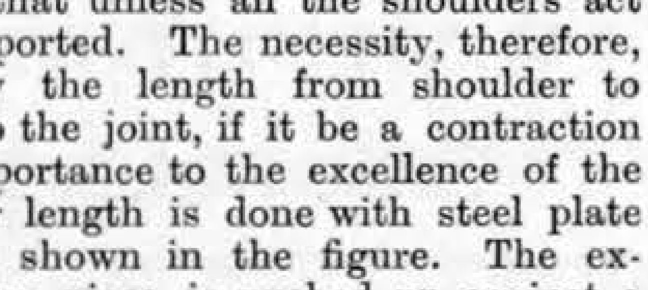
THE CONSTRUCTION OF MODERN WIRE-WOUND ORDNANCE.

No. VI.

THE barrel having been passed for diameter and straightness, and having received the official stamp which indicates that work on it may be continued, passes to the lathe for fine turning. It is necessary, however, to go back a step. Whilst the barrel was being bored the next hoop or jacket which has to be shrunk on to it was in progress, also being hardened, rough turned, annealed, &c., and fine bored. In certain respects the boring of the hoops is an easier matter than that of the barrels; they are larger in diameter, so that not only can larger boring bars be used, but the progress of the work can, as a rule, more readily be observed, and any defect at once put right. On the other hand, several steps occur in every hoop, and there are corresponding reductions in diameter, and the greatest accuracy has to be observed, both in the concentricity of the bores and the regularity of the shoulders. As the latter have to withstand the longitudinal stresses in the piece, the work is usually done in very heavy and stiff machines, which attain very great sizes when the outer hoops for the largest guns have to be dealt with. The boring tool itself is quite different from that used for barrels, and resembles very closely the common tool used in ironworks for boring steam cylinders. In the largest size the bar itself does not move longitudinally, but the tool head carefully fitted upon it is moved slowly along by two or more screws all worked simultaneously from a single central toothed wheel. The work itself in this case being fixed, and not revolving as in the barrel, the boring bar has to be made as stiff and short as possible. The work is often thus very much cramped or shut up, and the difficulty of dealing with it increased.

One or more tools are used, but the number rarely exceeds four, and is generally two, except for the first borings, when a pair of roughing-out tools precedes a pair taking a finer cut. The finishing cut is frequently executed with one tool only. The part of the bore of greatest diameter, if of any extent, is bored to size first, the tool for the next diameter being adjusted from that already bored by gauging between the cutting edge and the inside of the work, an ordinary point or bar gauge being used. It should be mentioned that a horse-shoe gauge is used to check the diameter of the first part bored, the method being that adopted in all engineering works. The tool for the other steps is set in a similar manner, as a rule off the first bore. This class of boring, it is hardly necessary to say, is exceedingly tedious work, the greater diameter of necessity making the progress far slower than on the barrels.

To give longitudinal strength to the gun—that is to say, to make as stiff as possible, considered as a cantilever or girder—it is necessary that the hoops should be joined together where they butt. It is also of importance, for the same reason, that the steps in the hoop should in contracting bring an equal amount of pressure on the corresponding steps on the barrel, or in the case of an outer course, on the hoops below it, and at the same time the joint must do its full work without being unduly stressed. In the case of the 12in. service gun the steps are formed by the fastening rings of the wire course. In a case where there are a number of consecutive steps, it is of the greatest importance that all the steps bear equally; for as it is impossible from the nature of the construction to present a large excess of area in any one shoulder, damage to the material is likely to occur if the load is not distributed over all the bearing surfaces. It will be evident, too, that unless all the shoulders act the gun is less well supported. The necessity, therefore, of knowing absolutely the length from shoulder to shoulder, and finally to the joint, if it be a contraction joint, is of the first importance to the excellence of the gun. This gauging for length is done with steel plate templates of the form shown in the figure. The extremity A of the longer piece is pushed up against a shoulder, the hook of the shorter placed against the next shoulder, and the two square ends brought together. They should, of course, just touch, when the distance



between the shoulders will be that required. The greatest care is necessary with the use of a gauge of this description to ensure that it is lying on a true median longitudinal line, otherwise an error will occur. To check these dimensions further, and to make sure that the shoulders are presenting a true surface, a gutta-percha mould is taken, embracing a pair of steps. The gutta-percha is steeped in hot water till it is soft and plastic, when it is spread in a very thick layer on a special board prepared for it, which is then placed in position and the gutta-percha pressed between it and the part of the bore of which the impression is to be taken. When the gutta-percha has quite hardened the pressure is removed and the mould readily examined.

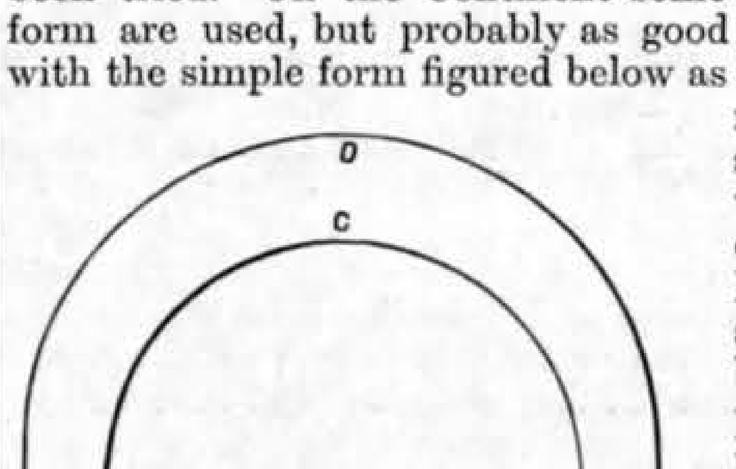
A few sentences back reference was made to a contraction joint; of this and other gun joints it will now be necessary to say a few words. The object of their use is, as we have said, to connect two hoops together, or occasionally, as in the new 4in. guns, to connect an outer hoop to the barrel. They are so arranged as to cause the contraction of the hoops or tubes to take place all in one direction, so that the courses of the gun are drawn closely together. A common form of joint consists in turning a number of rings on the outside of one tube, and corresponding rings on the inside of the adjoining tube. In section the rings present the appearance of serrations in the form of a buttress screw thread, and they are occasionally made as screws. They are only very shallow, but deep from back to front. When the outer hoop is heated its serrations pass over those on the other part, but as it cools its serrations fit into those on the other, and bind the two firmly together. Another form of joint resembles a bayonet catch. The outer tube whilst hot is dropped into place and given a partial turn, when it is at once locked.

The formation of the female part of any of these joints has to be made on the boring machine in which the rest of the work has been executed; or occasionally the exigencies of management make it necessary to transfer the work to another machine, in which case the resetting has to be performed with the utmost care. The serrated joint is now the most commonly used, and is, on the whole, the easiest to make, but the greatest nicety in gauging the serrations and making the male exactly to fit them has to be observed.

The second course—the barrel is known technically as the first course—being ready, and having been gauged with the greatest accuracy by means of bar gauges or verniers for diameter; and corresponding gauges to the length gauges, already described, having been made; or the same gauges themselves, if suitable, being again used, the fine turning of the barrel is commenced. In the 12in. gun the second course is entirely of wire, so that this description does not strictly apply to it. The barrel is generally chucked first with the muzzle end held and centred by four dogs on a face-plate, for which purpose an excess of length is left, whilst into the opposite end—in small guns, as a rule, rough-chambered at this time—a centre is fixed with a split ring in the usual way. The work is then set by the smooth places on its exterior which were used in the course of boring.

Turning is a comparatively rapid operation. The tool, as a rule, is not in any way lubricated. Frequent gaugings for diameter are taken, and when the various portions have been reduced to size, the shoulders are carefully cut to length. The final scraping to gauge is done with a rather broad tool, used dry, which produces a surface with very slight, regular undulations; this is rather an advantage than otherwise. A file is used but rarely, and generally only locally, in places which are so slightly above the gauge that the tool cannot be made to cut.

Various forms of gauge for external diameter have been tried. On the Continent some of rather complex form are used, but probably as good work can be done with the simple form figured below as with any. This is made of sheet steel, about $\frac{1}{4}$in. to $\frac{3}{8}$in. thick. The extremities A and B are hardened, and the distance between their polished faces made exact by adjustment with a hammer, a blow at C increasing the gauge length whilst a blow at D—on the flat side, be it understood—decreases it. The final adjustment is made by rubbing the faces A and B with an oil stone. The gauge is set either by another gauge or by a standard measuring machine of any good description. The use of such a gauge is, we feel tempted to say, psychological, the exact moment when the gauge just touches and no more is so very nearly an abstract sensation. The manner of holding the gauge is of considerable importance. The lower limb of the gauge is supported by resting in the hollow of the left hand, the fingers and thumb grasping it securely. The point of it is pressed firmly against the work and held there steadily. The operator with his right hand grasps the gauge rather above its centre, and by moving his arm slightly backwards and forwards causes the upper point to pass over the work.



Gauges of smaller diameter which can be dealt with by one hand are firmly grasped by the centre. In either case, whether using one or both hands, the instrument is not pushed straight over the cylinder to be measured. The motion is rather a rotation about one of the extremities, which is always that which is either lowest or nearest to the operator. An exception to this action, and, indeed, to the whole method, is necessitated when the gauge is too heavy to be held satisfactorily in the horizontal position. The same pattern gauge is employed, but the operator stands over the work and lowers the gauge so that both points touch simultaneously. Another reason which favours this method for large gauges may be mentioned. It will be understood that when the calliper is used horizontally, the lower limb being supported by the left hand, the distance between the points will be slightly decreased by the bending downwards, due to its own weight, of the upper leg, and unless the precaution is taken of adjusting it in this position an error will occur. But with the gauge used vertically and supported by two hands, each of which should—of course, theoretically—be placed exactly on the centre of gravity of its corresponding half gauge, there is no deflection due to weight. Certain continental houses take the further precaution of insulating the steel by wooden handles, so that no heat deflection may occur. This, however, is an unnecessary refinement, and is never, we believe, employed in this form of calliper, as it is found by long experience that the gauge is always a little superior to the capabilities of methods and tools used in gun work. By this we mean to say that, unless the highest refinements of grinding to size were adopted, finish to anything under, say, $\frac{2}{1000}$in. is practically out of the question. In the hands of an expert—gauging is by no means to be learnt in a day—the form of calliper we have described will give results of a very high degree of accuracy. A clever gauger can, moreover, tell very approximately by the feel of the calliper how many thousandths the work is over size.

Gauging is never trusted solely to the turner, although he, of course, is provided with the gauges, and has to use them. But when he has brought the work, as he thinks, to size, he informs the foreman, who then, as a rule, goes over the work, too; if it is to his satisfaction one of the staff of regular gaugers repeats the measurements, gauging from breech to muzzle, at short distances, about 1ft. apart. It is usual to make long cylindrical parts very slightly taper, rather with a view to making sure that the greatest compression of the hoop is at the breech end, than with a view to letting the hoop go on easily—just as in the old whipping days it was usual to count one lash less than the specified number so as to make sure of being on the safe side.

It will, perhaps, be of interest to explain that the gun turners do not work from drawings in the ordinary sense of the word, although such are, of course, supplied to the shop. These shop drawings—we speak of the Elswick system—are mounted, as a rule, on boards, and are dimensioned to those sizes and diameter which the gun should have when completely built up. Now, from the theory of the construction of modern ordnance, the internal bore of a hoop is slightly less than that of the barrel over which it is to fit; it being, of course, put on hot, consequently the dimensions given on the mounted drawings must be wrong for the size cold of either the hoop or barrel. The drawing is, however, useful to work to, and from it rough sketches on long narrow strips of drawing paper are prepared in the gauger's office, and on them are marked the true dimensions. A separate set of such dimension sketches, as they may be called, is prepared for each individual gun, and they are filed and preserved for reference.

We may now suppose that the barrel has passed the inspector's hands and is ready to receive the next course. This consists of one, two, or three hoops in all wire guns over 4·7in., except the 12in. This gun, it will we remembered, has a double barrel, it has an "inner A tube" and an "outer A tube." The former is turned slightly taper and the latter bored to suit. The inner is then placed in the outer into which it enters easily to within a short distance of its end, the last foot or so being driven by a great "dolly," or pressed home. The object of this arrangement is that when erosion has occurred to such an extent that the barrel is useless, the inner A tube may be removed, probably cut out, and replaced without disturbing the remainder of the gun. The fitting of these two tubes together is, considering their great length, nearly 36ft., one of the finest achievements of modern ordnance manufacture. It should be said that in order to prevent any rotation between the two, due to the movement of the huge shot along the rifling, the outer tube is scored longitudinally for the forward half of its length.

SHIPBUILDING IN 1897.

(*Concluded from page* 147.)

ROUGHLY considered, the productive capacities of the shipbuilding works in foreign countries, including British Colonies, was requisitioned during 1897 to the extent of 513,000 tons, war as well as mercantile shipping included. This is, in round figures, the return made by Lloyd's Register. It does not include torpedo boats, and possibly it takes no account of some vessels of small tonnage, particularly sailing and fishing vessels, built in the more remote districts, which are included in the returns sent by individual firms to the *Glasgow Herald* and other journals. Few, if any, merchant vessels of any importance, however, have been omitted.

The total output of the United Kingdom, war and merchant tonnage, being 1,047,950 tons, the above total, it will be seen, comes very near being one-half—48·9 per cent.—of the United Kingdom production, an enormous advance on the returns of only a few years ago. Adding the two totals together gives the grand aggregate output for the whole world during 1897 as 1,561,000 tons.

Deducting warship tonnage from the above, one may derive some conception of the volume of merchant tonnage added to the fleets of the world, and of how this is affected by the losses during 1897. Exclusive of warships, the total output of the world, in round figures, appears to have been 1,331,000 tons, 1,202,000 tons being steam, and 129,000 sail. Now, Lloyd's Register Wreck Returns show that the tonnage of all nationalities totally lost, broken up, &c., in the course of twelve months amounted to about 712,000 tons—316,000 steam, and 396,000 sail—so that it will be seen that while the sailing tonnage of the world has been reduced by 267,000 tons during 1897, the steam tonnage has increased by about 886,000 tons. The net increase of the world's mercantile tonnage is therefore 619,000 tons. Of this total, the net increase in the tonnage of the kingdom is rather less than 8 per cent., but of the new tonnage launched the United Kingdom has acquired about 54 per cent.

Our three great national rivals in shipbuilding were, of course, Germany, the United States, and France, and that more particularly in regard to mercantile shipbuilding, although Germany's output of warships—51,000 tons—includes six vessels of 7100 tons to Chinese account, and America's one vessel of 4760 tons for Japan. Leaving warships aside, Germany's output during the year amounted to £140,000 tons, the United States to 87,000 tons, and France's 49,000 tons. Of the tonnage produced by Germany, as much as 39,350 tons were contributed by three vessels alone, the Kaiser Wilhelm der Grosse, of 14,350 tons; and the Kaiser Freiderich and the Pretoria, each approximately of 12,500 tons.

Of the tonnage reported from the United States about 60 per cent. does not affect directly the general commerce of the world, but is intended exclusively for service on the Great Lakes of North America. Of the vast trade carried on on these inland seas not many out of America—and even there the conception is sometimes at fault—are capable of adequately conceiving. This is not the place to think of dealing with the subject, but in view of the above remark as to the trade of the Lakes not affecting the general commerce of the world, it may be stated, on the authority of a member of the American Society of Naval Architects, who read a paper at the recent conference in New York on "The Commerce of the Great Lakes," that Duluth shipped flour to Liverpool last summer for 14½ cents per cwt., and that rails had been coming by the various railways from Cleveland to tide water, bound for Liverpool, also nails and iron rods. The cheap Lake transportation to Cleveland was a factor of prime importance. During 1897 over 28,000,000 tons passed through the Detroit River, which, if placed in 20-ton cars, would extend from New York to San Francisco and back. It was a greater commerce than that of Liverpool and London combined. The better class of vessels employed were able to make the coal record ·55 oz. per ton-mile, which economies were associated with triple and quadruple-expansion engines; and the increased length of vessels, which were now from 475ft. to 520ft. long. During 1897 three of the steamers built for Lake service were each between 4100 and 4200 tons, and in addition there were seven sailing and towing barges ranging between 3180 and 3800 tons.

As regards French shipbuilding the most noticeable feature, as already indicated, was the continued development of the building of large sailing vessels. Notwithstanding the generous support which the merchant shipowners of France, and her shipbuilders as well, receive from the Government in many ways, shipbuilding there is—as has frequently been pointed out in these columns—in anything but a flourishing condition. Only three merchant steamers aggregating 13,240 tons were launched during the year. Norway launched twenty-five vessels aggregating 17,250 tons, Denmark thirteen vessels of 13,540 tons, and Holland forty-two vessels of 20,350 tons.

As regards the largest and fastest steamers produced during the year it is to Germany rather than to Great Britain one has to look. Reference has already been made to the big liner Kaiser Wilhelm, which in speed and other qualities has shown herself the equal at least of our champion liners the Campania and Lucania. The most notable of the mail steamers produced in this country were the Briton, of 10,248 tons, by Messrs. Harland and Wolff, for the Union Line; the Egypt and Arabia, each of about 7900 tons, by Messrs. Caird and Co., for the P. and O. fleet; the Carisbrook Castle, of 7500 tons, by the Fairfield Company, for the Castle Packet Company's fleet; and more notable still as regards size, though not of speed and outfit, the Cymric, of 12,340 tons, by Harland and Wolff, for the White Star Line; and the Brazilia, of 11,100 tons, by the same firm, to German account.

Though less in number than in some previous years, large cargo-carrying steamers were certainly one of the features of the year. The Cymric, for example, is the largest cargo-carrying vessel afloat, being 600ft. long, 64ft. beam, and 42ft. deep, and her gross measurement of 12,550 tons exceeds that of the same company's Georgic, built two years ago, by about 2300 tons, and that of the leviathan Hamburg liner Pennsylvania, built the year subsequently. The Cymric, moreover, marks an important departure in the methods of the White Star Company, for, following the example of the Wilson-Furness-Leyland Line, and the Boston and Liverpool boats of the Leyland Line, she is provided with accommodation for a limited number of cabin passengers. Cattle accommodation is provided on two decks, while three large chill chambers are provided for the carriage of dead meat and dairy produce. If occasion requires, the Cymric can be quickly arranged to carry steerage passengers or a large number of troops. Notwithstanding all this, the arrangements and appointments of the saloons and berths are the same as those of the "express" mail steamers Majestic and Teutonic, and doubtless the comfort and convenience will not be behind what is experienced on board these crack greyhounds, although "the pace" may not be so marked.

Though not so large, several steamers of the combined cattle-carrying and passenger type were produced from Clyde shipyards, and the complete fulfilling of the conditions for conveying satisfactorily in the one bottom, luxurious man and live—not to say lively—cattle, forms testimony to the ingenuity and ability which builders bring to bear on their work. Whether such huge steamers as the Cymric and her predecessors and contemporaries of the same type are quite fitted for the highest class — the most "go-ahead" and the most luxurious—of cabin passengers has yet to be seen, but of second and third-class passengers they can, if required, carry an enormous number. On each voyage they can take more deadweight than the largest cargo boats of ten years ago could take in five voyages, and the conveyance of live stock is altogether safe from the risk of a large death-rate by stress of weather. The carrying trade of the world is being changed considerably by the building of these enormous vessels, and while they will make it more than ever difficult for cargo steamers of ordinary dimensions to earn paying freights, it is some compensation to think that largely through their agency, the days of high prices for foreign food products in one small bit of territory are never likely to return.

Apart from the torpedo boat destroyers and other craft for the Navy, there were few vessels of very high speed constructed during 1897, if we except several fast Channel steamers, and, of course, Parsons' notable Turbinia, which is as yet not a type, but a thing apart, though of great promise. For the Holyhead and Kingstown service, Messrs. Laird produced the twin-screw steamer Connaught, which, like her predecessors of the previous year, attained the 23-knot speed stipulated for. For the Irish trade, Messrs. Denny, of Dumbarton, produced the Cambria, and for the Channel service conducted by the Great Western Railway Company the celebrated works at Barrow produced the Roebuck and Reindeer. Besides a number of paddle steamers for river passenger service of types now pretty common, 1897 saw the production of the Empress Queen, the most powerful, and one of the largest—those on American rivers excelling in this respect—paddle steamers in existence. This notable vessel was built by the Fairfield Company, and, like others above named, has already been fully described and illustrated in our columns.

The output of large and splendidly-appointed steam yachts from the shipyards of the Clyde and the Forth formed one of the most notable features of the year's work in shipbuilding. The vessels of this class, from 50 tons upwards to 1800 tons yacht measurement, numbered eighteen, and the aggregate tonnage was 9450 tons. The three largest vessels were the Mayflower of 1780, the Nahma of 1800, and the Aegusa of 1200 tons, all being for American owners. The two first-named were built at Clydebank from designs by Mr. G. L. Watson, and are at once the largest and finest private yachts yet built on the Clyde. The Ailsa Shipbuilding Company, of Troon, which has now a high reputation for work of this class, produced three vessels each of 450 tons, all from Watson's designs, and noteworthy as being provided with boilers of the water-tube type. Messrs. Ramage and Ferguson, of Leith, whose annual output of such work is usually large, during the year produced five vessels ranging from 470 to 85 tons. Besides the magnificent new vessel for Baron Rothschild, building at Fairfield, a number of steam yachts for American ownership are at present being designed by Mr. G. L. Watson and contracted for—notably one for Mr. Gordon Bennett, the renowned newspaper proprietor of New York. The operation, however, of the new American Payne Bill for the protection of American shipbuilding can scarcely fail to have a curtailing effect—as it was intended to have by its promoter—on such orders in the near future.

Not one of all the palatial yachts built last year, or in any previous year, can cross the Atlantic at full speed under her own steam, and in connection with the yacht being designed for Mr. Bennett, a problem involving the coal endurance necessary to cross the Atlantic at a speed as near the top speed as possible is being tackled by her designer. The record in this matter is at present held by the Varuna, designed by Mr. Watson for Mr. Eugene Higgins, of New York, which vessel succeeded in doing the voyage at an average speed of 13½ knots, very much below the maximum of which she was capable. The question whether a steam yacht, having all the properties recognised as indispensable in such craft—fineness of form and luxuriance of living accommodation—can be built to carry all the coal necessary, and do the crossing at an average rate of 15 knots, has presented itself to Mr. Bennett, and believing the conditions can be complied with, he has commissioned Mr. Watson to prepare the plans for such a vessel. The length, it is said, will be over 300ft., and the engines of the quadruple expansion four-crank type, capable of developing 7000-horse power. It is more than likely that water-tube boilers will be adopted, but in any case the bunker capacity will be unusually large, so that the paramount condition of steaming from the Old World to the New at 15 knots speed without re-coaling may be fulfilled. A steam yacht intended to demonstrate the same problem has, it is understood, been placed in a United States yard by Colonel Oliver H. Payne, author of the protective Bill above referred to. She is to be 300ft. long, 35ft. beam, and, with abnormal coal bunker capacity, to steam 15 knots.

While there has been during 1897 the usual—perhaps more than the usual—number of novelties, or eccentricities designed to revolutionise naval architecture—and in this connection we need only mention the Bazin roller ship, and the roller ship, or cylinder rather, of Mr. F. A. Knapp, a Canadian lawyer, both of which notions, in respect of the results from experimental vessels, have proved nothing short of failures—naval architecture has progressed on lines not very far removed from the well-tried and conventional. An increased number of "turret" deck and "trunk" deck cargo steamers was turned out from North-East Coast of England yards, from which so very many utilitarian, and of course valuable, modifications of accepted types and methods emanate; and now we have Lloyd's Register, which at first set its face against these mild innovations, telling us that "during the year under review six steamers have been launched of the trunk-deck type, which was introduced in 1896, all having been built under the supervision of Lloyd's Register."

As regards the material employed in the construction of the ships of 1897, it goes without saying that, so far as the United Kingdom is concerned, it was almost wholly Siemens steel, only 1·1 per cent. of the tonnage having been built of iron, and this was virtually made up of steam trawlers, no vessel being larger than 200 tons. Of the craft sent abroad in pieces, however, a certain percentage was made up of iron, due to the exigencies of service in foreign and sometimes havoc-working waters. Of the sailing tonnage, 95·5 per cent. was steel built, and 4·5 per cent. wood. In connection with the question of structural material, however, it may be worth while to refer to the condition of things abroad in this respect. Undoubtedly, many of the great yards in Germany, Russia, France, &c., get large supplies of material as manufactured in this country, but it may interest many to learn that, as pointed out recently in an important paper read by Mr. C. E. Stromeyer, formerly of Lloyd's Register, now engineer-in-chief to the Manchester Steam Users' Association, German ships and boilers are very largely—Mr. Stromeyer says "almost exclusively"—built of basic steel. The basic steel referred to, however, is not that made either in a Thomas—basic—converter or in a basic open hearth, two qualities which have not earned for themselves in this country a good reputation in shipyards and boiler shops. The kind of basic steel in question—which Mr. Stromeyer refers to as "basic-refined" steel—although produced in a basic furnace, is a material which is now most extensively made in Germany, and which in Mr. Stromeyer's experience of it in various continental countries has "proved itself equal if not superior to steel made in this country." In view of the highly important bearing which this basic system has upon the possibility of rendering native ores available for our manufactures, it is worthy of attention. During 1897 some progress has been made in this country in introducing nickel-steel as an improved material for boiler shell plates, forgings, and other such purposes, due reference to which was made in our annual review in January 7th issue.

With regard to outstanding features in marine engineering practice, the year 1897 was not fruitful in such, except in the way of emphasising the value and still greater promise of departures previously instituted or just recently inaugurated. All that can with any certainty be said on such points has already been said in the annual review already alluded to appearing in our issue for January 7th.

HARBOURS AND WATERWAYS.

Swansea.—A movement has been on foot for some time past for developing the resources of the Mumbles, and a Bill is now before Parliament for giving power to construct a railway and extend the Mumbles pier, so that large steamers may be bunkered there without the need of going to Swansea; and also that it may be used for landing and embarking passengers. The Swansea Harbour Trustees, fearing that this may lead to a diversion of traffic from their docks, intend to oppose the Bill, and consequently the chairman, who is also chairman of the Mumbles Railway, has resigned his position on the Trust. Although at present there is no definite scheme for the construction of a new dock at the Mumbles, yet, considering that a low-water entrance could without difficulty be constructed at this part of the coast, and the advantage it would be to the Rhondda and Swansea Bay Railway by developing the coal district along their line, the Harbour Trustees have reasonable ground to fear that in the near future the Mumbles may affect them in the same way that Barry has Cardiff.

Manchester Ship Canal.—The report of the directors of the Manchester Ship Canal for the last half-year shows a balance of revenue over expenditure of £19,007, and of the Bridgwater department £22,052. The interest for the half-year on the first and second mortgage debentures amounted to £44,742, the difference between this and the revenue being supplied from the accumulated Bridgwater revenue. The unpaid half-year's interest due to the Manchester Corporation, £112,500, makes the accumulated amount now outstanding on this account £618,750. The traffic increased from 925,659 tons in 1894 to 2,065,815 last year. The increase of sea-going traffic of 1897 over 1896 was 190,821 tons.

As showing the difficulty to be overcome by the managers in securing traffic, the case of the Irish trade may be quoted. It was thought that considering the very large amount of food and cattle exported from Irish ports to the Manchester district, and the export from there to Ireland of manufactured goods, this would lead to the running of a direct service between Ireland and Manchester, yielding a considerable revenue to the canal. No less than five unsuccessful attempts have been made to maintain a regular weekly steamship service between Manchester and the South of Ireland, but, owing to railway influence, both these and similar attempts made to run a regular service from Belfast have failed. This is due to the action of a Conference which embraces the principal railways connected with the steamship services between Ireland and the West of England, which arranges for through traffic and rates between the interior towns of the two countries on such a basis that there shall not be any outside competition. This hitherto has prevented the steamships trading direct to Manchester from competing with the Conference Companies. The railway rates in many cases from the Manchester docks to English stations are higher than the through Conference rates from Belfast to the same stations. Since the beginning of this year the direct service between Belfast and Dublin and Manchester has been re-organised, and in future the steamers are to run at more frequent intervals, and a determined attempt is to be made to enter into a successful competition with the Conference Companies. Almost from the opening of the canal there has been direct steamship service between London, Bristol, Glasgow, Aberdeen, Dundee, Leith, and Newcastle-on-Tyne, and in these cases the steamers have proved successful competitors with the railways, but in the case of Ireland, where the Ship Canal is the natural channel of communication to and from Manchester for a large and profitable trade, owing to the action of the Conference the repeated efforts of traders, shipowners, and the company have failed to divert to any considerable extent the trade from the more expensive route. Of the total cross-Channel traffic from Belfast to the Lancashire ports, amounting to about 800,000 tons, only 50,000 tons cleared for the Ship Canal, notwithstanding the fact that Manchester, besides having a large trade of its own with Ireland, is more favourably situated for dealing with through traffic than any of the other ports.

Grand Junction Canal.—The last dividend declared by the directors is at the rate of 4 per cent., being the thirty-fifth half-year in succession when a similar amount has been paid to the ordinary shareholders. The balance of £10,439 carried forward would have allowed of another 2 per cent. being paid, but in prospect of new works required it was not considered prudent to carry forward a less balance. The agreements with the Leicester and Loughborough Navigation and the Erewash Canal companies, for extending the through traffic arrangements, with the optional power of purchase, have been completed; and it is intended now to proceed with the improvement of the lockage system at Watford and Foxton. The increasing traffic has rendered the dredging and deepening of the canal in parts necessary.

The Grand Canal, Ireland.—At the half-yearly meeting of this company the directors were also able to declare a dividend at the rate of 4 per cent. per annum against 3½ per cent. for the corresponding period of the previous year. The chairman pointed out the difficulty of maintaining the traffic in competition with the railways, and the advantage of further developing the canal system of Ireland by connecting the Shannon with Lough Erne, which would form the keystone of the whole system.

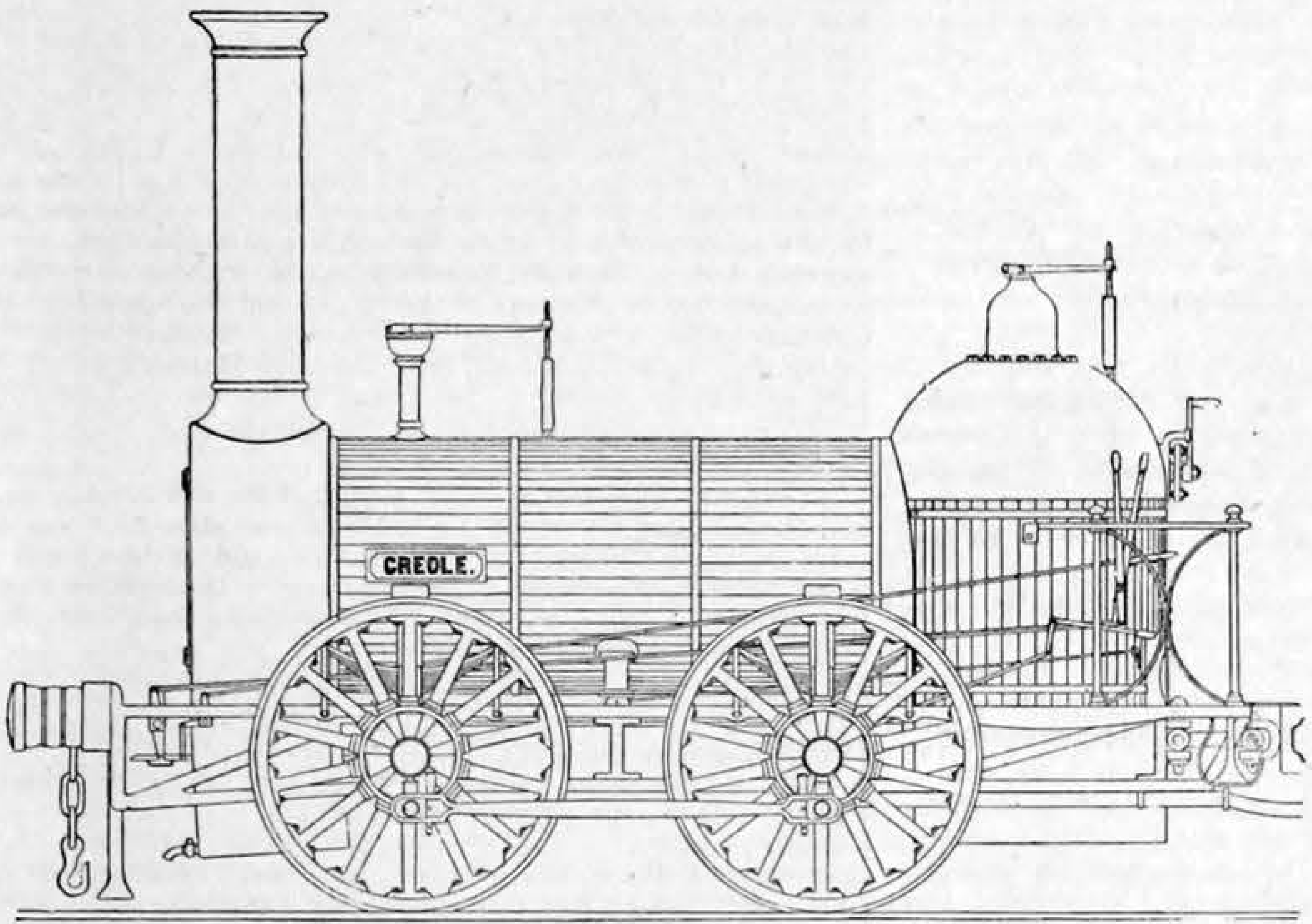
Kennet and Avon Canal.—A serious landslip occurred recently on the banks of this canal between Limpsley Stoke and Freshford, the embankment giving way, and the water from a nine miles' length of canal escaping and inundating the low land adjacent. Fortunately there was no traffic on this part of the canal at the time of the accident. The place where the slip occurred has always been a source of trouble, the bottom being on the bare rock.

Buenos Ayres.—It is expected that the extensive dock and port works which have been in course of construction for the last ten years, and have cost the Argentine Government about £7,000,000 in gold to construct, will in the course of a short time be completed. These works were designed and have been carried out under the direction of the late Sir John Hawkshaw and the partners of his firm, Mr. Dobson acting as resident engineer. The late Mr. Thomas A. Walker was the original contractor, and since his death the works have been in charge of his nephew, Mr. Charles Walker, for his executors. These works were authorised in 1882, and consisted of the conversion of the flat muddy banks of the River Plate for a distance of three miles in front of the city of Buenos Ayres into a succession of basins, locks, and docks, the whole works being enclosed by long massive stone walls, reclaiming a large area of building land. The docks are approached by means of two dredged channels, one to the south and the other to the north basin, the two converging in the River Plate seven miles below the city. The works were so designed that the several basins or docks could be opened successively as they were completed. The south basin, covering 35 acres, was opened in January, 1889; and the first dock in January, 1880; the second in September, 1890; the third in 1893, and the fourth in 1896; and the north basin last March. Large warehouses have been erected, two graving docks have been constructed of sufficient size to take warships, and a thorough equipment of hydraulic machinery, shedding, and railways provided. The original estimate was £4,000,000, but owing to the delays due to the troubled state of the country, and additional works carried out beyond those originally intended, this estimate has been nearly doubled. The docks are now crowded with shipping, and the revenue gives a return of nearly 4 per cent. on the outlay.

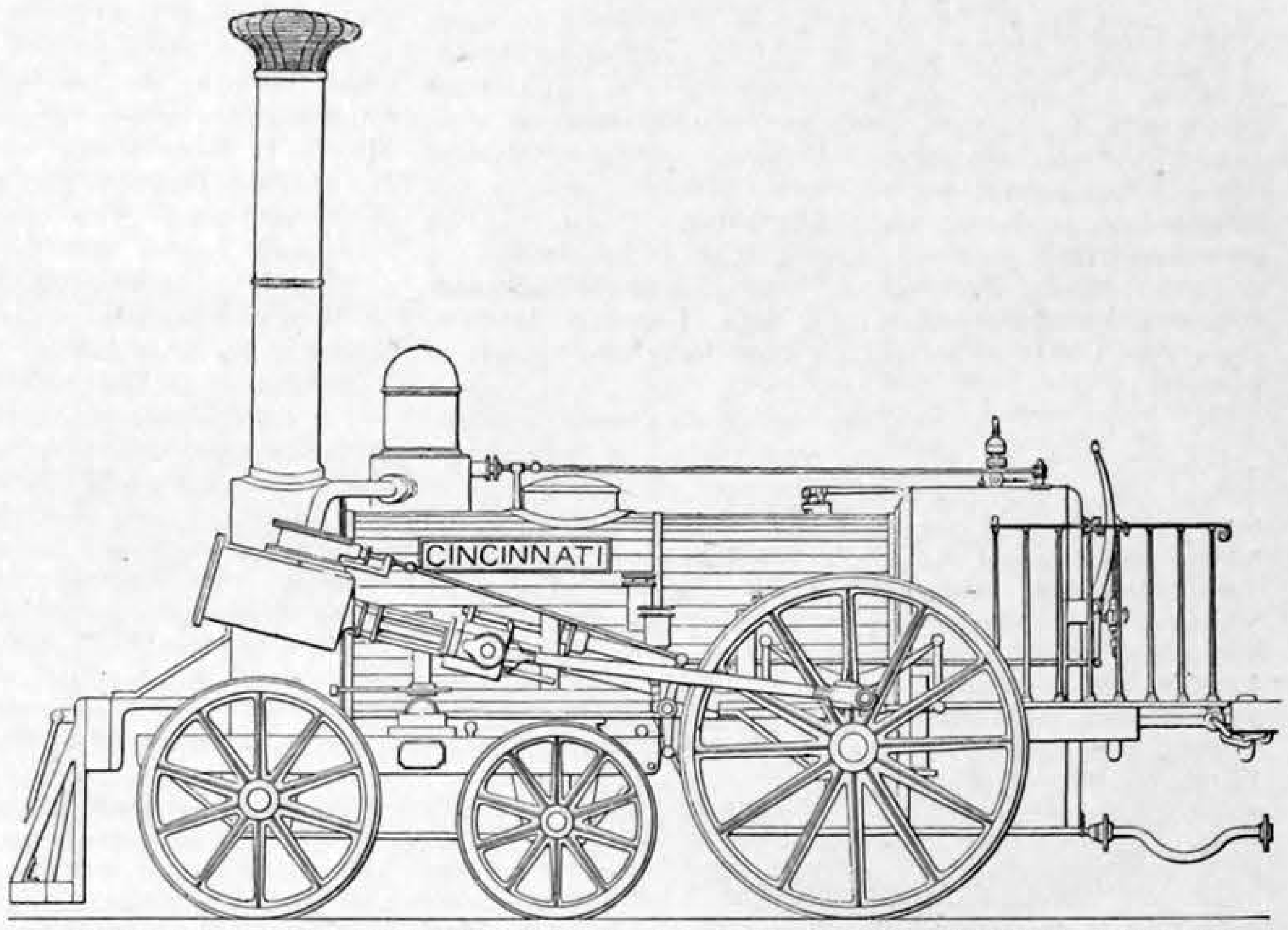
Owing to the immense amount of deposit brought down by the river, in its long course of 1200 miles, there is considerable difficulty in maintaining the deep-water channels which are being dredged to give access to the docks, and the large liners of the Royal Mail Steamship and of the Italian companies prefer to discharge at Ensenanda, some distance down the river. Vessels drawing over 23ft. still run risks in navigating the River Plate up to Buenos Ayres. To obviate this difficulty a project has for some time been under consideration for the construction of a new harbour at Monte Video. It is proposed to enclose an area of 363 acres by means of breakwaters, and thus to afford shelter to the dock and wharves. From an inner harbour to the sea it is proposed to dredge a channel nearly two miles long, with a depth of 23ft. at low-water. The estimated cost of this scheme is £3,000,000. The amount of tonnage which now enters the port of Monte Video is about 3½ million tons.

Rochdale Canal.—At the annual meeting of this company, a dividend at the rate of only 1 per cent. for the year was declared, which was attributed by the chairman to the attitude taken towards the company by the Manchester Ship Canal Company.

Nicaragua.—The Commission sent out by the United States Government are now engaged in making the preliminary surveys for the purpose of preparing a report as to the feasibility of the canal and its cost. The amount of appropriation for the cost of the survey appears, however, to have been very inadequate, and unless fresh funds are voted, there is a prospect of the work not being properly completed.



E BURY & CO'S "CREOLE" (No. 10), 1833, PONTCHARTRAIN RAILROAD



C TAYLEUR & CO'S "CINCINNATI," (No. 20), 1835, SOUTH CAROLINA RAILROAD

LOCOMOTIVES SUPPLIED BY BRITISH FIRMS TO AMERICAN RAILROADS.

PART IV.

THE Pontchartrain Railroad obtained two locomotives from the Clarence Foundry. The first of these was named Creole —No. 10—and was built in 1833, the accompanying illustration being a copy of one of the working drawings to which it was built. It had cylinders 11in. by 18in., and four coupled wheels 4ft. 6in. in diameter, standing on a wheel base of 6ft. The boiler barrel was 8ft. long, and contained eighty-six tubes, 8ft. 10in. long by 2in. diameter; and the fire-box and smoke-box had lengths respectively of 3ft. 8in. and 2ft.; while the length of framing was 17ft. over all, and the height to top of chimney 13ft. Three years later, in 1836, the Orleans—No. 39—was built for the same road, this being an engine of similar type, but with 12½in. by 20in. cylinders, 5ft. 3in. coupled wheels, and a 7ft. wheel base.

Messrs. E. Bury and Co. built, in 1834, two engines for the South Carolina Railroad, with the names Georgia and Augusta—Nos. 15 and 16. These had cylinders 12½in. by 20in., and were otherwise practically identical with the Creole already illustrated, except that the height to the top of the chimney was 1ft. more, or 14ft. altogether.

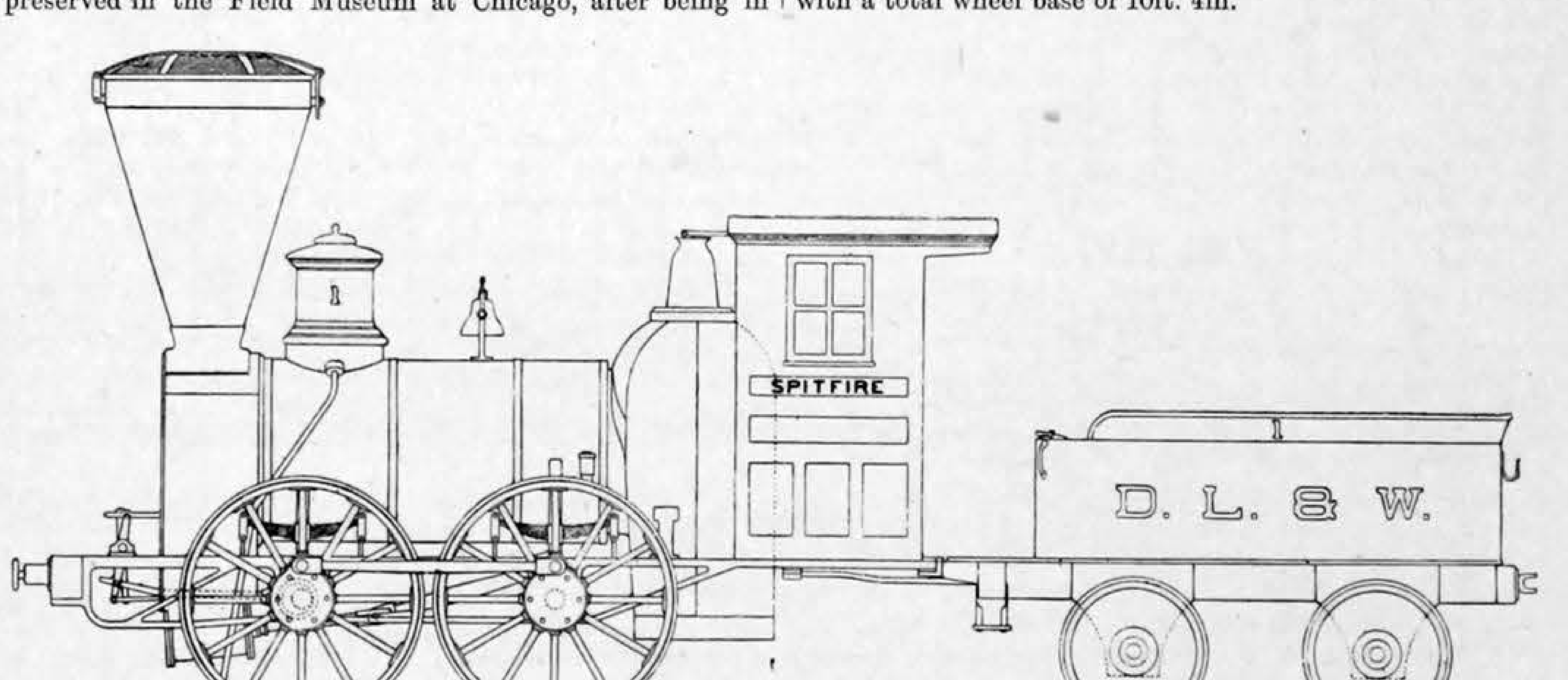
The same working drawing was also used for the Boston—No. 17—built in 1835 for the Boston and Providence Railroad, which had 12in. by 18in. cylinders, but was otherwise identical with the Creole.

One engine was built by the Clarence Foundry for the Boston and Worcester Railway in 1836, with the name Lion —No. 31—which had 13in. by 20in. cylinders, and four coupled wheels 5ft. in diameter, on a wheel base of 6ft. 6in.

The remaining engine of the list built by the firm was the Wilmington—No. 37—built in 1836 for the Philadelphia and Wilmington Railroad. It had cylinders measuring 12in. by 18in., and four coupled wheels 5ft. in diameter, with a wheel base of 6ft. 6in.

From the point of view of numerical importance, the firm of Messrs. Braithwaite, Milner, and Co., of London, comes next. In 1833 one engine was ordered by Mr. McNeil for the Paterson and Hudson River Railroad, with the name McNeil, having 10in. by 16in. cylinders, and four coupled wheels, 4ft. 6in. diameter, and the dimensions of this engine, which was the standard pattern of the firm, and of what is known as the "Bury" type, are given by Whishaw as:—Boiler, 7ft. 0⅝in. by 2ft. 8in., containing sixty-five tubes, 1⅝in. in diameter; fire-box, 2ft. 3½in. by 3ft. by 3ft. 10in.; heating surface, tubes, 219·40; fire-box, 45·35; total, 264·75 square feet.

Three engines of this pattern were ordered by Mr. A. E. Young, through Messrs. Baring Brothers and Co., for the Allegheny Portage Railroad, their names and dates being respectively Delaware, 1833; Allegheny, 1834; and Comet, 1837. These were afterwards sold to the Philadelphia and Reading Railroad. The Petersburg Railroad had one, named Weldon, built in 1835, and the Richmond, Fredericksburg, and Potomac road had one, the Jefferson, ordered by Messrs. Summer Graves and Day, and built in 1837. This engine was afterwards sold to the Philadelphia and Reading Railroad. In the same year Messrs. Baring Brothers and Co. ordered eight engines of this type for the Philadelphia and Reading Railroad, which bore the names of Rocket—No. 1 in the railway company's books—Fire Fly, Spitfire, Dragon, Comet, Planet, Hecla, and Gem. The accompanying illustration shows the Spitfire after it had been "Americanised" by its owners, the smokestack, bell, "caboose," and tender being all of them foreign to the original design of the engine. This locomotive was subsequently, in 1849-50 sold to the Delaware, Lackawanna, and Western Railroad, of which company's stock it constituted No. 1. The Rocket is now preserved in the Field Museum at Chicago, after being in almost continual service. Its coupling rods are removed, as happened to many of the four-coupled engines sent over.



BRAITHWAITE, MILNER & CO'S "SPITFIRE," 1837, PHILADELPHIA & READING RAILROAD

The two other engines built by Messrs. Braithwaite were of a different type. They had horizontal outside cylinders 9½in. in diameter, with a 16in. stroke, and four coupled wheels 3ft. 7in. in diameter, and were built for the Natchez and Hamburg Railroad in 1834 and 1835 respectively, with the names Mississippi and Natchez. The weight of these engines was about 6 tons 5 cwt. each. No very detailed record seems to be in existence with regard to these engines, but the Mississippi was in work from 1836 to 1838. Thirty years later, in 1868, it was removed from Natchez to Vicksburg, presumably after a career of honourable usefulness, and was then put aside and buried in sand. For ten years this state of things lasted, until in 1878 it was dug out, and put to work again on the Meridan, Brookhaven, and Natchez Railroad, a seven-mile branch line, on which it hauled trains until as late as the year 1891.

Messrs. Rothwell and Co., of the Union Foundry, Bolton, sent seven locomotives to American railroads. The first of these—No. 2 in the books of the makers—was the Pontchartrain, built in 1832 for the railroad of the same name, and it remained in work for about thirty years. It had cylinders measuring 10in. by 18in., a pair of leading wheels 3ft. in diameter, and a single pair of 5ft. driving wheels. According to Whishaw, the boiler barrel was oval in section, being 6ft. in length, with two diameters of 38in. and 27in. respectively, and contained eighty-eight tubes of 1½in. diameter. The fire-box measured, according to the same authority, 24in. by 38½in. by 36in., and the heating surface was, tubes, 215·60; fire-box, 35·59; total, 251·19 square feet. To the Bangor and Piscataguis Railroad, the firm supplied two engines having 3ft. leading wheels and 4ft. 6in. driving wheels, Pioneer—No. 4—being built in 1832, and Bangor—No. 6—in 1836. The former had 9in. by 18in. cylinders, and, according to Whishaw, a boiler 6ft. 4in. long by 2ft. 8in. diameter, containing fifty 1⅝in. tubes. The Bangor, on the other hand, had 11in. by 16in. cylinders, and a boiler 6ft. 8in. long by 3ft. diameter, containing 88 tubes 1½in. in diameter, with a fire-box measuring 28in. by 40in. by 42in., and a total heating surface of 283·64 square feet. An intermediate engine, Nottoway—No. 5—was built in 1833 for the Greensville and Roancke Railroad, of the same dimensions as the Pioneer. In 1836, the Tennessee—No. 8—was built for the South Carolina Railroad, this being a bogie engine constructed to Mr. Allen's design, and exactly similar to the Cincinnati of Messrs. Tayleur and Co., which is described and illustrated later on. The other engines built by Messrs. Rothwell and Co. were two four-coupled locomotives with 10in. by 16in. cylinders, and 4ft. 6in. wheels, turned out in 1837 for the Richmond, Fredericksburgh, and Potomac Railroad, with the names of Robert Morris—No. 23—and Oliver Evans—No. 25. An engine mentioned by Whishaw—No. 7—of the same class as Bangor, was sent to Canada, not to the United States, so that it should not be included in this list.

Messrs. Charles Tayleur and Co., of the Vulcan Foundry, built seven locomotives for American roads. In 1833 two bogie engines—Class G, Order No. 3, Rotation Nos. 4 and 5—were built for the Camden and Woodbury, now a part of the Pennsylvania Railroad system. These, which are illustrated by the accompanying reduction from the firm's working drawing, were named respectively Fire Fly and Red Rover, and had each a pair of inside cylinders 9in. by 14in., and a boiler barrel measuring 6ft. by 2ft. 7in. The bogie wheels were each 3ft., and the single driving wheels 4ft. 6in. in diameter, with a total wheel base of 10ft. 4in.

In the latter part of 1835 three more bogie engines were built by this firm to Mr. Allen's design for use on the 5ft. gauge of the South Carolina Road. These were officially known as Class H, Order No. 13, Rotation Nos. 20, 21, and 22, and were named Cincinnati, Allen, and Kentucky respectively. In contradistinction to the earlier bogie engines, these had outside cylinders and inside frames, the cylinders being 10in. by 16in., and the boiler barrel 7ft. 7in. by 2ft. 8in. A peculiarity of Mr. Allen's design lay in the employment of unequal-sized wheels for the bogie, the leading pair being 3ft., and the second pair only 2ft. 6in. in diameter. The driving wheels, 4ft. 6in. in diameter, were placed in front of the fire-box, thus reducing the wheel base to 8ft. Other builders turned out engines of the same pattern, as has already been mentioned. The accompanying illustration shows the leading features of this type of engine.

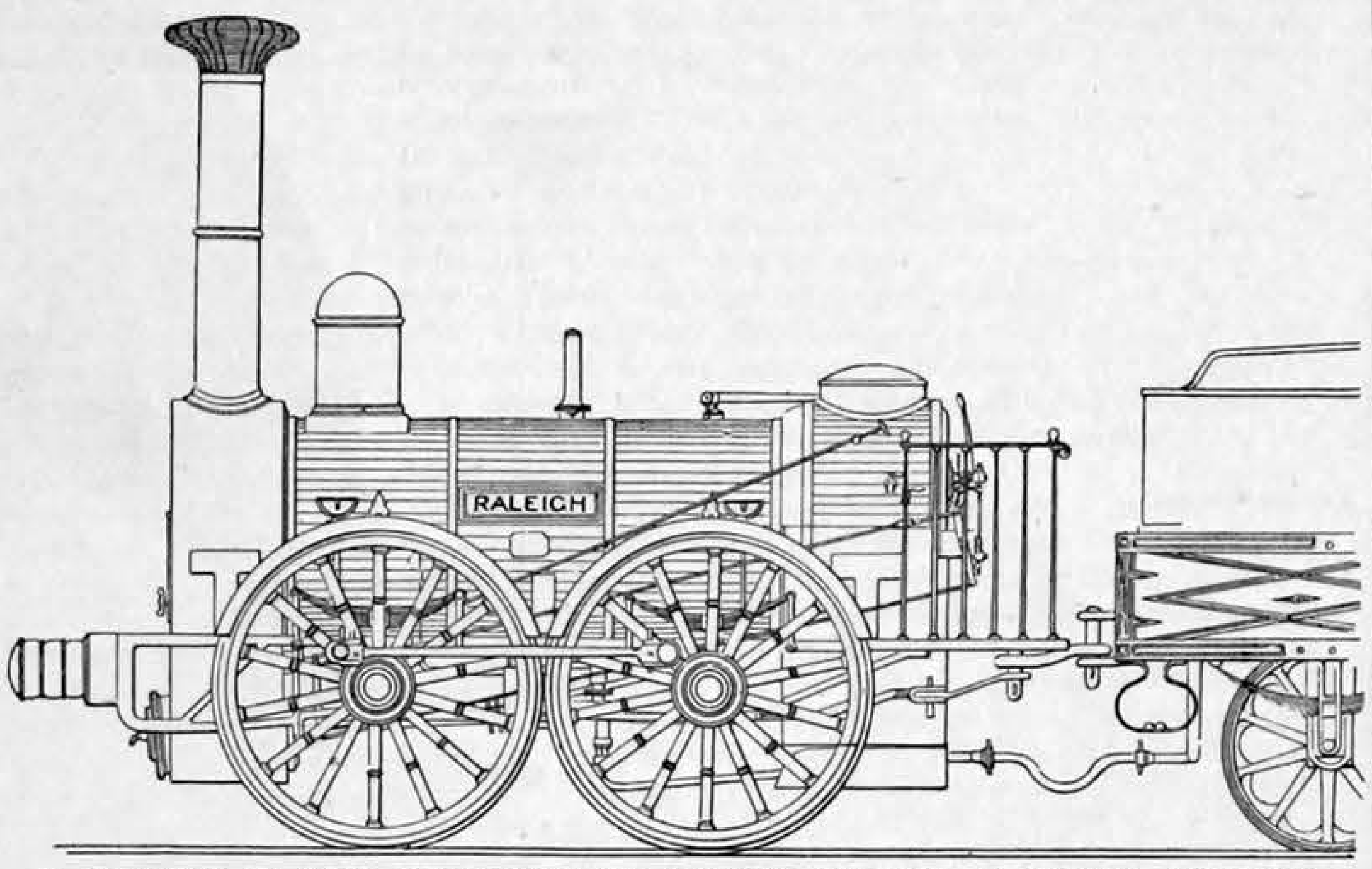
The other engines built by the Vulcan Foundry for America were two in number—Raleigh and Gaston, Class A2, Order No. 20, Rotation Nos. 38 and 39—and are illustrated in the accompanying drawing. They were built in 1836 for the Raleigh and Gaston Railroad, and had 12in. by 16in. cylinders and four coupled wheels 4ft. 6in. in diameter.

Five engines were the contribution of Messrs. Benjamin Hick and Co., of Soho Works, Bolton, to American railroads.

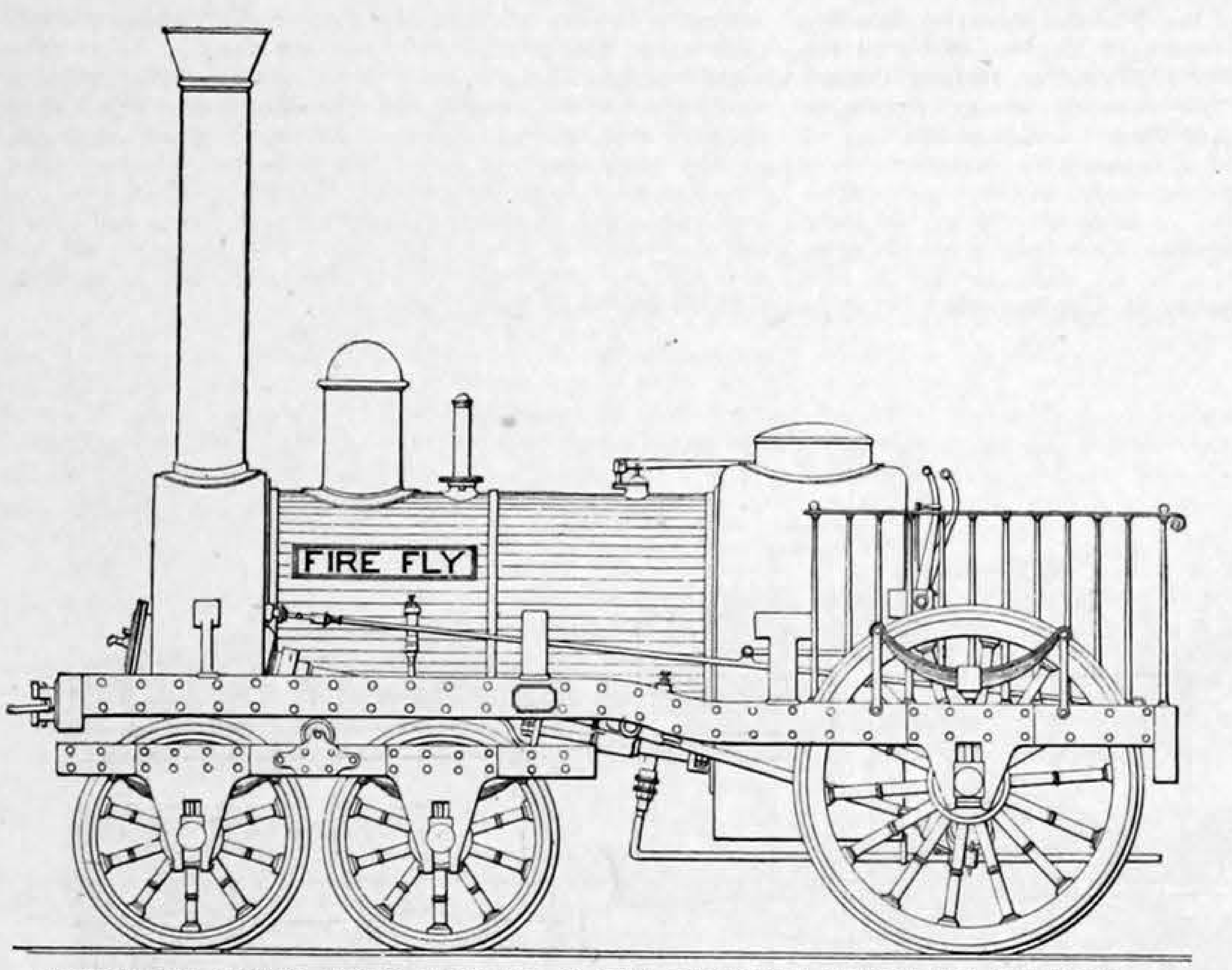
In 1834 the Fulton was built for the Pontchartrain Railroad, with 10in. by 16in. cylinders, and four coupled wheels 4ft. 6in. in diameter. Then followed, in 1836 and 1837 respectively, two engines named Potomac and Louisa for the Richmond, Fredericksburg, and Potomac Railroad, having 10in. by 16in. cylinders, a four-wheeled bogie with 3ft. wheels, and a pair of single-driving wheels 4ft. 6in. in diameter. In 1837 the New Orleans was built for the Carrollton Railroad, with 13½in. by 18in. cylinders, a pair of 4ft. leading wheels, and a pair of single-driving wheels 5ft. 9in. in diameter. This engine enjoyed the distinction of having the largest driving wheels of any of the locomotives sent to America, it being the idea of Mr. Charles Carroll, the founder of the railroad, to "go one better" than the prevailing English practice, as has, indeed, been the idea of his countrymen from that time to this, with varying success. When this engine was ordered, early in 1836, 5ft. 6in. was the mark reached by English makers, so Mr. Carroll expressly ordered the wheels of his engine to be 3in. larger, or 5ft. 9in. The fifth engine sent out by the Soho Works in 1837 to the Raleigh and Gaston Road with the name Virginia was equally noteworthy as the only one of its kind. It was a six-wheeled engine having cylinders 14in. by 18in., four-coupled wheels of 4ft. 10in. diameter, coupled in front, and a pair of trailing wheels 3ft. 6in. in diameter. So far as we are aware, this was the first and only instance of a six-wheeled front-coupled engine being in use on an American road.

The Petersburg Railroad obtained three locomotives from the firm of Messrs. Mather, Dixon, and Co. These were built in 1833 and 1834, and were named respectively New York, Philadelphia, and Petersburg, the two first-named having 10in. by 16in. cylinders, and four coupled wheels of 4ft. 6in. diameter, while the Petersburg had 12in. by 20in. cylinders, a pair of 4ft. 6in. leading wheels, and a single pair of driving wheels 5ft. 6in. in diameter. All these seem to have had the same type of boiler, the barrel measuring 7ft. 4in. by 2ft. 8in., with 90 tubes of 2¼in. diameter, and a fire-box having the following dimensions: 2ft. 6in. by 3ft. 4in. by 3ft. 3in. The heating surface, according to Whishaw, was, tubes, 396·18; fire-box, 42·79; total, 438·97 square feet.

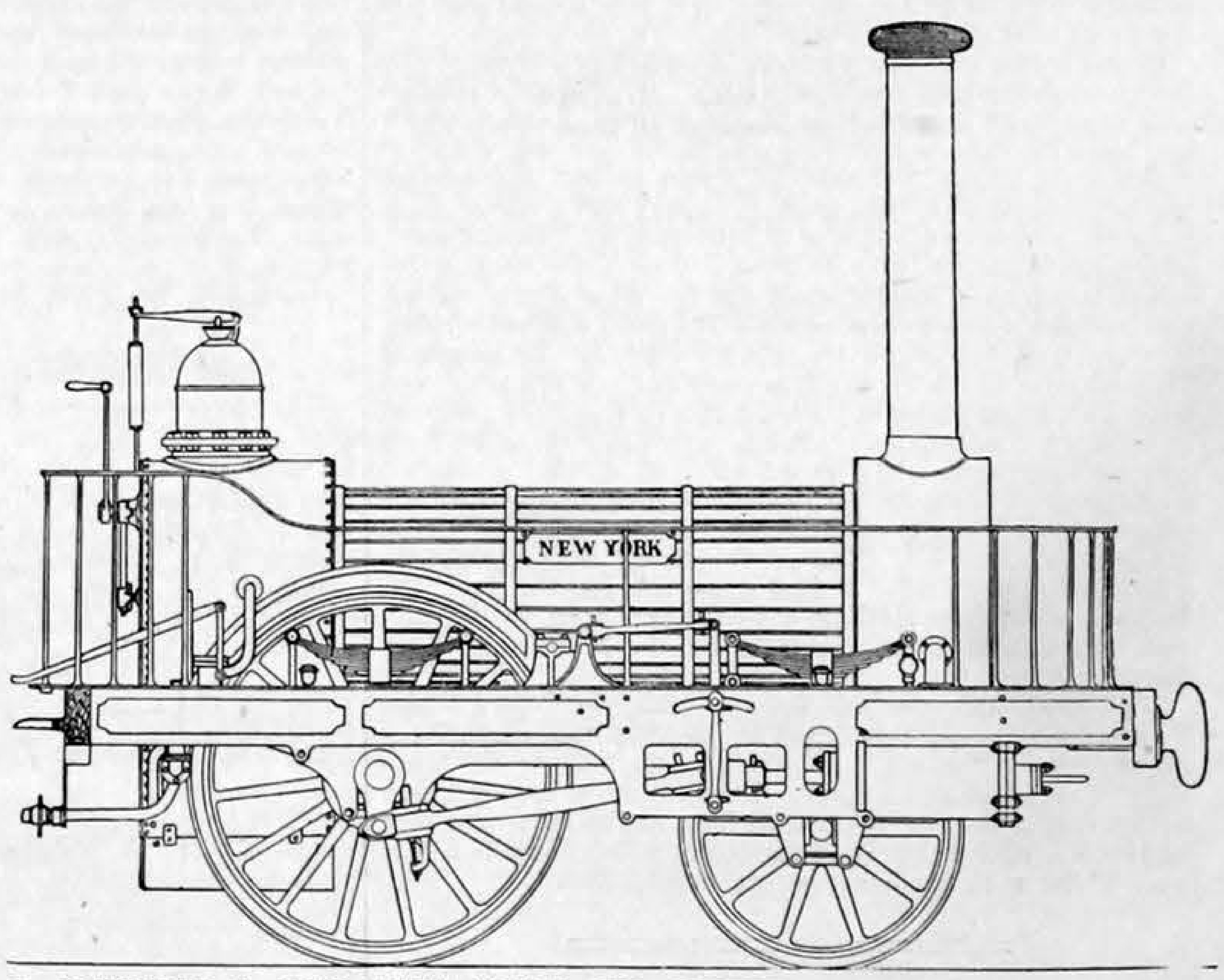
Messrs. Hackworth and Co. built two engines for the Wilmington and Raleigh Railroad in 1838 to the order of Mr. Jennings, through Messrs. D. and J. Burr and Co., both being six-coupled engines with cast iron wheels. The Halifax had inclined cylinders at the sides of the smoke-box, with the connecting-rods driving on to the cranks of the middle pair of wheels, which had "blind" tires, *i.e.*, without flanges.



C. TAYLEUR & CO.'S "RALEIGH," (No. 38) 1836, RALEIGH & GASTON RAILROAD



C. TAYLEUR & CO.'S "FIRE FLY," (No. 4) 1833, CAMDEN & WOODBURY RAILROAD



G. FORRESTER & CO.'S "NEW YORK," 1834, BOSTON & PROVIDENCE RAILROAD

The Samson, on the other hand, which was in use for about forty-five years, had outside vertical cylinders, driving downwards on to the rear pair of wheels, and must have been something of an anachronism, as English practice had certainly at that date achieved a better method of driving than that most objectionable one.

One engine was built by Messrs. G. Forrester and Co., of Vauxhall Foundry, Liverpool, for the Boston and Providence Railroad in 1834, and was delivered in the following year. It was named New York, and, as can be seen from the accompanying illustration, was a four-wheeled single engine, embodying all the peculiar features of the firm's standard patterns of the period, to which the nickname of "Boxers" so appropriately attached itself. The New York was, in fact, built to the same drawings as the three engines which were supplied to the Dublin and Kingstown Railway at about the same time.

In all, as the foregoing brief description will have indicated, there were 106 engines built by English firms for American railroads between the years 1828 and 1838, the distribution being recapitulated in the following table:—

R. Stephenson and Co.	42	locomotives.
E. Bury and Co.	20	"
Braithwaite, Milner and Co.	16	"
Rothwell and Co.	7	"
C. Tayleur and Co.	7	"
Benjamin Hick and Co.	5	"
Foster and Rastrick	3	locomotives
Mather, Dixon, and Co.	3	"
Hackworth and Co.	2	"
G. Forrester and Co.	1	"
	106	

Of these 19 were bogie engines, 80 were on four wheels, and seven were on six wheels with a rigid base. A further analysis shows that 45 had a single pair of driving wheels, 58 were four-coupled, and only three six-coupled. With the exception of the 19 bogie engines, it may be pointed out that none of the engines were built with any special consideration for the roads on which they have to run. They were generally the standard pattern of the different firms at the periods when the orders were given. That being so, and the condition of the primitive American tracks being taken into account, there can be no doubt that many of them were practical failures from the moment they were landed on the other side. Some were capable of being adapted, as witness the Stevens—John Bull—and several others, and, indeed, it is possible that few, if any, performed any efficient service until so transformed.

At the same time, this article will not have been written in vain if it serves to show that American mechanics were at the outset largely indebted to British makers for providing the first ideas of locomotive building, and to remind them that many of the most famous railroads in the United States derived their first engine power from this country. If with this common ancestry, British and American practice have appeared to develop widely divergent traits, it may be pointed out that the difference has at all times been more apparent than real, and that, as time progresses, there are not wanting evidences that in many vital respects the two practices are slowly perhaps, but surely, coming together again.

In later years two engines have been sent to America. The first of these was a Webb compound engine of the well-known London and North-Western type, which was purchased by an American railroad for the purpose of making elaborate tests of Mr. Webb's system, and which, despite the vastly different working conditions under which it had to labour, seems to have ably maintained the high reputation of its designer. Still more recently Mr. F. C. Winby designed, and Messrs. R. and W. Hawthorn, Leslie, and Co., built, the large eight-wheeled engine, James Toleman, which was sent across to the Chicago Exposition in 1893, and subsequently ran for a short time on the Chicago, Milwaukee, and St. Paul Railroad. It was described and illustrated in this journal at the time, and in an article published in THE ENGINEER of January 29th, 1896, we gave details of its working and present fate.

Neither of the engines last named, however, call for detailed mention here, as they scarcely come within the province of this article. Nor, on the other hand, need more than the barest allusion be made to the few isolated examples of locomotives supplied by American builders to English railways. These were five in number, four being engines with leading bogies and single driving wheels, named respectively England, Philadelphia, Columbia, and Atlantic, supplied by Messrs. Norris and Co., of Philadelphia, to work the Lickey incline on the Birmingham and Gloucester Railway, in 1840. The fifth was the famous Lovett Eames—No. 5000 from the Baldwin shops—which was sent over in 1881, more as an advertisement of the Eames brake than for any other purpose. It was a single driver, with a Wootten fire-box, and after working a few trains on the Lancashire and Yorkshire and Great Northern railways, was scrapped in 1884, as no company seemed inclined to take it over.

CENTRAL LONDON RAILWAY.

THE following particulars of the system to be adopted in working the Central London Railway have been supplied to us by the Thomson-Houston Company:—

The total length of continuous railway over which electric traction is to be provided is about six and a-half miles, exclusive of crossovers at stations and sidings. It is intended to run a two and a-half minutes' service, with trains of seven carriages each, with a total seating capacity each of 336 passengers, and weighing 105 tons loaded, exclusive of the locomotive. The average speed of the trains is to be fourteen miles per hour, including stoppages at stations. The electric plant, which is to be installed by the British Thomson-Houston Company, is on the three-phase system, and has been designed by their consulting engineer, Mr. H. F. Parshall. There are to be three sub-stations in the lower portion of the lift shafts at the Davies-street, Notting-hill Gate, and Post-office stations. Additional plant is to be installed at the Marble Arch station, but will at present be only of the nature of a spare plant. The boiler plant will consist of sixteen Babcock and Wilcox boilers in eight batteries of two each. The evaporative power of each boiler is to be 12,000 lb. per hour, the heating surface 3580 square feet, and the pressure 150 lb. per square inch. The boilers will be fitted with Vickers' mechanical stokers, which will be supplied with coal by a conveyor from a storage tank on the top of the boiler-house, having a capacity of 1500 tons. The coal conveyor also serves to remove the ashes, and will be driven by an electric motor. Each engine will be supplied with an independent combined jet condenser and air pump of sufficient capacity to take the maximum quantity of steam. The condensing and injection water will be forced to the top of four Barnard cooling towers, each tower being furnished with two fans driven by electric motors. The engines are six Reynolds-Corliss cross-compound condensing engines running at 94 revolutions per minute, to give 1300 indicated horse-power each, with cylinders 24in. and 46in. diameter by 48in. stroke. The engines are capable of being run non-condensing, and either high or low-pressure side can be run independently. The steel fly-wheel is to weigh 44 tons, and is built up in eight segments. The engines are guaranteed for a consumption of 13½ lb. of steam at 1000 indicated horse-power when run condensing with 26½in. vacuum.

The three-phase generators will have 32 poles, and a capacity of 850 kilowatts, 500 volts, and 25 cycles. They are of the revolving field type, the coils of the stationary armatures being held in slots. There are ventilating ducts through the body of the armature, similar to the standard armature construction of the British Thomson-Houston Company. The total weight of each generator is nearly 36 tons. Four of the six units will be sufficient to take care of the average load. There is, therefore, a margin of 50 per cent. over the present requirements of the plant. The switchboards have been specially designed, the high tension switches being double break, half of the break being on each side of the panel. All high-tension contacts are mounted on ebonite.

The Notting-hill Gate and Davies-street sub-stations will contain one rotary converter in each station, with necessary transformers and switchboards. At the Marble Arch and Post-office sub-stations there will be two rotaries in each. Each rotary has a capacity of 900 kilowatts, and will be of the 12-pole type, running at 250 revolutions per minute. They are capable of being run up either from the three-phase or the direct-current side. The step-down transformers reduce the line potential from 5000 volts to 330 volts. They are of the air-blast type, but instead of following the usual plan of forcing the air through the transformers, the air is drawn through, and the hot air is expelled through sheet steel pipes running up the centre of the spiral staircase of the stations, thus providing ample ventilation for the sub-stations, as well as effectively cooling the transformers. The weight of each transformer will be 3·5 tons.

The cables connecting the power-house with the sub-stations will be carried through the tunnels on brackets. They are of the B.I.W. Co.'s standard paper insulation type. The third rail will be of steel, weighing 80 lb. to the yard, of channel section, supported on creosoted wood insulators, each joint being bonded with four flexible crown bonds. The rails of both up and down lines will be divided into four sections, and interconnected by circuit breakers. The locomotives will be mounted on two trucks, each truck carrying two motors of 150-horse power. The total weight of the locomotive is about 42 tons. Total length of locomotive 29ft.; total height, 9ft. 8in. The motor will be controlled by series parallel controllers, provided with magnetic blow-outs, which will place the four motors in series, two in series and two in parallel, or all four in parallel, as desired. The trains will be fitted throughout with Westinghouse air brakes. Lifts will be provided at each station, and it is proposed that these should be operated electrically, with current taken from a separate power wire.

IT is estimated that the railways bring into London about 80,000,000 gallons of milk per annum.

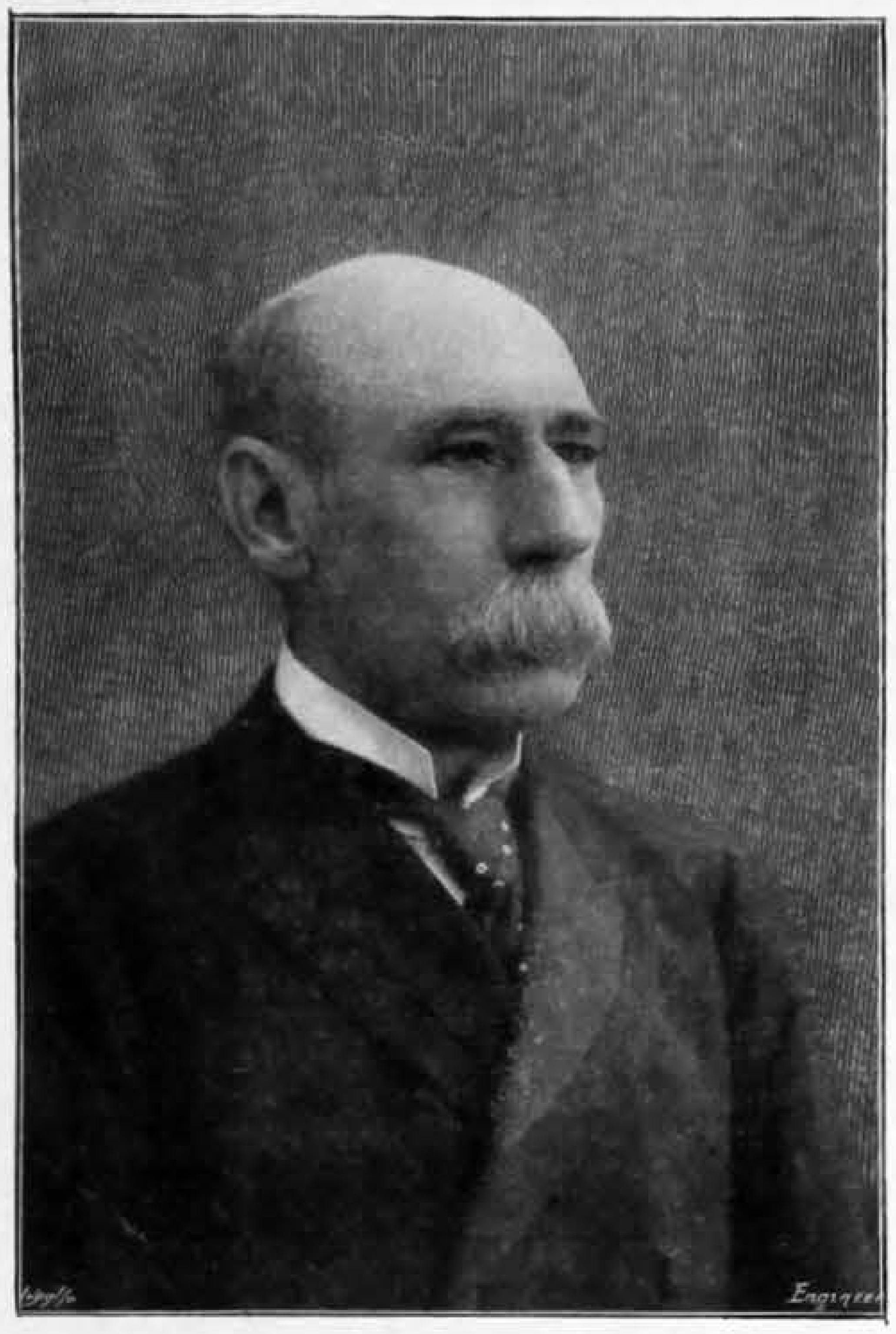
MODERN CHINA FROM AN ENGINEER'S POINT OF VIEW.

No. I.—RAILWAYS AND RAILWAY PROJECTS.

[*From our Special Commissioner.*]

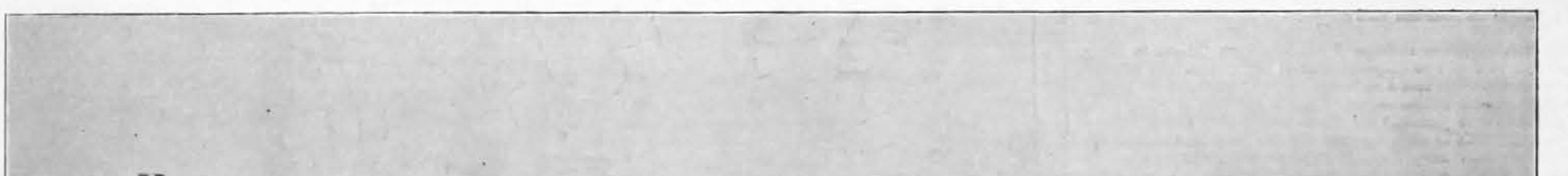
Shanghai, January 15th.

Most English engineers will remember that there was a modest, though energetic attempt to obtain for railways a footing in China as far back as 1876; and before dealing with the present state and future prospects of railways here, it is as well to recapitulate briefly the career of that first and unfortunate enterprise. Many people look to railways as affording the only practical method of modernising China; and as there is no doubt that foreign pressure will force their adoption on a considerable scale



GABRIEL JAMES MORRISON, M. INST. C.E.

in the country before many years are over, the vicissitudes of the old original railway scheme become endowed with considerable interest at the present time. All sorts of weird accounts appeared in the press of twenty years ago to explain the tearing up of the line, the prevailing impression being that it was due to religious fanaticism on the part of the simple Chinese, who regarded the locomotive as an evil spirit destined to play havoc with their morals and their prospects. This was rather sensational and romantic, but not at all true.



THE STARTING OF THE FIRST RAILWAY TRAIN IN CHINA, JUNE, 1876

The principal promoters of this enterprise, which was a purely British one, were Messrs. Jardine, Matheson, and Co., of Shanghai and elsewhere in the Far East. The joint contractors were Messrs. Ransomes and Rapier, of Ipswich, and the late Mr. John Dixon, of Cleopatra Needle fame, who were also large shareholders. A concession was obtained for the building of an experimental line of light railway of about ten miles in length, destined to connect Shanghai with Woosung. The locality was well chosen, for Shanghai was the most prosperous, cosmopolitan, and enlightened city in China. It was in great need of rapid communication with a town nearer the mouth of that interminable river and beyond its exasperating bar; the country was a dead level, and there was, as Chinese opposition goes, practically no opposition to the scheme. By this time, too, the railways in Japan had begun to show that there, at all events, the people took to them with enthusiasm, and their future success in that country was already assured. Then why not try them in China, where the field was immensely larger, where the population was immensely greater, where the distances and cost of transporting produce to available markets were immensely heavier, and where, above all, there were no earthquakes worth mentioning? For the simple reason that Chinese methods do not resemble those of Japan, and that it by no means follows that what is a success in the one country will prove to be so in the other. So, if the Woosung Road Company, as this railway company was called, built its hopes at all on the success of the railways in Japan, it made a miscalculation.

In 1876 Mr. Gabriel James Morrison, of Westminster, came out as engineer in charge of the laying and running of this line, and in the dual capacity of representative of the shareholders' and of the contractors' interests. In June of the same year about half of the line was opened for traffic. I enclose a photograph of the starting of the first train. The prospects of this railway still looked very satisfactory, as the Chinese population took a vivid interest in the undertaking, making long journeys from all sorts of places to have the satisfaction of riding up and down the line—treating, in fact, the new means of locomotion as we in England treat a "big wheel," a "fat lady," or a "tatooed nobleman," at a show. Long before the line was closed, however, the business value of it was recognised by the Chinaman, and he utilised it steadily as a practical time-saving machine. Great, therefore, was the consternation of this energetic little company when the British Minister from Peking notified it a couple of months after the start to close its line.

The Chinese officials had said they would not have it, in spite of the concession. That was all, and we, as we usually do in our policy in China, acquiesced. However, by agreement, which means by "making things right" in certain quarters, the Chinese allowed the railway to be completed, and the whole length from Shanghai to Woosung was opened in November of the same year, and actually ran successfully for about twelve months, during which time it carried 300,000 passengers. Meanwhile, the Chinese authorities purchased the line at a fraction over the cost price, the company selling it to them because it knew that if it did not do so something would happen to stop it working. And the day after the Chinaman had bought the railway, or rather the day after he had paid the final instalment, he began quietly to take the line up; and such of the material as was not lost, stolen, or spoilt, eventually found its way to the island of Formosa.

There were no "hordes of infuriated religious fanatics," tearing up the white man's work, and "wreaking their vengeance on the foreign devils." The Chinamen wanted and appreciated the railway, but the mandarins, whose safety lay in keeping the country closed to them, said simply that they would not have it, and that was enough. If Great Britain had chosen to make a stand then, or on many of the occasions which presented themselves afterwards from time to time, she could have insisted on the proper introduction of railways into China, and have arranged for them to be controlled by Englishmen. It is to be hoped that if she is lending money to China now she will obtain important railway concessions. Such railways, for the purpose of "saving the Chinaman's face," as it is called, might be named "Chinese Imperial Railways;" but the revenue from them should be controlled by Great Britain as security for her loan, as in the case of the Chinese import duties.

On the first railway above referred to Mr. Morrison employed only four foreigners, all of whom were British subjects, viz., one contractor's foreman, one platelayer, and two engine drivers.

The next step towards railway making in China came about in an unexpected manner, and its influence asserted itself so gradually that the railway became an established thing almost before people realised its existence. In 1877 or 1878, Mr. Claude Kinder was appointed as assistant engineer to the Kaiping Collieries, in the neighbourhood of Tientsin. One of the first things he was called upon to construct was a tram line for the purpose of carrying the company's coal. These mines were owned by Chinese capital, which perhaps was a fortunate thing, for had it been otherwise it would have been hardly likely that the mining tramway would have been allowed to develope by degrees into the first permanently established railway in the Chinese empire.

This was not all brought about in a day, however, for there was no suggestion in the first instance of a line for public traffic, nor was the idea of mechanical traction even admitted. Whether or not the original tram line was a wide-gauge one I do not know; but at the end of a few years we heard of a 4ft. 8½in. gauge, and also of a sort of nondescript locomotive made by Mr. Kinder out of, I believe, an old traction engine adapted to the work and fitted to a trolley. This apparatus must have been crude in the extreme, and one need hardly lay stress either on its speed or on its economy in working; but it was something to have got the Chinese to accept the

SHENG TAOTAI, Director-General of Chinese Railways

principle of mechanical traction, even had it taken the form of a steam roller. The thin end of the wedge, however, having been inserted, Mr. Kinder did not let it rest there. He later on constructed locally a rough locomotive, from which better results were obtained, and eventually got the authorisation to purchase locomotives from England and America. Finally, this line became extended from Kaiping to Tonku, which is within a mile or two of Taku, on the coast of the Gulf of Pechili—see railway sketch map herewith. There were about eighty miles of 4ft. 8½in. railway between these points, constructed in the cheapest possible manner, except that the rails and bridges were of good quality. But, bearing in mind the funds at Mr. Kinder's disposal for the purpose, the work has been extremely well done. About twelve years ago this line, owned by the Chinese Engineering and Mining Company, was opened to passenger as well as goods traffic, and its owners became a railway company in the ordinary sense of the word.

Here again we have a forcible example of the contrast between Japanese and Chinese methods. In Japan it was the Government who introduced and nursed the railways, until they had taught private companies how to run them satisfactorily; whereas in China we find that there has been a steady and uphill fight on the part of foreigners and private individuals against the Government to force railways on the country. This persistent pressure took practical effect in about 1888, when the Imperial Government, always on the initiative of Mr. Kinder, decided to construct a line on their own account, connecting Peking with Tientsin and Shan-Hai-Kwan. This they did, utilising as far as they went the existing lines belonging to the Chinese Engineering and Mining Co., but not taking them over. These combined railways, having a total length of something under 200 miles, represent at the present day the whole of the lines in operation in China, as far as public railways are concerned, and this little system affords the strange incongruity of a private line sandwiched in between two extremities of Imperial railway — a line begun in the centre at unimportant towns, and extended outwards in both directions. The greatest railway engineering triumph that has been carried out up to the present in China is the building of the bridge across the Lan Ho. This structure stands on stone piers, with concrete foundations on the caisson principle. It measures, between abutments, 2174ft., and the main spans are 200ft. each. The principal workshops of these railways are at Tongshan and Tientsin. The speed of the trains does not exceed 20 miles an hour.

It was the opening of the Peking-Tientsin section of the railway last year that may be said to have finally broken down the barriers of prejudice from certain quarters as to the adoption of railways in this country; the enormous advantages to trade in connecting two important centres like those having brought an object-lesson with it that even the opposition of highly-placed individuals will find it hard to efface. There is consequently every prospect of a reasonable and continuous extension of railways from this date forward in China.

Now, it rests mainly with Great Britain as to which of the foreign countries are to get the benefit of this work, and there is not the least doubt that if we allow Russia, Germany, and France between them, to run China for their own ends—and this is what the British Government seems inclined to let them do at present—we shall see very little advantage from the extension of railways or anything else in China; and this in spite of the fact that Great Britain and British subjects have been at once more energetic and more disinterested than any other people in assisting China to modernise herself. It is to be feared that we have let matters slide too far to admit of our having a voice in railway concessions north of Peking, and it is probable that the Chinese, in bringing their railway up as far as Shan-Hai-Kwan, have reached the northern limit of their extension, for the Russians, who, in dealing with China, do not mince matters as we do, have, as will be seen by a glance at the map, permeated Northern China with their railway projects, including one line running south as far as Shan-Hai-Kwan. Anyone who studies Russian methods in the Far East knows quite well that she does not wait, like Germany, for the murder of missionaries, or of anybody else, to afford her a lame excuse for violating international law, but when dealing with a weaker party she always takes what she wishes to take. So that, unless some other Power should endeavour to check Russian action, it may be taken for granted that the Russian railway projects shown on the map will have effect.

If any illustration is required as to the practical backing which Russia affords to her engineers and shareholders when building a railway in a foreign and nominally friendly country, it is conveyed by the following extract from the *North China Daily News* of a few days ago, and refers to the Russian troops who are destined to protect the Manchurian railways:—

The Russian volunteer steamer Voronish, from Odessa to Singapore and thence direct to Nagasaki, left that port on the 4th inst. for Vladivostock. She had a valuable cargo of 5000 tons of railway materials. General Tchetchagoff, and a large staff of officers and their families, were passengers; she is taking also a fine body of 850 Kuban Cossacks to form a guard for the Manchurian Railway, where the banditti have been giving great trouble to the constructors. These men have been engaged for years in similar duty in protecting the trans-Caspian railways against the Tekkes and other nomads. They are all mountaineers from different tribes in the Caucasus, and are men of splendid physique, having been selected out of a large number of volunteers from the railway troops in the trans-Caspian region. They are very well found in everything, and have besides a pay of a rouble a day; and many have their families with them. . . . It speaks volumes for the skill of the Russian rule, that it can successfully change in a few years such implacable foes into faithful soldiers. They are particularly fine riders, and they will be mounted from the large mobs of wild Siberian horses in the trans-Baikal, and any bandits that may happen to meet them will be promptly attended to. When the great length of the railways projected under Russian influence in and about China is compared with the extent of those in trans-Caspia, it may be taken for granted that this force is not the last one of its kind to find its way to the plains of Manchuria.

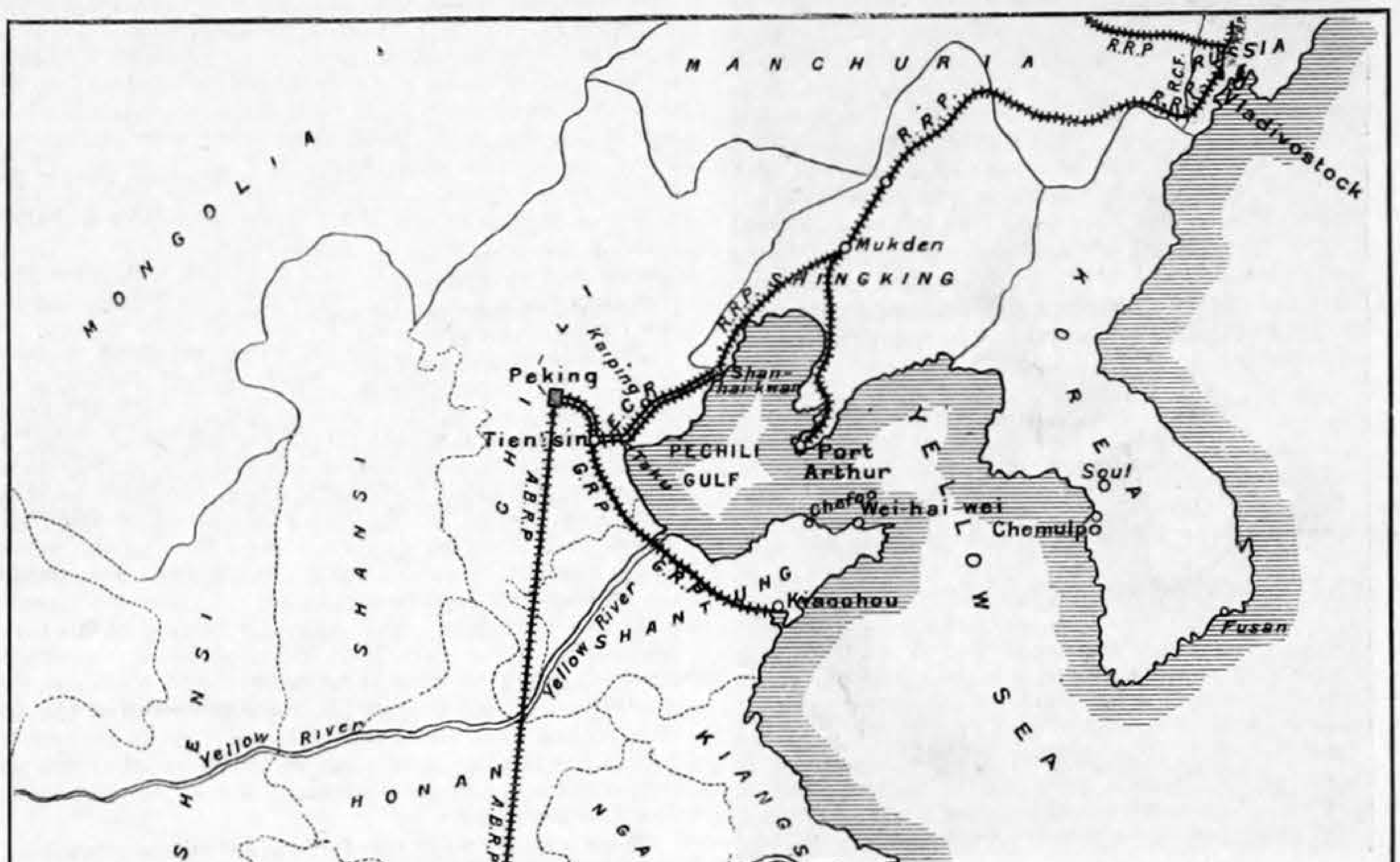
Thus the North of China is to be flooded with irregular troops, and other legalised desperadoes in the pay of Russia; and it may be taken for granted that the presence of these men will have a much more powerful effect on the Peking Government than any half-hearted diplomatic negotiations which we may think well to institute.

Let us, however, assume that we have no right to interfere with Russian projects in Northern China, and that the railway schemes of France in the south, who is already beginning to push her projects of lines across the frontier from Tong-King into China proper, are equally outside our sphere of interest. Let us assume with an exaggerated humility that British interests are mainly confined to the provinces in and around the Yangtsze Valley, or at all events that they do not extend further north than Peking, or further south than Canton. Under these conditions, we find Germany stepping in between us and Peking, and filling the Shantung Province with troops—there will be five or six thousand of them there by the time this letter reaches you—and with an aggressive programme which includes the building of a railway from Kiao-chow to Tientsin and Peking, with the avowed object of tapping the trade from the northern provinces, which now finds its way down through waterways to the Yangtsze, and of diverting it into her own hands. Thus the Russians are backing up their demands for railway concessions by armed troops on the north of Peking, and the Germans are doing the same between Peking and the Yangtsze Valley. The French are building railways on territory acceded to them by China in violation of China's treaty with Great Britain. And finally, we are told, but I cannot say yet whether it is a *bonâ fide* scheme or not, that terms have practically been arrived at between the Chinese Government and a Belgian Syndicate for the construction of a line between Peking and Hankow. This, if it is true, represents the most valuable railway concession of the lot. This project is merely indicated on the map by a bee line between the two points, as its actual course is undetermined. There is no doubt that Great Britain or British financial people, unless they wish to be left out altogether, should lose no time in securing any railway concessions that are to be got between Peking, Hankow, Nanking, and Canton, which represent the districts where railways are most needed, and would bear the greatest profit.

Mr. Gabriel Morrison, whose photograph I enclose, and who besides being the pioneer railway engineer in China, is thoroughly acquainted with the whole of the above defined area of country, states that there are no very great obstacles in railway building to be encountered throughout the whole route from Peking to Canton, with the exception of the traversing of the Yellow River, with its shifting bed. A railway from Peking to Canton, *viâ* Hankow or Nanking, would probably have a length of some 1400 or 1500 miles, and in conjunction with the Yangtsze River, which cuts it at right angles at a little more than half way down its length, would control all that is valuable, commercially and industrially speaking, of get-at-able China of the present day. With such a railway concession, properly authenticated and adequately protected, Great Britain could afford to lend China any money she might want, and to be indifferent with regard to the concessions accorded to other nations. But unless we take measures to obtain some very substantial concession in China for railways, Englishmen stand the greatest chance of seeing their trade and their prestige, both of which until now have been able to hold the first place among nations here as elsewhere, rapidly dwindling and being absorbed by the representatives of more enterprising countries.

One of the most promising signs as to the intention of the Chinese to extend their railway system is that Mr. Sheng, who was at one time Tao-Tai, or District Governor, of Tientsin, has been appointed Director General of Railways. I send his photograph herewith, and would point out that to this gentleman the Chinese owe the organisation of the system of telegraphy which now permeates their country. The area of his control over the railways is said to cover from the Yangtsze northwards; but as he has nothing to do with the Government or the private lines above referred to, and there are no others open in China as yet, he may be said to be a king without a kingdom. It is to be presumed that it will be to his advantage to build railways elsewhere to justify his title, the more especially as a handsome building has just sprung up in Shanghai, a little off the Bund, which bears the promising inscription on the door-plate, "Imperial Chinese Railways." He has already a little project in hand, and it is a strange thing that this first undertaking to which he is destined to devote himself should be to construct, over practically the same road as that used by the former English company, a new 4ft. 8½in. railway between Shanghai and Woosung. Thus it would seem that a sort of post-mortem tribute of respect is being paid to the excellent judgment of the shareholders of the defunct company by the Chinese who killed it. Let us hope that the new road will be as well built and meet with better treatment. The construction of the new line has been placed in the hands of Mr. H. Hildebrand, a local German engineer, who, from all accounts, is an extremely able man.

A reference at least to the orthodox Chinese wheelbarrow is not so out of place in a railway article as one might think, for it is against this primitive vehicle that the railways of China will have to compete both for passenger and goods traffic. Until now it may be said to have held its own, and as a practical conveyance it has its merits, for on it I have seen as many as six people being wheeled by one man on the level. Nor is it so out of date as one might imagine, for I understand that the British Government have recently ordered a number of them for carrying cement in connection with railway work in Africa. An ordinary



THE "ENGINEER" SWAIN ENG.

load of cement in this country for these barrows is two 400 lb. casks.

Thus while we complain of Chinese procrastination in adopting our civilisation, they at all events let us build a railway for them twenty-two years ago, even though they purchased it and destroyed it. Well, now it would seem that our Government is adopting the time-honoured Chinese national means of locomotion. It is highly probable that after a short trial we shall discard the Chinese barrow, as they did our railways, for I do not believe that anyone but a Chinese coolie could handle one. Thus Great Britain will have had her revenge. And that is all that Great Britain is likely to get, unless our Government should wake up to the fact that our prestige as a nation and our commercial interests are at stake in China. Russia, France, Belgium, and Germany are all on the railway concession hunt out here, and three out of the four Powers named are prepared to back their demands with a big display of force. America, too, seems likely to cut England out in the supply of materials for China. Great Britain and Japan, the only two countries who would seem to have a legitimate claim on China for concessions or consideration, are the only ones who are not attempting to push their interests here. Perhaps this is because they are the only two Powers with interests in this part of the world who have had any regard for international law—and China knows it, and consequently is not afraid of us.

SHIPBUILDING AND MARINE ENGINEERING ON THE THAMES IN THE VICTORIAN ERA.

No. XIV.

BEFORE leaving on her maiden voyage to Melbourne the Crœsus had a three-days' trial at sea, as a test of speed, &c., when the following results were obtained:—In a stiff breeze, under canvas, with screw disconnected, she made from 13 to 14 knots; close hauled, with double-reefed topsails, courses, trysail, and jib, and no steam, her speed was 10½ knots. In smooth water, with no sails, she steamed 10½ to 11 knots; and against a heavy N.E. gale, with a rough sea—coming up the Channel—she went through the water 4½ to 5½ knots.

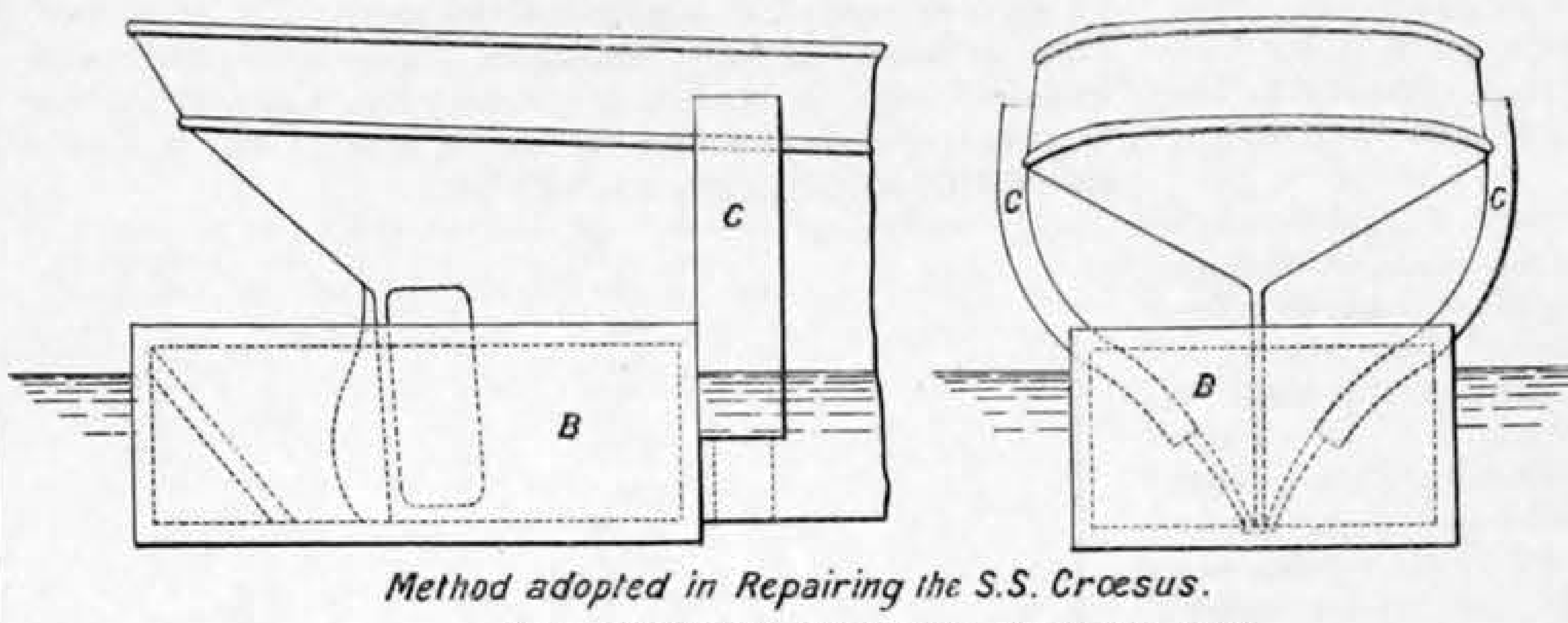
Being but an auxiliary steam-powered ship, the results attained at her trials were deemed most satisfactory, as throughout them the engines worked admirably, without any heated bearings, the boilers giving an ample supply of steam at all times. During the trials the engines averaged fifty-two revolutions a minute, the average steam pressure being 16 lb. and the vacuum in the condenser 27in. The ship having bunker room for a supply of coal more than sufficient for the voyage out, and having stowed in the hold an additional 600 tons for the homeward passage, it was thought that she would be able to make her voyage to Australia and back either way in sixty days or under.

Having taken on board a fair complement of passengers, the Crœsus, shortly after the completion of her trials, left Southampton for Melbourne. As she was fitted with a screw-lifting apparatus — somewhat similar to that described and illustrated in a previous article—it was only intended to use her auxiliary power as occasion required.

All went well on the passage until the ship was off the Cape of Good Hope. The previously favourable winds having dropped, orders were given to ship the propeller and proceed under steam. In doing this the lifting gear gave way, and the propeller falling several feet, so damaged the keel and plating of the ship—where attached to the stern-post—that it was deemed necessary to put in at the Cape for assistance. Here there was procured sufficient clay and clinkers to enable a watertight dam to be built, to prevent the water made by leakage finding its way to the engine and cargo spaces. With this temporary provision for safety the ship proceeded on her voyage under sail, and eventually reached Sydney without further mishap. Arrived there, it was found necessary to detain and repair her before she could be allowed to proceed on her homeward passage.

Now, at that date—1853—there were no graving docks in any of the Australian ports, so to repair the damage done, it had to be effected while the ship lay afloat in deep water, the plan adopted being that shown in our sketches Figs. 72 and 73. After mooring the vessel in a protected bay on the north side of Sydney harbour, a wooden cofferdam, B B in the sketches, was built on the adjacent beach, one end of it being made to fit the shape of the ship under water at a point as far forward as the damage was thought to extend. This dam was launched into the bay and towed into position at the stern of the ship, sufficient weight—some fathoms of the ship's cable—being put into it to sink its bottom below the level of the ship's keel, and it was then drawn under her bottom. When in position it was firmly secured to the vessel, and the deadweight within it taken on board and carried forward.

On relieving the cofferdam of its temporary ballast, the upward pressure of the water caused its shaped-out end to press upon the ship's plating, some sheepskins being interposed to form the joint; the dam was then pumped free of water, a few shores being fitted to relieve the outside pressure of the water on its sides, and in a short time it was ready for workmen to start the repairing of the damage done. On an examination of this damage it was found that all the rivets securing the ends of the lower strakes to the sternpost and those in the plate landings were started, and, in addition, the keel bar was fractured in the middle of the screw space. In due time this damage was repaired—work being carried on day and night—when it was decided to test the riveting by water pressure from within, which showed that some of the rivets beyond the forward end of the dam were leaking, but how to get at them was now the difficulty. This, however, was overcome by fitting small camels—C C in the sketches—made to fit the ship's sides, which were kept in position by chains, taken under the ship's keel, at their lower ends, and by athwartship chains above kept taut by stretching screws. Through the open tops of these camels the workmen descended, and in a few days replaced all leaky rivets by fresh ones. After the repairs were completed, the fractured keel bar being strengthened with fish-plates, the cofferdam was released from the ship's bottom, with the assistance of her cable to sink it until clear of her keel, when it was hauled from under her, possibly again to do duty in a similar emergency. From the foregoing brief description of a great damage done and successfully repaired, our younger readers will be able to note how the

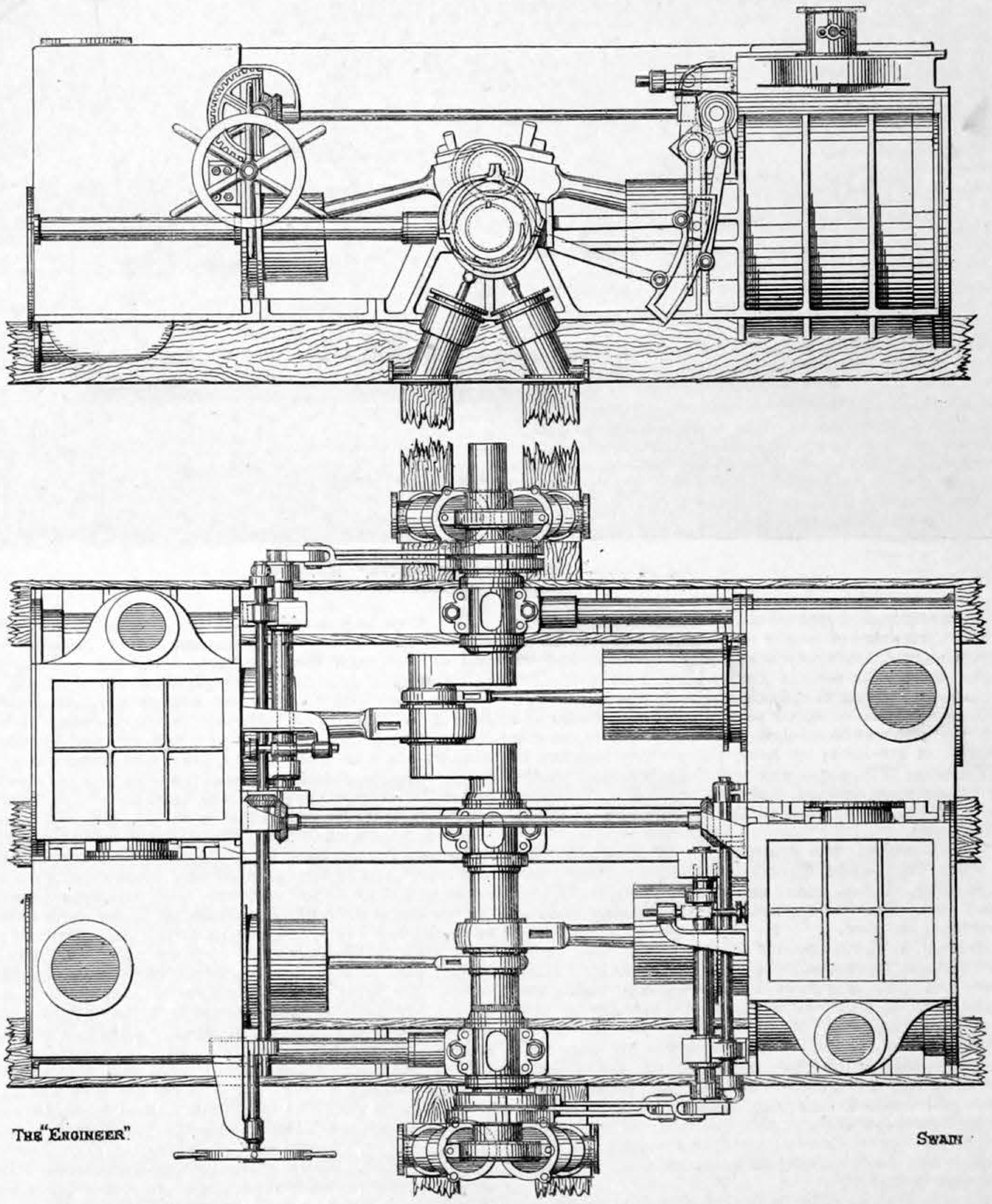


Method adopted in Repairing the S.S. Crœsus.

Figs. 72 and 73—CRŒSUS REPAIRS, 1854

seeming difficulties of the situation were surmounted with what were in reality very simple appliances.

The misfortunes of the Crœsus were, however, not at an end with the falling of her screw propeller off the Cape. With the repairs effected in Sydney harbour she succeeded in reaching England safely, where she was docked and made thoroughly seaworthy; but by this time, the country being involved in war with Russia, the ship was taken up by the Italian Government for the conveyance of troops to the Crimea, and while engaged



Figs 74 and 75—ENGINES OF THE SLOOP OF WAR "VICTORIA" BY MESSRS. RENNIE, 1855

in this work she caught fire and was run ashore in the Gulf of Genoa—a sorry ending to a very fine ship.

Although there were no instances during the Crimean War of our Australian dependencies being molested by hostile cruisers, yet as their populations—particularly that of Victoria—were rapidly increasing in numbers and wealth, it became necessary for them to provide themselves with some maritime protection. This was specially necessary to the rich gold-producing colony just named. To this end the Victorian Government ordered in this country, in the early part of 1855, the construction of a screw steam warship, to be named the Victoria, from the designs of Mr. O. Lang, of the Royal Dockyard at Pembroke. The vessel was built by Messrs. Young and Co., of Limehouse, and engined by the Messrs. Rennie, of Blackfriars. As the engines of this vessel were of a type differing from any yet noticed in these articles, we are glad to be able to include them as a class, the product of the second decade of the reign of our Queen, after whom the vessel in which they were fitted was appropriately named.

The engines were designed and built on the patented direct-action principle of the Messrs. Rennie, each cylinder, with its condenser and air pump, being placed on either side of the main crank shaft; the position of these, which are both on the single-trunk principle, being alternated, so that the pull and thrust on the shaft is equalised. The general arrangement of the engines, with their details, given in our illustrations of them in Figs. 74, 75—the first being an elevation and the second a plan—shows their simplicity and compactness, a great advantage being derived by the condensers being close to the cylinders, thereby ensuring a better vacuum. Beyond this they need little further description than a few particulars as to their dimensions and the kind of boilers that supplied them with steam.

The diameter of the cylinders was 41in., with a piston stroke of 1ft. 10in. The engines drove, at 82 revolutions a minute, a common two-bladed screw 10ft. diameter and 15ft. pitch, its length being 2ft. 10in. They were supplied with steam by two four-furnaced boilers of box form, worked at a pressure of 20 lb. per square inch, that were not required to be kept below the load-line of the vessel, which had a water draught of 11ft. 6in.

The vessel was timber-built—on the diagonal principle of her designer—consisting of two thicknesses of plank worked diagonally from gunwale to gunwale across the middle line at right angles to one another, and then externally planked in the usual way. She was 166·5ft. long on deck, 27·16ft. beam, and 14·5ft. deep in hold, her tonnage being about 581 tons. She was completely fitted as a sloop of war.

While noting the typical iron steamships built on the Thames in the early part of the decade, 1847—1857, those constructed of wood must not be overlooked. Of these the most notable—and at the same time the most unfortunate—was the steamship Amazon, built by Messrs.

R. and H. Green, of Poplar, for the Royal Mail Company. This vessel, which was the largest timber-built paddle-wheel steamer ever constructed in England, was 310ft. long and 42ft. moulded breadth—72ft. over paddle-boxes. She was fitted by Messrs. Seaward and Co. with side-lever engines of 800-horse power, having cylinders 96in. diameter, with a piston stroke of 9ft. These engines drove paddle-wheels of 40ft. 8in. diameter at fourteen revolutions a minute, which gave the ship a speed of 11 knots an hour. The Amazon was tastefully fitted for the accommodation of passengers, having cost over £80,000; but an ill fate awaited her on her maiden voyage. She left Southampton on January 2nd, 1852; but when about 110 miles to the westward of Scilly a fire broke out on board, which entirely consumed her, some ninety-six of her passengers and crew perishing in the conflagration.

Another notable Thames-built wooden ship of the time was her Majesty's line-of-battle ship Hannibal, of 91 guns, built at the Royal Dockyard at Deptford, and launched thence in January, 1854. She was considered to be one of the finest specimens of a fighting ship that had ever been seen afloat, combining with a full bow above water—giving ample room for working her guns—a fine entry and run below, while the extra length given to her for the admission of the machinery imparted a lightness to the vessel not possessed by the old man-of-war sailing ships. Her principal dimensions were:—Length between perpendiculars, 217ft. 6in.; moulded breadth, 58ft. 1⅝in.; depth of hold, 23ft. 11½in.; displacement, 3300 tons, on a mean water draught of 20ft. 6½in.

The auxiliary propelling machinery of the Hannibal, which was supplied and fitted by Messrs. Scott, Sinclair, and Co., consisted of a pair of geared horizontal direct-acting engines, having cylinders 71¾in. diameter and 4ft. piston stroke, the ratio of gearing being 2·36 to 1. The engines, which were of 450 nominal horse-power, drove an ordinary two-bladed screw propeller, 17ft. diameter and 22ft. 6in. pitch, at 65 revolutions a minute, giving the ship a speed of 8·6 knots an hour, the working pressure of steam being 12lb. per square inch. In these engines the air pumps were vertical, and were worked by a rocking lever coupled up by rods to the first motion, or engine crank shaft.

The Hannibal was armed with twenty-eight 8in., 65 cwt.; thirty-eight 32-pounder, 56 cwt.; twenty-four 32-pounder, 42 cwt. guns; and one 68-pounder, 95 cwt. pivot gun. She was the last line-of-battle ship built in Deptford Dockyard.

Happily, in direct contrast to the fate of the Crœsus and Amazon, there was building at this time by Messrs. Mare and Co., at Blackwall, a steamship which was destined to do excellent work for the country for over forty years, and to be still in existence—although lately sold out of the service. This vessel was her Majesty's late troopship Himalaya—launched on the Queen's birthday, May 24th, 1853—originally built for the Peninsular and Oriental Company, but being found too large for its then requirements, she was in the following year sold to the English Government for a troopship, in which employment she did admirable work, and was remarkably free from accidents.

We give above an illustration of this fine old vessel, which for apparent lightness of build and beauty of form was very noticeable. She was—in January, 1854—the largest ocean steamer in the world, her principal dimensions being:—Length between perpendiculars, 339ft.; breadth, 46ft.; depth, 34ft.; water draught, loaded, 20ft.; and burden, 4000 tons. The Duke of Wellington, of 131 guns, the largest battleship then in existence, although of more beam and greater depth, was 92ft. shorter than the Himalaya, whose length over all was 372ft. 9in.; her spar deck, as first built, was flush from stem to stern, and afforded an uninterrupted promenade of over 360ft. Her main saloon, nearly 100ft. long, would dine 170 persons at a sitting; and she had cabin accommodation for 200 passengers — first and second class — the cabins being the largest and most roomy ever before appropriated to sea travellers. The ship would carry 1000 tons of measurement goods, could stow 1200 tons of coal in her bunkers, and had besides, the usual mail, baggage and store-rooms.

At the time of the building of the Himalaya there were no definite Lloyd's Rules of construction, or Tables of required dimensions of parts of iron ships. The first of these, based on the gross tonnage of the ship, was not issued until January, 1855. By this table it would appear that no iron ships at that date exceeded 3000 tons, so a fair comparison cannot be made between the scantlings of the Himalaya and those that would have been required by the Committee of Lloyd's at the time. We give, however, in tabulated form below, for comparison, the scantlings adopted in this ship's construction and those that would now be required by Lloyd's for a three-decked ship 340ft. by 46ft. 2in. by 26ft. 3in.:—

Items.	Scantlings of s.s. Himalaya.	Lloyd's scantlings for a three-decked vessel.
	Inches.	Inches.
Keel	10 × 5	11 × 3
Frames, midship ..	7 × 5 × ½	6 × 3½ × $\frac{9}{16}$
,, ends	4 × 3½ × $\frac{7}{16}$	6 × 3½ × $\frac{8}{16}$
,, spacing ..	20 midship 24 ends	25 throughout
Reverse frames ..	4 × 3½ × $\frac{7}{16}$	4 × 3½ × $\frac{9}{16}$
Sheer strake	$\frac{12}{16}$ to $\frac{9}{16}$	$\frac{15}{20}$ to $\frac{12}{20}$
Garboard do.	1$\frac{1}{16}$ to $\frac{14}{16}$	$\frac{15}{20}$ to $\frac{17}{20}$
Remainder	$\frac{12}{16}$ and $\frac{11}{16}$ to $\frac{11}{16}$ and $\frac{9}{16}$	$\frac{17}{20}$ to $\frac{9}{16}$
	L bars.	Plate. L bars.
Upper deck beams..	8 × ⅜ plate 3 × 2½ × ⅜	10 × $\frac{12}{20}$ 3½ × 3½ × $\frac{8}{16}$
Main ,, ,, ..	12 × ⅜ ,, 4 × 3½ × ½	11½ × $\frac{12}{20}$ 3½ × 3½ × $\frac{8}{16}$
Lower ,, ,, ..	10 × ½ ,, 3½ × 3 × ⅜	10½ × $\frac{12}{20}$ 3½ × 3½ × $\frac{8}{16}$
Upper deck plating	Stringer, 1ft. 6in. × $\frac{9}{16}$in.	Complete iron deck, $\frac{7}{16}$
Main ,, ,,	,, 2ft. 2in. × $\frac{8}{16}$in.	Stringer, 3ft. 8in. × $\frac{9}{16}$in.

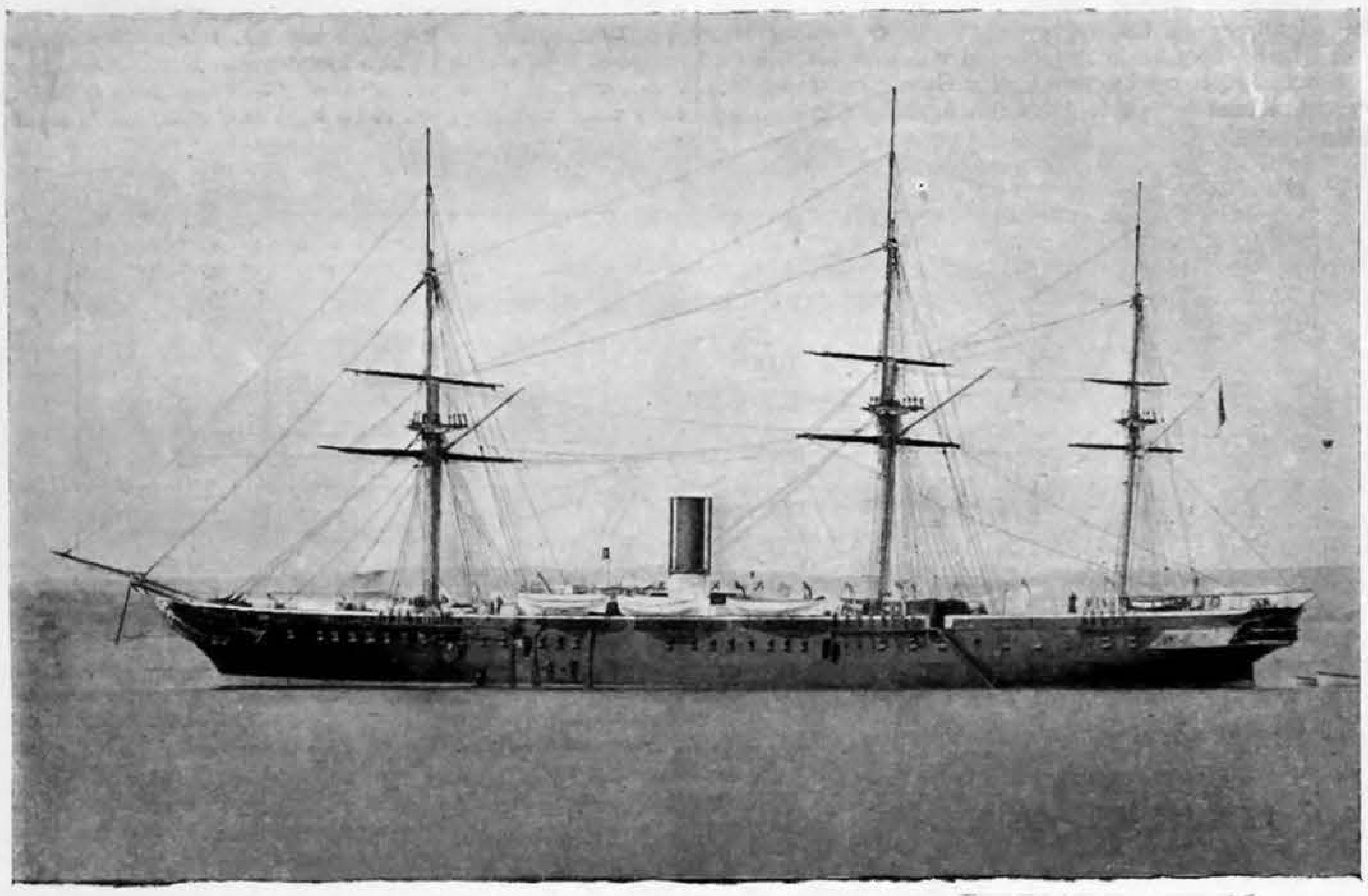


Fig. 76—H.M. TROOPSHIP "HIMALAYA," 1854

The propelling machinery of the Himalaya, supplied and fitted by Messrs. Jno. Penn and Son, consisted of a pair of horizontal trunk engines, direct-acting, having cylinders 84in. diameter, with a piston stroke of 3ft. 6in., making from fifty to sixty revolutions a minute, and driving a common two-bladed screw propeller 18ft. diameter and 28ft. pitch. Steam was supplied by four box-shaped six-furnaced boilers, fitted with Lamb's sheet flues—a type we shall illustrate later on—instead of tubes; and made for a working pressure of 14 lb. per sq. in. They were each 20ft. 2in. across the front, 12ft. 2in. high, and 10ft. 2in. from back to front, the furnaces being 2ft. 9in. wide, with 7ft. fire-bars. On the measured mile trial of the ship in Stokes Bay the speed attained—a mean of several runs—was 13·78 knots per hour. As a passenger vessel she performed the run from Gibraltar to Malta—over 1000 miles—in 74½ hours, the quickest run then on record; from Malta to Alexandria—830 miles—in 61¼ hours, thus beating the quickest passage ever before made by 7¾ hours. Her best run in 24 hours was 350 miles with plain sail set, her speed for some hours being 16 knots, while against a heavy head sea and strong breeze she would make 10 knots.

After purchase by the Government, and conversion into a troopship, a long forecastle or half deck having been added to her, she could embark and transport as many as 3000 men from Southampton and land them in Turkey in eleven days. Taking on board—on February 25th, 1854—at the former place some 320 sappers, miners, and riflemen, she ran from thence to Plymouth—140 miles—in 9½ hours, and there embarked the 93rd regiment of foot for the Crimea, landing them there in the time above mentioned.

As shown in our illustration, Fig. 76, the Himalaya was full ship-rigged, the masts, spars, and sails supplied to her being equal to those of a clipper sailing ship of 1600 to 1800 tons. Her spread of canvas, with the aid of her engines, enabled her in a stiff breeze to make 18 knots an hour, a result then proving—now 55 years ago—the superiority of the screw over paddles in vessels of large tonnage, either as respects speed, space occupied by machinery, or consumption of fuel; yet, with all this, there were still sapients in those days who could prove to a nicety that the screw was neither suitable nor profitable for ocean navigation. Their confidence was in proportion to their ignorance.

THE BIRKENHEAD DESTROYERS: OFFICIAL TRIALS OF THE WOLF.

H.M.S. WOLF completed on the 9th inst. her official full-power speed trials on the Clyde, in the presence of the Admiralty representatives. Six runs were made on the measured mile, with the following results:—

	Steam.	Time. min. sec.	Speed.
First mile	211	1 58⅕	30·46
Second mile	212	1 56⅕	30·98
Third mile	222	1 55⅕	31·25
Fourth mile	215	1 54⅗	31·41
Fif h mile	223	1 55⅕	31·25
Sixth mile	208	1 55⅗	31·14

The mean speed thus realised was 31·2 knots. After completing the six miles the vessel was taken outside the Cumbrae to complete the three hours' steaming at her contract speed of 30·0 knots, which was easily obtained, the results at the finish showing a speed of considerably over a quarter of a knot in excess of the contract. After completion of this trial the usual steering trials at full speed ahead and astern were carried out, and the stopping, starting, and reversing of the engines demonstrated for efficiency. The Admiralty were represented by Messrs. Welch and Wisnom, Devonport Dockyard by Messrs. Rider and Barry, and the chief engineer of the vessel, Mr. Glanville, was also present. Mr. R. Ratsey Bevis, jun., and Mr. Roy M. Laird represented Messrs. Laird Brothers, the contractors. The Wolf is the tenth 30-knot destroyer that Messrs. Laird have now completed for the British Admiralty.

MOTOR CAR NOTES.

THE following members have been elected judges for trials of motor vehicles for heavy traffic to be held by the Self-Propelled Traffic Association in May next:—From the London Council: Sir David Salomons, Bart.; Mr. Boverton Redwood, F.I.C., F.R.S.E. From the Liverpool Council: Professor H. S. Hele-Shaw, LL.D., M. Inst. C.E., &c.; Mr. John A. Brodie, M. Inst. C.E., &c.; Mr. Everard R. Calthrop. Reserves: Mr. S. B. Cottrell, M. Inst. C.E., &c.; Mr. Henry H. West, M. Inst. C.E., &c.

THE Automobile Club of Great Britain is organising a somewhat ambitious tour for Easter, to occupy six days. The proceedings will commence with a lunch at the Club, No. 4 Whitehall-court, on the Thursday; and at 3 p.m. the tourists will make a start for Guildford, where there will be dinner at the White Hart Hotel. The members of the Club sleep at Guildford that night, proceeding on Good Friday morning to Winchester, by way of Farnham. The night will be spent at the old cathedral city, which will be left for Chichester the following morning. The Club makes Chichester its head-quarters for the night, and proceeds the next day to Worthing. On Easter Monday the programme is from Worthing to Tunbridge Wells, and the next day will witness the closing of the tour by the run home to London through Sevenoaks. As there will be no adequate re-charging stations on the route, it is not expected that any electrical vehicles will put in an appearance. The extent of the tour will be somewhat over 220 miles.

ENGINEERING NOTES FROM SOUTH AFRICA.

(*From our own Correspondent.*)

THE engineering strike at home has caused some inconvenience to the Witwatersrand gold mines, owing to delay in the delivery of machinery on order. In one case the starting of a stamp battery had to be postponed for a couple of months because of the non-arrival of the mill engine from the works in England. Mine managers complain that British firms are very lacking in this important respect of punctual delivery. The Americans are much more dependable, and will strain every nerve to execute an order to time. Probably the restrictions introduced into British workshops have a good deal to do with this state of affairs. It is a fortunate thing, so far as the local foundries and engineering shops are concerned; they receive work which would certainly not reach them but for the difficulty of calculating on a prompt execution of the work at home. The two principal works in Johannesburg are busily engaged at present. The wages paid to fitters range from £1 to 30s. a day. It is small wonder that the men have been able to contribute liberally towards the support of the men on strike at home. By the way, the engine drivers at one of the mines have just struck on a question of wages and hours.

The considerable loss of power which occurs in rock drilling with compressed air has led to an eager desire to apply electricity to this class of work. Several electric rock drills have been tried in the mines of the Witwatersrand, but so far none have secured any practical success. The electric rock drill has not only to compete against the working efficiency of the compressed air drill, but also against the important fact that the exhaust air is of value for the ventilation of the mine. One of the latest electric drills to be tried on these fields was made by the firm of Siemens and Halske of Berlin. It did not answer, but its comparative failure is said to be due to its being put to do work not suited to its construction. The claims of the inventors of the "Bladray" drill have excited a good deal of dissent from local electricians.

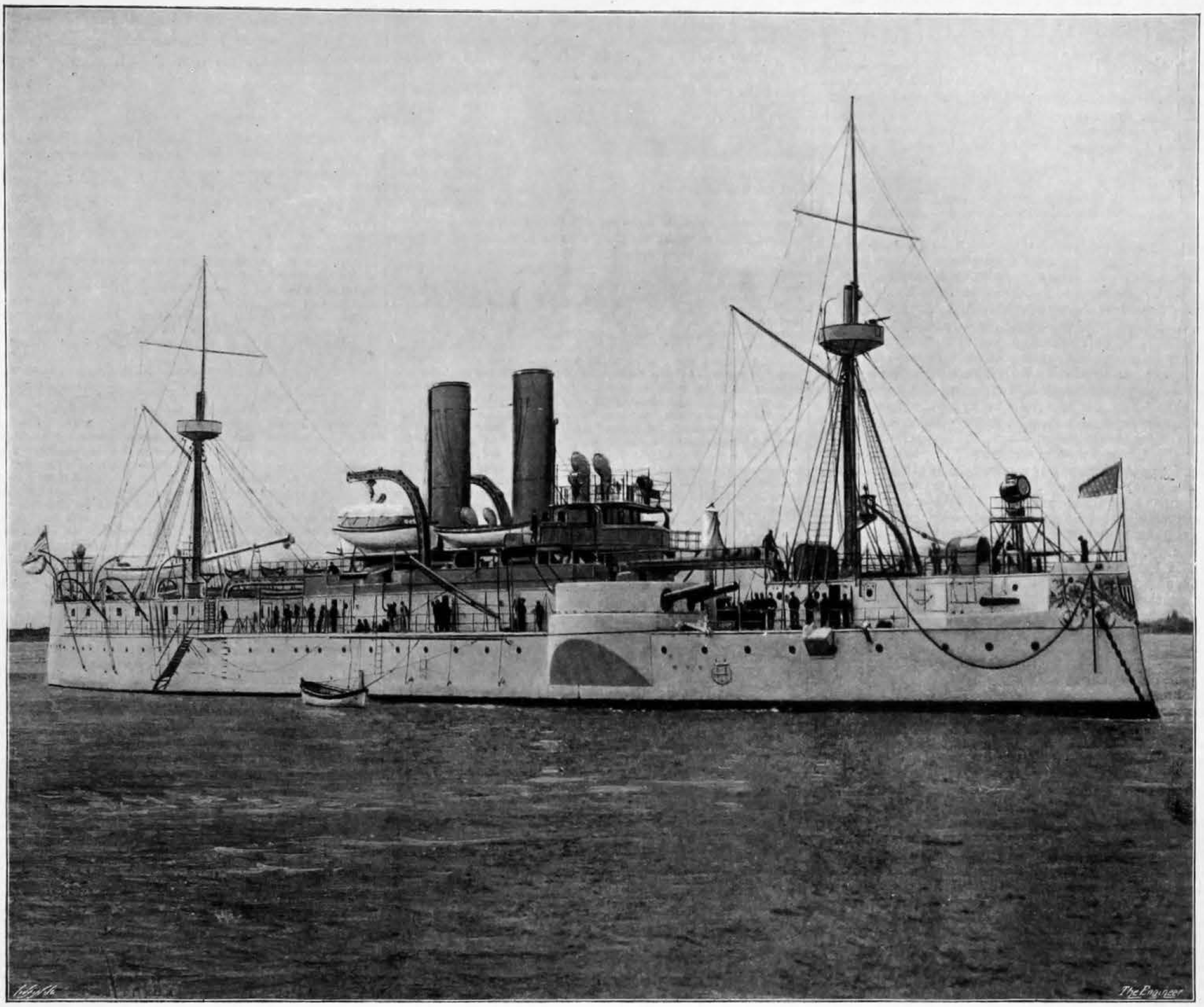
Dock questions are still exciting a great deal of attention in South Africa. The proposal to spend five millions sterling upon the extension of the harbour works at Capetown, by taking in an additional area of Table Bay, has aroused considerable opposition. It is urged that the annual interest upon the debt would involve a burden upon trade for which the extra facilities for shipping would not compensate. At Durban the Right Hon. H. Escombe has been returned to Parliament as an opponent of Sir Charles Hartley's and Sir J. Wolfe Barry's scheme for the extension of the North Pier. A limited company proposes to spend a million sterling in improving the docks at Lourenço Marquis—Delagoa Bay—and installing additional plant for handling cargo.

Several new railway schemes are about to be put into active execution in the Transvaal. The survey of the Pietersburg line is at once to be pushed forward, and the contract for the Vryheid line has just been signed. The routes for the two railways to Lydenburg and Ermelo are also now almost settled by the executive council. A new line is to be opened in the Cape Colony within a week or two, from Middelburg to Graaf-Reinet.

It may be of interest to many of your readers to learn that the head of the Public Works Department at Pretoria has applied to the Government to be allowed to use the metric system in the work of his department in place of the present English measures. As the Government entertains a great jealousy of all things English this request will probably be granted. It may have some slight effect in strengthening the already strong inclination of the Government to go to the Continent in preference to England for machinery. In answer to the Witwatersrand's demand for an efficient school of mines in Johannesburg, the State mining engineer has introduced a draft law proposing the establishment of such an institution. One clause of the Bill provides that all the instruction must be given in Dutch. As nearly all the engineers in the mines are English or American, with a few Germans, the absolute absurdity of this proposal can easily be gauged.

For some time past the Cape Government has been giving the free use of machine drills for striking underground water supplies. Several promising discoveries of water have recently followed the use of these drills in the Colesberg district.

U.S. SECOND-CLASS BATTLESHIP MAINE



THE UNITED STATES BATTLESHIP MAINE.

WE take it for granted that our readers know all that is known in this country concerning the terrible catastrophe which sent the Maine to the bottom of Havana Harbour in a few minutes. Various illustrations of the ship have been published. These are for the most part fancy sketches. We this week publish two views, both taken from photographs, one illustrating the perfect ship, the other so much of her as appeared above water after the explosion. This last was taken on the morning of Wednesday, February the 16th, 1898, by the photographer for the *New York Herald*. The ship was blown up at 9.40 p.m. on Tuesday, February 15th. In our next issue we shall give sectional drawings and deck plans which will make her construction clear.

The Maine was the first ironclad possessed by the United States, for the Monitors scarcely deserve that title. She was built at the New York Navy Yard. Her keel was laid October 11th, 1888, and she was launched on the 18th November, 1890. She was 310ft. long between perpendiculars; length over all, 324ft. 4in.; beam, at load-water draught, 57ft.; her normal draught was 21ft. 6in.; displacement, 6650 tons; and coefficient of fineness, 0·596.

In her design there are certain features more or less undesirable. She was provided with two echelloned turrets, each carrying two 10in. breech-loading guns. The turrets were carried in part outboard, so that to a certain extent they resembled caponiers. In a seaway they must have stressed the ship considerably. The guns and turrets were worked by hydraulic gear. Her main armament consisted of six 6in. breech-loaders mounted in her superstructure, two firing ahead, two astern, and one on each broadside. These were all hand-served behind 2in. shields. She had a number of small quick-fire guns of the Gatling type, and four torpedo tubes fitted on the broadsides of the berth deck.

She had an armour belt of Harveyised steel, 180ft. long and 7ft. deep. It was 12in. thick above the water-line, and tapered to 7in. below it. There was a 2in. protective deck, and a steel 6in. bulkhead across the ship forward. The turrets were of 10in. plate, and the barbettes protecting the base of the turrets were of 12in. mild steel.

The ship was propelled by twin screws. The triple-expansion engines had cylinders 35½in. + 57in. + 88in. × 36in., giving 9000-horse power at 125 revolutions. The safety valves were loaded to 135 lb. Steam was supplied by eight single-ended "Scotch" boilers, with twenty-four corrugated furnaces. Each boiler had 72 square feet of grate and 2373 square feet of heating surface. They were 14ft. 8in. in diameter and 10ft. long. The closed ashpit forced draught system was used. All the machinery was supplied by the Quintard Ironworks, New York. The official trial of the Maine took place in Long Island Sound on October 17th, 1894, and lasted four hours, during which the average speed was 17·45 knots. The indicated horse-power of the main engines at 123·5 revolutions was 9171, and of the auxiliary machinery 121, the aggregate being 9292. The coal consumption was 35 lb. per square foot of grate surface and 2·18 lb. per indicated horse-power per hour.

The Maine was a useful type of cruiser, but she scarcely deserved to be called a battleship. No vessel of the type were old-fashioned. The ship would, however, no doubt have withstood a good deal of hard hitting and put in some shrewd blows in return, but there is a certain measure of consolation in the circumstance that the Maine was far from being the best warship possessed by the United States.

As to the cause of the explosion, we may say that it is generally held in naval circles that the ship was blown up from the outside. It is stated that portions of her bottom plating,

THE MAINE FROM THE PORT QUARTER, LOOKING FORWARD

would be laid down in the present day. While carrying four heavy guns, only two of these could be brought to bear at the same time on an enemy taking up a position a little to port or to starboard, either ahead or astern. The firing of her heavy guns over her deck and parallel to her superstructure must have had very objectionable effect. It is questionable, indeed, if under the circumstances her bow 6in. guns could have been worked at all. The above-water torpedo tubes which was painted green, have been found inside the hull by the divers. As to how or why or by whom the villainous deed was done, it is impossible to say anything. It is to be feared that the catastrophe will have to be added to the list of the world's mysteries. In this country the warmest sympathy is felt for the widows and children of those slain, and some consolation is to be found in the fact that the people of two great nations have in this way been drawn closer together.

SIR HENRY BESSEMER.

SIR HENRY BESSEMER died on Tuesday evening at his residence at Denmark Hill. He was born on the 19th of January, 1813, and his long life has carried him into a generation for whom his achievements lack the interest which they possessed for the few great metallurgists his contemporaries, yet alive. By those who had had the good fortune to know him well his death will be keenly lamented. But his increasing years and infirmities have long withdrawn him from public life; and for the younger metallurgists his name is not one with which to conjure.

Concerning the work which he accomplished, most of the details are familiar to those interested in the manufacture of steel, and nothing more is necessary—or indeed possible—just now than a recapitulation of certain prominent facts and dates. But the man himself was too remarkable in many respects, and his career too instructive and suggestive, to be passed over wholly in silence. It is satisfactory to know that for a considerable period he was at work on an autobiography. Bessemer wrote excellent English. He was extremely genial, and very happy and sanguine in disposition, and brought therefore excellent qualifications to the work of authorship. The history of his life and work will consequently no doubt possess exceptional interest. It will be necessary, however, to read between the lines to learn what manner of man he was. Bessemer was a very peculiar product of the nineteenth century. His total lack of systematic scientific training at once made him and marred him. It is a noteworthy fact that in all ages, consciously or unconsciously, those who teach deem it certain that what they have to impart represents finality. We very seldom meet in text-books or hear from lecturers suggestions that improvements in such and such directions are possible. If Bessemer had been carefully taught metallurgy, as it was understood in the days of such men as Truran, for example, he would never have invented the Bessemer process. On his own showing, indeed, he rather blundered upon it than invented it; and he was carefully assured by those who were supposed to know all about steel making that ever had been known or could be known, that the process was wholly impossible. No scientific training stood in the way and stopped Bessemer from trying experiments. In a single instance he was successful, and his success worked a greater change in the world's ways than it is easy to realise. But it is said that he spent no less than £10,000 on Patent-office fees; and of all the hundreds of inventions which he made, very few attained to success. The reason must be sought in Bessemer's character. His ideas singularly lacked proportion. He failed to catalogue all the conditions affecting an invention, and determining its success or its failure; and to those whose existence he did recognise he was wholly incapable of attaching a just value. For example, he invented a steady cabin for ships, which was to prevent sea sickness. This cabin or saloon was hung upon gimbals, and somewhere about the middle of it was mounted a fly-wheel weighing a couple of tons, which was to revolve at 1000 or 1500 revolutions per minute. The gyroscopic action of the revolving mass was to keep the saloon steady. That it would operate to prevent rolling under certain conditions was admitted. Bessemer had a model saloon fitted up in his grounds at Denmark Hill, on a rocking platform, to resemble the hull of a ship. Everything worked admirably. What the inventor failed to see was that no strict parallel could be drawn between the mechanical action of the rolling platform on land and the tumultuous universality of violent motion brought about by a moderate gale in the English Channel. The Bessemer steamship, on which he certainly spent £25,000, and probably twice that sum, was a pronounced failure. Again, he spent very considerable sums on the production of a steam gun. In order that the action of the steam on the bullet might be sufficiently prolonged, the barrel was coiled up in itself in a flat spiral, terminating in a few feet of straight pipe at a tangent to the rest. He took an almost childish delight in seeing this weapon flatten lead bullets against an iron plate; he quite failed to see that there was no use for such a thing, or that it was as absolute a toy as the steam gun of Jacob Perkins. No doubt if Bessemer had had a sound mechanical training he would have avoided this class of work; but, on the other hand, he would have lost that splendid audacity of ignorance which led him to magnificent triumphs.

Until Sir Henry Bessemer's autobiography is published very little will be generally known concerning his early life. His father was a Frenchman, an artist, and a member of the French Academy of Sciences. We believe we are correct when we state that young Bessemer first made a living by designing patterns for Paisley shawls. His sister was presented one Christmas with an illuminated gift book, in which were so-called gilt letters. She set about illuminating a book for herself, and asked her brother to get her some "gold paint." This used to be sold in "shells," and when the lad went to buy one, he found to his dismay that the shells cost half-a-crown each. Half-crowns were very scarce, but he bought a shell, and formed the idea that he would himself make gold paint. The story of his endeavour we have had the good fortune to hear from his own lips. He believed that the paint was made of Dutch metal "gold" foil, ground up to a powder with a little honey, and subsequently treated with varnish. He was on the right track, but his gold paint would not shine; it lacked lustre. At last he discovered that it was not an amorphous powder that would do. The foil must not be ground up, but torn up, until each little flake resembled the feather on a butterfly's wing. He made his machinery, and to this day the secret of its structure has, we believe, been maintained. The machine described in his patent will not work. The whole story is far too long to tell here. It must suffice to say that bronze paint was the foundation of Bessemer's fortune.

Early in his career, long before the advent of the steam gun, he turned his attention to ordnance, and tried to make shot, with spiral feathers and other devices, to do away with rifled grooves in the gun. But he could not get cast iron strong enough to satisfy his needs, and nothing would serve him but he must try to make a tougher metal. His first experiments were made in 1855. He melted pig iron in a reverberatory furnace, and into the molten metal he put broken-up bars of blister steel. He got the very high heat necessary to secure fusion by making a wide grate and giving the hearth a narrow throat. This he patented on January 10th, 1855. He found the clue to this process in Fairbairn's attempt to toughen cast iron by adding some malleable scrap to the cupola, which, however, only resulted in producing white cast iron. Bessemer made a model gun of his new metal and took it over to France. He presented it to Napoleon III., who was much pleased with the weapon, and wished to reward the inventor with the Grand Cross of the Legion of Honour, which, however, the English Ambassador would not permit him to wear. He proceeded, however, to erect gun-casting works at Ruelle, for the French Government; but these were stopped by a discovery which he made in London. We must here quote Bessemer's own words from a paper which he read before the American Society of Mechanical Engineers.

On my return from the Ruelle Gun Foundry I resumed my experiments with the open-hearth furnace, when the remarkable incident I have twice referred to occurred in this way. Some pieces of pig iron in one side of the bath attracted my attention by remaining unmelted despite the great heat of the furnace, and I turned on a little more air through the fire-bridge with the intention of increasing the combustion; on again opening the furnace door after an interval of half an hour these two pieces of pig still remained unfused. I then took an iron bar with the intention of pushing them into the bath, when I discovered that they were merely thin shells of decarbonised iron, thus showing that atmospheric air alone was capable of wholly decarbonising gray pig iron, and converting it into malleable iron without puddling or other manipulation. It was this which gave a new turn to my thoughts, and after due consideration I became convinced that if air could be brought into contact with a sufficiently extensive surface of molten crude iron the latter could rapidly be converted into malleable iron.

The history of the Bessemer process, even in its earlier stages, would fill a volume. The invention as it is known now was not arrived at for years. Up to a certain point Bessemer had things all his own way, and then came a crash. It was found, indeed, that steel could be made, but only with utter uncertainty as to the quality of the product. It was necessary to leave a little carbon in the metal, but the percentage depended on the duration of the blow, and no satisfactory commercial result was possible. But besides this, far from getting rid of sulphur and phosphorus, the process seemed to aggravate the evil of their presence. In a word, the whole process was a failure. He worked away for more than two years, and at last succeeded in producing a saleable article from a pure ore, but by this time the steel makers had lost all faith in the affair. Bessemer, however, about 1858 started a small steel works in Sheffield, with a partner, Robert Longsdon, Messrs. Galloway, of Manchester, supplying the plant, and steel was made and sold in small quantities.

Next Robert Mushet appeared on the scene, and it appears to us to be beyond all doubt that to him the ultimate success on a great scale of the Bessemer process was due. To settle the carbon question he blew all the carbon out of the charge, and then added a definite quantity of speigeleisen, the manganese of which formed an invaluable ingredient. Of the disputes as to priority of invention, and the validity of Mushet's claims, we do not care to write. They are matters of history.

Mr. Bessemer and his partners were eminently successful, and realised huge profits. We have heard Sir Henry Bessemer say that he had realised himself personally one million sterling. He went on inventing various improvements in the apparatus used for conversion; and he took out scores of patents for various other inventions, such as sugar-cane crushing machinery and telescopes. In 1875 the Bessemer Channel steamer was launched. She was designed by Mr.—now Sir—E. J. Reed, and was fully described and illustrated in our pages. She was one of the very few steamships built with four paddle wheels, two of which were forward and two aft of the swinging saloon. She was a failure from the first, slow and unhandy. On the very first trip she made she fouled Calais Pier, and did herself and the pier much harm. Her engine frames were too weak, and the great gyroscope in the saloon could not be made to work properly. The company was wound up, and we believe that the hull of the Bessemer was finally converted into a screw cattle boat, and plied in the North Sea.

To say that Sir Henry Bessemer was a genius gives but an inadequate idea of the man. The curious way in which he got at results, almost, as it were, by instinct, was very remarkable. It is nearly certain that he never really mastered the chemistry of his process, and we are strongly disposed to believe that he took far more interest in the machinery he used than he did in the details of the process it carried out. It was quite useless to tell Bessemer that any given device would not answer. He seemed to possess some special power of making things succeed which ought to have failed. Of course he committted a multitude of mistakes, but they were all swallowed up in his successes. We should but write platitudes did we attempt to dilate on the importance of the part which his process has played in the development of the carrying trade of the world. The facts are patent to everyone who pleases to give them a moment's thought.

The world began to appreciate Bessemer at a tolerably early period. He got the Telford Medal for a paper on his steel process read before the Institute of Civil Engineers in 1859. In 1871 and 1873 he was President of the Iron and Steel Institute. In 1877 he was elected a member of the Institution of Civil Engineers. In 1879 he was elected a Fellow of the Royal Society. In the same year he was knighted, and in 1880 he was presented with the Freedom of the City of London. His reputation was world-wide, and the world delighted to honour him. He married in 1833 Miss Allan, by whom he had several children. Lady Bessemer died last year.

Sir Henry Bessemer retained his health and his faculties, notwithstanding his great age, until quite recently. About three weeks ago he was taken ill and had to keep his bed, but he rallied, and wrote and talked, and no immediate danger was apprehended. On Tuesday afternoon, however, he collapsed suddenly, and passed away quietly about twenty minutes past seven.

PASSENGER S.S. BRUCE.

BY the section of the vessel given on page 258 we now complete our illustrations of the passenger steamship Bruce, of which we gave drawings of the engines last week, and a full description on January 21st of the present year.

THE METRIC SYSTEM.

AT a meeting of the Associated Chamber of Commerce, Whitehall Rooms, Thursday, 17th March, Sir H. Stafford Northcote, Bart., M.P., in the chair, Mr. E. Matheson, M. Inst. C.E., president of the Leeds Chamber, moved the following resolution:—"That, in the opinion of this Association, the compulsory adoption within some limited period of the metric system of weights and measures legalised by the Act of last session be advocated by every possible means, with the view of inducing her Majesty's Government to afford facilities for the amendment of the law in this respect, and that a copy of this resolution be sent to the President of the Board of Trade and to the First Lord of the Treasury. This Association urges the Government meanwhile to adopt the metric system of weights and measures, as far as possible, in all Government contracts and returns, so as to make it familiar to the people; and recommends individual Chambers of Commerce to press the matter upon the attention of local governing bodies, to the end that these also may employ the system in all public contracts, and thus facilitate its general adoption." Mr. Matheson said the subject had been so constantly supported by the Chamber that there was no need to justify the position taken, or to go into the details of the system advocated; but it might be convenient to state what are the present prospects of its adoption. It is already legalised, and contracts made in metrical weights and measures are recognised. These measures are taught in many of our Board Schools, and the principles on which they are based explained. The great majority of manufacturers and traders in this country is with us, the support coming mostly and naturally from those who are engaged in foreign trade, and who recognise how greatly they are handicapped in our method of invoicing our goods. Not only the whole continent of Europe, except Russia, but Central and South America find difficulty in dealing with goods so presented to them. No doubt the difficulty is enhanced by the peculiarities of our coinage system. The question of money and the decimal system are, however, not now before us; as we have agreed not to burden our proposal as to metrical measures by any action at present in that direction. Those engaged in education are almost all with us. The schoolmasters say that the change will be equivalent to a year saved or gained in the school life of every pupil. Not only the scientific societies support us, but also those engaged in the manufactures and commerce in what may be termed the scientific branches, more especially the vast industries established in chemicals and electrical apparatus, where metrical weights and measures are already largely adopted for transactions at home as well as for those abroad. This example is of importance in converting those whose interests lie only at home, and who oppose our claim for a change for which they themselves feel no need. In this regard it is significant to note that quite recently a deputation from the Chamber of Agriculture waited upon Mr. Long, the Minister of Agriculture, to impress upon him the great inconvenience caused by the variety of methods used in the different markets of the kingdom in the weighing of grain, live stock, and other produce. Surely if uniformity is desired they ought to side with us and make the bold plunge into metrical weights. It is almost certain that we shall have the immediate support of the United States, whose decimal coinage lends itself to metrical measures, and who have already taken steps in the right direction by abolishing the weights intermediate between the pound and the ton, and who make their contracts in tons of 2000 lb. If the United States join us, Canada will certainly come in, and our Colonies will have to follow. India has already adopted for her light railways the metre gauge. Mr. Arthur Balfour in Parliament last year gave as a reason or excuse for abstention in pressing our proposal as a Government measure, with which he mainly agreed, that we had proposed so short a time as two years within which it was to be made compulsory, and which, he said, would raise intense opposition. Our present resolution does not specify a period, but we do urge promptitude. As an example of the kind of opposition we have to encounter may be instanced a series of articles in the *Times* by an eminent scientist who, utterly ignoring the reasons put forward by traders, demonstrated that the metre was not on a true scientific basis, that it was not, as asserted, the fraction of the diameter of the globe at the equator, and matters of that sort. We claim the metrical system for two main reasons—one, because it is decimal, and banishes the confusion of what is known as compound arithmetic; but second and principally because we want uniformity with the rest of the civilised world. The world has adopted the British railway gauge for the sake of uniformity, not because of any abstract merit it possesses. Let us respond by adopting the world's gauge of weights and measures. It is the break of gauge in the journey made by our merchandise that we want to remedy. On the question of Government contracts I leave the representatives of the Bristol Chamber to speak.

This resolution was seconded by the representative of the Bristol Chamber of Commerce, who urged that the Government should help to educate public opinion by at once adopting the metrical system in contracts. Sir Samuel Montague, M.P., and Colonel Sir Edward Hill, M.P. for Bristol, who have long taken a lead in promoting the change, cordially supported the resolution, which, after some further discussion, was carried unanimously.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

THERE is still a great pressure for steam coal, and owing to the uncertainty of the agreement about the sliding scale there is a difficulty in arranging stems. Prices are advancing and very firm, especially small coal. There is rather a better demand than last week for house coal. The quantity of coal exported for the week ending March 12th was:—Foreign, 67,500 tons; coastwise, 15,047 tons. Imports for week ending March 15th were:—Pitwood, 4181 loads; iron ore, 10,605 tons; pig iron, 1550 tons; and spiegel iron, 550 tons. Steel and iron works are well employed with orders for rails, bars, and billets. The Ebbw Vale Company have an order for 15,000 tons steel rails. The various foundries in the neighbourhood were well off as regards orders.

Coal: Best steam, 11s. to 11s. 6d.; seconds, 10s. 6d.; 3d. extra shipment at Cardiff; house coal, best, 11s.; deck screenings, 7s.; colliery small, 6s. 9d. to 7s.; smiths' coal, 6s. 6d. Patent fuel, 10s. Pig iron: Scotch warrants, 46s. 5d.; hematite warrants, 49s. 5d., f.o.b. Cumberland; Middlesbrough No. 3, 40s. 8d prompt; Middlesbrough hematite, 51s. Iron ore, Rubio, 13s. 8d. to 13s. 9d.; Tafna, 13s. to 13s. 3d. Steel, heavy sections, £4 10s. to £4 12s. 6d.; light ditto, £5 10s. to £5 12s. 6d., f.o.b.; Bessemer steel tin-plate bars, £4 1s. 6d.; Siemens steel tin-plate bars, £4 2s. 6d., all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 9s. 9d.; Siemens, coke finish, 10s. Pitwood, 14s. 9d. to 15s. London Exchange telegram:—Copper, £50 10s.; Straits tin £65 Freights very firm, especially Mediterranean ports.

RAILWAY MATTERS.

IN New Orleans, practically the whole of the street railway system has been converted during the past three years from mule haulage to electric traction. Out of 170 miles of road, 163 miles are now operated electrically. The cost of the conversion has been close upon £3,000,000.

THE total number of passengers carried on the Prussian State Railways for the year 1896—97 was 436,717,857, as against 397,759,674 in the former, being an increase of 38,958,183, or of 9·79 per cent. Of these, 33 per cent. were first-class passengers; 10·53 per cent., second-class; 52·11 per cent., third-class; 35·58 per cent., fourth-class.

THE contract for the construction of the extension of the City and South London Railway from Stockwell to Clapham Common is said to have been placed. This extension, which is to be completed in fifteen months, with the opening of the company's line to Moorgate-street, now being rapidly pushed on, will, it is confidently expected, open a new era of prosperity for the company.

VISITORS to the South of France resorts will be pleased to hear that the London, Chatham, and Dover Railway Company have arranged with the Paris and Lyons Railway Company for the Homeward Mediterranean Express Train de Luxe to start two hours earlier from Mentone, Monte Carlo, Nice, and Cannes, beginning on March 25th, in order to secure the connection in Paris for Calais, and thus always enable them to reach Victoria and Holborn at 7.30 p.m.

A BIRMINGHAM correspondent telegraphs to the *Financial News* that the Indian Government has placed exceptionally large orders in Staffordshire and the Midland districts for locomotives, railway material, and rolling stock for the State railways. One well-known Staffordshire firm has secured contracts representing over £20,000. Considerable contracts for steel and other requisites have been placed in South Yorkshire, whilst the Birmingham Wagon Company has obtained large orders for wagons and carriages.

LAST Saturday afternoon on the South-Eastern Railway an engine attached to several empty carriages slipped the points in the centre of the track on the Bermondsey side of London Bridge Station, and ran off the metals. The track for a short distance was torn up, and the metals were damaged. The carriages, however, kept the rails, and these were easily uncoupled from the derailed engine and shunted back. A breakdown gang was quickly set to work, but two or three hours elapsed before the engine was replaced on the track.

THE attention of locomotive builders is drawn to the fact that the Russian Government has set aside the sum of 20,000,000 roubles for the purchase of locomotives for the Russian State Railways during the current year. A large number will have to be ordered abroad, as the Russian works, which are already full up with orders, cannot turn out more than about 1000 per annum at the most, says the *Consular Journal*. In addition, 400 locomotives have been ordered for the Siberian Railway, and 100 more will be ordered this year, while 1,500,000 roubles will be spent upon rolling stock on this line.

A RECENT report of the British Consul at Belgrade states:—"A Government Commission is sitting at Belgrade to consider the improvement of internal communication, and is expected to elaborate a general plan for the construction of railways to act as feeders for the main line. Foreign capitalists will probably be asked to tender for these lines, which Servia has no means of constructing for herself. The long-talked-of railway between Nisch and Kladovo, will it is said, be specially given to a Belgrade syndicate. A contract has been signed between Servia and Roumania for the construction of a bridge at Kladovo on the Danube, where the new railway will join the Roumanian line near Turvseverin."

A SERIOUS accident, which happily resulted in no loss of life, occurred at Potter's Bar Station on Saturday night to the 7.50 Great Northern passenger train from Hatfield to King's Cross. The train connects with the service of the Luton, St. Albans, and Hertford branches, but fortunately on Saturday there were, contrary to custom, very few passengers. It left Hatfield at the appointed time, and travelled on the up slow line, in order to allow the Manchester express to pass. On arriving at Potter's Bar the train is turned on to the up fast line to admit of passengers alighting and entering the train at the station platform. On Saturday evening, however, for some reason to be explained, the driver ran past the signals, which were at danger, with the result that the train cut through the catch points and buffer stops, and crashed on to the platform with terrible force. The front part of the engine was smashed, and the first coach wrecked, the driver, fireman, and guard escaping injury by a miracle. Some of the passengers complained of being much shaken, but they were able to proceed to their homes.

WE learn from an American railroad contemporary that a new profession has sprung up on that side of the Atlantic. The profession seems to depend for its existence upon faulty maintenance of railway stations, thereby enabling the professor to temporarily disable himself, and sue the company for damages. The *Street Railway Review* gives the following account of a professional contortionist who has chosen for a vocation the dislocating of his hip joint when the circumstances are favourable to securing a verdict for damages against a railroad company. Some months ago a man fell on the platform of a passenger station near Indianapolis, having caught his heel in a crack, and the result was a dislocated hip. The company settled for £440 and attorney's fees, and extended courtesies in the way of furnishing transportation for the man and his nurse, &c. Quite recently a similar accident occurred in Virginia, and a claim of damages presented. The man had been seen the day before hunting about the platform for a hole in which to catch his heel, and a traveller who was present recognised him as the victim of the "accident" in Indiana. The Virginia road did not settle his claim, and the Indianapolis company want his present address.

THE action of the railway companies in nearly equalising their rates for the carriage of timber from Rouen and east ports, such as Caen, Dieppe, Havre, and Honfleur, to towns in Central and Northern France, is a most serious consideration for those carrying timber to Rouen. The action is owing to the greater competition for traffic, and the increased efforts of the companies to secure for themselves that now carried by the canals. The position of Rouen upon one of the main navigable waterways of the country has always made it a favourite port for the timber lands. Freights to Rouen from the Gulf of Bothnia and other timber-exporting centres are higher than to the above coast ports, but at Rouen the timber can be placed in lengths and despatched by cheap carriage to any port of France. As a general rule timber despatched from Rouen to towns in the South of France is carried by canal as far as Grenouille on the Canal latéral à la Loire, or to Roanne in the Department Loire, and there placed on trucks and sent to its destination, the railway at both places joining the canal. The port of Rouen is now at a disadvantage, relatively with the east ports, so far as timber is concerned, as freights to Rouen will always be higher than those to the coast, and the difference in the railway rates for carriage of timber is insufficient to compensate for the higher freight. The bridge "Arhodin," or Pont Trasbordeur, which is to span the Seine at a height of 160ft., and convey passengers and goods, carriages and tramcars across the river in a car slung at the level of the quays, progresses slowly. The foundation has been constructed, and the placing of the ironwork will shortly be commenced, but the whole is not expected to be finished before the beginning of next year.

NOTES AND MEMORANDA.

THE total output of gold from Auckland, New Zealand, during 1897 amounted to £402,501, being an increase of £73,760 over 1896.

NEAR Boise City, in one of the States of America, there is said to be a subterranean lake of hot water of 170 degrees temperature, 400ft. below the surface.

IT is interesting to note, as demonstrating the almost exclusive employment of steel in shipbuilding, that during last year 98·5 per cent. of the tonnage classed by Lloyd's Register was built of that material, and only about 1·2 per cent. of iron.

A PROPOSAL is on foot to invite the British Association to Bradford for the year 1900. It was unanimously decided at a meeting presided over by the mayor of that town to send an invitation to the Association for the year 1900, and an executive committee was appointed to make arrangements if the invitation should be accepted.

A NUMBER of tests have been made with roller bearings on a 3in. line shaft 80ft. long, running at a speed of 200 revolutions a minute, and found to show a remarkable saving in power, says the *American Miller*. When running in babbitted boxes the shaft consumed 6·21-horse power, and came to a standstill two minutes after being disconnected from the source of power. After the shaft was fitted with roller bearings the power required to overcome the friction was found to be only 3·01-horse power, and the shaft revolved ten minutes after being disconnected from the source of power.

THE average daily supply of water delivered in the metropolis from the Thames during the month of December last was 101,849,282 gals.; from the Lea, 57,668,200 gals.; from springs and wells, 34,184,975 gals.; from ponds at Hampstead and Highgate, used for non-domestic purposes only, 122,496 gals. The daily total was 193,824,953 gals., for a population estimated at 5,748,366, representing a daily consumption per head of 33·72 gals. for all purposes. The relative proportions of the supplies from the above various sources were as follows:—From the Thames, 52·55 per cent.; from the Lea 29·75 per cent.; from springs and wells, 17·64 per cent.; from ponds, 0·06 per cent.

ACCORDING to a return made by Mr. Bathurst, of the Public Carriage Department of the Metropolitan Police, there are 3190 omnibuses and 1378 tramcars in the metropolis, making together 4568 public vehicles. Added to this there are 3583 four-wheeled cabs and 7923 hansoms. Together we have a grand total of 16,076 cabs and omnibuses and tramcars. The General Omnibus Company runs 1151 vehicles, and these carry 172 millions of passengers, the Road Car Company runs 350, and these carry 58 millions. But there are still to be included in the aggregate of omnibuses licensed by the Commissioner of Police 1650 omnibuses that are not owned by the two leading companies.

TESTS as to the effects of impurities on the electrical conductivity of aluminium have recently been communicated to the Franklin Institute. The results show that with 1½ per cent. impurity the specific conductivity of the aluminium was 55 per cent. that of copper. If the impurity were decreased to 1 per cent. this figure rose to 59 per cent., while for ½ per cent. of impurity the conductivity is 61 per cent. that of copper. Finally, with absolutely pure aluminium, a specific conductivity of 67 per cent. that of copper is obtained. So if the price of this new metal of commerce, when pure, can be reduced until it costs one-third less than copper, it can compete commercially with this latter metal as an electric conductor.

THE monthly report of the Labour Department of the Board of Trade shows a marked improvement in the state of employment in the month of February compared with the previous month, though not quite up to the level of the corresponding month in last year. The improvement is not fully shown in the figures given below, owing to the fact that the number of unemployed members of engineering trade unions has been temporarily increased by a certain number who have not yet succeeded in finding employment after the engineering dispute, and who in previous months were omitted from the figures as being on strike or locked out. In the 116 trade unions making returns with an aggregate membership of 466,362, 20,517—or 4·4 per cent.—were reported as unemployed at the end of February, compared with 4·96 per cent. at the end of January, and with 3·0 per cent. in the 115 unions with a membership of 453,144, from which returns were received for February, 1897.

THE circumstances attending an explosion during the thawing of gelatine dynamite called gelignite, which occurred at Porthcawl, in Glamorganshire, on January 10th last, form the subject of a Home-office report by Captain J. H. Thomson, R.A., H.M. Inspector of Explosives. The accident, by which two men lost their lives, occurred in a rock cutting made for some new sewage works, and was caused by placing the cartridges in a flat pan on the top of a brazier to thaw. "The cause of this accident," says the report, "is not far to seek. If an explosive is deliberately placed on top of a fire and gradually heated, it is only a question of time and degree of temperature which determines whether or when an explosion shall occur. This accident is the eighty-first of which we have record, caused by the improper thawing of nitro-glycerine explosives, and brings the list of casualties up to sixty-eight killed and ninety-seven injured. It is unfortunate that an idea still prevails that nitro-glycerine compounds can only be exploded by means of a detonator, and that they can be ignited or thrown on a fire with impunity. No greater or more dangerous fallacy could be maintained, as is shown by the above large number of accidents, and others not immediately connected with the operation of thawing."

A PRACTICAL demonstration of Dr. Linde's method of producing extreme cold and liquefying air was given on Monday and Tuesday in the rooms of the Society of Arts. The principle of working the apparatus, which was shown in operation, is based on the reduction of temperature which takes place when air—as well as other gases, except hydrogen—is allowed to escape from a higher to a lower pressure. The most important parts of the machine employed are a two-cylinder air compressor and a counter-current interchanger, the compressor being driven by an electric motor. The interchanger consists of a triple spiral of three tubes wound one inside the other. The cycle is performed in such a manner that compressed air at about two hundred atmospheres flows through the inmost tube of the spiral from top to bottom, and passes out at the lower end through a valve under a pressure of some sixteen atmospheres, returns upwards through the annular space between the inner and middle pipes, and is then again raised to a pressure of two hundred atmospheres by the smaller cylinder of the compressor to begin the same cycle over again. A small machine, in which the air is delivered at two hundred atmospheres pressure, and taken back at sixteen atmospheres, is stated to require three horse-power to drive it, and to give about 0·9 litre of liquid air per hour. Confirming certain experiments by Professor Dewar, Dr. Linde finds that on evaporation of liquid air the nitrogen escapes first, so that the percentage of oxygen remaining in the liquid progressively increases. Under laboratory conditions, when 60 per cent. of the liquid has evaporated, the residue consists of 50 per cent. of oxygen, and when 95 per cent. of the liquid has evaporated the remainder still contains 90 per cent. of the oxygen originally present. Besides the application of this highly oxygenated liquid for scientific experiments, Dr. Linde proposes to utilise it in the manufacture of chlorine, sulphuric and nitric acids, and to employ it in combination with powdered charcoal as an explosive in blasting operations.

MISCELLANEA.

THE Manchester Corporation have had under consideration the utilisation of the water supply at Longdendale, as a means of generating electrical power. The question is to be referred to an electrical engineer for report.

AN Industrial and Mining Exhibition is to be opened in Auckland, New Zealand, in December next, and will remain open during January. The Exhibition will be under the patronage of the Governor, the Earl of Ranfurly. The secretary is Mr. W. R. Holmes, 1, Fort-street, Auckland.

AT a meeting of the Lynn Town Council on the 9th inst., the resignation of Mr. E. J. Silcock, C.E., Borough Engineer, was accepted, but it was decided by the Council to retain Mr. Silcock's services for the completion of the works for a new water supply to the town and new sewerage scheme which have been designed and commenced by him. We understand that Mr. Silcock has been appointed engineer to the King's Lynn Harbour Conservancy Board, and that he will also carry on a general practice as a civil engineer.

THE Government of Newfoundland have decided to dispose of the dry dock at St. John's to Mr. Reid, owner of the screw steamer Bruce, of 1155 tons measurement, and high speed, built last year by Messrs. A. and J. Inglis, of Pointhouse, and illustrated this week on page 258, which now plies between Placentia and Sydney, Cape Breton, performing important service in the linking together of separate railway systems. It is the intention of Mr. Reid at once to give the orders to Clyde builders for no fewer than seven new steamers intended to ply about the coast of Newfoundland and Labrador.

A FINANCIAL contemporary states that a French company has requested the French, Belgian, and Dutch Governments to allow them to establish along the navigable rivers and canals in these three countries a system of electric traction, in order to form an international network of electric towage which will stretch from the Rhine, in Holland, to Marseilles, though the eastern provinces of France. Several canals of the North of France are to be connected with the Upper Meuse. It is urged that when this project is realised a great and probably favourable influence will be exerted upon the French and Belgian coal mining industry.

MESSRS. RAMAGE AND FERGUSON, engineers and shipbuilders, of Leith, on the approaching expiry of the present lease of their premises from the Dock Commissioners of Leith, are arranging to have a portion of the foreshore reclaimed, whereby they will be enabled to lay down vessels of double the length at present possible. They have now on their stocks a vessel of 340ft. in length to the order of Swedish owners, which is the largest steamer ever built at Leith. The firm have it in contemplation, also, to introduce the system of electric-motor driving for the various isolated machine tools throughout their works.

THE defects of Dublin on account of the neglect of sanitary arrangements were again made public at the meeting of the Dublin Sanitary Association held last week. Owing to the amount of sickness which has been prevalent during the past year, and the consequent crowding of the hospitals, the Council have brought before the proper authorities the subject of the very inadequate accommodation afforded by the existing hospital arrangements for the treatment of infectious and febrile diseases. The first step to be taken in this matter, says the *Architect*, is to provide accommodation for convalescents, who, by being removed to houses specially selected and properly fitted up would make room for other patients to be admitted to the hospitals. The president drew attention to certain seaside summer resorts in the vicinity of Dublin, the sanitary conditions of which might, with advantage and, indeed, good profit, be improved. The health of Dublin must suffer if disease instead of health be the result of a summer vacation.

THE fountains of Paris are among the most interesting features of the city, and the authorities are careful to increase their attractiveness whenever an opportunity arises. An experiment has been tried by which the waters will become luminous. It was not contemplated to have the variety of colours which are displayed from time to time by fountains in the grounds of international exhibitions, and which are manipulated by the aid of apparatus placed at a height. In Paris a sort of golden yellow will alone be employed; but the waters will assume the appearance of cascades of diamonds and topazes. According to the *Architect*, the effect will be attained by means of electric lights and coloured glasses placed around the basin in such a way that the beauty of the fountain will not be diminished when seen by daylight. The fountains which were selected for trials were those in the Place Théâtre Français and the Place de la Concorde, and up to the present the anticipations of the municipal engineers are satisfactorily realised.

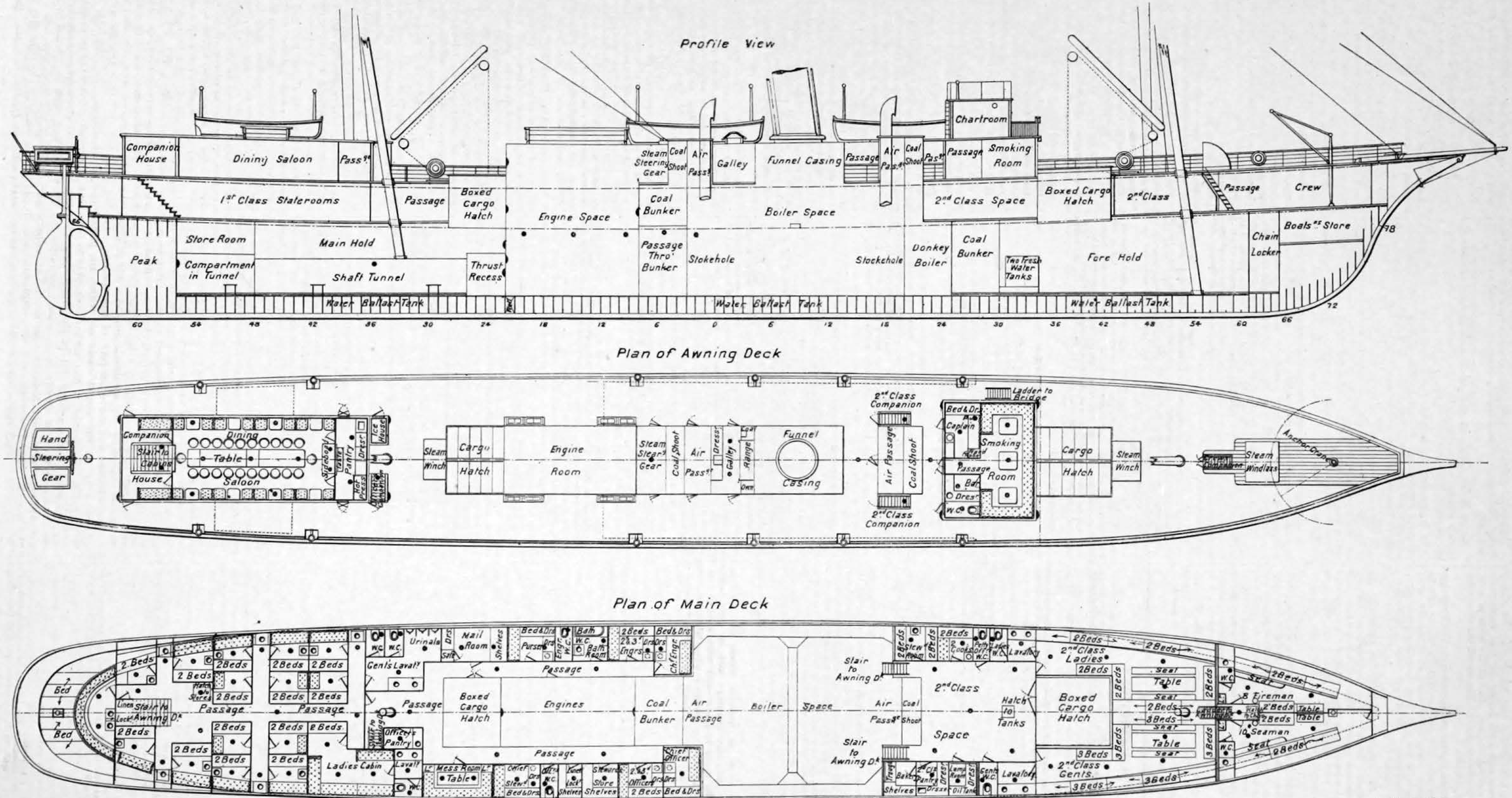
ACCORDING to a Consular report machinery, instruments, and arms were imported into Servia in 1896 to the value of £45,184, an increase as compared with 1895 of £11,489. This trade was divided between Austria-Hungary and Germany; Great Britain supplied some £3325 worth of sewing and knitting machines and scientific instruments. The total value of metals imported in 1896 was estimated at £115,397, or £23,047 more than in 1895, distributed as follows: Austria-Hungary, £90,184; Germany, £19,080; and Great Britain, £2139. The importation of nails, screws, bolts, nuts, clamps, &c., during 1896 was valued at £14,524. Ploughshares, axes, tires, tools, and gardening implements are estimated at £8975, and of this amount only a little over £100 was spent in England. Considerable improvement can be made in this class of goods by our manufacturers, and the contemplated reduction of sea freights from England to Fiume, if carried out, will be of material assistance to them, says the *Consular Journal*. The Consulate at Belgrade is acquainted with an agent in Servia who is desirous of attempting the importation of bar, hoop, and plate iron, and tin-plates from Great Britain. On application his name will be given to any British firm wishing to open up correspondence upon the subject.

IN the House of Commons last Friday evening Lord Charles Beresford asked the First Lord of the Admiralty if he would settle all doubts as to the qualities of the Belleville boilers by ordering the Diadem when ready for sea to steam across the Atlantic at 12,500-horse power. Mr. Goschen, in reply, said the Diadem, like all other ships in commission, will have to make her twenty-four hours' passage trial as provided by the regulations once a quarter. Any further trials that may be necessary to satisfy the Admiralty as to her efficiency will be made. It is not desirable to start a newly-commissioned ship on a long-continued run at full speed until the engine-room staff have had time to become accustomed to the engines and their duties generally, unless in case of emergency. Much better results would be obtained by gradually training the men to the use of the machinery under conditions that admit of errors being pointed out, and of any defects being remedied as they occur. In reply to Mr. Allan's remarks on the recent trip of H.M.S. Powerful, Mr. Goschen said he had an intimate knowledge of the captain who conducted the trials of the Terrible and the Powerful, and that distinguished and experienced naval officer was convinced of the propriety of having the water-tube boilers. They would not be able to go back to the cylindrical boilers any more than they would to the muzzle-loading guns. Naval opinion had distinctly come round to the water-tube boilers. He admitted that they required more scientific stoking, and the stokers of the Navy were being instructed in their management. It was a fact that the more the stokers were instructed in their management the more successful these boilers were.

S. S. BRUCE

MESSRS. A. AND J. INGLIS, POINT HOUSE, GLASGOW, ENGINEERS

(*For description see page 256*)



THE "ENGINEER"

SWAIN ENG.

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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.*

REPLIES.

J. A.—17,000 lb. pressure is considerably over 3½ tons per square inch; more nearly 8. A solid forged steel cylinder would have to be used.

J. S.—The vessel you have designed would make a cheap and economical collier, but the arrangements are unsuitable for a ship with more than one deck.

O. R. W.—There is nothing whatever worth noticing in such a performance. A load of 100 tons was little more than such an engine needed to steady it. Sixty miles an hour with 200 tons is a very common performance on our main lines.

VENTILATE (Manchester).—The Bryant saw for metal work, described in THE ENGINEER of July 2nd, 1897, is manufactured by the Q. and C. Company, Western Union-building, Chicago, U.S.A. Messrs. Charles Churchill and Co., of London, are the agents for Great Britain.

SUBSCRIBER.—Address as follows:—Metropolitan Co.: G. H. Whissell, 32, Westbourne-terrace; Metropolitan District: A. Powell, Parliament-mansions, S.W.; L.C. and D.: W. P. Ward, Wandsworth-road, S.W.; N. Staffordshire: W. D. Phillips, Stoke; Taff Vale R.: J. Ellis, Cardiff.

W. B.—No deflection would take place. The use of double plates of any kind has always given indifferent results. The only way in which the best class of projectile can be successfully resisted by plates of moderate thickness consists in providing an outer surface so hard that it breaks the points off the shot.

TOM CAT.—The light is supposed to all on the object from the left side of the board in such a manner that shadows are thrown to the right-hand side and underneath all projecting parts, viz., over the left shoulder of the draughtsman. In the plan view the shade lines should, therefore, fall to the right and upper parts of the drawing, but they are not infrequently placed as if the object had been put on its side to draw the plan view.

"SENEX."—The illustrated descriptive matter of the engines referred to in your letter is from authentic information supplied by the builders of them. Surface condensation was, as you know, no new thing in 1854, but the use of the particular type of condenser fitted in this case had for some few years been in abeyance through the difficulty of obtaining seamless tubes. The firm, however, supplying the engines referred to by you fitted several vessels with similar condensers before and subsequent to 1854.

INQUIRIES.

TAR SPRINKLER.

SIR,—Can any reader oblige me with the name of a firm who supply tar sprinklers? MANAGER.
Morecambe, March 13th.

GRINDING FRENCH CHALK.

SIR,—I shall be obliged for the address of a maker of machinery for grinding French chalk to an impalpable powder. BEMBRIDGE.
March 14th.

CLEARING OUT PONDS.

SIR,—I shall be glad if any reader can refer me to any firm of engineering contractors, or to some firm of civil engineers, who have had special experience of the clearing out of accumulated silt from fresh water streams and ponds. I understand there is some process of doing this by steam power. P. W.
Nottingham, March 11th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, March 24th, at 8 p.m., at the Institution of Civil Engineers, 25, Great George-street, Westminster, S.W. Paper, "Cost of Generation and Distribution of Electrical Energy," by Mr. R. Hammond, Member.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 22nd, at 8 p.m., Ordinary Meeting. Paper to be discussed, "Calcium Carbide and Acetylene," by Mr. Henry Fowler, Assoc. M. Inst. C.E. Paper to be read, "Extraordinary Floods in Southern India: their Causes and Destructive Effects on Railway Works," by Mr. E. W. Stoney, M.E., M. Inst. C.E.—Friday, March 25th, at 8 p.m., Students' Meeting. Paper, "Internal Governor Friction," by Mr. H. O. Eurich, Stud. Inst. C.E.

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, March 25th, at 9 p.m. Discourse on "Canterbury Cathedral," by the Very Rev. the Dean of Canterbury, D.D., F.R.S.—Afternoon Lectures at 3 p.m.: Tuesday, March 22nd, "The Simplest Living Things," by Prof. E. Ray Lankester, M.A., LL.D., F.R.S.; Thursday, March 24th, "Recent Researches in Magnetism and Diamagnetism," by Prof. J. A. Fleming, M.A., D.Sc., F.R.S., M.R.I.; Saturday, March 26th, "Portraits as Historical Documents," by Mr. Lionel Cust, M.A., F.S.A.

SOCIETY OF ARTS.—Monday, March 21st, at 8 p.m. Cantor Lectures. Three Lectures on "The Thermo-Chemistry of the Bessemer Process," by Prof. W. N. Hartley, F.R.S. Lecture II.: The course of chemical change in the "blow"—Thermo-chemical data—Thermo-chemical data in their application to metallurgical operations—Assumed composition of pig iron—Calculations applied to the "acid" and the "basic" processes—Other calculations—Temperature of the metal—The study of the Bessemer flame and its spectrum.—Wednesday, March 23rd, at 8 p.m., Ordinary Meeting. Paper, "The Preparation of Meat Extracts," by Mr. C. R. Valentine.

DEATH.

On the 15th inst., at his residence, Denmark-hill, Sir HENRY BESSEMER, F.R.S., &c. &c., in his 86th year. Funeral at Norwood Cemetery, on Saturday next, at 11.15. No flowers, by request. Friends are asked to accept this, the only intimation.

THE ENGINEER.

MARCH 18, 1898.

THE MINERS' PROVIDENT FUND AND WORKMEN'S COMPENSATION.

THE colliery proprietors and miners of South Wales and Monmouthshire hold a somewhat peculiar position in regard to the Employers' Liability Amendment Act, which comes into force in July next. During seventeen years a Provident Fund has existed in the district for the relief of men injured in the course of their daily work in the pit, and to make provision for their dependents in the case of fatal accidents. It is true that the subscribing members comprise only 75,000 out of the 125,000 workmen, and that when such calamitous explosions as those at Cilfynydd, the Great Western, and Llanerch collieries have occurred, the fund has proved inadequate to the demands made upon it without an appeal to the benevolent public. But as everyone concerned in the mining industry knows, individual casualties and fatalities sum up a far larger annual total than those caused by the wholesale disasters which shock the sensibilities and move the pity of the nation. Thanks, however, to the sound basis on which the permanent fund is established, it has always been able to meet the ordinary claims arising out of the distressing incidents which seem to be inevitable in colliery operations. The fund is maintained from two sources. The miners contribute 3½d. per week, and the employers add 25 per cent., in consideration of the men agreeing to contract themselves out of the Liability Act. The management of the fund, which is mainly in the hands of the miners' elected representatives, is able to point with satisfaction to the fact that it has £200,000 to its credit. The scale of distribution is, in the event of death, £5 for funeral expenses, 5s. per week to the widow, 2s. 6d. a week per child up to the age of 13; or if the victim be an unmarried man, £20 to the next of kin; while in the case of disablement, 6s. per week is paid for the first six weeks, and 8s. per week afterwards so long as the man is incapacitated for work. In this connection it is interesting to learn, on the authority of a member of the Board of Management, that from 30 to 40 per cent. of the South Wales colliers who are injured recover within a fortnight, and the remainder are generally able to resume their employment within a month.

The authorities of the Provident Fund, taking time by the forelock, have been considering the effect of the new Compensation Act upon their organisation, and they have come to the conclusion that, unless the society is remodelled, its beneficent operations must be restricted to the pensioners on its books in July. The £200,000 would be ear-marked for the widows and orphans; but as subscriptions would cease, the capital must be gradually exhausted by the grants made to the present beneficiaries. But is it necessary that a contingency, which would be little short of a catastrophe, should be allowed to arise? The board of management takes a very strong negative view of it, and it has devised a scheme, certainly meritorious in its purpose, with nothing doctrinaire or impracticable about it, so far as we can see, and one which would avert all the disputes and litigation under the Workmen's Compensation Act, if the South Wales colliery proprietors approve the plan. It is proposed that the colliers, at least the members of the Provident Fund, shall continue to contract themselves out of the Act, on condition that the coalowners increase their contribution to 6d. per head per week, the miners' subscription remaining at 3½d. per week as before. It is pointed out that the employers' quota upon this scale would amount to considerably less than the estimate of Sir William Lewis and others that the new Act involves an extra burden of 3d. per ton on the total output. The argument that the increased subvention—*i.e.*, from 25 to 70 per cent.—would fall upon the coal and be borne by the purchaser, seems to us far-fetched, and need not be discussed now. The question at present is rather which is the most advantageous course for masters and men—a joint and mutual arrangement on the lines suggested, or recourse to the Act, which, it is feared, must introduce a disturbing element in every colliery, and flood the Law Courts with claims of compensation for all sorts and conditions of accidents, from a broken leg to such a catastrophe as is sadly too familiar in the mining annals of the fiery coal basin. "Whether 'tis better to bear the ills they know, or fly to others that they wot not of," aptly describes the issue with which coalowners and colliers are just now confronted. The project of the Provident Fund is recommended to the employers by its authors as not only the most amicable, but the most economical method of procedure. For one thing the doctrine of common employment is gone, and their responsibility is enormously increased. Whereas, under the old rule, "the serious or wilful misconduct of a miner," almost invariably exonerated the colliery owner from liability, the new statute only disqualifies the culprit or his relatives from claiming compensation, and leaves the employer the object of attack by all or any of the injured survivors, or the relatives of the dead. One hears from the colliery districts, now and then, that this and that solicitor is surrendering a public position or private business to devote himself to practice under the Compensation Act, and the announcement contains a sinister indication of the abundant crop of suits the lawyers expect to follow the enforcement of the new law. But the managers of the Fund lay most stress on the benefits of their proposal to the coalowners from a financial point of view. It is calculated that each collier sends up 280 tons per annum, on which 1d. per ton would amount to 2⅔d. per week, while the proposed 6d. per head per week would represent 26s. per annum. That sum is compared with the employers' own statement that the Act, if the men did not contract out, would add 3d. per ton to the cost of the whole output, and it is urged that the coalowners would therefore be greatly the gainers by the bargain. Apart from the heavy sums payable under the Act for fatal accidents, which would be ruinous on the occurrence of a disaster of any magnitude, the compensation in the constant and scarcely diminishing series of individual injuries would reach a portentous amount in the aggregate. When the members of the Fund numbered 73,000, there were 15,000 in receipt of weekly payments for disablement during one year, and the Act prescribes that these persons shall be entitled to half their average wages for the previous twelve months, or, say, 12s. 6d. per week, against the 6s. and 8s. the existing society pays now, or the 10s. it proposes to pay if its revised scheme is adopted. A further reason in favour of the 6d. per week basis is placed before the colliery owners. They would be spared the cost and onerous labour of administering the compensatory allowances paid by agreement or by order of the Courts. It is easy to foresee the mischief, the waste, and extravagance, likely to ensue from the delivery of lump sums to a disabled collier or a bereaved family. The Fund is in a position to safeguard the money and profitably dispense it in weekly grants.

The advantages to the colliery population of the proposed scheme are more obvious, and are direct as well as indirect. If they resolve to avail themselves of the Act as it stands, the probable consequence will be, as a thoroughly competent authority has predicted, that the old men who have been permitted to remain in the pits as a favour, and in recognition of long service, will be weeded out, together with a very large class who have lost a limb, or who are deaf, or whose sight is affected, and, as far as possible, preference will be given to young unmarried miners, because if anything happens to them the Act awards only £10 to the next-of-kin, while the relatives of a married man may claim from £150 up to £300. The Act ignores the collier who is injured as the result of his own negligence; if he be a subscriber the Fund relieves him irrespective of the cause of his disablement. The Act directs that compensation is not to be paid for the first fortnight; the Fund grants relief at once. The average cost to the Fund for the widow and orphans of a deceased member has been £227; the average under the Act is approximately set down at £180. It may be taken for granted, without going further into details, that by contracting out of the Act, according to the plan of the Provident Fund, with the employers' contribution raised to 6d. per head, the position of the South Wales collier would be vastly improved. Whether in its re-modelled form and its increased revenue the Provident Society could bear the burden, as is suggested, of an old-age pension fund, is a matter for the actuaries, on which Mr. Neison, the adviser of the management, must needs be consulted; but the idea is favourably regarded by men in the district whose opinions deserve respect.

So far we have confined ourselves to describing the proposals of an association which has rendered inestimable service during its seventeen years of life, and, while we cannot help considering the plan sympathetically, it must not be assumed that we are unconscious of the obstacles which have to be surmounted before it is carried into effect. Little more than half the mining community is at present associated with the Provident Fund. All the colliery proprietors are not yet contributors to its revenue. There are close on 50,000 men outside the society who are under no restraint, or, it might be said, inducement, to avail themselves of the opportunity of contracting out in order to secure the more solid advantages the scheme of the Provident Fund offers them. It does not appear probable that the colliery owners will consent to the increased contribution, and abrogate a right which is indefeasible while they stand united together, until they are assured that the Board of Management of the Fund can speak with more binding force for a greater majority of the whole body of colliers. As the proposal is presented, they would be giving a subvention to members of the society, but they would still run the risk of being shot at under the Act by all the *franc-tireurs* and independent skirmishers whom the South Wales Provident Fund has hitherto been unable to bring into line.

THE STORAGE OF ENERGY.

AMONG the problems which vex the soul of the thoughtful physicist, few are more interesting, none more important, than the question, how is energy stored up? What do the words mean? That energy is stored up there is no dispute. The sudden and awful destruction of the United States battleship Maine brings the fact home to us all in a very unmistakeable way. So common is the practice of storing up energy, indeed, that we forget the extraordinary peculiarities of the process. When we wind up our watches we store energy, and we perform the operation in an automatic fashion, which takes no cognisance of the fact that much the same natural laws are probably involved in the working of our watches as those which attended the effects of the explosion on board the Maine. It is to be noted that nothing can exceed the density of the ignorance prevailing concerning the storage of energy. The mathematician, the chemist, the natural philosopher, have all pushed inquiry to its limits in various other directions; but the storage of energy they have left severely alone. We may ransack a library of physical text-books, and we shall find little more than a bare mention of facts. No serious attempt at useful speculation has been printed; and the world has had to rest content with a few stock phrases which are almost devoid of meaning, to explain phenomena of the utmost importance to mankind.

Let us consider first what is meant by the word Energy. The most usually received definition is that it implies a capacity for performing work. At one time we used to be told that it meant power of exerting a Force; but the word Force is gradually and happily disappearing from the language of precise science, and so we may confine our attention to the modern definition. After all, however, that definition only works round in a circle. A far better definition is, that energy means the power of producing motion. If we think the matter out, we shall soon see that work always means movement of something. There is no work done unless there is motion; at least, none of which man is able to take cognisance. Thus, for example, when the Maine was blown up, it was the motion of gas which did the work of destruction; and that destruction consisted, in turn, in the movement of certain parts of the ship in relation to other parts; as, for example, the blowing up of one of her decks meant the movement with more or less violence of that deck away from the other portions of the hull. It is not easy, we think, to mention any manifestation of energy apart from motion. We insist on this fact for reasons which will be understood in a moment. The idea of work implies motion against a resistance. It, is indeed, impossible to form any conception of work or energy which does not in some way or other mean motion. It has more than once been suggested that the words "conservation of motion" are far more precise than the words "conservation of energy." The objection to their use lies in our ignorance, and the fact that apparently they will not cover all the ground that ought to be covered. But be this as it may, we invariably come back mentally to the same position. Manifestations of energy are manifestations of motion. Bearing this truth in mind, grasping it firmly so that it may not be lost, let us proceed to consider some of the statements made about the storage of energy, which must not be confounded with the conservation of energy, which is quite another matter. That is to say, the storage of energy is a particular case of the general theory covered by the conservation of energy.

Physicists tell us that there are two forms of energy—kinetic or dynamic, and potential. As an example of the former, we have a weight in the act of falling. As an example of the latter, we have a weight at rest, on the top of a wall let us say. The word "potential" is so far unsatisfactory that some physicists have rejected it in favour of "energy of position." But no one has attempted to explain how energy is stored up in the weight on the top of the wall. Let us suppose that we lift a mass of iron weighing 33,000 lb. 16ft. in one minute and retain it there. We have expended energy at the rate of 16-horse power in lifting the mass, and we are told that it represents potential energy equal to 528,000 foot-pounds. Meanwhile, what has become of the energy expended in lifting the weight? How is it stored up? How is the energy conserved? We know that the mass of matter is wholly inert. We know that energy is only a mode of motion. How can a mode of motion, or motion at all, be stored in that which is at rest? The text-books leave us without a glimmer of light on this subject. Either their authors regard the whole subject as an inscrutable mystery which it is useless to tackle, or they fail to understand the nature of the contradiction of terms involved in these propositions. It may not advance matters much, but it does advance them a little to say that the work done in lifting the weight has been done against gravity, and that the energy exerted is stored in gravity, where it remains kinetic, and can be got back again as kinetic energy by letting the weight fall; which is far more reasonable than saying it is stored in the weight.

But this set of phenomena are extremely simple as compared with those presented by explosives. It is commonly assumed that the energy of any explosive is the precise equivalent of the energy expended in the isolation of its separate elements. But this is really pure assumption in part; in part pure deduction from particular known facts in chemistry. There is no absolute certainty, for example, that explosives do not utilise forms of ether energy. It is enough, however, merely to mention such speculations. Let us take it not only for granted, but as proved, that the energy of combination is the precise equivalent of the de-combination which necessarily preceded combination, and ask ourselves what follows. In what is the energy of a charge of powder stored? The Maine is lying quietly at anchor at one moment, the next she is rent and tortured and ransacked by torrents of white hot gas. Where did this energy come from? If all energy is kinetic, how could it have been stored up in motionless cordite or gunpowder? If it is not kinetic—if, in a word, energy is not a mode of motion, how is it to be defined? what is it? As regards explosives, we know that the chemists find salvation by believing that "chemical attraction" explains everything. In point of fact, of course, the words explain nothing. They are lamentably deficient in all that relates to explosion by detonation. We can burn gun-cotton or cordite quietly. If we explode a percussion cap in either the result is entirely different. Is the energy exerted by a pound of gun-cotton burning away quietly the same in amount as that developed by a pound of gun-cotton detonated? Be this as it may, we are driven back to the old problem, where and how are the foot-pounds of work stored away in an explosive?

It may seem at first sight that to look for the answer to such questions is to attempt a vain thing. But it is not so. The reward of the man who could tell the world how and where and why energy is stored in explosives would be very great in a pecuniary sense, and honours would be showered upon him. If the facts were known, a great doubt would be removed from our minds. There are not wanting signs that the advent of new, so-called high explosives is probably accompanied by dangers heretofore unknown. It is very desirable that there should always be a large factor of safety in the magazines of our warships. It will not do to carry ammunition of such a nature that it is an even chance whether it will or will not "go off" of itself. It would, perhaps, be too much to expect absolute immunity from risk; but the chances ought to be not less than a thousand to one against accident. It has been admitted in the United States that certain new high explosives have been tried experimentally, and that they have not been proved to possess the requisite stability. Now, stability is of two kinds—that which is obtained by using materials of maximum purity; all about this is known. But there is another stability about which very little is known, namely, stability against concussion. The phenomena of detonation are but ill understood—if it can be said that any rational comprehension at all of their nature exists. According to one view a detonator causes explosion by driving red hot gas through the mass of gun cotton, and so igniting it all at once. On much the same principle "pebble powder" is perforated with holes, to augment the burning surface. Rockets are rammed on a spindle with the same object. There is reason to believe, however, that a detonator seems to work by violently shaking the gun-cotton, for example, which it is intended should explode. At one time it was held that heat was essential to the setting up of explosive combination; but it has long been recognised that the equivalent of heat is to be found in concussion. One theory is that heat sets up combination simply because it sets up vibration. If, now, it is found that for the higher explosives lacking stability nothing more is wanted than the rapid vibration which concussion may bring about, we have at once a clue to more than one mysterious explosion, and a warning of future peril which it would not be wise to neglect. And so we come back to our previous statement, and repeat that the modern man of science desirous to find a field of exploration cannot do better than endeavour to settle what energy really is, and in what way it is stored up in explosives; or whether it is stored up in them at all, and not in some force of nature which is not yet recognised much less understood. For many years it was held that all the energy of combustion was stored up in the solid fuel, which was so much bottled sunlight ready to be let loose. More sensible views have found their way into the world, and it is just beginning to be recognised that as the kinetic energy of water is very much less than that of oxygen and hydrogen, so the combination of the two gases leaves some kinetic energy to spare; and that inasmuch as the kinetic energy of carbonic anhydride is much less, weight for weight, than that of oxygen, that a large part at least of all the energy got out of the combustion of carbon is derived from the oxygen instead of the coal. In like manner it may be found that the energy of explosives is derived from some up to the present unsuspected source, and that the materials of the explosives are themselves acted upon as well as acting. Energy is no more stored in them than it is in the top brick of the chimney, although energy was expended in putting it there.

BRITISH AND FOREIGN TYPES OF BATTLESHIPS.

THE discussion of our Naval Estimates in the House brought up the question of the type to be adopted and the proportioning of the various features according to the special requirements of the time—requirements necessarily shaped by the character of the warships built by other nations, as well as the development of war material at home. The Cressy class, we are informed, awaits the final conclusion as to some features till the last moment, in order to benefit by the latest information as to foreign construction, as well as to obtain all possible data with regard to our own new guns which are in course of production. Anyone who has followed the development of ships and guns must see the necessity for this. We propose, however, to call attention to a few features in the most important types of warships to illustrate the matter, taking for our text such data as are published and in the reach of all. The Inflexible class, including the Ajax, Agamemnon, Colossus, and Edinburgh, completed in 1886, form the last batch of ships which depended wholly on a few very heavy guns for their artillery power, these guns being gathered in turrets in a central citadel. In the Admiral class was first recognised the importance of a secondary armament of medium guns, and this was placed in a central battery, the heavy gun positions being fore and aft. As quick-fire guns came in, the importance of the medium guns enormously increased up to the present moment, when, as we have often said, most naval captains depend probably more on their heavy quick-fire pieces than on their primary heavy guns. In this matter England has completely taken the lead. No unprejudiced man can fail to see in such vessels as the Russian Sissoi Veliky and Tria Sviatitelia, the Italian Garibaldi class, the United States Kearsarge and Indiana classes, and even in the German Kaiser Friedrich III., the essential plan of the British ships reproduced; while even in detail the later designs of Sir William White have been copied to such an extent in many cases that he may almost be said to be the designer of the principal warships of all nations. France, no doubt, constitutes an exception, yet even she has at last adopted double gun turrets fore and aft, and has placed her quick-fire guns amidships, precisely on the British plan, in her Charlemagne class; and if she still persists in carrying her water-line up to the bows and stern, leaving inviting unarmoured spaces beneath her batteries where common shell may enter freely, we must bear in mind that her national *amour prôpre* may be still more susceptible to injury and of more account to her than her ship's batteries. At all events, in replacing the central heavy gun position in the Admiral Baudin and other ships by a battery of quick-fire guns, France is illustrating the necessity of conforming to the development of new features and increased power in her rivals.

Before leaving the general question of types to pass to particular matters now claiming attention, we would ask our readers to look at the figures of the most characteristic types of war vessels of England and other Powers, as depicted in the plates in "Naval Annual" or the "Austrian Almanac." Let us suppose artillery fire either distributed at chance over such figures, or directed with such discrimination as to strike unarmoured parts in a fair measure with common shell, and armoured now and then with armour-piercing shot. It will be concluded, we think, that our own Magnificent and Royal Sovereign classes will bear almost any conceivable amount of fire without suffering very seriously in fighting power, while such a class as the Charlemagne could hardly escape something like ruin. Some French types might no doubt bear punishment a little better, but some older ships, such as the Magenta class, would be liable to even worse injury; while the very best Russian ships, such as the Sissoi Veliky and Tria Sviatitelia, with belts of great thickness and substantial central structures, have their quick-fire guns mounted on batteries with open interiors, so that a single common shell from a primary gun might work wholesale destruction. Such an examination should strengthen our confidence in our own Admiralty and construction department, and enable us to leave matters in their hands with more comfort, to be shaped according to the latest requirements. At present much depends on these guns above mentioned. We have described the Vickers quick-fire 6in. gun, recently tried and approved. Besides this there are in contemplation 12in. and 9·2in. guns of increased power. Increased power affects the mountings and also involves increased length of gun. It is well worth while sacrificing something for such pieces, however, if they give the results expected of them. Take the 6in. gun. In a hotly-contested action much depends on the silencing of the enemy's principal quick-fire batteries, and these are generally protected by from 3in. of steel upwards; happily in our case generally by 6in. Very few foreign quick-fire batteries have at present anything approaching this. The Charlemagne class has 3in., the Carnot may have 4in., while the Sissoi Veliky and Tria Sviatitelia have 5in.; so that at present our 6in. quick-fire guns ought to be able to use armour-piercing shells and occasionally common shells with effect, while hardly open to attack even by the enemy's quick-firing shot. As time goes on no doubt the shields will thicken, and 6in. or even more may be met with. It is thus specially important to master such shields to the greatest possible extent. When thin, to be able to use common shell with large bursting charges; when thicker, to use if possible armour-piercing shell, and failing these, shot, which are very inferior, entering as dead metal. Increase of power in our 6in. guns is therefore of great importance, and should be secured if possible; and the same reasoning applies to the other guns in their own spheres of action. How far we can do this, and how far other considerations claim priority, depends much on the features of foreign ships; it is therefore important to leave certain questions open until the latest possible date, and we hope that our readers feel with us that we are justified in doing so with confidence.

ARMOUR FOR THE NAVY.

MUCH satisfaction has been expressed in Sheffield at the discouragement given by Mr. Goschen to the proposal for establishing Government armour works. While it is certainly a fact that the supply of plates for her Majesty's Navy has not been equal to the requirements of the Admiralty, it is only fair to remember the cause. There are, in fact, two causes, one being part of the evil wrought by the engineers' strike. The managers of local works exhibited remarkable energy in meeting the extraordinary difficulties which were placed in their way when the engineers went out, and it is entirely to their credit that they were able to continue working in any of the skilled departments while that trouble was on. It ought to be remembered that the labourers usually attendant upon the planing, slotting, and other machines had to be placed upon skilled craftmanship under the superintendence of the managers, who practically worked night and day to meet the emergency. A remarkable amount was done even under such abnormal difficulties, but the strike taking place at a time when the requirements of the Admiralty were exceptionally pressing, it was impossible for the best organised establishment to do everything that was required. It is held in Sheffield, however, that this is no argument whatever for establishing rival Government armour plate works, as the three large armour-producing establishments are quite prepared, as they have been in the past, to expend any amount of capital in providing additional plant and machinery if they are assured of abundant work to keep it employed. There have been long seasons in the history of the armour plate trade when the mills have stood practically idle for months at a time. The loss upon capital during that time has been keenly felt, and, although for many months now the demands of the Admiralty, owing to the revived interest of successive Governments, and of aroused public opinion in the Navy and the country, have been adequate to keep the plant fully employed, it is only fair to remember that this activity is but of recent date, and came in consequence of the threatened coalition of continental Powers against this country. Mr. Goschen, it is held, does wisely in preferring to rely upon private enterprise, which will not be found lacking if the Government exhibit any continuity of the policy in keeping up the strength of the fleet, and giving out orders accordingly. This question was brought before the annual dinner of the Press Club, Sheffield, on Saturday night, when the Marquis of Lorne was the principal guest, and he too shared in the general view that the enterprise of private manufacturers, if properly encouraged and utilised, would be found sufficient for the needs of the nation. Lord Charles Beresford is very popular in the city, and his pronouncement in favour of Government-assisted armour mills was accepted as part of his characteristic *rôle* of a judicious alarmist, who raises his voice in order to keep the Ministry in power up to what he regards as the rightful and patriotic standard of maintaining the nation's strength. Nor should the second cause of inadequate delivery be left out of the reckoning. Armour is in a continual state of evolution. Iron gave place to iron and steel—the compound plate—then came steel treated by the Harvey process, and now it is the Krupp plate. The changes in plant and other re-arrangements on this account have been very great, involving heavy expense and immense trouble; but they are now being steadily overcome, and the Sheffield firms will soon be in a position to meet the utmost demands that can be made upon their resources, and there will be no hesitation in spending money to any extent to supply the Admiralty with all they want.

LITERATURE.

Railway and Track Work. By E. E. RUSSELL TRATMAN, Am. Soc. E.E. New York: The *Engineering News* Publishing Company. 1897.

IN his introduction Mr. Tratman tells us that the railway system of the United States now aggregates about 181,000 miles of railway, with 237,000 miles of track; of this 180,000 miles are single. The traffic over the system amounts to about 800,000 train miles a year—which is a mistake, for it really amounts to about 767,000,000 of train miles—and about 1 per cent. of the entire population finds employment in working it. "It will be seen at once that the maintenance of 237,000 miles of track to keep the railways in normal condition for traffic is a stupendous work, and one which affords great opportunities for the exercise of good judgment and executive ability in combining efficiency and economy in the conduct of the work." We may push this argument a little further, and add that the railroad track of the United States affords excellent opportunities for technical literature, and that Mr. Tratman has taken full advantage of these and produced a very interesting book.

It is not very easy for the reviewer to settle on the best way of dealing with a volume of this kind. There is nothing in the world of literature with which to compare it. We cannot say it is better than this treatise, worse than that. We can only form an idea of its merits by considering what such a book ought to be, and comparing the volume before us with this ideal standard. Unfortunately, working in this way, it is easy on the one hand to over-estimate the worth of the book, or, on the other, to depreciate it too much. However, proceeding as best we can, we ask ourselves how it has come to pass that in all these years no book of this kind has ever before been written? The answer seems to be that it was not wanted; and the more carefully we study the pages of Mr. Tratman's work the more we doubt its utility. Our author has produced an exceedingly practical book. Its literary merits are considerable. The style is terse, lucid, and yet ample. It is a text-book of the whole subject. Who, we ask, is to be taught by it? The rising generation of railway engineers, we presume; but will they be content to take their knowledge from text-books? Mr. Tratman tells us in his preface that "Inquiries are being continually made for a modern comprehensive book on 'Track Work,' and it appears that there is a large field open for the introduction of a work of this character, and it is to meet this demand that the present book has been prepared." We are disposed to think that its principal value will be found to lie not in its educational utility, but in the information that it will supply to various railway engineers as to what other railway engineers are doing. In this country distances are so small; our whole railway mileage is, comparatively speaking, so insignificant, and methods of track construction are so uniform, that every railway engineer from the Land's End to John o'Groat's House knows what every other engineer is doing, has done, and is going to do. But in an enormous country like the United States the case is very different, and a book such as this may serve an excellent purpose there, while it would be of small utility at this side of the Atlantic. Judging the merits of the book from this standpoint, we can have nothing for it but praise. The author has been throughout minute, thorough, and comprehensive. We have failed, however, to discover much that is applicable to u r practice. But the book will be found none the less interesting by English readers.

The contents are divided into twenty-five chapters, the first of which is introductory. Then comes "Road Bed Cross Sections;" "Ballast, Ties, and Tie Plates;" "Rails, Rail Fastenings, and Rail Joints;" "Switches, Frogs, and Switch Stands;" "Fences and Cattle Guards;" "Bridge Floors and Grade Crossings;" "Track Signs;" "Tanks and other Track Accessories;" "Side Tracks and Yards;" "Track Tools and Supplies;" "Organisation of the Maintenance of Way Department;" "Track Laying and Ballasting;" "Drainage and Ditching;" "Track Work for Maintenance;" "Gauge Grades and Curves;" "Track Inspection and the Premium System;" "Switch Work;" "Bridge Work and Telegraph Work;" "General Improvements;" "Handling and Clearing Snow;" "Wrecking Trains and Operations;" and finally, "Records and Reports." It will be seen from this list that Mr. Tratman has covered the whole ground, and he seems to have said pretty well all that is worth saying about each subject.

We naturally turn to such a book as this to test the trustworthiness of the multitudinous statements that are made in this country in favour of American permanent way. For some reason which we fail to understand there has broken out in Great Britain within the last few years a violent onslaught on British railway methods and an exaltation of those of the United States. Among other things we have been assured that we are all wrong in the matter of chairs, sleepers, ballast, and rails. So much has United States practice been praised, that we have felt much the same curiosity as the little girl, who, after a course of inscriptions on gravestones, asked her mother "where the wicked people were buried?" Out of 237,000 miles of track there must surely be some not superlatively excellent. We learn from Mr. Tratman that this is indeed the case, and that the good track is quite the exception. "On many main lines there is, it is true, a very excellent and substantial track construction second to none in this or any other country; but the aggregate length of such track is but a small proportion of the total mileage of railway track carrying heavy traffic." Our author gives ample details as to the number of sleepers—or as they are called in the United States "ties"—on principal lines. The main difference between them and those used in this country is that the American sleeper is a little thicker. He tells us that the deflection of a rail under a load varies as the cube of the tie spacing. So that if we take 1 as the deflection for sleepers 24in. apart centre to centre; then for 30in. and 36in. centre to centre the deflection will be 1·9 and 3·4 respectively. It is to be regretted as misleading that he gives the price of all ties delivered in New York. It will be remembered that we stated recently that the cost of sleepers is very much less in the United States than in this country, not greatly exceeding, indeed, a shilling each over wide areas of country. To this Mr. Tratman took exception in a letter which we published. Here, however, are his own figures:—"The cost of material in a short-leaf pine tie is about 3 cents; cutting, $12\frac{1}{2}$ cents; hauling to a landing, $1\frac{1}{2}$ to 3 cents; transportation to port, 3 to 5 cents; total cost at port, 20 to $23\frac{1}{2}$ cents;" or, as we have said, less than a shilling. After that comes the cost of carriage from the port to the locality where it is wanted. But even at New York the sleeper only costs 38 cents, or 1s. 7d. It is obvious that over large tracts of country, where forest land still remains, sleepers can be had for a very small price. As we read the fourth chapter we rub our eyes and ask ourselves is it possible that a system of permanent way, which we have been told is so excellent, so superior to anything met with in this country, can really deserve what Mr. Tratman says of it. The passage is too long to quote, but we may refer our readers to page 35. But what will those of our readers who hold that our chair roads are all wrong, say to the following passage on page 41:—

As already noticed, there is usually considerable trouble from the cutting of the ties by the rails, due to local rot under the rail, and the wear and tear and disintegration of the softened wood by the motion of the rail. This is especially the case with soft ties. The cutting also decreases the hold of the spikes by letting the rail drop loose below the spike head, and, by causing rot around the spike holes, allowing the rail to get out of gauge, and to tilt on curves. The direct pressure of the rail on the tie has no effect beyond a very slight compression of the wood; but the cutting and wearing are due to the slight motion of the rails, which grinds and abrades the fibres, and greatly facilitates local rot and softening, which in turn hastens the cutting effect.

Now in this country we found out all this long ago, and abandoned the flat-footed rail for the chair-held rail, and in the United States they are now drifting in the same direction, because they have found it necessary to interpose a "tie plate" of steel between the rail and the sleeper. These tie plates are made with teeth to take into the sleeper, and ribs to take the flange of the rail. They have been in use, we are told, but a short time, and yet they have become so popular that many patents have been taken out for different forms, and very little further development is needed to produce a veritable chair.

Not the least interesting portion of the book is Chapter XV., on "Track Laying and Ballasting." This is a very complete account of the methods adopted in the actual formation of a permanent way, and from it a curious picture may be drawn of the work and life of those engaged in a country whose characteristics are very different from those of Great Britain. In the United States the engineer has to deal with lines far removed from the centres of civilisation. Indeed, the road is usually in advance of it by months, if not years. Concerning track laying by machinery, of which absolutely nothing is practically known in this country, Mr. Tratman writes:—

While track-laying machines have been very extensively used on large railway contracts, mainly in the Western States, comparatively little is known by engineers generally of their operation. The common system of track laying is to have the ties hauled on to the grade by teams, and the rails run forward on small hand-cars. For long stretches of work, however, and on difficult country—rugged or swampy—especially where teams cannot be used to distribute the ties ahead in the usual way, machine track laying is very extensively employed, and permits great rapidity with a saving in cost over the ordinary method.

Our author then goes on to describe the system, which is very well worth consideration by English engineers, above all by those engaged in colonial work.

Lack of space prevents us from saying much more. We believe that most, if not all, railway engineers and locomotive superintendents in this country will read Mr. Tratman's book. They will find in it much that is worth thinking about quietly, some things to be avoided, but a few that might in this country be done with advantage. But we rise from its perusal, certified, so to speak, that for every climate, every country, there are methods of thought, ways of doing business, systems of working, which are the result of more or less occult influences, preventing uniformity; and those who argue that what suits one country, or kingdom, or nation, must suit all others, are wrong. It is not to be disputed that mechanical truths are equally true all over the world. But somehow mankind does not always utilise these truths in the same way; and, as a rule, the engineer does not make mistakes. The outcome of which homily is, that it does not follow because the permanent ways of Great Britain and of the United States are unlike, that those responsible for their construction are either or both wrong. At its best, the railway track of the United States is quite as good as the best English track. Of what either is at its worst we do not care to write.

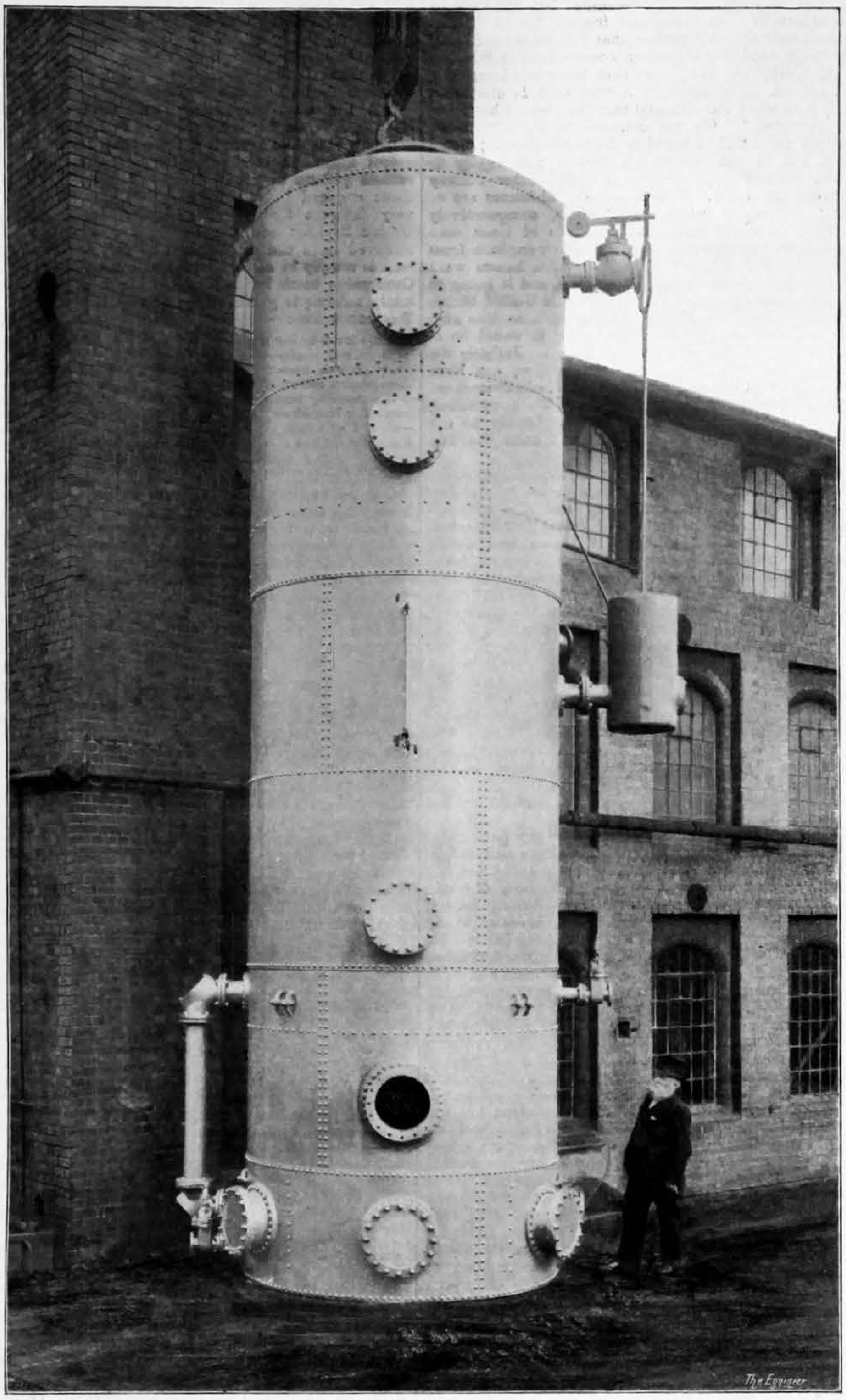
THE INSTITUTION OF JUNIOR ENGINEERS.—A highly successful conversazione of this society was held on Saturday last at the Westminster Palace Hotel. In addition to the usual musical entertainment there was a nice collection of exhibits of engineering and scientific interest, including a working sectional model of a Thornycroft water-tube boiler; Mr. Morly Fletcher's motor for utilising the force of waves; sectional full-size models and diagrams of the Westinghouse quick-acting brake: and Maxim guns. There were also "lecturettes" by Mr. Hiram S. Maxim on the evolution of the design and working of his most modern automatic machine gun, illustrated by the aid of lantern slides, and Mr. John A. Prestwich, who is a member of the Institution, provided an excellent series of cinematograph pictures. The members and friends were received by the President, Mr. John A. F. Aspinall, M. Inst. C.E., Mrs. Aspinall, Mr. H. B. Vorley, the chairman, and Mrs. M. Vorley.

TRADE AND BUSINESS ANNOUNCEMENTS.—Messrs. Lockwood and Carlisle, Eagle Foundry, Sheffield, have, for family reasons, registered themselves as a limited company, under the Companies Acts, 1862—93, by the title of Lockwood and Carlisle, Limited. The capital of the company will be all subscribed by the partners, and no shares will be offered to the public.—The directors of Messrs. Crompton and Co., Limited, have to inform the shareholders that, in consequence of certain differences of opinion between themselves and Mr. J. F. Albright as to the management of the company's business, Mr. Albright is relinquishing his position as a managing director, and has also informed the Board that as soon as may be convenient to the company he is desirous of resigning his position as a director. The directors regret that this course should have become necessary. To provide for the future management of the company the directors have appointed Mr. F. R. Reeves, the company's secretary, to the post of general manager; Mr. R. E. Crompton continuing to superintend the technical part of the company's business.

DEATH OF AN OLD RAILWAY ENGINEER.—The death is announced at Aberdeen of Mr. William Cowan, who was for many years the locomotive superintendent of the Great North of Scotland Railway Company. Mr. Cowan was born in Edinburgh in 1823, and was educated at the High School there. He began his railway career in 1839 in the locomotive department of the Arbroath and Forfar Railway, and afterwards held posts in the Edinburgh and Glasgow Railway, the Great Northern, and other railway companies, and, last of all, in the Great North of Scotland Railway at Aberdeen. Mr. Cowan entered the service of the Great North Company in 1854, and three years later he was promoted to the charge of the locomotive department, and in that important position he remained till October, 1883, when he severed his connection with the company. The first locomotive superintendent of the Great North of Scotland Railway was Mr. Daniel Kinnear Clark, who afterwards became a well-known consulting engineer in London. Mr. Clark was succeeded by Mr. John F. Ruthven, who held the post for only a couple of years, and in May, 1857, the then vacant locomotive superintendentship fell to Mr. Cowan. Up to that time Mr. Cowan had been acting as an engine driver, but his education and practical training in the engineering work of a railway stood him in good stead in his new and responsible sphere, and his *régime* at the Kittybrewster Works was attended with conspicuous success. He was a general favourite with the men employed under him, and, on his retirement, was presented with a handsome testimonial from the staff. Mr. Cowan kept himself well abreast of the developments of engineering science, and many of the early improvements on the plant of the Great North Railway were due to his undoubted enterprise and skill as an engineer. Mr. Cowan is said to have been the first to introduce modern bogie engines in this country.

FEED-WATER HEATER

MESSRS. JOSEPH WRIGHT AND CO., TIPTON, ENGINEERS



THE EXCELSIOR FEED-WATER HEATER.

MOST steam users are now keenly alive to the great importance of obtaining pure boiling feed-water for their boilers, but in many cases the water is of such a character that it requires to be softened and filtered as well. The grease contained in condensed steam water often prevents it from being used for feed-water, when if it could be extracted the water would prove valuable.

Messrs. Joseph Wright and Co., Tipton, have made a very careful study of this question for some time past, with frequent experiments, and have introduced into their own works, and several others, a system by which all that is necessary is done at a very moderate cost in a single apparatus, namely, their "Excelsior" patent heater, softener, filter, and grease separator. We illustrate above a gigantic separator, which has lately been supplied by this firm to the Iron and Steelworks of the Frodingham Company, near Doncaster. This heater will take the exhaust steam from a new rolling mill engine, having three cylinders, 45in. by 52in. stroke, and will deal with the feed-water for eighteen Lancashire boilers, 30ft. by 8ft. 6in., having a total evaporative capacity of 10,000 gallons per hour.

This remarkable heater, which is 29ft. high by 8ft. diameter, with 28in. steam inlet and outlet, is perhaps best described as follows:—Its height is divided into three separate chambers, the upper one being by far the larger. The central chamber is the one which first receives the steam, and in which all the thick grease in the steam is extracted. The upper chamber is occupied in its lower portion by the feed water in process of being heated, and its upper part contains an ingenious series of devices for mingling the water and steam. Large vertical pipes are attached to the floor of this water chamber, and conduct the steam from the inlet chamber through the water lying in the upper chamber to the devices referred to. Here the steam is so directed on emerging from the pipes as to be compelled to pass through showers of falling water, and such steam as remains uncondensed passes out at the top outlet. The feed-water enters the top of the heater by the pipe shown, and its quantity is controlled by a float valve, which delivers the water exactly in accordance with the requirements. The effect of the commingling of the steam and water, and also of the steam passing through the tubes surrounded by water, is to raise the temperature of the water to boiling point.

From the lower part of the upper or water chamber the heated water passes by a pipe provided for the purpose to the lowest of the three chambers. Here it is compelled under pressure to pass through an enormous mass of filtering material—specially suited to the purpose—and is finally delivered from the lower outlet of the heater, softened, filtered, absolutely free from grease, perfectly clean and hot, and ready for use in the boilers, to which it is delivered by the usual boiler feed pumps at 200 deg. to 208 deg.

By means of very large manholes easy access is obtained to every compartment for cleaning out and changing the filtering material; in fact, everything that the large and varied experience of the makers can suggest has been introduced into this unique apparatus, in order to ensure its giving the most satisfactory results. As regards the saving, it is reasonably anticipated that the saving in coal, water, and boiler repairs, effected by the heater in our illustration, will be so large that the heater will pay for itself in two years' time or less.

DOCKYARD NOTES.

LAST week we made some reference to the Alexandra, now alongside the jetty at Portsmouth Dockyard for her re-fit. Since then we have renewed our acquaintance with the Duke of Edinburgh's old flagship, and, despite all that has been said in criticism, cannot lose our original opinion that the Admiralty have acted very wisely in the amount of re-armament that they have given her. For the benefit of those who are not *au fait* with battleship armaments, it may be stated here that the original armament of the ship was four 25-ton and eight 18-ton rifled muzzle-loading guns, protected by 12in. of iron armour. This armour covers a great deal of the ship, and includes a complete belt; there is also a 2in. steel protective deck. The gun decks are two, four guns on the upper deck training nearly ahead or astern, or on the broadside, through an arc of about 75 deg. On the main deck each side another gun has a 75 deg. arc forward or on the beam, and on either broadside are three guns with an arc of perhaps 30 deg. before and abaft the beam. This is a very restricted arc of fire. On this deck all the old guns have been left; but in the upper deck battery four 19-ton breech-loaders replace the old 25-tonners. They are better guns, having 10,900 tons muzzle energy, against 7015; and their muzzle perforation is, theoretically, just double. On the other hand, their common shell is but 380 lb. in weight, against the 541 lb. of the old muzzle-loader. The 18-ton muzzle-loaders fire a shell of a trifle over 400 lb.; had breech-loaders been substituted, the shell would have been only a little more than half that weight. The newer guns—they, too, are old now—have, it is true, a better trajectory and range, but the advantage is not great that way. As common shell is the staple ammunition of even our most modern ships, and is certainly the projectile that the Alexandra would most need in war time, those with heavy bursting charges have obvious advantages. The newest 8in. guns would certainly have much greater penetration, but as implied above, any action in which we should be likely to employ the Alexandra would not probably be won by penetration. Against cruisers and lightly-armoured ships such as she would meet, solid shot—which alone have much penetration value—would not do much harm. Bad as the old muzzle-loading guns may be, the breech-loading guns of the same date in foreign ships are no better; the breech action in itself confers no particular value. True, the gunners of a muzzle-loader would be more exposed to a hail of small projectiles, but few captains now-a-days contemplate using the tertiary armament against ships. The cost in life would be too great; such guns would be silenced almost immediately by a single big shell. It should also be borne in mind that the supply of modern guns is limited, that we barely keep pace with our requirements for new ships as it is, and that a new ship is better far than an old one, no matter how rejuvenated. When the Alexandra was *transformé*—as the French phrase it—six 4in. guns were supplied to her, mounted on the top sides. These are now to be replaced by 4·7 quick-firers. The Alexandra is a singularly roomy ship, nearly twice as high 'tween decks as a modern vessel. Despite her bluff bow, she is, and always has been, a fast ship, making a continual sea speed of 12 knots very easily, and good for more if pushed. The Majestic can do about 15 knots, or keep station at about 14 knots, so the Alexandra is not very far behindhand in speed, even when compared to a modern ship.

THE old battleships Iron Duke and Invincible were to have been fitted with fighting tops, but the Admiralty have decided that they are not worth the expense, so the order has been cancelled. In the two modern naval actions—Angamos and the Yalu—the fighting top has had its share. At Angamos it is claimed that the Blanco Encalada and Almirante Cochrane cleared the Huascar's decks with Gatlings in their tops, but gun fire in that action was slow. At Yalu every man in fighting tops seems to have been killed or wounded by ricochets. Hundreds of projectiles must miss, and whether they go high or low the military top runs a high risk of being hit. It is questionable whether they have any value at all: certain that their value is not great. Consequently the Admiralty have probably shown considerable wisdom in the matter of the Iron Duke and her sister.

THE Medea is having her 6in. guns taken out for conversion into quick-firers. These converted guns always have the latest breech action fitted to them, and are a good deal more than the "quick-firers in name only" that some folks call them; but it is only their rate of fire that is improved. The old 6in. breech-loader is a short gun with a high trajectory; between it and a new 6in. gun, like the Vickers gun, for instance, there is no comparison possible. Since, however, guns cannot be manufactured in a day or two, the best is being made of a bad bargain. After all, a very large proportion of foreign quick-firers are merely converted guns.

WHILE on the subject of quick-firers, we may mention that the Japanese have replaced the old 6in. guns of the Chin Yen—ex Chen Yuen—by quick-firers. They have also mounted a couple of 4·7in. quick-firers abaft the funnels, an improvement in the ship's fighting capabilities. Recently they substituted six 6in. quick-firers for the 4·7in. of the Trafalgar; but the matter excited little if any comment, although it certainly doubled the value of the secondary armament of this ship.

FROM time to time one reads in the papers that the Formidable is to be laid down at Portsmouth. As a matter of fact a good deal of her is already in existence, and she grows rapidly. She is building on a slip, as the Prince George was, and not in a dock as is so frequently done now-a-days.

THE Terrible is in dry dock, at Portsmouth preparing for commission. It is necessary to see this ship in dock to get the full idea of her enormous size; it is something of an "eye-opener" even to those who are fairly well acquainted with her on the water. Close alongside the old Inflexible is in dock, and the contrast between the two is remarkable. It is heightened by the fact that several destroyers lie astern of the Inflexible: the cruiser occupies as much space as the battleship and three destroyers. It is reported that the

BOILER EXPLOSION, DEVONPORT DOCKYARD

Terrible is to undergo very exhaustive steam trials for a considerable while. There is a general idea that she is somewhat of a white elephant; but at the same no one believes very much in the sensational rumours about the Powerful.

MR. GOSCHEN is to be congratulated upon his attitude about the discharged dockyardsmen; their action was tantamount to rank mutiny, and for him to reinstate them after the demands that have been made would be absolutely detrimental to every form of discipline.

THE Barham is being fitted with topmasts instead of the pole masts that she originally carried. When complete she will resemble the Mercury in rig, but her funnels being differently placed, all resemblance ends, of course, with the masts. The bow and stern guns, which were formerly carried close to the sides, are now nearer the centre line, and the sponsons have been done away with.

AN accident by which one man lost his life and two others were injured happened at the Formidable's slip in Portsmouth Dockyard on Tuesday. A number of old wooden derricks, 60ft. high or more, surround this slip, and men were engaged in cutting the guys preparatory to removing them. Directly the guys of one were severed it fell, killing the man who cut these supporting ropes. It then transpired that the derrick was not sunk in the ground at all, but merely stood on a post.

BOILER EXPLOSION.

THE official report—No. 1052—of a serious boiler explosion which occurred at Devonport dockyard, on September 23rd, is before us. The annexed cuts, reproduced from the report, will give a notion of the enormous force of the explosion. By it two men lost their lives, and two others were severely injured. The boiler was of the ordinary vertical type, with a central uptake and two cross tubes in the fire-box, and was made throughout of iron. The shell was 7ft. 6in. high, and 4ft. in diameter, and was composed of two rings of plates, with one plate ⅜in. thick in each ring. Its crown, which was made of one plate ⅜in. thick, was dished upwards about 6in., and flanged downwards at its outer edge for attachment to the cylindrical part. The fire-box was 4ft. 6in. high, and 3ft. 4in. in diameter. The cylindrical part was made of two plates, each ⅜in. thick, which were flanged outwards at the bottom to meet the shell. Its crown, which was slightly dished, was composed of one plate ⅜in. thick, and was flanged downwards at its outward edge, and riveted to the cylindrical part. The uptake, a welded tube, 10½in. in diameter, and ⅜in. thick, was flanged at its bottom and riveted to the crown of the fire-box, and was attached to the crown of the shell by an iron angle ring. The two cross tubes, which were each 7½in. in diameter, and $\frac{5}{16}$in. thick, were welded, flanged at their ends, and riveted to the sides of the fire-box. The boiler was lap-jointed and single riveted throughout with rivets ¾in. in diameter, spaced 2in. apart. A manhole, 15in. by 10in., fitted with a compensating ring, was cut in the upper part of the shell; there were also two hand-holes opposite the cross tubes, and three mud-holes. The boiler was fitted with a safety valve loaded by a lever and Salter's spring balance, a feed injector, a blow-off cock, a glass water gauge, and a steam gauge.

The boiler was occasionally used at a pressure of 80 lb. per square inch, but on the occasion of the explosion was supposed to be working at only 50 lb. It was, however, shown at the inquest that the safety valve had been tampered with, so that the pressure greatly exceeded this limit. It was a spring safety valve, and orders had been given shortly before the accident that it should be fitted with a ferrule, but this precaution had not been taken. The boiler was cracked and broken in a very remarkable manner, as the cuts show, and parts of it were projected to great distances.

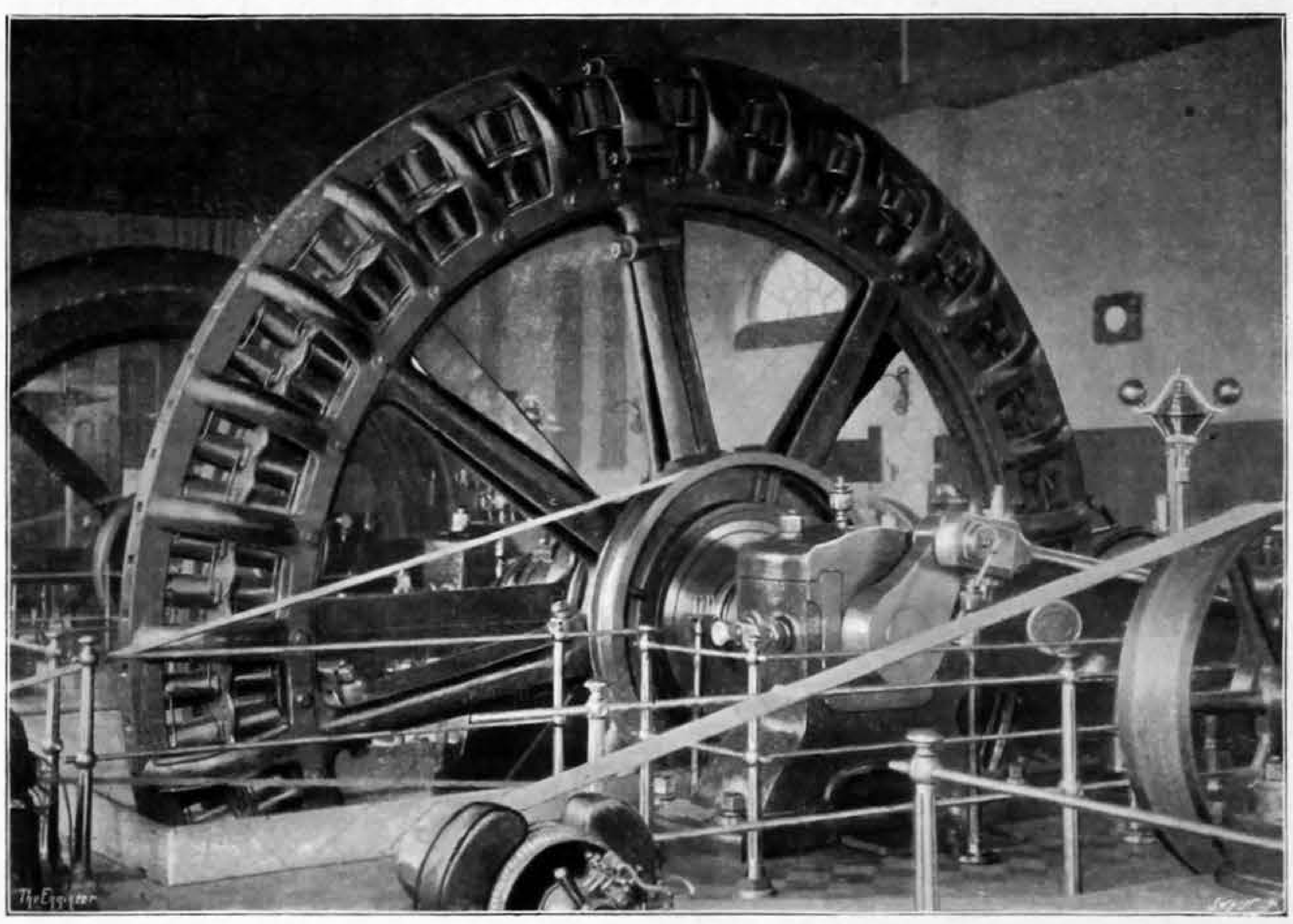
ELECTRIC LIGHTS IN HUNAN.—The North China *Daily News* says Hunan has got so far forward in her adoption of western civilisation that her provincial capital of Ch'angsha can now boast of an electric light company. Incandescent lights are used all over the offices of the company and the residences of the directors and higher officers, while, in addition to a large 2000-candle power light—called by the natives "a moon"—at the gates of the governor's yamên, the greater portion of the yamên itself is also lighted now with incandescent lamps. The company is also prepared to light up any house or shop in Ch'angsha, and a notification to that effect has been published, giving prices per lamp per night as follows:—No. 1 grade electric lamp, 500 cash (about 1s. 3d.); No. 2 grade, 32 cash; No. 3 grade, 30 cash; No. 4 grade, 28 cash; No. 5 grade, 25 cash. That is to say, there will be five descriptions of lamps, and the above charges are made for lamps that are lighted from sundown to the second watch of the night—about 10 o'clock. Lamps used all night are to be charged double the above prices. The U.S. Consul at Hankow states that the electric plant has proved such a success that the large halls for the examinations of the students for the M.A. degree, lately held there, were lighted by electricity, something undreamed of in this—the central—province, and in excess of any other province of the empire. In Hankow a native company has been organised to light the city with electricity, and it will only be a short time before it will be under way, as most of the capital has been subscribed. Several of the tea hongs in the English concession are now lighted with electricity—a great improvement on kerosene lamps.

M. PATIN'S NEW FLY-WHEEL DYNAMO.

WE illustrate this week a somewhat novel type of dynamo in use at the fine central station recently established at Puteaux, Paris, by the firm of Patin and Co. It is not generally known that Monsieur Patin has been one of the first, if not actually the first, to set up electric-light stations on the alternating system in France.

Although, as will be noticed from our illustrations and diagrams, the dynamo machines employed are themselves of a sufficiently novel type, it was, nevertheless, not actually the invention and design of a new type of electric generator that formed the central object in M. Patin's studies. The remarkably high efficiency of slow-rotating engines of the Corliss type, as contrasted with the increased expenditure of the high-speed engines usually employed in connection with dynamo machines, attracted, M. Patin states, his attention some time back, and a dynamo—whose magnetic field forms, as will be seen from the accompanying illustrations, an integral part of the engine itself, thus performing its appointed work at the low speed of 60—120 revolutions a minute, has been the result of this gentleman's twenty years' experience.

The system employed in all of M. Patin's stations—viz., the motive force and general output required from the dynamo on the necessary speed of rotation, &c. The inner and outer rings of magnets are bolted together by a number of radial arms proceeding from the central axle E, Fig. 2. Fig. 4 shows the construction of the armature coils in detail. A is the side view; *b* shows the coils in position, as they appear when clamped on to the steel ring supporting the armature T. It will be seen that these are Ferranti copper tape coils, and lie all round the fly-wheel in the narrow spaces at the ends of the bobbins. We have already stated that a lateral movement along the main shaft of the engine permits the whole ring of coils to be displaced bodily out of the magnetic field. Each coil is independently fastened to the rim of the armature, thus making its renewal, repair, &c., in case of accident, easy. The centre of each coil N is of bronze, and the winding is composed of a band of thin sheet copper, the various layers being isolated by a strip of material resembling asbestos. The whole is covered with a thick coating of lacquer. The armature itself is supported by a massive pillar of cast iron, through the centre of which passes the crank shaft. The revolving electro-magnets, as has been already stated, are firmly bolted to the shaft, and a second series of bolts prevent the rotation or shifting of the armature in the magnetic field. The exciting current for M. Patin's dynamo is produced either by a small auxiliary



PATIN FLY-WHEEL DYNAMO

generation of high tension alternating currents, and their subsequent reduction, per transformer, to the 200-volt maximum—has been everywhere recognised as being the most economical, when long cables are used, and needs no eulogy here. We will proceed at once to a detailed description of the dynamos themselves.

The engines employed at the Puteaux Station are of the improved high-speed Corliss type, from the workshops of M. Boyer, at Lille, acting without slide valves or dashpots, and furnished with an ingenious device for regulating the admission of steam from 0 to 75 per cent. at will. Want of space forbids us to attempt a more detailed account of the various devices employed to assure regularity and economy in working, &c. The fly-wheel alone claims our attention, forming, as it does, an integral part of the dynamo itself. The three essential parts of M. Patin's dynamo may be stated in order:—(1) The fly-wheel, which carries the field magnets of the dynamo. (2) The armature, fixed but capable of being slid out of the magnetic field by a lateral movement, thus permitting the coils to be re-varnished or renewed whenever necessary. (3) An exciter, in certain cases.

The revolving magnetic field—Fig. 1—is formed of two pieces, an inner and outer rim of magnetic poles, between which the armature remains motionless. A detailed diagram of one of these poles is seen in Fig. 3. The cylinder of soft iron *b* is cast into the circumference of the fly-wheel *d*. The number of these poles is variable, depending on the electro-

dynamo or by a shunt circuit taken from the main leads. These are the principal details of M. Patin's dynamos. They are constructed in sizes varying from 50-horse power to 600-horse power.

We will now give a few figures concerning the output, efficiency, &c., of two dynamos of this kind. They are the result of a series of experiments conducted in two of the leading central stations fitted with M. Patin's generators. The first dynamo was coupled direct to a turbine of the Faesch and Piccard make, the second to a steam engine from the workshops of Boyer in Lille:—

	No. 1.	No. 2.
Power produced in watts	40,000	120,000
Voltage	2400	2400
Resistance of armature	4·5 ohms	0·96 ohms
Number of coils on magnets	24	104
Resistance of magnets	4·8 ohms	2·5 ohms
Number of coils on armature	24	104
Revolutions per minute	300	95
Efficiency	94 per cent.	96 per cent.
Power used for exciting	1200 watts	2400 watts

The expenditure of energy required for the exciters has been, of course, taken into account in the calculation of total efficiency. The dynamo at present working in the Boyer workshops is of a far higher output in horse-power than the engine employed to drive it; so that the efficiency may be almost taken to be really higher than the above-mentioned figures indicate. The absorption of power per number of

THE PATIN FLY-WHEEL DYNAMO

M. PATIN ET CIE., PARIS, ENGINEERS

Fig. 1

THE "ENGINEER"   SWAIN ENG.

lamps is as follows:—280 lamps of 16-candle power absorb 30·3-horse power; 380 lamps of 16-candle power absorb 38·6-horse power —*i.e.*, 12 lamps of 16-candle power per horse-power.

CENTRAL STATION ELECTRIC POWER SUPPLY.

THE MIDLAND SCHEME.

A PAPER on this subject was read before the South Staffordshire Institute of Iron and Steel Works Managers, on Saturday, March 5th, at Dudley, by Mr. L. Addenbrooke, M.I.E.E., of London and Wolverhampton, engineer to the Midland Electric Corporation for Power Distribution, Limited, which is about to apply to the Board of Trade for authority to supply electric power for a group of South Staffordshire industries within a radius of about six miles from Tipton, at which place the central station would be established. The iron and steel masters and manufacturers are most of them favourable to the scheme, and a meeting convened at Birmingham by the Midland Iron Trade Association has provisionally approved it, but a good deal of opposition has been forthcoming from several of the eighteen local authorities whose districts it would affect. The chair was occupied on Saturday by the President of the Institute—Mr. J. W. Hall, of F. H. Lloyd and Co., Ltd., Jamesbridge Steel Works, near Wednesbury—and the attendance included several honorary members of the Institute, works proprietors, and others interested in the scheme.

The difference in annual cost between water and steam power supplied on a large scale for general purposes is practically the cost of coal and of handling it. The author allows £200 per annum for stoking a 1000-horse power boiler, or 4s. per indicated horse-power, and adds another 3s. 6d. per indicated horse-power for cleaning boilers and other necessary duties, making 7s. 6d. per indicated horse-power in all. This is for hand work; with mechanical stokers a reduction might be made. First-class merchant steamers, with triple-expansion engines, working at 180 lb. pressure, are now built to specifications requiring them to give an indicated horse-power hour in practice for an expenditure of 1·4 lb. to 1·5 lb. of Scotch or North Country coal, which is not quite so good as Welsh. Arguing from this, the author takes it that, with Staffordshire coal at 5s. per ton delivered, an indicated horse-power could be obtained, including all losses and uses, for every 2¼ lb. of coal burnt. This is allowing 75 per cent. more than in the case of steamer coal, the allowance being made in consequence of the lower calorific value of Staffordshire coal. At this rate we get 2240 lb. ÷ 2·25 lb., or, say, 1000 indicated horse-power for one hour from one ton of coal. Now, there are 8760 hours in the year.

If we assume that a plant could be run for 8000 hours, allowing the remainder—about 10 per cent.—for repairs, &c., it is clear that it will take eight tons of coal to keep an indicated horse-power going for one year. This, at 5s. per ton, amounts to £2; or, if no stoppage is allowed for at all, for under £2 5s. Incidentals might bring it up to nearly £2 10s. This is for taking power continuously. But in most cases work is not continuous, being only fifty-four hours per week.

But if the power is supplied to works operating only fifty-four hours per week, little more than one-third of the coal and stokers' wages will be needed, all the other items remaining the same in both cases or being similarly reduced. Consequently the costs of an indicated horse-power per annum from coal for a 3000-hour load are only about 17s. 6d per annum in excess of what they would be for conveniently situated water power, if such were to be got, while the capital costs would be about the same. And he thinks that probable improvements in steam working and possible advances in gas engine construction will, during the next ten or fifteen years, reduce this difference further. At the voltage at which the primary mains will be worked the cost of a cable to convey 1000-horse power, laid complete, will not exceed £1000 per mile, or £1 per horse-power capacity; a cable for 600-horse power about 25s. per horse-power; and a cable for 300-horse power about 42s. per horse-power. In their agreements with such local authorities as have so far come to terms with the Midland Electric Corporation, the following are the rates for power supply, which are not to be exceeded:—Three pence per unit for the first hour's use per diem, on the maximum demand in any quarter, the number of first hours being taken as 78, *i.e.*, six days per week for thirteen weeks, and ·825 of a penny for each subsequent hour's use.

The president, Mr. J. W. Hall, in opening the discussion, gave calculations which he had made independently of the author, and which were even more in favour of water power than the author's own. The president also pointed out that these calculations coincided in both cases pretty nearly with figures which had been given by Mr. Philip Dowson. The president further said that astonishingly large sums were generally necessary for the permanent works required to get the water up to and away from the wheels, excluding the wheels themselves. £10, £20, £30, and £40 per horse power had been spent in different places on that one item alone. That item had cost at Lyons 25,000,000 francs, or about £1,000,000 English money. Interest on large outlays of capital soon counterbalanced fuel saving. In other cases the cost was not so great. He believed the cost of installing water-power at Interlaken was £34 per horse-power. In consequence of droughts, frosts, and floods, engines had to be kept at many stations in case the turbines went wrong. But in cases on the Continent where coal cost 28s. to 30s. a ton it might pay them to use water. He believed that at Galway a gas-producer plant and gas engine had to be kept as well as the water plant. Some of the Swiss installations were not so costly. He thought the Swiss average was about £4 per horse-power per annum. Bayonne was £5, Montreux £8, and Fribourg £8 2s. 6d. The lowest figure in the world was at Holyoak, Connecticut River, where electric power was said to be supplied for 18s. 3d. per horse-power per year, delivered. His friend Mr. Ritchie, of Edinburgh, who had laid down numbers of installations, estimates—by letter—the cost of installing water power in this country per brake horse-power as varying from £10 to £15; and in America as £10 to £14. Working costs for a power of, say, 100-horse power could be managed working night and day, by two men to attend to sluices, screens, and oiling. The working expenses would not exceed £2 per horse-power per annum. If a water power costs more than £4 or £5 per horse-power it would not, in Mr. Ritchie's opinion, pay to transmit that power. Mr. Thomas Parker, of Thomas Parker, Limited, electrical engineers, Wolverhampton, pointed out that the idea of the promoters of the scheme was to accumulate manufacturers as customers, so that they might keep pretty much a maximum load on the station. This was where the waste came in in the case of the Corporation installations. The plant at Wolverhampton, for instance, was practically doing nothing for fifteen-sixteenths of the year, for, if worked continuously to its full capacity it could generate in twenty-two days so much as was now supplied to the town in a year; and the position was similar at Manchester, where the station was practically idle save for one-twelfth of its time. He could not understand the opposition with which the scheme had been met by some of the local authorities.

Mr. Spence, Wolverhampton, described his visits to water-driven installations in Switzerland and other portions of the Continent, and found that the expense of those systems was vastly greater than the cost would be of putting down steam power in England.

Mr. Edmund Howl, secretary and general manager of the South Staffordshire Mines Drainage Commissioners, described his visit to the installation at Niagara Falls, which quite bore out the assertions of previous speakers as to the enormous cost of permanent works in water installations, counterbalancing saving in fuel. In fact, he was very disappointed with the works there, from a civil engineering point of view. As a maker of patent forced-draught boilers he had just had a letter offering him "good fine coal-dust at 3d. per ton." Mr. Belliss, of Belliss and Co., Ledsam-street Engineering Works, Birmingham, dwelt on the enormous and rapidly-growing scope for the employment of steam engines for electric driving. His firm had put down engines and installations up to 1500-horse power in single works. At one electric lighting station in London his firm first put down three 500-horse power sets eighteen months ago; then three further sets were put down there last spring, and there were six more sets going through his works at the present time, making about 6000-horse power for that one station. There was an enormous demand for this class of work just now. And whereas some ten years ago 200-horse power or 300-horse power per set was considered a large unit, electrical engineers were now making 500, 600, 700, 800, and 1000-horse power sets. There was a great future before engines for electric driving. The discussion was continued by Mr. T. Arnall, from the office of the City Surveyor, Birmingham, Mr. Le Neve Foster, Mr. Alexander Tucker, and others. The last-named gentleman suggested that copies of the paper and discussion should be sent round to the various local authorities whose interests would be affected by the scheme, so that the *imprimatur* of the Institute might be given to the movement. It was understood that this suggestion would be considered by the Council.

KING'S COLLEGE ENGINEERING SOCIETY.—At a general meeting held on Friday, March 4th, Mr. C. E. Atkinson read a paper on "Gold." Commencing with a short history of the gold fields, he passed on to the methods of extraction by panning, hydraulicing of placers, the treatment of quartz loads, chlorination by the vat and barrel process, and the McArthur and Forrest process of cyaniding, concluding with the refining of bullion. The paper was illustrated by numerous lantern slides and specimens. The meeting then terminated with a vote of thanks to Mr. Atkinson for his interesting paper.

SEWERAGE OF LEIGH-ON-SEA.—Mr. E. Bailey Denton, M. Inst. C.E.—Bailey Denton, Son, and Lawford—has been instructed by the Urban District Council of Leigh-on-Sea to report to them as to the best means to be adopted for the sewerage and sewage disposal of their district. Since the provision of a public water supply, and the development of several estates within the parish, the population has greatly increased, and sewerage has become a matter of necessity. Leigh is the last town on the Essex side of the river Thames within the jurisdiction of the Conservancy Board, and is immediately above Southend, where the council, on the advice of Mr. James Mansergh, have recently spent a large sum of money upon sewerage. The method of sewage disposal, therefore, which will ultimately be adoped at Leigh, is a matter of great interest to other towns situated within the tidal reaches of the Thames.

LAUNCHES AND TRIAL TRIPS.

BY Saturday afternoon's tide there was launched from the shipbuilding yard of Messrs. D. and W. Henderson and Co., Partick, a large steel screw cargo steamer, which they have constructed to the order of Messrs. MacLay and McIntyre, Glasgow. This latest addition to the large fleet of vessels already owned by this firm is in length 375ft., breadth 50ft., with a depth of 28ft. 3in., having a gross tonnage of about 4300 tons, and will be classed in Lloyd's 100 A1. She has been fitted with all the latest improvements to ensure the rapid and safe working of the large cargo which she has been designed to carry, including seven powerful winches, and also large derricks fitted at the hatches. Steam steering gear by Messrs. Bow, MacLachlan, and Co., Paisley, is fitted admidships, the saloon and officers' accommodation is on the fore end of bridge deck, and a chart-room and wheel-house have been built above this, with a bridge which will give every facility to the officers in the navigation of the vessel. A set of triple-expansion engines will be supplied and fitted by the builders, having cylinders 25in., 41in., and 67in. diameter by 4ft. stroke. As the vessel left the ways she was named Angola by Mrs. Thomas E. MacLeod, Regent Park-square.

Messrs. Sir W. G. Armstrong, Whitworth, and Co. launched the s.s. Haliotis from their Walker Yard on the 22nd February, the vessel being named by Mrs. Samuel, wife of Mr. Alderman Marcus Samuel, to the order of whose firm the ship and a sister vessel are being built. The dimensions are 248ft. 6in. overall, 40ft. moulded, and 17ft. 3in. depth moulded; and the vessel has been specially constructed for the carriage of petroleum in bulk under the supervision of Messrs. Flannery, Baggallay, and Johnson, of London and Liverpool. There are one or two unusual points about this vessel, she being intended to use liquid fuel on her service in the East, and her engines and boilers have been fitted up with this special view. She is constructed on the trunk-turret system, which gives a larger carrying capacity in proportion to register tonnage than the ordinary form of construction. The engines are, for special reasons, of the compound surface-condensing type, taking steam from two boilers at 100 lb. working pressure, and are 30in., and 63in. diameter by 39in. stroke. Electric light is fitted throughout the vessel, and there is a complete installation of duplex pumps for prompt dealing with oil cargo. The bunkers of the vessel are stayed, riveted, and caulked so as to contain oil fuel, and they are also so arranged as to be available for coal in case of emergency.

On the 9th inst. Messrs. Ropner and Son, Stockton-on-Tees, launched a fine steel screw steamer of the following dimensions, viz.:—Length between perpendiculars, 336ft. 6in.; breadth extreme, 46ft 6in.; depth moulded, 27ft. 3in. The steamer has been built to the order of Messrs. Evan Thomas Radcliffe and Co., Cardiff, and is built off the three-decked rule, and fitted with the builders' patent trunk, full poop, bridge, and topgallant forecastle. The saloon and cabins for captain and officers will be fitted up in an iron saloon house on the bridge deck, and the accommodation for engineers will be provided under the bridge deck at the after part, the crew being berthed in the forecastle as usual. She has double bottom on the cellular principle for water ballast, and has been designed to carry a deadweight cargo of about 5925 tons on Lloyd's summer freeboard, on a light draught of water; she will have all the most recent appliances for the expeditious and economical loading and unloading of cargoes, has direct steam windlass, steam steering gear amidships, with powerful screw gear aft, six large steam winches, to which steam is supplied by an auxiliary boiler working at 160 lb. pressure, stockless anchors, &c. This is the fifth steamer built by Messrs. Ropner and Son for the same owners, and the third of the patent trunk type. She will be completed under the inspection of Captain Hesketh, the owner's marine superintendent. She will be fitted with a set of powerful triple-expansion engines by Messrs. Blair and Co., Ltd. The naming was performed by Miss Ropner, of Preston Hall, who gave her the name of Paddington.

The screw steamer Berry, Captain Alberti, went down the Mersey on Saturday for her official trial trip after having had her machinery converted to high pressure compound by Messrs. David Rollo and Sons, Fulton Engine Works, Liverpool. She has two double-ended boilers, each 11ft. diameter by 16ft. 6in. long, built of steel to the requirements of Bureau Veritas for a working pressure of 160 lb. per square inch. Each boiler has four Purves patent flues, made on the late Mr. Ashlin's patent interchangeable plan, and is also fitted with his very effective water circulator. The new cylinders are 34in. and 63in. diameter respectively by 42in. stroke, intended to indicate in ordinary working service 1200-horse power, the vessel maintaining an average speed of twelve knots. The Berry is a vessel of 1600 tons register, her dimensions being 255ft., by 34ft. by 16ft., and is one of the fleet of the Société Generale de Transports Maritimes à Vapeur, of Marseilles. The alterations have been carried out to the specifications of Messrs. Ashton and Co., of Liverpool. Messrs. H. E. Moss and Co., who have been the company's representatives in this country for between thirty and forty years, were represented at the trial trip by Mr. E. A. Cohen, Mons. Lamtinet, the company's superintendent engineer, being also present. Mr. L. Murphy, representing the United States Metallic Packing Company, whose packing was supplied to the Berry, was also on board, and was congratulated as to its merits. Advantage was taken during the lay-up to fit steam steering gear, a "Higginson's" steam quarter-master replacing the original hand gear. The trial proved in every way perfectly satisfactory, the consumption of coal being much less than before, whilst the speed was considerably increased, thus showing the advisability and economy attached to the conversion of ordinary compound engines to the high-pressure compound type. The vessel proceeded to sea with a full cargo on Sunday for Marseilles.

On the 9th inst. Messrs. C. S. Swan and Hunter launched from their yard at Wallsend the fine twin-screw passenger liner s.s. America Maru, one of three large steamers being built in this country to the order of the Toyo Kisen Kabushiki Kaisha, of Japan, for regular service between that country and the United States. The vessel has been built under the immediate supervision of Messrs. Flannery, Baggallay, and Johnson, of London and Liverpool, who are associated in their duty with Captain Tomioka, the marine superintendent of the company. The vessel has been specially designed to attain high speed at sea, and is 412ft. between perpendiculars, 25ft. 3in. depth moulded to upper deck, and 50ft. 6in. in breadth. Both ship and engines are to the highest class at Lloyd's, and in accordance with the rules of the Imperial Japanese Government and the British Board of Trade. The passenger accommodation, which is of the most complete and luxurious description, provides for sixty-four first-class, forty second-class, servants, and 230 emigrants, there being also a special suite suitable for a bridal party. The first-class passenger accommodation will consist of a handsomely-arranged saloon to seat seventy persons, surmounted by a large arched skylight tastefully panelled and gilded, the decoration throughout having been most carefully considered as regards scheme of colour; thirty-two state-rooms and a suite; a lofty social hall supplied with piano, bookcase, and other appurtenances of like nature; ladies' room; smoking-room of similar scheme of decoration to the saloon; and a spacious entrance hall fitted up as a lounge. Special attention has been paid to the lighting, which will be by electric lamps tastefully and effectively arranged; and ample provision has been made for heating during the cold season, and efficient ventilation throughout. The second-class passengers will be housed in an equally efficient manner, being allotted one berth to four persons, and the accommodation consists of a saloon for forty-five people, smoke-room, and ladies' room. A sufficient number of baths is provided, those for the first-class passengers being of marble; and there is also a complete arrangement of other necessary accessories, such as barber's shop, doctor's room, &c. The vessel will also be supplied with specially constructed mail and silver rooms, and refrigerating facilities for the storage of fresh meat. As she is also intended to carry express cargo, a very complete arrangement of deck gear has been supplied, so as to enable cargo to be dealt with very expeditiously. The electric light installation is of a very complete description, and the vessel will be lighted throughout with an ample number of lights. The engines, which are being constructed by the Wallsend Slipway and Engineering Company, Ltd., are of the triple-expansion type, there being two twin sets, of dimensions as follows:—28½in. by 46in. by 75in. by 48in. stroke, taking steam from four double-ended boilers 15½ft. by 10½ft., working at a pressure of 180 lb. It is expected that the vessel will maintain a speed of nearly 17 knots. The ship was named by Mrs. Samuel, wife of Alderman Samuel, in the presence of a large company.

LETTERS TO THE EDITOR.

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

THE ENGINEERS' LOCK-OUT.

SIR,—On my return from the Continent, my attention has been drawn to paragraphs appearing in the Press during the past week to the effect that "Messrs. Tangye had last week forwarded to the Federation of Engineering Employers a cheque for £500, which cheque had at once been returned to them." As this statement is wholly misleading, I would like to be permitted to set forth the facts of the case.

At the end of January last, we were urgently invited to contribute to the Engineer Employers' Special Fund, on the ground of the heavy strain which had been imposed upon the employers in the recent struggle.

On the 10th February, my Company contributed the sum of £500 to the fund, but, in handing over the cheque, expressly stipulated that the amount should be applied to the relief of the less wealthy members of the Federation, upon whom the strain had told most heavily, stating, at the same time, that a similar amount had already been given to the Amalgamated Society of Engineers in aid of the men who were still out of employment.

So far from being "at once" returned, the cheque was cashed and paid into the fund and an acknowledgment sent us by the Federation, at the hands of their secretary, Mr. Thomas Biggart, who, under date February 11th, said, "We are desired by our Committee to acknowledge with thanks your firm's handsome contribution of £500 towards the Federation's Special Fund."

On February 28th—*i.e.*, seventeen days after this acknowledgment, Mr. Biggart sent us a banker's draft for £500, with a letter in which he says, "We have now had an opportunity of reporting your contribution of £500 to our Committee. This is the first meeting held since your cheque was received." He goes on to say his first letter was sent *per incuriam*, but as it contained the distinct statement that he had been desired by his Committee to thank us, the explanation of this extraordinary discrepancy must be left to that gentleman.

I should explain that long before we gave our contribution to the Federation it was well known to every member of that body that we were not in sympathy with their policy. This fact we expressly stated at an early period of the struggle, and again laid stress upon when handing over our cheque. It was therefore with this knowledge that the Federation accepted and thanked us for the gift we had been invited to make. With their reasons for subsequently reversing their own action I am not concerned.

In some of the paragraphs which have appeared, reference is made to the "probable reasons" actuating us in making our gift. It is natural to a certain class of mind to ascribe motives that are base, but my Company is no more moved by these insinuations than it was affected by the threats so freely showered upon us at an early period in the struggle.

Our course has been perfectly clear and consistent from the outset. What was it we were asked to do? Having no quarrel with our men, having received no demands from them, having had an unexampled record of forty years of peaceful relations with them, we were asked to turn them—nearly 2500 persons—into the street. In speaking to one of the principal members of the Federation I said that such an act on our part would be a crime. Its folly will be appreciated when I state that we have long possessed all the advantages the employers claim to have secured as a result of the late ruinous contest—advantages which I firmly believe they also might have possessed without conflict had their relations with their employés been the same.

RICHARD TANGYE.

Birmingham, March 15th.

COALING WARSHIPS.

SIR,—In your issue of February 4th you gave an interesting account of the coaling experiments at Portsmouth, and if not trespassing too much on your space, I would like to know the weight of bag referred to, when you say the coal whips take six bags usually, and that the fore Temperley could do twelve bags a time. You also say, "In the Mars the whips beat the Temperley by fifty bags an hour on the average, thus taking in 1¼ tons coal more per hour." This would make the weight per bag figure out as ½ cwt. Is this correct? I would also be glad to know if the coal should during loading become saturated with salt water, whether it introduces any additional risks of spontaneous ignition or other troubles, beyond some deterioration in steam-raising qualities. Perhaps some of your readers may have had some experience in this matter, in which case I should be much obliged for information.

BUNKER.

London, March 7th.

[(1) The normal weight of a service bag of coal is 2 cwt. Thi does not reconcile with the figures of the Mars' performance as given in THE ENGINEER of February 4th, but as those figures were given independently by two officers on board, they should be accurate for that particular case. (2) As regards coal being impregnated with salt, the question is not so much a matter of the salt as the water. There is no actual risk, in the first place, because every effort is made to prevent the coal getting wet, and coaling is usually under conditions where no such chance occurs; in the second place, bunker lids are always left off if the coal should have got wet. Were they closed there would, of course, be then a very great risk indeed of spontaneous combustion. It is difficult to collect exact data with regard to coaling, as individual officers hold individual opinions, and no two ships are coaled alike. For instance, one officer will claim that a Temperley can easily take twenty bags at a time, another will limit it to six or seven, in order to avoid the risk of anything carrying away.—ED. E.]

THE LABOUR BUREAU.

SIR,—Now that the strike is over we hear little or nothing of the Labour Bureau which was frequently mentioned at that time. Now myself, and probably other non-unionists, would like to be put in the way of communicating with this agency. It seems to me that if offices in connection with this association were established in all our great centres, where workmen could go and register their names when out of employment, for a payment of a small sum, and of course proper organisation between the various offices, that it ought to be of considerable advantage to non-unionist workmen, and masters wishing to employ them.

NON-UNIONIST.

Birmingham, March 14th.

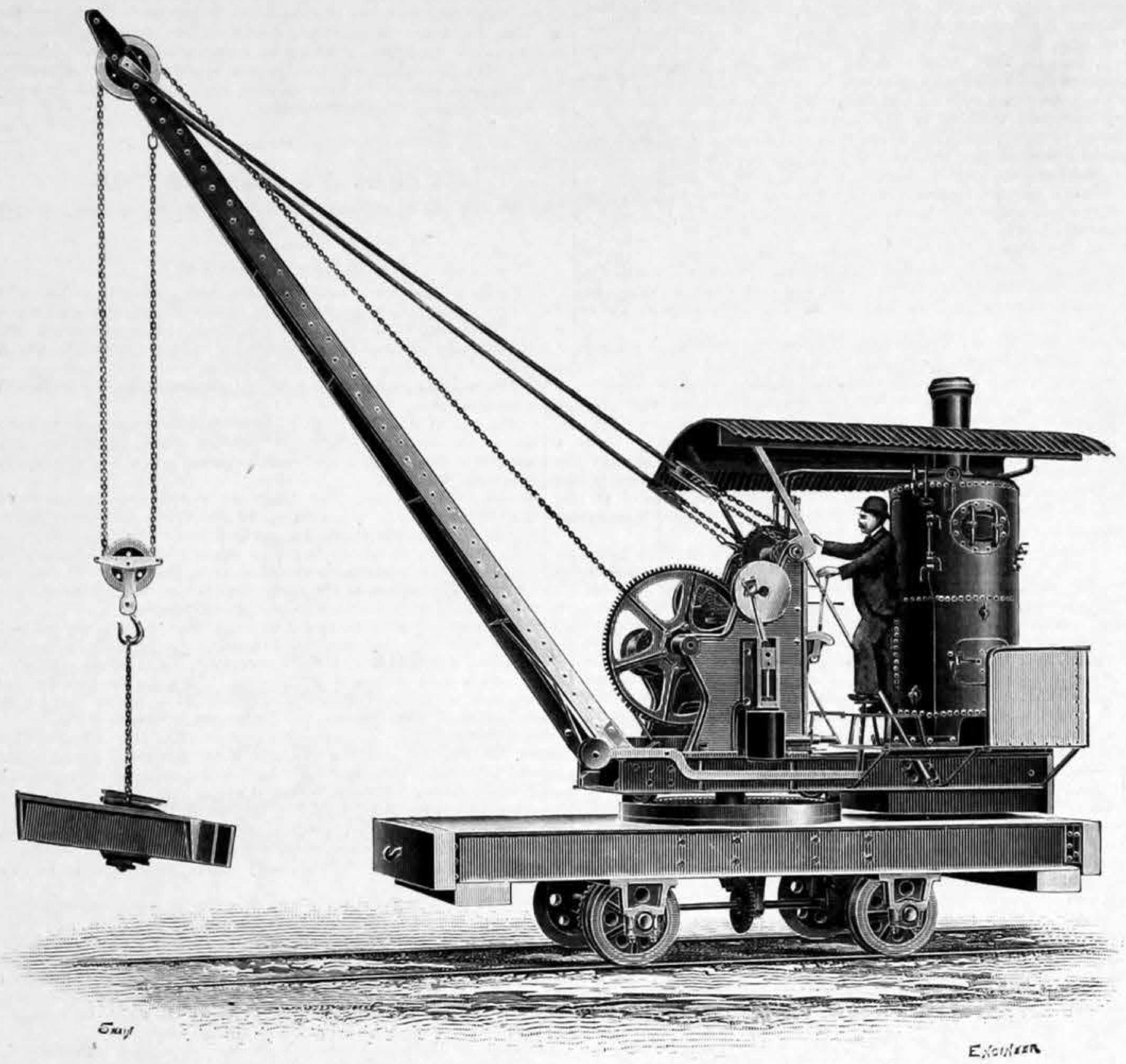
THE EFFICIENCY OF SCREW-JACKS.

SIR,—In answer to "H. E. W.'s" letter in your issue of March 4th, I may say that 25 per cent. is rather too small for the efficiency of a screw-jack. In a series of experiments which I carried out last year, I found the efficiency to average from about 30 per cent. to 33 per cent., in one or two cases being as high as 38 per cent.

London, March 10th. G. P. W.

STEAM SHUNTING CRANE

BEDFORD ENGINEERING CO., ENGINEERS



LOCOMOTIVE STEAM SHUNTING CRANE.

THE above engraving represents a 5-ton locomotive steam shunting crane of the type built by the Bedford Engineering Company, of Bedford, for Messrs. Sir Christopher Furness, Westgarth, and Co., Limited, of Middlesbrough, Messrs. Eastwood, Swingler, and Co., Limited, of Derby, and others, for yard work and shunting purposes. The crane runs on the standard 4ft. 8½in. gauge, and has a margin of stability equal to 20 per cent. A special feature in the design is the revolving bed, which, instead of being a single casting as is usual, is built up of H-section steel girders, with cast iron transoms for carrying the anti-friction rollers, &c., and of sufficient length to receive the balance box tank at the tail end, avoiding thereby trusting to cast iron lugs for connecting the tank to the revolving bed. Another improvement consists in fixing both the hoisting and derrick barrel shafts so that they act as stays between the side cheeks, the barrels running loose upon their shafts. All motions are taken direct from the crank shaft.

Steel gearing and brass bushes are used. The total weight of the crane is 21 tons, and it will travel with its load suspended in any position.

CATALOGUES.

The London Emery Works Company, Clerkenwell, E.C. Cork polishing wheels.—A great advantage claimed for these wheels is that they are flexible, rendering them suitable for the finest work.

Brett's Limited, Coventry.—Illustrated and descriptive catalogue of Brett's patent lifts.

W. E. Kenway, Birmingham.—Illustrated catalogue devoted to Kenway's electric traction system.

Consolidated Steel and Wire Company, New York. Woven wire fencing.—This fence has no fine wire in its construction. It has a slight bend at every joint, sufficient to allow of expansion and contraction. It has no twisted cable to hold water and moisture, and thereby start rust and decay. The London agents are Messrs. E. le Bas and Co., Billiter-street, E.C.

William Skinner, London.—Cycle fittings.

The Manchester Laundry Engineering Company, Manchester.—Cooking apparatus.

Steinle and Hartung, Quedlinburg. — Illustrated pamphlet descriptive of their patented steel quicksilver thermometers.

Cole, Marchent, and Morley, Bradford. Steam engines and condensing plants.—This is a very neatly-got-up little book, in which the illustrations, nicely reproduced from wash-drawings, are worthy of special mention. The printing is a credit to its producers.

The Lozier Manufacturing Company, London. — Cleveland bicycles, 1897.

Sir Theodore Fry and Co., Ltd., Darlington.—Section book, 1898.

AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

Large railway shops.—The Boston and Maine Railroad have recently completed extensive engine and carriage works at Concord, covering about 4½ acres of ground, and at these shops about 300 locomotives will be repaired and rebuilt, while the car shops have a capacity of 400 freight cars and 50 passenger cars per month. The machine and erecting shop is 305ft. by 130ft., with a boiler and tender shop 105ft. by 70ft. The freight and passenger car shops are 170ft. by 162ft. each. The buildings are all of brick, with steel roofs. The erecting shop has three longitudinal tracks, one of which, with an overhead travelling crane, runs on into the boiler shop. The engines will be dismantled on the middle track, and the parts carried by travelling cranes to the machine shops on either side. The blacksmith shop has ten double forges and one large forge, also four power hammers of 500 lb. to 1800 lb. A 15-horse power electric motor on the roof trusses drives the blowing and exhausting fans, and a 20-horse power motor on the ground drives the other machinery. Outside the car shops is a transfer table 70ft. long, running in a pit 280ft. long, and operated by electricity. Very complete systems of steam and electric distribution are provided, and there is also a system of compressed air piping and a double system of water supply, one for fire service at 110 lb. pressure and one for shop use at 90 lb. The entire plant is heated by hot air, circulated by fans. The various shops are as follows:—

	Feet.		Feet.
Machine and erecting shop	305	×	130
Boiler and tender tank shop	105	×	70
Wash-house for machinists	62	×	26
Blacksmiths' shop	100	×	60
Office and storehouse (two-storey)	100	×	40
Timber shed	300	×	40
Dry house for timber	72	×	25
Cabinet, pattern, buffing, tin, and pipe shops	200	×	40
Planing mill	300	×	60
Passenger car repair shop	170	×	162
Freight car repair shop	170	×	162
Paint shop	200	×	165
Paint and oil store	50	×	25
Varnish room	81	×	36
Upholstery room	81	×	36
Power house	111	×	65
Boiler-house	65	×	50

American locomotives for Japan.—Nearly all the large locomotive-building firms in the United States have recently had orders for locomotives for Japan, and the Brooks Locomotive Works has completed a shipment of twenty passenger engines of the eight-wheel or "four-coupled bogie express" type for the Imperial Government Railways. These engines are of standard American construction, with the exception of copper fire-boxes, brass tubes, and six-wheeled tenders. They have also spring buffers and screw couplings, and the Smith automatic vacuum brake, all of which goes to show that American builders can and will meet the requirements of purchasers, and do not tell purchasers that if they do not want engines as the makers build them they can go elsewhere for the engines. The general dimensions of the engines are as follows:—

Gauge	3ft. 6in.
Cylinders (2)	15in. by 22in.
Driving wheels (4)	4ft. 6in.
Truck wheels (4)	2ft. 3½in.
Driving wheel base	7ft.
Total wheel base	19ft. 4in.
Weight on driving wheels	50,400 lb.
Weight, total	74,500 lb.
Steam ports	1⅞in. by 14in.
Exhaust ports	2½in. by 14in.
Valve travel	6¼in.
Boiler, diameter	4ft. 6in.
Dome, diameter	2ft. 6in.
Height of centre line from rail	7ft. 1in.
Length of smoke-box (with netting spark arrester)	4ft. 1½in.
Boiler pressure	160 lb.
Fire-box (above frames), length	6ft. 6in.
" width	2ft. 6in.
Crown sheet	Radial stays
Tubes (210), diameter	1¾in.
" length	9ft. 8in.
Grate area	15·2 square feet
Heating surface, tubes	965·0 "
" " fire-box	90·0 "
" " total	1055·0 "
Height to top of smokestack	12ft. 1½in.
Driving axle journals	6½in. by 8in.

Tender.

Length over all	16ft. 2in
Weight, empty	52,000 lb.
Wheels	3ft.
Wheel base	9ft. 10in.
Journals	4¼in. by 8in.
Length of tank	14ft. 6in.
Width of tank	7ft. 4in.
Height of tank	5ft. 6in.
Thickness of plates (steel)	3/16in. and ¼in.
Capacity of tank	2400 gallons
Coal	5 tons

NOTES FROM JAPAN.

(*From our own Correspondent.*)

IT is concurrently reported, and the report is confirmed by the best informed vernacular papers, that the Imperial Railway Bureau have engaged a German civil engineer of high qualifications to succeed to the post formerly occupied by Mr. C. A. W. Pownall, M. Inst. C.E. It was originally attempted to obtain the services of a British engineer, but the salary offered—£1200 a year—was not sufficient to attract a man possessing the high qualifications required. It has also been suggested that, as the Japanese army is organised upon the German model, and as Imperial railways were primarily projected for strategical purposes, those considerations may have had something to do with the selection. In any case there is plenty of scope for his abilities, as the railways have been steadily deteriorating, both in structural condition and in actual efficiency, while, in spite of the very considerable additions that have been made to their locomotive and rolling stock, the congestion of traffic grows daily more and more serious. In a recent, and by no means exceptional case, a package delivered to the Railway Company at Yokohama took just three weeks to reach its destination in Tokyo, 18 miles distant. Several of the Yokohama officials were recently arrested on the charge of receiving bribes, which had been paid to induce them to give preferential despatch to goods which were urgently wanted. The *Japan Mail* states that this is the first instance in which a German expert has been employed on a Japanese railway; but this is not the case, as Herr Roemschutel—I am by no means certain of the spelling of his name—an engineer of high repute and abilities, previously in the employment of the German Government, was for some years engaged in laying out and developing the Kinshin Railway. It is now some years since he left, and I regret to say that—without any imputation upon his abilities—that line has since earned the reputation of being the worst found, worst managed, and the most uncomfortable to travel upon of any of the Japanese railways of any importance or length.

The concluding remark of the *Japan Mail*, when commenting upon the shortcomings of Japanese railways and the reported new appointment, is too true and pithy to be omitted. "The trouble will not prove amenable to German management, however. No foreigner, whatever his nationality or capacities, is entrusted with any administrative authority in Japan, and so long as that is the case no foreigner can be really efficient. The Japanese employers are the sufferers."

Some time since a movement, influentially supported and strongly backed up by some of the leading capitalists, was set on foot for the purchase from the Government of the most important section of its railways, namely, that connecting Tokyo, Kyoto, Osaka, and Kobe, and for amalgamating it with the Sanyo Railway, which runs southward from Kobe. At that time the capital required would probably have been readily subscribed; and if the excellent management and accommodation to be found on the Sanyo Railway had been extended to the Tokaido—or Eastern route—line, as the above-mentioned section is called, it would have been a distinct boon. But the scheme fell through, owing probably to the Government manifesting no disposition to sell out. Now the pendulum is swinging in the other direction, and it has been seriously suggested that the Government should buy up the whole of the railways in the country. The advantages, according to the doctrinaires who are responsible for the suggestion, would be almost incalculable. In the first place, an enormous amount of capital, now locked up, would be released, and would be available for promoting innumerable industries now starving on account of the tightness of the money market. Secondly, the Government, which would purchase on exceptionally favourable terms—this part of the scheme is rather hazy, but apparently the shareholders would be glad to exchange their shares, now paying 10 per cent. or more, for the sweet security of Government stock paying only 4½ per cent., would make a clear profit of 1 per cent. (*sic*)—could remit half the taxes, double the army, and treble the navy! Further details are much to be desired.

Telephone service.—Out of 1500 additional telephones for Tokyo, to be delivered during the fiscal year ending March 31st, 1898, one-half have already been supplied, and the remainder will be delivered by the specified date. During the fiscal year 1898—9, 4597 new telephones are to be supplied in Tokyo, Nagoya, Sakai, Osaka, Kobe, and Yokohama. Telephone exchange offices are also to be opened in Nagasaki, Tuknoka, Bakan, Yokkaichi, and Kuwana. In the northern island, Yezo, land for new buildings has been purchased in Hakodate, Otaru, and Sapparo. A lively scene was witnessed at the Nagoya Telephone-office on January 10th last, the first day for receiving applications for subscriptions. The installation had originally been designed for 200 telephones, but 100 more were afterwards added. But before 5 a.m. upwards of 1000 eager applicants were collected outside the office, and the numbers increased every minute. The police were powerless to control the crowd, and the office was stormed and partially wrecked.

Vegetable wax, or ro, is an important item of Japanese commerce, and according to the *Mainichi Shimbun*—daily newspaper, published in Tokyo—is chiefly produced in Hyogo, Wakayama, Yamaguchi, Yehime, Fukuoka, Saga, Oita, Nagasaki, Kumamoto, and Kagoshima, the total production of these ten provinces alone exceeding 3,000,000 yen per annum in value, and the exports are said to range from 200,000 to 500,000 yen per annum, chiefly to China, England, France, Germany, the United States, India, Australia, and the Philippines. Its principal uses are for candles, medicines, artificial flowers, the prevention of rust, and the like. From various causes the production of beeswax in the south of France, Austro-Hungary, and other parts of Europe has of late decreased considerably, and this appears to have stimulated the foreign trade in the Japanese product. Until recently the process of manufacture has been simple and primitive. The wax-trees, of which there are three principal varieties, *Rhus succedanea*, *vernicifera* and *sylvestries*, begin to bear in the fifth year after planting, each producing about 4 lb. of berries, increasing gradually to 60 lb. in the fifteenth year, and declining from the eighteenth. Four pounds of berries yield about 1 lb. of wax. After being dried and stored for some time, they are pounded in conical wooden bowls by tilt hammers worked by foot, to separate the husk and kernel from the wax-bearing body of the fruit lying between them. The latter, after winnowing, is steamed in hemp bags, pressed, and moulded into cakes. That intended for export undergoes a crude process of refining by being melted and dropped into water, which separates it into flakes, which are afterwards bleached in the sun. More than one factory equipped with modern appliances has recently been projected, but none are yet in actual operation, and a certain amount of experimental work will no doubt be required before the most effectual and economical mode of treatment is arrived at.

According to the *Asahi Shimbun*—daily paper—the Nippon Yusen Kaisha — Japan Steamship Company — has at present in its employment 1190 ships' officers, experts, clerks, and other officials without reckoning coolies. Of this number 193 are foreigners, or more than fifty less than a year ago. It has for some time past been the steady policy of the company to reduce the number of foreigners in its service and replace them by those of its own nationality. This is, of course, natural enough, both from considerations of patriotism, independence, and economy; but it is open to question if the last-named advantage is not being purchased too dearly at the expense of efficiency. This company receives heavy subsidies from Government in various forms; but, according to the *Yomiuri Shimbun*, the only lines which receive a fixed annual subsidy are those running to Australia and Bombay. Those running to Europe and America only receive the "special encouragement allowance" granted to vessels which have passed the very severe official examination, and, under the circumstances, these two lines were unable to declare any dividend for the last half-year, and it was rumoured that they would be discontinued.

On the contrary, the service is being increased and new steamers added, so as to have one leaving Yokohama for Europe every fortnight. Two new boats, built in England, are expected, one in March, the other during the summer; and two others, each of 6500 tons, are approaching completion at the Nagasaki Shipbuilding Yard, with others to follow, all of which, it is hoped, will obtain the special allowance and assist materially to put matters on a more satisfactory footing. It is also stated that the amount of cargo and number of passengers is increasing on the European line, especially between Shanghai, Singapore, Bombay, and Europe. At the present time the company owns in all fourteen vessels, on which they receive the special allowance, the last one to secure it being the Inaba Maru, of 6191 tons displacement and a speed of 14 knots, which was launched in England on the 1st June, 1897.

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

(*From our own Correspondent.*)

MANUFACTURERS on 'Change at Birmingham to-day—Thursday—testified to a somewhat better and more cheerful tone in Midland business circles. The district mills and forges are kept in fairly regular operation, naval ironworks manufacturers being very busy on home and foreign orders. It is also expected that the proposals of the Admiralty in regard to the heavy naval expenditure will have a very considerable indirect influence on many of the district industries. The railway wagon and constructional firms have good orders from the Indian Government and other sources, which necessitate their taking large quantities of metal. The big engineers and machinists are fairly well occupied.

The sheet trade remains in a depressed condition alike for plain, rolled, and galvanised sheets. Black sheets were this afternoon sold as low as £5 17s. 6d. to £6 for singles and 5s. extra for doubles. The Welsh manufacturers are still cutting prices in the hope of wresting trade from Staffordshire, and it appears to be a question of who can stand the ruinous competition the longest, as the business at present prices is decidedly unprofitable. Galvanised sheets were unchanged at £9 10s. to £9 15s. f.o.b. Liverpool.

The Mayor of Wolverhampton has received replies from the London and North-Western, Great Western, and Midland Railway Companies, to his communication in regard to the excessive charges levied upon sheet iron and other goods from South Staffordshire. The companies assure the Mayor that the matter shall receive their careful attention.

In other descriptions of finished iron to-day, marked bar was £7 10s.; second grade, £7; unmarked merchant iron, £6 to £6 5s.; and common bars, £5 15s. to £6. Hoop iron was £6 5s. to £6 10s.; special nail iron, £8; and gas strip, £5 12s. 6d.

The demand for foundry pig was in excess of the supply, owing to the continued increase of ironfounding establishments. Some smelters are consequently confining their attention to the production of foundry qualities of pig, and one of the two blast furnaces recently started at Bilston and Cradley is on pig, and one on foundry. Staffordshire best all-mine pig was £3 4s. 6d. to £3 7s. 6d.; ordinary all-mine, £2 10s. to £2 15s.; part mine, £2 4s. to £2 8s.; and cinder, £2. Derbyshire, Leicestershire, and Nottinghamshire forge was £2 5s. to £2 6s.; North Staffordshire, £2 4s. to £2 5s.; and Northamptonshire, £2 2s. to £2 3s.

Constructional steel continues in brisk request, but there is not much doing in the soft steel for tube drawing. The large steel works at Bilston and Brierley Hill, however, have plenty of current orders to augment those taken earlier in the quarter, and prices are very firm at recent quotations, viz., £6 5s. to £6 7s. 6d. girders, £5 10s. to £5 15s. angles, £5 17s. 6d. to £6 2s. 6d. plates, £6 to £6 2s. 6d. bars, £4 10s. to £4 15s. Bessemer blooms and billets, and 5s. per ton extra for best Siemens ditto.

Great interest attaches to operations that have been carried on recently upon the western side of the Cannock Chase coalfield. Nearly twenty years ago a company called the Cannock and Huntingdon Colliery was formed, with a capital of £100,000, for the purpose of proving and developing the seams of coal believed to be under the estate of Lord Hatherton, between Cannock and Stafford, although deeper than in the explored Cannock Chase coalfield, there being a down-throw fault of considerable magnitude to the west. A French firm—Kind-Chaudron—was engaged to carry a pair of shafts through the gravel beds, containing a large volume of water. The French mode of piercing is that of sinking a series of rings of cast iron tubbing. The shafts, about 19ft. diameter, were carried down in this fashion about 140 yards, at which depth it was thought work might be carried on in the ordinary way. But the water broke in beneath the tubbing and quickly filled the shaft, compelling the company to go into voluntary liquidation. A year ago the present Lord Hatherton recommenced operations, placing the work in the hands of Messrs. S. and J. Bailey, mining engineers, Birmingham. They have successfully cleared out the water, pinned iron tubbing below the trench work for 16 yards, and carried the sinking down with brick lining to a total depth of 200 yards. It has passed through several seams of coal, identified as the upper measures of the Essington and Cannock Chase district. A further sinking to 300 yards is proposed, to prove the lower measure and the shallow and deep seams of the Cannock Chase coalfield. The pumps used are those of Messrs. Joseph Evans and Sons, of Wolverhampton, which have done the work in a splendid manner. They were worked by special machinery arranged by Messrs. Evans. The further sinking is progressing satisfactorily. Should the results be such as are anticipated, a new company will be formed to work the mines.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—No specially new feature is noticeable as regards either the engineering or the iron trades of this district. The iron market, although very slow in developing any appreciable improvement as a result of the general resumption of operations throughout all branches of engineering, maintains a position of firmness, with makers not at all eager about booking forward at current rates. So far, the resumption of work in the engineering industries has scarcely made itself felt as regards increased requirements for material, consumers not being yet in a position to put in hand any really heavy new work, whilst in most cases, what with suspended deliveries on account of contracts during the dispute, and large purchases which were made in anticipation just prior to the termination of the lock-out and strike, it is very exceptional where there are any really large requirements just at present to cover. Throughout all branches of the engineering trade, however, extra pressure of work continues to be reported, more especially amongst machine tool makers and both stationary and locomotive engine builders, whilst boilermakers have been booking new orders freely during the last few weeks, and all the large concerns throughout Lancashire are very full of orders. In many cases engineering firms are compelled to allow orders to pass by owing to their inability to comply with requirements for specified delivery, and it is exceptional where any of the leading concerns are in a position to undertake new orders for delivery this year. With this exceptional activity prevailing throughout the engineering industry a large amount of buying must before long inevitably come upon the market, and it is not improbable prices may then take a decided upward move.

Not more than a moderate sort of business was reported on Tuesday's Manchester iron market, consumers still giving out only comparatively small orders either for raw or manufactured material. Here and there low cutting might be come across for some special orders, but underselling is much less frequent than it was a short time back. In fact, the belief is becoming much more prevalent that, notwithstanding makers are just now booking comparatively little new business, they are nevertheless delivering so heavily on account of contracts, and stocks are so exceptionally light, that when buying of any weight does come forward it will inevitably give a decided upward move to prices. Local and district brands of pig iron are without quotable change, but firm at 45s. 6d. for forge, to 48s. 6d. for foundry, Lancashire, less 2½; 43s. for forge, to 45s. 6d. foundry, Lincolnshire; and 48s. 6d. to 49s. 6d. for foundry, Derbyshire, net cash, delivered Manchester, the tendency in some quarters being if anything to hold out for rather better prices. Outside brands fully maintain last week's improvement. Good foundry Middlesbrough averages 49s. 4d. to 49s. 10d. net, delivered by rail Manchester, and Scotch iron 47s. 6d. to 47s. 9d. for Glengarnock, and 47s. 9d. to 48s. for Eglinton net, delivered Lancashire ports, and 2s. 3d. more at Manchester docks. American foundry pig iron is still offering as low as 45s. at the docks, and a noticeable feature in the competition from America is that considerable quantities of forge qualities are now sent into the Lancashire finished iron and steel-making districts to replace the ordinary English hematites, at a saving in cost of nearly 10s. per ton.

Manufactured ironmakers generally report forges fully going on bars, with orders to carry them over the next couple of months; but there is still no appreciable improvement in prices. The advance of 2s. 6d. per ton recently put on is only being very partially got, and £5 12s. 6d. to £5 15s. remain the average figures for Lancashire, with North Staffordshire bars £5 17s. 6d. per ton, delivered Manchester. Sheets, if anything, show a slight improvement; but business is only practicable at very low prices, averaging about £6 15s. per ton. In hoops there is but an indifferent trade doing at the Association list rates of £6 10s. for random to £6 15s. for special-cut lengths, delivered Manchester district, with 2s. 6d. less for shipment.

In all branches of the steel trade there is a decided improvement, resulting largely, no doubt, from the exceptional activity in shipbuilding and general structural work. Hematites continue to harden, the minimum quotations being 57s. 6d. to 57s. 9d., with the better class foundry qualities quoted 58s. 6d. to 59s. 6d., less 2½, delivered here. Local-made billets remain at £4 6s. 3d. net, and bars are steady at £6 to £6 5s. Plates have advanced fully 5s. per ton, common qualities being now quoted £6 2s. 6d. to £6 5s., and boiler plates £6 10s., delivered in this district.

At a meeting of the Northern Society of Electrical Engineers, held on Monday, Mr. T. Hawkins contributed a paper on "The Practical Operation of Multiphase Currents."

The balancing of engines was dealt with in a paper read before the Manchester Association of Engineers, at a recent meeting, by Mr. James Whitcher, A. Inst. C.E., in the course of which he remarked that the demand for higher piston speeds in engines for marine and electrical work had forced this question much to the front, so that the scope of interest in it, instead of being practically limited to locomotive circles, extended over almost the whole area of motor engineering. There was really no great obstacle in the way of a perfect balancing of locomotives, even though standard patterns were held as entirely sacred as they had been deemed by those who built them. Alterations of the dispositions of the crank and cylinders opened the way for many solutions. A simple one was possible when the cranks were opposite, by operating a bob-weight in line with each cylinder, from the opposite crosshead, provision being made for keeping strain off the slides, and compensating the secondary components by the mode of linkage. The same was applicable to stationary and marine engines, but it must not be forgotten that when balancing mechanism was operated from the cross-head the inertia stresses were not relieved from main bearings. Mr. Whitcher also referred to the fact that hydraulic balancing was possible, a piston being employed to vibrate columns or masses of fluids, such as oil, water, or mercury, in the required manner. Secondary pistons could be adopted to modify the movements of the columns to balance the secondary components if the pump could not be operated by a reverse connecting-rod. Likewise, hydraulic linkages or connections could be employed to operate the balancing weights.

In conclusion, Mr. Whitcher drew attention to the want of balance caused by the uneven rotation of shafts—of which the Otto cycle gas engine furnished a striking instance. For less than quarter of the cycle they had a very powerful torque applied to the fly-wheel by the crank. During the remaining three-quarters there was a reverse torque of correspondingly smaller dimensions. The size of fly-wheel did not affect these stresses, as although with heavier fly-wheel the variation of speed and therefore the acceleration were smaller, the mass was proportionately larger. There was evidently only one solution to this difficulty, to steady the turning movement. Until this was done it was almost useless to think of applying any of the refinements of balancing to the modern gas or oil engine.

Mr. Hunter, engineer of the Manchester Ship Canal Company, in discussing the paper, said that, speaking from a bridge builder's point of view, unbalanced high-speed locomotives affected them in two ways. When the locomotives dashed over bridges at a high speed the bridge was subject to alternating stress and relief of stress, many parts being now in tension, now in compression, now at rest. Added to that was a factor most difficult to take into account, but which seriously affected the lives of the bridges, *i.e.*, the molecular change, which, he feared, was produced in the material of the bridge by the dynamic shocks caused by the unbalanced weight of the moving portion of the engine. The engine builder must consider the man who had to make and maintain the roads and the bridges over which the locomotives travelled. The difficulty was there, and it behoved the engine builder to face it; and some day, sooner or later, probably by a process of tentative procedure, the solution would be found.

At a meeting of the Manchester Association of Civil Engineering Students, held last week, Mr. B. K. Adams read a paper on "The Crossing of the Manchester, Bolton, and Bury Canal, by the Intercepting Sewer of the Bury Corporation." After referring to the conditions laid down by the company, and describing the proposed sewer, Mr. Adams gave a number of interesting details of the methods of carrying out the work, the cost of construction, &c., and concluded his remarks by a description of the manholes on each side of the canal. The president, Mr. Worthington, observed that the above style of paper was one which they required occasionally at their meetings, as it dealt with comparatively small work in very minute detail, and brought before them every-day pieces of construction, which in the ordinary class of paper were overlooked as being too self-evident to call for mention, but which, as a matter of fact, were least known.

The position in the coal trade is not more than steady, with only a moderate sort of business reported generally. House-fire qualities are not moving off quite so freely, with prices unaltered. Steam and forge descriptions continue plentiful in the market, and in some quarters are cut very low, especially for shipment, 6s. to 6s. 6d. being average figures at the pit mouth on inland sales, with commoner sorts of steam coal obtainable at 7s. 6d. to 7s. 9d., and better qualities quoted from 8s. to 8s. 6d. delivered Mersey ports. Engine classes of fuel are moving off fairly well, but supplies are ample, and prices not more than steady at late rates, common sorts averaging 3s. to 3s. 6d.; medium, 3s. 9d. to 4s. 3d.; and better qualities, 4s. 6d. to 4s. 9d. at the pit mouth.

Barrow.—The hematite pig iron market is very steadily employed, and a good demand exists for both prompt and forward deliveries. Makers, however, are too fully sold forward to be able to quote for prompt deliveries, and as a consequence some transactions are noted in warrant iron, which has ranged in price from 49s. 4d. to 49s. 2½d. net cash, and has recovered to 49s. 6d. sellers, buyers, 49s. 5½d. Makers still quote firmly 50s. per ton for parcels of mixed Bessemer numbers net f.o.b., and although this is a normal quotation, it would be impossible to do much business at a lower figure. During the week stocks of iron have been reduced by 1029 tons, and now total up to 181,358 tons, or 3092 tons less than at the beginning of the year, and 116,962 tons less than in the corresponding week of last year. Forty-one furnaces are in blast, as compared with thirty-six in the corresponding period of last year.

Iron ore is in very brisk demand, and raisers have profited on new contracts on the last advance in the prices of pig iron. Good average prices are quoted at 11s. per ton net at mines, with best descriptions at 16s. per ton. There is still a large consumption of Spanish ores.

Steel makers are very busily employed, and the mills in the Bessemer department are as fully employed as the supply of metal from the converters will permit of. Heavy steel rails are in large output and in good demand, and are quoted at £4 10s. per ton net, f.o.b. Ship plates are in very full demand, and both the heavy and the light mills are kept fully employed. Makers have more orders offered to them than they can undertake at present, and prospects seem to indicate there will be a very brisk demand in this branch of trade during the year. Prices of average plates are steady at £5 10s. per ton. In the minor branches of steel business is steadily maintained.

Shipbuilders are showing more activity in all departments, and much progress has been made with the arrears of work in the engineering department. Prospects of new business are very good.

The coal trade is very quiet, and prices remain low. Coke enjoys a brisk market at full prices.

The shipping trade at West Coast ports is very busily employed in metal exports. Last week 10,610 tons of pig iron and 12,810 tons of steel were exported, as compared with 11,155 tons of pig iron and 7025 tons of steel in the corresponding week of last year, showing a decrease of 545 tons of pig iron, and an increase of 5785 tons of steel. Since the beginning of the year 100,816 tons of pig iron and 116,392 tons of steel have been exported, as compared with 72,024 tons of pig iron and 89,426 tons of steel in the corresponding period of last year, showing an increase of 28,792 tons of pig iron and 26,966 tons of steel.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

ALTHOUGH the seasonable weather of the last fortnight has made the retail trade in house coal somewhat firm, values have not appreciably altered, and it is too late now in the season to expect any considerable rise in quotations. About five days are being worked per week on an average. In some directions there is rather less now being done. The slackening trade in several quarters has led to a settlement of various disputes, which have been standing for a considerable time. Some difficulty is being experienced in coming to an amicable arrangement to meet the liabilities imposed by the Workman's Compensation Act, but it is not expected that these difficulties will lead to any exceptional trouble. Consignments to the metropolitan market have been quite up to the average for the season, and there is now a distinct improvement in the demand for secondary qualities of coal, which, up to a short time ago, were in very little demand, finer qualities having previously had the preference. Values continue firm, best Silkstones are 8s. 6d. to 9s. per ton; ordinary from 7s. 6d. per ton; Barnsley house, 7s. 6d. to 8s. per ton; seconds from 6s. 6d. to 7s. per ton. In steam coal, for which the demand is well maintained, considerable advance is shown in the weight sent to Hull for export. It is expected that the Baltic trade this season will be unusually good, and it is hoped that an advance may be obtained in steam coal for distant markets. Barnsley hards make 7s. to 7s. 6d. per ton; seconds, from 6s. 3d. per ton. With the lengthening days there is less doing in gas coal, but values show no disposition to fall. Engine fuel steadily maintains its position, the diminished working of the soft coal pits causing the supply of small fuel to decrease. Nuts are 6s. to 6s. 6d. per ton; screened slack, from 4s. per ton; pit slack, from 2s. 6d. per ton. There is rather less doing in coke; ordinary coke makes 9s. to 10s. per ton; washed coke, 11s. to 12s. per ton.

Not a little restlessness has been evident in the iron market during the last ten days, but a steadier feeling is now evident. It is significant that, in spite of the prevalent uncertainty, prices have shown a tendency to stiffen, although quotations do not appear to be higher. All our large iron and steel works are still fully employed, with every prospect of this condition of affairs being maintained during the year. In the East-end further large orders for military material are looked for, and, as additions are also being made to merchant craft, the firms who make a speciality of marine forgings, castings, and similar appliances, are certain to be well employed for a considerable time. The activity noted in railway material is as great as ever, and steel manufacturers have been heavily pressed. In the rolling mills, tilts, and forges full time is being worked, the business done being steady, consistent, and well sustained.

In the lighter trades there is no change to record from what has already been stated. In one important speciality, the manufacture of sheep shears, the accounts given are fairly satisfactory, except in regard to the Cape trade, which has been injuriously affected by the rinderpest and disease. It is not at all probable that the Cape market will be worth much this season. Some very fair business has been done with the South American market, and there seems a gradual tendency to use a cheaper kind of goods, instead of the higher qualities which were ordered at one time. Makers for the Australian markets complain of the fickleness with which shearers forsake one pattern for another. Manufacturers are at their wits' end to know why the shear which was in favour one season entirely drops out the next; but there seems to be a pretty general agreement that, however much they change, the Australian wool-growers find the best article to be most in demand by their shearers. It is encouraging to know that the Russian trade, which is now at its briskest, keeps on the up-grade, and very good business is at present being done.

The cutlery trade cannot be said to be very brisk, but Sheffield silversmiths, electroplaters, edge-tool, file, and saw manufacturers are all satisfactorily employed.

The Sheffield Gas Company has decided to reduce the price of gas by 2d. per 1000 cubic feet.

NORTH OF ENGLAND.

(*From our own Correspondent.*)

A MORE favourable report can be given of the iron and allied industries this week than has been possible for several weeks past, business having shown improvement, though as yet there is nothing like the activity in buying which is looked for at this season of the year.

In this district the poor shipments, especially of pig iron, during the last few weeks have had a depressing influence, for something quite different was looked for, and this slackness led people to form an opinion that we had experienced the best of the revival in trade. However, it is satisfactory to see that there is a change for the better in this respect, as during the last few days a substantial increase has been reported in the pig iron exports, not only to the Continent, but also to Scotland, and there promises to be as good an increase in the shipments of finished iron and steel, for the number of steamers now loading in the Tees is larger than it has been for many months. This month up to Wednesday evening the exports of pig iron from the Cleveland district reached 50,319 tons, as compared with 40,633 tons last month, and 66,481 tons in March, 1897, to 16th. The small-pox epidemic at Middlesbrough has somewhat interfered with shipments from the Tees, as shippers held back whatever iron they could rather than pay the increased freights. As, however, the epidemic is now abating, it is not likely that it will further interfere with exports, and these will probably be all the brisker for having been delayed. Little Cleveland pig iron is going into the public warrant stores, and there is an uninterrupted decrease in the quantity of hematite pig iron held. On the 16th Connal's had 87,603 tons of Cleveland iron in stock, an increase for the month of 1147 tons, while their stock of hematite pig iron was 44,841 tons, or 1322 tons decrease this month.

The price of Cleveland No. 3 G.M.B. pig iron for prompt f.o.b. delivery has this week been kept at 40s. 9d. per ton by the makers, but occasional sales by merchants have been made at 40s. 7½d.; this, however, was early in the week, and since then the market has stiffened considerably. For delivery over next quarter, 41s. had to be paid. Other prices are firm: No. 1 is at 42s. 6d.; No. 4 foundry, 40s.; grey forge, at 39s.; and mottled and white, at 38s. 9d. per ton for early delivery; 3d. per ton more being asked for next quarter.

For mixed numbers of East Coast hematite pig iron 50s. 3d. is quoted, and in exceptional cases 50s. was taken early in the week, but now the full 50s. 3d. is firmly held, though this is almost too high to allow of East Coast makers competing successfully for the Sheffield trade. Sheffield has for some years been one of their principal markets, but such a good local and export business has sprung up that they are not making the efforts to keep the Sheffield trade that they did, and the West Coast makers—who previously had the monopoly of it—are doing the chief part of it. Though the West Coast firms have more to pay for carriage of their pig iron and also for their coke, they are underselling East Coast makers in Sheffield, and at the same time supplying what many consider a better quality of iron.

Foreign ore prices are tending upwards, rubio having advanced 3d. per ton this week, and average qualities delivered in Tees wharves can scarcely be met with under 15s. per ton, this being on account of the advancing freights. Probably the advance in these will be very substantial, as there is a report that the Spanish authorities, who are greatly in want of funds, will endeavour to relieve themselves by, among other things, putting a duty on shipping. This will, in the first instance, have to be paid by the shipowner, but by raising the freights it must eventually come out of the consumer of the ore, and will thus add to the cost of producing hematite iron and steel. This puts ore sellers in a state of uncertainty, and the merchants are not very ready to commit themselves for more than a short time ahead.

Rail makers report good inquiries, especially on Indian account, and they are so well supplied with orders that they keep their mills in full operation, as they have done for more than two years past. Manufacturers are agreed in quoting £4 10s. per ton at works for heavy steel rails. Business in plates and angles is improving, and is already very good, as nearly every shipyard is again in full operation. This week the yard of Messrs. Ropner and Sons, at Stockton, has started on full time. The tendency of prices is more favourable, and Scotch manufacturers having advanced their prices, producers in this district are expected to follow suit. As yet, however, they quote £5 8s. 9d. for steel ship plates, £5 3s. 9d. for steel ship angles, £5 5s. for iron ship plates, and £5 for iron ship angles, all less 2½ per cent. f.o.t. The demand is as good for girder and boiler plates as it is for ship plates, and the bridge builders are very good customers of the platemakers at present. During the period of the engineers' strike the platemakers in this district did a large trade with German shipbuilders, which went far to make up for the loss in local trade. The German platemakers look with envious eyes upon this invasion of their preserves, and they are endeavouring to induce the State Railway authorities to reduce the rates for carriage from their works to the shipbuilding centres to such an extent that they can there undersell the British manufacturer, who has the advantage of cheap carriage by sea. The bar trade is steady, a good demand being reported on home account, and the price for common iron bars is at £5 5s. per ton, less 2½ per cent. f.o.t. Packing iron is about £4 12s. 6d.

It is many years since the shipbuilding industry was so brisk, and at some yards a scarcity of workmen is reported.

In all branches the coal trade is quieter than it was, and there is nothing like the improvement that is to be expected at this time of the year in the steam coal department. Best Northumberland steam coal is now at 8s. per ton f.o.b., and smalls at 3s. Gas coal is in rather quiet request, but there is a large order in the market for Rotterdam. Coke is in fair request, and the average price is 13s. 6d. per ton, delivered equal to Middlesbrough, or 15s. 6d. f.o.b.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been comparatively quiet this week. Speculative business has been limited, but there was a slight reaction from the decline of the past week. Scotch warrants were done at 46s. 2½d. to 46s. 4d. cash and 46s. 5d. to 46s. 6½d. one month. For Cleveland warrants the demand was very backward at 40s. 5d. to 40s. 6d. cash, and 40s. 8½d. one month. Only a very small business was reported in Cumberland hematite warrants, the prices of which have been 49s. 4d. to 49s. 5d. cash, with scarcely any inquiry for delivery in one month. In Middlesbrough hematite there was nothing doing.

While the warrant market is quiet at the moment, a large amount of Scotch-made hematite is constantly going into consumption. Merchants quote for this class of iron 53s. 6d. per ton for delivery at the steel works. It is feared that there may be a scarcity of hematite from England. Stocks of this class of iron are much reduced, both on the Tees and the West Coast. The stocks in Cleveland amount to only 45,000 tons, compared with 100,000 tons at this time last year, while in the Cumberland district they are 182,000 tons, being 114,000 tons less than twelve months ago. These decreases have taken place notwithstanding that in the Middlesbrough district there are three furnaces and in Cumberland five more than at this time last year.

The output of pig iron in Scotland is maintained at what it was a year ago, although there are several furnaces out of blast for re-building. The total number in operation is 81, and of these 35 are producing ordinary, 40 hematite, and 6 basic iron.

The prices of Scotch makers' iron show little change. Govan and Monkland, f.o.b. at Glasgow, Nos. 1, is quoted 47s. 7½d.; Nos. 3, 46s. 3d.; Wishaw and Carnbroe, Nos. 1, 46s. 10½d.; Nos. 3, 46s. 4½d.; Clyde, No. 1, 51s.; No. 3, 47s. 6d.; Summerlee, Calder, and Gartsherrie, Nos. 1, 51s. 6d.; Nos. 3, 48s.; Coltness, No. 1, 52s. 6d.; No. 3, 48s. 6d.; Glengarnock, at Ardrossan, No. 1, 51s. 6d.; No. 3, 46s. 3d.; Eglinton, at Ardrossan or Troon, and Dalmellington, at Ayr, No. 1, 48s. 3d.; No. 3, 46s. 9d.; Shotts, at Leith, No. 1, 52s.; No. 3, 48s.; Carron, at Grangemouth, No. 1, 51s. 6d.; No. 3, 48s. per ton.

Shipments of pig iron from Scotch ports, both coastwise and abroad, are small, amounting in the past week to only 2837 tons, compared with 4871 in the corresponding week of last year. There was sent to the United States 50 tons, India 236, Australia 25, Italy 510, Germany 468, Holland 50, Belgium 20, other countries 125, the coastwise shipments being 1359, compared with 1768 in the corresponding week of last year.

The finished iron and engineering trades are well employed, some departments of the latter being very active. In the steel trade the output continues large, and there is a prospect of the business still further increasing. A large amount of fresh tonnage for private owners is coming forward, and there is every likelihood that a proportion of the new warships will be constructed on the Clyde.

In some of its branches the coal trade has exhibited an improving tendency. There has been more inquiry for the better qualities of ell coal for shipment. Steam and main are in fair request. There is a good demand for house coal, and small coals and dross are in brisk request for manufacturing purposes. The week's coal shipments from Scottish ports amounted to 133,597 tons, compared with 131,472 in the preceding week and 120,124 in the corresponding week of last year. The prices f.o.b. at Glasgow are, for main coal, 6s. 6d.; ell, 7s. to 7s. 3d.; splint, 7s. 3d. to 7s. 6d.; steam, 8s. to 8s. 3d. per ton.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE discussion between the coalowners' representatives and those of the colliers is the leading subject of interest. Two adjourned meetings have been held since my last report, but the conclusion of the last gathering left matters pretty well as they were before. In one respect the men may be said to have shown their hands more than at previous meetings. The adjourned meeting took place on Saturday, at Cardiff, and was well attended by collier delegates. Proceedings were conducted in private, but the Press had an official report supplied at the end. A resolution, proposed by Monmouthshire men, intimated that no sliding scale arrangement should be accepted, unless it gave 10 per cent. in the shilling upon the present standard. Also a 5 per cent advance. This brought on a stream of argument *pro* and *con.*, Mr. D. Morgan declaring his advice to be: "No scheme, no scale; if they had no scheme, no umpire, no control of output, then no scale."

Several of the delegates demanded a minimum. Most of them insisted upon the 10 per cent. One of the Moderate party suggested due consideration, and spoke of the poverty of the people, and their inability to stand a strike or a struggle in the present state of things. In Abertillery many miners were sending their children to beg from door to door, although wages in that district were equivalent to what they were in other parts of South Wales. Ultimately the following amendment to the Monmouthshire resolution was put, and carried by 69 votes to 26 for the resolution. The amendment was as follows:—"That the conference be adjourned to March 22nd, Cardiff, and that the delegates at this meeting return to their constituents and place the matter before them, with a view to obtaining their consent to grant the workmen's representatives on the Sliding Scale Joint Committee plenary powers to effect a settlement of the matters in dispute."

A fair inference, given by the latest impartial consideration of the condition, is that a strike is unlikely. The delegates, with one or two exceptions, show clearly a strong desire to avoid hostilities. Perhaps in this, as on many previous occasions there will be a "give and take." One of the concessions by employers—lookers on say—might be that of a minimum. If coal ran down below a certain figure stop work, but so long as it gravitated between two distinct figures let the collier be apportioned his share. This is the opinion of an old collier, who has now no interest either way, and it is worth quoting as the opinion of a practical worker.

Throughout the past week the coal trade, steam and house, has been in a buoyant condition, and the only complaints have been of short tonnage coming in, and at times short supplies. The total coal exports from Cardiff last week were 320,000 tons; Newport totals, foreign and coastwise, were over 82,000 tons; and Swansea, 34,363 tons. In the Cardiff district stems at all the collieries are well filled for the present month, best steam coal is firmly held at 12s. 6d. to 13s., and sellers, in many cases, state that they are unable to accept new business this month. Best seconds are very scarce at 11s. 6d. to 12s., while ordinary seconds readily fetch 11s. 3d. to 11s. 6d. As regards the dry coal trade, the firmness which has characterised this branch of late is well maintained at prices ranging from 10s. to 11s. per ton. Monmouthshire semi-bituminous for shipment at Cardiff is in strong request, and a larger sale could be easily effected if supplies came in more freely. Westerns are selling at 10s. 6d. to 10s. 9d., and Easterns 9s. 9d. to 10s.

Small steam coal has now touched higher figures than it has for some years past. One of the alleged reasons for this is the quantity banked for emergencies, though there has been for some time a good open demand. Latest prices are as follows:—Special, 7s. 6d., in some cases 7s. 9d. has been had; best ordinaries, 6s. 6d. to 7s.; dry and inferior, 5s. 9d. to 6s. 3d. f.o.b.

House coal is now in fair normal condition, the colder weather and larger demand for bunkering having had a good effect. The inland demand has led to increased prices, but for ordinary shipment prices are as follows:—Best households, 11s. 3d. to 11s. 6d.; seconds, 9s. 9d. to 10s. 6d.; No. 3, Rhondda, 10s. 9d.; brush, 9s. 3d. to 9s. 6d.; small, 8s. 3d. to 8s. 6d.; No. 2 Rhondda, 9s. 6d. to 10s.; through, 7s. 3d. to 7s. 6d.; small, 5s. 3d. to 5s. 9d.

Swansea prices:—Anthracite, 11s. to 11s. 6d.; seconds, 10s. to 10s. 6d.; ordinary, 8s. to 8s. 6d.; small rubbly culm, 4s. 9d. to 5s. 9d. Steam coal, 11s. to 11s. 6d.; seconds, 9s. 6d. to 10s.; bunkers, 8s. to 8s. 9d.; small, 4s. 9d. to 5s. 9d. House coal, No. 3 Rhondda, 10s. 6d. to 11s.; through, 9s. to 9s. 9d.; small, 8s. to 8s. 6d.; No. 2 Rhondda, 9s. 6d. to 10s.; through, 8s. to 8s. 6d.; small, 5s. 6d. to 6s. All Swansea f.o.b., cash thirty days, less 2½.

At Cardiff patent fuel is in good demand, and makers are fairly well sold forward. Last week a large cargo of 3000 tons went to Vera Cruz, and 1400 tons to Barcelona, Prices range from 10s. to 11s. according to brand. Swansea shipments were close upon 6000 tons. Prices, 9s. 9d. to 10s.

In coke increasing firmness is very marked. Furnace coke is at 15s. to 17s.; foundry, 17s. 6d. to 18s.; best washed foundry, 20s. to 20s. 6d.; special, 24s. Iron market is weaker. Tafna, 13s. to 13s. 3d.; best Rubio, 13s. 9d. to 14s. Pitwood, 13s. 9d. to 14s. I note that larger exportation of Irish pitwood from Cork to Cardiff is at present occupying the attention of the Cork Harbour Commissioners, with a view to its extension and improvement. Trench wood has been coming in pretty freely of late.

Wales is evidently regarded as a good place for opening trade. Of late substantial cargoes of old rails have been sent from Waterford and Dublin.

Animation is the distinguishing characteristic of the iron and steel trades, look in what direction one may.

The natural curative of an over-abundance of supply is, clearly, that production should be reduced, and this is now seen very clearly in connection with the tin-plate trade. The receipt of tin-plates from works last week showed a marked falling away, there being a great number of mills laid off. Makers do this now freely rather than undertake orders at low figures, and the result is healthier figures in the trade. Last week the shipments from Swansea totalled 97,766 boxes, while the receipts from works only came up to 48,125 boxes. Present stocks are now only 91,917 boxes. Gratifying accounts come from the Far East. The exports for the Straits Settlements, China, and Japan are advancing rapidly. A good idea of the improved trade is given by returns for February, as compared with February, 1897:—Russia 5288 tons, as against nil; Sweden nil, against 18 tons; Denmark 219 tons, against nil; Germany 880 tons, as compared with 1555 tons; Holland 70 tons, against nil; France 935 tons, against 1019 tons; Portugal 333 tons, against 342 tons; Italy 371 tons, against 1015 tons; Austria 119 tons, against 148 tons; Straits Settlements, 197 tons, against 2095 tons; China 375 tons, against nil; Japan 452 tons, against nil; United States 4312 tons, against 4272 tons; total 13,558 tons, compared with 10,464 tons.

Swansea imported 1310 tons pig, 350 tons scrap steel, and 1260 tons iron ore last week. On 'Change, mid-week, it was reported that there was no new feature to record in connection with pig iron. Prices were affected by the disturbing influences of political news. Scotch, Middlesbrough, and West Coast hematite have fallen in the past week between 3½d. and 5d. Welsh hematites continue in fair demand at last prices. Closing figures generally are as follows:—Glasgow warrants, 46s. 3d. cash; Middlesbrough No. 3, 40s. 6d. prompt; hematite, 51s. Welsh bars, £5 7s. 6d. to £5 10s. Sheets, iron and steel, £6 7s. 6d. to £6 10s. Steel rails, heavy sections, £4 10s. to £4 12s. 6d.; light, £5 10s. to £5 12s. 6d. Bessemer steel bars, £4 1s. 6d.; Siemens, £4 2s. 6d. Tin-plates: Bessemer cokes, 9s. 6d. to 9s. 9d.; Siemens, 10s. to 10s. 3d.; ternes, 17s. 6d., 18s. 6d., to 21s. Best charcoal, 10s. 6d. to 12s. Block tin, £64 17s. 6d. to £66 8s. 9d.

In the Briton Ferry district last week, eighteen mills worked full time. There is now hope of a re-start at the Dafen Works, near Llanelly, if satisfactory terms can be arranged with the men. In the Swansea Valley there are many gratifying signs. The Foxhole dispute in the sheet department has been arranged. The large smelting furnace at Messrs. Wright and Butler's is being rapidly constructed. Improvement is reported at the Beaufort, and additional sets are in construction at Cwmfelin Tin-house. There is a rumour of the possibility of Birchgrove being again started as a steel works. Foundries are rather quiet.

A new era was inaugurated at Llanelly this week by the cutting of the first sod of the new dock. This will be of satisfactory proportions. Its area will be nine acres, length 1000ft., breadth 400ft., quayage 1200ft., depth on sill 27ft., width of entrance 50ft. The work will be conducted under the supervision of Sir Alex. Rendel, consulting engineer, and Mr. C. P. Fowler, resident engineer. The contractor is Mr. Nott. Time, two years.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

As a rule, both makers and manufacturers in the iron and steel department remain moderately well employed; some branches are even reported to show increasing animation, but the tendency of prices, though perhaps inclined to improve for some articles, is generally dull. In Rheinland-Westphalia and in Silesia the position of the iron industry is about the same as in previous weeks. Output of pig iron, which has been slightly reduced lately, meets with ready demand; much the same may be told concerning billets and blooms. The majority of the plate and girder mills have been well occupied upon the week, and prospects are fairly good, it appears; the accounts that are given of the activity in the bar and steel trade are, however, decidedly unfavourable for the present.

Production and consumption of coal and coke in February of present year was:—For the Ruhr district, 3,200,370 t., against 3,174,340 t.; for the Saar district, 535,450 t., against 491,610 t.; for Silesia, 1,157,640 t., against 1,118,150 t.; and for the three districts together, 4,893,460 t., against 4,804,100 t.; which shows an increase of 0·2 p.c. for the Ruhr district, 8·9 p.c. for the Saar district, and 3·5 p.c. for Silesia against the corresponding month last year. Total output and consumption during the first two months of present year was:—For the Ruhr district, 6,565,170 t., against 6,413,450 t.; for the Saar district, 1,094,250 t., against 1,013,690 t.; for Silesia, 2,521,370 t., against 2,371,710 t.; and for the three districts together, 10,180,790 t., against 9,798,850 t.; increase against the same period last year being, for the Ruhr district, 2·4 p.c.; for the Saar district, 8·0 p.c.; for Silesia, 6·3 p.c.; and for the three districts together, 4·0 p.c., or 381,940 t.

The last quarter of 1897 shows the highest figures as regards production and consumption of coal in Silesia for that year as well as for the preceding years. Compared to the year before, the figures are as under:—

	1897. Product.	1897. Consumpt.	1896 Product.	1896 Consumpt.
1st Quarter	5,099,138 ..	4,586,177 ..	4,897,704 ..	4,505,372
2nd „	4,580,870 ..	4,130,241 ..	4,473,004 ..	4,014,303
3rd „	5,343,774 ..	5,035,793 ..	5,051,778 ..	4,672,168
4th „	5,604,179 ..	5,820,314 ..	5,190,703 ..	4,928,033

In spite of the mild winter, which caused a considerable falling off in the demand for house coal, the last quarter shows a strong increase in consumption, which is partly owing to the heavy demand for industrial purposes, and also to the improving export business, which has been favourably influenced by the reductions in freights. Average prices have been good during the last quarter, and the Silesian coal trade in 1897 is altogether regarded as having been quite satisfactory.

The Friedrich Krupp Gruson Works in Magdeburg are reported to have sent one of their managers to Macassar—Dutch East India—for the purpose of negotiating with the directors of the mining company that is working in North Celebes, regarding the forming of a central mining station to work ore that is gained. The establishment is to be erected on the Gold Coast of North Celebes, district Sumalata. One of the most important agency firms of Amsterdam is going to assist in the undertaking, the funds required having already been signed.

In a colliery near Aachen an explosion occurred, causing the death of three colliers, while three others were severely injured.

The number of men employed in the German bicycle manufacture amounts at present to about 90,000, which shows an increase of 35,000 men against 1896. Foreign demand for German bicycles is increasing, several firms having got orders from Japan, where hitherto only English bicycles have been bought, and there are likewise numerous orders coming in from South America, especially from Buenos Ayres and Columbia. The Brennabor Works in Brandenburg, A.H., has recently got a contract for 300 bicyles for South America.

The *Rhenish-Westphalian Zeitung* has published a note, according to which nearly one-quarter of total export in sewing machines and in bicycles from America goes to Germany. Exports were in 1896 and 1897:—Sewing machines worth 3,051,000 dols. and 3,193,000 dols., of which 484,700 dols. and 856,900 dols. fall to Germany; bicycles worth 3,796,000 dols. and 6,902,700 dols., 303,100 dols., and 1,378,600 dols. falling to Germany.

Only very small sales have been effected on the Austro-Hungarian iron market during the week now past, the trade in merchant iron developing much more slowly than was at first anticipated. There is a somewhat better business done in hoops, and for girders, too, a fair inquiry comes in. The machine company Ganz and Co. has acquired the water power of the river Tanaro, in Piemont, with 2000-horse power, which will be sufficient to provide the district within a circle of 25 kiloms. with an electric current.

There is no alteration and certainly no symptom of an improvement to be noticed on the French iron market.

The number of orders that come in on the Belgian iron market continues limited, and the prices realised are, as a rule, pretty low and unremunerative.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, March 9th.

THE latest features of a commercial import are calculated to encourage expenditure in a few of the many long-standing paper industrial enterprises that have been pigeon-holed. The facts regarding railway earnings as just surmised are that 235 railroads having 168,900 miles of track earned last year gross earnings 1,227,884,322 dols., against 1,162,303,527 dols. for 1896, an increase last year of 65,558,795 dols. These include roads in Canada and Mexico. Complete returns will probably show gross earnings last year at 75,000,000 dols. Sales of bonds last week for permanent investment 15,000,000 dols. The banking situation is favourable. There is 7,000,000 dols. gold on its way. Government gold is 168,000,000 dols., and has latterly been increasing at the rate of 1,000,000 dols. The New York banks have 36,000,000 dols. more gold than a year ago.

The iron and steel makers are disposing of their production at living margins, but the pressure is not sufficient to allow strong prices to be asked. The capacity is sold up, but not far enough ahead to warrant an advance. There is still a struggle for business, and low prices prevail. The demand for all manner of finished products is heavy, especially for rolling stock and engines, machinery, boilers, engines. Steam pumps and electrical equipments are still being ordered for early delivery.

The coal trade is improving. The production in Pennsylvania is so far this year not far from 1,000,000 tons in excess of same time last year. Industrial requirements are expanding with regularity. The total volume of business as indicated by bank clearings is over one-half greater than last year. The low level of prices is something of a surprise in view of this fact.

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.

3rd March, 1898.

5190. TIRES, W. Evans, Manchester.
5191. BOXES, J. P. Kelly, Manchester.
5192. BAG, J. Ridings, J. D. Ainsworth, and A. Smith, Manchester.
5193. CRANKS, C. Keightley, S. Tozer, and W. H. Keightley, Teignmouth, Devon.
5194. ROAD SCARIFIERS, R. and B. Bomford, and H. Evershed, Birmingham.
5195. LEATHER ARTICLES, P. A. Martin, Birmingham.
5196. ATTACHING ARTICLES to VELOCIPEDES, H. Halford, Bristol.
5197. PHOTO-MECHANICAL ENGRAVING, E. S. Padmore, Marple Bridge, Derbyshire.
5198. LOCKING a COMPARTMENT of a TRAIN, R. R. Meacock and E. P. Dix, London.
5199. MECHANICAL ADVERTISEMENTS, F. W. Hayward, Norwich.
5200. WRENCHES for CYCLISTS, J. Reid, Millom, Cumberland.
5201. SORTING FLAX, M. Montgomery and W. B. Morton, Belfast.
5202. CLOSING ENVELOPES, H. Smith, Sheffield.
5203. CHAIRS, T. M. Grant, Glasgow.
5204. FEEDING MACHINERY with WOOL, J. W. Tinker, Huddersfield.
5205. WEAVING, R. Heggie, jun., Dundee.
5206. CARRYING FIRE SCREENS, A. D. Mathews, Birmingham.
5207. COMBINATION GARMENTS, R. Pringle, Nottingham.
5208. GAS VALVES, The Actiengesellschaft für Fabrikation von Broncewaaren und Zinkguss, vorm., J. C. Spinn and Sohn, and S. J. von Romocki, Manchester.
5209. SLINGS for RIFLES, H. A. Bullock, London.
5210. TELESCOPIC TABLES, J. Paton and H. Currie, Glasgow.
5211. SPROCKET WHEELS, J. Liddle.—(*J. Kidd, United States.*)
5212. BREAD-CUTTING MACHINES, R. Semler and I. Sauer, Berlin.
5213. MUD-GUARD for CYCLES, C. and H. Adamy, Berlin.
5214. SCORING PORK, A. E. Jerram and H. J. Taylor, London.
5215. CASE for HOLDING JEWELLERY, T. B. Lambourne, Birmingham.
5216. HOLDING LIQUIDS, F. A. Bird, Birmingham.
5217. WATER VELOCIPEDES, R. Freitag, London.
5218. PRINTING PLANS, J. A. Sackville and J. H. Swallow, Manchester.
5219. STEAM SUPERHEATERS, J. H. Rosenthal, Glasgow.
5220. STEAM SUPERHEATERS, J. H. Rosenthal, Glasgow.
5221. FILTERING APPARATUS, T. F. Seitz, Glasgow.
5222. SHUTTLE BLOCKS, O. W. Schaum, London.
5223. WATER WHEELS, F. Jacob, London.
5224. INCANDESCENT GAS MANTLES, C. E. J. Berthold, Manchester.
5225. FIRE-GRATES, G. C. Marks.—(*A. Couillaud and J. Besombes, France.*)
5226. CLIPS for CYCLES, H. Lucas and A. C. Davison, London.
5227. ELEVATED DRAWING BOARD, F. Haslam, Cheltenham.
5228. MATCH-BOX, H. S. Basnett and J. R. Nesbitt, Edinburgh.
5229. NON-SLIPPING HORSE SHOE, A. J. Roberts and G. Crees, Lea Hall, near Ross, Herefordshire.
5230. TOBACCO PIPES, C. Millington, Leytonstone, Essex.
5231. GLOBES, A. Biddles, Leicester.
5232. HANDLE BAR for CYCLES, H. H. Neale, Birmingham.
5233. BOOT HEEL, C. J. Chapman, London.
5234. PAPER BAG, W. F. and H. J. G. Ball, Birmingham.
5235. HARNESS, L. P. Ford, London.
5236. PAPERMAKING, W. Benson, London.
5237. ORNAMENTATION of FABRICS, K. J. M. Aston, Leicester.
5238. PREVENTING LADDERS from SLIPPING, I. N. H. Watson, Kingswear, South Devon.
5239. TIRE, J. F. Hyde, Slough.
5240. HOT PLATES, G. B. Waddell, Glasgow.
5241. FRAMES for VELOCIPEDES, W. T. Wilson, London.
5242. AERATING FILTERS, P. H. Palmer and F. Candy, London.
5243. TILLER, G. Harris, Laleham, near Staines.
5244. FIRE-BRICKS, J. S. Pullan and W. H. Mann, London.
5245. VELOCIPEDES, J. Smith and H. Dickinson, London.
5246. TIRES, H. Y. Dickinson, London.
5247. SPINNING, J. Marjerison, London.
5248. METAL BOXES, J. Gersant and A. G. Buttifant, London.
5249. BOILERS, C. A. Allison.—(*J. C. Parker, United States.*)
5250. STEAM ENGINES, C. A. Allison.—(*J. C. Parker, United States.*)
5251. OIL LAMPS, C. S. and A. W. Pocock, and R. H. Bishop, London.
5252. PORTABLE EXPLORING X-RAY LAMP, A. E. Dean, London.
5253. BENDING RIMS, S. T. Richardson and R. Price, Birmingham.
5254. TIRE, S. T. Richardson and R. Price, Birmingham.
5255. STOPS and HOLDERS for DOORS, E. B. Ludlow, Birmingham.
5256. ATTACHMENTS for HATS, P. L. Deighton, London.
5257. COLOURING MATTERS, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
5258. ATTACHING ROLLER BLINDS, R. F. Shillingford, London.
5259. SELF-PROPELLED VEHICLES, The British Motor Co., Ltd.—(*L. Didier, France.*)
5260. BATTERY, E. A. Mitchell, London.
5261. CHIMNEY POTS or VENTILATING TERMINALS, J. Walker, Liverpool.
5262. BRAZELESS CYCLE FRAME JOINT, J. Seil, Birmingham.
5263. CARTRIDGE HOLDERS for FIRE-ARMS, S. M. McClean, London.
5264. SALT, J. G. Shearer and W. H. Flett, Ltd., Liverpool.
5265. AUTOMATICALLY CHECKING MOTION, H. G. Sadgrove, Birmingham.
5266. BRACES, D. D. Esson, London.
5267. BRACES, D. D. Esson, London.
5268. BOTTLES, W. B. Fitch, London.
5269. BOTTLES, W. B. Fitch, London.
5270. COLLAPSIBLE ARCHED WINDOW BLINDS, G. Wells, London.
5271. COMPOSITION of MATERIALS, W. H. Akester, London.
5272. PUMPING APPARATUS, A. Samson and W. Gilbert, London.
5273. AUTOMATIC COUPLINGS, E. Edwards.—(*I. Kohler, Germany.*)
5274. RACKETS for USE in LAWN TENNIS, G. H. Shepherd, London.
5275. CARPET-STRETCHING APPARATUS, H. Rosar, London.
5276. CHAIRS, H. B. Banes, London.
5277. PIANO STOOL and MUSIC CABINET, H. B. Banes, London.
5278. SHADES for INCANDESCENT LIGHTS, S. Biheller, London.
5279. PRESSES, C. Schumacher, London.
5280. SUPPORTING POSTS, A. W. Gamage and A. E. Lock, London.
5281. CRUSHING MACHINE, A. F. and A. G. Beyer, Edinburgh.
5282. COMBINING TRUNKS with AIR-TIGHT CASES, H. W. Poole, London.
5283. LAST, W. W. Cabena, London.
5284. TRUNKS, F. Hirschler, London.
5285. ORDNANCE, A. T. Dawson and G. T. Buckham, London.
5286. NITRO-CELLULOSE, A. Luck and C. F. Cross, London.
5287. COIN-FREED MECHANISM, R. Haddan.—(*M. Vidal, France.*)
5288. GLOBES for INCANDESCENT LAMPS, P. Herre, London.
5289. TIRES, H. D. Paterson, London.
5290. INKSTAND, G. Cotterell and J. G. Hickson, London.
5291. DRIVING GEAR for CYCLES, C. G. J. Schultz, London.
5292. PREVENTING CASKS GETTING FOUL, J. B. Smelt, Exeter.
5293. CHLORINE, P. Naef, Birmingham.
5294. PRINTING by MEANS of X-RAYS, G. Izambard, Paris.

4th March, 1898.

5295. COMBINED MUDGUARD for CYCLES, J. Crabtree, Lincoln.
5296. SECURING TAPES of VENETIAN BLINDS, J. Pearson, Birmingham.
5297. SHIRT STUD or FASTENER, J. W. Middleton, Liverpool.
5298. MOTORS, C. and H. Roe, and H. Knight, Birmingham.
5299. POSTAL WRAPPER for PHOTOGRAPHS, H. W. Boughton, Thetford.
5300. LIGHTING TRAINS, R. R. Meacock and A. J. Harper, London.
5301. "THE RUSH to KLONDYKE," W. Clark, Kirkby, near Liverpool.
5302. ENGINES, J. Southall, Worcester.
5303. WATCH GLASSES, G. Pelmear and W. H. Cummings, Middlesbrough.
5304. DOMESTIC FIRE-ESCAPE APPARATUS, J. Thompson, London.
5305. WRITING, J. A. A. Percebois, London.
5306. MAKING LIDS, J. King and W. G. Barrett, Stoke-on-Trent.
5307. PANS, H. J. Savery, Bristol.
5308. SEED DRILLING MACHINES, D. Belcher and Richmond and Chandler, Ltd., Manchester.
5309. JARS, N. Neville, Halifax.
5310. SYPHONS, F. M. Sims and T. Bardsby, Manchester.
5311. PRINTING MACHINES, J. A. Sackville and J. H. Swallow, Manchester.
5312. MECHANICAL OIL SPRAY, W. E. Maddock, Burslem.
5313. HAIR CURLERS, J. F. M. Bennett, Wolverhampton.
5314. FIRE-ESCAPE LADDERS, W. Rose and J. G. Hall, Manchester.
5315. AIR ENGINES, G. and F. M. James, Liverpool.
5316. CASE for TRANSPORTING EGGS, J. Motz, Brussels.
5317. APPARATUS for MANUFACTURING ACETYLENE GAS, E. Bauer, F. Fried, and J. Bredel, Brussels.
5318. MANUFACTURING OIL-CAKES, J. Kraus and E. Debo, Brussels.
5319. CALENDARS, J. Sim, Glasgow.
5320. COMBINED CAMERA DIAPHRAGM, J. Stark, Glasgow.
5321. BALANCED VALVE, R. T. Walker and R. Wilson, Glasgow.
5322. AUTOMATIC TRAVERSE MOTION, A. Dewar, Dundee.
5323. WEAVING of TEXTILE GOODS, R. Heggie, jun., Dundee.
5324. CYCLE DRIVING GEAR, J. Crosby, Sheffield.
5325. BOILERS, La Société Anonyme Du Temple and H. Brillié, London.
5326. SEALING BLOCK, A. Chapman, Lincoln.
5327. HANDLE BAR for BICYCLES, A. Merritt-Henry, London.
5328. SHAFTING, W. Clegg, Bradford.
5329. CAN OPENERS, A. Pass, Liverpool.
5330. CLOSING WATER-TIGHT DOORS, W. and A. R. Crawford, Glasgow.
5331. CYCLE STANDS, J. Pumphrey, Birmingham.
5332. DRIVING CYCLES, J. H. Teale, London.
5333. CONDENSING APPARATUS, L. Sterne, London.
5334. REVERBERATORY MELTING FURNACES, A. J. P. Whitaker, London.
5335. FEED BAGS for HORSES and CATTLE, T. Peel, Surbiton, Surrey.
5336. REGULATING the SUPPLY of GAS, T. E. Barralet, London.
5337. SHUTTLES for LOOMS, B. Mortimer, London.
5338. STEAM BOILERS, D. Adorján, London.
5339. TRANSMISSION of LIGHT, A. E. Lardeur, London.
5340. DRAIN PIPES, H. Fowler and J. E. Willcox, London.
5341. DRESSING and MOULDING STONE, F. Trier, London.
5342. CONTROLLING FLASH-LIGHTS, C. and T. H. White, London.
5343. IMPREGNATING FABRICS with FLUIDS for ELECTRIC LIGHTING PURPOSES, F. P. Foster and G. Puchmüller, London.
5344. IMPREGNATING FABRICS with FLUIDS for ELECTRIC LIGHTING PURPOSES, F. P. Foster and G. Puchmüller, London.
5345. CARDS for FORTUNE TELLING, R. J. Walker, London.
5346. AUTOMATIC DRILLING MACHINE, A. Bug, London.
5347. TREATMENT of SULPHIDE ORES, J. B. de Alzugaray, London.
5348. MOTOR VEHICLES, J. R. Rickard, London.
5349. BOTTLES, L. M. Thomas, London.
5350. WHEEL for ROAD VEHICLES, L. C. Mason and J. C. Cook, London.
5351. PRODUCTION of HARD STONES, P. A. Winkler, Leipzig.
5352. INFLATING PNEUMATIC TIRES, R. W. Leeming, Kendal.
5353. DRAWING GEAR for BICYCLES, D. E. Norton, London.
5354. CONSUMPTION of SMOKE, J. W. Meek, Glasgow.
5355. COMPOSITION for BURNING in CYCLE LAMPS, J. R. Asbury, Glasgow.
5356. LOWERING and RAISING BOATS, T. Dillon, Glasgow.
5357. ARTILLERY FORT, A. T. Dawson and G. T. Buckham, London.
5358. TRAYS for TEA-DRYING MACHINERY, S. C. Davidson, London.
5359. NOZZLES for BUNSEN BURNERS, R. T. and J. G. Glover, London.
5360. CLAMP for JOINERS, H. Smith, R. J. Collins, and P. O'Donnell, London.
5361. OIL LAMPS, E. Berchten.—(*Schwintzer and Gräff, of Germany.*)
5362. DRESS PRESERVERS, F. C. Oliver, London.
5363. WRITING NIB, J. T. L. Davies, London.
5364. BRAKES for VELOCIPEDES, J. H. and R. B. Harrison, London.
5365. KNIFE CLEANERS, F. R. Lloyd, London.
5366. CALENDERING ROLLERS, E. Lehmann, London.
5367. CIGAR MANUFACTURE, J. Wetter.—(*F. W. von Pittler, Germany.*)
5368. PRODUCING SATIN STRIPS upon COTTON FABRICS, S. H. Sharp, London.
5369. FLOATING DOCKS, E. Box, London.
5370. LOCOMOTIVE ENGINES, J. A. F. Aspinall, Manchester.
5371. DRIVING GEAR for VELOCIPEDES, J. A. N. and C. B. H. Rasmussen, London.
5372. DRIVING GEAR for VELOCIPEDES, J. A. N. and C. B. H. Rasmussen, London.
5373. ANTI-FOULING COMPOSITIONS, J. F. Dell, London.
5374. CANDLE LAMP for CYCLES, J. W. Martin, London.
5375. PLASTERING of WALLS and CEILINGS, J. Bassett, Birmingham.
5376. DEPRIVING COAL of MOISTURE, J. H. Darby, Liverpool.
5377. LITHOGRAPHIC MACHINES, F. Sheridan and J. A. Heaps, Liverpool.
5378. FREEZING MEAT, H. Rouart, Liverpool.
5379. TELEPHONE CABLES, W. T. Henley's Telegraph Works Company, Limited, and G. Sutton, London.
5380. MILK CAN, The Friern Manor Dairy Farm, Limited, and C. H. Taylor, London.
5381. REDUCING VALVES, J. E. L. Ogden, London.
5382. CYCLOMETERS, W. Nickalls and A. da Silva, London.
5383. VESSEL PROPELLER, R. C. Westphalen, London.
5384. SOUNDING BOARDS, R. Haddan.—(*C. Schmidtlein, Germany.*)
5385. ENGRAVING MACHINERY, N. Dedrick, London.
5386. DISPLACING MUSIC MACHINERY, T. A. Plessing, London.
5387. SPRING FRAMES for VEHICLES, A. J. Boult.—(*J. Truffault, France.*)
5388. DRIVING GEAR for SELF-PROPELLED VEHICLES, The British Motor Company, Limited.—(*Daimler Motoren Gesellschaft, of Germany.*)
5389. AGITATING the WATER in BOILERS, J. C. A. Griese, London.
5390. STEERING HANDLES for BICYCLES, B. Davies, London.
5391. NUMERATION and NOTATION FRAME, G. Horsfall, Birmingham.

5th March, 1898.

5392. BOOT HEELS, D. McNabb, A. Livingston, and J. Cochrane, London.
5393. CRAYON HOLDERS, F. M. Rugeley, London.
5394. NUT-LOCK, W. Buffington, London.
5395. LAMP CHIMNEY-CLEANING MACHINES, S. Larson, London.
5396. SURFACES of ICE for SKATING, T. Hewett, London.
5397. LOCK-NUT, C. A. Houfton, Shirebrook, near Mansfield.
5398. GAME MANUFACTURE, D. G. and A. S. Rose, London.
5399. IRON RIMS for RUBBER TIRES, S. Johnson, London.
5400. CRANKS, C. M. Johnson, London.
5401. BREAD CUTTER, J. W. Brown and W. H. Exley, Eccleshill, near Bradford.
5402. CONSTRUCTION of TRUSS, R. Hope-Jones, Birkenhead.
5403. GEAR WHEELS and GEARING, W. H. Monk, Coventry.
5404. FIRE-ARM EJECTOR MECHANISM, T. Dykes, Birmingham.
5405. APPARATUS for USE in WASHING, C. Meakins, London.
5406. DEVICE for FASTENING BOOT LACES, A. Kotin, London.
5407. ABSTRACTING IMPURITIES from COAL, H. Kirkham, London.
5408. STERILISING INFANTS' FOOD, B. Vornhecke, London.
5409. LAMPS, F. W. Harbord and G. M. Minchin, Englefield Green, Surrey.
5410. ANIMATED PHOTOGRAPH PROJECTORS, H. W. Joy and W. Bainton, Bristol.
5411. CHAFF-CUTTING MACHINES, J. Gillingham, Chard, Somerset.
5412. BOILERS, A. E. Smith, Burnley.
5413. CRICKET BATS, T. Coop and J. Kay, Manchester.
5414. TIRES, J. Crabtree, London.
5415. CONSTRUCTION of FIRE SCREENS, R. H. Best, London.
5416. SECURING CRANKS to BICYCLES, H. Tarbuck, London.
5417. LAMP, C. Collins, O. W. Horobin, and R. W. Brett, London.
5418. ELECTRIC TELEPHONY, C. Adams-Randall, London.
5419. DOLLS, P. Eadié, jun.—(*L. S. Liversedge and P. E. Rea, United States.*)
5420. EXHIBITING GOODS, J. Redman, Halifax.
5421. BRUSH-SCRAPING ATTACHMENT, E. T. Blakeley, London.
5422. PIANOFORTES, T. C. Lewis, London.
5423. ELECTRIC SWITCHES, J. Goddard, Ashton-under-Lyne.
5424. COVERING BOXES, A. H. Stevenson and N. B. Chadwick, Manchester.
5425. METAL CANISTERS, P. J. N. Gelston, Northampton, London.
5426. SHOW BOXES, G. Gould and J. W. Moss, Manchester.
5427. LAVATORIES, W. Cassels, Kirkintilloch, near Glasgow.
5428. BOOT LACES, J. Paton, Glasgow.
5429. UPSETTING IRON BARS, F. Tilly and P. Fischer, Berlin.
5430. PNEUMATIC TIRES, W. and L. H. Swain, Keighley.
5431. HOLDING DEVICE, B. Holmes and I. H. Wright, Keighley.
5432. DRIVING GEAR, W. Anyon, Manchester.
5433. COPYING DOCUMENTS, W. G. Heys.—(*N. Ponsolle, France.*)
5434. SPEED REGULATORS, S. Drummond and T. Abbott, Bradford.
5435. PENHOLDER, C. J. Biddiss, London.
5436. FASTENERS for WINDOWS, J. Somerville, Edinburgh.
5437. SOUNDING APPARATUS, J. C. Dobbie, Glasgow.
5438. TIRES, J. H. Price, Birmingham.
5439. CHECKING ROTARY ACTION, J. G. T. Lee, Birmingham.
5440. CYCLE DRIVING GEAR, J. G. T. Lee, Birmingham.
5441. MACHINERY for CRUSHING ORES, T. Lees, Glasgow.
5442. REVERSING VALVES, T. Lauder and J. Ross, Glasgow.
5443. SWING MIRRORS, J. Paton and Hamilton-Currie, Glasgow.
5444. APPLYING POWER, W. W. and T. A. Barton, London.
5445. FIRE-LIGHTER, F. Mercereau, London.
5446. WAGON WHEEL, B. Turowski and J. Zarsky, Brussels.
5447. ARM PADS for CRUTCHES, J. Walker, Glasgow.
5448. SCRAPERS for GARDEN ROLLERS, A. J. Smith, London.
5449. INDICATING ELECTRIC CURRENTS, W. D. B. Duddell, London.
5450. CIGAR PIERCER and CUTTER, T., H., and W. Crookes, London.
5451. IRONING PADS, L. J. Crossley, F. Sutcliffe, and A. V. Kergon, London.
5452. METHOD of STORING CYCLES, E. S. Copeman, Kensington.
5453. FEED APPARATUS, W. P. Thompson.—(*A. Wegmann-Hauser, Switzerland.*)
5454. BRUSHES, A. Willis, London.
5455. FARE-COLLECTING BOXES, R. Marston and F. Tidswell, Liverpool.
5456. ACETOPHENONPHENETIDIDE, F. Valentiner, London.
5457. PUMPS, E. Williams, London.
5458. EMBROIDERY MACHINERY, E. and R. Cornely, London.
5459. OPENING SEALED CANS or CASES, J. H. Jack, London.
5460. WORD-WRITING MACHINES, C. C. Balston, New York, U.S.A.
5461. FASTENING RAILWAY FISH-PLATES, J. M. Dowsett, London.
5462. SCREW PROPELLERS, T. Makepeace and A. S. Fowles, London.
5463. APPARATUS for HOLDING CYCLES, J. Harrington, London.
5464. FASTENING MUSICAL PIPES, J. T. Hanson, London.
5465. CONSTRUCTION of CYCLE WHEELS, S. Harper, London.
5466. SOUNDING BOARDS, R. Haddan.—(*C. Schmidtlein, Germany.*)
5467. COIN-FREED APPARATUS, J. O. Tonkin, London.
5468. COIN-FREED VENDING MACHINES, J. O. Tonkin, London.
5469. ELECTRIC TRACTION, A. J. Boult.—(*J. P. Anney, France.*)
5470. VULCANISING APPARATUS, H. J. Doughty, London.
5471. AIR CUSHION TUBES, H. J. Doughty, London.
5472. EARTH SCOOPS, J. Conrad, London.
5473. TIRES, F. G. Waddington, London.
5474. BOOT STRETCHER, J. Hewitt, London.
5475. DYEING VATS, J. and L. Bündgens, London.
5476. WATER-TUBE BOILER, J. H. Toulmin, T. Coulthard, jun., and W. Norris, London.
5477. OBTAINING TUBERCULOSIS TOXINS, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
5478. ELECTRIC CURRENT TRANSFORMER, J. A. McMullen, London.
5479. ACETYLENE APPARATUS, W. Faludi, London.
5480. HOSE SUSPENDER, A. C. A. Hutton, London.
5481. EXTRACTING ACID from LIQUIDS, W. Coleman, London.
5482. TIRES, R. D. Sanders, London.
5483. COVERING for PADDED FRAMES, S. Pocock, London.
5484. PUZZLES, C. J. Croft and F. E. Dannell, London.
5485. PHOTOGRAPHIC PROJECTING MACHINES, W. V. Miller, G. P. Rice, and E. B. Dunn, London.
5486. WATER-CLOSETS, S. Jennings and J. Morley, London.
5487. APPARATUS for WASHING BED-PANS, S. Jennings, London.
5488. MAKING TEA, The Aerated Bread Co., Ltd., and J. Sanways, London.
5489. SUPPLY of LIQUID, H. H. Lake.—(*La Compagnie Continentale d'Incandescence et de Chauffage [systemes Franck et Poitrimol], Belgium.*)
5490. BOOT HEELS, H. H. Lake.—(*F. McDonald, United States.*)
5491. BOTTLE LABELS, H. H. Lake.—(*J. C. Stedman, United States.*)
5492. FIREPROOF DOORS and FRAMES, A. de Man, London.
5493. HOOKS and EYES, H. H. Lake.—(*J. W. Burke, United States.*)
5494. CLIPS or BANDS for SCAFFOLDING, V. Berrurier, London.
5495. CORSETS, J. Tinsley, London.
5496. CHARGING BLEACHING POWDER CHAMBERS, W. W. McLauchlan, Manchester.
5497. PRODUCING ACETYLENE GAS, L. P. Hvüd, London.
5498. GENERATING and USING ACETYLENE, L. P. Hvüd, London.

7th March, 1898.

5499. MACHINE for PROPELLING BALLOONS, F. W. Bennett, London.
5500. CYCLE HUBS, J. N. Birch and W. B. Leech, Birmingham.
5501. REGULATING the PRESSURE on ELECTRIC MAINS, J. S. Highfield, Stafford.
5502. CYCLE GUARDS, A. Winser, Bristol.
5503. VALVES for PNEUMATIC TIRES, W. Burton, Nottingham.
5504. HOLDING UPRIGHT TUBES in SHOP FITTINGS, W. H. Wilton, Birmingham.
5505. WIRE NAIL, A. E. Gorse and G. A. Probert, Worcester.
5506. ROLLERS for DYEING APPARATUS, F. L. Spicer, Manchester.
5507. RAISING SUNKEN SHIPS, J. B. Pegden, Hull.
5508. STOVES, E. W. T. Richmond, Liverpool.
5509. CYCLING SKIRTS, J. Tenenbaum and L. Stillmann, Liverpool.
5510. LOCKING TIP CARTS, W. Wilson, Crosshouse, near Kilmarnock.
5511. DRYING YEAST for FOOD, W. Wardle, Burton-on-Trent.
5512. HAT PINS, F. Reast, Hastings.
5513. LADIES' UNDERCLOTHING, A. L. Baird, Broughty Ferry.
5514. BRONZING PAPER, F. G. Job, E. Marsden, and J. A. Hunter, Bradford.
5515. HINGING WINDOW SASHES, G. C. Brown, jun., Glasgow.
5516. SYPHON TRAPS for BASINS, H. Hobson, Stoke-on-Trent.
5517. CYCLE FITTINGS, T. H. Fleming, Douglas, Isle of Man.
5518. CYCLE FITTINGS, T. H. Fleming, Douglas, Isle of Man.
5519. LIME-LIGHT JET, W. Maddison and A. Frew, Durham.
5520. NON-PUNCTURABLE TIRE for CYCLES, H. Pace, London.
5521. COWLS for PREVENTING the DOWN-BLOW of SMOKE, E. J. R. Coxhead, London.
5522. WATCH PROTECTOR, R. G. Ker, London.
5523. SLATING HOUSES, H. Boddy and J. R. Davidson, Ripon.
5524. WARP STOP MOTIONS of LOOMS, S. W. Gillett.—(*J. F. Dustin and The Parkhill Manufacturing Company, United States.*)
5525. DOUBLING-FRAME TRAVELLERS, P. Bazin, Manchester.
5526. CYCLE TIRES, C. L. Jackson and J. Edge, Manchester.
5527. INCANDESCENT GAS BURNERS, W. Hooker and R. Morrell, London.
5528. MACHINE for WASHING BOTTLES, C. B. Inman, Leeds.
5529. IDENTIFYING BUTTER, R. Palmer, Manchester.
5530. FACING for LADIES' SKIRTS, J. Hallworth, Manchester.
5531. PLAYING GAMES of SKILL, H. Wright and G. Turner, Birmingham.
5532. EXHIBITING CYCLORAMIC VIEWS, T. W. Barber, London.
5533. FUSE HEADS for BLASTING, W. A. and S. R. Malson, Sheffield.
5534. SADDLE PROP for BICYCLES, W. Brenneisen, Germany.
5535. SHAPED ARTICLES, C. Wittkowsky, Berlin.
5536. LAWN TENNIS BATS, F. H. Ayres and G. E. Potts, London.
5537. SAFETY PETROLEUM CAN, E. Ravey, Brussels.
5538. PRODUCING ACETYLENE GAS, L. J. Dedecker, Brussels.
5539. WOODWORK for PIANOFORTE CASES, A. F. Slatter, Grimsby.
5540. MOSS KILLER, J. Logan, Glasgow.
5541. WINDOW SAFETY, E. B. Poyser, London.
5542. BOBBINS for SEWING MACHINES, W. Eiselt, jun., London.
5543. JUNCTIONS of CYCLE FRAMES, J. H. Copeland, Birmingham.
5544. FOG-SIGNALLING APPARATUS, J. Woods, Woodford Green, Essex.
5545. PHOTOGRAPHIC CHANGING BOXES, H. Posen, Paris.
5546. CYCLE STAND, A. Thompson and T. Tucker, London.
5547. BOXES for HOLDING MAGAZINES, W. Neil, London.
5548. CHIMNEY FLUES, F. J. White, London.
5549. JOINING LEAD and POTTERY PIPES, J. W. Moore, London.
5550. ELECTRIC MACHINERY, M. T. Pickstone, R. S. Portheim, and A. C. Peebles, Edinburgh.
5551. BALL JOINTS for GAS PENDANTS, E. D. Burkitt, London.
5552. DRAIN TRAPS, T. R. Waite, London.
5553. SCREW STOPPERS for BOTTLES, A. R. Wilson, London.
5554. BAND BRAKES for BICYCLES, A. B. Wilkins, London.
5555. FOG SIGNALS, E. A. B. Bowden and M. C. I. Partridge, London.
5556. PNEUMATIC TIRES, O. M. Smith and L. W. Bradley, London.

5557. SECURING ELASTIC to HATS, A. Grant, Birmingham.
5558. COUPLING, J. Morgan, J., C., A. E. A., and F. Scherber, London.
5559. BRAKING FIBROUS PLANTS, F. J. Mazier, London.
5560. HOLDER for CARBON BRUSHES, A. L. Armstrong, London.
5561. AIR PUMP, G. E. Brown and R. F. Adams, London.
5562. INFLATING VALVE, G. E. Brown and R. F. Adams, London.
5563. GAS IGNITERS, H. H. Böhndel and A. von Ticholka, London.
5564. LAMPS, G. Birch, W. Reilly, and J. T. Cowman, Manchester.
5565. TRESSELS, C. A. Day, T. Burgess, L. H. Renshaw, and J. J. Burgess, Manchester.
5566. LAMPS, B. Pierpoint, Manchester.
5567. SLICING GERMAN SAUSAGES, W. A. van Berkel, Liverpool.
5568. NICKEL BRONZE, P. E. Secrétan, Liverpool.
5569. IRON CASTINGS, S. Hufty and J. K. Caldwell, London.
5570. MOTOR VEHICLES, J. Y. Johnson.—(*A. L. Riker, United States.*)
5571. ELECTRICITY, W. T. Carter, J. A. Dawson, and T. Gray, London.
5572. PEDALS, W. B. L. Graham-Toler, London.
5573. FILLING CIGARETTE TUBES, G. F. Zimmer, London.
5574. SHOES, G. Lemon, London.
5575. SHOES, G. Lemon, London.
5576. ROTARY ENGINES, L. Labois, London.
5577. ENGINES for OPERATING PLOUGHS, G. Woolnough, London.
5578. GAS, G. F. Dinsmore, London.
5579. PREVENTING INJURY to CYCLES, J. L. A. Aymard, London.
5580. CHAIRS, F. Littlewood, Manchester.
5581. DOG'S KENNEL, F. Laska, London.
5582. TOOL, W. G. Muyderman, London.
5583. WATER METERS, W. L. Wise.—(*The "Kölner Wassermesserwerke" Gesellschaft mit beschränkter Haftung, Germany.*)
5584. ELECTRIC SWITCHES, A. B. Kistritz, London.
5585. INCANDESCENT MANTLES, A. M. Clark.—(*Süddeutsche Glühkörper Fabrik F. Sauer, Germany.*)
5586. DISH WASHERS, C. Fellows, London.
5587. SEWING MACHINES, P. H. Hewitt, E. A. Cockle, and C. Matthews, London.
5588. SEWING MACHINES, P. H. Hewitt, E. A. Cockle, and C. Matthews, London.
5589. FASTENINGS for WINDOWS, F. J. J. Gibbons, London.
5590. MICROPHONES, A. H. Sköld, London.
5591. ARMOUR PLATES, H. A. Royce and W. Beardmore, London.
5592. BRAKE for VELOCIPEDES, W. E. K. Shore, London.
5593. COLOURING MATTER, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
5594. ACETYLENE GAS, C. H. P. Schlüter and C. L. F. Lüdemann, London.
5595. LANTERNS for STREETS, J. H. Sheldrake, London.
5596. ELECTRIC ARC LAMPS, S. Bergmann, London.
5597. CLOSING VESSELS, J. Goriup, London.
5598. FEED-WATER PIPE ARRANGEMENT, C. Reich, London.
5599. GLOVE FASTENERS, H. Sauer, London.

8th March, 1898.

5600. UMBRELLAS, B. J. B. Mills.—(*C. H. Ely, J. W. Danser, and F. B. Rae, United States.*)
5601. SHUTTLES, W. Schalck, Barmen, Germany.
5602. RAILWAY MILK CHURN COVERS, T. Grayson, Derby.
5603. PURIFICATION PROCESS, J. J. Deery, London.
5604. GLAND-COCKS for STEAM ENGINES, J. O'Neil, London.
5605. LOOM SHUTTLES, R. Crompton and H. Wyman, London.
5606. LOOM SHUTTLES, R. Crompton and H. Wyman, London.
5607. BRUSHES for CLEANING CYCLES, T. J. Pickford, Leeds.
5608. ORTHOPTIC SIGHTING DEVICES, H. Andrews, London.
5609. TUNDISH, H. P. and T. Glazebrook, Northwich, Cheshire.
5610. SMEARING FLY PAPERS, T. Kay and Kay Bros. Ltd., Stockport.
5611. METHOD of DRAWING WIRE, A. T. Gorse and G. A. Probert, Worcester.
5612. GLASS PANELS, L. Mondron, London.
5613. SHAFT for SCREW PROPELLERS, F. W. Lanchester, London.
5614. BALL BEARINGS, T. W. Blumfield, London.
5615. CYCLE GEAR CASE, J. Parr, Leicester.
5616. HANGING DESK TABLE, R. F. Barry, Parsonstown, Ireland.
5617. NEW LIFTER for CARRIAGE WHEELS, E. Berry, London.
5618. TIRES, G. L. Scott, Manchester.
5619. REFINING ANIMAL SUBSTANCES, J. Williamson, Glasgow.
5620. BRUSH for POLISHING MACHINES, J. Cooper, Manchester.
5621. BICYCLES, H. Tee, Liverpool.
5622. MANHOLES, G. W. Beldam, Liverpool.
5623. SPRING STEERING STEM for CYCLES, D. Edwards, Liverpool.
5624. ELECTRIC ALARMS, G. T. Moore, Dublin.
5625. NEEDLE PROTECTOR, M. Fox, London.
5626. CARRYING and STORING CYCLES, J. McCleery, London.
5627. SAFETY BOLT for RIFLES, L. B. Taylor and E. H. Parsons, Birmingham.
5628. SEWAGE TANK COVERS, H. Grimshaw and J. Barnes, Accrington.
5629. CAN OPENER, J. Chapman, Nottingham.
5630. BORING HOLES, A. M. and W. C. Walker and R. C. Craig, Glasgow.
5631. TOBACCO PIPES, B. P. Wilson, Bradford.
5632. TIRE INFLATOR, J. Dalgairns and C. J. Griffith, London.
5633. DRAINAGE SYPHON TRAPS, G. F. Matthewson, Nottingham.
5634. BOILERS, W. B. Johnson.—(*J. Pierpont, United States.*)
5635. SWINGING CURTAIN BRACKETS, W. B. Whittaker, Altrincham.
5636. HEADSTOCK, R. and W. B. Lang, Johnstone, near Glasgow.
5637. BANJOES, G. Birch and J. E. Sykes, Manchester.
5638. WOOL HORSE HEAD ORNAMENTS, J. W. Ricketts, London.
5639. NUTS, T. Campbell, Glasgow.
5640. SECURING HATS, A. McMeekin and J. Stalker, Glasgow.
5641. INTERNAL COMBUSTION TUBES, G. McGhee, Glasgow.
5642. PACKING, A. E. Muirhead, Glasgow.
5643. COATING MOULDS, J. W. Miller.—(*E. A. Mehling, United States.*)
5644. LAMPS, W. C. Cubbin and G. E. Johnston, Liverpool.
5645. FLUES for OIL COOKING STOVES, H. Lowe, Birmingham.
5646. MUSIC DESKS, C. Kemmler and E. Bénard, London.
5647. LOOM APPLIANCES, W. and R. Cornthwaite, Burnley.
5648. TUBE-MAKING MACHINERY, J. F. Donaghy, J. Humphrey, and W. Gregg, London.
5649. INCANDESCENT GAS BURNERS, F. W. Harland, London.
5650. TIRES, J. Pearson, J. B. Price, and E. T. Whitelow, Manchester.
5651. DRIVING MULES for SPINNING, J. Heald, London.
5652. APPARATUS for BEVELLING GLASS, W. O. Bailey, London.
5653. "STEEL NON-SLIPPING TIRE SHIELD," R. B. Baines, Liverpool.
5654. REGISTERING GOLF SCORES, P. Wigley, Birmingham.
5655. MUSIC LEAF HOLDERS, W. Summerfield, Birmingham.
5656. DIE for CUTTING FABRICS, W. Stevenson, Aldershot.
5657. GAME, B. R. Puri, London.
5658. PAPER CUTTING MACHINES, &c., W. Howard, London.
5659. PENCIL SHARPENING MACHINES, J. Marsh, London.
5660. DRAIN HOLES and SINK GRATINGS, G. Hyde, London.
5661. FERRULES for WALKING STICKS, W. Lederle, London.
5662. NOSE BAG, E. Wells, Gunnersbury.
5663. CONDUCTORS, P. C. Middleton and F. Huggins, London.
5664. SCREW-CUTTING ARRANGEMENT on LATHE SADDLES, J. Lang, jun., and W. B. Lang, Johnstone, near Glasgow.
5665. TUBELESS INFLATABLE TIRES, A. Lavelly, London.
5666. SPOOLS, C. L. Burdett, London.
5667. INCANDESCENT LIGHT, H. J. Cantley, and J. R. and G. Davies, London.
5668. DOORS, H. Becker, London.
5669. COMBINED SKILL GAME, H. J. G. Pessers, London.
5670. STRETCHING BOOTS and SHOES, F. J. Caparn, London.
5671. TREATING SEWAGE, D. Cameron, F. J. Commin, and A. J. Martin, London.
5672. MINERS' LAMP, H. H. Lake.—(*O. Siedentopf, Germany.*)
5673. AIR COMPRESSING MACHINE, H. H. Lake.—(*P. Cramer, United States.*)
5674. ROLLING MILLS, E. Norton, London.
5675. BOTTLES, E. Gerlach, London.
5676. LEVELLING DEVICE, J. W. Roche and J. Berns, London.
5677. CORNICE POLE BRACKETS, C. F. Grimmett, Birmingham.
5678. BALL BEARINGS, The Pittler Co.—(*F. W. von Pittler, Germany.*)
5679. BURGLAR ALARM, T. B. Thurgood and W. Smith, London.
5680. TELEPHONE TUBE RECEIVERS, H. A. Cutmore, London.
5681. PAPER-CUTTING MACHINE KNIFE, T. F. McCoy, London.
5682. HEATING or COOLING LIQUIDS, A. Slucki, London.
5683. CYCLE ATTACHMENT, E. C. Alexander, A. Spain, and A. Ogden, London.
5684. BARREL TAPS, H. H. Lake.—(*The Rochester Bunging Apparatus Co., United States.*)
5685. UTILISING HYDRAULIC FORCE, D. Morgan, London.
5686. DYNAMO-ELECTRIC MACHINES, S. G. Brown, London.
5687. CYCLE BRAKE, C. Wheatland, London.
5688. WEFT STOP MOTIONS for LOOMS, E. Slicer, London.
5689. WEAVING SHUTTLES, E. Slicer, London.
5690. QUICK-FIRING GUNS, J. MacKenzie, London.
5691. GAME, T. Brighton, London.
5692. GAS BURNER for ASBESTOS FIRES, E. G. Bagley, London.
5693. ELECTRIC LIGHTERS, W. von Zabern, London.
5694. ROTARY GYMNASTIC APPARATUS, G. Grade, London.
5695. RIVETING MACHINES, F. von Kodolitsch, London.
5696. BALL BEARINGS, G. E. Strauss, London.
5697. BEDSTEADS, T. F. Rigby, Liverpool.
5698. VALVE GEAR for STEAM ENGINES, J. T. Mallinson, Manchester.
5699. HORSE SADDLES, P. W. Peters, Birmingham.
5700. MEASURING LIQUIDS, D. V. Hallbergh and C. F. Denker, London.
5701. GAS GENERATOR, R. Clayton and H. B. Steward, Liverpool.
5702. SEWING MACHINE, D. Nadel and H. Herzberg, London.
5703. ELECTRODES for ACCUMULATORS, H. Pieper, fils, London.
5704. ELECTRODES for ACCUMULATORS, H. Pieper, fils, London.
5705. ELECTRODES for BATTERIES, H. Pieper, fils, London.
5706. MACHINES for THREADING and CUTTING-OFF PIPE, R. P. and L. B. Curtis, London.
5707. STEAM INJECTORS, F. Sticker, London.
5708. MUZZLES for DOGS, W. Coulter, London.
5709. SOLES of BOOTS, H. Marlow, London.
5710. SOUND-RECORDING INSTRUMENTS, J. W. Jones, London.
5711. SEATS for VELOCIPEDES, O. Imray.—(*D. M. B. H. Cochrane, France.*)
5712. OIL VAPOUR BURNERS, W. S. Sargeant, London.
5713. CHARGING TURRET GUNS, A. T. Dawson and T. Thackeray, London.
5714. BLEACHING of FABRICS, W. Mather and R. H. Haworth, London.
5715. LEAD PENCILS, J. Wood, London.
5716. PILE FABRICS, J. Reixach and H. Scott, London.
5717. CLEANING WOOL, A. J. Boult.—(*H. Bunzel, Germany.*)
5718. OIL-FEEDING DEVICES, The British Motor Company, Ltd.—(*M. Loyal, France.*)
5719. TREATMENT of METALLIFEROUS ORE, E. B. Parnell, London.
5720. GAS and PETROLEUM ENGINES, R. O. Allsop, London.
5721. PRODUCTION of RELIEF PHOTOGRAPHS, C. Pietzner, London.
5722. METALLURGICAL TREATMENT of METALLIC ORES, E. J. Ball, Plymouth.

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5723. DRIVING GEAR for VELOCIPEDES, T. Ryland and E. Bird, London.
5724. VELOCIPEDES, R. Smith, London.
5725. ACTIONS of ORGANS, L. B. Cousans, Lincoln.
5726. MECHANICAL TOYS, J. C. Martin, London.
5727. TENSION DEVICES for CYCLE CHAINS, A. Strauss-Collin, London.
5728. WAIST BELTS and GARTERS, A. G. McKewan, Birmingham.
5729. ELECTRIC IGNITION in INTERNAL COMBUSTION ENGINES, R. A. Miles, Coventry.
5730. ROLLER BLIND FURNITURE, G. C. Watson, Croydon.
5731. THE OSCILLATING DUSTBIN, G. Greensill, Douglas, Isle of Man.
5732. PNEUMATIC CRUTCH HEAD, C. Salmon, London.
5733. ATTACHMENT to STONE-SAWING MACHINE, C. Lewis, Blackburn.
5734. HANDLING INCANDESCENT MANTLES, M. J. Silver, London.
5735. ROTARY EXHAUSTERS, J. Sharp, Glasgow.
5736. ALARM CALL BELLS, A. Loewenberg, Manchester.
5737. FIXING HANDLES to SAUCEPANS, T. C. Clark and G. Hurdman, Wolverhampton.
5738. CRANK and CHAIN-WHEEL of CYCLES, B. D. Wilmot, Birmingham.
5739. BOXES for SURGICAL PURPOSES, F. W. T. Turton, Birmingham.
5740. HERMETICALLY SEALING JARS, &c., C. Emmet, Sheffield.
5741. LUBRICATORS for AXLE BEARINGS, W. Chappell, Halifax.
5742. PILES, W. Roberts, Tipton, Staffs.
5743. ASHGUARD, C. Forrest, A. Sym, and F. Keating, Manchester.
5744. WINDOW RODS, J. Davies, Bradford.
5745. DRIVING MECHANISM of CYCLES, H. and J. B. Hardy, Bradford.
5746. COLOURING MATTERS, W. E. Heys.—(*The Chemical Works, formerly Sandoz, Switzerland.*)
5747. NICOTINE, R. Mackill, Glasgow.
5748. FLY-CATCHING DEVICE, J. N. Wright, London.
5749. CYCLE HEAD-LOCK, R. Orme, Newbury.
5750. SWITCH, J. E. M. Stewart, Bournemouth.
5751. CYCLE CRANKS and CHAIN WHEELS, G. A. Smith, London.
5752. AXLE CYLINDER for CYCLES, G. Thornhill, Manchester.
5753. GOLF CLUBS, M. B. Castle, Bristol.
5754. WINDING APPLIANCE, G. J. May and S. A. Everett, Penarth.
5755. MACHINERY for MOULDING BRICKS, W. A. Gill, Leeds.
5756. LOOKING-GLASS MOVEMENTS, E. A. Allen, Birmingham.
5757. KNITTING MACHINE, J. C. L. Poron, Brussels.
5758. APRON FASTENER, H. S. Basnett and J. R. Nesbitt, Edinburgh.
5759. CRANE BUCKETS, D. Roche, London.
5760. GENERATION of ACETYLENE GAS, J. Main, Newcastle-on-Tyne.
5761. SHAVING CHAIR HEAD-REST, F., W., E., and H. Claughton, Leeds.
5762. FILES, J. Russell, Sheffield.
5763. TUYERE BOTTOM BLOCKS, T. Harrop, Sheffield.
5764. FLANGED SMOOTHING IRON, S. A. Greene, Winchester.
5765. PRINTING MACHINES, T. Cossar, Glasgow.
5766. CONNECTION BETWEEN UNDERGROUND CONDUCTOR and VEHICLE MOTOR, H. L. Butler, London.
5767. RAILWAY SIGNALLING APPARATUS, W. Saunders, London.
5768. PNEUMATIC TIRES and RIMS, S. Scoble, London.
5769. GRINDING MACHINES, P. U. Askham, W. Wilson, and W. G. Slack, Sheffield.
5770. WATER GAUGES, R. H. Radford, Sheffield.
5771. PREVENTING the OVERFLOW of WATER from COOKING UTENSILS, F. C. Kitchen, London.
5772. SMOKE-PREVENTION MOVABLE FURNACE GRATE, G. H. Halliwell, London.
5773. ADVERTISING by INCANDESCENT LAMPS, C. Raleigh, London.
5774. STOCKINGS, J. N. Sedgley, London.
5775. FOOTBALL BOOTS, T. Welford, London.
5776. PREVENTING the BREAKING of SHIPS' CHAIN CABLES, W. Jardine, Kingston-on-Thames.
5777. RIDDING HOUSES of RODENTS, T. H. Bradish and W. B. Edwards, London.
5778. INJECTING WATER into STEAM GENERATORS, J. Kirkwood, London.
5779. SUBMARINE TORPEDOES, J. Jacobson, M. Johnson, and M. Anderson, London.
5780. PIVOT ADJUSTMENTS, B. Banks and E. Verity, London.
5781. HEARSES, R. Rainsford.—(*N. Carpenter, sen., United States.*)
5782. ROTARY ENGINE, J. Croft, Bourne.
5783. ELECTRIC RAILWAY SYSTEMS, W. C. C. Hawtayne, London.
5784. LAMP CHIMNEYS, P. Symons, London.
5785. ROTARY ENGINES, J. Keller and C. H. Haeseler, London.
5786. CHAIN GEARING for CYCLES, W. A. McCormick, London.
5787. CHIMNEY TOP, J. Markham, London.
5788. CONSTRUCTION of PISTONS, J. Hind and M. Rowan, London.
5789. TOOTH SUBSTITUTE BRUSH, A. Reymann, Germany.
5790. MACHINES for THREADING SCREW-NUTS, F. A. Meischner, London.
5791. LOCKING DEVICES for AUTOMATIC MACHINES, G. Igersheimer, London.
5792. CYCLING SKIRT, I. Rubinstein, London.
5793. WORKING GRABS, W. Pitt and Stothert and Pitt, Ltd., London.
5794. BANKERS' THIMBLE, D. W. Owen, London.
5795. SCREENING COAL, A. Oberegger and E. Greaves, London.
5796. OBTAINING PHOSPHORUS, Electric Reduction Company, Ltd.—(*W. T. Gibbs, Canada.*)
5797. SWIVEL HEAD HORSE PLOUGHS, W. Baverstock, London.
5798. GENERATING OZONE, W. Elworthy, London.
5799. BOAT PROPELLER, E. A. Storer, Lynmouth, North Devon.
5800. STAMP BATTERIES, J. F. Webb, J. E. Lilley, and J. Chapman, London.
5801. EDGE RUNNERS, J. F. Webb, J. E. Lilley, and J. Chapman, London.
5802. NEW FOG-SIGNALLING APPARATUS, C. Dunham, London.
5803. PREPARING SYRUP, E. Shaw, London.
5804. HOLDING CYCLES in VEHICLES, H. A. Ivatt, London.
5805. BISCUITS, W. T. Carr, London.
5806. METAL BASES for LAMPS, H. H. Lake.—(*La Compagnie General des Lampes à Incandescence, France.*)
5807. DEODORISATION of COCOANUT OIL, J. C. W. Stanley, London.
5808. INTERNAL COMBUSTION ENGINES, J. A. Hurst and A. Harcourt, London.
5809. BEAM-COMPASSES, T. Kolbe, London.
5810. ELECTRICAL CONDUCTOR, W. P. Thompson.—(*A. Lessing, Germany.*)
5811. INCANDESCENT GASLIGHT BURNERS, W. P. Thompson.—(*A. Weber and Co., Germany.*)
5812. PREPARATION of CORK, W. P. Thompson.—(*A. Domer, France.*)
5813. FIRELIGHTERS, H. Arrowsmith, Liverpool.
5814. PRESERVING ORGANIC SUBSTANCES, F. Dickmann, London.
5815. CANS, R. Parker, Manchester.
5816. BOOTS, J. Douglas, Birmingham.
5817. MECHANICAL PUZZLE, J. N. Beevor, Birmingham.
5818. BUFFER GUIDES, W. A. Austin, London.
5819. FEEDING FUEL to FURNACES, C. W. Stauss, London.
5820. FOLDING ARTICLES of FURNITURE, L. A. Cambier, London.
5821. WINDOW BLINDS, J. F. Adams and C. R. Iorns, London.
5822. AUTOMATICALLY GRIPPING CORDS, C. R. Iorns, London.
5823. CONDUIT ELECTRIC RAILWAYS, E. Heyl-Dia, London.
5824. LINOTYPE MACHINES, G. H. Law and W. Ingle, London.
5825. CONTROLLING MOTOR CARS, A. Herschmann, London.
5826. ARTIFICIAL LEATHER, E. Heyl-Dia, London.
5827. UMBRELLA FASTENING DEVICE, W. F. Floyd, London.
5828. SEED DRILLS for GARDENERS, G. Abbey, jun., London.
5829. RIM and TIRE for VELOCIPEDES, L. Carmichael, London.
5830. INCANDESCENT ELECTRIC LAMPS, E. Heyl-Dia, London.
5831. RETAINING LADIES' SKIRTS in POSITION when CYCLING, E. Matthews and C. Carter, London.
5832. RUBBER TIRE COVER MOULDS, S. E. Wakelin, Birmingham.

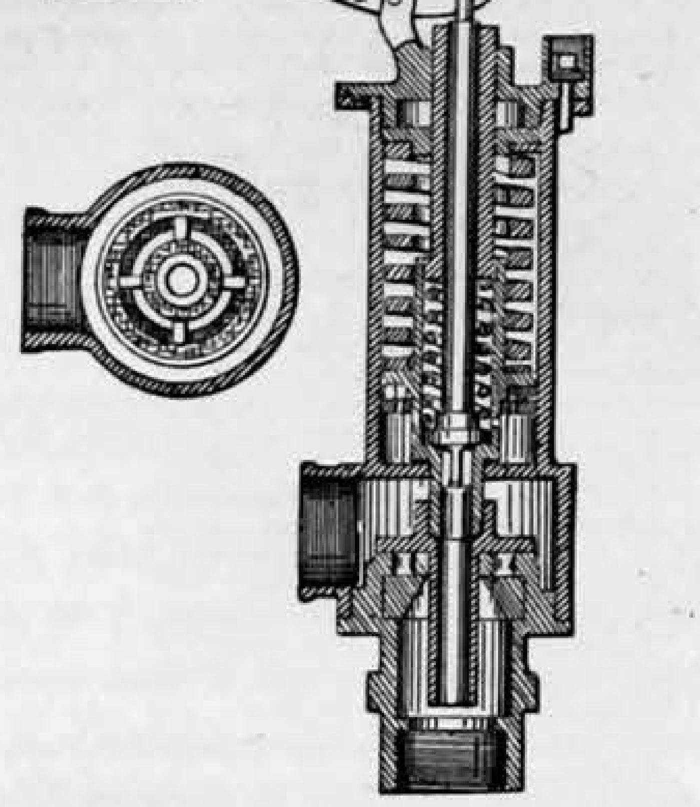
SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

591,013. SAFETY VALVE, *F. Schreidt, Mansfield, Ohio.—Filed March 18th, 1896.*

Claim.—The combination of the main-valve chamber, the main valve having a tubular stem extending into the inlet passage, and a tubular extension upon the back of said valve having a valve seat within it, a tubular stem having a reduced lower end to pass through the partition of the main-valve chamber, a seat within the upper tubular extension of the main valve the enlarged upper portion of said stem above the partition having a valve in its lower end and a piston above the valve forming a pressure chamber, a tubular follower screwed into said stem and forming an upper extension thereof, a spring compressed between said follower and said valve to hold it to its seat, the tension of said spring being regulated by the follower, a spring to bear upon the piston of the tubular stem and hold the main valve to its seat, a follower above said spring

591,013

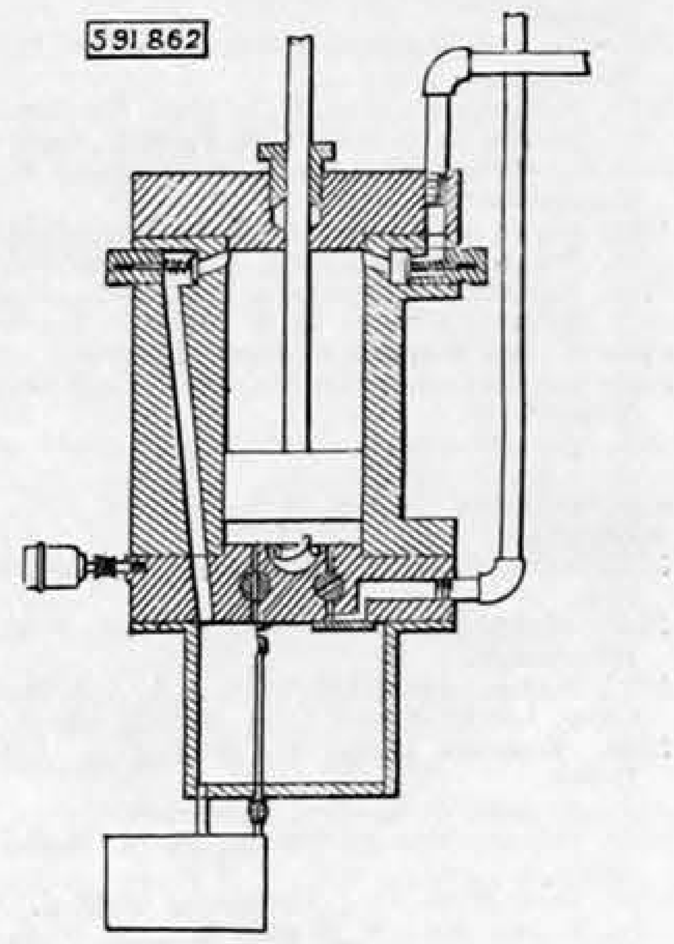


in the upper end of the case, and the top cap of the case having a screw-threaded neck to engage the external thread in the upper end of the case and bear upon said follower, whereby the tension of the main-valve spring is regulated, substantially as shown and described.

591,862. GAS ENGINE, *C. L. Mayhew, Saratoga Springs, N.Y.—Filed December 11th, 1895.*

Claim.—(1) The combination with a cylinder, piston, inlet and exhaust ports, of plug valves G, H, and excentric and connections for rocking the valve H, an arm extending from said valve, a lug upon the valve G arranged to make contact with said arm and springs connected with the valve G to hold it normally in one position, substantially as set forth. (2) The combination with the fixed and movable contacts of an electrical igniter and with the rocking valve G, of a shaft carrying the movable contacts and an arm upon said shaft adapted to make contact with a lug extending

591 862



from the valve, substantially as set forth. (3) In a gas engine, the combination with the cylinder and its piston, of a compression chamber at the rear of the cylinder, means for supplying said chamber with compressed air and gas, an inlet port connecting the cylinder and compression chamber, and a valve controlling said port, means for positively operating said valve, and means for supplying water to a point adjacent to the inlet port, substantially as described.

591,952. EXPLOSIVE ENGINE, *C. I. Cummings and J. C. Hilton, Erie, Pa.—Filed December 19th, 1896.*

Claim.—(1) In a gas engine, the combination of an oscillating cylinder having hollow trunnions mounted in bearings, a gas-supply pipe connected to one of said trunnions, a port leading from said trunnion to the bottom of the cylinder, a corresponding port communicating with the cylinder near the bottom thereof and intermediate its ends, an exhaust port, and a piston, substantially as described. (2) In a gas engine, the combination of an oscillatory cylinder provided with hollow trunnions mounted in bearings, a gas supply pipe communicating with one of said trunnions at its outer end, a port leading from the inner end of said trunnion to the bottom of the cylinder, a corresponding port leading from the bottom of the cylinder

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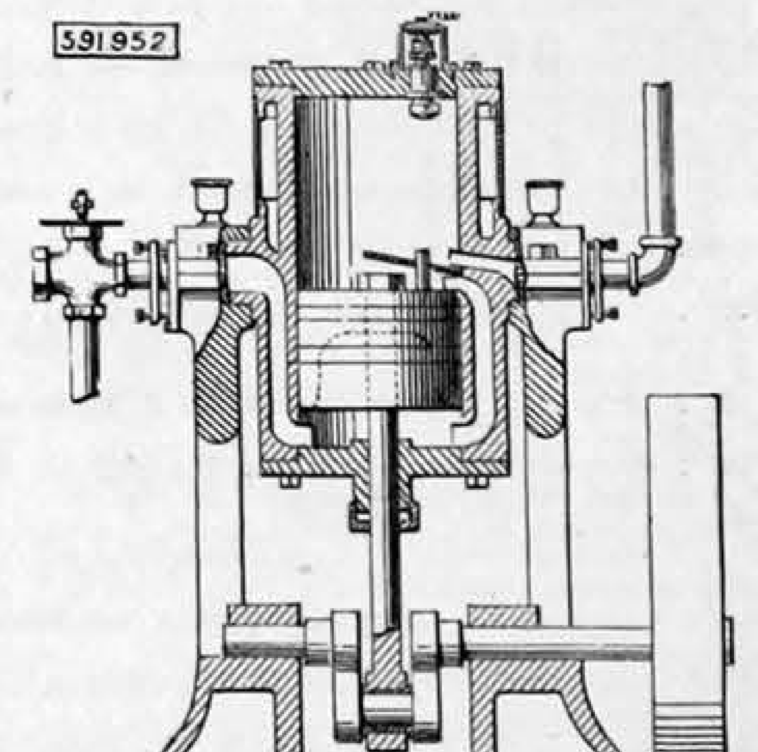

to a point intermediate its ends, an exhaust port extending through the other trunnion, a piston, and an electric sparking device arranged to produce a spark when the piston starts on its downstroke, substantially as described. (3) In a gas engine, the combination of an oscillatory cylinder provided with hollow trunnions mounted in bearings, a check valve arranged in one of said trunnions and opening inwardly, a valve casing communicating with said hollow trunnion and provided with a gas-regulating valve, a gas-supply pipe, an inwardly-opening air valve for supplying air to said valve casing, a port leading from the inner end of the said trunnion to the bottom of the cylinder, a similar port communicating at its opposite ends respectively with the bottom of the cylinder and at a point intermediate its ends, a piston, and an exhaust, substantially as described.