Monmouthshire is attributable to concessions on the one side as much as on the other. We have good reason to have confidence in the South Wales system of avoiding wages disputes and the other questions affecting labour. That may be said in full remembrance of one of the paragraphs in the letter of our South Wales correspondent the other week. There have been meetings held, he informed us, to discuss whether the Sliding Scale ought to be abandoned or amended. He wrote in particular reference to an Aberdare meeting of miners. There has since been one or two conferences of the whole of the representatives of the coalfield at Cardiff. It is noteworthy that not one of the legitimate delegates of the Welsh colliers said a word against the principles of Conciliation Boards or Sliding Scales. What the colliers—shall they be called the reforming colliers?—want is an amendment of the Sliding Scale Agreement, to provide for the appointment of an umpire in cases of differences between the two sections of the Joint Committee, and the establishment of a minimum beneath which wages cannot fall under the scale. They ask also for a conference with the coalowners to discuss the means of preventing underselling and keeping prices above a certain price. These may be dreams; but it illustrates the amicable relations the Sliding Scale has established in the South Wales Coal district, that the coalowners have provisionally agreed to meet the men on some convenient day to discuss the latter and some cognate questions.

PROJECTED WATER SUPPLY FOR PARIS.

It is difficult, upon reflection, to avoid coming to the conclusion that there must exist some cause, some reason, why the numerous projects and schemes recently put prominently forward for the execution of engineering enterprises in France of considerable magnitude should one and all have fallen to the ground. It may just be possible that the disastrous collapse which attended the last great undertaking in Central America is still fresh enough in the minds of our neighbours to act as a powerful deterrent for some time yet against all large works of a somewhat similar character. To whatever cause it may be due, the fact remains, and at present there is another scheme seriously mooted which appears to us to have less chance of ever passing the ideal stage than any of its hitherto abortive predecessors. This latest project contemplates the accomplishment of a task which shall bring the waters of Lake Leman to the gates of Paris. While it may be admitted that there is absolutely no pressing urgency, no driving necessity, for an immediate fresh water supply for the French capital, it is equally certain that, in the opinion of excellent authorities, the outlook for the future—and a somewhat near future too—is by no means of an assuring character. The Seine, the Ourcq, and the Marne have all been drawn upon to supplement the supply afforded by existing sources, and although the water so obtained is of a very impure description, it is better than none at all for other than potable purposes. Another misfortune is that, owing to the small river pressure, good and pure water from the best of sources, which should be used solely for domestic consumption, has to do the duty of flushing and cleansing the sewers and drains in certain quarters of Paris, for which a very inferior fluid would suffice. If, as already stated, the limited resources of the Seine basin are "played out," or so nearly so as to necessitate, at no very distant date, an urgent demand for a further supply, the situation becomes grave and imperative as well.

In the present exceedingly incipient stage of the proceedings it may be conceded that the data, or at least some of them, indispensable to the practical realisation of a scheme of this nature, are sound and valid. It may perhaps be taken for granted that the Lake of Geneva, which is fed by the Rhône, by some smaller confluents, and by liberal contributions from glacial waters, has a sufficient, and probably always will have a sufficient, quantity, even to comply with the fairly exorbitant demands proposed to be made upon it. We are disposed also to allow the purity of the water to be up to the usual standard, as the people of Geneva have used it from a very early age. At the same time the fact must not be lost sight of that the habitual drinking of glacial and snow-melted water seriously affects the health of individuals. To the consumption of it is attributed, rightly or wrongly, that peculiarly disagreeable and unsightly complaint termed goitre. There is also a distinct class of idiots, "crétins," which are met with in the Alpine valleys, who are generally afflicted with goitre. It is the large admixture of river water, and of water from other sources, which has no doubt contributed to the purity of the contents of Lake Leman, a condition which by the additional purifying influence of air and light during the long journey of three hundred and fifty miles from the Alpine frontier to Paris, will ensure, *à fortiori*, the purity of the supply at the walls of the metropolis. Fortunately, in order to obtain the water, it is not necessary for France to go outside her own territory either for the "take off" from the lake or for the placing of the canal, aqueduct, pipes, or other constructive details of the undertaking. Both France and Switzerland have joint interests in the waters of Lake Leman. Both are riverain proprietors, and have each a claim to a fair share of the contents of the lake, the proportion, nevertheless, being largely in favour of Switzerland. While, therefore, France could, if she chose, prosecute the proposed scheme without in any way consulting the interests or views of her trans-Alpine neighbour, it is extremely unlikely that such a course would be adopted. As it is, the Swiss have already established a powerful hydraulic installation in connection with the supply, and the probability is that in the event of the enterprise assuming a more tangible form, mutually satisfactory arrangements would be arrived at between the two nations, and the *entente cordiale* maintained. If it be taken for granted that there are no engineering difficulties to be encountered in carrying out the project, then so far there would appear to be nothing unreasonable nor impossible in the scheme.

But there remain a few more points and details to be considered which will be found to throw a strong chimerical halo over the undertaking. In the first place, the cost is put at the sum of £22,000,000, to which it would be prudent to add twenty-five or thirty per cent., as the estimated original expenditure required for vast engineering works, especially those of a hydraulic character, is invariably below, and frequently very much below, the actual amount spent on their execution. But apart from the question of cost, there is another standpoint from which this projected enterprise must be regarded, and one which, as our readers are aware, was fatal to a great international undertaking between France and Great Britain. Strategical reasons in a great measure, if not altogether, forbade the one, and as the same reasons obtain with even greater force with respect to the Parisian water supply, they will no doubt put a veto upon its practical realisation. It is true that the whole work from one end to the other is in French territory, but it would be impossible to safeguard, in the event of a hostile invasion, a water supply over three hundred miles in length. It would inevitably be cut in more places than one, and to expose the inhabitants of the capital, as well as possibly of other important towns—Lyons, for instance—to such a terrible calamity as the failure of their water supply is a proposition which is self-condemnatory.

FAST TRAIN RUNNING IN FRANCE.

It appears from the statement of one of themselves that Swiss engineers, whose train services are regulated on more modest and, perhaps, on more prudent rates of speed than our own, adroitly and politely turn the conversation when their foreign *confrères* speak of "seventy-five miles an hour" as by no means an extraordinary velocity. Possibly with the view of testing the validity of the assertion, a writer in the *Schweizerische Bauzeitung* gives a description of some journeys personally undertaken in French express trains, from which we extract some interesting information and particulars. The first journey was made from Paris to Amiens, a distance of eighty-two miles, in a train drawn by one of the forty compound locomotives built at Belfort from the design of M. de Glehn. There is no necessity for describing these engines to our readers, but it may be mentioned that the Western, Midland, and Paris-Lyons-Mediterranean Companies have adopted them as the type of an express locomotive. Leaving behind the stations of Louvres and Chantilly at a speed of 56·25 miles per hour, Creil was next passed. It is at Creil that the Calais line branches off from that of Brussels and Cologne. It is over the latter track that the journey from Paris to St. Quentin is accomplished by the ordinary express trains in two hours, at the rate of 47·62 miles per hour. Between Creil and Amiens a speed of 65·62 miles was several times reached. The whole route from Paris to Amiens was achieved at the rate of fifty miles the hour, the maximum gradient being $6^{0}/_{00}$, and the sharpest curve having a radius of 2310ft. At Amiens the locomotive was changed, and the *voyageur* pays the English engineers a compliment in describing it as a superb engine, perfectly new, with 7ft. driving wheels, and one of the handsomest of its kind, having been built in accordance with the best English type and style. Between Boulogne and Calais the physical features of the route resemble in form a donkey's back, and the gradients of $8^{0}/_{00}$ reduced the speed to 37·5 and thirty-five miles per hour. The time lost by the ascent was made up by the descent upon a similar gradient, from Guinnes to Calais, when the high speed of eighty miles per hour was attained without any sign of danger. It is stated that upon this part of the line, over which trains are said to run daily at seventy-five miles an hour and more, the permanent way consists of rails 66 lb. per yard, 27ft. in length, and supported each by ten cross sleepers. The Northern Company of France lays down no generally fixed rate of velocity, but indicates by signals the maximum speed allowed along certain parts of the track. In Switzerland the Railway Department limits the greatest speed of trains to forty-seven miles per hour, but for some inscrutable reason permits engines—presumably running single—to attain 56·25 miles. There is no reason why on such a favourable and well-laid line as that between Lausanne and Bienne, a speed of fifty miles should not be attained. A still higher speed of sixty miles per hour might be attained on the Lausanne-Geneva line with perfect safety. On the return journey from Calais to Paris, only one stop was made for a brief five minutes at Amiens. Between Abbeville and this latter station a speed of 62·35 miles was reached, and intermediate stations, prudently or imprudently, were run through at fifty-six miles per hour. A fresh engine was attached at Amiens, so we may now sum up the result of the journey. The total distance from Calais to Paris, 186·25 miles, was run in 3 hours 46 min., which gives an average speed mileage of 49·47 miles, which, if the stoppage time at Amiens be deducted, will be increased to fifty-one for the real mean velocity. Two other trips were made with express trains on the Eastern Railway of France, which compare exceedingly well with the record achieved by the Northern Company. The journey from Paris to Reims, 97·5 miles in length, was accomplished in two hours, with an average speed mileage of 48·75. The maximum velocity attained was 62·5 miles, the weight of the train being 150 tons. All these averages are very good running, and compare favourably with our own efforts in the same line, but our neighbours are still somewhat behind us in the matter of total distances without any stoppages.

ADMIRALTY INSPECTION.

There appears to be a desire on the part of the Admiralty to do something towards reducing one source of friction between contractors and dockyard officials. A gentleman holding the rank of constructor at one of the dockyards has been appointed to act as head of all overseers who are inspecting constructive work, as distinct from engines, for Admiralty vessels building at private yards. This constructor will, of course, be considerably more in touch with dockyard officials than the resident overseers, and this alone will tend to save friction, but it is not, in our opinion, all that might be done. The present evil arises chiefly through junior officials being sent out as overseers to private yards. These officials should, from an official point of view, merely act as an intermediary for the Admiralty as far as forwarding details to headquarters for approval is concerned, their work being to see that approved details are actually carried out; but this does not always quite agree with overseers' ideas, and they will not sometimes submit tracings which they may or may not be right in assuming will not meet approval. If the builder takes upon himself to attend at the Admiralty—practically his only resource if he thinks the overseer is wrong—he will hardly, to say the least, work more smoothly with the overseer afterwards; and, generally speaking, he prefers to allow the overseer to be in the right. To take an instance, we have it upon the authority of the firm themselves that a certain detail was altered to suit the overseer's own ideas before being forwarded to the Admiralty, and was modified at headquarters to the original form in which it was submitted to the overseer. Numberless instances of this kind have no doubt occurred. Again, it has very often happened that certain things have been altered by the overseer's directions, and when the ship has been delivered at the dockyard, the builders have been called upon to alter the work back to the original form. Similar remarks apply to auxiliary machinery which may be passed by the overseer attending at the maker's works, but this inspection in itself is no guarantee that the work will be passed at the dockyard. Keeping these points in view, it would be worthy of consideration by the Admiralty, whether one or more officials ranking with the chief constructors of the principal dockyards should not be appointed as chief overseers for contract work, and a similar line adopted by the engineering branch. Any doubtful point could then be referred to one of these officials without it being looked upon as passing over the resident overseer, and where a detail or modification was approved by the chief overseer it should not be open to refusal at the dockyard, except under very unusual circumstances.

AMERICAN RAILWAYS.

ONLY now, in a complete form, have the official statistics of the various United States railways for the year ending June 30th, 1895, become available, and late in the day as they are, the view they afford of the working of American railways is instructive, especially seeing that the experience of the lines from that date up to the present time has not been such as materially to alter the general position. Translating the American into English money, the total amount of railway capital on the date named is returned by the Interstate Commerce Commission as somewhat over £2,197,000,000, some eleven thousand million dollars, or £12,666 per mile for the 180,657 miles then open. The aggregate capital was an increase on the previous year of not far off £38,000,000, and the increase in the length was 1948 miles, or a little over 1 per cent. The passenger revenue showed a decline of 11½ per cent. for the year; but the goods revenue, which amounted to nearly £146,000,000, increased by 4½ per cent. The gross earnings for that year were £215,000,000, or only about £400,000 more than in the year previous; and the expenses are somewhat over £145,000,000 It is true that the expenses were more than £1,000,000 less than in the previous year; but, taking a five years' period, expenses are evidently on the upward grade on American railways, for the "percentage of operating expenses to operating income" for 1895 is returned as 67·48, as compared with the lesser figure of 65·80 for 1890. Moreover, of the total outstanding railway stock at the close of June, 1895, more than 70 per cent. paid no dividends, and of the funded debt nearly 17 per cent. paid no interest. We hardly think British railway engineers, or shareholders, would be satisfied with such a result on this side the Atlantic.

LITERATURE.

Petroleum and its Products. By BOVERTON REDWOOD, assisted by G. T. HOLLOWAY and other Contributors. Royal 8vo, Two Volumes, together 900 pages. With numerous Illustrations. London: Charles Griffin and Co. 1896.

IN these volumes, which represent the accumulated experience of twenty-five years' consulting practice in connection with the petroleum industry, the author has brought together an immense mass of information concerning mineral oil and its uses, which from its comprehensive character and systematic arrangement cannot fail to be of permanent value as an authority upon this important branch of mineral industry. The work is divided into eleven sections, each as far as may be complete in itself; an arrangement which, although it may cause some repetition of matter, is decidedly convenient for reference. In the first section the historical development of the petroleum industry is noticed under the heads of the different countries, with an exhaustive list of the authorities from Herodotus and Jonas Hanway down to Colonel Drake and the Standard Oil Company, which may be said to be pretty much the beginning and ending of the subject.

Section II., which is one of the longest, and in many respects one of the most important, deals with the geological and geographical distribution of petroleum and natural gas, the structural characters of the different regions being described in geographical order, from observations partly by the author and, to a greater extent, by numerous other authorities in all parts of the world, whose assistance is acknowledged in the preface in a manner which is highly commendable, their names and the nature of their contributions being set out at length. Much assistance was rendered in this section by the late Mr. William Topley, F.R.S., who unfortunately died very suddenly shortly before the completion of the work.

Section III., on the chemical and physical properties of petroleum and natural gas, contains a large amount of original information on the density and other properties of mineral oils, &c., which form a valuable addition to the knowledge previously available. The same may be said of the other sections specially representing the author's work, such as testing and its uses, and the conveyance of petroleum in bulk in tank steamers, and the precautions to be taken to avoid accidents from the presence of explosive vapours in the tanks, when the oil has been removed. These latter subjects, it will be remembered, were treated in a valuable paper by the author in the "Proceedings" of the Institution of Civil Engineers, about two years since, the substance of which is reproduced, with additions, in Section VIII., on transport, storage, and distribution.

The theoretical aspects of the subject are but briefly touched in Section IV., the views of different authors as to the inorganic and organic origin of petroleum being presented without any particular support being given to either. In connection with this we notice that on page 230 the production of petroleum-like hydrocarbons from spiegeleisen, by the action of acids, is attributed to Cloez in 1877, but no mention is made of the much earlier investigation of the same subject by Dr. Percy and Mr. C. Tookey, described in Dr. Percy's "Iron and Steel" in 1864.

The operations of drilling oil wells, pumping, and other operations in connection with crude oil production, is treated in Section V., typical examples being given from he United States, Canada, Galicia, Russia, and elsewhere, the illustrations being mostly from American sources. The section on refining is also general in character, the leading principles of the operations being first noticed in outline before proceeding to describe the special points characteristic of different districts. As necessary subjects of importance, although not perhaps strictly coming within the title, accounts are given of shale oil distilling, as practised in Scotland and near Autun in France, and oil gas manufactures, which add to the complete character of the work. A few pages are given in Section X. to the consideration of petroleum motors, but these are mainly valuable as references to more complete accounts elsewhere. This, however, cannot be said of Section XI. on the statutory, municipal, and other regulations relating to the testing, storage, transport, and use of petroleum, which covers nearly a hundred pages, giving the regulations adopted by national and local authorities for the handling and use of this much protected or persecuted substance in all parts of the world, which are remarkable for their variety, or as the author puts it, their regrettable absence of uniformity. With the over stringent character of many of these regulations the author is decidedly out of sympathy, as will be seen from the following extract:—"Moreover, when petroleum was first introduced it was often carelessly and improperly handled, and the accidents which occurred led to an exaggerated estimate being formed of the risk involved in the use of oil as an illuminant, with the result that legislative restrictions of a needlessly stringent description have been placed upon the trade." A conclusion for which there is much to be said.

The compilation of this section and of the elaborate statistical appendixes following it represent an amount of work which must have required more than ordinary resolution on the part of the author and his coadjutor to accomplish, but they are certainly to be congratulated on the result of their labours, which will probably take the leading place as an authority for a long time to come. It is unfortunate that the illustrations have not been better cared for, as, although they are many in number, a very large proportion are executed in a manner that is quite unworthy of the text.

Metallic Structures: Corrosion, Fouling, and their Prevention. By JOHN NEWMAN. 8vo. pp. 374. London: E. F. and N. Spon. 1896.

IN this volume the author, whose attention has been specially directed during many years to the subjects of corrosion, fouling, and their prevention, has placed on record his experience and that of others in all parts of the world, with the intention of supplying concise practical information on a matter of much importance to all who have to do with the design, construction, or maintenance of metallic structures, whether floating or fixed. The information so conveyed contains some useful practical hints, such as recommending the removal of scale from ironwork, and drying it before painting; the use of a small number of coats of paint of good quality in preference to a more abundant allowance of an inferior quality, even although the latter may be cheaper; the danger of bringing unprotected woodwork into surface contact with iron, and similar points of advice which are essentially sound and practical, if not very novel; but the manner of their presentation can scarcely be called concise, the practical parts being overlaid by bulky incrustations of popular science of the guide-to-knowledge order, poetical quotations from Milton and Darwin, doggrel verses of the author's own production, and other odds and ends, put together in a manner worthy of Mrs. Nickleby, Mr. Snagsby, Albert Smith's engineer, and similar traditional masters of inconsequential narrative. The chemistry is especially funny; for instance, the use of white lead upon iron is considered questionable—"for, being a carbonate of lead, it is a compound of carbonic acid, &c., and carbonic acid is an active corrosive agent;" and, as far as we can see, rust and ferric-oxide are everywhere considered as synonymous, which they certainly are not.

The second part, on the prevention of fouling in ships, contains a chapter on "Anti-fouling Paints, Compositions, and Fluids," from which we gather that many compositions have been more or less successfully introduced with the object of protecting the fouling of ships' bottoms and other submerged structures. Detailed descriptions are given of the appearance of ships' bottoms when docked for re-coating, with notes on the condition of the plates, which varied from very good indeed to very rusty. Nothing, however, is stated as to the nature of the preservative agents used in the different cases, the author's object apparently being to indicate that there are differences among the compositions in use rather than to specify which is the best among them.

In fact, he considers it improbable that a new and efficient anti-fouling and anti-corrosive ship paint will be introduced, unless those possessing considerable knowledge of zoochemy and zoology, and the analytical chemist, the botanist, the mineralogist, and the engineer act more or less in unison. Pending the result of the united action of these different talents, the consumer cannot go far wrong if he consults some of the well-known manufacturers of these compounds, most of whom are represented in the advertising pages at the beginning and end of the volume.

The Spectator Mathematical Tables. Actuarial. Royal 8vo. cards in portfolio. Compiled by J. W. GORDON. London: Crosby Lockwood and Son, and W. J. West. 1896.

THESE tables, which are due to the initiative of the *Insurance Spectator* of London, include some novel and interesting features, which appear to be well calculated to abridge the labours of the calculator when a long series of computations has to be gone through. They include a complete set of four-place logarithms, cologarithms, antilogarithms, and reciprocals, the whole of these functions being collected in one table, so that whichever one may be sought for a given number the entry is always made in the same place. The different functions are rendered easily distinguishable by the use of four distinct kinds of type, an innovation which certainly is pleasant in use. The cologarithm table, which now appears for the first time, though perhaps a superfluity, may in many cases prove convenient. The table of reciprocals is also calculated upon a new plan, so as to give additive instead of subtractive proportional parts. The precautions necessary to be taken in consequence of these changes are very clearly presented, together with several other useful hints, in the accompanying pamphlet by Mr. Gordon.

The principal tables are printed on the front of a series of cards, which are united together by tapes at the edges, in the fashion of an Oriental manuscript, the backs being devoted to supplementary tables, which in this instance are actuarial in character; but other series containing physical, engineering, or astronomical constants are in preparation. We hope that the present venture may be sufficiently satisfactory to the publishers to ensure the speedy appearance of the companion series.

SHORT NOTICES.

The Mining Manual for 1896. By Walter R. Skinner. Containing full particulars of mining companies, together with a list of directors of mining companies. Separate sections are devoted to Australasian mining companies and South African mining companies. Eighth year of publication. London: 26, Nicholas-lane, Lombard-street. Price 15s.—This well-known and useful manual, which now appears for the eighth time, bears abundant witness to the important position that mining companies have taken in the commercial and financial world. The extraordinary creation of companies more or less directly and intimately connected with mining industry having necessitated an increase to nearly 600 pages in the size of the volume, which now contains notices of 2712 companies, no less than 1565 of them being new concerns. The results of these enterprises may, on the whole, be considered satisfactory, as from the excellent statistical abstract in the introduction, we gather that the world's production of gold has in the past four years increased by nearly 50 per cent., or from 7,000,000 ounces in 1892 to 10,219,158 ounces in 1895, about two-thirds of the total being contributed in nearly equal proportion by Australia, South Africa, and the United States.

Photography Annual: A compendium of Photographic Information, with a Record of Progress in Photography for the past year. Edited by Henry Sturmey. London: Iliffe and Son. 1896. Price 2s. 6d. —Notwithstanding every effort to economise space by improved arrangement, the annual grows apace. The present issue is a very full store of information. All we can say here is that a photographer, amateur or professional, who will not find therein much to interest him, must be very hard indeed to please.

BOOKS RECEIVED.

The People's Palace, East London, Technical College Calendar. Session 1896-7. London: George Reynolds. 1896. Price 1d.

Journal of the Association of Engineering Societies. Vol. xvi., June. 1896. No. 6, Philadelphia, U.S.A.: John C. Trautwine, jun. Secretary. Price 30 cents per number.

Forty-third Report of the Department of Science and Art of the Committee of Council on Education, with Appendices. London: Eyre and Spottiswoode. 1896. Price 1s. 10d.

Fifteenth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1893-94. By J. W. Powell, Director. Washington: Government Printing Office. 1895.

The Institution of Junior Engineers. Record of "Transactions," vol. v. Fourteenth session, 1894-95. Edited by W. T. Dunn, secretary. London: Published at the Institution, 47, Fentiman-road, S.W.

Journal of the Chemical Society, containing Papers read before the Society, and Abstracts of Chemical Papers published in other Journals. Vols. lxix. and lxx., No. cccv. August, 1896. London: Gurney and Jackson.

The Durham College of Science, Newcastle-upon-Tyne. Calendar, Session 1896-97. *Also Prospectus of Day Classes, and of the Evening Department, and of the Special Saturday Classes. Session* 1896-97. London and Newcastle-on-Tyne: Andrew Reid and Co., Ld.

The Jubilee of the Chemical Society of London. Record of the Proceedings, together with an account of the History and Development of the Society, 1841-1891; *also No.* 168 *of the Proceedings of the Chemical Society, Session* 1895-96. London: The Chemical Society. 1896.

Administration Report on the Railways in India for 1895-96. By Colonel T. Gracey, R.E., Director-General of Railways. Part I. Submitted to the Government of India on the 10th June, 1896. Simla: Printed at the Government Central Printing Office, 1896.

The Vestry of the Parish of Hammersmith Tenth Annual Report to 25th March, 1896, *together with the Annual Reports of the Surveyor, Medical Officer of Health, Public Analyst, and Public Library Commissioners, Abstract of Accounts of Vestry, &c.* Printed by order of the Vestry. Hammersmith, London: Printed by Andrew Churchman. 1896.

RAILWAY EXTENSION IN PARIS.

AN important extension to the Paris-Orleans Railway is projected with the object of bringing its terminus to within a few paces of the Place de la Concorde. The plans and memorandum prepared by the railway company have already been submitted to, and approved by, the Public Works Ministry, and the Ministry of Finance has also gathered together all such matters as particularly affect it. The reports of the two administrations are to be at once submitted to a Council of Ministers, and the Government will then open an inquiry as to its public utility before granting the decree which alone is necessary preparatory to commencing the undertaking.

The site of the new terminus is to be on that of the Cour de Comptes, a ruin since the Commune, distant 2·2 miles from the present station in the south-eastern limits of the city. Passing under the block of buildings of the administration, forming the *façade* of the old terminus, the line will be laid in an open cutting along the low quays of St. Bernard, in front of the wine market, and, following the river, continue in tunnel behind the high quays to the Quai d'Orsay. This prolongation will be symmetrical with that now approaching completion on the western quays, and connecting the Champ de Mars station with the Esplanade des Invalides at a short distance from the proposed new station which will be erected at the side of the Quai d'Orsay, and facing the Rue de Bellechase; but as the area of the Cour de Comptes is of itself insufficient, the barracks on the same quay, which no longer answer the requirements of the troop nor the laws of hygiene, will be acquired from the War-office. The gradients, very apparent, will not, however, exceed 1 in 167, except in the rise at the junction, where they will amount to 1 in 67. The cost of road construction is estimated at £880,000, to which must be added the sum required for the buildings—in all about 18 millions—which would be advanced to the Orleans Company under the State subvention and guarantee of interest. In the technical department it is stated that no difficulty will result, either as regards the vehicular traffic or the accomplishment of the work, which may be terminated in time for the 1900 Exhibition. It may be mentioned here that it was the Paris-Orleans line which, by the prolongation from the old circular terminus in the south of Paris to the Luxembourg Palace, showed the feasibility of underground railways within the city, and that, too, against the strenuous opposition of interested persons. The plans are arranged by the company in no wise to clash with the interests or the execution of the Metropolitan Railway voted for by the Municipal Council.

LI HUNG CHANG AT THE HYDE PARK LOCOMOTIVE WORKS, GLASGOW

LI HUNG CHANG AMONG THE LOCOMOTIVES.

His Excellency Li Hung Chang, the minister who has done so much to encourage China to recognise the importance of railways and locomotives, visited the Hyde Park Locomotive Works of Messrs. Neilson and Co., Glasgow, on Tuesday last, accompanied by his suite and the Lord Provost of Glasgow. He travelled in a special train, which drew up in Hyde Park Locomotive Works alongside a temporary platform which had been erected for the occasion. He was received and guided by Mr. Hugh Reid, the senior partner of Messrs. Neilson and Co. The party was first conducted to the hydraulic flanging press, where the operation of flanging a fire-box throat-plate was performed for his edification. The visitors were then taken through the boiler-shop, where his Excellency seemed much interested in the operation of punching heavy frame plates, and in the hydraulic riveting. The interest was maintained when going through the smithy and forge, and many questions were asked through the interpreter, Mr. Tseng, regarding the details of what was presented. At the moment the large steam hammer was engaged forging a piston-rod—a duplicate of its own. Crossing to the machine shop the party was escorted through the various departments, and Li Hung Chang's interest was apparently maintained throughout, judging by the continuous run of questions which he addressed to Mr. Reid. Owing to the limited time at disposal, the visit had to be hurried through by the officials, although his Excellency seemed to be in no hurry to close his inspection. After a look at the electrical drills in the erecting shop the party was shown an engine in course of being tested under steam, and this led to very pertinent questions from his Excellency as to the comparative merits and lifetimes of the British, American, and German engines, and the comparative immunity of the first named from accident.

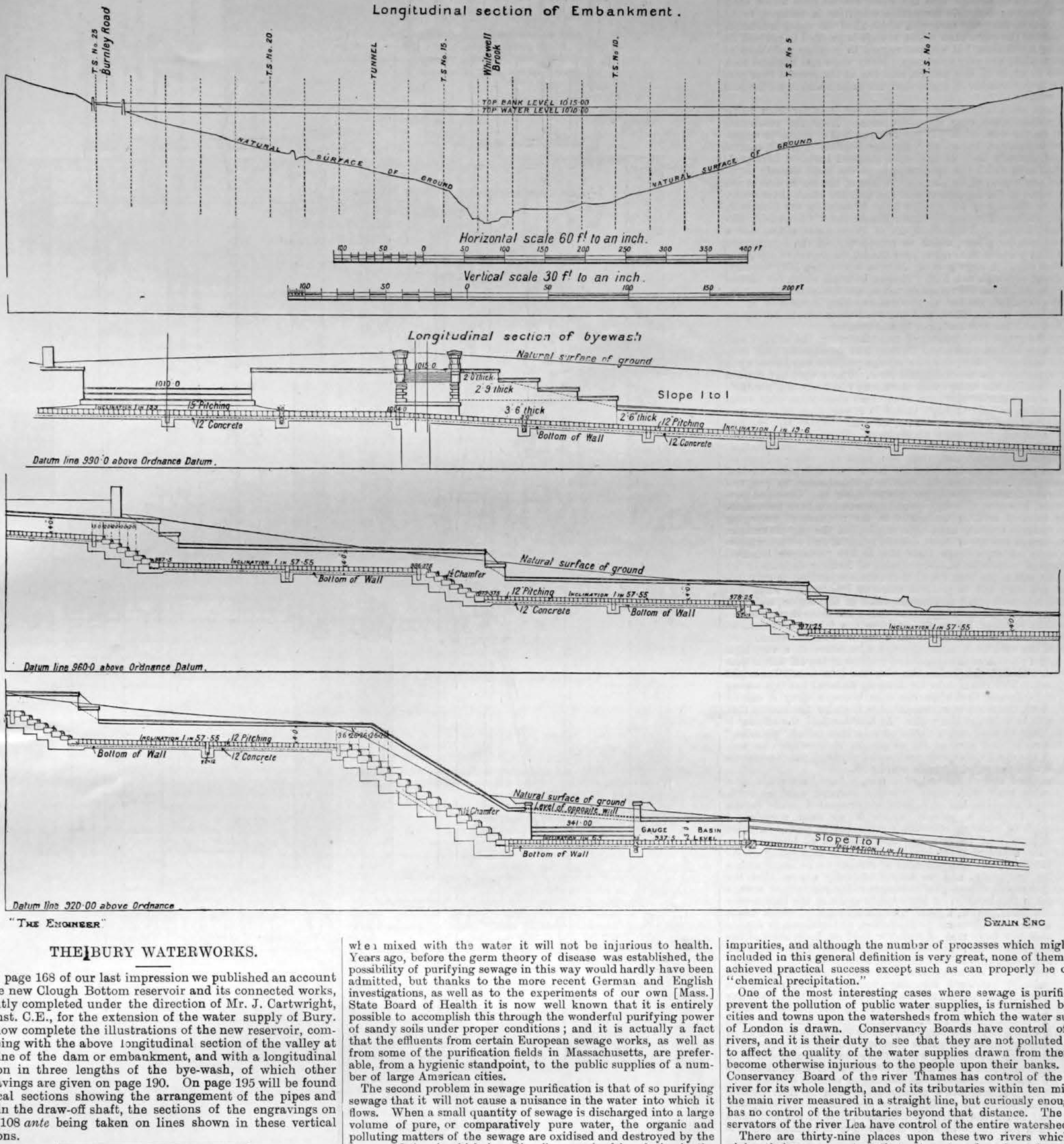
A visit was then paid to the paint shop, where a six wheels coupled goods engine and tender to the order of the Midland and Great Northern Joint Railway Company was receiving its last coat of varnish. Whilst in this department his Excellency wrote in the visitors' book in what was said to be excellent caligraphy, some lines of which the following is a translation:—"The principal Ambassador from China expresses his great pleasure at what he has seen to-day when visiting the Hyde Park Locomotive Works."

After further conversation with Mr. Reid, his Excellency was placed in his chair in front of a Midland and Great Northern engine, and, surrounded by his suite and the rest of the party, was photographed, and the above engraving is a reproduction of the picture then taken, Mr. Reid taking a prominent place, as will be seen, and his two brothers are one on the left-hand and the other near Li Hung Chang, who will be recognised in the centre of the group, who have as background a magnificent locomotive. The short time allotted to Hyde Park Works having elapsed, the party once more took their places in the train and departed amidst the cheers of the workmen and others.

A New Process for the Extraction of Gold—in which the use of water is obviated—has recently made its appearance. The principle of the process is to wash the crushed ore with quicksilver, forced through the body of crushed ore by a strong air current. The mercury picks up both coarse and fine gold, letting practically none escape. The cost of operating is said to be very small, as the quicksilver can be used over and over again. Moreover, the accessories are so portable that they can be placed on the back of a camel.

BURY WATER WORKS—EMBANKMENT AND BYE-WASH SECTIONS

MR. J. CARTWRIGHT M. INST. C.E., BURY, ENGINEER



"The Engineer" Swain Eng

THE BURY WATERWORKS.

On page 168 of our last impression we published an account of the new Clough Bottom reservoir and its connected works, recently completed under the direction of Mr. J. Cartwright, M. Inst. C.E., for the extension of the water supply of Bury. We now complete the illustrations of the new reservoir, commencing with the above longitudinal section of the valley at the line of the dam or embankment, and with a longitudinal section in three lengths of the bye-wash, of which other engravings are given on page 190. On page 195 will be found vertical sections showing the arrangement of the pipes and gear in the draw-off shaft, the sections of the engravings on page 108 *ante* being taken on lines shown in these vertical sections.

THE PRESENT EUROPEAN PRACTICE IN REGARD TO SEWAGE DISPOSAL.*

By Allen Hazen.

The countries of Western and Central Europe have a denser population than is the case with the greater part of the United States, and although their cities are growing, in many cases, almost as rapidly as ours, there have been for many years in Europe centres of population which compelled attention to various sanitary questions long before corresponding issues were raised in the United States, and processes of sewage purification have been in common use in Europe, particularly in England, for the last quarter of a century, which are just beginning to be seriously considered and adopted in the United States.

It is, of course, true that a certain amount of work, particularly experimental work, has been done in the United States which is of as high a grade as that which has been done anywhere, and some of the information which has been secured in America in regard to sewage purification processes, and the disposal of sewage by dilution in streams and lakes, is of great value to us, and could not be replaced by any amount of European experience obtained under other conditions of climate and geology; but, on the other hand, the continued experience of European cities for a long series of years with many of the problems which are now seriously confronting American cities has resulted in the accumulation of a fund of information which deserves to be most carefully studied by all who would be proficient in the art and science of sewage disposal.

There are in reality two sewage disposal problems, which are radically different from each other in their natures, and which present themselves in different cases. The first of these is the case of the discharge of sewage into bodies of water, either lakes or rivers, from which water is taken for domestic supply from points which may be reached by the discharged sewage. The problem presented in this case is to so completely purify the sewage, that when mixed with the water it will not be injurious to health. Years ago, before the germ theory of disease was established, the possibility of purifying sewage in this way would hardly have been admitted, but thanks to the more recent German and English investigations, as well as to the experiments of our own [Mass.] State Board of Health it is now well known that it is entirely possible to accomplish this through the wonderful purifying power of sandy soils under proper conditions; and it is actually a fact that the effluents from certain European sewage works, as well as from some of the purification fields in Massachusetts, are preferable, from a hygienic standpoint, to the public supplies of a number of large American cities.

The second problem in sewage purification is that of so purifying sewage that it will not cause a nuisance in the water into which it flows. When a small quantity of sewage is discharged into a large volume of pure, or comparatively pure water, the organic and polluting matters of the sewage are oxidised and destroyed by the oxygen of the air which is ordinarily contained in solution in the water into which the sewage is discharged. In case, however, the quantity of sewage becomes greater than can be oxidised at once by this oxygen, the last part of the decomposition of the organic matters takes place in the absence of air, and with the formation of products which are given off into the air causing objectionable odours, and the whole body of the liquid becomes foul. The condition becomes still worse when the water is still, or has so low a velocity that it allows the heavier matters from the sewage to be deposited upon the bottom, where they accumulate as masses of mud, which decompose with the most objectionable results. This condition of affairs may often result, even though the quantity of sewage is not great enough to render the whole body of the water offensive, and is thus likely to occur in sluggish streams which would otherwise remove the sewage without nuisance.

It is undoubtedly a fact that sewage has been purified much more frequently to prevent the production of a nuisance of this kind than to protect the purity of drinking water supplies, perhaps because a black dirty stream, giving off sulphuretted hydrogen gas, is more obviously a nuisance than is a polluted water supply, the relation of which to the health of the community is too often but imperfectly realised even by those having such matters in direct charge, and much less by the mass of voters and tax-payers whose support must be obtained before any expensive improvements are possible.

The processes which are used for purifying sewage may be divided into two general classes: Land treatment and chemical processes, although a combination of both of them is frequently used. The principles involved in purifying sewage by applying it to land are essentially the same whether it is applied to soils and loams at a very low rate, and with a growth of crops under the name of "broad irrigation," or whether it is applied to specially prepared areas of favourable materials at much higher rates under the name of "intermitting filtration;" and even the filtration at very high rates with forced ventilation, which has recently been proposed, but has not as yet been carried out on a large scale, involves exactly the same principles. The other class of processes are those which by chemical and mechanical means attempt to remove from the sewage in concentrate form a portion of its impurities, and although the number of processes which might be included in this general definition is very great, none of them have achieved practical success except such as can properly be called "chemical precipitation."

One of the most interesting cases where sewage is purified to prevent the pollution of public water supplies, is furnished by the cities and towns upon the watersheds from which the water supply of London is drawn. Conservancy Boards have control of the rivers, and it is their duty to see that they are not polluted so as to affect the quality of the water supplies drawn from them, or become otherwise injurious to the people upon their banks. The Conservancy Board of the river Thames has control of the main river for its whole length, and of its tributaries within ten miles of the main river measured in a straight line, but curiously enough, it has no control of the tributaries beyond that distance. The Conservators of the river Lea have control of the entire watershed.

There are thirty-nine places upon these two rivers which are giving their sewage systematic treatment, and, so far as known, no crude sewage is ordinarily discharged into the rivers at any point. Of these thirty-nine places, thirty-eight treat their sewage by applying it to land, while, one of the smaller places, Hertford, uses chemical precipitation. The Conservators do not regard the chemical precipitation as satisfactory, and have recently conducted an expensive lawsuit against the local authorities to compel them to further treat their effluent; but this suit was lost, as the court held that no actual injury to health had been shown. It is worth noticing, however, that the water into which the effluent is discharged is all carefully filtered before it is delivered to consumers.

The Conservators require, where land treatment is used, that sufficient area shall be provided to allow all of the sewage to percolate through it in ordinary weather, and they strongly object to allowing any sewage to flow over the surface of the land into the streams. The land used for this purpose, however, is, as a rule, much less porous than the land commonly used for sewage treatment on Continental Europe and in this country; and at times of heavy storms there is often as much water from the rain alone as the land can take without becoming unduly flooded, and it is then incapable of receiving even the ordinary quantity of sewage, and much less the storm flow, as the sewers are generally, if not always, on the combined system. At such times the sewage either flows over the surface of the land with the very inadequate purification due to the retention of solid matter in the grass and osiers, or perhaps more frequently it is discharged directly into the rivers without even a pretence of treatment. The conservators apparently regard this as an unavoidable evil and do not vigorously oppose it, as it is their theory that at these times the increased dilution with the high water in the rivers is such that there is no great danger from the sewage, although it would seem that the increased velocity and consequent reduction in time for the matters to reach the waterworks intakes would, in a large measure, counterbalance the increased dilution.

The water companies are expected to have so much storage capacity for unfiltered water that they will not be obliged to take in water at times of flood; but, as a matter of fact, it is believed that they often do take in water at these times although no records are kept either of the times when water is taken in, or of the times

* Read before the Boston Society of Civil Engineers, October 16, 1895.

when the sewage is discharged without treatment. This is one of the cases which one so often finds in England and elsewhere, where it is regarded safer to have no information than to keep records. It should be said, however, that no evidence has been found that the health of the inhabitants of London is in any way affected by this discharge of sewage into the water courses from which their water is drawn; but this favourable condition is believed to be largely due to the great care with which all of the water is filtered. The cases of the other class where sewage is purified to prevent its becoming a nuisance, but without regard to possible pollutions of water supplies, are very numerous. Many years ago England took the lead in works of this nature, and has at the present time probably a larger number of works than are to be found in all the rest of the world.

England has a very dense population, but it is far from being equally distributed over its entire area. Near the south-east corner, on the tidal estuary of the Thames, is that enormous aggregate of population known as "Greater London"; and in central England, directly back of England's greatest harbour, Liverpool, is a small area which has become perhaps the most densely populated of any region of its size on the face of the earth, due to the harbour and to the deposits of coal and iron ore which there occur. Within a distance of forty miles from Manchester are Liverpool, Salford, Bolton, Preston, Oldham, Blackburn, Huddersfield, Birkenhead, Leeds, and Sheffield, all of them great cities, and a hundred smaller places, which so completely fill the intervening spaces that parts of the region have almost the aspect of one great extended city. A large part of the area is a broken hilly country, with steep, although not high hillsides, between which are narrow valleys, in which are the railroads, mines, and factories. The rivers, as they are called, are but short streams rising in the hills immediately back of the cities, and many of them would hardly be dignified with the name of river in this country.

With the great development of manufacturing, the sewage and wastes were at first discharged directly into the streams until they became excessively foul, and the sewage problem was forced upon them in perhaps its most difficult form. There were but limited areas of land in the valleys with elevations which would allow their use for sewage purification, and even these areas were often occupied by mills, or held at high prices in expectation of such use, and the land itself was, as a rule, compact, impervious, and but poorly adapted to sewage purification. The conditions in this region were probably more favourable for chemical precipitation, as against land treatment, than at almost any other place, and chemical precipitation has been the most commonly used method of treatment, Leeds, Sheffield, Bradford, Manchester, Salford, and Huddersfield among the larger places using it. Chemical precipitation, however, although great improvements have been made in the form of settling tanks and in the methods of managing them, removes scarcely more than one-half of the organic matters in the sewage and never more than two-thirds, and effluents generally carry on an average from two to five parts per hundred thousand of suspended matters capable of forming deposits in the streams; and it has been found that effluents purified to only this extent are very apt to produce more or less trouble when discharged into such small streams as exist in this region, and it is becoming more and more apparent that some more thorough process will be required before the problem can fairly be considered solved. Already much has been done in this direction. At Sheffield the effluent is taken through coke filters at a very high rate, and a portion of the suspended matters in the effluent is thus removed, although the purification obtained is far from what might be desired. This use of coke for filtering material has this strong point in its favour, that when the coke becomes dirty it can be burned with the matters accumulated in it under the boilers that are sure to be in use at the works. At Huddersfield, the effluent is filtered through sand and a patented substance called "polarite," with the result that most of the suspended matters are removed, although the dissolved organic matters hardly have time to become oxidised with the rapid filtration employed.

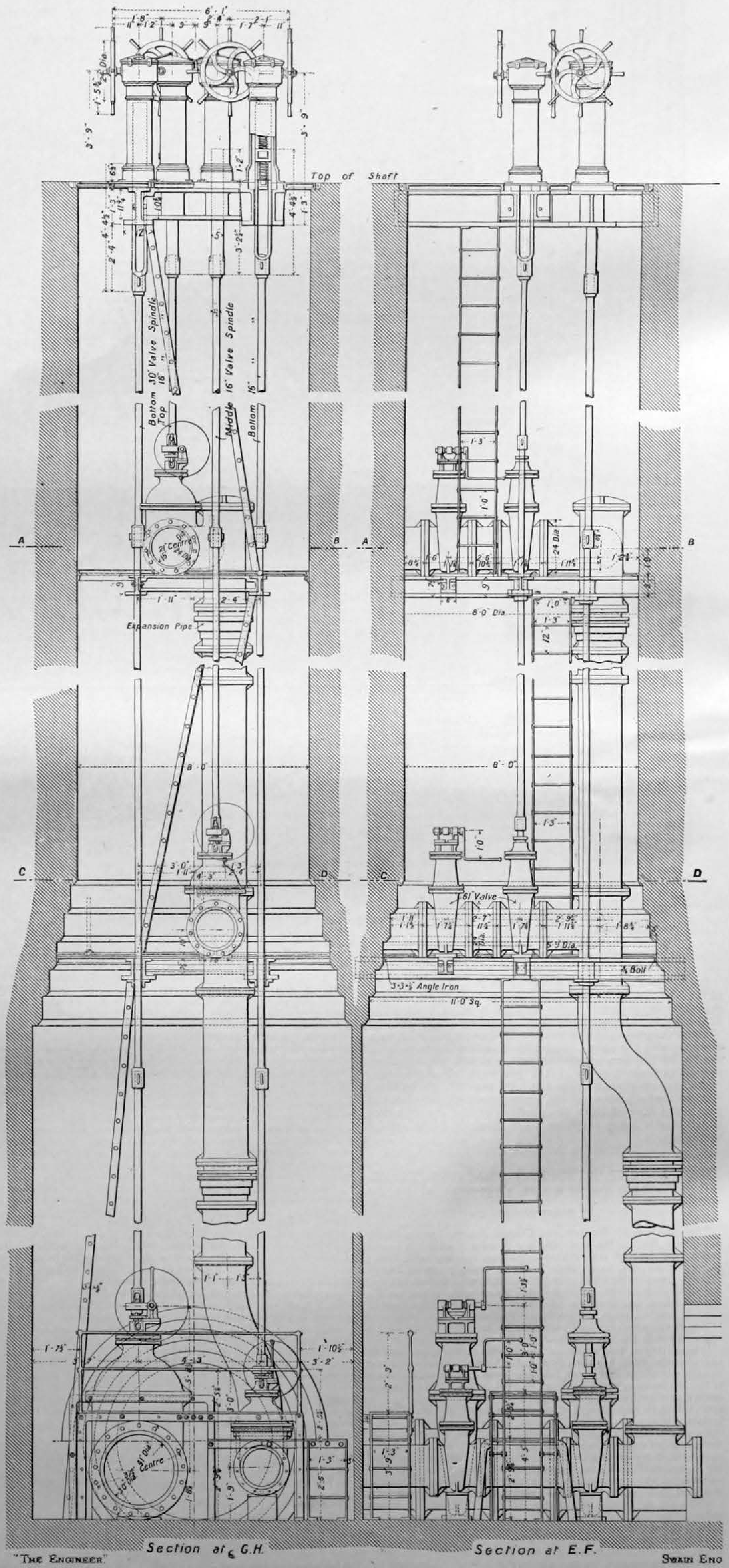
At Bradford and at Salford experiments have been made on a considerable scale with rapid filtration through sand or coke, and forced aëration has also been experimented with in the endeavour to find a process which is at once very rapid and capable of yielding effluents comparable in purity to those obtained from land treatments. This question of further purification for chemical precipitation effluents is now being everywhere discussed, and experimental filters are to be found with a surprising frequency, and we may confidently expect that the coming years will witness great changes in the methods of sewage treatment in this locality. A little to the south of the Manchester district is Birmingham, a great manufacturing city, which treats its sewage first by chemical precipitation, and afterwards applies the effluent to a large area of meadow land on both sides of the small river into which it eventually finds its way. Leicester, a few miles to the east, uses substantially the same process.

At London the sewers from a large metropolitan district have been gradually combined into one great system, or rather two systems, one for the north and one for the south side of the river Thames, both of which are administered by the London County Council. The conditions here are in many respects different from those of almost any other large city. The sewage is carried down by intercepting sewers to points some miles below the city, and is discharged into the estuary, where there are very powerful tidal currents, in addition to the natural flow of fresh water from the river. Formerly the sewage was discharged without treatment at these points, but it caused so great a nuisance in the river, both to the shipping and to the residents upon the banks of the river, both below and above the points of discharge, that in the last years works have been built to treat the whole of it by chemical precipitation, except the storm overflows. Although London is noted for its rainy weather, it seldom rains rapidly there, and the precipitation is more apt to come in the form of a slow drizzle, which the sewers are capable of removing, and the sewage which goes to the river through the overflows is much less than would be the case in an American climate. Mr. Santo Crimp, formerly in charge of the London Sewerage Works, has estimated that in the aggregate only about 4 per cent. of the sewage is discharged untreated into the river, the remaining 96 per cent. being treated before its discharge.

On Continental Europe the conditions for land treatment are, as a rule, more favourable than is the case in England, and chemical precipitation has gained but a slight foothold, only one large city, Frankfort-on-Main, in Germany, employing it, although it is used at a considerable number of smaller places, and is being considered at Leipsic. In the early days of chemical precipitation lime was commonly employed as a precipitant, and where the sewage contains a large amount of iron and acid from wire works, as is the case at Leeds, Sheffield, and Birmingham, lime answers as well or better than any other precipitant, but in other cases it has little to recommend it, and has usually been superseded either by copperas or by sulphate of alumina, although it is necessary to use with each of them a small quantity of lime to insure rapid precipitation. At London copperas is employed, while other English cities have varied their precipitants from time to time. One of the serious problems connected with chemical precipitation of sewage is the disposal of sludge, and in selecting the precipitant it is necessary to consider not only the purity of the effluent which can be obtained, but also the quantity and character of the sludge produced by it. At London several tank ships are employed, which carry the sludge out to sea, each ship making two trips daily and carrying about 1000 tons, of which 90 per cent. is moisture. To reduce the sludge to as small a volume as possible it is pumped from the settling tanks into another set of smaller tanks, and is settled over again, reducing it to one-third of its original volume. From these the supernatant liquid flows back into the incoming sewage to be treated over again, and the remaining sludge is run into the tank ships. These ships are of steel, and have air chambers in their bottoms to give them sufficient buoyancy, so that the sludge will flow out through the openings in their bottoms when they reach the point of discharge, fifty miles from the works.

At Birmingham the sludge is run upon and dug into several hundred acres of land with fairly good results. At Sheffield and

BURY WATER WORKS—VALVES AND DRAW-OFF PIPES IN SHAFT



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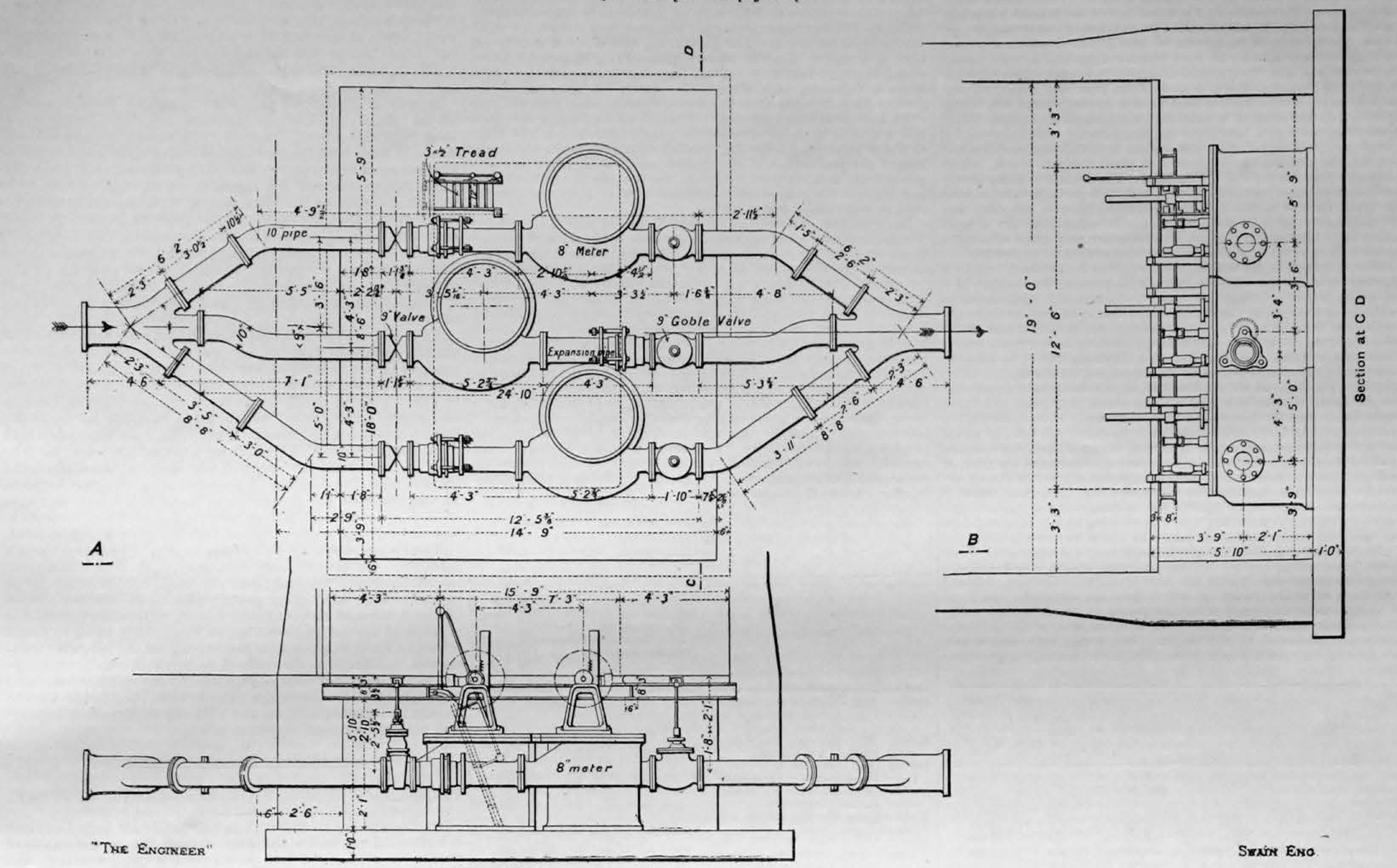
BURY WATER WORKS—METER HOUSE

(*For description see page* 195)



Section at A B

other places it is simply piled up on unused land and given away for a fertiliser when possible, and by sprinkling it with lime and chloride of lime in summer it does not become an unbearable nuisance, although this practice can hardly be recommended. Manchester and Salford have hoped to carry their sewage out to sea, as is done at London, by means of the Manchester Ship Canal, but I do not know that they have commenced to do so. Huddersfield and many of the newer works press the sludge in filter presses to solid cakes, which can be easily handled, and which can be applied to land or stored without creating a nuisance. The putrefaction, which make sewage and sludge offensive, seems to require the presence of an excess of moisture, and when the moisture is absent, as in pressed sludge and in land used for sewage treatment, this putrefaction did not occur, but the changes which take place are of an inoffensive nature. The cost of pressing is considerable, and it is this which probably prevents it from being more generally adopted.

The shape of the settling tanks for chemical precipitation has been changed somewhat in the course of years. The earlier tanks were nearly square, and were often used intermittently, being filled with sewage, allowed to stand, and afterwards emptied, and then filled up again. This was known as the intermittent process, and has been almost everywhere abandoned, although still in use at Sheffield. In the continuous process, now generally used, the tanks are connected with each other, and the treated sewage is run into a series of them, passing from one to another until finally it is discharged. The newer works, however, as a rule consist of long narrow tanks so arranged that a portion of the treated sewage passes through each of them and is then discharged, so that each tank is entirely independent of the others. These tanks are ordinarily from 30ft. to 60ft. wide, but are occasionally much wider, and in length range from one or two hundred to six and ten hundred feet. The bottoms slope rapidly from each side to the middle, and the middle slopes slightly from the outlet end of the tank toward the inlet, and there is usually a sludge channel in the middle a foot lower than the bottom, to ensure a rapid removal of the sludge when the tanks are cleaned. All of the earlier tanks were open to the sky, but in 1884 Lindley built precipitation tanks at Frankfort covered with a vaulting with soil above, laid out as a garden. This arrangement prevents any possible interference with the sedimentation by the wind or by ice, and also makes a much more attractive appearing place than the open tanks.

The settling tanks at London are also vaulted. On the north side of the river the tanks are only 32ft. wide, and there is an arched spandrel wall half-way between the sides, and the roof is made of two continuous arches covered with earth and with manholes to furnish light. It is stated that it was quite as cheap to build the tanks in this way as it would have been to build them open, because the walls between the tanks, being supported at the top, are very much thinner than would have been necessary with open tanks, and the excavated material was placed above the vaulting without expense for removing it, and the economies thus effected fully equalled the cost of the vaulting. The more recently constructed settling tanks on the south side of the river are of the same general construction, but the manholes were omitted; and it is found that there was both a great saving in the cost of construction, and the work of cleaning the tanks can be better done by artificial light throughout than by the very irregular light admitted through manholes.

Vertical settling tanks, like those used at the World's Columbian Exposition at Chicago, are occasionally used in Germany, particularly in small places, and are in some respects convenient, although the sedimentation is probably less complete than is the case with properly constructed horizontal tanks. The famous tanks at Dortmund are being replaced by broad irrigation. In other parts of England, where the population is much less dense than in the districts mentioned, and where land for sewage treatment is more easily secured, chemical precipitation works are the exception rather than the rule, and sewage farming is generally employed where sewage requires to be treated.

On the Continent, Paris first adopted land treatment for sewage many years ago, but selected an area quite near the city, and which was only large enough to receive a portion of her sewage. The process was entirely satisfactory as far as purification was concerned. No nuisance was created, and some return was obtained from the crops on the capital invested. There was, however, no land suitable and convenient for treating the remainder of the sewage without going some miles farther down the river, and for many years the system was not extended.

In the seventies, Berlin took the matter up, and adopted substantially the same system which was then in use at Paris, and has since extended it from time to time, until for many years all of the sewage of Berlin has been treated. Berlin, with its immediate suburbs, has at the present time a population of nearly two millions, and is growing almost as fast as Chicago; but the population is very compact, and the surrounding country for many miles consists of sandy land in every way suitable for sewage treatment, but too poor to repay ordinary cultivation. Under these circumstances there has been no object in economising in the area of land used, and the city has taken large areas of land, and is extending the mains to irrigate as large an area as possible with sewage. In 1893, 10,800 acres were in use, receiving on an average 4100 gallons per acre daily. The sewage is all pumped and treated, except when in thunder storms more rain falls than can be carried by the sewers. The Spree flowing through the heart of the city is said to have been as dirty as the Chicago River is at the present time, before the works were commenced, but it has been so thoroughly cleansed that one would hardly suspect it of having once been polluted with sewage. The irrigated land is cultivated with some profit to the city, and in good years 2 per cent. net profits on the capital of about 6,000,000 dols. have been earned. After Berlin adopted land treatment for her sewage, Dantzig and Breslau adopted substantially the same process, and more recently Magdeburg has been preparing land to be used in the same way, while Cologne, Hanover, and other cities are talking of doing so.

The German cities, as a rule, are situated upon much larger rivers than are the English cities, and sewage disposal has not been so pressing a problem with them; but, on the other hand, the conditions for disposing of the sewage upon land are much more favourable than in England, and the expense of carrying out the process is less; and now that the process has been demonstrated by many years' trial in the three cities mentioned to be a practical success, the Imperial Board of Health, which has great power in these matters, is insisting upon the adoption of sewage purification in almost all cases where important extensions or changes in the sewerage systems are adopted. As everywhere else, it is difficult to prevent a city which has been discharging its sewage into a river from continuing to do so, particularly where the river is large enough so that no great nuisance is caused. But when a city wishes to extend its sewerage system, or increase the size of its sewers, and the project is sent to Berlin for examination and approval, then the Board can take the position that the sewage should be purified, and it usually does so. Some of the leading officials in Berlin having charge of the German rivers were of the opinion that all sewage should be treated without regard to the size of the rivers into which it is discharged, although a number of the rivers, such as the Rhine, the Elbe and the Oder, are so large that from our standpoint it is hardly possible to conceive of any appreciably injurious results from the discharge of sewage into them.

The soils used for sewage purification in Germany are invariably sandy, pervious materials, and the natural surface of the ground is so nearly level that it can be developed with a minimum of expense. The areas are usually divided into separate beds by low earth embankments, quite similar to those at Framingham and Marlborough in this State. The surface of these beds is always cultivated—grass, beets, cabbages, wheat, rye, oats and apple trees being the leading crops. Wheat and oats when they are irrigated grow very rankly, and as the farmers say, run to straw, and good crops are seldom obtained. Our American corn or maize cannot be successfully grown, because the summers, and particularly the summer nights, are not warm enough, and the grain will not ripen. Germany is some degrees farther north than New England, and the winters are of about the same severity, but the winter nights are much longer and the days shorter, and it thus happens that in the darker months of the year it is impossible to distribute all, or even the greater part, of the sewage over the land by daylight, and it is found that however carefully instructions are given, the men having the distribution in charge will not properly perform their work at night. To provide for this contingency, certain areas are set apart upon all the German farms, having substantially level surfaces and surrounded by embankments much higher than the ordinary embankments—that is, 8ft. to 10ft. high. The areas are also much greater, often containing ten or twenty acres in one lot. During the long dark nights of the fall and winter, sewage is run into these basins, often filling them several feet deep. Of course little purification takes place under these circumstances, but owing to the cold weather the sewage is retained pretty nearly in its original condition, or at least without offensive decompositions, generally covered with an ice sheet during the winter.

As soon as the days become longer, in early spring, all of the sewage is again applied to the land, and these basins are no longer used. The ice melts and the pond of sewage soaks away in the course of a few weeks, and the surface of the land covered with the organic matters which have been strained from the sewage, is exposed to the air and becomes dry, and soon afterwards it is ploughed under, and the matters are destroyed, as in the ordinary process of intermittent filtration. Wheat and oats can be raised in these basins in the summer, and good crops are obtained. No sewage is ever put upon them except in winter.

Paris has for many years treated a portion of her sewage as mentioned above, by intermittent filtration upon the sandy soil of about 2000 acres of land, nearly surrounded by one of the broad bends in the river Seine, just below the city. The sewage has been pumped to this land from the main outfall sewer as needed by the crops, and when the crops did not require it, the sewage has been discharged untreated into the river. In recent years, only about 20 per cent. of the sewage has been treated; in rainy weather and winter a much smaller proportion, while at dry seasons a larger quantity was taken. The condition of the River Seine, below the point of discharge of the sewage, has become extremely foul, and the city has recently voted to construct an outfall sewer down to another and larger area of land in the next bend of the river below that now used, and to treat the rest of its sewage there. This outfall sewer involves the construction of three syphons under the Seine, and the purchase of 25,000 acres of land, which will give the city an ample area upon which to purify all of its sewage. The estimated cost of this work is 6,000,000 dols. At Paris, as in the English sewage farms, the embankments between the beds are a much less conspicuous feature, and one of the most common methods of applying sewage is to have the land in ridges and furrows, the sewage being turned into the furrows, while vegetables and other crops are raised upon the ridges, which are never covered by the sewage. Of course it is necessary at certain points to have embankments to prevent the sewage from running over the surface into the river, but these are reduced to a minimum.

There are some unusually interesting sewage disposal problems in some of the Dutch cities. Rotterdam is situated on the Maas, which is really the main outlet of the River Rhine, with its enormous flow from the mountains in the south of Germany and in France and Switzerland, and in addition there are strong tidal currents, so that the city has no difficulty in disposing of its sewage. Amsterdam and The Hague, however, are not situated upon rivers, but only upon the intricate system of canals which intersects a large part of Holland. Streets, as a rule, are 3ft. or 4ft. higher than the water in the canals, and the houses are built upon foundations about even with the streets, and there are no cellars. There is often a canal between every two streets, and in the few cases where it is omitted, it is in any case but a short distance from any part of the city to some canal. It has been the custom ever since the memory of man to discharge all sewage, garbage, and other wastes into the canals direct. This has resulted in the canals becoming extremely foul and sources of much complaint. The conditions have been somewhat improved by constructing considerable reservoirs, which, regulated by means of gates and used in connection with the tides, allow considerable currents to be maintained in most of the canals, and in this way the conditions have been maintained without becoming excessively bad. The limits of this system of flushing have, however, been nearly reached, and it is apparent that some further treatment will be required. Several of the leading Dutch engineers are exerting their ingenuity to see how a series of sewers can be constructed for The Hague, but the problems of ground water, canal crossings, and pumping stations are really very serious.

In Amsterdam a portion of the central part of the city has been for some years sewered on the Liernur system. This system, which many of you will remember, was much talked about some years ago, and was thought by many to afford a solution of the sewerage problem. It consists of a system of iron pipes in which a partial vacuum is maintained, and into which sewage matters are passed without water, and the material is drawn in a concentrated form to a pumping station, where it is distilled with lime, giving off ammonia, which is condensed in acid to form an ammonium salt, which is sold, and the residue is dried and compressed into cakes, which have some value as a fertiliser. At the present time about 62,000 people are connected with this system in Amsterdam, and about six tons of ammonium sulphate are produced per week, which partially pays for the cost of operation. The system is being slowly extended to other parts of the city, although perhaps it is too soon to state that it is the definitely adopted plan of the city, and developments may be awaited. This is altogether the largest plant upon the Liernur system, and possesses very great interest to those only familiar with the water-carried system of sewerage.

The question as to the dilution which it is necessary to give a sewage or a sewage effluent in order to prevent the creation of a nuisance, is a most interesting one. Unfortunately, statistics as to the flow of streams at the points where they pass various cities are extremely difficult to obtain, and even in those cases where statements are available there is often a question as to the exact conditions under which the gaugings were obtained, and as to whether the results are comparable with corresponding statements for other places. The flow of rivers, however, is in a measure proportional to the areas of the watersheds from which they flow, and these watersheds can be measured with ease and with comparative accuracy. The flow, and particularly the minimum flow, in which we are especially interested, of course depends upon the rainfall, and its distribution throughout the different seasons of the year, as well as upon the climate and the geological character of the watershed. But after making due allowance for differences of this nature, the comparative figures for the areas of watersheds are more satisfactory than any records of gaugings which could be obtained for all the numerous points in which we are interested.

In the following table are given the names of a number of cities having interesting sewage disposal problems, and their populations, as given in the last census for 1890 or 1891, as the case may be, together with the rivers on which they are situated, and their drainage areas measured from the points at which sewage is discharged into them, and in the last column the areas of the drainage areas per thousand of population. The areas, with one or two exceptions, have been measured from maps and are only approximations.

City.	River.	Population.	Drainage area.	Square miles per 1000 of population.
Manchester	Irwell	198,136	290	0·41
Salford		505,343		
Brussels	Senne	477,000	340	0·72
Leeds	Aire	367,506	310	0·84
Sheffield	Don	324,243	320	0·99
Bradford	Aire	216,361	220	1·02
Huddersfield		95,422	102	1·06
Chemnitz		138,955	160	1·15
London	Thames	4,211,056	4,900	1·16
Glasgow	Clyde	658,198	800	1·22
Berlin	Spree	1,578,685	3,800	2·40
Munich	Isar	348,000	1,200	3·45
Leipsic	Elster	355,485	1,700	4·80
Brunswick	Ilse	100,883	600	6·00
Paris	Seine	2,447,957	16,000	6·50
Hanover	Leine	163,100	2,000	12·30
Breslau	Oder	335,174	8,500	25·50
Frankfort-on-Main	Main	179,850	9,500	53·00

Manchester and Salford, on the opposite sides of the Irwell, discharge their sewage into it at nearly the same point, after treating it by chemical precipitation.

The population given for Brussels includes suburbs more populous in the aggregate than the city itself, and it is probable that only a part of them are connected with the sewers. The sewage is not treated, and the river is extremely foul below the city. The river has been straightened and arched over through the central part of the city, and a boulevard has been built over it, and intercepting sewers on either side of it are carried down to a point below the city, at which the sewage is discharged. At Leeds the sewage is treated by chemical precipitation before being discharged into the Aire, and at Bradford also the sewage is precipitated and discharged into a brook just above its junction with the Aire, but the drainage area given is that of the Aire below the junction of the brook. Sheffield and Huddersfield treat their sewage by chemical precipitation, and follow the treatment by rapid filtration.

The rivers mentioned above have been among the most grossly polluted rivers in Europe, and notwithstanding the efforts that have been made to purify the sewage, they are in far from satisfactory condition, although it seems probable that the large amount of cloudy weather and absence of extremely hot weather in England in summer at once have a tendency to maintain larger minimum flows, and are less favourable to the offensive decompositions that would be expected in a hotter climate and drier atmosphere.

Chemnitz discharges its sewage without treatment into the small stream which flows through it, and a serious nuisance is created, which will probably be corrected in the near future. The stream has quite a rapid fall, and it is perhaps this fact which has made the discharge of so much sewage possible. At London and Glasgow the sewage is discharged into estuaries, where there are powerful tidal currents, in addition to the flows of fresh water, which render comparison of them with inland cities impossible. At London the sewage is treated by chemical precipitation, and a similar treatment, followed by rapid filtration, has recently been put in operation to treat a portion of the sewage of Glasgow.

At Berlin the condition of the Spree became very offensive in the early seventies, when the population was only half as great as at present, and the drainage area per thousand of population was consequently twice as great. Since that time the sewage has been treated by broad irrigation, and the river is now in good condition. At Munich the sewage is discharged untreated into the river Isar, and has caused no serious nuisance. The river, however, has its origin in the Alps, and has a large flow and a rapid fall, so that the conditions for the discharge of crude sewage are unusually favourable. At Leipsic the untreated sewage has created a serious nuisance, and will be treated at an early date. Brunswick and Hanover do no treat their sewage, but probably will apply it to the land in the near future.

At Paris the Seine has been extremely foul, notwithstanding its large drainage area and the fact that part of the sewage has been treated. Deepening the river to allow the passage of ships of considerable draft has reduced the velocity of the current and made the conditions more favourable for the formation of deposits of sewage matter, with the decompositions which accompany them. At Breslau the sewage has been treated for many years by applying it to land, and the river has, so far as I know, never been in bad condition. Water taken from the river is used for public water supply by at least two large cities down the river. At Frankfort-on-Main the sewage is treated by chemical precipitation before being discharged into the artificial harbour, which has been constructed by building a dam at a little distance below and by deepening the channel opposite the city.

While the data given in the table are perhaps hardly adequate to serve as a basis for final conclusions, they are interesting as showing the discharge of crude sewage without nuisance into a rapid mountain stream, having only 3·5 square miles of drainage area per thousand of population, while the discharge of sewage into smaller streams proportionally has always resulted in the production of a nuisance, and other streams drawing their water from flat prairie country and with sluggish flows have become offensively polluted, although their drainage areas were equal to six or eight square miles per thousand of population, and one can readily see that in a region like the western part of the Mississippi basin, where rivers go nearly or entirely dry in summer, sewage might cause a nuisance, even though the watershed was enormously greater proportionally than the above figures. We also see that cities have grown up upon rivers so small as to furnish less than half a mile of drainage area per thousand of population, and while in these cases, by giving the greatest attention to the thoroughness of the purification of the sewage before discharging it, rivers can be kept in fairly good condition, the problem is a difficult one, and requires the utmost and continued care to keep the streams even in reasonably good condition.

In conclusion, the trend of the best European practice in sewage disposal is strongly toward the treatment or purification of sewage in all cases before it is discharged into rivers, with the exception of very large rivers and at points where there are strong tidal currents. The tendency is to use land treatment wherever the local conditions are reasonably favourable, as the effluents produced in this way are of much greater purity than can be obtained by any chemical or mechanical processes, and the cost is ordinarily less. Where the local conditions are such as to preclude the employment of land treatment, chemical precipitation is used, but although material improvements have been introduced in the construction of settling tanks and in the methods of applying chemicals, it is not possible to produce effluents of sufficient purity to be discharged into the smaller rivers without creating more or less complaint, and the tendency is strongly to follow chemical precipitation in such cases by a rapid filtration through some material which will remove substantially all of the remaining suspended matters, and will allow at least a portion of the soluble organic matters to become oxidised.

Mechanical Analyses of Samples of Materials from certain European and American Sewage Farms.

(Collected by the Author.)

Location.	Descripti'n of samples	Effective size, 10 per cent. finer than: (Millimetres)	Uniformity co-efficient.	Albuminoid ammonia, parts in 100,000 by weight.
Berlin, Malchow Farm.	Surface soil where it had recently been ploughed.	0·12	5·6	34
Berlin, Malchow Farm.	Subsoil 2ft. deep at same place.	0·12	3·4	33
Berlin, Malchow Farm.	Surface soil not recently ploughed.	0·12	2·2	90
Berlin, Malchow Farm.	Subsoil 2ft. deep at same place.	0·13	2·7	31
Berlin, Grossbeeren Farm	Surface soil in actual use.	0·15	2·0	26
Berlin, Grossbeeren Farm	From a sand bank near by, representing the original unused material.	0·15	1·8	1
Breslau.	Subsoil 1ft. below surface of sewage field in use.	0·24	1·9	2
Paris.	Surface soil from sewage fields in use.	0·13	5·9	64
Framingham, Mass.	Sand from sewage filters.	0·35 to 0·42	4 to 5	
Marlborough, Mass.	Sand from sewage filters.	0·12	3 to 4	
Gardner, Mass	Sand from sewage filters.	0·10 to 0·24	6 to 14	
Brockton, ,,	Sand from sewage filters.	0·30 to 0·60	2 to 5	
Poughkeepsie, N.Y.	Sand from sewage filters at Vassar College.	0·10 to 0·50	2 to 5	0 to 2
Plainfield, N.J.	Sand from sewage filters.	0·10 to 0·25	2 to 5	0 to 3
Pullman, Ill.	Soil from sewage farm	0·01	15	225

JUBILEE OF THE GAUGE ACT.

Fifty years ago, on August 18th, 1846, a short Bill of only nine clauses became law, and has had a lasting effect upon British railways since that time. This was the 9 and 10 Vic., cap. 57, otherwise, "An Act for Regulating the Gauge of Railways," and was the direct outcome of the report of the Gauge Commissioners appointed fourteen months before. In the main, of course, this legislation was brought about by the Great Western Company's departure from the gauge adopted by George Stephenson on the Stockton and Darlington Railway, and which, early in the forties, had obtained a start the broad gauge was never able to overtake. The Bill in question, which of course was a Government measure, had the strong approval of the military authorities. It was a favourite idea of the Duke of Wellington, then Commander-in-Chief, that railways would enable a small army to do the work of a large one; so far as its employment at home was concerned. In this he was no doubt right, and in those days, when riots of the most alarming kind were not uncommon, the argument appealed to most people more strongly than, perhaps, it would now. It was obvious that perfectly unnecessary breaks of gauge might cause fatal delay in the movement of troops, and, in fact, would do away with much of the advantage of conveying them by rail. The Gauge Commissioners examined a great number of railway officers, engineers, locomotive superintendents, traders, in fact, persons of all classes who were concerned with the making, maintenance, or utilisation of railways.

The bulk of evidence obtained was overwhelmingly in favour of uniformity of gauge throughout the country, as indeed it might have been expected to be. Of the engineering experts a few considered that a slightly wider gauge than 4ft. 8½in. might have been employed with advantage, but the majority were of opinion that gauge would admirably serve the needs of the country. Absolutely none, save those connected with the Great Western Railway, advocated so wide a gauge as 7ft. In commercial circles the testimony against the loss of time, the injury to goods, and the opportunities for pilfering caused by break of gauge was almost unanimous. All sorts of expedients for minimising these objections were proposed from time to time, which enriched the Patent-office, but brought the question no nearer solution. Telescopic axles, which could be lengthened or shortened to suit either gauge, were a favourite idea; also that of carrying goods in removable boxes, three of which should go on a broad gauge truck and two on a narrow gauge one. But it was felt that these half measures could but palliate an evil which existed solely to gratify a man whose inexperience of railway construction was only equalled by his abounding self-sufficiency.

The Gauge Commissioners themselves could only say for the broad gauge that at high speeds the motion of the trains was generally easier than on the narrow, and that it might be possible to run the fastest upon it. The former we know now to be more a matter of wheel base and of design and weight in the rolling stock than of gauge, whilst the latter has never been conclusively proved. On the two most important matters, viz., which was the most convenient for the usual loads of goods, and whether the increased outlay for the broad gauge was attended with any advantage really worth it, their verdict was distinctly in favour of the narrow gauge.

It was estimated at this time that one million sterling would have sufficed to convert all the broad guage then existing—about 274 miles—to narrow gauge, and well would it have been for the Great Western if they had repented of their error thus early. But they persisted that as Parliament had sanctioned the mistake, so it ought to find the means of rectifying it. As a matter of fact, Parliament probably understood the merits of the question in 1835 no better than the Great Western directors themselves, and it naturally refused to spend public money chiefly for private benefit. The broad-gauge companies were left to get out of a trouble of their own making as best they could, steps being taken by the Gauge Act to localise the evil and prevent its spreading too far.

The chief provisions of the Gauge Act were that except in certain specified cases, no new passenger railway should be made in Great Britain of any other gauge than 4ft. 8½in., or in Ireland of 5ft. 3in. It did not apply to any line which should be entirely south of the Great Western (*i.e.*, between London and Bristol), nor to any which might be made in Cornwall, Devon, Somerset, or Dorset. Certain lines already sanctioned to be made on the broad-gauge were not interfered with. The chief of these were the South Wales Railway, the Oxford and Rugby, and the Oxford, Worcester, and Wolverhampton. The first-named was worked as a broad gauge line down to 1872, the Oxford and Rugby, when it got to Fenny Compton, was altered to go to Birmingham and Wolverhampton instead, and was soon converted to "mixed gauge," broad and narrow together. On the Oxford, Worcester, and Wolverhampton, the mixed gauge was laid from the first, but the broad gauge rail was never used. Any gauges other than those authorised by the Act might be removed by Government authority, at the expense of the company owning or controlling the line; or it might be fined £10 per mile per day whilst the illegality continued. Although the evil of numerous breaks of gauge would probably have remedied itself in course of time without any legislation on the subject, the Act has been of the utmost benefit in bringing it to an end with the minimum of friction and within a reasonable period of time.

TECHNICAL EDUCATION AND WASTE OF TIME.

It is satisfactory to find that British people are finding out now in a practical way before the lives of more than a generation of certain classes of young men have been more or less spoiled, that the technical education craze is a thing harmful to about 70 per cent. of all who are led to believe it is a short and easy way to technical knowledge and usefulness. Those who take the technical college after school instead of the works postpone to too late a day that which is the most important part of their education, namely, the workshop and out-door part of it. They also postpone until too late the discovery that they are not fitted for an engineering or architectural building or special industries. The education in a technical college is easy, and all is so different to the realities of the work that is done for a commercial purpose and for a paying result, that the student does not know that he is unsuited for the real thing. If he went into the works early he would find this out, and if he is of the proper stuff he could make use of the technical colleges or schools in the evening. Judging from the following, we shall be saved yet from the sterilising influence of the technical school:—To ardent advocates of technical, or polytechnical, education much of the correspondence between the Board of Trade and representative societies of shipowners and engineers on the subject of apprenticeship for marine engineers will be disappointing reading. The qualifications proposed by the Board for candidates for a second-class engineer's certificate included the following:—"In calculating the five years of artisan service which are to constitute the required apprenticeship, time spent at a technical school where there is an engineering laboratory may be taken into account and accepted as equivalent to artisan service, at the ratio of three years in the technical school to two in artisan service, provided that the applicant was over fifteen years of age and can produce the master's certificates for regular attendances and satisfactory progress; and provided also that in such case the remainder of the time was not spent in a drawing-office." Considerable objection is raised to this by railway and shipping companies. The Castle Line, for example, remark:—"The introduction of technical school training—with an engineering laboratory—as a partial qualification is open to question. What is wanted in the mercantile marine is first-rate tradesmen with as much technical education super-added as practicable. Young men from engineering colleges have, in our experience, not proved the best fitted for a seagoing engineer's life." Still more emphatic are the Peninsular and Oriental Company, who consider that "the results of training such as indicated in this paragraph would introduce a class of men quite unfit to cope with the work expected of an engineer at sea, or to be of any practical use in the engine-room in cases of emergency." The London, Chatham, and Dover Company think that training in the drawing-office or at a technical school should not count; and the *Daily Telegraph* remarks that a senior Whitworth scholar states that "time spent in a technical school is not of great use in giving real practical experience"—a thing which everybody ought to have known always.

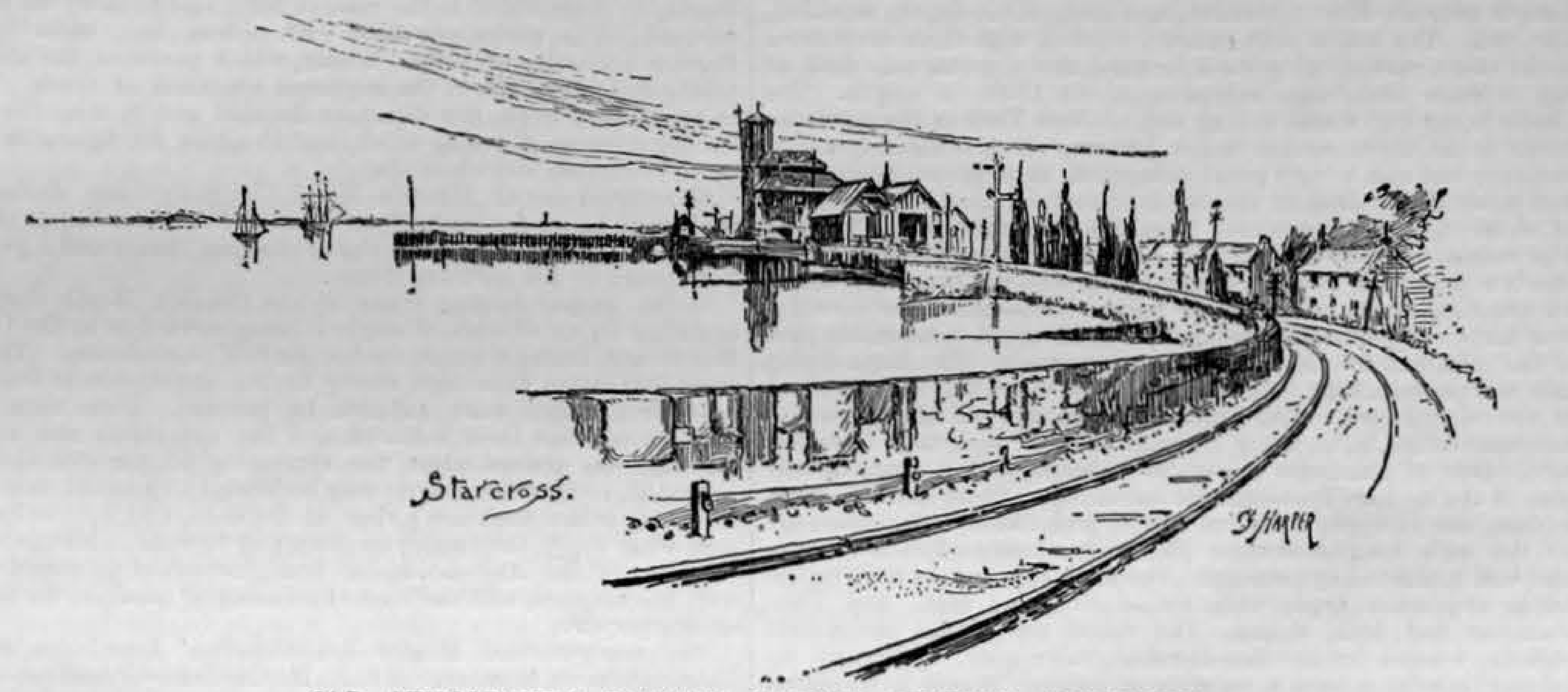
Naval Engineer Appointments.—The following appointments have recently been made at the Admiralty:—Staff engineer: George B. Alton, to the Talbot. Chief engineer: Samuel Godbeer, to the Pembroke, additional, for service in dockyard. Engineer: Gilbert C. Nicholson, to the Talbot. Assistant engineers: Henry Bell, to the Talbot; Albert G. V. Salter, to the Alexandra; Alfred Saunders and George E. Andrew to the Pembroke, additional.

The Scheme of Caversham Drainage.—On Wednesday last, at Caversham, Oxfordshire, the member for South Oxfordshire Division of the county, Mr. R. T. Herman Hodge, M.P., formally opened the Caversham Drainage and Outfall Work in the presence of the mayor of Reading and a large number of visitors. The length of sewers is about 11½ miles. The chairman of the Council said the greatest credit was due to their engineer, Mr. C. Nicholson Lailey, C.E., of Westminster, for although they had four miles of sewerage under water, with a pressure of about 5ft. of water, the leakage was inappreciable. The sewage on reaching the outfall works is dealt with on the International system, the sewage after precipitation passing on to polarite filters. Sludge pressing machinery is provided, and the tanks and filters are built on arches considerably above the ground in order to be above flood level. Great satisfaction was expressed with the scheme, which has been carried out with far more expedition than was at first anticipated, and for a sum well within the amount of the loan sanctioned by the Local Government Board.

A RELIC OF THE ATMOSPHERIC RAILWAY.

WE mentioned, in our article on the jubilee of the London, Brighton, and South Coast Railway, some slight vestiges that still remain of the atmospheric system that preceded locomotives on that line. There is, however, a much more striking survival of this obsolete system still remaining on the Great Western main line outside the little wayside station of Starcross.

When Brunel was laying out the route of the railway between Exeter and Plymouth the atmospheric system was still on its trial, and it was thought that here, on this extremely hilly section, it would have the greater chance of justifying its existence. Pipes, therefore, were laid down, and a great number of pumping stations erected along the line. From 1845 to 1848 the system was tried, and ultimately proved a failure, working at an extravagant cost, and performing such miracles of delay as dragging trains along at the rate of a mile in half an hour. Locomotives, of course, soon superseded the atmospheric system, and the pumping stations were all destroyed, except that which, with its tall red sandstone tower, forms so picturesque a feature of the railway as it curves along the estuary of the Exe. It owes its preservation to the Earl of Devon, brother of the present earl, who died some ten years ago. He saw how it completed the picturesqueness of the scene, and his influence with the directors of the Great Western Railway caused it to be left—at once an ornament, and a relic to tell of the early struggles of railways against imperfectly understood mechanical laws.



OLD ATMOSPHERIC RAILWAY PUMPING STATION, STARCROSS

MECHANICAL HAULAGE.*

By J. STURGEON.

(*Concluded from page* 158.)

I should have much liked to say something about electrical leakages and their destructive effects upon gas and water mains, &c., but the limits of a paper like this preclude my going into a subject which is, in itself, big enough and interesting enough to serve for a special paper. I can only say that this is another serious drawback against electric traction, and one to which sufficient importance is not attached. Electrolytic corrosion is certain to shorten the lifetime of the rails, and necessitate a serious addition to the sum that has to be set aside for renewals. The damage done to gas and water mains ought really to be debited to the working expenses, but unfortunately it is pretty sure to be set down to streets and sewerage, gas and water accounts, and paid for by the ratepayer. I would strongly advise all those who are interested in the subject to read the Report of the Parliamentary Committee on Electric Powers Protective Clauses of 1893; particularly the evidence of Major Cardew, Dr. John Hopkinson, Mr. Preece, and Sir F. Bramwell.

In fact, overhead electric traction has already seen its best day, and is doomed to follow in the wake of the accumulator. But hope springs eternal in the electrical faddist's breast; and now the electrical atmosphere is full of signs and tokens of another "new departure" in the form of conduit system of electric traction. These indications came first from America, where, notwithstanding the glowing accounts of the success of the overhead electric system, there has been a rapidly growing and widespread feeling of dissatisfaction with its results. It has been entirely swept out of Washington, it is prohibited in New York; and even in Boston, the very centre and headquarters of the system, it is condemned, and has to be removed within two years. A new era of experimenting in conduit systems has been entered upon. We find the same feeling of dissatisfaction now spreading to the European Continent. The city of Brussels has just granted a concession for the construction of the "Hoerde" conduit electrical system on four important lines, and the following extract from the report to the municipality is very significant:—

"La traction électrique par Câble aérien étant devenue la cause de nombreux mécomptes et de grave accidents, un désir ardent de voir surgir une traction électrique par Câble souterrain se faisait sentir de plus en plus. Ce besoin cette nécessité se montrant chaque jour, plusieurs des plus importantes firmes du Continent avaient semblé vouloir y répondre en adoptant sur certaines lignes en construction différents systèmes de traction électrique souterraine. Chacun de ces sociétés croyait avoir trouvé le meilleur système."

But it is a vain hope. There is nothing in the nature of underground or conduit systems that can in any way help to lessen the cost. On the contrary, the capital cost is much higher, and with all the complicated and delicate electric appliances under the street, the maintenance also will certainly not be likely to prove less. Anyway, it is a hopeless task these electric tractionists have taken upon themselves. They cannot contend against the fixed principles of mechanics; and the "new departure" is bound to depart too on the same road as the others.

A statement has just been published in *Engineering* of the working expenses—in detail—of the Hamburg Electric Tramways, showing a total cost per car mile of a fraction under 4d. This is a pretty fair sample of the utterly misleading and untrustworthy nature of these foreign examples. They look so convincing at first, and induce many people to rush away with the idea that if they can do so well across the Channel, we can do as well here. But when we come to examine into the details, and reduce them to English standards and English conditions of working, the case is entirely altered. In the first place, in the Hamburg case, we find the contracting and subsidising element largely in evidence. There is 0·192d. per car mile set down under the head of "Amount paid to contractors for guarantee." Then the electric current is supplied by the Electric Lighting Company, at the contract rate of 1·56d. per unit. The Lighting Company can afford to do that, because it gives them a day load for their plant, and their capital charges and management expenses being already covered out of their income from lighting, it costs them very little beyond fuel and wages for the supply sold to the Tramway Company. The Tramway Company are thus saved a large capital outlay on the power station and proportionate management expenses, and can afford to pay a profit to the Lighting Company, and still get their electricity at less cost than they could produce it at themselves. Besides that the Corporation pay back to the Tramway Company 20 per cent. of the cost of the electric current used. With all this the cost of the current comes out at 0·881d. per car mile. Then the wages of the conductors, motor men and inspectors, &c., work out to 1·327d. per car mile. Now in England, considering the higher rate of wages and shorter hours of work, that figure would be increased by about 25 per cent., making it 1·659d. But again, in Hamburg the cars have almost exclusive use of the track, and make quite double the speed we could make in our crowded streets here, even if the law did not limit us. That means that, to enable us to make the same mileage, we should have to double the number of cars running, and double the number of men employed, thus bringing the cost under that head alone up to 3·318d. per car mile. There being twice as many cars to look after and keep in repair, the cost under those heads would, if not quite doubled, be largely increased, and the capital charges, in respect of rolling stock, would be doubled. There is nothing whatever set down for repairs and maintenance of roads and permanent way, so I presume we may take that as being done by the Corporation and not charged against the Tramway Company. Without altering the contract items, and reducing the other items to English standards of speed, wages, &c., the cost soon mounts up to about 8d. per car mile. And this, bear in mind, is in the first year of working, before the repairs and maintenance begin to be seriously felt, and while they are still covered by the contractor's guarantee.

Now the working expenses as given are said to be only 48 per cent. of the receipts, and yet, strange to say, the company can only pay 5 per cent. dividend. There is something very queer about that. A very slight increase in the working expenses would soon wipe out that small profit, and where would it be on an English line, with the working expenses something like double?

But after all, what other result can we expect? Electricity can do many wonderful things, but it cannot work miracles. It cannot make three tons weigh less, and be easier to move than one ton. It cannot be converted into available power at less cost than it takes to generate the power necessary to effect the conversion. How then can we possibly expect to run it in competition with power applied direct, as in the cable system? In spite of all these deceptive figures and the sanguine utterances of electrical enthusiasts, the immutable law of conservation of energy will have its revenge in failure after failure, for all such violations of its principle.

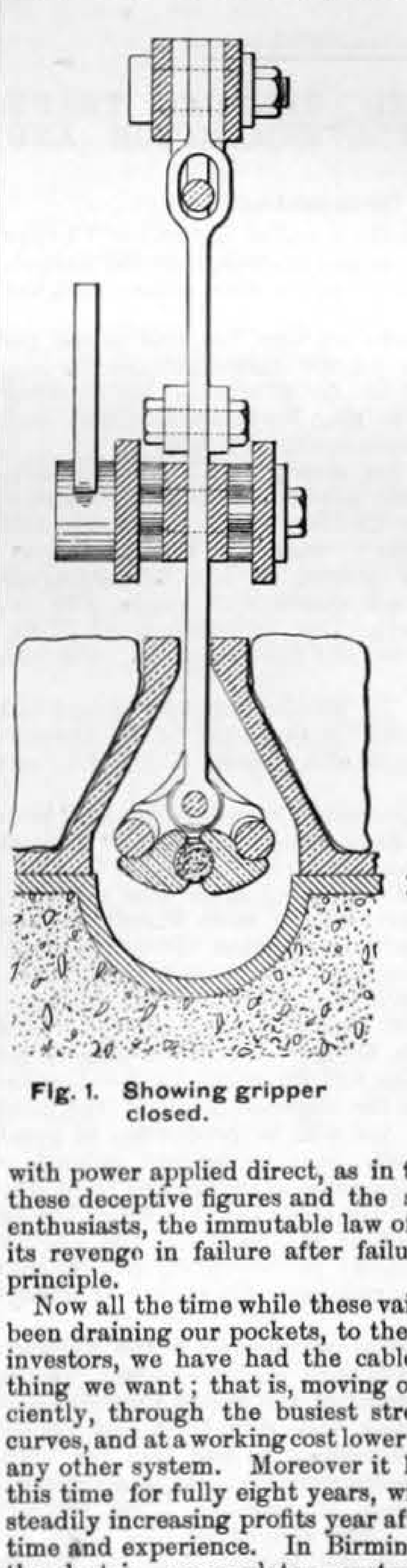


Fig. 1. Showing gripper closed.

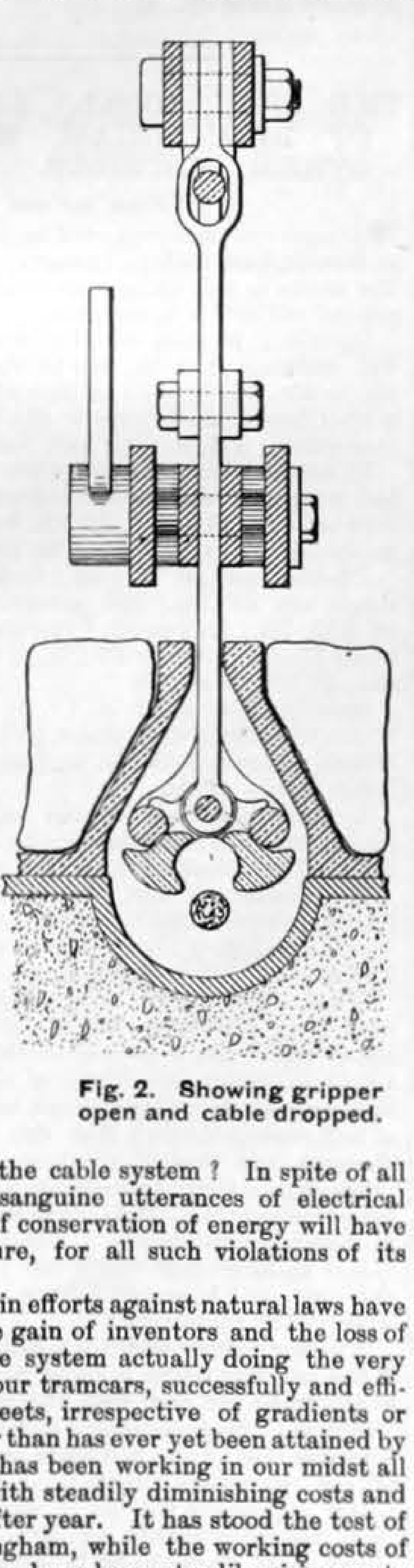


Fig. 2. Showing gripper open and cable dropped.

Now all the time while these vain efforts against natural laws have been draining our pockets, to the gain of inventors and the loss of investors, we have had the cable system actually doing the very thing we want; that is, moving our tramcars, successfully and efficiently, through the busiest streets, irrespective of gradients or curves, and at a working cost lower than has ever yet been attained by any other system. Moreover it has been working in our midst all this time for fully eight years, with steadily diminishing costs and steadily increasing profits year after year. It has stood the test of time and experience. In Birmingham, while the working costs of the electric—accumulator—system have been steadily rising up to 18·43d. per car mile, the working costs of the cable system have been as steadily diminishing down to 5·43d. per car mile, and the profit last year on three miles of street worked by cable represents about 20 per cent. on the capital outlay. Edinburgh and Brixton also show the same result, viz.: of steadily diminishing costs, as against steadily increasing costs on electric systems, of whatever kind they may be. One after another new inventions in electric traction have sprung up, run their short course, and disappeared to make room for others, foredoomed to the same fate; but the cable has kept steadily on, and held its ground and survived them all. Why, then, has it not been more largely adopted?

The run on everything electric is partly responsible for this. Electricity is an effective word with which to conjure money out of people's pockets, and company promoters have recognised this. Electric belts and hair brushes, electric sugar, electric soap, electric blue, and electric traction, all "catch on." The general public cannot look into the innermost recesses of the subject. It is a case of the "ignotum pro magnifico." They are attracted by anything in the nature of the marvellous, and easily become victims of the craze. That is one reason. Another reason undoubtedly has been the high initial cost of the cable system, and what is perhaps more serious still, the terrible obstruction of the streets during the construction period, which local authorities cannot contemplate without dread, and would do much to avoid.

Having been long convinced of the advantages of the cable system in actual working, I have been for some time past endeavouring to devise methods for overcoming these objections as to initial cost, and to reduce the interference with the streets during construction to a minimum. The deep excavation for the conduit, on the existing method, involving serious blockage of the street for a prolonged period, and frequent interference with service pipes, was evidently the point that would have to be tackled. If we could reduce the depth of the conduit, so as to avoid breaking through the concrete foundation on existing lines, that would accomplish all we want, as, of course, in the construction of a new line we should need no deeper excavation than would be required for the ordinary laying of the tramway, and for the conversion of an existing line to cable traction, we should only have to remove the setts between the rails and prepare the bed for the laying of the conduit. It was while engaged on this problem that I happened to mention the matter to my colleague, Mr. Wilson, of Belfast, and he made several practical suggestions as to the form and construction of the gripper and the arrangement of the supporting and guide pulleys in the conduit, which have resulted in the development of his shallow conduit system. The first necessity was to have a form of gripper which would occupy the minimum of space in the conduit. The form we have adopted is shown in Fig. 1. It is the modification of the form of gripper used in the

Fig. 3.

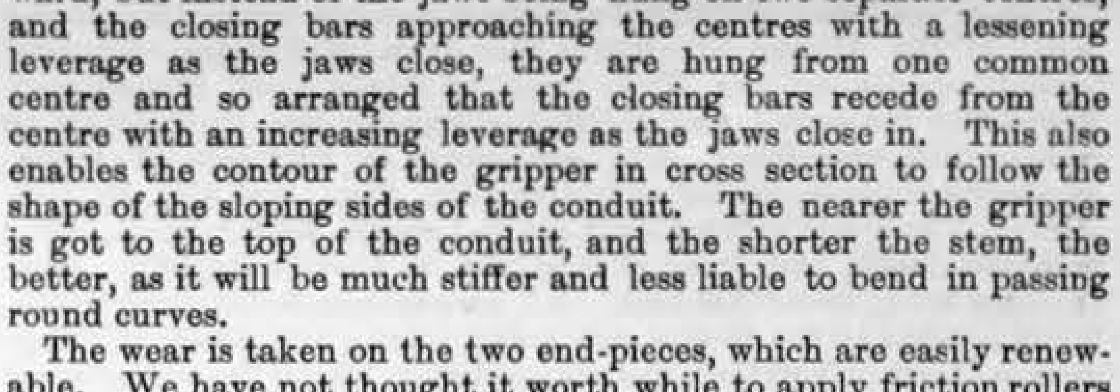
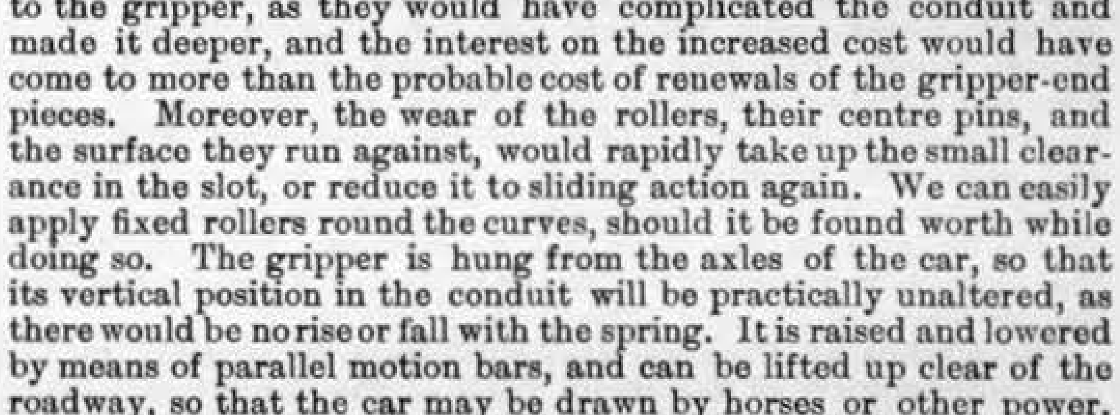


Fig. 4.



Geary-street cable road, San Francisco, with jaws opening downward, but instead of the jaws being hung on two separate centres, and the closing bars approaching the centres with a lessening leverage as the jaws close, they are hung from one common centre and so arranged that the closing bars recede from the centre with an increasing leverage as the jaws close in. This also enables the contour of the gripper in cross section to follow the shape of the sloping sides of the conduit. The nearer the gripper is got to the top of the conduit, and the shorter the stem, the better, as it will be much stiffer and less liable to bend in passing round curves.

The wear is taken on the two end-pieces, which are easily renewable. We have not thought it worth while to apply friction rollers to the gripper, as they would have complicated the conduit and made it deeper, and the interest on the increased cost would have come to more than the probable cost of renewals of the gripper-end pieces. Moreover, the wear of the rollers, their centre pins, and the surface they run against, would rapidly take up the small clearance in the slot, or reduce it to sliding action again. We can easily apply fixed rollers round the curves, should it be found worth while doing so. The gripper is hung from the axles of the car, so that its vertical position in the conduit will be practically unaltered, as there would be no rise or fall with the spring. It is raised and lowered by means of parallel motion bars, and can be lifted up clear of the roadway, so that the car may be drawn by horses or other power. As the jaws open downwards, they can readily drop or pick up the cable.

The next point was to avoid the depth taken up by the vertically running support pulleys, which practically controlled the depth of the conduit. This has been accomplished by the application of horizontal support pulleys, arranged in pairs, of the shape shown in Fig. 2, the cable being supported between the two pulleys. The centre pins run in oil wells, and the driving bell formation of the pulley prevents water and dirt being washed over into the bearings in case of the flooding of the conduit.

These arrangements enable the conduit to be made of the form and construction shown in Fig. 3, which represents a cross section of the road. This conduit needs no separate drain, as its form is such as to serve as a drain in itself, branch connections being made into the adjacent gullies wherever needed. The system in most of its leading features has been applied with marked success on the Sydney tramways by Mr. Gustav Fischer, the Government engineer.

It will be obvious from an inspection of the diagrams that there will be a material reduction in initial cost, as compared with the deep conduit, as well as reduction in the time required for construction, most of the work being of a kind that can be prepared beforehand in the workshops, gauged and fitted together, in readiness to lay down as soon as the foundation is prepared for it. These modifications entirely remove the only valid objections to the cable system, and enable it to compete in initial cost with the least costly form of electric traction, while in efficiency and low cost of working, no other form of traction, depending on adhesion and secondary power, can approach near it.

ON IRON SLEEPER PERMANENT WAY.*

By J. SCHULER.

IN reviewing the descriptions of various forms of iron sleepers which have appeared in the "Organ" during the last year, the author states that a sleeper, good from an economical point of view, must fulfil the following conditions:—First, it must ensure a firm fastening of the rail with a sufficient capacity for resistance, and must be capable of being advantageously packed; and secondly, it must secure for the permanent way a firm and fixed position in the ballast. None of the systems at present known fulfils the latter condition, because in consequence of the rigid connection between the rail and sleeper, the sleeper is forced to yield more or

* Read July 31st, 1896, before the Tramway Institute of Great Britain and Ireland

* "Minutes of Proceedings," Inst. C.E.—Abstracts.

less to the forces which act upon the rail, and the amount and direction of the movements of individual sleepers are unequal and variable. A wooden sleeper in bending tends to move in the direction of its longitudinal axis, whereas an iron sleeper has a tendency rather to rotate around its longitudinal axis, which is the most hurtful motion to which a sleeper is subjected, and it is therefore most important that a remedy for it be found.

The author, by the aid of figures in the text, enters into an analysis of the forces acting on a sleeper, and the conclusions he arrives at are, that iron sleepers with a cross section approaching most nearly to an arc will offer the least resistance to rotatory motion, and one of rectangular form the greatest resistance; those of trapezoidal form cannot be maintained in a fixed position in the ballast. A sleeper proposed by M. Schubert of a form similar to a V, with the centre solid and the tails turned back flat, adapts itself to packing more easily and advantageously than any other sleeper, and is better protected against rotatory motion.

The unstable position of iron sleepers laid in ordinary ballast caused some railway companies to use broken stone for ballast, and although this made a firmer bed with a greater resisting capacity, the rolling stock and rails were subjected to a greater strain in consequence of the diminished elasticity of the formation. Fractures of rails, sleepers, wheels, and springs increased on these lines.

The author states that a complete removal of the difficulty is only possible by using a flexible rail, and not therefore by increasing unnecessarily the weight of the rail; and if, whilst retaining the ordinary spacing of the sleepers and rails, whose moment of resistance is sufficient for the loads, an elastic bed-plate is used, by means of which the loads always act at the centre line of the sleeper, then the latter not only replaces the elasticity of the wooden sleeper, but it admits of the introduction of light iron sleepers with a large moment of resistance, of wider surface and capable of being well packed, because in the formation of these sleepers the moments tending to cause rotation need not be taken into consideration. An elastic bed-plate answering to these requirements was described by the author in an earlier number.† The elastic bed-plates reduce the action of the joltings upon the rail supports, and the ballast and rails are maintained much better in position; without increasing the weight or amount of expenditure, a greater security in working, and higher speeds are attained with a reduction of working expenses. The author is of opinion that the employment of metal sleepers would be materially extended if they were supplied with elastic seatings.

The papers are accompanied by various sections of iron sleepers.

J. A. T.

LAUNCHES AND TRIAL TRIPS.

In view of the forthcoming launch of H.M. first-class cruiser Diadem, the Fairfield Shipbuilding and Engineering Co., Govan, have commenced pile-driving operations at the end of the shipway on which the vessel is being built, to bind the soil and prevent land-slipping during her transit to the water. The Diadem is the largest warship ever built at Fairfield, her total weight in sea-going trim being estimated at 11,000 tons. She is one of four cruisers of similar dimensions and form building for the British Navy. The other three, which are named Europa, Niobe, and Andromeda, are building at Clyde Bank, Barrow-in-Furness, and Pembroke respectively. Although only laid down last January, progress with the Diadem has been so rapid that a considerable amount more material has been worked into her structure than in the sister ships. Her hull is completely plated from keel to topsides, while the 4in. teak sheathing, with which the under-water portion is to be encased, is being rapidly adjusted, fully one-half the required quantity having already been fixed into position.

Messrs. David J. Dunlop and Co., Inch Works, Port Glasgow, launched last week the steel twin-screw steamer Ilorin, built to the order of the African Steamship Company, of London, for their branch service on the West Coast of Africa, and immediately thereafter the vessel was moored alongside the yard wharf to receive her machinery, &c., consisting of two sets of triple-expansion engines, having cylinders 13in., 21in., and 34in. by 24in. stroke. The Ilorin's dimensions are:—Length, 220ft.; beam, 36ft.; moulded depth, 14ft.; and classed 90 A in Lloyd's Registry, gross tonnage being about 900 tons. All arrangements for easily maintaining steam in the tropics are being fitted; the steam steering-gear is Harrison's patent, the engine being placed in engine-room directly under the control of the engineers. The deck machinery includes direct steam windlass and five steam winches, all of Messrs. Clarke, Chapman, and Co.'s make, with their derricks. The poop bridge and forecastle, which are arranged to give exceptionally good light and ventilation, are fitted with cabin and saloon for officers, engineers, &c., the crew and firemen being located under the forecastle. The captain's cabin is fitted on the bridge deck, in a large teak deck-house. From this bridge the steamer is navigated. The rig is that of a two-masted fore-and-aft schooner.

The officials at Chatham Dockyard have transmitted to the Admiralty reports of the steam trials of the Venus and Spitfire. The former is a second-class cruiser, built and engined by the Fairfield Shipbuilding Company, Glasgow, and the latter a torpedo boat destroyer, built by Sir William Armstrong, Mitchell, and Co., of Elswick, and engined by Messrs. Bellis, of Birmingham. The trials of the Venus were of a most comprehensive and exhaustive character, and practically extended over ten days. The contract stipulated for a speed of 18·5 knots under natural draught, with the engines developing 8000 indicated horse-power; and the result of eight hours' steaming was to show 8204-horse power and an average speed of 19¼ knots. The forced draught test was equally satisfactory. The Venus steamed four hours continuously, and developed 9774-horse power, as against 9600 estimated in contract, whilst the average speed was at the rate of 20·18 knots, being nearly three-quarters of a knot in excess of what was required. Much interest was centred in the coal consumption trials, the Venus being under steam thirty consecutive hours. She left the Nore at six o'clock in the morning, and the test commenced at 7.45. Her machinery worked admirably, and she was able to reach the Eddystone Lighthouse before the return trip was commenced at 9.30 p.m., and she was back again at the Nore at 1.45 on the following day. She steamed throughout with open stokeholds, the draught being purely natural, and the horse-power attained was 4876—800 to the good—and the average speed per hour was 16·8 knots, although only going at half speed and running under the easiest conditions. The consumption of fuel was very satisfactory, being only 1·6 lb. per indicated horse-power per hour.

The new steamship La Plata, built by Messrs. R. Napier and Sons for the Royal Mail Steam Packet Company, London, had a most successful trial trip recently on the Firth of Clyde, when the conditions of the contract were fully implemented. The La Plata is the first of three steel screw steamers Messrs. Napier have on hand for the Royal Mail Company. These fine steamships have been specially designed to meet the requirements of the company's extra service to Brazil and the River Plate, and are intended to carry a large cargo, with comfortable accommodation for first-class passengers and emigrants. The general dimensions are:—Length over all, 360ft.; breadth, 44ft.; depth, 27ft.; with a top-gallant forecastle, long bridge, and full poop, and a gross tonnage of 3300 tons, built of steel to class 100 A1 at Lloyd's under special survey, and fitted in accordance with the Board of Trade regulations for passenger steamers. The upper deck and fittings are of teak, and the most modern appliances have been supplied for the efficient working of the ship and the rapid handling of cargo, with a complete installation of electric lighting throughout the vessel, and refrigerating machinery on the carbonic anhydride systems, with chambers of 7700 cubic feet capacity for the transport of frozen meat, &c. The vessel is built with a cellular double bottom all fore-and-aft, and is constructed in accordance with the recommendations of the Bulkhead Committee, and the ventilating arrangements throughout the ship are exceptionally complete. The machinery consists of a set of triple-expansion engines, having cylinders 36in., 42in., and 70in., by 4ft. 6in. stroke, with three steel boilers for a working pressure of 180 lb., and fitted with the most modern appliances for efficiency and economy, including Howden's system of forced draught.

The Creole passenger and freight steamer, built for the Cromwell Steamship Company by the Newport News Shipbuilding and Dry Dock Company, from the designs and under the superintendence of Mr. Horace See, for service between New York and New Orleans, was launched on the 8th inst. Her principal dimensions are:—Length over all, 375ft.; breadth, moulded, 44ft.; depth, moulded, 32ft. 6in. The hull is built entirely of steel, with three continuous decks and a partial orlop deck forward and a promenade deck at top of main deck-house extending about 170ft. in length. The Creole is the first vessel sailing out of New York in the coastwise trade to be fitted with a water bottom, which is not only a convenience but also a very great safeguard, as it gives her an inner and outer shell. Besides this her hull is sub-divided into a number of water-tight compartments by means of transverse bulkheads. Her outside plating has vertical lap joints below the water-line. She is rigged with two steel pole masts and the necessary booms for handling cargo. The Creole has accommodation for seventy-five first-class passengers amidships, in the most comfortable part of the ship, and for 150 steerage passengers aft. The large dining saloon is placed at the forward end of and extending the full width of the deck-house. The general arrangement of the passenger accommodation is, in many respects, a new departure from the usual type of coastwise passenger steamers, and is more on the plan of the modern Transatlantic steamship. There are two large lobbies, one on upper deck and one on promenade deck, connected by the main companionway. The deck accommodation is large and well protected by awnings. The main engine is of the vertical triple-expansion type, with cylinders 28in., 44in., and 74in. diameter and 54in. stroke. The valves are of the piston-slide variety, worked by the See-Marshall valve gear, each valve receiving its motion from a separate excentric. Steam is furnished by three cylindrical double-ended steel boilers, each having six corrugated furnaces with a common combustion chamber. The working steam pressure is 180 lb. The circulating pump is centrifugal, and driven by an independent engine. A hydro-pneumatic ash ejector will be fitted in each fire-room for discharging ashes.

† "Minutes of Proceedings," Inst. C.E., vol. cxv., p. 453.

AMERICAN NOTES.

(From our own Correspondent.)

New York, August 12th.

The commercial situation has not improved. Railroad earnings are unfavourable. Crop reports are right. General business flags. Prices are weak, and a restriction of production is general. Political agitations continue, and even in the Eastern manufacturing sections there is a silver sentiment, which newspapers dare not admit, and pretend to not know about. The quiet drain of gold must continue under the circumstances. Railroad building for autumn is more promising, but the big lines that have been built so long on paper will have to go over for another year. Rail makers will not yield on prices, nor will billet makers, who love monopoly prices like their brothers in the coke and iron ore businesses. This holding up of prices is not hard to understand. If there was a rush of orders quotations would weaken. Southern pig iron makers are holding out strong inducements to customers. Western Pennsylvania mills have recently all resumded. Work is being hurried along in open hearth plants. Rail makers hold on high prices, despite a falling off in demand. The volume of general business has declined during August, though coal production has increased. Parsimony in expenditures and in operating expenses will continue to prevail in all branches until the prizes in our national political lottery are known next November. The silver circus has not developed far enough yet to properly size it up.

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

(From our own Correspondent.)

The improved trade reported from the North of England on 'Change at Birmingham to-day, Thursday, helped to strengthen the market. The works in this district are well provided with orders, and the general outlook is favourable.

Pig iron is in quiet sale, but stocks are very low, and prices are well maintained at 35s. 6d. to 36s. 6d. for Staffordshire cinder pig, 40s. to 42s. 6d. for part mine, and 55s. for all mine. Cold blast pig is 90s.; Lincolnshire forge is 44s. to 45s.; North Staffordshire and Derbyshire, 41s. to 42s.; and Northamptonshire, 40s.

In finished iron, marked bars are steady at £7 to £7 12s. 6d., and merchant bars have a moderate sale at £6 to £6 10s. Common bars are in good call at £5 10s. to £5 15s. Black sheets are still in strong demand, owing to heavy orders for the galvanisers. Doubles are £6 17s. 6d.; and lattens, £7 17s. 6d.; stamping sheets are £9 10s.; and galvanised sheets of 24 gauge, £10 10s. to £10 15s., delivered Liverpool. Gas tube strip is £5 7s. 6d. to £5 10s.; angles are £5 15s.; hoop and thin strip, £6; and nail rod, £6 10s. to £6 15s.

Steel is active at £4 5s. to £4 7s. 6d. for Bessemer blooms and billets of Staffordshire make, and £4 10s. to £4 12s. 6d. for Siemens billets. Bars are £5 17s. 6d.; angles and girders, £5 12s. 6d.; and boiler plates, £6 5s.

An order for steam pump engineering requirements has been placed in South Staffordshire by Japan, and is the largest order of the kind yet received from that country.

It is announced that Messrs. J. Lysaght, sheet iron manufacturers, have decided to remove the whole of their Wolverhampton works, employing about 1500 men, to a situation nearer the coast. The removal will be gradual, extending over two or three years.

Much satisfaction is being expressed in this district at the Locomotive on Highways Bill of 1896 having become an Act. In a letter which has appeared in the Midland and other papers, Sir David Salomons, President of the Self-Propelled Traffic Association, asserts that there cannot be the slightest doubt in the mind of any reasonable man that this Act will be productive of great changes, and that if all those who have an interest in modern progress will strive to improve self-propelled traffic, and those who avail themselves of its benefits will act fairly towards others having no direct interest in the movement, it will be giving the English nation an advantage which can hardly be overrated, and without entailing, as I hope and believe, a vestige of discomfort or annoyance on any individual.

Another matter which is a cause of gratification in the Midlands is the progress which is being made with traction engine reform, as shown by the fact that the report of the Select Committee on Traction Engines on Roads has now been completed and issued. Business men in the Midlands are pleased to find that the Committee recommend that local authorities shall have no general power to prohibit the use of engines for specified hours through their county or county boroughs. It is understood that there are about 8000 locomotives in use on the highroads of the United Kingdom, employing from 30,000 to 40,000 men.

Sanitary engineers in this district are generally agreed that something ought to be done to stop the pollution of the river Tame, which is becoming decidedly detrimental to Tamworth and its neighbourhood. As the result of a conference between the sub-committee of the Sanitary Committee of the Staffordshire County Council and members of the Birmingham City Council and Tame and Rea Drainage Board, the Birmingham authorities have decided to appoint a surveyor to report jointly with Dr. Reid, the county medical officer, as to the whole area, causes of pollution, &c., with a view to agreeing upon what is necessary to provide a permanent remedy. A joint meeting of the Tamworth Town Council and the Rural District Council has been held, and it has been resolved to ask the other authorities named to add to the investigating body the Tamworth Borough Surveyor.

The directors of the Oldbury Railway Carriage and Wagon Company report that the result of the year's working, after deducting the adverse balance, is a profit of £14,707, with which they propose to pay the two years' dividend due to the 30th of June on the preference shares, and a dividend of 10 per cent. on the ordinary shares, to place £1500 to the reserve fund, and to carry the balance forward. The works are filled with orders, but, unfortunately, there is a scarcity of skilled labour, which prevents the directors taking full advantage of the improved condition of trade. Owing to pressure of work, the directors decided not to stop the works for the purpose of taking stock, and to adopt the figures as shown by the company's stock books.

The directors of Muntz's Metal Company have declared an interim dividend for the half-year ended June 30th last at the rate of 5 per cent. per annum on the preference shares and 5 per cent. per annum on the ordinary shares.

In the anchor forging trade of the Cradley Heath district an agitation for an advance of wages is being carried on by the Cradley Heath and District Small-anchor Smiths' Association. The men state that some time ago, owing to the depression in trade, the operatives' wages were reduced 1s. per cwt. Since then 6d. of that amount has been restored, and the operatives now consider the time has arrived when the remaining 6d. per cwt. should be conceded, so that the wages may be brought up to old rate. The foregoing is the workmen's view of the case, and it remains to be seen what reply the employers may put forward. Meanwhile the secretary of the Association has been instructed to communicate with the masters, with the view of securing, if possible, the advance of 6d. per cwt.

The newly-formed Master Brassfounders' Association met in Birmingham on Monday. Mr. J. H. Cartland—President—occupied the chair, and most of the leading brass foundry firms were represented, including Messrs. T. Pemberton and Sons, Tonks, Limited, Evered and Co., J. Collins, R. and C. Harcourt and Sons, Petford and Pountney, W. Hopkins and Son, Showell and Sons, &c. The rules as drafted by the committee appointed at the recent meeting of the trade were presented. These stated that the objects of the Association were to afford to members of the trade an opportunity for interchange of views, and for the discussion of any questions generally affecting the trade; the adjustment of difficulties between masters and men as and when they arise; to appoint the masters' representatives to act upon a Conciliation Board; and to assist the men in obtaining general payment of the bonus. Any manufacturer of cabinet or art, naval and general brassfoundry, is eligible for membership. The amount of the subscription is optional, but 5s. is to be the minimum. General meetings of the Association are to be held at least twice a year. The rules were adopted, and a large number of additional firms enrolled themselves as members of the Association.

The thirtieth annual report of the Birmingham Trades Council states that during the year the council has gained in numbers, notwithstanding some slight secessions from their ranks. It was pleasing to note that trade generally had been exceptionally good during the same period, and as far as present indications served they seemed to have entered upon a new period of prosperity. In view of the desirability long expressed of having working men on the magisterial bench, a memorial was drawn up by a committee appointed for the purpose and forwarded to the Lord Chancellor, together with the names selected by the Trades Council. The receipt of the memorial was duly acknowledged, and since then several appointments had been made, but the labour nominees were not accepted.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—In my previous notes I have referred to the possibility of American pig iron becoming a competitor in the market with some English brands, and although in well-informed quarters the successful competition of American iron here is regarded as too much dependent upon temporary and special conditions to assume anything like the character of a permanent or established trade, there is still the fact that negotiations are in progress with a view of exporting pig iron from the United States in considerable quantities to this district. One of the conditions which render such a trade possible is that the cotton-laden ships coming to Liverpool and up the Manchester Ship Canal have to carry a certain amount of ballast cargo, and the intention is to export pig iron at ballast rates in these vessels. No doubt this exportation of American iron into the Lancashire district is just now being stimulated by the depressed condition of the iron trade in America, and I believe that the principal portion of the iron it is proposed to send over here would come from Alabama, where, I believe, an export trade is the only outlet under existing conditions. A representative from one of the largest manufacturing companies in the above district has been on the Manchester Exchange during the past week, with a view of opening up direct negotiations with merchants here, and, subject to specially low ballast rates being obtainable, a fairly large weight of business is under consideration. It has been stated that the American pig iron makers are prepared, if these special ballast rates can be arranged, to ship over here not only surplus stocks which they are anxious to get rid of at under cost price, but to actually make iron for regular delivery at competitive prices with district brands, which are now largely used by Lancashire consumers. If this is actually the position, and considering that makers here are not able to secure more than a very moderate return upon current rates, this threatened competition of American iron could scarcely be met by any material reduction in price. The only alternative would be some concession on the part of the railway companies with regard to what are considered their present high rates of charges for carriage. I understand that negotiations are already in progress for a reduction of 1s. per ton on the rates for Middlesbrough iron, which at present costs 8s. 4d. for carriage to Manchester, whilst district makers, who have to pay almost as much for carriage from Lincolnshire and Derbyshire to Manchester, as the rate at which American pig iron has recently been shipped from Mobille, would, no doubt, also claim some concession. For the present the threatened competition of American pig iron presents a disturbing outlook in the trade of this district, and further developments are being watched with considerable interest.

Only a slow sort of business continues to be reported on the Manchester Iron Exchange, the holidays no doubt considerably interfering with transactions of any moment just for the present. The tone, however, is healthy, and notwithstanding a good deal of underselling by merchants, makers' quoted prices are generally steady at late rates. In pig iron a moderate business is doing, with quotations for local and district brands unchanged, foundry qualities still averaging 46s. 6d., less 2½, for Lancashire; 42s. net cash for Lincolnshire, and 45s. up to 47s. net cash for Derbyshire, delivered Manchester, with forge descriptions averaging 44s., less 2½, for Lancashire, and 42s. 2d. net cash for Lincolnshire, delivered Warrington. In outside brands there is a good deal of low selling by merchants, but makers are holding to late rates. For good foundry brands of Middlesbrough makers still quote 45s. 10d. to 46s. 1d. net cash, delivered by rail Manchester, but there are merchants who would sell as low as 45s. 3d. Scotch iron is obtainable through merchants at 45s. 9d. to 46s. for Eglinton, and 46s. to 46s. 3d. for Glengarnock, net prompt cash, delivered ports, although quite 6d. above these figures is quoted by makers. The threatened competition of American pig iron already referred to, and which I noticed last week, was a matter of considerable comment on 'Change, and some of the leading merchants are endeavouring to negotiate direct with makers in the States on the basis of prices, which would certainly cut out some of the district brands at present rates. In fact, American pig iron is already being offered against Lincolnshire at 6d. under the makers quotation for the above brand, and offers have been made to purchase considerable quantities of American pig iron, subject to favourable freight rates being obtained for carriage to this country; one offer, which I understand is under consideration, being based on prices equal to 38s. delivered Liverpool. A sufficiently low freight to enable American pig iron to be brought over here on the basis of the above figure has, however, not yet been obtainable; but there are evidently anticipations that some such price as the above may be possible, and some merchants are basing their present operations upon the assumption that American pig iron will tend to force down the price of some of the English brands, and enable them to cover sales that are just now being made at so much under makers' prices.

In the manufactured iron trade there is a fair weight of business stirring, and makers are kept well supplied with work, but they are not as yet in a sufficiently strong position to make any advance in their quoted rates. Prices, however, are steady at £5 10s. for Lancashire, £5 12s. 6d. to £5 15s. for North Staffordshire bars; £7 5s. to £7 10s. for sheets; and £6 2s. 6d. for random to £6 7s. 6d. for special cut lengths of hoops, delivered Manchester district, with 2s. 6d. less for shipment.

The position in the steel trade is just now anything but satisfactory. Hematites are easier, makers being prepared to accept 57s. to 57s. 6d., less 2½, whilst merchants continue to undersell. Local made billets do not average more than £4 7s. 6d. net cash, and even at these low figures there is threatened competition with American billets coming into this country. Notwithstanding the activity amongst boiler makers and all users of steel plates, prices for these are easier, boiler plates having been offered during the week at £6 2s. 6d. to £6 5s. delivered here.

In the metal market manufacturers continue busy on orders in hand for all descriptions of manufactured goods, and a brisk demand still comes forward, notwithstanding the holidays at local engineering establishments, which, in many cases, have placed large orders for delivery immediately on the re-starting of work. Prices are firm at late list rates.

With regard to the engineering trades of this district, except that the usual annual holidays just now going on in many of the principal industrial centres of Lancashire, are for the time being putting a temporary stop to operations, the position continues of much the same satisfactory character as I have reported for some time past, and although there is perhaps not quite so much pressure for the completion of orders, this is mainly attributable to the cause above referred to. In all branches work continues plentiful, and the returns issued by the trade union societies afford evidence of the favourable condition of trade in the exceptionally small proportion of unemployed members on the books, the present percentage being the lowest recorded for a considerable number of years past.

I have previously noticed one or two of the newest designs in electric driven cranes which Messrs. Vaughan and Son, Royal Iron Works, West Gorton, have made a speciality, and the other day I paid a visit to their works, which have recently been considerably extended to enable the firm to cope with their increasing business. The additions to the works include a new well-lighted erecting shop, 200ft. long by 50ft. wide, and a second floor or gallery for light machine work, the floor below being used for store-room and heavier machine work, whilst the firm have also in contemplation the erection of a new range of offices. The special feature of interest in Messrs. Vaughans' enlarged works is a 20-ton electric overhead travelling crane of their latest design, which they have installed in their large new erecting shop, and which forms a good example of the most recent advances in this class of work. In this crane a separate reversible motor combined with spur gearing is employed for each of the three motions of longitudinal travel, cross travel, and hoisting. The motors for cross travel and hoisting, which are compactly fitted to the crab, drive directly on to the spur wheel shafts without the intervention of any friction or worm gearing, and all the motions are perfectly under the control of the attendant seated in the cage, separate reversing switches being provided, so that all the motions can be carried on in either direction, simultaneously or separately, as desired. In order to secure the greatest economy in working, the longitudinal travel is arranged to be variable from zero up to a maximum of 250ft. per minute, this high rate of travel being obtained with perfect smoothness and safety, a reversible motor being fixed on one end of the girders driving one of the main carriage wheels, at each end, by means of a steel cross shafts passing from end to end of the girder and spur gearing. By this method of driving, a considerable saving of power is obtained, the current only being taken when travelling or hoisting is actually in progress, whilst ropes, pulleys, and belt-driving gear are entirely dispensed with, and the speed can be varied as required by a simple movement of the switch handle. I may further mention that at the time of my visit Messrs. Vaughan had in hand a number of cranes of various sizes for different works throughout the country, including a 15-ton three-motor crane, for new shops which are now being erected by Messrs. Neilson and Co., Glasgow.

Only a very slow demand is reported generally for all descriptions of fuel, and, except where collieries are putting into stock, very few pits are working above three to four days per week. In house coal, users to a large extent got in their winter supplies during the recent scare in the market, and there is consequently just now only a very limited business doing in the better qualities of round coal, which are accumulating in stock. Prices are without quotable change, except that they have got back to old rates, averaging 9s. 6d. to 10s. for best Wigan Arley; 8s. to 8s. 6d. for Pemberton four-feet and seconds Arley; 6s. 6d. to 7s. for common house coal, at the pit mouth. Common round coals for steam and forge purposes hang on the market, with 5s. 6d. to 6s. the full average figures for ordinary descriptions, at the pit mouth. Gas coal contracts are now generally settled for the ensuing season, and, as anticipated a month or two back, the general basis of prices has been quite 3d. under those of last year, 6s. 7d. to 6s. 10d. having been about the average figures at which contracts of the better qualities of screen Wigan Arley have been secured, as compared with about 7s. last year. Engine fuel is more plentiful, partly owing to the limited requirements for mill consumption during the holidays, and also to the increased supplies coming in from other districts, recent concessions in railway rates for carriage from Yorkshire having still further facilitated the competition from that important centre. Common slack at the pit mouth does not average more than 3s. to 3s. 6d., and better sorts 4s. 3d. to 4s. 9d. per ton.

Shipping business continues quiet, with ordinary steam coal averaging about 6s. 9d. to 7s. 3d. delivered Mersey ports.

Barrow.—The demand for Bessemer qualities of pig iron is steady and brisk, but there is still a poor market for forge and foundry qualities. Makers still hold firmly to old prices at 48s. to 49s. per ton net. f.o.b. for mixed Bessemer numbers, while warrant iron is easier at 46s. 3d. net cash sellers, 46s. 2½d. buyers. Stocks have been further reduced this week to the extent of 1397 tons, leaving 312,095 tons still in hand, or 22,920 tons less than at the opening of the year. Thirty-six furnaces are in blast as compared with twenty-eight in the corresponding week of last year.

Iron ore is quiet at 10s. per ton net at mines for ordinary sorts.

Steel makers are as busily employed as they possibly can be, and not only have makers large orders in hand, but a goodly number on offer. Rails are a good trade, and orders are largely offering from all sources, and particularly from foreign and colonial governments. Prices are steady. The trade in plates and other descriptions of shipbuilding material is brisk, and local and other shipbuilders are large buyers. Brisk business is reported in hoops and billets, and a busy trade is still maintained in heavy steel castings.

Shipbuilders and marine engineers are busy; but many more orders could conveniently be dealt with. Overtures are in progress for new Admiralty and commercial work, and it is expected new contracts of some importance will be obtained shortly.

Coal is still in quiet demand and prices are low. Coke is steady at old rates.

Shipping is busier. The exports from West Coast ports during the past week represent 10,875 tons, and of steel 8054 tons, as compared with 4038 tons of pig iron and 2552 tons of steel in the corresponding week of last year, an increase of 6837 tons of pig iron and 5502 tons of steel. The aggregate shipments this year so far have reached 198,400 tons of pig iron and 318,355 tons of steel, as compared with 186,260 tons of pig iron and 224,749 tons of steel in the corresponding period of last year, an increase of 12,140 tons of pig iron and 93,606 tons of steel.

Much interest was taken this week in the visit of the Chinese Envoy, Li Hung Chang, to Barrow this week. His Excellency devoted much attention to work going on at the Barrow Steel Works, and the Naval Construction and Armaments Company's works. He was especially interested in the weight of rails which ought to be put down on the new Chinese railways, and was advised by Mr. Aslett, the general manager of the Furness Railway Company, to put down rails not less than 85 lb. per yard, in view of heavy traffics, heavy locomotives, and heavy rolling stock.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

The pits in the South Yorkshire Colliery district are making rather better time, four to five days a week being generally wrought, and in a few instances a full week's work is given. This satisfactory condition of affairs is chiefly attributable to the certainty of peace being maintained throughout the area of the Miners' Federation of Great Britain, all the threatening symptoms having apparently died away. Several sentences in the yearly statement by Mr. Benjamin Pickard, M.P., the president of the Federation, who is also secretary of the Yorkshire Miners' Association, are a little disquieting, but they are not taken *au sérieux*, and are not likely to disturb the prevailing feeling of confidence in the districts. It is noteworthy, however, that in spite of the improvement in the general coal trade, no attempt is made to restart the collieries which were recently closed. It is in this direction that danger lies. The coalowners have made up their minds to limit operations to the seams which can be worked without loss, and this in no small measure accounts for the brisker business in the larger pits. Mr. Pickard intimates that there may be trouble if too many pits are shut up; but this appears to be the only course open to the coalowners working under conditions which handicap them in competing against localities enjoying the advantage of sea transit and considerably lower wages. The miners in the neighbourhood of the large pits just being opened will receive more pay; the others, resident in the places where the seams have been found to be thin or where the thicker beds are giving out, will have to seek other quarters; and in any case there will not be adequate work for the whole of them. This is what Mr. Pickard anticipates, for none know better than himself that the drain for support of the unemployed miners will in that case be too severe for the funds of the Miners' Unions, and if that relief is withheld on the ground that it is not strike pay, there will be trouble all the same.

Although the weather has been unusually chilly, with north-east winds dominant, the house coal trade has been by no means quickened. Householders laid in supplies prior to the expiry of the Conciliation Board, and thus anticipated the stocking season. What business there is for London is mainly taken by the North-country pits, from which the market is reached by sea. For best Silkstones the quotations range from 8s. to 9s. per ton, ordinary qualities making from 6s. 6d. per ton; Barnsley house, from 7s. to 8s. per ton; thin seam, from 5s. 6d. per ton. A very good business is being done in steam coal, fully an average tonnage being sent to Hull, while Grimsby is also loading fairly average deliveries. Several of the collieries are delivering more freely to the continental markets. Barnsley hards remain at 6s. 6d. to 7s.; secondary qualities from 5s. 9d.

In gas coal values are maintained, from 6s. to 7s. per ton being readily given. Manufacturing fuel is being largely ordered, the increased requirements for coking purposes keeping quotations fairly regular. Small nuts are from 4s. to 4s. 9d. per ton, screened slack from 3s. 3d. per ton, pit slack from 2s. 9d. per ton, smudge from 1s. to 2s. per ton. The output of coke is daily increasing—best makes, 12s. per ton; while ordinary qualities are to be had from 8s. 6d. to 10s. per ton. New ranges of coke ovens are being laid down in some directions.

The iron and steel trades are well maintained, and prices are firm at recently quoted figures, with a tendency to go higher. In Swedish steel the difficulty is to get the higher grades in weight sufficient to meet requirements. Prices are going up steadily £1 10s. per ton in best qualities and £1 per ton in second being the advance of a single week. This advance is attributable mainly to the abnormal demand from the United States and Birmingham district for steel for cycling and other tubing. Charcoal has also gone up through the same cause. Hematites are at former rates—54s. to 57s. per ton, according to brand, delivered in Sheffield—and forge irons are also quoted at previous figures—39s. per ton, also delivered in Sheffield, with a likelihood of their going higher. The general heavy trades are in a satisfactory condition, especially as regards railway material, which is still being freely ordered, chiefly on home account. The Eastern markets have of late yielded a good deal of important work, but not to the weight expected. It is a local disappointment that Li Hung Chang has not been able to visit Sheffield, for he would have seen much here that would have exercised an important influence on the future of his country. Still, whatever he does elsewhere is certain to favourably affect Sheffield, which provides the specialities in railway, marine, and military material, to say nothing of the extensive range of tools required in the Chinese arsenals. A gratifying feature of business this season is the steady improvement reported from the Australian markets. The orders at present are principally for tools, cutlery, and plated goods, the latter mainly in the secondary grades. At one time Australia was a great market for the best classes of silver ware. The tendency is now to take lower qualities. Makers of tools are exceedingly busy.

The foreign trade in unwrought steel for July amounted to £195,147, as compared with £179,222 for July of 1895. The increasing markets were Sweden and Norway, Denmark, Holland, France, British East Indies, Australasia, and British North America. Decreases were shown by Russia, Germany, and United States. In hardware and cutlery the value of goods exported last month was £172,555, against £155,295 for July of 1895. All markets showed an increase except Sweden and Norway, Belgium, France, Spain and Canaries, United States, Foreign West Indies, and Brazil.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

Holidays have somewhat interfered with business in this district this week, but nevertheless there is no doubt of the fact that the iron market has improved, and that producers have good reason to expect a busy autumn with better prices. Makers of pig iron report a large number of inquiries during the last few days, chiefly from the Continent, and it is evident that consumers have made up their minds that they will not be able to satisfy their requirements for the rest of the year on more favourable terms than now prevail. As yet, the brisker inquiry has not resulted in much extra business, because the prices that have been offered by buyers have not been such as the sellers could entertain, because no more was offered for forward than for prompt deliveries, and producers have grounds for expecting that they will be able to realise substantially higher prices next month when the autumn demand has fully set in. Most makers have preferred recently to put iron into stock rather than sell it at the prices that have been ruling, and some producers have never sold any No. 3 Cleveland pig iron under 37s. 3d. As compared with last week, No. 3 has advanced 3d. per ton, the lowest figure quoted either by producers or merchants being 37s. for prompt f.o.b. deliveries, and very little has this week been sold under that price, while 37s. 3d. is the minimum for next month. Cleveland warrants have improved in value, and there is a larger demand for them, as on account of their being so much cheaper than makers' iron, consumers have been buying them in preference. The increased demand for warrants accounts for the heavy reduction in the stock of Cleveland iron in Connal's warrant stores. On five days this month has the reduction exceeded a thousand tons, an almost unprecedented occurrence. On Wednesday night, 184,627 tons were held, the decrease for the month being no less than 9166 tons. Seeing that warrants have been 4d. to 6d. per ton cheaper than makers' iron, the extra demand for them is what might be looked for.

There is this week a reduced consumption of pig iron in the Teesside district, as almost all the finished iron and steel works, foundries, and indeed all establishments consuming pig, have been idle since Tuesday evening, and will remain so till the commencement of next week, the holiday being what is usually given in Stockton race week. But this decrease in consumption is counterbalanced by a decrease in the make, so that stocks are not likely to be much augmented this month. No 4 Cleveland foundry pig is quoted at 36s.; grey forge at 35s. 6d.; and mottled and white at 35s. 3d., and more of these forge qualities are available for sale than has been known for a long time. Mixed numbers of Cleveland hematite pig iron are firm at 45s. per ton. Rubio ore is 12s. 9d. per ton at wharves on Tees, and is not likely to be reduced as long as rates of freight keep up, and they will probably not be reduced until after the autumn. Blast furnace coke does not change in price, for though in this district the consumption has been reduced by the blowing out of furnaces, this has been counterbalanced by the relighting of others on the West Coast.

The production of pig iron in the North of England has been reduced this month by the stoppage of blast furnaces last Friday in order that the men might demonstrate in favour of the eight hours' day, a concession which they are not likely to obtain, seeing that the arrangement is not a success at works where it has been introduced. Out of the twenty-four pig iron manufactories in the North of England eighteen were idle last Friday. Those establishments were kept at work where the eight hours had been conceded, and operations were continued at the Linthorpe and Redcar Ironworks, where the men are not connected with the Association. The two furnaces making spiegeleisen at Messrs. Bolckow, Vaughan, and Co., Middlesbrough Works, and a furnace producing ferro-manganese at Messrs. Gjers, Mills, and Co., Ayresome Ironworks, were kept going, as they could not be stopped without serious results following. It is estimated that the holding of this demonstration will reduce the output of the month by 10,000 tons, as the diminution of production is not confined to the day alone, for several days less iron would be turned out by the furnaces which were stopped; and besides this, the quality would be poorer, makers in consequence being considerable losers, as they would produce less of the quality which is most in request—No. 3, and more of the lower qualities which are not so readily saleable, but which cost just as much to produce as the higher quality. Ever since Friday some of the furnaces have been damped down. The Clay Lane Iron Company have damped down a furnace for repairs, which will take three weeks or a month to execute.

As a result of the blast-furnacemen's demonstration two furnaces have been altogether blown out, and others may have to be stopped also. Messrs. Bell Brothers have blown out a furnace at Port Clarence, and the North Eastern Steel Company one at Acklam Ironworks, Middlesbrough. In the case of this latter furnace the company intended that it should run until they had one of the two new furnaces, now in course of construction, ready to take its place, which might be in six or seven months. But in order to keep it in operation for that period it was absolutely necessary that it should be run without interruption, and a stoppage for a day meant the blowing out of the furnace altogether. This state of affairs was represented to the men working at the furnaces, but they decided to have their day's holiday at any cost, and the consequence is that instead of having continuous work for six months till a new furnace is ready they will be idle over that period. Such action as this cannot well be credited, but nevertheless that is the fact. The North Eastern Steel Company, who acquired the Acklam blast furnaces last month, intend to add three furnaces to the four now existing, so as to supply themselves with basic iron, and two of the furnaces are already in course of construction.

There is no lack of orders in the finished iron and steel trades, and prices all round are well maintained with rather a tendency to advance. In Cleveland and South Durham some of the finished iron and steel works, the foundries and engineering shops, the shipyards, &c., have been idle all the week, but most establishments closed on Tuesday evening for the week on account of the holidays, which are always given in Stockton race week. The only important exceptions are Messrs. Bolckow, Vaughan, and Co.'s Eston Steelworks, and the North Eastern Company's Works at Middlesbrough. The fact that they have been kept in full operation over the holidays affords evidence of the activity of the rail trade. Other establishments would have been kept at work if the men had been willing, as the stoppage causes much inconvenience when the manufacturers are in arrear with the execution of their contracts. It was finally decided on Monday that the Darlington Steel and Iron Company should be wound up voluntarily. It is found impossible for that inland rail-making establishment to compete successfully with works which are situate where shipping facilities are good. Mr. W. Barclay Peat, of London and Middlesbrough, has been appointed liquidator.

The shareholders of Jno. Abbot and Co., Park Works, Gateshead-on-Tyne, will receive a dividend for the last financial year of 5½ per cent. A profit of £11,986 was made during the year. The directors report that in the first half of the year the demand increased, but prices remained stationary; in the second half a larger business was done, and at slightly improved prices. Chains and anchors were in greater request, and freedom from labour disputes allowed of profits being made. The sum of £9964 has been spent during the year in repairs and renewals, and this sum was taken out of revenue. New machinery has been added in several departments, and other additions are contemplated.

The North-Eastern Railway between Darlington and Barnard Castle has been doubled from Barnard Castle East Junction and Broomielaw, and the new line was opened on Sunday last. Gradually the whole line between Darlington and Tebay is being doubled. On Monday the company opened their new line between Annfield Plain and Blackhill, an extension of the line from Birtley Junction and Annfield Plain, which was opened in the early part of 1894. The length of line brought into use this week is 6 miles 69 chains, and has been constructed partly by Messrs. Nowell and Sons, Victoria-street, Westminster, and Mr. T. D. Ridley, of Middlesbrough. The route of the railway is that of an old line, long used for minerals. The line will shorten the distance from several points of the North-Eastern system to Consett, and may be used for the large ore trade from the ports to Consett.

Engineering establishments are in general well occupied, and the number of unemployed continues to decline, especially in the Teesside district. The Secretary of the United Society of Boiler-makers and Shipbuilders reports that there is an increasing demand or the members of the society, and the number of the unemployed s becoming "beautifully less." The present improvement in trade is not, in his opinion, likely to assume the same dimensions as the shipbuilding boom of 1881-3. Ironfounders, particularly those producing pipes, are doing well, and prospects are satisfactory.

The coal trade is on the whole less depressed than for some considerable time, and the demand has improved appreciably both for steam and gas coals, while the prices have stiffened. Shipments are satisfactory, and operations are brisk at all the docks and coal shipping places, more especially at Tyne Dock and Dunston. But Northumberland steam coal is steady at 8s. 4½d. per ton f.o.b., and steam smalls are at 3s. 6d. Best Durham gas coals are at 6s. 6d. per ton f.o.b.

Intelligence has been received that Mr. Joseph Proud, who was for many years connected with the South Hetton Coal Company, and who is now in New Zealand, has been appointed by the Government to act along with Judge Ward and Sir James Nector, F.R.S., on a Royal Commission to inquire into the cause of the Brunner Colliery explosion.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron market has been unsteady this week, in consequence of a threatened fresh dispute in the engineering trade. The circumstances connected with this affair are somewhat peculiar. In one of the Glasgow engineering shops there is a workman who objected on principle to become a member of the Union. His fellow-workmen sought to compel him to join by calling upon his employers to dismiss him, unless he consented. This the employers declined to do, and the rest of the men all came out on strike. The matter has been referred to the executive of the Engineers' Society, who have advised the men to return to their work. At the time of writing, however, they still remain out in defiance of instructions, and the gravity of the case consists in the fact that the action of the firm is supported by the united masters of Scotland and the North of England. It is felt that a dispute like this might cause a rupture between employers and workmen generally, were not wise counsels to prevail. The subject has been under the consideration of a conference of the masters held at Carlisle, and there is no probability that they would consent to relinquish their liberty to employ a competent workman whether he belonged to the union or not. Some authorities on 'Change are, however, of opinion that too much importance has perhaps been attached to this incident. At the same time there is no doubt that it has exercised a disquieting effect.

Business was done in Scotch pig iron warrants early in the week at 45s. 6½d. cash, and 45s. 7½d. one month. Subsequently the price fell about 3d. per ton, and a large quantity of warrants changed hands. It is worthy of note that so far speculation in pig iron is confined to professional circles. The interest in the market on the part of the outside public is very small. Cleveland warrants have met with a slow sale at 36s. 6½d. cash, and 36s. 7½d. to 36s. 9d. one month. Transactions have occurred in Cumberland hematite at 46s. 3d. to 46s. 3½d. cash, and 46s. 6d. to 46s. 5d. one month.

Since last report there has been some re-arrangement of blast furnaces, the result of which is that there is one furnace less making ordinary pig iron and one more producing hematite, the total number on blast being seventy-nine, the same as before. At this time last year there were seventy-six furnaces in operation. The weekly output of ordinary pig iron is about 1500 tons less than at this time last year, while the production of hematite is about 3000 tons per week larger than in August, 1895. This state of matters indicates pretty clearly the expansion that is taking place in the manufacture of steel.

The stocks of pig iron in Glasgow stores show a slight reduction, and there is a growing impression that stocks everywhere are light in comparison with the amount of raw iron now going into consumption. This belief is certainly having its effect as regards the market for makers' iron, which is firm in comparison with that for warrants. One or two brands are indeed being quoted 3d. to 6d. advance during the last few days.

The prices of Scotch makers' pig-iron are as follows:—Govan and Monkland, f.o.b. at Glasgow, No. 1, 46s. 6d.; No. 3, 45s. 3d.; Carnbroe and Wishaw, No. 1, 46s. 9d.; No. 3, 45s. 6d.; Clyde, No. 1, 48s. 6d.; No. 3, 46s. 6d.; Gartsherrie and Calder, No. 1, 49s. 9d.; Nos. 3, 47s. 6d.; Summerlee, No. 1, 50s.; No. 3, 47s. 6d.; Coltness, No. 1, 52s. 6d.; No. 3, 48s.; Glengarnock, at Ardrossan, No. 1, 49s. 6d.; No. 3, 45s. 6d.; Eglinton, No. 1, 47s.; No. 3, 45s.; Dalmellington at Ayr, No. 1, 46s. 6d.; No. 3, 44s. 6d.; Shotts, at Leith, No. 1, 52s. 6d.; No. 3, 48s. 6d.

The consumption of hematite pig iron is now believed to be quite as large as before the holidays. A very large quantity of Scotch-made hematite is being used. The tendency seems to be rather to displace Cumberland iron. This does not occur on account of any prejudice against the latter, but simply because the conditions are favourable to the cheap production of hematite in Scotland from imported ores. Merchants quote Scotch hematite 49s. 6d. per ton, free on trucks at the steel works.

It is worthy of special note that the shipments of Scotch pig iron have recently been improving. Those for the past week amount to 8474 tons, compared with 7903 tons in the corresponding week of last year.

The business in finished iron is on a moderate scale, the foreign demand being rather slow, while the consumption at home is well maintained. Prices are without change. The steel works are now getting very busy, turning out large quantities of material for a variety of purposes, the chief demand being perhaps on the part of the shipbuilders.

The coal trade is at length, after long months of dull uniformity and low prices, showing indications of an improvement. This appears to arise from a variety of causes. Just at the time when holidays are pretty general in some of the mining districts, the demand for manufacturing purposes, chiefly in connection with the iron and steel trades, has been expanding. The export trade with the Mediterranean has been gradually improving, and there is now more doing from East Coast ports with the Continent. At the same time, the miners in several districts, under the advice and influence of their leaders, have been restricting the output. The total coal shipments in the past week from Scottish ports have amounted to 196,487 tons, compared with 169,051 in the preceding week, and 173,373 in the same week last year. There is a total increase in these shipments for the present year to date of 234,422 tons. The prices f.o.b. at Glasgow are:—Main, 6s.; splint, 6s. 6d. to 6s. 9d.; ell, 6s. 6d. to 7s.; steam, 7s. 6d. per ton. In Ayrshire the demand is good, both for home use and export, and the prices there are, for best house coal delivered at the ship's side, 6s. 9d.; steam and main, 6s.; triping, 5s. 3d.; dross, 3s. to 3s. 6d. per ton.

There is a good deal of interest among working men in various branches of the iron and engineering trades, and here and there certain concessions are being made by employers either in the shape of improved conditions of working or slightly higher wages.

At a meeting held this week in Glasgow the Scottish Miners' Federation passed a resolution expressing its conviction that the miners are entitled to an advance of wages, and advising the men to strengthen their organisation with the object of obtaining such advance.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Reference has been made in this column from time to time to movements in imitation of the bold forward effort of the Dowlais Company to form an important branch, or, it might more properly be called, a duplicate concern on the Cardiff Moors. At one time a rumour was afloat that an English establishment had selected Barry, at another that even the attention of Tredegar and of Ebbw Vale Works was being directed towards the coast. Now I am told that even if the Barry step has not yet been perfected, unquestionably Llanelly and Newport, Mon., have been selected as sites for works in connection principally with steel. With regard to Newport I now learn that Messrs. Lysaght and Co., iron manufacturers of Wolverhampton, have entered on a lease for seventy acres near Newport, on condition that works are erected in five years. They have also obtained four acres from the Corporation, which will give them an outlet to the river. When the works are completed 1000 men will be employed. At Llanelly the directors of the new steel works have taken twenty acres near Old Castle tin-plate works on the Stradey estate, with the intention of erecting a steel works.

In all likelihood there will be further developments of this kind, consequent upon improving times in iron and steel, though some delay has occurred owing to the long drought. This week it was reported that serious stoppages are impending. Even at Cyfarthfa, where the supply of water has been much greater than at Dowlais, a belief prevails that another week of water famine must cause a serious hitch. Mid-week it was reported that at Dowlais one thousand men were idle, and a relief fund is to be started. At Llanelly a serious condition continues, and, more or less, this is the report from all quarters in Wales. A local authority cites the fact that the closest attention is now being directed to water supplies, and a busy time in engineering, plans and "seeking for powers" is coming on. It is calculated that it will take two years for the Welsh springs to regain their normal condition.

The pig iron market has slightly recovered the late drop, and on 'Change, Swansea, mid-week was reported as holding its own. Ironmasters are satisfied that an improvement is at hand, as the supply and demand are more equalised. The rail inquiries are increasing, and projected railways in Burmah and Uganda are likely to give business. It is expected that the increase of rail make will still further curtail the supply of tin bars, and lead to improved prices in that manufacture. Last week it was a novel and gratifying incident to see a rail despatch from Cyfarthfa, evidently of exceptional quality. There was also a fair make of tin bar sent away last week.

The coke trade keeps up a vigorous front, with good local and an increased foreign demand. Prices, 13s. to 19s. 6d., Cardiff, according to quality. Patent fuel is fairly good. Prices, Cardiff, 10s. to 10s. 3d.; Swansea, 9s. 9d. to 10s. Pitwood, Cardiff, is weakening, consequent upon the heavy stock held by importers. Prices, 15s. 3d.

General iron and steel quotations, Swansea, this week, were as follows:—Glasgow pig, 45s. 4½d. cash; Middlesbrough No. 3, 36s. 6½d.; hematite, 44s. 1½d.; Welsh bars, £5 10s. to £5 15s.; iron and steel plates, £6 15s. to £6 17s. 6d.; Bessemer steel: Tin-plate bars, £4 5s.; Siemens bars, £4 7s. 6d.; steel rails, heavy, £4 12s. 6d. to £4 15s.; light, £5 12s. 6d. to £5 15s. Tin-plates: Steel cokes, 9s. 9d. to 10s.; Siemens, 10s. to 10s. 3d.; ternes, 18s. to 22s.; best charcoal, 14s. to 14s. 6d. Block tin, £59 16s. 3d. to £59 18s. 3d.

Mid-week a quiet feeling prevailed in the seam coal trade, and prices remained easy. Best steam was quoted at Cardiff at 10s. to 10s. 3d.; seconds, 9s. 3d. to 9s. 9d.; drys, 8s. 9d. to 9s. 3d.; best Monmouthshire, 8s. 3d. to 8s. 6d.; seconds, 7s. 9d. to 8s.; best small, 5s. to 5s. 3d.; seconds, 4s. 6d. to 4s. 9d.; and inferior sorts from 4s. per ton f.o.b. In house coal there is a little more doing, and local business is improving, buyers beginning to lay in the first stocks for the lengthening nights. Signs of improved prices are evident. Latest prices Cardiff are:—Best house, 9s. 9d. to 10s. 3d.; No. 3, Rhondda, 9s. 9d. to 10s.; brush, 8s. 10 8s. 3d.; small, 7s. 6d. to 7s. 9d.; No. 2, Rhondda, 7s. to 7s. 6d.; through, 6s. to 6s. 3d.; small, 4s. 3d. to 4s. 6d. Swansea prices:—Best anthracite, 11s. to 11s. 3d.; seconds, 9s. to 10s.; ordinary, 8s. to 8s. 9d.; steam, 9s. to 10s.; seconds, 8s. 3d. to 9s.; No. 3, Rhondda, 9s. to 10s.

It is freely reported in the district of Plymouth collieries that Mr. Bailey, the general manager, has resigned his appointment. There can be no question of Mr. Bailey's great ability, and the South pit may be named as one where the mechanical and electric appliances are in greater perfection than in any colliery in the district. The works have been managed with great immunity from accident, but labour questions have been very prominent there. The workmen, over 2000 in number, include a number of Staffordshire and Welsh colliers, and the Irish element is considerable. The proprietors of the collieries since the death of Mr. Hankey, sen., are principally the sons, who for some time have had a temporary residence at Penarth, Cardiff, making periodical visits to the collieries.

The inquiry into Neath Colliery accident has been the subject of keen examination and cross-examination, and has again been adjourned, partly in the expectation that one of the sufferers will be sufficiently recovered to attend. One of the points elicited so far is that an unbonneted lamp, carried hurriedly in a current of wind, may permit gas to be forced through into contact with the flame. This admitted, even the "Davy," which is used by the firemen to test the working places, may not be proof.

About forty members of the Bristol Channel centre of Marine Engineers visited the Forest of Dean on Saturday last from Cardiff. During the proceedings an interesting paper was read by Professor Elliott on "Iron and Steel: Old and New," touching particularly upon the Roman ironworks, remains of which still exist in the Forest.

Swansea Harbour returns of last week are eminently satisfactory, showing an increase over the corresponding week of last year of 30,000 tons. Coal shipments were above the average, and one steamer—the Osborne—took 4750 tons of anthracite to San Francisco. Imports of pig have been large, millions figuring prominently. In all Swansea imported 2789 tons of pig, 1820 tons iron ore, and 153 tons rails. In tin-plate there was not a large difference between make and export, 56,491 boxes coming from works, and 59,421 boxes being despatched. Stocks are down to 122,755 boxes. Great complaints exist with regard to the short supply of tin bars; and it is expected that this will lead to an improvement in price both of bars and tin-plate, or as some assert, lead to more mills being stopped.

A sad accident occurred a few days ago at one of the anthracite collieries, Ystalyfera, called Hendreforgan. This is worked by a drift 1800 yards in length, falling on an average 8in. to the yard. By the Mines Regulation Act it is not allowed to ride in the trams to the surface, but a number of boys, taking advantage of an upset due to an accident, jumped into a train of trams, and were nearing the surface when the hitching plate of the last two trams broke, with the result of the death of two and severe injury to seven others.

At Powell's pit, Llancarach Collieries, the men have been out for some little time, consequent upon the objection of the proprietary to pay for small coal. The latest statement was that both sides appear determined, and that a settlement is remote.

The colliers still cling to the impression that it is the strength or weakness of organisation which controls the price of coal and lifts it or keeps it down, and that the excess of supply over demand has nothing to do with it. On Saturday the workmen's section of the sliding scale met in Cardiff for the purpose of preparing a scheme to submit to employers, with regard to the underselling of coal. Mr. Abraham—Mabon—was in the chair, Mr. D. Morgan, vice, and a number of influential members were present. One scheme, it transpired, debated was an alliance between coalowners and workmen, the other was not made public. An adjournment was carried.

Steel chests for tea packing are to be submitted to Li Hung Chang if he comes Newport way.

I hear good reports of the electrical railway in Bristol. The fares are 1d., and the movement is stated to be "easy to a degree."

NOTES FROM GERMANY.

(*From our own Correspondent.*)

No material alteration can be reported in the iron business generally; both the raw and the finished iron trades are busy, and orders are numerous and of considerable weight.

In Silesia the iron and steel industries continue in a very satisfactory condition. A strong tone characterises the different departments, prospects being encouraging. The slightly raised prices of former weeks have been willingly accepted; further advances are not likely to take place in the immediate future. Deliveries in the heavier articles of iron to the Danubian countries and to Russia have increased in weight.

The plate and sheet department is at present very favourably situated, the orders received being, as a rule, heavy, while foreign competition is less keenly felt than before. Foreign demand for plates has also steadily improved. The steel industry is in a good position, orders for rails and general rolling-stock coming to hand freely.

On the Austro-Hungarian iron market the satisfactory condition of former weeks has been well maintained all through this. A steady employment is reported to be going on at the different works; structural iron is specially brisk, and a further increase in demand is expected to take place. All sorts of railway material are likewise in good call, and there are prospects of a continued brisk activity in the railway department. Negotiations have already been carried on between the Austrian State Railway Administration and the Austrian wagon factories regarding next year's supply in passenger cars and load wagons, 400 of the latter and 100 of the former being required; the value will amount to about 1½ million florins. The locomotive shops also come in for a large share; no less than seventy-four locomotives and twenty-eight tenders are to be supplied within the next two years, the sum spent for these being estimated at 2½ million florins.

The tone of the French iron market is hopeful and healthy. The blast furnace works of the Nord raised the basis price for bars No. 2 on 155f. p. t. at works. Latest quotations published by the Plate Mill Convention are—heavy plates No. 1, 175f.; No. 2, 185f. p. t.; sheets, 190f. to 210f. p. t. In Paris bars are paid with 165f. p. t.; whole girders in iron or steel note 175f. p. t.

In Belgium the iron business moves on briskly; both on local and on foreign account an active demand is experienced. During the first two quarters of present year, 423,800 t. pig iron were produced in Belgium, against 408,465 t. for the corresponding period last year; of these, 157,875 t. were forge pig, against 179,936 t.; 46,220 t. foundry pig, against 44,400 t. and 219,705 t. basic, against 46,220 t. Of forty-four existing blast furnaces, thirty-three were in blow on the 1st of July. Although the position of the Belgian coal market is, on the whole, satisfactory, the restrictions in output which have recently taken place, owing to financial difficulties, are attracting general attention. First the colliery Midi de Mons stopped altogether, and all the hands employed were dismissed; now the collieries of Pâturages and Wasmes have announced their intention of suspending operations, and have dismissed their officials and their men. Demand for most sorts of coal has continued steady, and there has been no change in quotations since last report.

An extremely brisk activity is going on at the Rhenish-Westphalian ironworks. Alterations worth noticing have not taken place since last week, except that forge pig and basic has been raised M. 2 p.t. Luxemburg forge pig also realises 2f. p.t. more than last month, present basis quotation being 58f. p.t. Spiegeleisen does not show any alteration upon the week, and is still sold at M. 58 p.t. For good forge quality No. 1, M. 65 p.t. is paid; No. 3, M. 57 p.t. Bessemer costs M. 59 to 60 p.t., while basic is paid with M. 55 to 57 p.t. at works. The business in malleable iron and steel must be considered as decidedly satisfactory, numerous orders at fair quotations having been received at the different establishments. The slight falling off in the demand for bars which had been perceptible some weeks ago has again given place to a most lively inquiry, and the bar mills are contemplating a further advance of M. 5 p.t. Hoops have not followed in the general upward movement, and are still rather weak in quotation; angles and light sectional iron are very brisk of sale, and the mills engaged in the production of these articles continue very busy. Girders are so well inquired for that production can hardly keep pace with consumption. In spite of the heavy output of the mills in Rheinland-Westphalia and in the Saar district, the girder trade has developed most satisfactorily, a fact which is rather astonishing when the extremely keen competition among the different mills is taken into consideration. The plate and sheet mills are becoming more active from week to week; but the state of the wire business remains far from satisfactory, and, what is worse still, there are no symptoms of a change for the better.

For many months the employment of the tube mills has been exceptionally good, and prices—that is, those for home requirements—leave a fair profit. On foreign account a small business only is done in tubes generally, which is due to the successful competition of English firms. The wagon factories are engaged to their utmost capacity, having secured plenty of work for the State Railways.

List quotations for the different articles of iron and steel are as follows:—Good merchant bars, M. 125, in some instances M. 130; angles, M. 129 to 130; girders, M. 113 to 115; heavy plates for boiler-making purposes, M. 175 to 180; steel plates, M. 145 to 160; tank plates, M. 140; the same in steel, M. 125 to 130; sheets, M. 137 to 151; rails, M. 115 to 118; light section rails, M. 100, all per ton at works.

The collieries of the Saar district produced in July of present year 671,565 t. coal, consumption being 631,260 t.; during the same month last year 593,710 t. were produced, and 539,335 t. sold.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

The demand for steam coal keeps fairly good, with prices same as last week. Enquiries for house coal continue good, with prices firm. Tin-plates are in fairly good request. The iron and stee works continue to be well employed.

Coal: Best steam, 8s. 3d. to 8s. 6d.; seconds, 7s. 9d. to 8s.; house coal, best, 10s.; dock screenings, 5s.; colliery small, 4s. 6d. to 4s. 9d.; smiths' coal, 6s. 6d.; patent fuel, 10s. 3d. Pig iron: Scotch warrants, 45s. 6d.; hematite warrants, 46s. 4½d. f.o.b. Cumberland; Middlesbrough No. 3, 36s. 8d. prompt; Middlesbrough hematite, 44s. 4d. Iron ore: Rubio, 12s.; Tafna, 11s. 6d. Steel: Rails, heavy sections, £4 12s. 6d. to £4 15s.; light ditto, £5 12s. 6d. to £5 15s. f.o.b.; Bessemer steel tin-plate bars, £4 5s. to £4 7s. 6d.; Siemens tin-plate bars, best, £4 7s. 6d. to £4 10s.; all delivered in the district, net cash. Tin-plates: Bessemer steel, coke, 9s. 9d.; Siemens, coke finish, 10s.; ternes, per double box, 28 by 20 c, 19s. to 20s. 6d. Pitwood, 15s. 9d. to 16s. London Exchange Telegram: Copper, £47 7s. 6d.; Straits tin, £59 13s. 9d. Freights steady.

The *Aluminum World* gives the following rules with regard to obtaining the best castings with aluminium bronze. An essential point is the special care to be taken not to overheat the metal, for if it be heated to too high a temperature, the aluminium will oxidise, the oxide which is thus formed making the entire casting "dirty;" the metal will also be spongy from the presence of large amounts of occluded gases. The scum, which floats on top of the melted bronze in the crucible, must be prevented from going into the body of the casting. The greatest trouble in making bronze casting, however, arises from the great shrinkage of the metal, a difficulty which is overcome if the casting have a large sinking head and "risers," it being necessary, however, in many cases to make the sinking head fully as large as the casting.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

6th August, 1896.

17,378. Stoppers for Boiler Tubes, W. H. Carney and E. G. Sevenoaks, Norwich.
17,379. Producing Chemicals from Wool, C. Schmidt London.
17,380. Disinfecting Gases, S. E. Gunyon.—(*J. W. Hill, United States.*)
17,381. Shirts, H. J. Farley, London.
17,382. Solid Paste or Soap Compound, C. Uffelmann London.
17,383. Slide Measure, C. D. Abel.—(*The Deutsche Metallpatronen Fabrik, Germany.*)
17,384. Gas Motor Engine, G. Pereire and A. Lavezzari, London.
17,385. Cable Traction Tramways, M. Jemaledden, London.
17,386. Bicycle Fork Ends, T. Bennett and E. K. Kendall, London.
17,387. Covers for Pneumatic Tires, J. Cooper, London.
17,388. Taking or Reproducing Photos, T. J. Perrett, London.
17,389. Electric Rock Drills, &c., A. T. Snell, London.
17,390. Glass Sheets and Glass Tubes, P. T. Sievert, London.
17,391. Glass Sheets and Cylinders, P. T. Sievert, London.
17,392. Air Valves for Pneumatic Tires, C. K. Welch, London.
17,393. Cycle Driving Gear, J. Marriott and H. Tomlin, London.
17,394. Tire for Bicycles, Tricycles, &c., R. Westley, London.
17,395. Cut-outs, L. Andrews, London.
17,396. Cuffs, N. M. Shakour, London.
17,397. Pneumatic Tires, W. J. Clyde and J. R. Nesbit, London.
17,398. Cycle Pedals and Attachments, H. S. Halford, London.
17,399. Securing Lids of Boxes, A. Williamson, London.
17,400. Digger Tines, G. J. Hone and A. F. Hills, London.
17,401. Treatment of Saccharine, &c., C. Fahlberg, London.
17,402. Toboggans, W. P. Thompson.—(*C. M. Vohburger, Austria.*)
17,403. Preventing Shocks in Flow of Liquids, W. P. Thompson.—(*J. P. Serve, France.*)
17,404. Loom Picker, J., S., and F. Halstead, Manchester.
17,405. Feeding Cakes, Lever Bros., Ld., and J. W. Hope, Liverpool.
17,406. Bread, W. E. Rowlands, Liverpool.
17,407. Playing-cards, J. Norton, Liverpool.
17,408. Mixing Device, H. Hirzel and R. Hoffmann, Liverpool.
17,409. Packing, &c., Provisions, J. C. Blanchflower, London.
17,410. Cycle Handle-bar, C. R. Stevens and S. S. Bromhead, London.
17,411. Cycle Saddles, F. W. Golby.—(*H. Richter, Austria.*)
17,412. Taps, O. H. Steed, jun., London.
17,413. Boxes, C. Clifford, London.
17,414. Railway and other Car Brakes, P. Erb, London.
17,415. Machines for Perforating Paper, A. Krah, London.
17,416. Calendars, A. Jouvet, London.
17,417. Attachment for Sewing-machines, W. Fehling, London.
17,418. Tires, A. I. Rath, London.
17,419. Window Catches or Fasteners, W. A. Graves, London.
17,420. Process of Treating Leather, R. Widemann, London.
17,421. Hair Lotions, J. Herbst, London.

7th August, 1896.

17,422. Tap Spile for Beers, &c., H. F. Scarby, London.
17,423. Barrels, H. Berrer, London.
17,424. Packing and Protecting Tires, H. Beech, Manchester.
17,425. Fixing Saddles to Velocipedes, L. Lenton, Coventry.
17,426. Thrashing Machine Hummellers, G. Bowmar, London.
17,427. Hat Pins, J. Conner, London.
17,428. Generating Apparatus for Gas, A. C. Hale, London.
17,429. Spoke and Rim Fastener, J. E. H. Colclough, Dublin.
17,430. Lath for Ceilings and Walls, G. H. Walters, Bristol.
17,431. Method of Making Garments, E. E. F. Gulley, Bristol.
17,432. Hat Fasteners, W. Malone, Longport.
17,433. Armour-plates for Warships, T. Feather, Mirfield.
17,434. Bicycle Brakes, E. H. Ross and A. E. Hodder, London.
17,435. Wireless Umbrella Frame, F. W. Morris, Birmingham.
17,436. Compasses, T. Bassnet, Liverpool.
17,437. Venetian Blinds, W. H. Douglas, Manchester.
17,438. Construction of Artificial Limbs, J. Stubbs, Sheffield.
17,439. Looms, W. Baldwin, Manchester.
17,440. Mouthpieces for Tobacco Pipes, A. Gordon, Glasgow.
17,441. Shives or Bungs for Barrels, &c., E. Ball, Walsall.
17,442. Tires, W. H. Potter, London.
17,443. Carding Machines, W. Kilner and J. W. Crowther, Huddersfield.
17,444. Liquid Blue for Laundries, M. and I. Ward, Halifax.
17,445. Cycle Makers' Tool, J. H. Bury, Oswaldtwistle.
17,446. Harness Soap, E. Weldon, Nottingham.
17,447. Tires, R. Potter, Manchester.
17,448. Gas Engine Starting Device, G. F. H. Jahn, Manchester.
17,449. Force Accumulating Brake, G. J. Sonneborn, Cologne.
17,450. Generating Acetylene Gas, W. C. Clarke, Glasgow.
17,451. Street Lamps, W. C. Clarke, Glasgow.
17,452. Physic Box for Cats and Dogs, Z. C. William, London.
17,453. Automatic Machine, F. X. Bodnar and S. L. Kreppel, Glasgow.
17,454. Harrows, J. G. Deans, Glasgow.
17,455. Cycle Wheels, A. Hunter and W. J. T. Goatley, London.
17,456. Fire-bars, A. Hunter and W. J. T. Goatley, London.
17,457. Producing Continuous Vacuum, A. Dauber, Germany.
17,458. Skirt Protectors, W. Grote, Germany.
17,459. Conical Lining with Selvedge, A. Vorwerk, Germany.
17,460. Stiffeners for Collars and Belts, A. Vorwerk, Germany.
17,461. Stiffener for Ladies' Collars, A. Vorwerk, Germany.
17,462. Printing Textile Goods, &c., F. Wiebel, Germany.
17,463. Variable Crank for Cycles, &c., T. Sewell, London.
17,464. Pocket for Ladies' Dresses, &c., F. James, London.
17,465. Inflating Tires of Cycles, H. G. Harris and A. J. Miller, London.
17,466. Attaching Door Knobs, E. L. Freeman, Birmingham.
17,467. Bungs for Barrels, O. Morgan, &c., Birmingham.
17,468. Traps or Gins for Animals, A. Porter, London.
17,469. Gas Burners, T. Holliday, London.
17,470. Metallic Tubes, W. and A. Pilkington, Birmingham.
17,471. Treating Tea Leaf, N. W. H. Sharpe and S. R. Baildon, London.
17,472. Construction of Boxes, J. Mills, London.
17,473. Envelopes, C. N. Bintcliffe and J. Walker, London.
17,474. Reducing Lead Scum, J. Williams, sen., London.
17,475. Banjos, Guitars, Mandolines, &c., E. Simon, London.
17,476. Chain-stitch Sewing Machines, B. Köhler, London.
17,477. Handle-bars of Cycles, A. Blechynden and W. A. F. Crawford, London.
17,478. Adjustable Nipple Key, W. H. Sharpe, London.
17,479. Cycles, H. J. Watkins, London.
17,480. Cycles, H. J. Watkins, London.
17,481. Turbine Wheels for Steam Turbines, &c., J. Schmidt, London.
17,482. Saddle Safety Attachments, G. C. Roller, London.
17,483. Coupling Machines, C. D. de Forest, W. F. and J. T. Kenna, London.
17,484. Saddle Covers, The Eadie Manufacturing Co. and H. J. Milward, Birmingham.
17,485. Manufacture of Hose Pipes, D. Baxter and N. Knowles, London.
17,486. Helmets, &c., N. Knowles and D. Baxter, London.
17,487. Boot and Shoe Buttons, &c., A. Line, London.
17,488. Concentration of Salts, A. Kumpfmiller and E. Scheultgen, London.
17,489. Connecting Boiler Tubes, J. R. da Costa, London.
17,490. Apparatus for Attaching Cycles, E. R. Salwey, Bristol.
17,491. Work Holders of Machines, C. E. Fleming, London.
17,492. Means for Exhibiting Pictures, J. H. Pepper, London.
17,493. Gold Recovery, C. W. H. Göpner and H. L. Diehl, London.
17,494. Razor Wiper, W. P. Thompson.—(*A. Clovis, France.*)
17,495. Bicycles, W. P. Thompson.—(*H. E. and J. F. Dodge, United States.*)
17,496. Kennels for Dogs and other Animals, G. W. Riley, London.
17,497. Bicycles, W. E. Rowlands, Liverpool.
17,498. Sewing Machines, R. Brown and J. Quinn, Manchester.
17,499. Meters, E. Bennis, Liverpool.
17,500. Arrangement for Lubricating Axles, H. Dielitzsch, Manchester.
17,501. Receptacles for Coal, &c., J. F. Smith, Liverpool.
17,502. Manufacture of Braid, H. Lotery, London.
17,503. New Multitubular Boiler, J. R. da Costa, London.
17,504. Keys, J. P. Nunn, London.
17,505. Film Exposing Apparatus, T. H. Blair, London.
17,506. Washboard, W. Murphy, London.
17,507. Apparatus for Removing Garbage, W. Goetz, London.
17,508. Agricultural Machines, F. P. Krewson, London.
17,509. Journal Boxes or Bearings, E. H. Spencer, London.
17,510. Bicycle Gears, O. H. Gentry, London.
17,511. Dress Suspender, M. Fritzsche, London.
17,512. Cowls for Ventilating Shafts, W. F. Elston, London.
17,513. Working Stone into Pillars, K. Hergenhahn, London.
17,514. Manufacture of Fuel, H. C. B. Forester, London.
17,515. Detachable Pneumatic Tires, J. Favets, London.
17,516. Bottle Stoppers, A. J. F. Gunning.—(*E. T. Jenkins and L. H. Hurtt, United States.*)
17,517. Chairs, H. J. Haddan.—(*F. F. Fortney, United States.*)
17,518. Water Receptacle, W. A. Bowie and A. Bettger, London.
17,519. Preventing Refilling of Bottles, A. MacMahon, London.
17,520. Filter, C. H. Fitzmaurice and E. Mann, London.
17,521. Cleaning Kitchen Utensils, E. G. D. Laney, London.
17,522. Elevating Apparatus, &c., C. D. Seeberger, London.
17,523. Elevating Apparatus, &c., C. D. Seeberger, London.
17,524. Wheels, Mme. F. Bernard, P. Decaillót, and J. M. Thual, London.
17,525. Vehicles, &c., E. R. Calthrop and J. C. Taite, London.
17,526. Softening Water, C. H. Fitzmaurice and E. Mann, London.

8th August, 1896.

17,527. Flat Roof and Hanging Tile, J. Padbury, Scarborough.
17,528. Screws, E. R. Kirkpatrick and W. J. Hamilton, Belfast.
17,529. Centrifugal Pumps, W. and F. Marsh, Manchester.
17,530. Heating Gas Retorts, &c., G. Helps, Manchester.
17,531. Manufacture of Envelopes, A. Sumner and D. Smith, Sleaford.
17,532. Heating of Boilers and Kilns, T. Nicholson, Rochdale.
17,533. Trefoil Self-acting Magnifier, M. Eichbaum, Hastings.
17,534. Brushes for Cleaning Cycles, G. H. Fisher, Norwich.
17,535. Bicycle Wheels, G. Courtney, Southwick, Sussex.
17,536. Formation of Soluble Colloids, E. J. Mills, Glasgow.
17,537. Pneumatic Collars, C. A. Ruddock, London.
17,538. Hats, Caps, and Other Head Coverings, A. McMeekin, Halifax.
17,539. Sizing Machines, T. Haworth, Halifax.
17,540. Skates, F. Inman, Bradford.
17,541. Jointing Sanitary Pipes, J. Jarvis, Longport.
17,542. Bicycle Wheel Tire, J. J. Warry, Liverpool.
17,543. Horseshoe, W. Robinson, London.
17,544. Fastenings for Ladies' Veils, W. B. Robathan, Birmingham.
17,545. Picking Bands, G. Stannard, Manchester.
17,546. Steam Boilers, J. Liddle.—(*W. Hardie, China.*)
17,547. Ruling of Paper, W. Jamieson and W. Howard, London.
17,548. Purifying Butter, J. H. Hunter, County Dublin.
17,549. Manufacture of Tubing, F. A. Walton, Birmingham.
17,550. Cotton Spools, T. L. Phipps.—(*P. Phipps, Australia.*)
17,551. Brazing Hearths, E. F. and G. W. Goodyear, and T. Kennelly, Birmingham.
17,552. Counting Machine, J. and J. E. Henderson, Aberdeen.
17,553. Boring Apparatus for Deep Borings, A. Raky, London.
17,554. Screwing Machine, J. F. and R. H. Shaw, Manchester.
17,555. Hat Pouncing Machines, H. H. and A. Turner, Manchester.
17,556. Bevel Wheel Gearing Bicycles, J. J. Kingsley, Rochdale.
17,557. Continuous Current Dynamos, S. Z. de Ferranti, London.
17,558. Dynamo-electric Motors, S. Z. de Ferranti, London.
17,559. Furnaces, W. McG. Greaves, Manchester.
17,560. Producing Novel Effects, L. J. J. A. Goudesone, London.
17,561. Scorer for Games, H. O. and J. O. Roberts, Gloucester.
17,562. Gas Engines, T. W. Scott and G. H. Kenning, Bromley.
17,563. Electric Traction, T. Meacock, London.
17,564. Water Tap, J. Lomax and J. Tattersall, Manchester.
17,565. Brake for Cycle, &c., Wheels, H. Inwards, Luton.
17,566. Brake, C. A. Allison.—(*J. A. Eden, United States.*)
17,567. Handle-bars of Cycles, A. Littlehales, Birmingham.
17,568. Rotary Fitting for Shop Windows, J. North, London.
17,569. Puzzle, J. Greenfield, London.
17,570. Ships' Propellers, J. Greenfield, London.
17,571. Cycles, J. Hollis, London.
17,572. Tire, J. Zacharias, Oxford.
17,573. Igniting Charges in Compression Engines, E. J. Pennington, London.
17,574. Auto-cars, A. Birkmyre, Glasgow.
17,575. Blocks for Boat Lowering Gear, H. Ramsay, Glasgow.
17,576. Valve for Engine Governors, C. C. Cooper, London.
17,577. Electric Measuring Instruments, G. K. B. Elphinstone, London.
17,578. Electrical Signalling Apparatus, G. K. B. Elphinstone, London.
17,579. Electric Railway Systems, D. M. Therrell, London.
17,580. Advertising Books, H. Allwright and E. Swainson, London.
17,581. Sheet Metal Pipes, J. M. Frasher and J. W. Abrahams, London.
17,582. Shoe Brushes, G. P. Neal and J. P. Thurston, London.
17,583. Trace Releaser and Brake, J. Lechner, London.
17,584. Guards for the Horns of Beeves, J. L. Straw, London.
17,585. Reservoir Pens for Shading, J. C. Martin, London.
17,586. Water Gauge Cocks, W. Ripper, Sheffield.
17,587. India-rubber Mats, J. C. Margetson and W. Higham, London.
17,588. Producing Embossed Letters from Metal, A. Martyn and The Cameo Sign and Letter Company, London.
17,589. Chains, M. A. Wier, London.
17,590. Dyestuffs, S. Pitt.—(*L. Cassella and Co., Germany.*)
17,591. Production of Dyestuffs on Fibre, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
17,592. Heads of Carriage Lamps, H. Salsbury, London.
17,593. Cupolas and Blast Furnaces, I. A. Timmis, London.
17,594. Boxing Gloves, C. W. Smith, London.
17,595. Adjustable Spanners, J. T. Armstrong, London.
17,596. Incandescent Mantle, W. P. Thompson.—(*W. Buddéus, Germany.*)
17,597. Devices for Supporting Rails, K. Krüger, London.
17,598. Motors, L. P. Maréchal, L. Yomet, and F. Spiro, Manchester.
17,599. Continuous Ceramic Furnaces, H. Sturm, Liverpool.
17,600. A New Game, S. Marsh, London.
17,601. Propulsion of Light Vehicles, H. J. Dowsing, London.
17,602. Preservation of Cotton Seeds, B. F. Smith, London.
17,603. Drawbridges, J. T. Knowles.—(*J. Coup, United States.*)
17,604. Coating Aluminium, E. Edwards.—(*H. Wachwitz, Germany.*)
17,605. Incandescent Bodies, W. H. Wheatley.—(*C. Schmid, Belgium.*)
17,606. Radial Axles for Railway Vehicles, O. Busse, London.
17,607. Hydrochloric Acid, J. R. Wylde, J. W. Kynaston, and J. Brock, London.
17,608. Effecting the Electro Deposition of Zinc upon Metals, The Cowper-Coles Galvanising Syndicate, Ltd., and S. O. Cowper-Coles, London.
17,609. Apparatus for Stopping Engines, G. W. Brown, London.
17,610. Showing Facsimiles of Diamonds, E. Fellows, London.
17,611. Producing Blood Forming, &c., F. Rebling, London.
17,612. Toy in form of an Air Balloon, M. Badorff, Cologne.
17,613. Construction of Vehicles, W. Bains and W. Norris, London.
17,614. Bicycles, E. A. Smith, J. F. W. Searle, and G. C. Jackson, London.
17,615. Petroleum Motor Mechanism, C. Moreau, London.
17,616. Playing Stringed Instruments, S. Hey.—(*W. S. Reed, United States.*)

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17,617. Taps, The Patent Rotary Self-measuring Tap Company, Ld., and H. E. Brice, Birmingham.
17,618. Tire, A. Girling, Brighton.
17,619. Sock Stretcher for Foot Gear, J. T. Szék, Germany.
17,620. Self-propelled Vehicles, &c., F. J. Burrell, Thetford.
17,621. Non-slipping Horse-shoes, &c., R. Skelton, Leyton.
17,622. Bicycles, W. J. Tanner, London.
17,623. Metal Purifier, A. Phillips, London.
17,624. Draining Rocky Beds, G. F. H. W. and F. H. Poetsch, London.
17,625. Brakes for Motor Cars, &c., B. Whiteley, Sheffield.
17,626. Edgings of Sewing Machines, J. Köhler, Manchester.
17,627. Artificial Stone, W. Millar and O. J. Owen, London.
17,628. Gear Wheel and Chain, &c., T. McGovern, Dublin.
17,629. Shuttles, T. McKernan, Hebden Bridge.
17,630. Locking and Fastening Doors, G. Whittaker, Burnley.
17,631. Shuttle Guard, G. Bateman and H. Smith, Manchester.
17,632. Cycles, J. D. Tomlinson, Manchester.
17,633. Ovens for Baking Porcelain, &c., W. Dall, London.
17,634. Cycle Driving Gear, T. and O. J. Meacock, London.
17,635. Non-burnt Sand Brick, A. Easterbrook.—(*T. T. Wood, United States.*)
17,636. Paving, G. Hutchinson and T. H. and A. J. Lawson, Bristol.
17,637. Covering Composition, G. Hutchinson and T. H. and A. J. Lawson, Bristol.
17,638. Vessels for Liquids, F. W. Golby.—(*P. Lochmann, Germany.*)
17,639. Flushing Device for Water-closets, J. T. Gibson, jun., London.
17,640. Organ Electric Pneumatic Action, E. Smith, Blackburn.
17,641. Cycle and other Brakes, D. and W. S. Provand, Glasgow.
17,642. Tongues for Boots and Shoes, H. Warry, Colyford.
17,643. Electric Lamp, R. A. Smith and F. G. B. Green, Glasgow.
17,644. Gas Plant and Acetylene, &c., R. Goodwin, Dublin.
17,645. Tire, T. D. Harries, Aberystwith.
17,646. Acetylene Gas Generators, M. Duffield, Slough.
17,647. Raising and Lowering Blinds, E. C. Buik, London.
17,648. Camera Front and View Finder, E. S. Ullmer, London.
17,649. Railway Brakes, G. I. Root and A. Begg, London.
17,650. Baking Frame, J. Lacroix and F. E. Searll, London.
17,651. Pulverisers, J. C. Clark, London.
17,652. Fence Posts, A. Davison, London.
17,653. Support and Rest for Bicycles, F. W. Voisey, London.
17,654. Fire Alarms and Indicators, W. H. Short, London.
17,655. Screw Stoppering of Bottles, B. Turner, London.
17,656. Tire for Cycles, T. Müller and G. Hoyer, London.
17,657. Electric Indicators, H. Korten, London.
17,658. Preserving Beer, Fruit, Meat, &c., W. Junge, London.
17,659. Receptacle for Electric Wires, E. F. Jones, London.
17,660. Reels, F. Jones, London.
17,661. Electric Pendulum Indicators, F. Jones, London.
17,662. Device for Cycle and other Chains, J. Mills, London.
17,663. Vehicle Brakes, L. Barreau and E. Guinaudeau, London.
17,664. Pneumatic Tires, E. L. Parker and J. Luckock, London.
17,665. Boots and Shoes, R. B. J. T. Soanes, London.
17,666. Maximum Speed Governors, H. F. Parshall, London.
17,667. Treadle Mechanism, A. Lindigkeit, London.
17,668. Driving Gear for Cycles, &c., J. Byrd, London.
17,669. Displaying Advertisements, F. Steinbrecher, London.
17,670. Hair Curler, W. H. Murray, London.
17,671. Obtaining Porous Metals, L. Hoepfner, London.
17,672. Automatic Fire-arms, H. W. Gabbett-Fairfax, London.
17,673. Projectiles for Rifles, H. W. Gabbett-Fairfax, London.
17,674. Means for Supporting Articles, W. T. Colyer, London.
17,675. Cycle Saddle Cushions or Pads, R. Bell, London.
17,676. Construction of Traps, A. W. Johnson, London.
17,677. Loom-healds, G. G. M. Hardingham.—(*Felten and Guilleaume, Germany.*)
17,678. Liquefying Acetylene, A. C. Fraser, London.
17,679. Mechanical Movement, W. P. Thompson.—(*W. T. Hanson, United States.*)
17,680. Hard Metal, W. P. Thompson.—(*T. G. Orwig, United States.*)
17,681. Bottle Filling Machine, T. Skurray, London.
17,682. Sweat Bands for Hats, J. Taylor, Manchester.
17,683. Sweat Bands for Hats, J. Taylor, Manchester.
17,684. Device for Saving Life at Sea, P. Clibborn, London.
17,685. Elastic Supporting Devices, N. Wahl, London.
17,686. Landing Nets, A. Holmes, London.
17,687. Regulating Fluid Currents in Pipes, R. Goll, London.
17,688. Draining Board for Drying Dishes, W. J. Bromley, London.
17,689. Stoppering Bottles, F. N. Friend, London.
17,690. Caps, H. J. Haddan.—(*I. Pachner, United States.*)
17,691. A New Toy, W. Krauss, London.
17,692. Printing Multicoloured Designs, C. Dratz London.
17,693. New Valve for Pneumatic Tires, G. Bianchi, London.
17,694. Railway Signals, F. Davis, London.
17,695. Rotary Engines, N. Malewski, London.
17,696. Covering Cardboard Boxes, W. E. and J. Goss, London.
17,697. Gear Cases for Velocipedes, P. Hunaeus, London.
17,698. Screw Fans, The Honourable C. A. Parsons, London.
17,699. Cigarettes and Cigars, C. H. Kitching, London.
17,700. Rotary Engines, B. Dumont, London.
17,701. Electrical Switching Apparatus, H. Edmunds, London.
17,702. Drying Tea, H. Stevenson.—(*J. S. Stevenson, Ceylon.*)
17,703. Propelling of Cycles, &c., H. E. Webb, London.
17,704. Air Brakes, W. C. Colwell, London.
17,705. Wheels of Velocipedes, F. W. Gostick, Melton Mowbray.

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17,706. Chain Wheels, L. and E. W. Cooper, Coventry.
17,707. Sewer Ventilator, A. B. Roxburgh, Birmingham.
17,708. Taps for Lavatories, F. C. Lynde, Manchester.
17,709. Tobacco Pipes, H. F. Easton, Teddington, Middlesex.
17,710. Midwifery Forceps, E. E. T. B. Greville, Sheffield.
17,711. An Accessory to Bicycles, E. A. Lake, Hastings.
17,712. Life Belt, R. Sutcliffe, Horbury, near Wakefield.
17,713. A New Brake for Cycles and the like, J. Lang, Halifax.
17,714. Acetylene Gas, A. J. B. Légé and A. D. Pennellier, London.
17,715. Pneumatic Pads or Cushions, O. Tilley, Leicestershire.
17,716. Door Curtains, J. H. Hunter, Newcastle-on-Tyne.
17,717. Chemical Compound, F. J. and G. W. Jones, Worcestershire.
17,718. Combined Funnel Strainer, W. L. Pike, London.
17,719. Tables, S. E. Paine, London.
17,720. Fruit Evaporators, H. M. Amos, London.
17,721. Thill Couplings, C. C. Brown, London.
17,722. Filter, J. Armstrong and W. Heywood, Manchester.
17,723. Weaving Machinery, P. Prouvost, London.
17,724. The Flue Tobacco Pipe, W. H. Wort, near Liverpool.
17,725. Suspender for Feeding Bottles, W. Nicholls, Birmingham.
17,726. Augers, A. Y. Pearl, London.
17,727. Sprocket Wheels and Chains, P. G. Gardner London.
17,728. Pumps, A. W. Thierkoff, London.
17,729. Treatment of Illuminating Gas, I. N. Knapp, London.
17,730. Cycle Wheels, E. F. Elliot and W. B. Lake, London.
17,731. Gloves, F. Couty and J. Grunhut, Leicester,

17,732. Engines, R. L. Weighton and D. B. Morison, Hartlepool.
17,733. Flues for Steam Boilers, O. Meredith, Birkenhead.
17,734. Skeleton Band, E. B Coumbe, Somerset.
17,735. Shaking Grates for Marine Boilers, J. Reagan, London.
17,736. The Consumption of Smoke, A. Stevenson, Chester.
17,737. Chocolate Cooling Machine, T. Maw, London.
17,738. Washing Machine, J. Savery and R. Barbour, Cheltenham.
17,739. Interlocking Tiles, F. Furness, London.
17,740. Boots, J. Kennell, London.
17,741. Stopping the Vibration of Cycles, F. Vial' London.
17,742. Clothes Horse, J. Savery and R. Barbour, Cheltenham.
17,743. Obstetric Calendar, F. H. Collins, Birmingham.
17,744. Mops and Brushes, H. D. Fitzpatrick.—(*P. J. Grace, United States.*)
17,745. Absorbent Pads of Mops, H. D. Fitzpatrick.—(*P. J. Grace, United States.*)
17,746. Dinner Carrier, H. H. Kirby and W. B. Ward, Birmingham.
17,747. Rail Joints, S. Hey.—(*J. H. Williams and T. Mair, United States.*)
17,748. Chimney Cowls, G. Platner and A. Müller, Manchester.
17,749. Securing Sheets of Zinc for Roofing, E. B. Podmore, Halifax.
17,750. Celluloid Watch Cases or Protectors, A. Wacker, Halifax.
17,751. Meter Testing Machines, B. E. Chollar, London.
17,752. Embrocation, J. F. Hill, London.
17,753. Cycle Brakes, T. H. Simmonds, London.
17,754. Paper Bag Making Machine, G. O. Woolley, Gloucester.
17,755. Bottle, S. Gutmann, Darjeeling, India.
17,756. Machine for Making Constructive Parts, G Barker.—(*The Sterling Cycle Works, United States.*)
17,757. Separating Metals from Seeds, W. R. Harrison, London.
17,758. Unpuncturable Pneumatic Tires, H. M. Ashley, Ferrybridge, Yorks.
17,759. Detachable Pneumatic Tire, &c., T. Tully, Morpeth.
17,760. Explosion Engines, W. Woolidge, Southampton.
17,761. Safety Saddle Bar, T. Osment, Beaulieu, Hants.
17,762. Contrivance for Multiplying and Measuring the Minute Differences between Solid Articles, S. Wells, London.
17,763. Valves for Pneumatic Tires, F. W. Gostick, London.
17,764. Securing Tires to Wheels, F. W. Gostick, London.
17,765. Disinfecting Sewer Gas in Closets, P. O'Dowd, London.
17,766. Castors, T. C. Fairweather and E. Hentschel, London.
17,767. Power Transmitting Chain, T. C. Fairweather and E. Hentschel, London.
17,768. Producing Motive Power, T. Armstrong and L. Dove, London.
17,769. Mountings of Seats for Boats, G. C. Coate, London.
17,770. Strap Buckles, A. Watson and N. Buxton, London.
17,771. Dancing Apparatus, H. T. Bellerby and G. Tournier, London.
17,772. Photographic Apparatus, G. H. Thomas and B. Whitworth, London.
17,773. Pneumatic Tires for Cycles, W. A. G. Birkin, London.
17,774. Fire-grates of Furnaces, W. H. Sharp, Bush Hill Park, Middlesex.
17,775. Supporting Ambulance Stretchers, J. W. A. Rule, London.
17,776. Syringes, E. Edwards.—(*The Shattuck Novelty Company, United States.*)
17,777. Motor Carriages, C. Gautier and X. Wehrlé, London.
17,778. Producing Carbonic Acid Gas, B. T. L. Thomson, London.
17,779. Driving Gear, H. de L. Weed and F. W. Gridley, London.
17,780. Rubber Ball Tires, W. H. and J. R. Caldecourt, London.
17,781. Shedding Mechanism for Looms, E. Gates, London.
17,782. Shedding Mechanism for Looms, E. Gates, London.
17,783. Beating-up Mechanism for Looms, E. Gates, London.
17,784. Loom Shuttle Operating Devices, E. Gates, London.
17,785. Eyeglasses, H. H. Lake.—(*J. W. Riglander, United States.*)
17,786. Rotary Steam Engines, H. H. Lake.—(*K. D. Dunlop, United States.*)
17,787. Manufacture of Pneumatic Tires, T. A. Dodge, London.
17,788. Couplings for Railway Vehicles, F. P. Norton, London.
17,789. Glazing Paper, J. G. Accles and J. Pinfold, London.
17,790. Sewing Machines, H. H. Lake.—(*A. O. Towns, United States.*)
17,791. Stocking Protector, A. Robb, London.
17,792. Pipe Fittings, C. G. Harrison and H. Howard, London.
17,793. Driving Gear for Bicycles, &c., W. Wanliss, London.
17,794. Wire-swaging Machines, W. P. Thompson.—(*The Marcus Mazon Manufacturing Company, United States.*)
17,795. Refrigerating Bottle or Decanter, E. Foucher, Liverpool.
17,796. Dress Protectors, J. C. Fell.—(*W. W. Dennis, United States.*)
17,797. Vices, P. Jensen.—(*The Bolte Cycle Manufacturing Co., United States.*)
17,798. Geographical and Star Maps, M. L. Bostock, London.
17,799. Hardening Bituminous Substances, E. T Dumble, London.
17,800. Propelling Auto-cars, &c., A. G. Melhuish, London.
17,801. Belting, R. Broadbent, London.
17,802. Cutting Paper for Box Banding, T. Salmon, London.
17,803. Moulding Soap, E. G. Scott, London.
17,804. Valve Gear, P. A. Newton.—(*The Ingersoll-Sergeant Drill Company, United States.*)
17,805. Channelling Machines, P. A. Newton.—(*The Ingersoll-Sergeant Drill Company, United States.*)
17,806. Horticultural Structures, J. F. Pickering, London.
17,807. Driving Gear for Velocipedes, J. Kennedy, London.
17,808. Feed Mechanism for Fire-arms, H. W. Gabbett-Fairfax, London.
17,809. Firing Mechanism for Automatic Fire-arms, H. W. Gabbett-Fairfax, London.
17,810. Feed Belts for Automatic Fire-arms, H. W. Gabbett-Fairfax, London.
17,811. Driving Gear for Cycles, G. W. Amos and E. T. Gilbert, London.
17,812. Mortar Mountings, W. B. Gordon and T. R. Morgan, sen., London.
17,813. Automatic Protector for Gas Mantles, M. Raphael, London.
17,814. Elevators, R. Harvey, London.
17,815. Manufacture of Hydrocarbon Oils, J. E. T. Woods and H. B. McKenna, London.
17,816. Linotype Machines, The Linotype Company.—(*O. Mergenthaler, United States.*)
17,817. Mechanism of Linotype Machines, The Linotype Company.—(*O. Mergenthaler, United States.*)
17,818. Dynamo-electric Machines, The British Thomson-Houston Company.—(*D. P. Thompson and A. H. Armstrong, United States.*)
17,819. Developing Photographic Plates, F. W. Golby.—(*W. Herrmann, Germany.*)
17,820. Door Locks, E. S. Sutton and J. Hagan, London.
17,821. Carbonating Liquids, T. B. Booth and A. Robinson, London.
17,822. Filling Bottles, T. B. Booth and A. Robinson, London.
17,823. Bottles, &c., L. D. Murphy, London.
17,824. Sprays, &c., C. F. Slater, London.
17,825. Detachable Cycle Handle Bar, F. Geddes and G. F. Jenkins, Ascot.)

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17,826. Coat, M. Holzer, London.
17,827. Pneumatic Tires for Velocipedes, &c., C. de Rossetti, London.
17,828. Surgical Splint, R. Marchant, London.
17,829. Corsets, T. Smith, Portsmouth.
17,830. Kilns for Burning Limestone, &c., J. Foster, Dublin.
17,831. Gear Cases, C. T. Cooper, Coventry.
17,832. Lowering Globes of Arc Lamps, H. G. Cotsworth, Surrey.
17,833. Inanimate Bird or Target, W. P. Jones, Birmingham.
17,834. Hinges for Fall Down Doors, H. Hyde and J. A. Adey, Sheffield.
17,835. Dog-ended Curbs and Fenders, C. Meason, Birmingham.
17,836. Top Bars for Kitchen Ranges, W. P. Eglin, Halifax.
17,837. Motor Cars, S. Evans, Northampton.
17,838. Saddles of Cycles, A. M. H. Walrond, Manchester.
17,839. Treatment of Zinc Ores, &c., H. Brewer, London.
17,840. Speed Indicator, E Pease, Stockton-on-Tees.
17,841. Ornamenting Textile Fabrics, W. Grimshaw, Manchester.
17,842. Automatic Gaff Hook, R. R. Beard.—(*C. Imbrie, United States.*)
17,843. Folding Newspaper Holder, A. Knott, Liverpool.
17,844. Adjustable Steering-rod for Cycles, A. Schnepff, Berlin.
17,845. Toy Appliance, S. E. Statham, Manchester.
17,846. Telephone Switchboard Plugs, The Telegraph Manufacturing Company, and J Taylor, Helsby, near Warrington.
17,847. Combined Throttle and Stop Valve, H. Hyde, Manchester.
17,848. Projecting Zoetropic Pictures, J. Peschek, G. H. Chard, and H. Akermann, London.
17,849. Paint Brushes, W. Callaghan, London.
17,850. Driving Gear for Cycles, J. Aldred, Manchester.
17,851. Padlocks, R. L. Hickes, London.
17,852. Pneumatic Horse Collar, A. R. W. Derby, Sheffield.
17,853. Bicycles and Tricycles, H. J. C. McGroarty, Sheffield.
17,854. Metallic Casks, F. A. Rhodes, Birmingham.
17,855. Cycle Sprocket Wheels, F. A. Rhodes, Birmingham.
17,856. Driving Gear for Cycles, C. B. Lawson, Glasgow.
17,857. Clearing and Painting Windows, &c., J. J. Kennedy, Dublin.
17,858. Grinding or Pulling Rags, D. Wilson and H. Dunn, London.
17,859. Watch Holder, J. Bray, London.
17,860. Automatic Stop Safety Valves, F. Hennebohle, London.
17,861. Automatic Relief Valves, F. Hennebohle, London.
17,862. Filters, C. A. Künzel, jun., London.
17,863. Door Opening Devices, C. W. Cougill, London.
17,864. Treatment of Sulphide Ores, L. R. Scammell, London.
17,865. Wheels of Cycles and other Vehicles, A. Black, Glasgow.
17,866. Car Starter, T. Heather, London.
17,867. Securing Cranks, F. L. Martineau and W. A. Taylor, London.
17,868. Pneumatic Tires for Cycles, J. W. Smallman, Nuneaton.
17,869. Puncture Resisting Medium, J. Favets, London.
17,870. Bicycle Rack for Luggage Vans, E. S. Copeman, London.
17,871. Transferring Designs to China, J. R. Gilman, London.
17,872. Air Brake Operating Device, D. Bentley, London.
17,873. Preparing Potatoes for Cooking, J. Goodfellow, London.
17,874. Combined Shell and Torpedo, E. M. T. Boddam, London.
17,875. Shoe Lace Fasteners, M. E. Johnson, London.
17,876. Bicycles, E. Sheridan, London.
17,877. Machine for Pulverising Soil, E. Piggott, London.
17,878. Pens, M. Heitmann, London.
17,879. Electric Batteries, V. M. Cornely and L. C. H. Dautel, London.
17,880. Pneumatic Tires, G. F. Redfern.—(*C. H. Riches, Canada.*)
17,881. Cinematographs, A. Wrench, London.
17,882. Rule Cutting Machines, G. F. Redfern.—(*W. H. Golding, United States.*)
17,883. Treatment of Manure, E. van de Griendt, London.
17,884. Cycle Brake, W. S. McCay and J. M. Barr, London.
17,885. Ballot Box, V. Totwen and A. Astafiew, London.
17,886. Velocipedes, H. G. Harris and W. Blackmore, London.
17,887. Shafts for Weaving, C. T. Hunger, London.
17,888. Vapour Burners, E. Oldenbourg.—(*L. Runge, Germany.*)
17,889. Caster, E. Goullière, London.
17,890. Batteries, E. Tilmann and C. K. Lexon, London.
17,891. Furniture Legs, P. Engelmeyer, London.
17,892. Puzzle, W. Wathen, London.
17,893. Game, W. Parsons, London.
17,894. Manufacture of Medicated Honey, D. Simpson, London.
17,895. Construction of Cycle Frames, A. Shelton, London.
17,896. Garment for Saving Life, S. P. Bremmell, London.
17,897. Testing Bottle, W. P. Thompson.—(*A. Legrand, France.*)
17,898. Timing Instruments for Vehicles, E. G. Dorchester, London.
17,899. Differential Changing Gears, W. J. Ewing, Liverpool.
17,900. Driving Chains for Cycles, C. R. Garrard, London.
17,901. Band Brake for Bicycles, C. R. Hutchings, London.
17,902. Bag or Envelope, R. B. Reeves and C. J. Belson, London.
17,903. Utensils for Table Use, &c., H. Marbeau, London.
17,904. Utilising Gas, H. H. Lake.—(*O. Grenier and J. Grand, France.*)
17,905. Apparatus for Recording Votes, C. T. Marzetti, London.
17,906. Electric Conductor Crossings, A. T. Snell, C. E. Grove, and A. F. Hills, London.
17,907. Capsules, H. Dudeck, London.

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17,908. Attaching Tires to Wheel-rims, W. Ham, London.
17,909. Negative Printing Holder, I. Renshaw, Rochdale.
17,910. Pneumatic Tires for Vehicles, J. H. Barry, London.
17,911. Pitch Chains, H. S. Bishop and C. Salmon, Kent.
17,912. Means for Propelling Vehicles, T. Browett, Manchester.
17,913. Stokers, Z. J. Parkes, Manchester.
17,914. Pneumatic Tires for Vehicles, C. E. Halden, Oldham.
17,915. Manipulation of Lamps, A. J. Ireland and C. W. G. Little, London.
17,916. Axle Boxes, G. H. Byrd, London.
17,917. Lifting Gear for Hammers, D. Smith, Wolverhampton.
17,918. Pad for the Seats of Bicycles, L. Classey, Shepton Mallett.
17,919. Machines for Ring Spinning, J. Horrocks, Manchester.
17,920. Garment for Ladies, &c., T. H. Brown, Manchester.
17,921. Tires for Wheels of Vehicles, E. Alexander, Dundee.
17,922. Lamp Glasses, G. F. Ransome, Liverpool.
17,923. Bulk Measuring Apparatus, P. S. Bullock and A. Moir, Wolverhampton.
17,924. Fire Escapes, G. W. Cleveland, London.
17,925. Game Recording Apparatus, T. E. Hallewell and W. T. Eggleston, Manchester.
17,926. Motor, W. Reynolds, Coventry.
17,927. Attaching Tires and Wheel Rims, C. Merington, London.
17,928. Map or Guide Carrier for Cycles, A. Barr, Glasgow.
17,929. Railway Passenger Vehicles, A. T. and J. F. Moore, Manchester.
17,930. Studs, M. Nathan, Manchester.
17,931. Manufacture of Hames, J. Moseley, Birmingham.
17,932. Cartridge Belt Manufacture, P. A. Martin, Birmingham.
17,933. Cycle Saddles, J. B. Brooks, Birmingham.
17,934. Leg Pad for Cricket Players, L. Classey, Shepton Mallet.
17,935. Saddle Bar, E. Allsopp, Walsall.
17,936. Means for Controlling Horses, H. de Garrs, Sheffield.
17,937. Handle Bars, &c., A. Littlehales, Birmingham.
17,938. Filling of Scoops, C. W. Lyon and G. Deighton, Dewsbury.
17,939. Vessels for Holding Gum, R. Bell and W. T. Hall, London.
17,940. Appliance for Raising Objects, F. Hughes, London.
17,941. Arsenic Elimination, B. and J. W. Thomas, London.
17,942. Oil Cans, H. Hudson, London.
17,943. Wind Chests for Reed Organs, F. Jennings, London.
17,944. Chain Driving Gear Wheels, H. Morrison, London.
17,945. Hampers, C. Cox, London.
17,946. Game, R. Richardson, London.
17,947. Method of Fastening Shoes, J. and W. Burgess, London.
17,948. Apparatus for Recording Speed, J. H. Crompton, London.
17,949. Method of Securing Door Handles, W. R. Wynne, London.
17,950. Metallic Tube Manufacture, W. and A. Pilkington, Birmingham.
17,951. Motor Dynamo, A. de Puydt and M. Poncin, London.
17,952. Car Couplings, W. H. Munns.—(*C. E. Ward and D. L. Hall, United States.*)
17,953. Machinery for Washing, &c., E. D. Reeve, London.
17,954. Improved Drawing Compasses, A. J. Gormand, London.
17,955. Screw Connection for Tobacco Pipes, J. Head, Croydon.
17,956. Closing the Mouths of Bottles, R. Stichler, London.

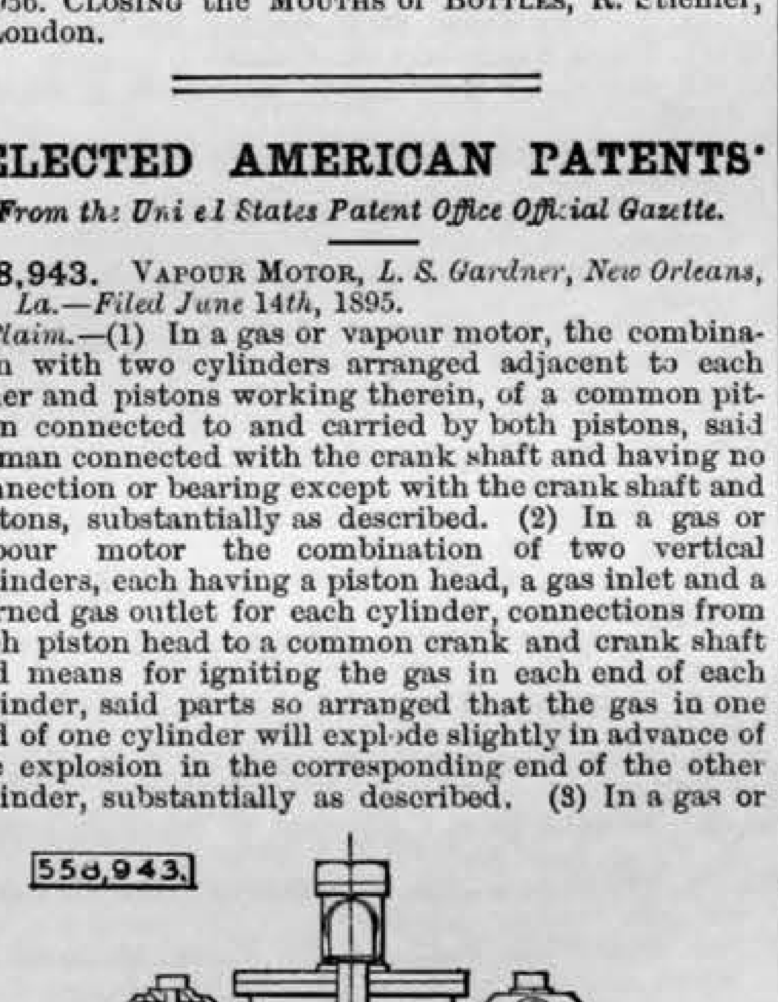
SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

558,943. Vapour Motor, *L. S. Gardner, New Orleans, La.—Filed June 14th*, 1895.

Claim.—(1) In a gas or vapour motor, the combination with two cylinders arranged adjacent to each other and pistons working therein, of a common pitman connected to and carried by both pistons, said pitman connected with the crank shaft and having no connection or bearing except with the crank shaft and pistons, substantially as described. (2) In a gas or vapour motor the combination of two vertical cylinders, each having a piston head, a gas inlet and a burned gas outlet for each cylinder, connections from each piston head to a common crank and crank shaft and means for igniting the gas in each end of each cylinder, said parts so arranged that the gas in one end of one cylinder will explode slightly in advance of the explosion in the corresponding end of the other cylinder, substantially as described. (3) In a gas or

558,943.



vapour motor, the combination with the cylinder, having inlet and outlet ports for the fresh and burned gases respectively, of the piston, having a deflector or diaphragm against which the fresh gases strike, said deflector having its side edges extended in a plane parallel with the longitudinal plane of the inlet and outlet, and said edges terminating closely adjacent to the outlet, substantially as described. (4) In a gas or vapour motor, the combination with the cylinder, of the piston having a flanged end, and inlet and outlet ports therethrough, an electric contact, insulated from the cylinder, projecting to a point adjacent to the path of the piston, another opening in the piston flange, and a contact spring extending through the latter opening, substantially as described. (5) In a gas or vapour motor, the combination with the flywheel having an excentric groove, of a rod, one end engaging the excentric groove, a rod to which the excentric rod is engaged, said rod operating the gas pump piston at one end and the water pump piston at the other, substantially as described.

558,944. Blowing Engine, *W. E. Good and A. Marichal, Philadelphia, Pa.—Filed May 27th*, 1893.

Claim.—In a blowing engine or compressor the combination of the tub, a discharge valve, a link valve motion, means for communicating motion from said valve motion to the valve, a cylinder as U, a piston V

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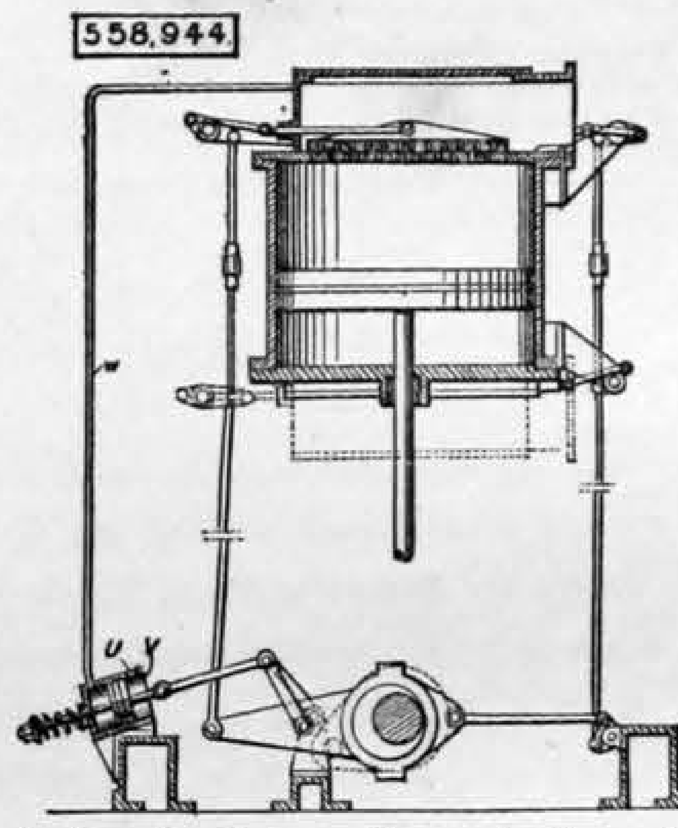

moving in said cylinder, and connected to mechanism for varying the motion of the valve motion mechanism, a conduit *w* leading from the receiver of the engine to the cylinder, and a constantly acting force as spring *z* arranged to act on piston V in the opposite direction to that in which the air from the receiver moves it.

558,947. Process of and Apparatus for Manufacturing Steel Castings, *F. W. Hawkins, Detroit, Mich.—Filed August 7th*, 1895.

Claim.—(1) The herein described process for purifying and refining iron, which consists in conducting the molten metal in a thin sheet into a reverberatory chamber in which it is exposed to the products of combustion from a furnace in a manner to heat the metal and maintain the same at a white heat, in subjecting it therein to the action of a concentrated current of superheated steam and air, and then thoroughly eliminating the impurities and decarbonising the metal by puddling the molten mass to

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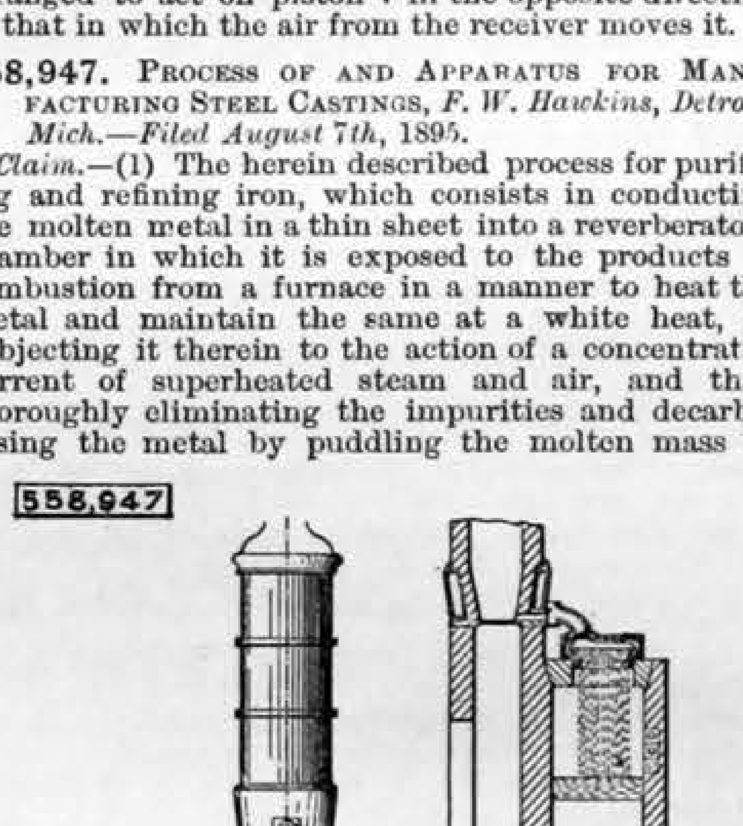
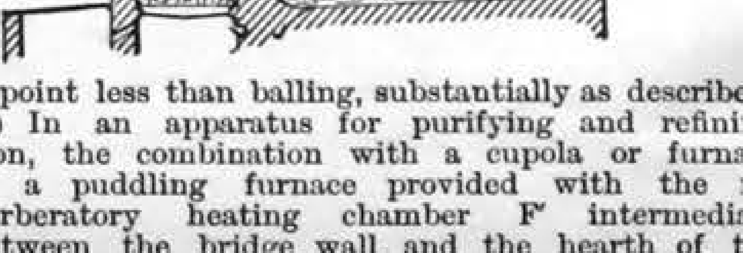


a point less than balling, substantially as described. (2) In an apparatus for purifying and refining iron, the combination with a cupola or furnace of a puddling furnace provided with the reverberatory heating chamber F' intermediate between the bridge wall and the hearth of the puddling chamber, and into which the heated products of combustion pass, the hot well D having a discharge spout E into the reverberatory chamber, and communicating with the furnace or cupola and the steam and air tuyeres J O for producing a concentrated current of superheated steam and air, substantially as described.

559,372. Tap, *C. Elterich, New York, N.Y.—Filed June 28th*, 1895.

Claim.—A tap constructed with a thread composed of alternating straight and taper sections of constant diameter at its bottom; the top of the thread being

559,372.



reduced at the entering end of the tap, and gradually increasing in diameter toward the finishing end, substantially as described.

559,384. Coaling Tub, *C. W. Hunt, West New Brighton, N.Y.—Filed January 10th*, 1895.

Claim.—(1) The combination in a tub or bucket for coal or other material, of two half buckets, a bail having rigid arms at its ends extending out laterally in opposite directions and within the tub, pivots connecting the half buckets near their centres of gravity to the arms, and two toggle bars connected together in the middle and pivots connecting the ends of the toggle bars with the upper edges of the half buckets for holding such half buckets closed when the toggle

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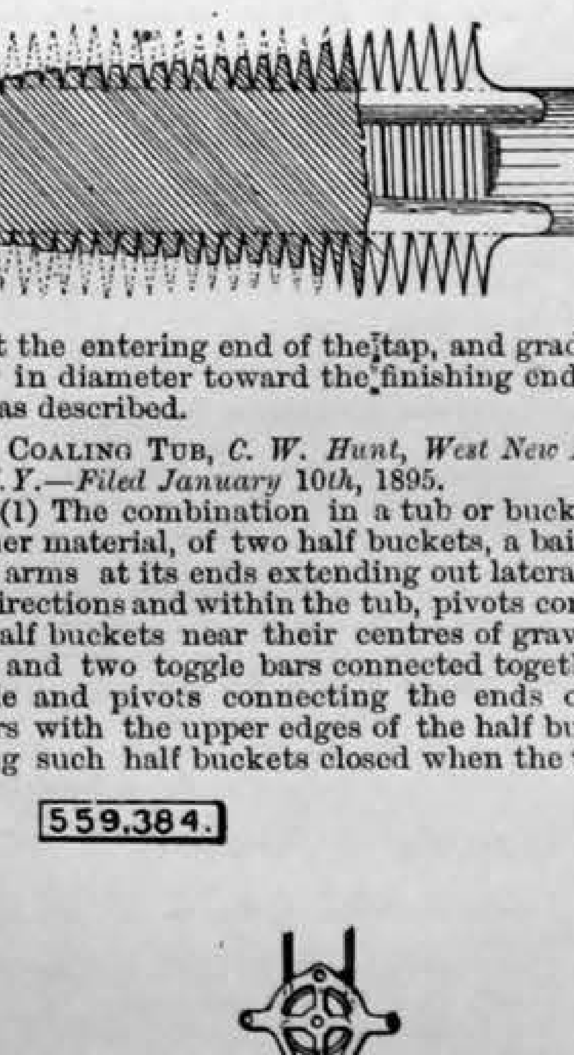

bars are in line with each other, substantially as set forth. (2) The combination in a tub for coal or other material of a tubular bail having arms extending laterally at its ends, half buckets pivoted at or near their centres of gravity to the arms, toggle bars hinged together and connected at their ends to the half buckets, a shaft passing through the tubular bail, and a cam thereon for acting upon the toggle bars to liberate the half buckets and allow them to open, substantially as set forth.