THE CHICAGO EXHIBITION IN JULY.

(From our Special Commissioner.)

CHICAGO, June 30th.

THE English summer holiday period is now beginning for those who are not so unfortunate as to have to settle the question of Home Rule inside the House, and the inquiry, "Is a visit to Chicago worth its cost?" presses for answer.

Many of the American newspapers, and especially those of New York, have been very liberal, almost unmeasured, in their dispraise and expression of contempt for everything connected with the World's Fair. To a large extent the English papers adopted their tone from these American criticisms, no doubt backed up more or less by special reports sent by Englishmen privately, and by way of official correspondence. Much of this severe criticism was justified by the state of affairs in April and in May; but in judging of the value of the American reports, a very considerable allowance ought to be made for the bitter feeling that still exists between Chicago's unsuccessful city rivals for the privilege of having the Exposition held within their walls and triumphant Chicago herself.

It will be remembered that half-a-dozen big cities, including New York, fought Chicago for this honour, and were beaten. The jealousy thus created of the "upstart Western village" is still a real active influence that has, as a matter of fact, interfered to a large extent with the flow of visitors from the Eastern States here.

Another fact that ought to be taken into account in judging between the conflicting reports that reached England from different sources, is that many of them must have been adversely affected—and quite justifiably and honestly so—by a natural revulsion of feeling against the extravagant advertising laudations of the Exhibition indulged in by the whole of the Chicago press. After two and a-half month's residence in Chicago, I have not been able to discover any authentic indications that any of the Chicago papers were bought by the Exhibition administration, with money or otherwise, to do the work of booming the Exhibition. But the Chicago papers depend on the Chicago people, and, in this year of 1893, upon the Exhibition, for their prosperity; the Chicago people, rich and poor, business man, artizan, and labourer, believe that a very great deal of the future of Chicago depends on this Exhibition, believe that their deepest, widest, and most lasting interests are involved in it; and the Chicago newspapers have, in the matter of advertising the Exhibition, devoted themselves to the interests of Chicago with a perfervid local patriotism which, however admirable from one point of view, has led them into a persistent and total disregard of fact. The journalists of other parts of the world may justly glory in their own imaginative powers; but correspondents placed here in Chicago, after having read daily for weeks and weeks reports which represented, as often as circumstances permitted, the reverse of what they knew to be historical fact, were very naturally driven to consider the propriety of throwing in some counterbalancing weight which would bring the average newspaper reports a little nearer the simple straightforward truth. It would be unfair to take the Chicago Press as the authentic mouthpiece of the Chicago people; so far as my experience teaches me, the Chicago people are as fully alive to the defects of their city and of their Exhibition as are any foreigners, and they understand the reasons of these defects a good deal better, and condemn them more intelligently than does the foreigner. But if for the moment we take the Chicago Press as the authorised advertising medium of the Chicago people, as regards this Exhibition, it must be confessed that they have overreached themselves—or at any rate did so at first—in their efforts to accomplish the task set them, which, if it were undertaken and carried out in a legitimate manner, would be recognised on all hands to be a perfectly legitimate task.

In last April and in the first half of May few towns in the world can have been more disagreeable to live in than Chicago; the impossibility of moving anywhere or the smallest distance outside one's house without wading very deep in mud, too often of the most filthy description; the difficulty of getting decent food to eat outside the narrow limits of the city seven miles away from Jackson Park; the extreme difficulty in finding filtered water, coupled with the knowledge that the city pours its sewage into the Lake, and from the same Lake pumps its water, which it delivers to one and a-half million people direct from the shore pumps without passing it through even the pretence of a filter bed or even a settling tank; the extreme backwardness of all the arrangements in connection with the Exhibition, and the tramways and railways leading to it, quite as much or greater in the arrangements and structures depending upon Columbian official management as in those of the exhibitors, while the papers were daily proclaiming loudly the novelty of this World's Fair as being the first and only great international exhibition that would be complete and perfect on the day of formal opening; these things were certainly discouraging to the foreign correspondent who, in the kindness of his cosmopolitan neighbourliness, would fain have written sweet things about Chicago. Without total loss of self-respect, he could not say that things were well managed at the Fair, when he *knew* that they were managed by almost dozens of separate committees and heads of departments, whose jealousy of, and contempt for, each other were such that they acted practically quite independently of each other, and countermanded each other's orders freely; he could not honestly throw the major part of the blame for the emptiness of the show cases weeks after the 1st of May upon the exhibitors, when he *knew* that the greatest difficulty was to get the packing cases out of the Exhibition storehouses after they had been delivered there by the railway companies, and where they were kept unnecessarily for weeks in charge of apparently irresponsible baggagemen, who could be moved only either by dollars or by soul-stirring but impolite language. Under these conditions the foreign correspondent, no doubt, sometimes gave way to irritation when he read in his daily morning local that the exact reverse of all these conditions actually existed in "this glorious heaven on earth, where the soul of man is perforce bowed in humble adoration of art, whose majesty is greater than the majesty of God's eternal mountains, and the brilliant radiance of whose white beauty almost surpasses that our unfettered souls may hope to bask in when they have wung their way into the holy recesses of the celestial courts."

But the people of Chicago themselves wish well-made streets and side-walks, *i.e.*, foot pavements, quite as much as do foreigners, and are always insisting upon getting them, and are getting them, only it is at a very slow rate, while the town increases in size at a fast rate. They are continually uttering their protest against the "slaughter at the level crossings," and have already reduced this to an average of two people killed per day within the City boundaries, and have also already forced some railway lines to elevate their tracks, and hope eventually to force them all to do so. They are fully convinced of the impropriety of drinking the sewage-laden near-shore water of the lake, and hope that in a few year's time they will be able to bring all the water they need from "cribs" located four miles and more from the shore. They have gone on inveighing against the stupidity of the system of scattered authority and management of Exhibition affairs, until they have forced the Fair authorities to centralise their organisation. They have complained so loudly and vigorously of exorbitant restaurant charges in the Fair, that now these charges have been reduced to reasonable rates—although still high as measured by the English standard. They have grumbled so bitterly about the absence of free seats in the Fair grounds, that they compelled, first, the local papers to declare that the authorities had placed 20,000 free benches on the walks and in the pavilions; then, secondly, a week later, the same papers to announce that free seating accommodation for 20,000 people would be provided within a few days; and, lastly, three weeks later still, some thousands of benches actually to arrive in gradual instalments and get distributed over the place. Chicago grows rapidly, as one hears frequently from one's Chicago friends, and the Chicago people are not to be blamed for their inability to keep pace with their own growth in size in their efforts to get things straight. The Chicago people live in hope; not that their growth in bigness will ever moderate itself, because it is the great culminating glory of Chicago that it has beaten all other cities in the rate at which it has increased in bulk, but that sometime or other their means of making themselves comfortable and wholesome will start ahead, growing at a much greater rate than their bulk. Of course it would have been better to have got things straight before inviting the world to their Fair, but Rome was not built in a day, neither could an Exhibition of a degree of bigness such as would be worthy of Chicago's aspirations after bulk be got ready in three years.

And now that the warm bright weather has dried up the seas of mud; now that the exhibitors have got from the Columbian store-houses nearly all their goods, and have nearly all finished the decoration and arrangement of their stalls; now that the administrative departments have struggled two months beyond the date of formal opening towards the attainment of an organisation, and have at last come within measurable distance of that goal by the simple expedient of sweeping out of existence all the numberless managing committees that have quarrelled with each other for three years, and centralising all chief management in a directorate of three or four men with a single supreme executive officer, who is to have a single chief lieutenant; now it becomes possible to discover the good things of the Exhibition.

Even before the 1st May it was easy to appreciate the beauty of the general architectural design, and the great cleverness shown in the grouping of the buildings round the various sheets of water so as to produce very numerous extremely striking and effective architectural landscapes. A few weeks tramping about the place was all too sufficient to impress on one's mind, and upon one's limbs, a recognition of the enormous size of the undertaking and of the liberal scale on which everything is planned. And finally, towards the end of June, the completely arranged exhibits have become numerous enough to convince one that never before has there been brought together a collection of things beautiful, interesting, and instructive of anything like such almost infinite variety, produced under such diverse conditions of climate and natural produce, designed to supply the wants of such diverse racial characteristics. As a matter of course, American products occupy the great bulk of the space in every building; but it would be altogether untrue to say that the fascinating interest of the exhibit is coterminous with the American continent. Nearly every European and Asiatic country is more largely represented than it was at Paris in 1889. England alone of all the great countries of the globe has sulked in her tents and refused to show herself. Practically Britain has three exhibits: first, in the Fine Arts, where her pictures illustrate the best productions of her modern artists in a much more perfect manner than this is done by the pictures displayed by any other country except America itself, which, of course, does not pretend to rival the mother country in this particular "class of goods;" second, the magnificent collection of ocean-ship models chiefly contributed by the Clyde builders; and third, a limited collection of our best modern locomotives.

To engineers the greatest interest will concentrate in the Transportation, Mines, Forestry, Electricity, and Machinery Buildings.

Certainly, never before has any collection of forest trees and timbers been brought together so grand in its extensive range, of such absorbing and instructive technical interest, or, considering that it is not a university botanical museum, so scientifically arranged. It is far and away the finest illustration of forestry ever dreamt of.

Almost as much might be said of the Mines Exhibition, except that in practical interest it does not range much beyond America and Australia. Austria adds an interesting exhibit, but one not corresponding to or fairly illustrating her mineralogical and metallurgical importance. Japan has a small exhibit, which makes up for its smallness by its thoroughly neat and scientifically instructive arrangement.

The Electricity Building distinguished itself by being later in getting ready than any other part of the Chicago Exhibition, except the Anthropological and Natural History section, which at the date of writing is rather more than one quarter arranged. Much of the Electricity Exhibition is of the side show toy character, intended to "tickle the eyes" of the multitude, but the reports of your Special Electrical Correspondent will show that it contains a great deal of real practical and scientific importance. He has already explained the reason of the immense and overwhelming preponderance of the General Electric Company in this building. Suffice it to say here that the amalgamation into one huge syndicate of so many leading electric engineering concerns has certainly not produced advantage to the Chicago Exhibition, and can hardly yield anything but the reverse of advantage to the public of the United States.

The Transportation Exhibition is one of the best in the grounds. The excellent ship models have already been mentioned. They attract great crowds of Americans, who are generous in their admiration, There is a grand display of American locomotives and rolling stock. The Baldwin collection comes *facile princeps*, but in a general letter like the present it would be invidious to mention other names. The exhibits are extensive, handsome, and of much technical interest. I hope immediately to begin illustrating this department in detail.

There is also a fine collection of full-size illustrations of various continuous brake systems, about which, however, there is, from the nature of the circumstances, not much possibility of novelty. Then a fairly extensive exhibit of cable and electric tramways and cars occupies a good deal of space; and in the gallery, innumerable bicycles of all standards and styles, good, bad, and indifferent, are displayed. There is little variation in the leading features of the mechanical design. The differences consist to a greater extent in quality of workmanship and in the construction of small details, upon both of which latter, of course, depend the excellence of the cycle as a riding machine more than on anything else. It is worth mentioning that the "Whitworth" cycle made in Birmingham, England, claims a first place as regards simplicity and effectiveness of detail, design, combined with lightness and substantial rigidity, upon which so much of the enduring quality of both racer and roadster depends. One real novelty deserves mention, namely, a bicycle with elliptical driving gear, by which it is intended partially to equalise the driving power during the down stroke of the pedal.

But to the European visitor the American common road carriage exhibit will, perhaps, offer greater interest than any other. Of the bewildering variety of light, graceful and comfortable vehicles I intend to make a reasonably small selection for illustration, and hope also to be able to give some particulars concerning the large and wonderfully organised workshops in which American vehicles are manufactured wholesale.

Lastly, there is the Machinery Hall. I need say very little about it here, because it will be my duty to describe its contents hereafter somewhat in detail. Here England is represented by a fairly large Galloway steam engine, a group of small Massey steam hammers, a stand of anvils and smiths' tools, contributed by Peter Wright and Co., of Dudley, one Willan's engine and dynamo, a loom or two from Platt Bros., and from Coventry, and a brick and tile machine from Fawcett, of Leeds. There are a few other English exhibits, but the above list gives a fair measure of the noticeableness of our English exhibit in this vast collection of first-class machinery. The commercial reasons for the absence of British machinery from this Chicago Exhibition are well understood; but from an industrial point of view it seems a pity that for good or bad cause our display should be so minute that the visitors from all parts of the globe should see almost literally nothing to remind them that Great Britain has not yet sunk under the Atlantic waves.

The chief display of engines is that of the power plant supplying electricity to all parts of the grounds. These are all American with the single exception mentioned above. There are other steam engines driving the shafting of the Machinery Hall; among these is the Galloway engine already spoken of. Generally it is a remarkably good display of steam machinery. A large proportion of the engines have Corliss gear, and an almost invariable rule is that the cut-off should be automatically regulated by a wheel-governor acting directly on one or more excentrics. The condensing engines have almost invariably independent condensers, *i.e.*, worked by an independent donkey engine. This results partly because the condensers are generally supplied by different makers, partly from a desire to be able to get up the vacuum before starting the main engine.

The collection of machine tools is very extensive and remarkably fine. Especially does this criticism apply to the two classes of wood-working and metal-milling machines. The Stearns Manufacturing Company has a very powerful band-saw and other shingling plant set up in a separate building behind the boiler-shed. Pumps and turbines are also numerously represented, but the show in this respect is a little disappointing. In a not very distant part of the grounds, near the south end, is a large and interesting group of windmills. Of all these sections it will be my duty to write in considerable detail later on. For the present it is enough to say that to make a thorough examination of all the interesting machines exhibited would require one to devote several months to the task.

This letter was written in order to answer the question, "Is it worth an English engineer's while to come

across the Atlantic to see the Chicago Exhibition?" The reply intended to be conveyed is—Yes, his stay in Chicago will be an interesting, instructive, and, now that steady fine weather has set in, it *might* be a pleasant one.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE meeting of the Institution of Naval Architects at Cardiff began on Tuesday under the most favourable auspices. This is the first time that the Institution has visited Wales, and the warmth of the reception given to the Institution can hardly fail to leave most pleasant memories. We have already in our last impression indicated the character of the business to be transacted and of pleasures to be enjoyed, and we have briefly sketched the wonderful history of Cardiff, which now exports one-third of all the coal sent foreign by Great Britain. It is unnecessary to repeat what we have said. The formal work of the Institution began on Tuesday, when at half-past ten the members were received in the Council chamber at the Town Hall by the Mayor (Mr. W. E. Vaughan), who was accompanied by the Deputy Mayor (Alderman Lewis), Councillor J. H. Cory, and the Town Clerk (Mr. J. L. Wheatley), together with Mr. Heywood, Mr. Lewellen Wood, Count Lucovich, Mr. John Cory, Mr. J. B. Ferrier, Mr. W. Riley, Captain Pomeroy, Mr. Hancock, jun., Mr. Martin, and Mr. Lewis, members of the local Reception Committee.

Mr. Heywood, chairman of the local committee, introduced to the Mayor Sir George Barnby, Mr. Martell, Mr. White, Sir James Ramsden, Admiral Boys, and all the other members of the Institute, and added his regret that Lord Brassey, the president, who had attempted to come round to Cardiff in his yacht the Sunbeam, had been obliged to put back to Torbay through stress of weather, and had telegraphed that he would come to Cardiff by train as speedily as possible.

The Mayor, in the name of the town and Corporation of Cardiff, accorded the members of the Institute a hearty welcome to the town, and expressed the gratification felt locally at the visit of the Institute.

Mr. Heywood, as chairman of the local executive committee, seconded, and emphasised the welcome accorded by the Mayor.

Mr. J. Cory, as representative of the Cardiff Shipowners' Association, added his note of welcome, and then, after a brief pause,

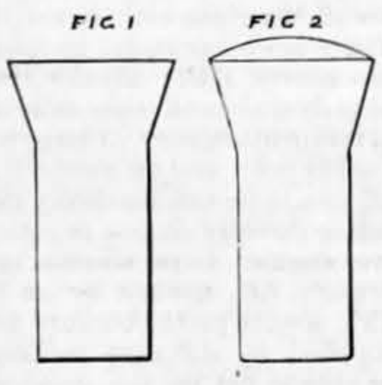
Sir Nathaniel Barnaby, one of the senior vice-presidents, in reply, expressed himself deeply sensible of the cordiality of the welcome accorded on all hands.

The members then adjourned to the Nisi Prius Court for the first business meeting.

THE first paper read on Tuesday was by Mr. B. Martell,

ON POINTS OF INTEREST IN THE CONSTRUCTION AND REPAIR OF VESSELS CARRYING OIL IN BULK.

The paper dealt altogether with questions as to the general sufficiency of scantlings and arrangement of details in their construction, and the points which should occupy special attention when they come under repair. As regards the general scantlings of framing and plating, experience has shown that the scantlings adopted for ordinary cargo vessels are suitable for petroleum vessels. It is mainly in matters of detail that special precautions have to be taken to render these vessels efficient, and the first point to which Mr. Martell would direct attention is to the rivets and riveting. The case of a vessel carrying a liquid cargo in bulk out to the outer skin differs from one carrying ordinary cargo, inasmuch as that in the first case the cargo is carried directly on the outside plating of the vessel instead of on the floors and framing, and the main strains are therefore brought on the riveting connecting the plating to the frames. Further, in pitching and rolling the pressure due to the inertia of the cargo is very considerably increased, even when the tanks are quite full. As regards the form of rivet, there could be no doubt that many of the failures which have occurred have arisen from the inefficient heads given to the rivets. An opinion existed amongst some builders, which has been to a considerable extent abandoned, that the best form of rivet for producing oil or water-tight work was the plug-headed rivet, as shown in Fig. 1. This all experience shows to be a mistake, and that the best form of rivet for insuring oil tightness is the pan-headed rivet with swollen neck under the head, as shown in Fig. 2. Whichever form of rivet be adopted the points should be left sufficiently full or convex, and in cases where rivets, are found on testing to be unsatisfactory, they should be renewed and not caulked, as is sometimes done. Great care is also necessary in these vessels to ensure fairness of holes, as without absolutely sound work at the seams and butts, vessels carrying oil in bulk are sure to give trouble and necessitate costly repairs. Holes that are found to be not quite fair should be rimed and not drifted, and rivets specially prepared should be used in such cases where necessary. And here it may be remarked that sound workmanship throughout is essential and of primary importance in these vessels; as, however satisfactory the general arrangements may be, unless the very best workmanship be executed failure is certain to ensue. The author then proceeded to consider at considerable length all the details of construction of an oil steamer. The paper was illustrated by numerous diagrams. The paper concluded with a valuable set of tables, containing the principal dimensions of a large number of oil steamers.



The discussion which followed raised few points of interest, save for those who are actually engaged in building or running petroleum tank steamers. On the whole, it seemed to be taken for granted that Mr. Martell had said all that need be said on the subject. The prevailing opinion was that tanks must be kept as small as possible to avoid momentum stresses, and that it was highly desirable to keep the boilers well isolated, to avoid the chance of oil or oil vapour creeping down to the furnaces and causing an explosion.

The second paper read on Tuesday was by Dr. Francis Elgar

ON FAST OCEAN STEAMSHIPS.

After a few preliminary remarks, Dr. Elgar went on to say that the Great Eastern is the most wonderful instance the world has seen of attempts to obtain high speed over long distances at sea. She was designed forty years ago, and her name is probably associated in the minds of most people only with errors and disaster. It is universally known that she was remarkable for her enormous size, but it is often forgotten that there was anything else about her worthy of notice or admiration. Every new ship that is built of greater dimensions than her predecessors is naturally compared in size with the Great Eastern. The Great Eastern was remarkable, however, not only for the vastness of her proportions, but also for the thought, care, and skill employed in her design and construction, and for the extent to which problems relating to high speed upon the longest ocean voyages, some of which are at times thought to be peculiarly modern, were understood and worked out by her designer. I have thought it might be interesting to compare the latest large steamships with the Great Eastern more in detail than is usually done, and to bring into the comparison not merely size but some of the leading details of design and construction.

In the latter part of 1851 Mr. Brunel began to work out his idea of a great ship for the Indian and Australian trade. He spent two years in inquiries, investigations, and calculations relating to the numerous problems—many of them quite novel then, though more familiar now—that were raised by such a tremendous stride in advance of all former experience and ideas. The magnitude of the stride was as great as would now be involved by the construction of a ship 1200ft. long and 30 to 35 knots speed. The following is a comparative statement of particulars of the Great Eastern and Campania:—

Particulars.	Great Eastern.	Campania.
Length over all	692ft.	622ft.
Length between perpendiculars ...	680ft.	600ft.
Breadth moulded	82ft. 2in.	65ft.
Depth moulded to upper deck ...	58ft.	41ft. 6in.
Register tonnage, gross	18,915 tons	12,950 tons
,, under deck	18,837 tons	10,267 tons
Load draught	30ft.	27ft.
Passenger accommodation, 1st class	800	600
,, ,, 2nd class	2000	300
,, ,, 3rd class	1200	700
Indicated horse-power of engines ...	about 8000	about 30,000
Speed at sea in knots at full power...	14 to 14½	22 to 23

The Geat Easterrn had two separate sets of propelling machinery; one driving a screw propeller, and the other a pair of paddle-wheels. The screw engines were the most powerful, and could indicate up to 4500-horse power at sea. The paddle engines indicated 3500; so that the maximum indicated horse-power was about 8000. This power gave a speed of 14 to 14½ knots at sea, with a coal consumption of about 400 tons per day. There were four cylinders to each set of engines; those of the screw engines being 7ft. in diameter, with a stroke of 4ft., and those of the paddle engines 6ft. 2in. in diameter, with a stroke of 14ft. The screw was four-bladed, and had a diameter of 24ft. with 44ft. pitch. The paddle-wheels were 56ft. in diameter. The working steam pressure appears to have been about 20 lb., and steam was cut off in the cylinders at one-third of the stroke. The boilers were tubular, and of the square box type, and they were double-ended. There were ten boilers in all, 18ft. long, 17ft. 6in. wide, and 14ft. high, with 112 furnaces.

The Campania has also two separate sets of propelling machinery, but in her case they drive twin screws. The propelling power is fully three and a-half times that of the Great Eastern, and the speed more than 50 per cent. greater. This increase in power and speed is obtained with a daily coal consumption that is but little in excess of the Great Eastern's. There are five cylinders to each set of the Campania's engines, and they work three cranks. There are two high-pressure and two low-pressure cylinders, and the high-pressure cylinders are pl aced upon the low-pressure. The cylinders are 37in. 79in., and 98in. in diameter respectively, with 69in. stroke. The screw propellers are smaller than that of the Great Eastern. The boilers are thirteen in number, twelve being double-ended and one single-ended, with 100 furnaces — or twelve furnaces less than in the Great Eastern.

FIG 1.

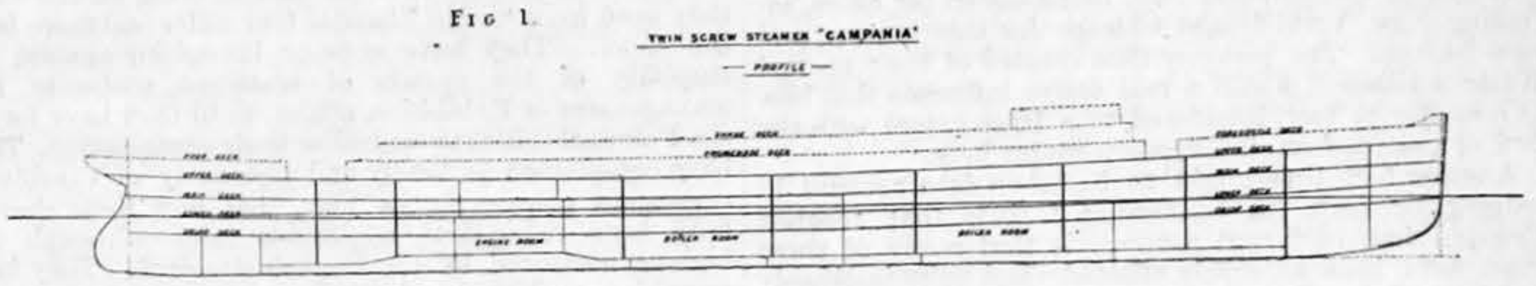
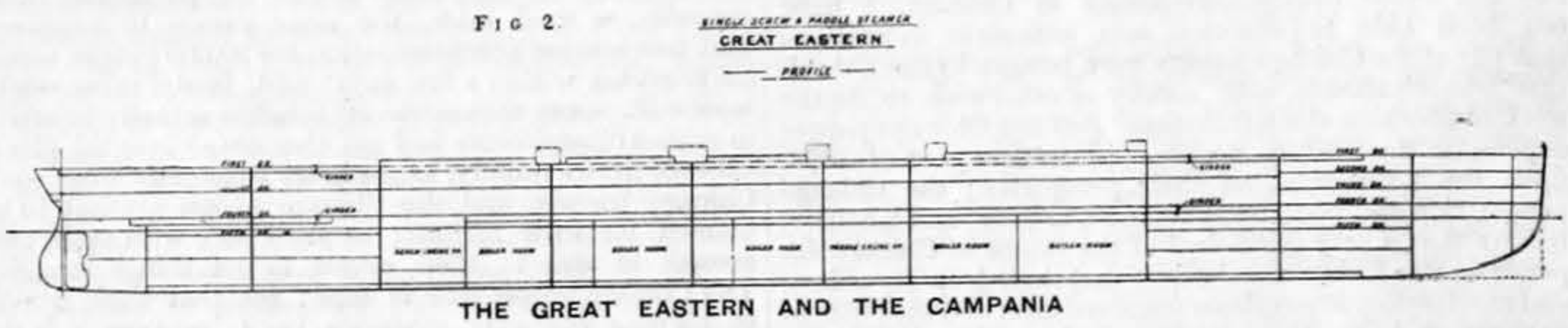


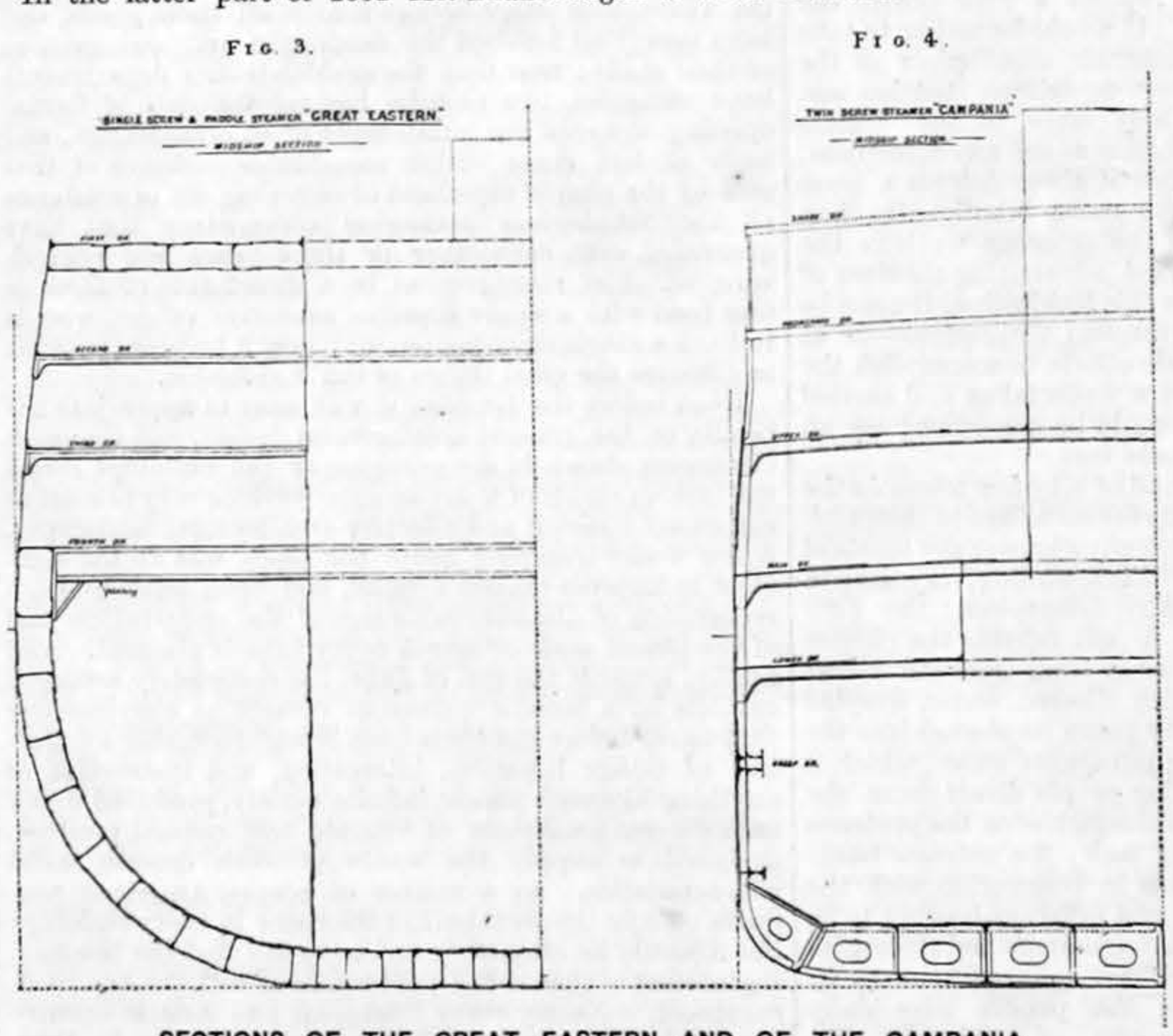
FIG 2.



THE GREAT EASTERN AND THE CAMPANIA

FIG. 3.

FIG. 4.



SECTIONS OF THE GREAT EASTERN AND OF THE CAMPANIA

Figs. 1 to 4 show the main structural features of the Great Eastern and the Campania. One of the chief differences is that the main structure of the hull is much deeper in the former vessel than in the latter. The Great Eastern was a flush-decked ship, with no erections on deck, except a few small houses at the middle line, shown by dotted lines; and the moulded depth from this deck was 58ft., making the vessel 11·7 depths in length. The Campania carries upon her upper deck — in conformity with the type of vessels that has been developed for the accommodation of the largest number of passengers—two tiers of decks. The first, or promenade, deck consists of forecastle, poop, and midship deck for passengers, nearly 400ft. long. This deck is practically continuous, the midship part being separated from the forecastle and poop only by a small break at each end. Upon the promenade deck a large amount of first-class passenger accommodation is provided, which includes library, drawing and music-rooms, smoking-room, twenty state-rooms, &c. The second, or shade deck, is carried right across the promenade deck as a shelter to the passengers, and it extends fore and aft over the whole length of that deck. Upon it are carried the boats, cabin accommodation for the captain and officers, chart-room, wheel-house, &c.

The moulded depth from the upper deck of the Campania is 41ft. 6in., making 14½ depths in length. The moulded depth from the shade deck is 59½ft., which is only 1½ft. more than the moulded depth of the Great Eastern from the upper deck. Apart from this difference in moulded depth, the main features of the structural design of the hull are very similar in the two cases. There are several complete iron or steel decks—the upper one being of great extra strength;* a bottom made very strong by means of inner bottom plating and longitudinals, and a very similar amount and arrangement of internal

* In the Great Eastern this deck is cellular in construction, and consists of longitudinal girders plated at the top and bottom with ½in. plates.

subdivision of the hull by watertight bulkheads.

The framing of the hull was entirely longitudinal in the Great Eastern, and the inner bottom was carried up as shown in Fig. 3. The longitudinals were 2ft. 10in. deep, and ½in. thick. They were about 2ft. 6in. apart on the flat of the bottom, and 5ft. apart from the bottom to a height of 36ft. The scantlings of the hull seem to have been arranged upon a simple principle, for Mr. Scott Russell says, in his work on "Naval Architecture," page 394, "There is one thickness of plates, ¾in., for skin, outer and inner; one thickness for internal work, ½in.; one size of rivet, ⅞in.; one pitch, 3in.; and one size of angle iron, 4in. by 4in. by ⅝in.

The shell plates, which were ¾in. thick, were only 10ft. long and 2ft. 9in. wide; being, it may be presumed, the largest obtainable at that time. The weight of one of these plates would be under 7½ cwt. The bulkhead plates, which were ½in. thick, were about 9ft. long and 3ft. wide. The progress since made in the manufacture of ship plates is shown by the fact that the shell plates of the main portion of the hull of the Campania, which are ⅞in. thick, average over 26ft. in length, 5ft. 3in. in breadth, and 45 cwt. in weight. Mr. Scott Russell says, "The Great Eastern was entirely built with single riveting, the double riveting being at the butts mostly." We have since learned that much can be done to increase the strength, and prevent the undue straining, of such a structure as a ship's hull by extra riveting. In the Campania, three of the edges of the bilge strakes and the top edges of the upper strakes of plating on each side are treble-riveted, and the remainder are double-riveted; and all the butts, which are lapped, as in the Teutonic and Majestic, are quadruple-riveted — except at the extreme ends, where they are treble-riveted.

The author then went on to sketch the history of the Great Eastern, and then passed on to some of the general questions involved by the growing demand for increased speed at sea.

There are already several ships that can cross the Atlantic at an average speed of over 20 knots, or 23 statute miles per hour. The Campania crossed from Sandy Hook to Queenstown, on her first voyage in May last, at an average of 21·3 knots, and during one day she averaged 22·3 knots. These speeds are a little over 24½ and 25½ statute miles per hour respectively. Among the conditions essential to high speed in all weathers are:—(1) Great size of ship; (2) a form suitable for driving easily at high speeds over heavy seas without shipping heavy water, or lifting the propellers sufficiently to cause racing; (3) deep draught of water; (4) steadiness in a sea-way; (5) great strength of structure and of machinery; (6) a large proportion of boiler power, so as to enable a full supply of steam for the engines to be easily kept; (7) a full and well-regulated supply of air to the furnaces.

The speed of a ship at sea approximates more nearly to that obtained in still water, with the same propulsive power, the larger she is made. No doubt length is the principal element of size in this respect, but depth, or draught of water, is also very important. Whatever might be the speed obtained with a ship on trial in smooth water, the extent to which her average sea speed would afterwards approach this would depend very greatly upon her size.

The full effect of form upon average speed at sea, over long voyages and in all weathers, cannot be measured by still-water trials. The form that gives the best results in still-water trials, with any size of ship, does not necessarily give the best results at sea. It is sometimes said as an objection to model experiments, such as Mr. Froude taught us to make, and to still-water trials—which belong to the same category—that they do not tell us what the speed will be at sea, or what is the best form for speed at sea. The reply is that Mr. Froude never said they would.

In Dr. Elgar's opinion, the improvement of existing forms in suitability for Atlantic seas must be looked for more in knowledge and experience of what such a sea requires than in mere still-water experiments. One of the chief points in connection with the form best adapted for sea speed is that it should offer resistance to pitching. The fineness of ends that would give the best results in smooth water requires to be corrected by the fulness necessary to prevent undue pitching. It is only the judgment and experience of the naval architect that can decide where the line is to be drawn between the two directions. If he err on the side of fineness, as attempted perhaps by the desire to obtain the highest possible still-water results, he will lose in speed when there is any sea; and if on the side of fulness, he will lose by excess of resistance in smooth water, and perhaps at all times.

Deep draught of water is a most important element of speed at sea, and it is now strictly limited by the depth of water in the ports and docks used by the fast passenger steamers on both sides of the Atlantic. Twenty-seven feet is the extreme limit of depth to which a ship can load on either side. The Campania cannot load an inch deeper than the Umbria, although she is 100ft. longer. If the underwater dimensions of the Campania had been increased proportionately to those of the Umbria, her draught of water would have been 32½ft. This class of steamers are increasing in length and breadth, but the draught of water has to be kept the same. Dr. Elgar here considered at some length structural strength as modified by draught of water, and went on to say that steadiness is important, not only as a very desirable element of comfort to passengers, but also as contributing to speed. When a vessel is rolling heavily from side to side her resistance must be increased. This is shown by the fact that whereas bilge keels have an appreciable effect upon speed on a smooth-water trial, they cause no reduction in speed upon sea voyages—at any rate, that was his own experience. The advantages of bilge keels are well known in the Royal Navy, but they are not generally understood in the mercantile marine. They are often objected to on the ground of the increased frictional resistance they offer. This increase of resistance is, however, fully compensated for at sea by the reduction of resistance due to diminished rolling. It would add greatly to the comfort of passengers if rolling could be reduced in these large steamers; and bilge keels furnish a ready and certain way of doing it, when they are properly fitted and are of appropriate size.

He concluded by saying that the improvements that would have the greatest effect in promoting the increase of speed at sea are: Increase of depth of water in harbours and docks, such as would admit of much greater draughts of water being obtained; and improvements in boilers, by which greater steam power could be developed out of the same space and weight. In the matter of boilers, it is necessary to move very cautiously, and above all to run no serious risks. Stronger qualities of steel may also be obtained; but the tensile strength of steel used is not a measure of its efficiency for all the purposes of a ship's structure. The present steel is 40 or 50 per cent. stronger than the iron that was formerly used; but it cannot be reduced in thickness so as to save more than 12 to 15 per cent. in weight. In any improved material that may be introduced, the rate of elongation with tension, or, speaking more generally, the relation of strain to stress may be more important than the mere tensile strength, as a ship's hull requires to be very rigid, and to be practically free from movements due to stretching or compression of materials. The Atlantic trade is increasing at such a rapid rate that larger and swifter ships are certain to be soon called for. The depth of water has lately been somewhat increased at Liverpool; but much deeper harbours and docks will be required if further great increases of speed at sea are to be obtained without excessive difficulty and cost.

The discussion which followed cast very little new light on the points raised by Dr. Elgar. Sir Edward Harland could not find much about the Great Eastern to admire. During the building of the Great Eastern he was struck with the boldness of the designers, and he envied them their possession of such a mass of matter to turn into a structure which they had the power of the company to build. He only wished he had had the same amount of material to turn into two ships in the place of one, and he believed if he had, some of the companies with which he was connected would never have come into existence. Unfortunately for several generations of owners, the Great Eastern proved a lamentable failure. The machinery and propelling power were simply two masses of very lamentable failures. Paddles ought not to have been applied to such an immense hull as the Great Eastern, because when rolling to the extent to which she did roll one paddle would be invariably out of water. The Great Eastern was a very melancholy illustration of great ignorance. As to the launch, he believed that if Brunel had given the order to let her go, and had then run away out of the yard, the launch would have been a great success. But Brunel was afraid that one end would reach the water before the other. This was checked, and the launch was spoiled. The Campania was the last and most magnificent type of vessel in the mercantile marine; but he would have liked Dr. Elgar to favour them with a comparison with the City of New York, Paris, Teutonic, or Majestic, all ships more nearly her size, and more nearly her age in existence. The comparison with the Great Eastern was artistic, but it had no practical advantage to them. As to the draught of water, they must be very pleased to find that not only in Liverpool but in New York the draught of water was being increased, and it would encourage owners and builders to go on and build vessels even larger than the Campania. They could increase the beam; but it did not give increased strength, and they could not obtain that without depth. The steel of the present day was something magnificent, and was more like copper in its utility.

Professor Biles followed Sir Edward Harland. He devoted himself principally to considering the methods in which depth might be made to add to the strength of a ship. He pointed out again that as the length of a ship increased the stresses due to waves would decrease. Thus, a ship 600ft. long was more likely to meet with waves 600ft. apart on which she would be carried at the two ends, than a ship 1000ft. long was likely to meet with waves 1000ft. apart; and as, furthermore, it was possible to augment the strength of a ship in the middle without adding to the weight at each end, he could not accept the rule that the weight must increase as the cube of the dimensions as in any way precise for large ocean steamers.

Mr. White, referring to the influence of form on speed, said that in their practice at the Admiralty they had been careful to distinguish between sea work and smooth water work. They had obtained exceedingly good results in cases where they gave increased length, increased breadth, well-rounded ends, and smooth lines, and had achieved enormous economies by working on the general lines laid down by Mr. Froude. In his paper published in the "Transactions" of the Institute in 1886, they would find particulars of the results achieved in speed by the warships Collingwood and Warrior. There could be no doubt that the matter of the draught of water in the ports was a most important matter bearing upon possible economies of the future. Dealing with the influence of length upon pitching, Mr. White said he had advised an increase of length up to the full extent possible, but in the Admiralty they were always hampered by the requirement that they should get the quart into the pint pot, and he envied the free hand held by the gentlemen who designed and constructed the Campania and vessels of that class. He entirely endorsed what Dr. Elgar had said as to the utility of bilge keels, but he thought that Dr. Elgar would agree as the size and height of ships increased the useful effects of bilge keels must diminish, and in experience they had had instances in which no practicable bilge keels could have produced any appreciable effect.

Mr. Martell having spoken,

Dr. Elgar, in reply, said his suggestion as to the promenade deck was that, instead of its being a light structure, it should be made the upper deck of the ship; and, by a redistribution of weight, a stronger and more stable ship would be obtained with the same weight of material.

This concluded the morning's proceedings, the paper, remaining on the programme, on "Wear and Tear in Ballast Tanks," being deferred till Wednesday morning.

After luncheon, hospitality provided by the reception committee, the members of the Institute proceeded by train to the Bute Docks, concerning which we have already said something and shall have more to say. A visit was then paid to the new Dowlais Steel Works, which we have already described and illustrated in our pages.

In the evening the dinner of the Institution took place in the Park Hall, a very handsome and convenient hall, so large that there was no crowding. A great many speeches were made, but they were for the most part curiously political in tone, totally devoid of technical interest, and outside the province of THE ENGINEER.

We must reserve our report of the proceedings of Wednesday and yesterday (Thursday) for our next impression, with the exception of Mr. Hamilton's paper, of which the following is an abstract:—

ON WEAR AND TEAR IN BALLAST TANKS.

The author said that the two forms of ballast tanks now common consist of the ordinary, or McIntyre, and the cellular double bottom. The various forms might be tabulated thus:—No. 1, as cellular double bottom with the floors complete from centre line to wings of tank, lightened by large holes, and continuous centre keelson, with girders fitted intercostally between the floors. No. 2, cellular double bottom with centre keelson and side girders continuous, and the floors fitted intercostally as diaphragm plates. No. 3, cellular double bottom fitted with continuous centre keelson and side girders, and brackets for floors.

In the McIntyre tank, excepting in the way of the boilers, the wear and tear is principally confined to the riveting of the angles at the bottom of the fore-and-aft girders, the rivets being often found loose and broken, more particularly at the wing keelsons; this attachment becoming loose allows the girders to cut into the reverse frames, and in many cases breaking the fore-and-aft angles. From the fact of these keelsons being in some cases found displaced at their bottom edges, it is possible to suppose that this movement is generated at times by the tank being filled after the vessel has left port, and the heavy body of water rolling about before the tank is full, strikes the girders with great force every time the vessel rolls. Corrosion in these tanks, apart from the machinery space, is found to be slight, owing, no doubt, to the interior being nearly always in the same wet condition, and by the ironwork being covered with a deposit, more or less thick, of mud.

The cellular double bottom differs in an important respect from the McIntyre, inasmuch as it is an integral part of the vessel's construction, and the continuity of strength of the inner bottom should be maintained in a fore and aft direction. In the case of No. 1 it is found that, like the McIntyre, they are little liable to internal corrosion apart from the machinery space. Like the McIntyre tank, however, its vulnerable part is in the machinery space, and in one case of a vessel the entire tank top within range of the extreme heat of the boilers was found to be completely wasted, the floors were destroyed, having been corroded through, in a line at a distance of about 8in. to 14in. under, and parallel to, the tank top, the reverse bars on same, and the intercostals with their angles were deteriorated in a like manner, and to such an extent as to render the tank useless as such, and detrimental to the strength of the vessel. As to No. 2: In a steamer with this arrangement of bottom it was found necessary, upon examination, owing to corrosion, to renew at least one length of plate of each of the side girders, the top plating, the intercostal floors with their angles, and the entire boiler bearers.

The author had two photographs illustrative of the dire effects of corrosion on plates situated in the machinery space of a vessel arranged under the heading of No. 1, and he concluded by describing briefly the method of repair adopted.

THE annual convention of the American Institute of Architects is to be held in the new Memorial Art Institute, on the Lake Front in Chicago, in the week beginning July 31st, and the Grand Pacific Hotel has been selected as the headquarters of the Institute of Architects during the convention. The Grand Pacific is conducted on the American plan only, is but a short distance from the Art Institute, and is only four blocks from the station where the trains start for Jackson Park, the site of the Columbian Exposition, making the run without stopping in fifteen minutes. The following figures give some idea of the cost of a visit to the Exhibition:—The rates per day, including board, are as follows: Single rooms, 4 dols. to 5 dols.; same, with bath, 5 dols. to 6 dols.; double rooms, one person, 6 dols.; two or more persons, 5 dols. each; double rooms, with bath, one person, 7·50 dols.; two or more persons, 5 dols. to 6 dols. each. These prices, it is stated, are as low as the lowest in the city for the same class of accommodation, and will, it is thought, be cheaper than a 3 dols. room in a temporary building near Jackson Park, with the added expense of obtaining meals elsewhere. It is, however, further announced that rooms can be obtained for one person in a single bed, with two or three in a room, for as low as 1 dol. per day, and that the management of the Lakota, a new ten-storey fire-proof hotel, on the corner of Thirtieth-street and Michigan-avenue, about midway between Jackson Park and the Memorial Art Institute, has agreed to accommodate the architects who prefer the European plan, at the rate of 1·50 dols. to 4·50 dols. per day. The local committee, consisting of Messrs. W. W. Clay, 218, La Salle-street, and S. A. Treat, 58, Wabash-avenue, will, if desired, undertake to secure quarters at the Lakota or elsewhere, as far as in their power, from 1·50 dols. to 5 dols. per day, on the European plan, if they have timely notice of the same, stating the time of proposed arrival, length of contemplated stay, and the price which the members are willing to pay.

THE MERSEY BAR.

In holding her place among British seaports, Liverpool has two difficulties to grapple with. The greater portion of her dock system was constructed long before it was surmised that vessels would attain anything at all approaching their present dimensions. Thus Liverpool has over and over again had to adapt as best she could her obsolete dock facilities to meet the ever increasing requirements of modern commerce. Her first dock dates back to 1709, when the Liverpool Old Dock, the first wet dock constructed in England for the reception of vessels, came into existence. The site of this dock is at present occupied by the Custom House, but its memory is still preserved by the fact that all tidal and other level data are referred to the sill of this dock as the basis of measurement. This sill was some 21in. below the mean level of low water of neap tides. From this date the Mersey dock system slowly but surely developed, and in 1858 the whole of the various dock estates on both sides of the river passed into the management of the Mersey Docks and Harbour Board. This Dock Board has not only had to face the question of reconstructing old docks and providing new ones, it has also had to preserve the navigable channel leading from the Irish Sea into the Mersey estuary proper. The maze of sandbanks between which this waterway runs is subject to the usual changes that mark such channels. The oscillations that mark the shifting of the banks of sand and detritus have frequently modified the main scouring forces, with the result that new channels have been formed, and old ones have become practically silted up.

A glance at the sketch accompanying this article will show that there are some three channels leading from the Mersey into the Irish Sea. One of these, that running between Jordan Bank and the fringe of sandbanks adjacent to Formby Point, may be left out of the question, for during the year 1892, only eleven small craft passed through the Formby Channel. Through the Rock Channel there passed 5822 vessels, while no less than 41,145 vessels used the Crosby Channel.

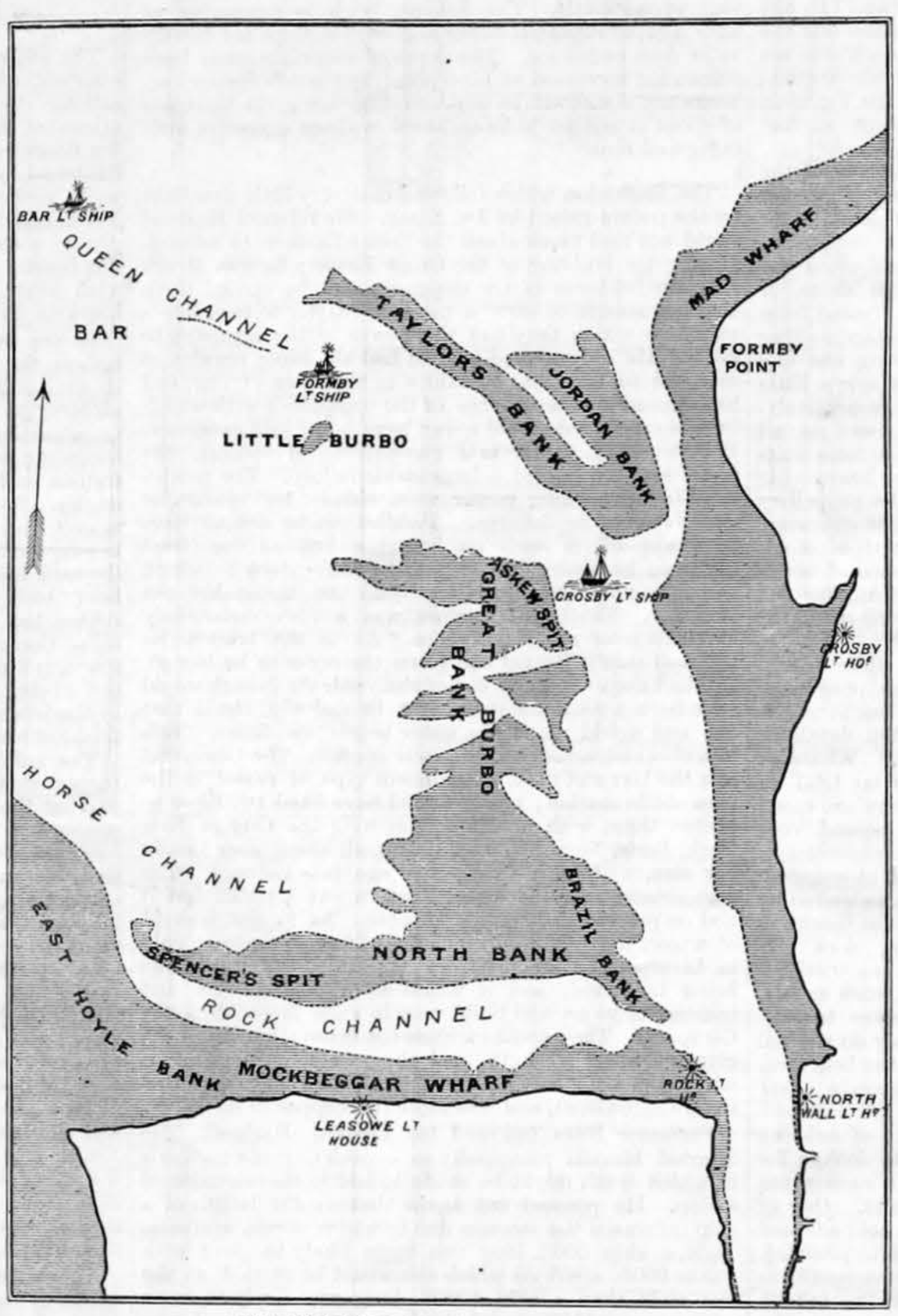
A ship leaving the Mersey makes in a straight line for the Crosby Lightship, from thence to the Formby Lightship. Between this light vessel and the Bar Lightship flows the Queen Channel, and about half way between those two limits lies the Mersey Bar. This impediment to navigation did not always occupy its present position, nor has the depth of water upon it been constant. Before dredging operations were commenced upon it, the depth at low water of springs seems to have ranged from 8ft. to 12ft. The distance of the Bar of the Queen Channel from the Rock Lighthouse was 17,250 yards in 1857, 18,000 in 1866 and 1876, while it increased to 18,700 yards in 1871. At the present time the distance along the leading line of the Crosby and Queen Channel to the Bar is about nine and a-quarter miles. From time to time a passage of water has opened up from the Crosby Channel across the Great Burbo. These streams of water, however, as well as the banks themselves, have shown a more settled character during the past few years than they did in the early days of the port. The Queen Channel, which is the present connecting link between the Crosby Channel and deep water, has now been in use since 1857. Prior to that date the Victoria Channel lasted in a navigable condition from 1837, while Denham's "New Channel," first noticed in 1833, lasted till 1841. Within the Queen Channel itself the sea bed is by no means stationary. Between 1890 and 1892 the 30ft. contour line outside the Bar has advanced about 175 fathoms to the north-westward, and the 18ft. contour line has similarly advanced outwards about 100 fathoms. The same contour from Taylor's Bank has advanced some 130 fathoms into the channel. With this exception, this sand bank has remained stationary. Askew spit, however, has undergone an expansion towards the north, while its western front has receded. In the Horse and Rock Channel the silting up process is much more rapid, and Spencer's Spit and the Brazil Bank are gradually approaching to the banks that are connected with the Cheshire coast. This, however, is not altogether to be deplored, as it will probably lead to an increased scour down the Crosby Channel, and thus tend to deepen the water over the bar. The area of the banks which form such a feature of Liverpool Bay may be estimated at about thirty-two square miles; at least, that is the measurement of that section of them which is dry at low-water of spring tides. Their area was much the same in 1736, while in 1835 it was put down at some four miles less. About two-thirds of the banks exposed at low-water are quite detached from the mainland.

Having seen what is the nature of the banks and channels that lie off the Mersey entrance, we now come to the Bar itself. This ridge of sand, which now lies midway between the Bar and the Formby Lightships, may be regarded as the practical boundary of the Mersey estuary. Seawards from the Bar the water rapidly deepens. Thus soundings show a depth of 33ft. at low water close up to the Bar, and this deepens to 42ft., 36ft., and 48ft. until the Bar Lightship is reached. From here to the North-west Lightship, which is some eight miles further seawards, the soundings run 48ft., 54ft., 60ft., 66ft., 72ft., and 84ft., the sea bed being deeper to the northward of the line than it is on the south.

The dredging operations were first made on the Bar towards the end of September, 1890. A 500-ton steam hopper barge, fitted with powerful centrifugal pumps for removing the sand, then commenced work. The least depth of water in the channel operated upon was 11ft. on the seaward edge of the Bar and 15ft. on the Mersey side. This shoal patch obstructed the navigable waterway for a length of a thousand yards, and a width of a thousand feet, the straight line joining the Bar Lightship with that known as the Formby passing through the centre of the area. The autumn of 1890 was exceptionally tempestuous, and interruptions were frequent in consequence. In the month of November a series of very heavy gales from the north-west was experienced, so that whatever improvement the dredger may have effected was obliterated. Thus the practical result of three months' intermittent work was *nil*.

In April, 1891, another dredger took up its station on the Bar, and the two sand-pumping vessels worked together for the remainder of the year. The engineers to the Mersey Dock Board estimated that the removal of 800,000 tons of material would effect a deepening of 6ft. 6in., and thus give a least depth of 17ft. upon the Bar at low water. Before the close of 1891 there had been a clear gain of 5ft., notwithstanding that several severe spells of bad weather had occurred. This improvement was made at the comparative trivial expenditure of £15,000, and was the result of 2239 hours' working, no less than 657,000 tons of sand being removed. This was considered so satisfactory, that in May, 1892, the Dock Board contracted with the Naval Construction and Armaments Company, of Barrow, for a twin-screw sand-dredger capable of carrying 3000 tons of sand, and fitted with pumps sufficiently powerful to fill her with that quantity in forty-five minutes. This vessel, named the Brancker, was launched on the 4th March last, and has commenced work. Her length between the perpendiculars is 320ft., and her moulded depth is 20ft. 6in., while she has a beam of 40ft. 10in. She is built of steel, and is of 2560 tons gross register. Amidships are eight large hoppers, four on each side of the vessel, having a total capacity of 3000 tons of sand. These hoppers are fitted with Mr. A. G. Lyster's patent hydraulic apparatus. A well is formed in the centre of the ship between the hoppers to allow the working of a sand pump suction tube 3ft. 9in. in diameter. The tube works through the bottom of the vessel, and is raised and lowered by hydraulic pressure. It can work at a depth of 45ft. Rectangular landing platforms are fitted above the hoppers, and so arranged that spoil may be distributed among the sand-holding chambers at pleasure. Two large centrifugal pumps, having suction and discharge pipes 3ft. in diameter, driven by triple-expansion engines having cylinders 11½in., 18in., and 29in. in diameter by 18in. stroke, and working at 160 lb. steam pressure, complete the sand-raising apparatus. The Brancker is the outcome of a number of experiments that have been made relative to the best possible equipment for the work, and hence the impossibility of executing the order as speedily as some would have liked.

The two dredgers to which we have alluded above did good work during 1892, removing in all upwards of 1,000,000 tons of sand. The greater part of this was removed during the latter half of the year, the amount excavated being 37 per cent. greater than that removed between January and June. During this interval one of the dredgers was absent upon other work for four months. Under these circumstances it is hardly surprising to learn that the maximum average depth of the cutting through the Bar was reached at the end of January, and that up to the end of June there had been fluctuations, tending generally in the direction of a slightly diminished depth of water. Assuming that there was nothing abnormal in the deposit of silt in the Queen Channel during the first six months of 1892, then it is quite a legitimate assumption that the 450,000 tons of detritus removed during that period was, roughly, coincident with the amount deposited upon the 3,000,000 square feet of Bar surface operated upon by the dredgers. If this be so, then the Dock Board have not only to deepen the Bar Channel, they have also to maintain it when secured. To remove a million tons of sand, is, for a vessel of the Brancker type, an exceedingly easy matter, and probably this is about the amount of solid matter deposited on the area in question during the course of a year. Of course it may be that the increased depth will give an increased scour along the Bar Channel, and then dredging operations of a permanent character will be unnecessary. There is, however, the shifty character of the currents through this maze of sandbanks to be considered, and this is a factor of the most uncertain nature. It has in the past produced both improvement and deterioration of the Bar Channel, and may do so in the future. Everybody is now convinced, however, that the Mersey Docks and Harbour Board hold in their own hands the solution of the Bar problem, and that it is only a question of another twelvemonths' work before steamers of the very largest class will be able to enter the Mersey at any state of any tide.



THE ENTRANCE TO THE RIVER MERSEY

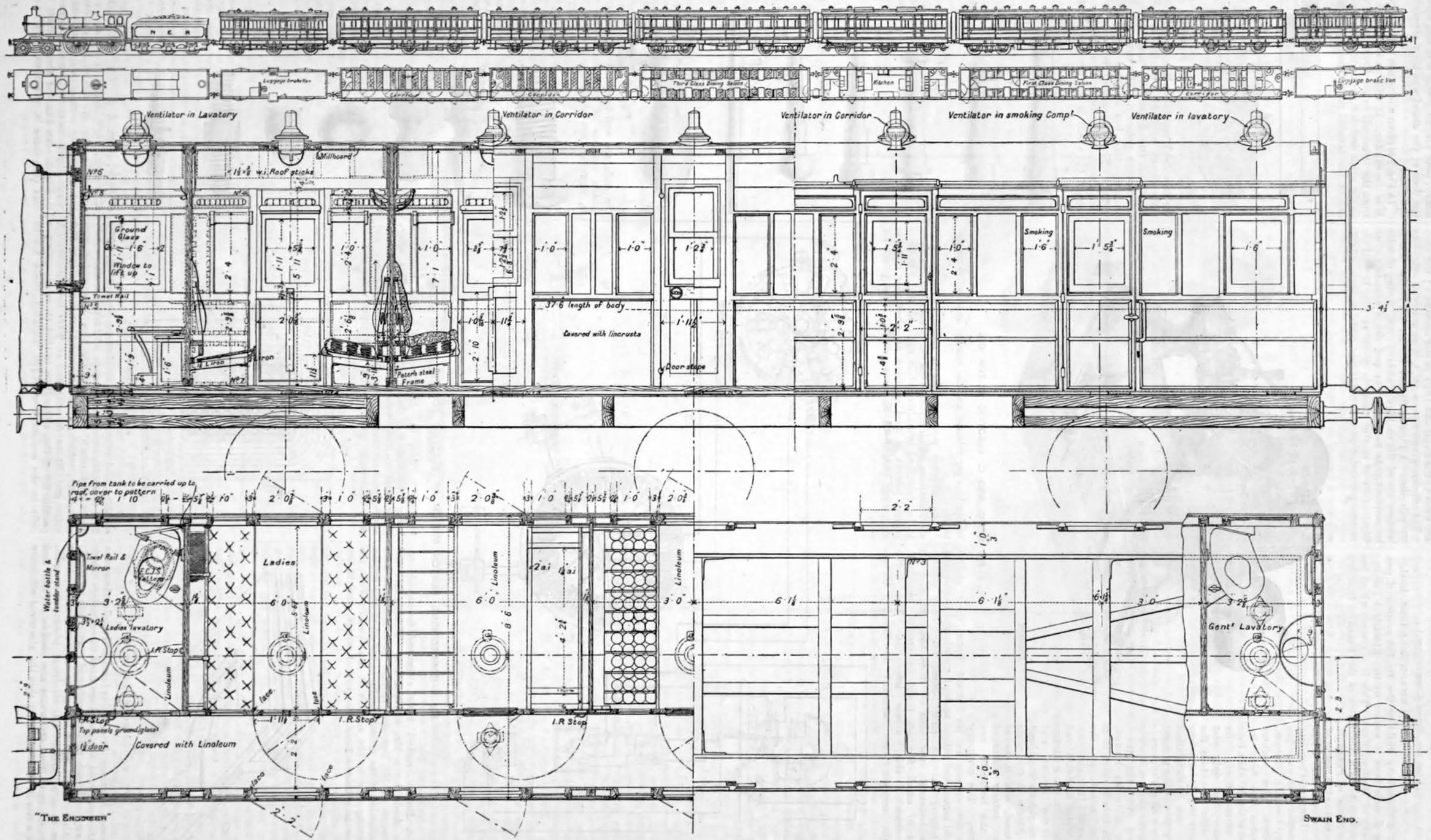
ROADS IN CHINA AND PERSIA.

Roadmaking among the Chinese has never been brought to any degree of perfection. Except in the neighbourhoods of Amoy and of the few foreign settlements at the treaty ports, there are none but the most primitive and unimproved roads in the country. Roads outside the cities, whether for communication, conveyance, or military purposes, are merely lines of ruts across the fields. During nine months of the year, when free from rain, they keep in very good condition; but at other times they form an impassable bog, and travel, except on foot, is suspended. Nearly all traffic and travel is carried on over the canals and rivers which exist only a few miles apart all over the settled parts of the country. To this, and to human labour having been always found preferable to that of pack horses over circuitous and narrow mountain passes, may be ascribed the principal reasons for the neglect of road construction. Inside cities and towns, the streets are from 6ft. to 12ft. wide. Some of the most crowded thoroughfares are paved with massive blocks of stone. When kept in repair these streets are serviceable, but they are so few as to accentuate the impassability of the others. Greater attention is now being paid to road-making, especially for military purposes, the feeling which caused the Chinese 2000 years ago to build a wall 3000 miles long to keep out foreign invaders, not having become extinct. It is considered necessary to have a chain of forts all along the sea coast and up the Yantgze. In the district of Chefoo there is to be a naval station at Chiao Chou, south of the Shantung Promontory, one at Chefoo, and another at Wei Hai Wei, to the east of that place. The general in command has set his men to work to make roads about the forts and a trunk military road from Chefoo to Wei Hai Wei. When completed the road is to be continued from Chefoo westwards to Chinanfu. The soil in this part of the country soon cakes into a hard clayey mass. Consequently while the roads about the forts which have been levelled and supplied with ditches on each side look everything that could be desired, Commander Adair, R.N., asserts that they can never carry a heavy gun. During some heavy snowstorms last winter this military road became a quagmire. This may teach the General the necessity of using metal for making roads. Suitable stone is both cheap and plentiful. A good road to Chinanfu passing through the silk and straw-braid districts would be an incalculable benefit to the trade of Chefoo. Carriageable roads in Persia are few, their total length not exceeding 182 miles, and there are neither canals nor navigable rivers, circumstances which greatly hinder the development of trade. One of these roads was constructed from the village of Peri Bazar, the landing stage, after traversing the lagoon of Enzelli to Resht, a distance of five miles, and thence to Cazreen and Tehran. This road is used for wheeled traffic as far as Imamzadeh Hashem, twenty-eight miles from Resht. It is as a rule in a shocking state of disrepair, and is only patched when a distinguished traveller passes through Resht on the way to or from Tehran, or by express orders from the Shah. The road is in a comparatively decent condition when the weather remains dry for a fortnight or three weeks, but this seldom happens. From Imamzadeh Hashem to Cazreen the road is little better than a wide mule track, dangerous for both man and beast in wet weather. A Russian company has a concession for the construction of a carriage road from Enzelli to Tehran.

THE NEW EAST COAST DINING AND CORRIDOR TRAINS—COMPLETE TRAIN AND THIRD-CLASS CORRIDOR CARRIAGE

THE OLDBURY CARRIAGE AND WAGON COMPANY, BIRMINGHAM, BUILDERS

(*For description see page* 43)



ELECTRICAL ENGINEERING AT THE CHICAGO EXHIBITION.

(*From our Special Commissioner.*)

CHICAGO, JUNE 19TH, 1893.

IN the Electricity Building the Burton system of producing electric heat is shown by the Electrical Forging Company of Boston, Mass. This is a system which has been examined by a committee of the Franklin Institute of the State of Pennsylvania, and as the result of their report the John Scott Legacy Premium and medal was awarded to Mr. Geo. D. Burton. Although the various apparatus has been installed at the World's Fair for some time, the company has only just been able to obtain the requisite supply of power from the Exhibition authorities. The general principle of the system is the application of electric current to the piece which is to be heated, and in this respect it is closely allied to the Thomson-Houston process, which was exhibited by Sir Frederick Bramwell at the Institution of Civil Engineers some time ago. Alternating currents are used, and it is of course totally different from the Benardos arc process. The company does not appear to lay stress upon their ability to weld metal, but rather to heat metal, and to carrying out forging and stamping operations. They exhibit some beautiful specimens of drop forgings, and all kinds of small forgings made in special machines, to which I shall allude later on. The works of the company are situated at 163-167, Oliver-street, Boston, and I have examined favourable reports made by a Mr. Robinson, of Chicago, Ill., and Professor P. H. Van der Wayde, of New York, after examination of the actual results obtained at the works. Referring now to the exhibit at the World's Fair, the power is obtained from the general power plant in the Palace of Mechanic Arts, and is furnished as direct current at 500 volts. At the stand are fixed three motors which are supplied with this current, and were made by the C. and C. Electric Motor Company, of New York; two of these motors develope 100 electrical horse-power each. I am informed that 600 watts are used in the field and 1875 watts in the armature; that the electrical efficiency is 96·78 per cent., and the commercial efficiency 93 per cent. The third motor gives 40 electric horse-power; 580 watts are used in the field, and 1370 in the armature; the electrical efficiency is 93·8 per cent., and commercial efficiency 91 per cent. All these figures are for full loads. These motors are of the makers' standard type, having circular consequent-pole field-magnets and drum armatures, an illustration of one of these is given in Fig. 1. All the motors are shunt wound, the larger ones running at 600 revolutions per minute, and the smaller one at 700 revolutions.

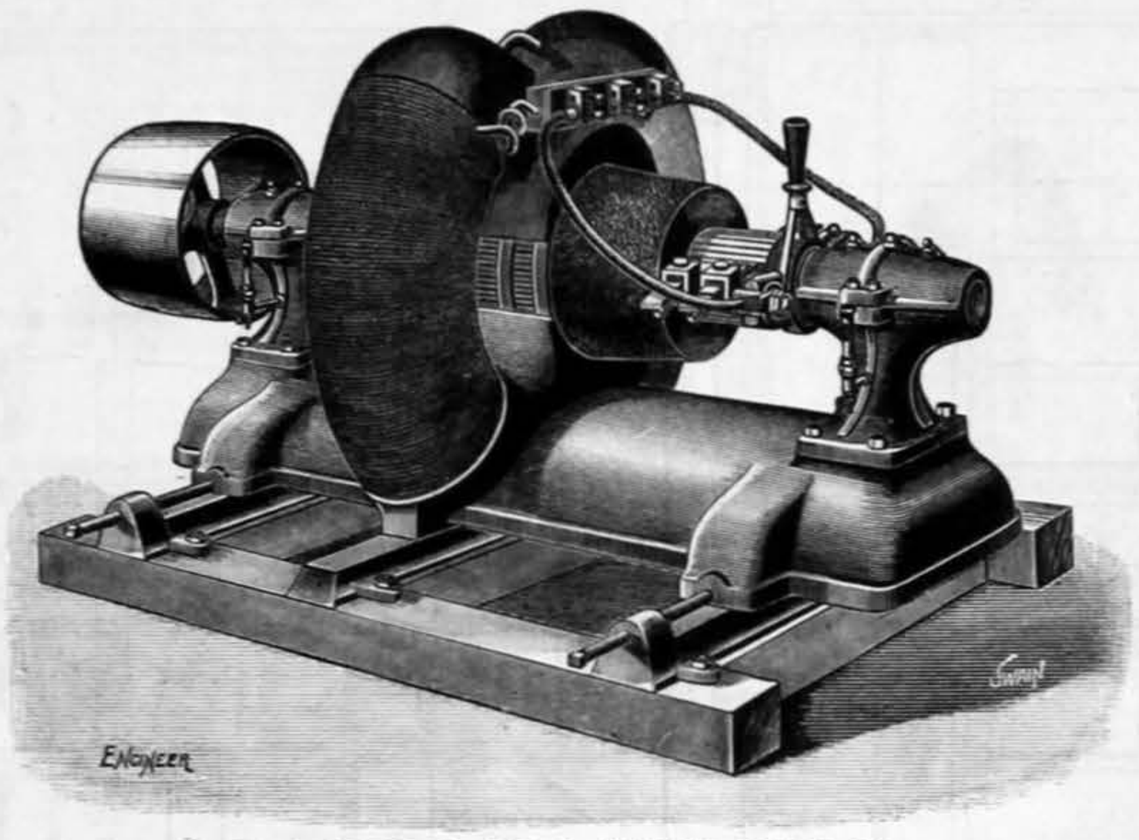


Fig. 1—MOTOR, C. AND C. ELECTRIC MOTOR CO.

The 40-horse power motor is merely used to drive some shafting which actuates the various forging machines to be described hereafter, while each of the 100-horse power motors is used to drive an alternator capable of giving out about 85-horse power. The plant for forging is thus in duplicate, only one alternator being required for the plant exhibited. The alternators and exciters were made by the Eddy Electric Manufacturing Company for the Burton Company, and each alternator gives at full load 1600 volts and 50 ampères, and runs at 600 revolutions per minute. The field of each alternator consists of 10 poles, alternately north and south, and each machine is provided with an exciter, which is shunt wound, and developes 220 volts and 30 to 40 ampères at 2000 revolutions. A peculiarity of the alternators is that there are only five coils in the armature windings, although there are 10 poles in the field. This I shall allude to afterwards. In passing I may remark that as all the plant is somewhat heavy, pine planking was first laid upon the ground, and the floor of the stand was then supported by about sixty uprights.

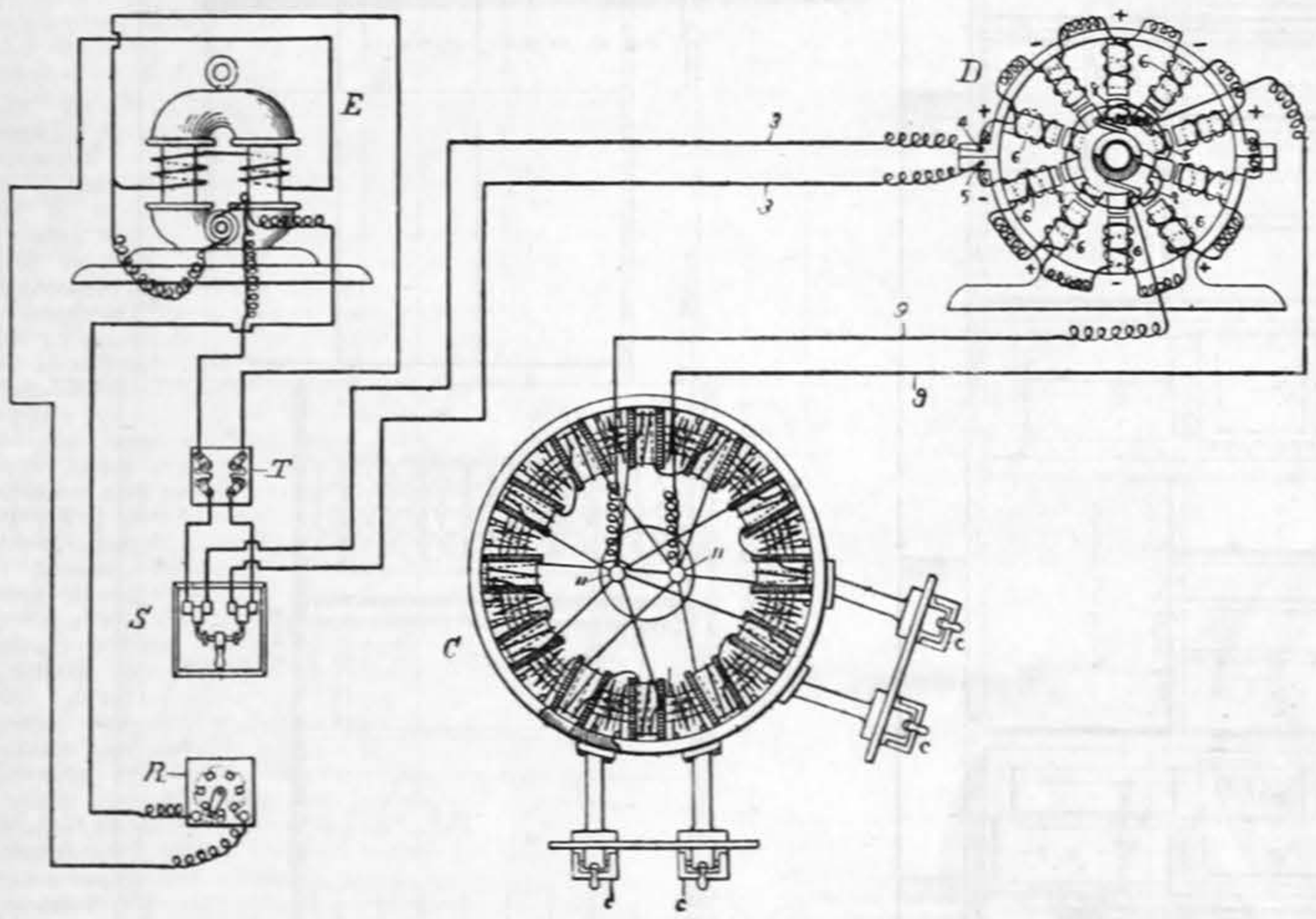
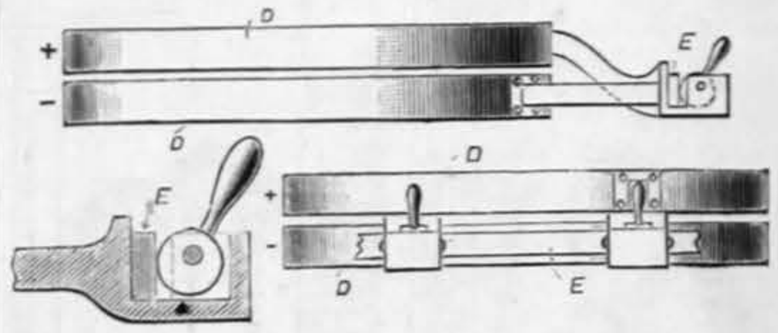


Fig. 2—CONNECTIONS, BURTON SYSTEM OF ELECTRIC FORGING

Fig. 3—SECONDARY COIL

Fig. 4—PRIMARY COIL

In Fig. 2 is given a diagram of the connections, in which E is the exciter. It will be seen that the line wires run from the terminals to the double pole cut-out T, and then to the main switch S, while the shunt circuit passes from one of the brushes round the field-magnets, and through the adjustable resistance R back to the other brush. The main direct current is carried to the alternator, and passes all round the field magnets in series producing the proper polarity. The armature is provided with ten projectors, but of these only every alternate one is wound. The alternating current is collected in the usual way, and passes into the primary of a transformer C, which is by far the most important portion of the plant. The terminals of the primary coils are figured 11, and the main current is then split into half as many branches as there are primary coils. Each branch is wound round two primary coils in series, and a secondary coil is placed between each two primaries. It will thus be seen that all the primary coils are wound alike, and all pairs in parallel. The secondary coils consist of a few turns of flat copper ribbon A A, with plates of insulating material between each pair of windings, as shown in Fig. 3. A primary coil is illustrated in Fig. 4. B, and all the coils are well insulated from the core, shown at C, which consists of galvanised iron wire. This wire is, however, not continuous, but is in the form of a number of incomplete rings, so that there is a gap between the two ends of each coil. The secondary windings are attached to two heavy solid copper rings D D, which encircle the whole transformer, and are shown in section. One of these rings is therefore positive, while the other is negative, and Figs. 5 and 6 illustrate the method of forming the connections for the bar of metal E which is to be heated. The excentric clamp—Fig. 7—is one of the forms most frequently adopted for securing the bar in position, but in many cases where only a short length of metal is to be heated, it is merely held across the two main bars by means of tongs. It is obvious that several arrangements for cramping the pieces may be attached at different points of the circumference, and in the machine exhibited four such connections are made. The secondary current is at a pressure of only about five volts. So that its quantity is, of course, very large, in some cases reaching 8000 ampères. As it would be impossible to regulate the secondary current by introducing resistance, the whole apparatus is controlled by means of the resistance R, Fig. 2, placed in the shunt circuit of the exciter. In this case there is, of course, only a small current to be



Figs. 5, 6, and 7

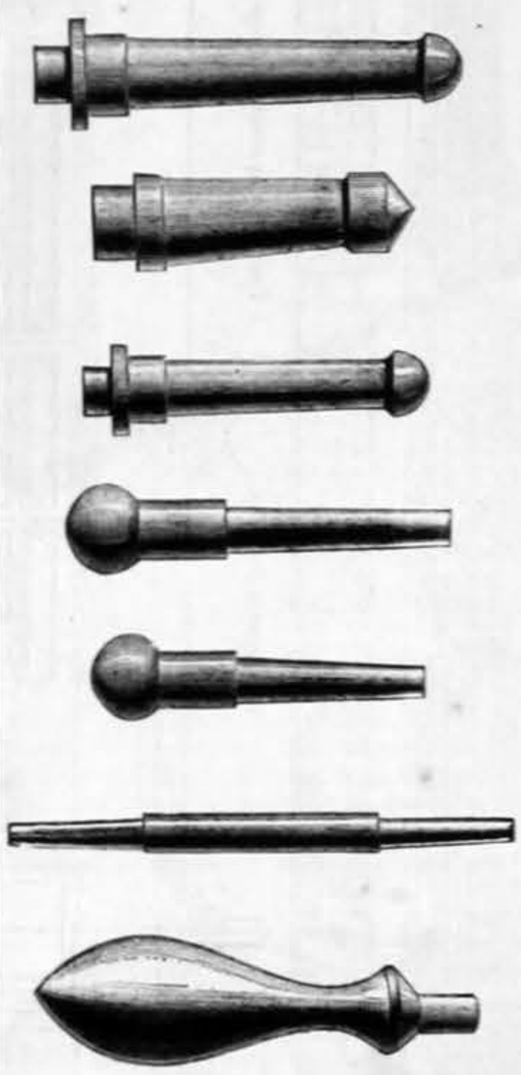


Fig. 9

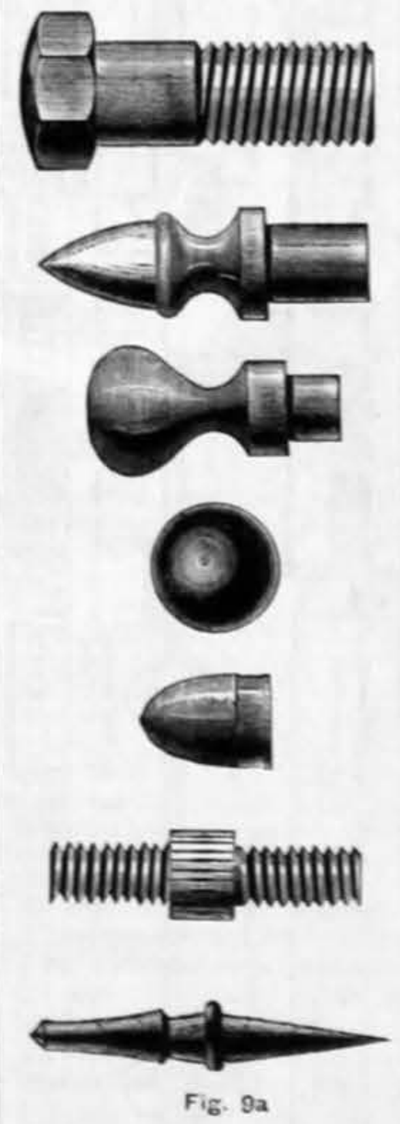


Fig. 9a

controlled, and the rheostat is placed in such a position that the workman can regulate the heating effect while manipulating the bar. The position and use of this rheostat appears to be one of the features upon which special stress is laid by the inventor of this system. The Electrical Forging Company, besides supplying special plant, are also manufacturers of a large variety of forgings, and they claim that, as the electric current first heats the centre of the piece of iron being used, therefore that piece will retain its heat for a longer period than if heated from outside in an ordinary fire, and that one heat is sufficient to finish such a forging as a hammer head made of tool steel throughout. Another advantage appears to be the entire absence of scale upon the piece heated. Fig. 8 represents a special machine made by the firm for producing rolled forgings of the types shown in Fig. 9. A pair of special tools are required for each pattern, and one of these tools is fixed upon the rotating drum, while the other is attached to the inside of the fixed sector. The tools for ball-rolling are shown in position in Fig. 8, and they are so formed as to shape a perfect sphere, and cut it off the heated rod during one revolution of the drum. Each of the other forms shown in Fig. 9 are also turned out in one revolution, and thread is put on the studs or screws at the same time. I examined some of these specimens, and they appeared to be very well shaped. The balls are not turned in any way afterwards, but are merely ground up true. In certain cases where end heat upon the bars is all that is required, the clamps upon one of the electrodes are provided with a number of holes through which rods may be inserted. As soon as these rods come in contact with the other electrode, they are heated to a forging temperature, and a lad can feed the rolling machine as fast as the rods are heated. I was informed that a bar of iron 1½in. square and 20in. long, could be brought to a forging heat in 5½ minutes, with an expenditure of 42-horse power. In order to give an appreciation of the capability of the plant, I was informed that a round bar of tool steel ⅞in. diameter and 11in. long between the clamps, is raised to a forging heat in one minute by 32-horse power, and the steel for making balls, which is often ½in. diameter and 5in. distance between the clamps, is heated in half a minute by 27½-horse power; and this heat can be maintained for any length of time. A drop-hammer is shown at the stand, and a tool of this kind is used for forging hammer heads. I examined some fitters' hammers made by the system of electrical heating and drop forging at one heat, which appeared remarkably perfect in form. This evening I was present at the stand, and witnessed the actual working of the plant.

In one case a bar of tool steel 1¼in. square in section was taken, and a length of 8in. heated between the gun-metal cramps. The heating appeared quite uniform on the outside, and was carried to such an extent that the metal was melted. It was interesting to observe that the inside of the bar had been hotter than the outside, as the molten metal ran out of a hole which was produced at the lower side of the middle of the piece. After this operation a bar of tool steel ½in. square in section was cramped with the jaws 3ft. apart, and was equably heated to whiteness throughout its whole length. It was not possible to make accurate quantitative tests during these tests, but it may be possible to add these at a later date. The cleanliness of the whole operation, and the extreme facility with which the apparatus can be manipulated, seem to assure a widespread use for the system. I learn that a complete outfit has been recently shipped to England, and another to Canada, which will heat a bar up to 5in. square and 3ft. long throughout its entire length in about five minutes, with an expenditure of from 75 to 100-horse power. I do not give an illustration of the actual transformer at the Word's Fair, as little can be seen from the exterior, the coils being completely enclosed in a wooden case, and only the large copper bars, about 3in. diameter, which lead to the cramps being visible.

The Elektron Manufacturing Company, of Springfield Mass, U.S.A., exhibit at their stand in the Electricity Building a very neat type of electric elevator, and specimens of motors and dynamos of the Perret type, which have some novel features.

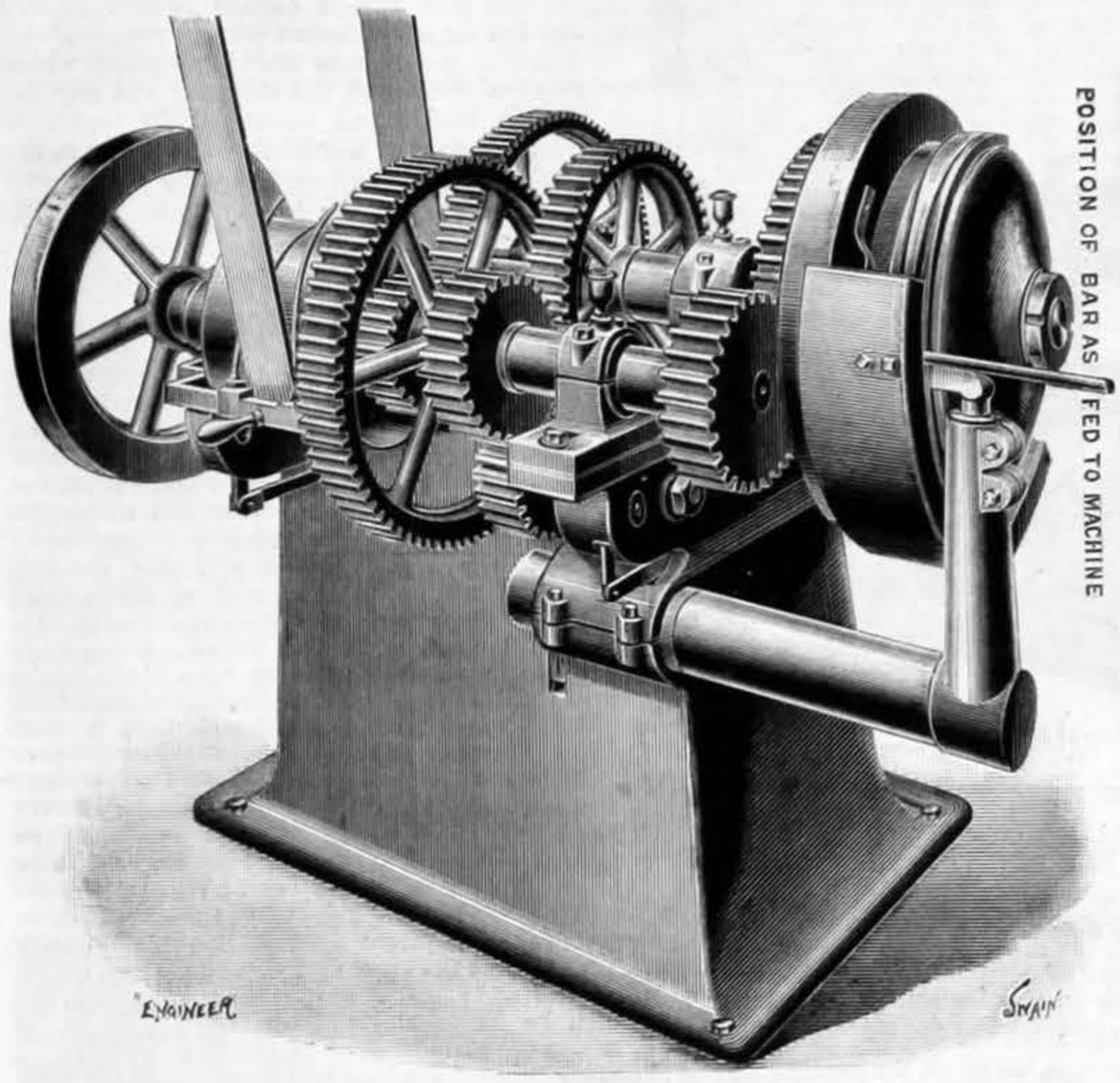


Fig. 8—ELECTRICAL FORGING MACHINE

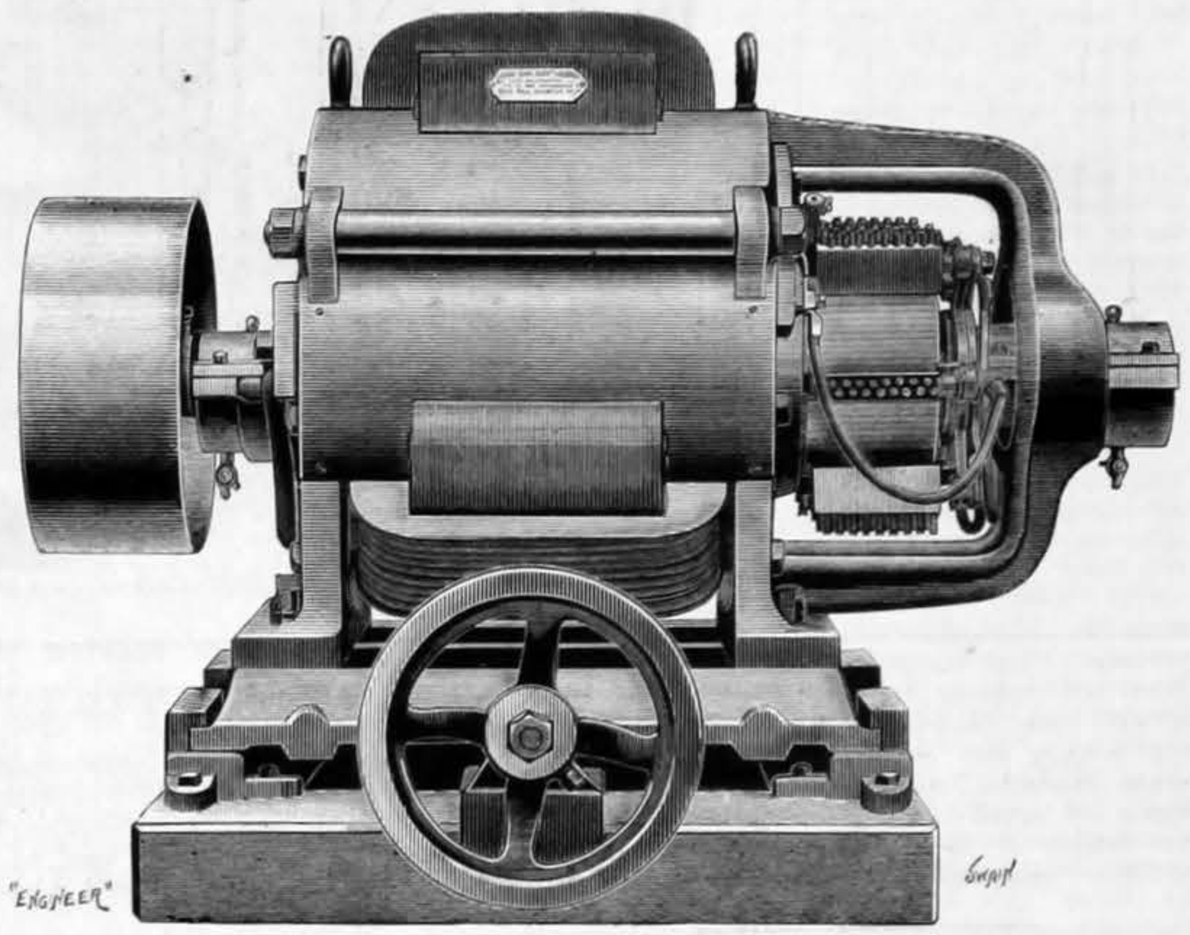


Fig. 10—PERRET MOTOR

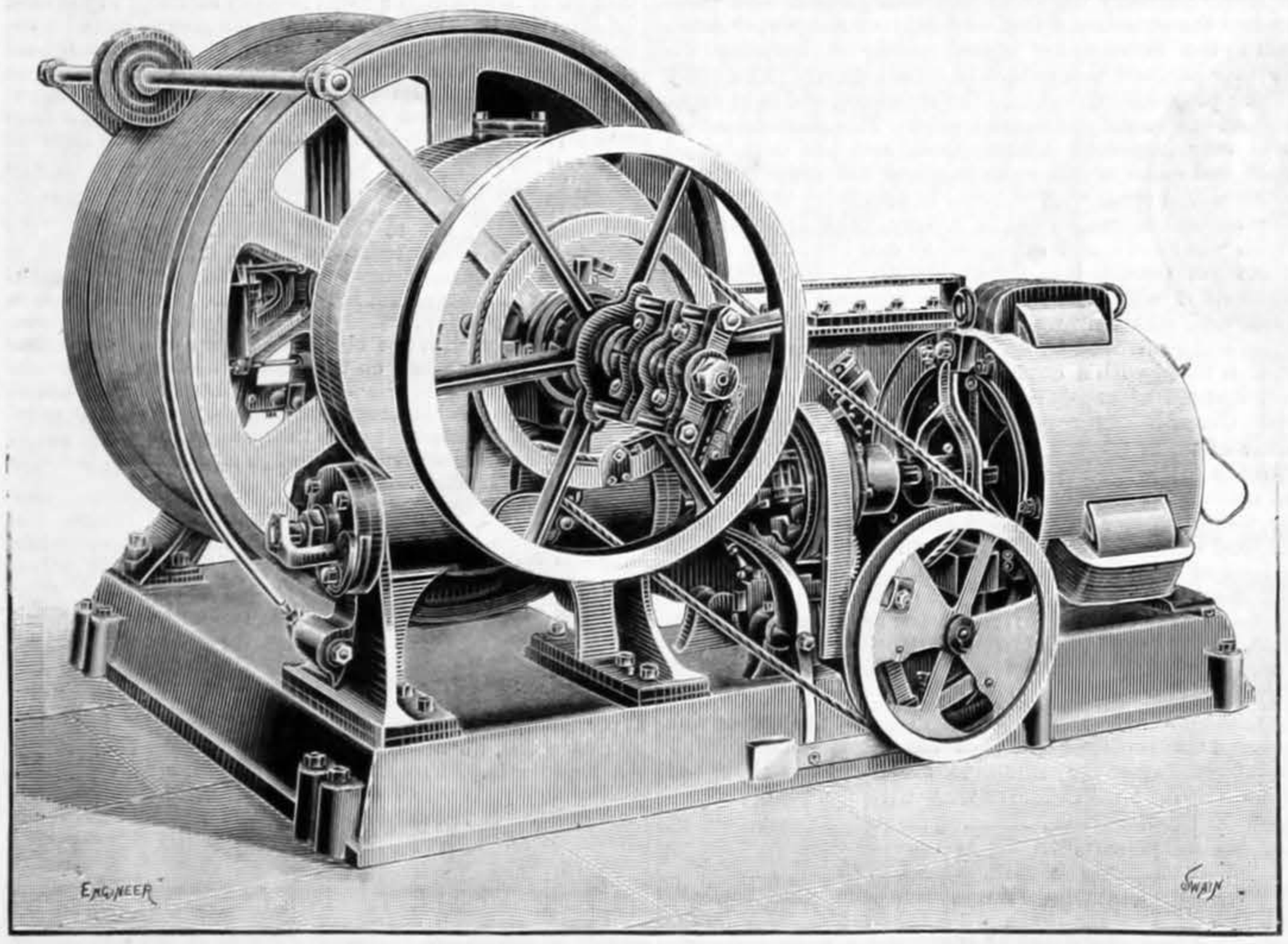


Fig. 15—MOTOR AND CRAB FOR ELECTRIC ELEVATOR

One of the Perret motors is illustrated in Fig. 10. The framework of the machine is of cast iron, held together by cross bolts. The field magnet cases are of soft sheet iron stampings, cramped tightly together by bolts; the stampings are in three pieces, all duplicates of one another, and they are jointed inside the field coils by taper ends, as shown in Fig. 11. There are three field coils, and, therefore, six consequent poles are produced. The object of using sheet iron stampings for the core of the field magnets is to enable magnetisation and de-magnetisation to go on more rapidly than would be the case with solid iron cores, as it is possible to obtain softer iron in the form of sheets. It is also stated that the cost of the cores is less than would be the case if forgings had to be machined all over. In Fig. 10 the machine is provided with six brushes, or rather brush carriers, but this is only done where the potential of supply is not higher than about 110 volts. In cases where a pressure of 500 volts can be obtained, it is usual to cross-connect the armature, and use only two brush carriers. The brushes are of a form specially designed by the makers to avoid sparking. It is stated that with the ordinary form of carbon brush, although ample wearing surface is usually allowed, that in practice only a few points at the end of the brush are in contact with the commutator, and that on this account sparking is produced, which again tends to cause inequalities upon the wearing surface of the carbon. In the Perret dynamos and motors the brushes consist of a number of separate carbon pencils, about ¼in. diameter, and these pass through round holes in a solid gun-metal block, and are placed radially to the commutator. The brushes are "staggered" so as to cover the whole width of the commutator, and each carbon pencil is provided with a separate small spiral spring, which acts upon the end of a small copper lever, and tends to press the carbon lightly upon the commutator. In a 10-horse power motor used for the elevator, only two carriers were employed, and each was provided with nineteen pencils, ten placed in one row and nine in the other. It is claimed that these brushes require absolutely no attention, and that the wear after six months' constant running is very slight. Theoretically, doubtless, the plan is a good one, but the spiral springs and small levers seemed to us rather delicate and liable to be broken unless handled with great care. The armature consists of a Gramme ring, the core being of soft sheet iron plates, with Pacinotti teeth, as shown in Fig. 12. The 10-horse power size has ninety-six coils altogether. It will be seen from Fig. 10 that the cores of the field magnets are not so wide as the space between the uprights of the frame, and that this prevents leakage of magnetic lines. The commutators are, in my opinion, decidedly good, the end is absolutely flat, and there are no grooves cut in the face of the bars. A favourite practice with some makers is

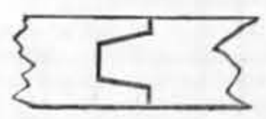


Fig. 11

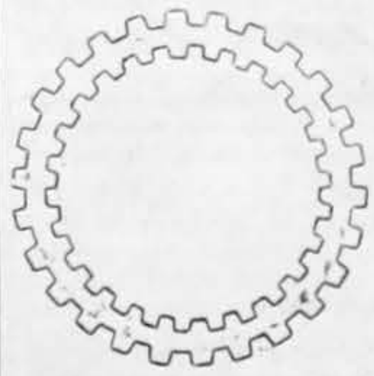
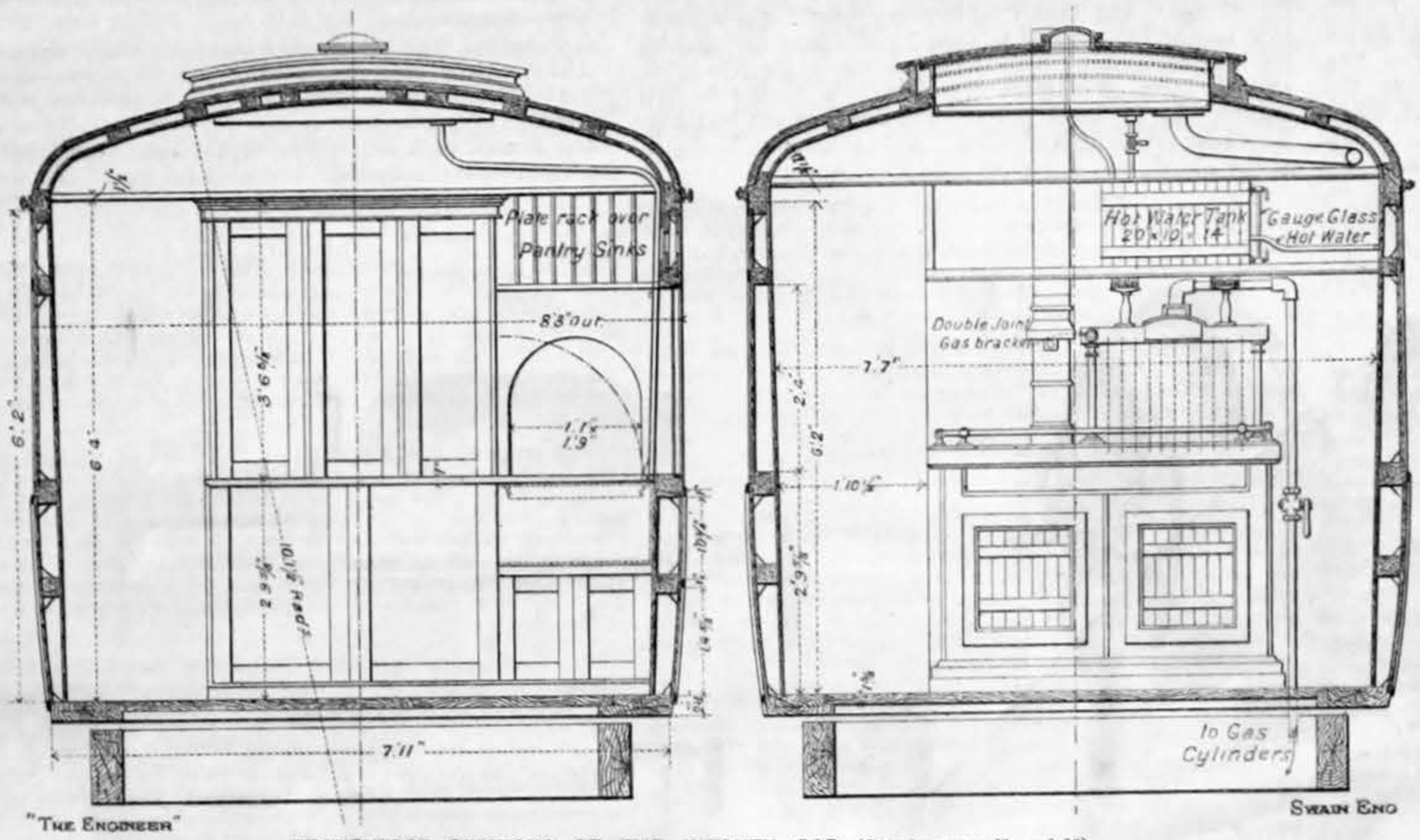


Fig. 12

THE EAST COAST FIRST AND THIRD-CLASS DINING TRAIN



TRANSVERSE SECTIONS OF THE KITCHEN CAR—(*See also pages* 31 *and* 38)

to cut two grooves in the commutator bars to allow for turning off the tops of the bars, these being arranged as shown in Fig. 13 annexed. This practice is often the cause of the bar being short-circuited through the copper dust which lodges in these grooves, and they are a fruitful source of mischief in street car work. In the Perret motors this is avoided altogether, and no nuts or collars are put on outside of the commutator, the method of connection being shown in Fig. 14, where D is the shaft, A a wrought iron plate, keyed on and held by a set screw inside, and B another plate tightened against the bars C by means of nuts, which are inside between the commutator and armature; the outer end of the commutator is therefore absolutely flat, and can be kept clean with ease. Fig. 15 represents a view of the motor and hoisting crab for the electric elevator I spoke of previously. The motor is supplied with current at 500 volts pressure from the Machinery Hall, and when running at 600 revolutions per minute will give out 10-horse power. The field magnets are shunt wound, and there are only two brushes upon the commutator; the motor itself is thoroughly well insulated from the bed-plate by means of a thick plate of fibre. The armature shaft is connected to the driving shaft by means of a self-adjusting insulating coupling of the form shown in Fig. 16. The shaft *c* has an enlargement at its end, and is

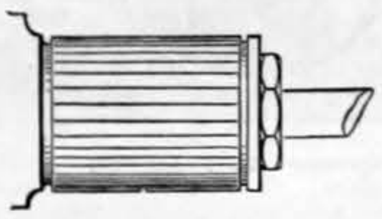


Fig. 13

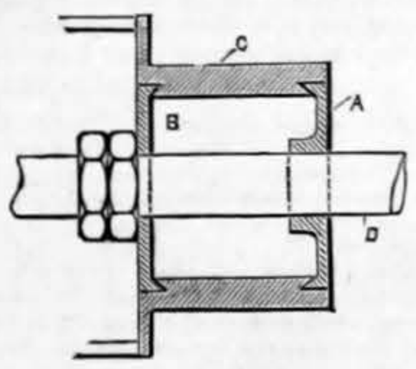


Fig. 14

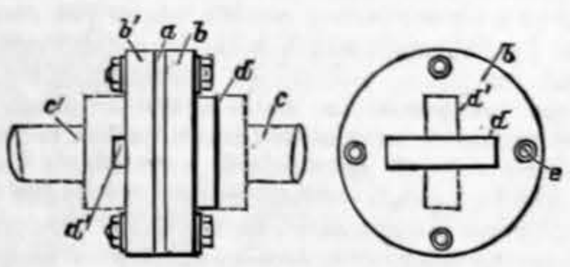


Fig. 16

provided with a key-way across the end, and the shaft c^1, is formed in a similar manner. The coupling consists of two discs of wrought iron, *b* and b^1, provided with keys *d* and d^1 at right angles to one another. A plate *a* of insulating material is placed betweed the two flanges, and they are held together by bolts passing through tubes *e* of insulating material, and having insulating washers under the nuts and bolt heads.

The portion of the shaft which is insulated from the motor carries a steel worm forged solid on, and afterwards cut by machinery; this worm gears with a phosphor-bronze wheel, and both are enclosed in a cast iron case—easily seen in Fig. 15—which is filled with oil, so that the lubrication of the gearing is as perfect as possible. Upon the same shaft that bears the worm wheel is keyed the cast iron winding drum, which carries the steel wire rope used for lifting the elevator car. In case of actual breakage of the rope itself, the car is prevented from falling by means of cam-shaped pawls, which grip the sideways upon which the car works. If the drum should for any reason begin to travel too fast, this motion is checked by the action of a centrifugal governor, controlled by powerful springs and placed inside the drum. As soon as the speed rises above the calculated maximum, the strap brake is put upon the edge of the drum.

A special apparatus is also designed to avoid slack in the wire rope, which might entail serious consequences. This apparatus consists of a pair of arms pivoted on the drum shaft, and carrying a cross bar and jockey pulley—seen in Fig. 15—resting upon the surface of the winding drum. This jockey pulley rides against the hauling part of the rope, and if this should become too slack the pulley will fall towards the floor; in doing so it actuates a clutch mechanism provided with engaging claws, and by its means causes a second powerful strap brake to grip an enlargement of the driving shaft, close to the insulated coupling we have already described. The action of the apparatus is thus fully safeguarded.

The starting and stopping of the machine is effected by means of a wire rope which is passed round the large grooved pulley in the fore-ground, and a second grooved pulley is keyed upon the same shaft as the former, and this second pulley is connected to a grooved pulley seen at the base of the machine in the front. The last pulley actuates, through a small cross shaft and gearing, a system of levers partially visible in the background, and these control the switches. One switch gives the proper direction to the current for either raising or lowering the elevator car, and this switch is closed first. The other switch puts the current into the armature, and is in series with an automatic resistance frame. This starting switch is of very ingenious construction, and has both quick make and quick break, so as to avoid the serious arcing which would occur with currents at a pressure of 500 volts. The automatic resistance is a very neat arrangement, which was shown and explained to me, but as the design is not yet patented in Great Britain I am unable to illustrate it in detail. Suffice it to say that it consists of a solenoid, which draws down a core connected with a lever, and controlled by an air dashpot. The end of the lever is fitted with a contact piece, and describes an arc over a series of separate contacts which are connected with German silver resistance coils. At starting, the whole of the resistance is automatically inserted in series with the motor, and is gradually switched out as speed is got up. I am informed that the current used at starting was from two to two and a-half times the ordinary full load working current of the machine. The makers told me of a case where a series-wound motor by a very well-known firm was used for an electric elevator in Boston, and it took a current of 160 ampères to start it. The current was obtained from an electric street car line at a pressure of 500 volts, but this large starting current so seriously affected the generators at the power station that the manager there objected to its use, and the motor was removed and replaced by one of the Perret type, which, I am informed, does the same work with a starting current of 50 ampères. I may observe that with the Perret motor shown in the Electricity Building no resistance is used in the field magnet circuit.

The present drum is 36in. diameter, and the speed of lift is 140ft. per minute, and the maximum load is 2000 lb. If a larger drum were used a load of 1200 lb. could be lifted at a speed of 225ft. per minute, and with a 15-horse power motor 2000 lb. could be raised at this speed. One noticeable feature of the plant is that in case of a serious overload the machine will not start at all, as the whole of the resistance is kept in series with the armature coils by the automatic regulator. This appears to me a very desirable feature, as I know of a certain other type of American electric elevator, where the mere pull upon the controlling cord first puts the resistance in for an instant, and then cuts it out. If, therefore, the car has not started owing to overloading, the current through the armature of the motor may be enormous, and quite sufficient to destroy it altogether. I was particularly struck with the easy starting and stopping of this elevator, and I am told that it is particularly suitable for a current supply at 220 volts, such as is common in the metropolis on the three-wire system.

The cost of working is said to be considerably below that of elevators actuated by water-power, but I am unable to obtain any exact data. The rest of the exhibit of the Elektron Company comprises one 15 brake horse-power motor, supplied with current at 500 volts, and belted to a dynamo supplying 160 16-candle power incandescent lamps upon the neighbouring stands. This dynamo gave 110 volts, and was provided with six of the compound brushes already described. Each brush had in this case fifteen carbon pencils in two rows of eight and seven pencils respectively. Another motor was working a pump which filled a tank, and the stopping and starting of the motor was automatically regulated by the height of the level of the water in the tank. Some small motors were also shown in pieces, and these I may be able to illustrate in a future article.

ROYAL OBSERVATORY, EDINBURGH.

WE gather from the third annual report of the Astronomer-Royal for Scotland, just published, that this year considerable progress had been made in the erection of the new Royal Observatory in Blackford-hill Park. Work was commenced in May last year, and at present all the buildings, including the observatory itself, the transit house and the dwelling houses, are up to the level of the ground floor. Some parts of the structure have been carried up a good deal higher, the eastern tower in particular having reached the height of 21ft. above the ground. Red sandstone from Doddington Hill, in Northumberland, is used for the face work, and grey freestone from Haile's quarry, near Edinburgh, for the inner walls and less conspicuous portions of the building. The transit circle stands on hewn granite pillars, the foundations of which are finished and capped by a large granite slab, weighing nearly four tons. When the piers are completed, they and the bearings of the transit circle will be approximately adjusted by means of an ordinary telescope, with pivots of the same size as those of the actual instrument. This arrangement having been completed, the piers will then be boxed in, until the building is so far finished as to admit of the erection of the transit circle. It will be necessary to leave the final adjustment until the piers have become thoroughly and permanently settled, as the bearings have no screw adjustments, either in altitude or azimuth.

It is expected that the domes will be ready to fix as soon as the masonry is fit to receive them. Owing to the exposed nature of the site, the domes have, says the author of the report, been specially designed to resist the most violent gales, while they can be partially opened to permit of the safe and efficient use of the instruments in the windy or showery weather so often associated with a partially clear sky in Scotland. Through the pierced tube of the transit circle the collimators will be mutually visible, and the slope of the ground to the south will admit of the use of a meridian mark visible through holes in the supports of the southern collimator. As the distance of this mark is something less than 300ft., a lens of long focus properly mounted will be used for observing it. The stones forming the granite piers for the transit circle already mentioned were brought from the old piers at Dunecht, and the task of separating them required extraordinary care and patience. The Astronomer-Royal observes:—"They had been bedded in cement in the most solid manner, and this hard cement had to be solely removed from the joints by means of iron blades fed with emery and water." Success, however, attended the operation, and our author mentions that the successful accomplishment of this task was mainly due to the aid of Mr. John Smith, the experienced and skilful mason who had erected the piers at Dunecht more than twenty years ago, and it is gratifying to state that the same skilful hands are rebuilding the piers in their present position.

In connection with the observatory there is a time gun at Edinburgh, a time ball on Nelson's monument, and several sympathetic clocks in the city and at Dundee. On several occasions the outside communication has been interrupted owing to the multitude of wires in the neighbourhood, but in no case has a failure occurred through causes under the control of the observatory.

THE EAST COAST DINING AND CORRIDOR TRAINS.

ABOVE and on pages 31 and 38 we publish further engravings illustrating these trains. One part of the engraving illustrates one whole train on a small scale, the other shows one of the third-class corridor carriages. These carriages were described in our last impression, and to this we need not at present make any addition. In our impression of the 30th ult., page 580, we illustrated and described the kitchen and other carriages. The trains are now running the usual preliminary journeys to see that everything is quite satisfactory, and it is intended to commence regular service on Monday next.

A TERRIBLE fire broke out in a cold storage warehouse in the World's Fair grounds at 2 o'clock on Monday afternoon. The cupola of the warehouse where the outbreak was first noticed was 200ft. in height, was built of wood, and elaborately ornamented, near the top being a landing. The flames were first observed 30ft. above this landing, and when the firemen arrived thirty-five or forty of them climbed up to it. They were preparing to bring their hose into play when the flames, which had made their way downwards inside the tower, suddenly broke out on all sides beneath the landing. Five firemen saved themselves by sliding down the ropes, but before their companions could follow the ropes were burnt through. The remainder were then left huddled together on the north side of the cupola, quite beyond the reach of ladders or any other means of rescue. The crowd of spectators, which now numbered 20,000, being unable to render any help stood horror-stricken, watching the flames mount higher and higher until the firemen were almost concealed from view. One of the men sprang from a landing far out into the air, but was dashed to pieces on the roof of the building 80ft. below. Four others followed his example and met with a similar fate. The upper portion of the cupola was then seen to give way, and the remaining firemen were swallowed up in the burning mass of timbers.

RAILWAY MATTERS.

MR. G. N. TYRRELL, who retired from the service of the Great Western Railway Company in 1888 after forty-six years' service, during the last twenty-four years of which he held the position of superintendent of the line, died on Wednesday morning at his residence at Slough.

THE Great Eastern Railway Company is taking considerable pains to popularise holidays in Belgium by improved services of trains and steamboats, and to make the various places in Belgium sufficiently known by means of pamphlets to English people, describing in an interesting way some of the many interesting features of that country. The company has recently issued, and there can be obtained from all booksellers, a new edition of the handbooks by Percy Lindley, and a new pamphlet by Mr. Joseph Hatton, entitled, "Cigarette Papers for Holiday Smoking," and giving short descriptions with illustrations of Scheveningen, Lubeck, Hildesheim, Rotterdam, and Spankenburg.

THE Glasgow Tramway Company last Monday formally took over the Govan section of the Vale of Clyde Tramways, the lease of twenty-one years having expired. The Govan line, which is about two and a-half miles in length, has hitherto been operated by steam locomotives; but these are to be immediately abolished, and horse-power substituted. There will thus be an end of all mechanical traction on tramways in the Glasgow district for the present; as the City Corporation, when it takes over the Glasgow lines next July, intends to operate with horses, the Committee appointed to consider the matter having decided that all other systems are more expensive. This decision was, however, arrived at before the joint Committee of the House of Lords and Commons had even been appointed.

IN answer to the repeated demands of the public, and particularly of those inhabiting the neighbourhood of the Northern and Eastern stations, it has been decided, from the first of next month, to reorganise the circular service from Paris-Nord to Paris-Nord. Starting from La Rappée, and returning by Courcelles, there will be two trains per hour from 8.10 a.m. until 8.40 p.m. The trains will leave Paris-Nord at ten and forty minutes respectively after the hour, and will arrive at the same station two and thirty-two minutes also after each hour. Again, starting from Courcelles and returning by La Rappée, there will be likewise a couple of trains from 7.58 a.m. to 8.58 p.m., leaving Paris-Nord at twenty-eight and fifty-eight minutes, and arriving there at eighteen and forty-eight minutes after the hour. In addition, before 8 a.m. and after 9 p.m. trains, working on the shuttle principle, will be run between Paris-Nord and the Chappelle-Saint Denis, to meet at the latter station the circle trains of Courcelles and La Rappée.

As compared with the operations of the year 1891, the receipts of the Eastern of France Railway diminished in 1892, while the expenses increased. The falling off in revenue has not been due primarily, as in the case of some other French lines, to the revision of tariffs. The receipts from express traffic have increased by about 1½ million francs, or 3 per cent., which represents only about the normal growth of business. Five million more passengers have, however, been carried, the total rising from forty-two to forty-seven millions. The parcel traffic also shows a slight increase. In the ordinary goods traffic the tonnage carried has been almost stationary, but the average receipts per kilometric ton has fallen from 5·15 centimes to 5·09 centimes. As the average distance per ton carried is given as 114·5 kiloms., this represents a loss of seven centimes on every 1000 kilogs. This loss is not entirely due to lower rates, but to a falling off in high-priced manufactured goods. The effect of the increase in customs duties is shown in a reduction of 10 per cent. in the foreign exports from Paris carried over the system, and of no less than 29 per cent. in the raw materials carried from the frontier to the capital. One effect of a stricter protectionist policy has thus been to increase the Government obligations to the railway proprietors.

MAJOR-GENERAL HUTCHINSON held an inquiry on Tuesday, at Highgate, into the condition of the Highgate cable tramway, which has been stopped since last December in consequence of an accident which occurred upon it. The company applied for a new licence. The Hornsey Local Board opposed the application on the ground that the company was insolvent and the permanent way unsafe. It appeared that the machinery had been repaired, but not to the satisfaction of the Local Board. There was to be a new company with a capital of £1500, but out of that costs of reconstruction, &c., to the amount of £115 had to be paid, leaving only £350 in hand, and the inspector said that all that would be absorbed by the repairs. Where would the Local Board be able to get the cost of repairing the road if it became necessary through the company's neglect? Mr. Carruthers Wain, on behalf of the company, said that out of the £1500 they would insure against accidents on the line and have a competent staff of men. Mr. T. F. N. Colam, on behalf of the Local Board, said they were responsible for the safety of the line, and until it was made safe and the company had at least a reserve fund of £500 they could not sanction the opening of the line. The inspector promised to report as soon as he could.

THE inspecting officers of the Department of Engineers for the Province of Buenos Ayres have submitted a report on the rolling stock of the Southern and Western Railroads of that country. They say that the whole of the rolling stock of the Great Southern is of English construction, sufficiently solid, and of good material, but in designing it the nature of the railroads has been left out of consideration; consequently, there are extreme rigidity and excessive weight, completely unfitting the rolling stock for the roads over which it is to run. An American contemporary says:—"The result is said to be an excessive expenditure in the maintenance of way and rolling stock. Moreover, the cost of the English rolling stock is said to be unreasonably high. On the Western Railroad the locomotives are from the United States, and are said to be simple in construction, but "of the highest order." Although severely taxed in consequence of the deficient number of locomotives, they gave satisfactory results in all respects. In general, the verdict of the Department is altogether in favour of North American rolling stock because of greater simplicity, less weight, and better system of suspension. First cost and cost of maintenance are lower than with European rolling stock, and in the American passenger cars the dead-weight per passenger is about half that of the English-built coaches.

A MECHANICAL engineer has usefully called attention in the *Standard* to the steam carriages of M. Serpollet. He says:—"These carriages are a great advance on any previous attempts to use steam on the highways. There is no visible steam or smoke. the products of combustion being ejected at the rear near to the ground; there is very little more noise than is made by a heavy road carriage or an omnibus. The carriage is under excellent control, and during our ride it must have passed hundreds of horses, and only one seemed to take any notice of the carriage. My object in drawing attention to this carriage, some twenty or more being in use in Paris and suburbs, and others in the provinces of France, is the state of the law in England, by which such vehicles would come under the Traction Engine Acts, and only be permitted to run at stated hours and limited to a speed of four miles per hour; but as M. Serpollet has shown how the objections to motor carriages on our roads can be obviated, it seems to be time that some relaxation in the law should be made. We are a mechanical nation, and it is vexatious to see a trade—which might in a few years be as extensive as the cycle trade—remain in the hands of other nations; a trade which might find occupation for thousands of our working men; but, until some considerable modification of the law is made, no manufacturer would venture to put down plant for making motor carriages."

NOTES AND MEMORANDA.

THE deaths registered last week in thirty-three great towns of England and Wales corresponded to an annual rate of 23·8 per 1000 of their aggregate population, estimated at 10,322,429 persons in the middle of this year. The rate varied from 11·8 at Derby and Oldham to 42·1 at Preston.

To overcome the residual magnetic effect in electromagnets, Mr. S. H. Stupakoff makes his magnets with a thin sheet of soft iron in between the poles and the armature. This is found sufficient to neutralise the effect of residual magnetism without harmfully increasing the magnetic resistance.

IN London 2220 births and 1847 deaths were registered last week. Allowing for increase of population, the births were 389 below, and the deaths 328 above, the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 19·1, 22·6, and 22·2 in the preceding three weeks, was 22·4 last week.

MARBLE equal to the best Carrara is stated to have been discovered in apparently large quantities at the Avondale quarries in Chester Co., Pa. A chemical and physical examination of some diamond drill cores made by Prof. J. F. Kemp, of the Columbia College School of Mines, New York city, is stated to have shown a crushing strength of 22,150 lb. per square inch, and from 0·052 of 1 per cent. to 0·025 of 1 per cent. of absorption.

ACCORDING to the *Annales Industrielles*, General Sebert has, in the name of the committee of the economic arts, made a communication with respect to the transformation of coordinates. This is effected by means of an instrument constructed by M. Barthélemy, after the design of M. Bertrand, which has for its object the finding by simple inspection of the value of the sides of the right angle of any right-angled triangle, when the hypothenuse and the angle at the base are given.

THE number of hours of bright sunshine recorded during 1892 by the Campbell-Stokes sunshine instrument at Greenwich was 1277, which is about seven hours below the average of the preceding fifteen years, after making allowance for the small difference of the indications with the Campbell and Campbell-Stokes instruments. The aggregate number of hours which the sun was above the horizon was 4465, so that the mean proportion of sunshine for the year was 0·286, constant sunshine being represented by 1.

THE scheme for running canal boats by overhead electric trolley traction seems to be taken up with some promise of success in America. Governor Flower has suggested an appropriation for the purpose from Congress, and the Superintendent of Canals, Mr. Hannan, is prepared to receive plans and suggestions. The problem is to supply power in small units—25-horse power to 100-horse power—along a line 300 miles in length. Governor Flower thinks the whole cost would not be over a million dollars—£200,000—to fit twelve power-houses thirty miles apart, and the cost 2s. 6d. per day per boat. The *Electrical Engineer* says it is thought that this estimate is too low in both cases, but that the project is worthy of attention.

A METHOD of hardening sandy roads is practised about Orlando, Fla., which is described by Dr. Thomas R. Baker in *Science*. There is a kind of clay found in the vicinity which has to be quarried from its bed, but disintegrates rapidly after handling. Its colour is reddish, which is probably due to the oxide of iron contained in it, analyses showing the clay to contain 4·20 per cent. of moisture, 69·03 per cent. of silica, 18·21 per cent. of silicate of alumina, and 8·53 per cent. iron oxide. This clay, the *Engineering Record* says, is simply spread over the street to a depth of several inches, sprinkled with water, and then rolled. Roads improved in this way are said to be remarkably hard and firm, when the small amount of labour expended on them is taken into consideration.

COMPRESSED air is used in the Ludlow, Ky., shops of the Cincinnati, New Orleans and Texas Pacific Railway for emptying oil barrels in a manner that might be useful for other purposes in many establishments. The air is forced into the barrel through a ⅜in. iron pipe. This passes through a plug fitting in the bung hole. The plug is a conical brass casting 6⅜in. long, 1⅜in. in diameter at its smaller end and 3in. at the larger. The interior is hollow, leaving considerable space between the sides and the iron pipe passing through it. When air is forced into the cask through the pipe, the oil is forced into the plug, and through a small pipe tapped into it, which conducts the oil to any desired place. It is stated in the *Railway Age* to have proved to be a very handy device, easily operated by a hand pump. It is very much the same as the long-used device for supplying beer in France.

IT is stated by the British Consul at Batoum that last year as many as 72,565 tons of raw cotton were transported across the Caspian to Baku, and thence by the Transcaucasian Railway to Batoum and Poti. After re-shipment at these places the cotton was conveyed to Odessa and Sebastopol, and thence to the weaving mills at Lodz, Warsaw, and those in the Moscow district. As it is cheaper than either American or Egyptian cotton, which pays a very heavy import duty, it is expected that in a few years, when the cotton crop of the Transcaspian provinces will suffice to furnish the raw material required by the Russian mills, American and Egyptian cotton will cease to be bought in Russia. The Vice-Consul at Poti, in his report, mentions that the large quantities of cotton arriving there from Transcaspia have blocked up the port, as it exceeds the capacity of the Russian steamers to transport it.

OF the one hundred and seventeen cyclists who entered in the cycle race from Vienna to Berlin, thirty-one Germans and six Austrians arrived in Berlin by nine o'clock on Saturday morning. The first thirty of the competitors have done well enough to receive prizes. Of these, five are Austrians and three Berliners. The other seven receive a diploma. Only three of the thirty-seven used more than one cycle in the course of the race. Of the machines employed by the other thirty-four men, eighteen were of German, thirteen of English, and three of Austrian manufacture. Herr Fischer, of Munich, who came in first, rested only twice, from fifteen to seventeen minutes each time, and he stopped only for refreshments. He performed the whole distance at about thirteen miles per hour all the way, and in less than half the time taken on last year's cruel horse ride. The German champion failed to fulfil the expectations which had been formed of his probable performance. He had to stop three times on the road, owing to the breakdown of his cycles, presumably the tires.

WITH regard to the recent drought, the following particulars given by Mr. W. H. M. Christy, the Astronomer Royal, may be of interest:—The sunshine registered in the months of March and April has been phenomenal. For March it was 155·1 hours, and for April 231·0 hours; the greatest numbers for these months in the sixteen years, 1877-1892, being 141·0 h. (1880 March) and 196·3 h. (1892 April). The greatest values for any month in the sixteen years preceding are 277·1 h. (1887 July), 267·1 h. (1877 June), and 237·8 h. (1882 May); and if we consider the ratios of sunshine to the total time the sun was above horizon, or to the total time, less than one and a-half hours each day, during which the sun is too low to give a record on the paper, we find that April, 1893, was the sunniest month yet recorded.

	Ratio to Total No. of hours.	Ratio to Total, less 1½ hours daily.
1877 June	0·540	0·594
1882 May	0·493	0·546
1887 July	0·558	0·615
1893 April	0·557	0·624

MISCELLANEA.

THE Highland and Agricultural Society of Scotland this year holds its annual show at Edinburgh, from the 25th to the 28th inst. inclusive.

THE tender of the International Electric Subway Company for the whole of the electrical mains for Portsmouth has been accepted, and the Johnstone system of conduits will be laid throughout.

THE annual excursion of the North-East Coast Institution of Engineers and Shipbuilders takes place on the 25th inst., when the members will visit the Leeds Forge Company's works and will lunch at Harrogate, on the invitation of Mr. Samuel Fox, the managing director.

A TEST of nickel steel armour plates was made on the 11th at the United States Government proving grounds at Indian Head. Two plates were tested, a 9in. plate representing the side armour for the monitor Monadock, and a 17in. plate representing the armour to be used for the barbettes of the battleship Indiana. It is stated that in both cases the trials were a success, and the day's firing showed that thick armour could be made with as much success as thin.

THE formal inauguration of the Corinth Canal has been fixed for the 20th inst. There will be a brilliant *fête* on the occasion, in which the Greek Royal family, the Ministers, and the leading members of the Corps Diplomatique will take part. Crowds of visitors will also be present from all parts of the kingdom, as well as deputations from the Colonies of Greek citizens residing in Turkey, Egypt, and other countries abroad. The canal, it is anticipated, will considerably stimulate the trade of Greece.

ON Wednesday morning the screw steamer Louise, belonging to Douglas, Isle of Man, ran with much force into the starboard quarter of her Majesty's ship Albacore, 4, screw gunboat, second-class, the flagship of Rear-Admiral St. John, as she lay moored to Government buoy No. 1 with her lights burning brightly. The crash was heard a considerable distance, and those on board the United States war cruiser Chicago, lying in the harbour, made preparations to render assistance. They promptly used their powerful flash-lights, which were played upon the two ships. It was found that the Albacore was not making any water, but had received much damage.

REFERRING to the development of the Dieppe-Newhaven route, the *Journal des Transports* points out that since the improvement of the service ten years ago the number of passengers carried in one year has increased from 79,000 to 104,500, and the receipts per passenger have risen from 15f. to 17f. 15c., owing to the relative increase in first-class travel. The total goods receipts, which were 1,482,000f. in 1882, were last year 1,857,000f., the increase being entirely in ordinary traffic, the express business having fallen off. Of the French vessels only one, the Seine, is at present used for the passenger service.

FIGURES collected in New York as to the transatlantic passenger movement show hitherto somewhat disappointing results. It is expected the attractions of the Chicago Exhibition have kept at home a certain proportion of the usual American visitors to Europe, but this has not been compensated by an increase in westward travel. The total volume on all the lines has fallen off 4·44 per cent., the eastward movement having fallen off 28·5 and the westward increased 23·2. It seems probable, however, that the westbound movement will increase considerably as it becomes known that the fair is worth going to see. Moreover, the stories of exorbitant charges for all sorts of things at Chicago have kept back a good many European visitors.

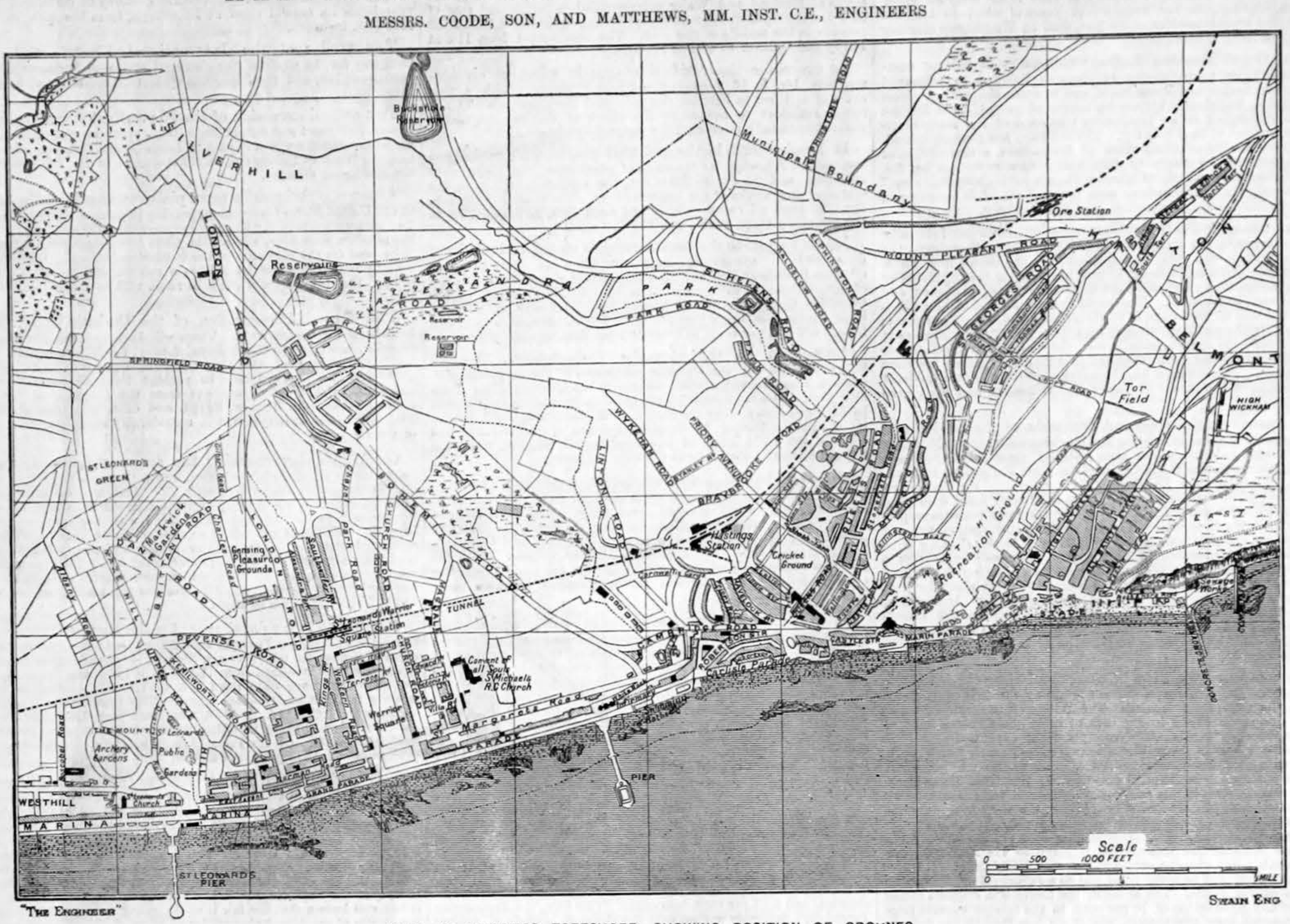
A COLLISION that might have been attended with very serious results occurred on Tuesday afternoon at Chatham Dockyard. During the moving of some of the vessels which are to take part in the naval manœuvres, No. 64, first-class torpedo boat, was under full steam leaving the Basin, when she collided with the second-class cruiser Medea, which was lying at moorings. The force of the impact partially smashed the bow of the torpedo vessel and knocked a hole in the side of the Medea. The torpedo boat was allowed to proceed to Sheerness, where the necessary repairs will be carried out, and it is thought these can be executed by the time fixed for her departure from the Medway. The damage to the Medea has been temporarily dealt with to stop the leakage, but she will have to be docked for repairs. The Medea was not one of the vessels to take part in the manœuvres.

MR. W. H. PREECE, F.R.S., in giving evidence before the joint committee of Lords and Commons on Electric Powers Protective Clauses, is reported to have shown a series of diagrams illustrating the effect upon the earth of the City and South London Electric Railway. That railway did not designedly use the earth, but the return circuit was made by means of the rails, and also by the tubes or tunnels. Currents were produced which had disturbed the observing instruments at Greenwich, and which had been traced as far as North Walsham, in Norfolk. Last year the disturbances began to increase, and his attention was called to the fact that in Clapham-road there was a chemist who had in his shop window an instrument for recording the passing movement of every train on the electric railway, the instrument being connected on one side with gas-pipes, and on the other with water-pipes in the house. He had caused the currents to be measured, and they were found to be sufficient to light a lamp, or, as he had proved, to ring one of the division bells of the House of Commons. Another difficulty had occurred in connection with the railway block system. Some years ago the London and North-Western Railway lighted Holyhead Harbour by electricity. The effect of the five arc lamps employed was to break down the block signals in the district within a mile. But the difficulty was removed by supplying metallic circuits to the signals. At Blackpool, the disturbing currents from the electric tramway had lowered a block-signal on the railway and fired a time gun at the same moment, a minute or so before the time when the gun ought to have been discharged.

IN consequence of the intention to close the port of Cronstadt to all merchant vessels at the close of 1895, and to make the roadstead of the Russian capital the future port of commerce, it will be necessary to carry out some very important and extensive marine works to accomplish that object. A special commission has been entrusted with the details of the whole scheme, and the conclusion arrived at is that the progress of the works can be so arranged as to admit of the utilisation of a portion of the anchorage ground for the use of steamers early in the same year. It will be necessary, in the first place, to deepen the existing roadstead until there is 22ft. of water in it. The excavated material will be employed in raising some of the low neighbouring land, which is State property, upon which stores for the reception of wood and coal, and domestic buildings will be subsequently erected. In this manner St. Petersburg will become the focus, to which will converge the coal brought by sea, and the timber and cereals arriving by land, which latter will be destined for exportation. It is intended, in laying out and preparing the basin for the occupation of steamers, that the area shall, at any future time, be capable of enlargement, so that the traffic, however extended it may become, may be concentrated in the same locality, and not driven, as frequently occurs, to seek more favourable quarters. Sailing vessels, many of which frequent Russian ports, will be accommodated in the southern part of the roadstead. The estimate for the proposed undertaking has been submitted for the approval of the Minister of the Interior, and is put at a sum of £150,000.

HASTINGS FORESHORE PROTECTION WORKS

MESSRS. COODE, SON, AND MATTHEWS, MM. INST. C.E., ENGINEERS



PLAN OF HASTINGS FORESHORE, SHOWING POSITION OF GROYNES

MILWAUKEE.

(From our Special Commissioner.)

CHICAGO, June 23, 1893.

THERE was yesterday a gathering of journalists at Milwaukee. They travelled thither from Chicago on the invitation of the citizens and the Press Club of Milwaukee. Perhaps a majority of the party were foreigners, *i.e.*, English, French, Austrian, German, Polish, Italian, Canadian, Australian, Turkish, and Japanese. It was asserted that many of these foreigners were, before they received their cards of invitation, ignorant of the existence of Milwaukee. It is certain that, before they saw it to-day, most of them did not know what Milwaukee actually is.

Milwaukee is built on the west shore of Lake Michigan, 2¼ hours rail ride north of Chicago. There is rivalry and jealousy between Chicago and Milwaukee. For fifteen or twenty years there has been run a race for the title of Western Capital between the cities of Cincinatti. St. Louis, Chicago and Milwaukee. In point of growth to larger size and greater material wealth, Chicago has long since out-distanced her rivals. St. Louis has not yet given up dreams of overtaking and passing Chicago in the moderately near future, and is even now making great railway preparations for the diversion to her more southerly and more direct route of the traffic to the west and south-west. Milwaukee, with its quarter of a million inhabitants, as against Chicago's one and a-half millions, declares, with somewhat of the sour grape in its accents, that *mere* bigness is only vulgarity, coarseness, lack of culture, the negation of beauty, but in the same breath that it charges Chicago with the ugly sin of a huge, unromantic, and merely material overgrowth, with a naïve inconsistency, it eagerly puts forward as its best foot the statement of its own rapid growth; its population in 1860, 50,000; in 1870, 70,000; in 1880, 116,000; in 1890, 220,000; while its wealth as indicated by the deposits in its banks, increased in these decades from two to five, fifteen and twenty-seven million of dollars. Milwaukee was one of the candidates for the honour and labour of erecting the Columbian World's Fair in its midst, and if it had been successful in its candidature we would have had certainly more picturesque, and probably more comfortable surroundings to this memorable international show.

The rail ride from Chicago to Milwaukee takes one through a rich, fertile, and well-wooded country, on the whole flat, but here and there undulating after the graceful lines of the English Midlands; but it keeps us out of sight of the great lake. Arrived there, the party of some hundred and fifty journalists mounted electric cars, and spent an hour and a half in careering at the usual American break-neck electric speed through the business and industrial quarters, and thus learning the great extent of the city; the number, the magnitude, and (to distinguish it from Chicago) the architectural elegancies of its office-buildings, and the enormous size of its factories and workshops. Among the latter may be mentioned, as interesting to engineers, E. P. Allis's engineering works, employing 1500 hands, and building engines, pumps, and flour-roll mills of the largest size; the Bay View Iron and Steel Works, employing 2000 hands; tin, malleable iron, boiler, and many other mechanical works; the great breweries of Pabst, Schlitz, Blatz, Obermann, and others, producing beer which, according to my taste, is not equalled by any other made in America; the leather, cement, and tobacco factories; flour mills, producing two million barrels of flour per year; and at least one company bringing down from Northern Winconsin large quantities of lumber and shipping it at Milwaukee. E. P. Allis and Co. furnish the largest electric-power engine in the World's Fair, an engine of which I hope shortly to send you full detail drawings. They have very extensive shops equipped with specially heavy machine tools and excellent travelling crane arrangements, some of the largest cranes being electrically driven. With regard to the breweries, it should be mentioned that the buildings are architecturally both massive and handsome, really forming one of the artistic features of the city. Milwaukee boasts of 100 miles of electric tramway, 200 miles of water mains, and 25 miles of river deep-water dockage, and an excellent, large, and well-protected harbour.

But it is not its industries that form the very attractive feature of Milwaukee. Our 1½ miles electric car ride landed us at the entrance to the large wooded grounds of the Soldiers' Home, an institution of which all Americans are justly proud, where the veterans of the great war are maintained in comfort and leisured ease. After taking luncheon here, the party started in a procession of some forty carriages on a two hours' drive through the avenues, boulevards and parks of the residential quarters. The very charming picturesqueness of these well-wooded roads, and the massive handsomeness of the numberless residences that line them with their beautiful tree, turf and flower-bed landscape gardens, all freely open after the usual American fashion, without wall or fence of any kind, are revelations even to the European acquainted with the Parc Monceau, the Buttes Chaumont, Kensington Gardens, the Prater and the Thiergarten. No other city in America can match the artistic beauty of these Milwaukee suburbs either in quality or in extent. It is doubtful whether they are surpassed in any town in the world. The effect is aided on the one side of the town by the undulations of the country, which send these avenues rolling up long easy hills and down into hollows that might almost be called valleys; while on the other or east side it is made specially charming by the proximity of the Lake, upon which one looks down and across from the overhanging bluffs, and on which bluffs there are laid out delightful sloping public gardens, adorned by statues of the heroes of the West. Indeed it would be difficult to find anywhere else a more fascinating drive than that this party of journalists enjoyed on the 22nd of June, under a brilliant blue sky, the heat of which was moderated to refreshing coolness by the breezes from the great Lake Michigan. The pleasure of it was certainly very greatly enhanced by the strange contrast from the weary and hopeless ugliness of three-quarters of the fatiguing dead flats of Chicago, which, although it also has some handsome parks and boulevards, has nothing of which it can justly boast very much except the architecturally hideous height of its great blocks of plain, featureless office buildings.

On leaving their carriages our party visited the admirable little art gallery given to the town by Mr. Frederick Layton, an Englishman who still loves England as much as he does his adopted state of Wisconsin, and who yearly visits Europe and brings back for his Milwaukee fellow-citizens some fresh rare works of art. This gallery contains only 145 pictures and seven sculptures, but its almost unique characteristic is that every piece is of the highest grade of artistic excellence. The journalists finished their delightful day with an excellent and tasteful dinner at the Pfister Hotel, which hotel, besides being in whole and in part fitted up with a superabundance of modern requirements, has this peculiarity, that the owners run it at a yearly heavy loss, apparently half in affectionate remembrance of their dead father's wishes, and half out of a sentiment of pure benevolence towards the travelling public. In spite of an inordinately long series of hours spent in speechifying, the journalists rose briskly next morning, and formed a merry party on their way back to Chicago, the scene of future dismal hard labour upon the infinitude of things frequently seen before and displayed afresh in the *biggest* of all past and, let us hope, of all future International Exhibitions.

HASTINGS FORESHORE PROTECTION WORKS.*

By Mr. A. HAVELOCK CASE, Assoc. Inst. C.E.

THE borough of Hastings—incorporated with the town of St. Leonards, and situated on the Southern Coast of England—occupies an exposed position where the South Downs push seawards into the shallow bay enclosed by the high cliffs of Beachy Head to the west, and the low-lying point of Dungeness to the east. The larger bay by this means being subdivided into two smaller ones, called Pevensey Bay to the west and Rye Bay to the east. This borough has a sea-frontage of about five miles, with an actual parade wall and promenade of nearly three miles, which the author believes to be the longest and finest to be found in any town of England.

The local authorities of Hastings have for long fully recognised the value of protection to their front line afforded by the presence along the shore of a large quantity of beach, and have consequently spent their money and energy for years past in securing it as much as possible, and in preserving it when once secured. For this purpose they have incurred a total expense of about £66,000 during the nine years of 1876 to 1884, the date when the work about to be described was commenced.

In 1876 the Marine Baths and splendid promenade, forming one of

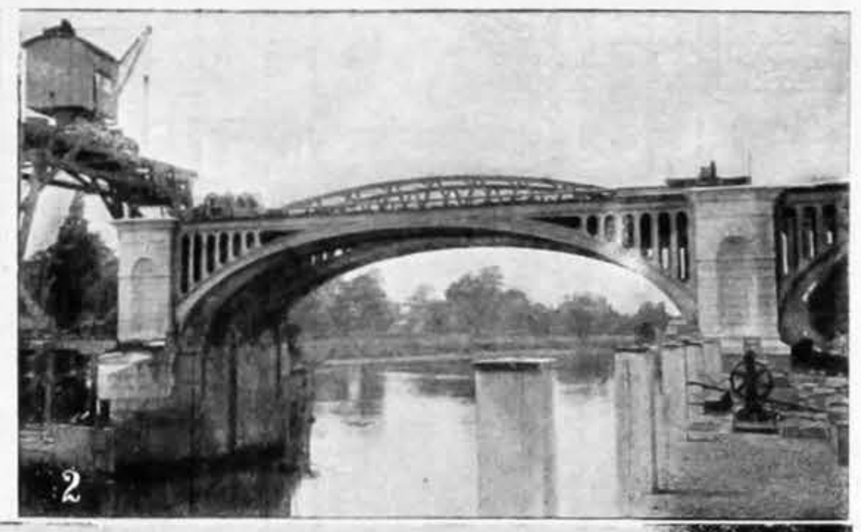
* Paper read before the Newcastle Association of Students Inst. Civ. Eng.

THE RICHMOND LOCK AND WEIR.—PROGRESS OF THE WORKS

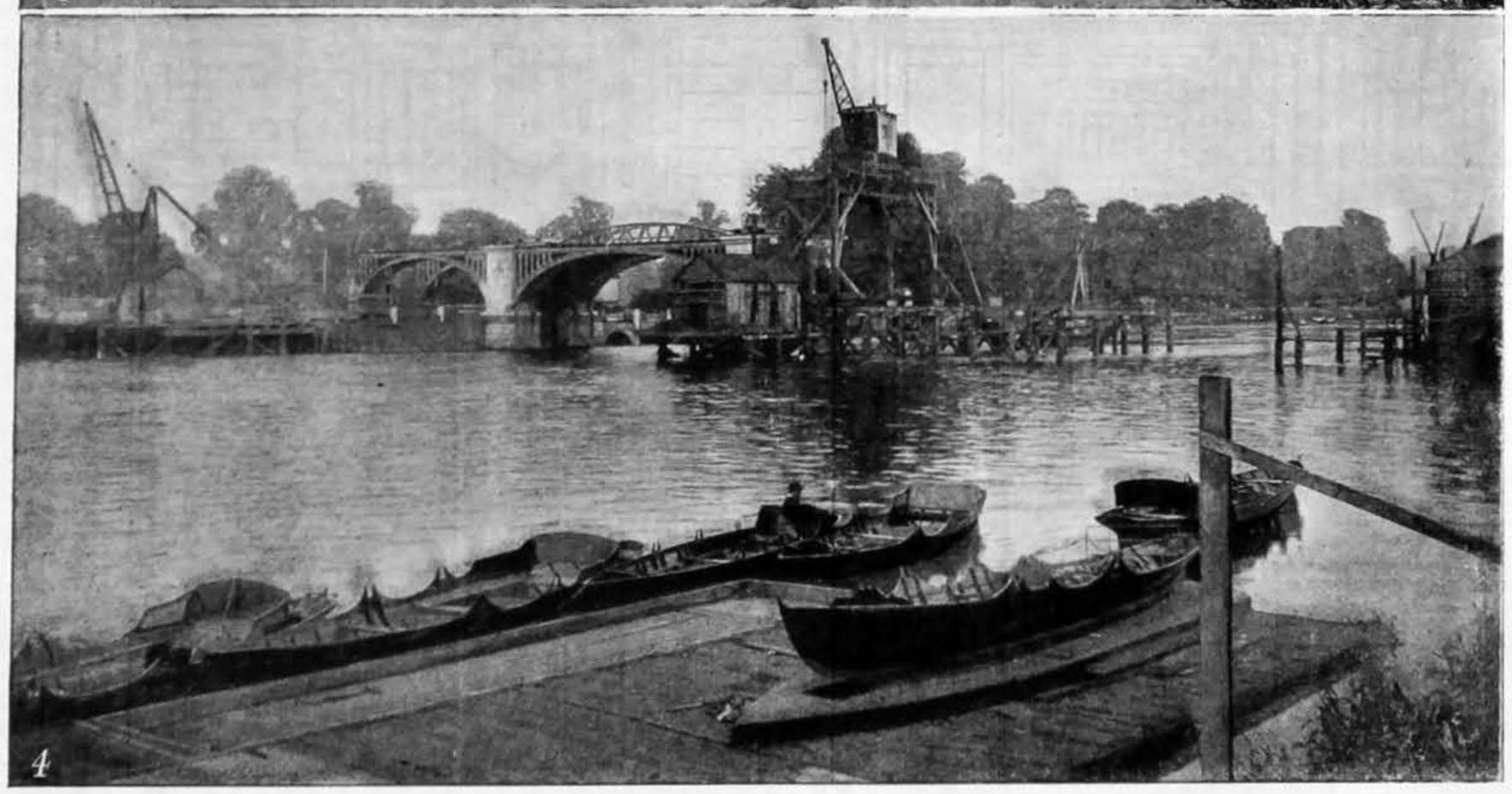
MR. C. J. MORE, M. INST. C.E., ENGINEER

(*For description see page 43*)


1


2


3


4

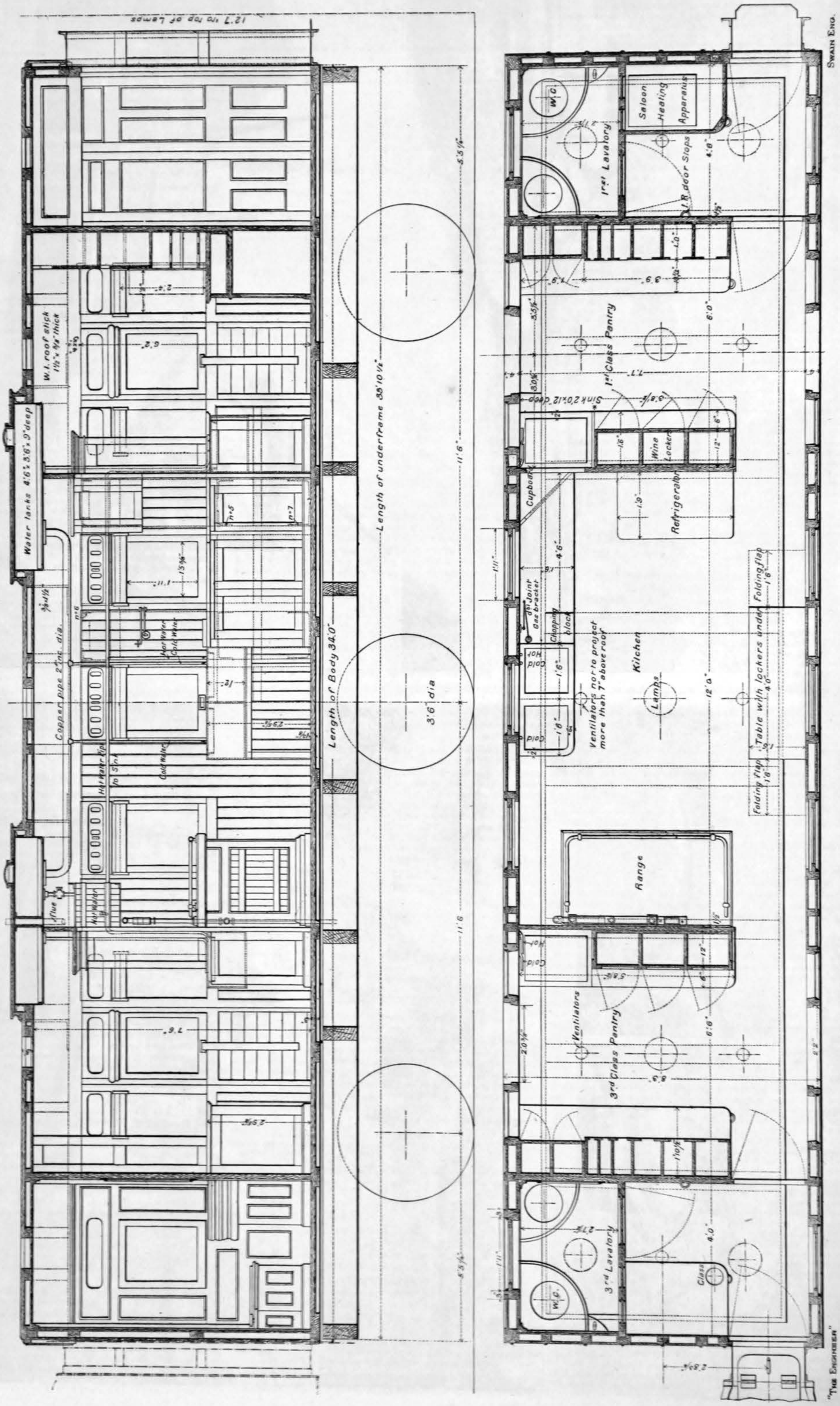

5


6

THE EAST COAST DINING AND CORRIDOR TRAINS.—THE KITCHEN CAR

THE BIRMINGHAM RAILWAY CARRIAGE AND WAGON COMPANY, BUILDERS

(For description see page 34)



the characteristics of Hastings, were constructed; and in order to provide room for this work the promenade wall was moved still further seaward, causing a retreating angle at the eastward end. This very soon caused the sea to erode the beach, and to expose the sea wall along the front of Carlisle-parade, putting its stability as well as the valuable property behind it in danger. This trouble was met in the usual manner by putting down more timber groynes in front. In the same year—1876—anxiety was felt for the stability of a large outfall sewage bank situated at the extreme east end of the sea front, and Sir John Coode being consulted he proposed the construction of two large concrete groynes, shown on p. 36. The Council, however, after deliberation would not face the expense, but decided to carry out the more easterly one, and to construct a very large timber groyne in place of groyne No. 2. The groyne No. 1 answered its purpose so admirably that no further apprehension for the safety of the sewage works has been felt. In 1880 a Council committee recommended application for borrowing powers to carry out Sir John's complete scheme, but the matter was postponed once more, and it was not until the autumn of 1883, when the question was forced to the front by a serious trouble at another retreating angle—eastward of the eastern termination of the east parade—the sea at this point during some unusually heavy gales from the south-west, accompanied by high spring tides, which have a range of about 25ft. 6in., cut its way back so much as to remove the whole of the roadway, and place the houses in such jeopardy that the inhabitants feared the houses were going with each succeeding high water. In fact, the cellars of one house were exposed by the removal of the roadway in front; and it was only by the most heroic efforts on the part of the borough engineer—Mr. Andrews—and his workmen, that a much greater amount of damage was not done. His *modus operandi* was to bring by horse wagons a large quantity of brushwood and stakes. On the ebb tide and during low-water this brushwood was spread on the shore and staked down, with as much beach mixed amongst it as could be obtained. But the author is informed that the seas at high-water demolished a great deal of the result of this labour, and it was only when the heavy weather abated that security was felt. No doubt this breach in the front line may be attributed to the small amount of beach lying on this part of the shore at the time; and in all probability the want of beach, which was felt more or less all along the foreshore, was caused by the stoppage of the supply and travel from the westward—owing to extensive groyning operations which were being carried on at Bexhill, a new seaside resort to the westward. In consequence of these continual troubles at different parts of the borough frontage, with the great expense they entailed, taken in connection with this last serious breach at the fishmarket, the authority again applied to Sir John Coode for advice as to the best means to prevent its recurrence, and to render efficient protection. He advised the putting down without delay of a piled timber revetment along the line of the recently-formed breach, the surface of the backing to be protected from wash by a thick tar skin, and this to be followed by the construction of a very big concrete groyne and revetment on the site of the existing large timber one at the east end of the foreshore, and which practically was the same work which had been recommended to the Council in Sir John's report of 1866, and only partly carried out by them.

(*To be continued.*)

SOCIETY OF ENGINEERS.

ON July 5th a visit was paid by the Society of Engineers to the New Lock and Weir Works and the Waterworks at Richmond, Surrey. The object of this work, which is now being carried out by the Thames Conservancy under the direction of their engineer, Mr. C. J. More, M. Inst. C.E., is to increase the depth of water in the river Thames between Richmond and Teddington Lock, at and for some time before and after low-water. This we deal with on another page.

The present water works were commenced in the year 1876, by the laying of about twenty-two miles of cast iron water mains, varying from 14in. to 3in. diameter with hydrants, the conversion of the old brewery at the bottom of Water-lane into a pumping station, the sinking of two wells, the dummy or pumping well, 8ft. 6in. diameter by 140ft. in depth, and the artesian well, 7ft. diameter reduced to 3ft. at a depth of 254ft.—on surface of chalk—from this level the boring commences and has been carried down to a depth of 1446ft., varying from 2ft. to 7in. diameter, terminating in the red sandstone. The expectation of a sufficient supply of water not having been realised from this source, a certain proportion of water is drawn from a shallow well, situated in the Petersham meadows, eleven hundred yards from the Water-lane works, and connected by a 9in. syphon pipe with the dummy or pumping well.

Owing to the steady increase of the population and the greater consumption of water for all sanitary purposes, the Water Supply Committee took into consideration the necessity for increasing the supply of water, and in the year 1887 requested their engineer—Mr. W. G. Pierce—to prepare plans and estimates for sinking a new well to the chalk, and driving adits in various directions to intercept fissures, and by this means improve the supply. The well has been sunk 9ft. 6in. diameter, in brickwork, through the London clay, reduced to 8ft. and 7ft. diameter with cast iron cylinders, through the Thanet sands, and 6ft. 6in. diameter into the chalk to the depth of 320ft. from the surface of the ground; at this depth adits have been driven 6ft. by 4ft. 6in. in several directions, amounting at this date to nearly 4000ft., the greatest length in one direction, 2378ft., connecting the new well with the old well at Water-lane. It may be mentioned that soon after starting adit driving, the Corporation purchased the contractors' plant, and have since carried out this part of the work by their workmen.

Owing to the limited supply obtained from the wells a duplicate system of mains and pumping plant have been provided, for giving a constant supply of water from the river for road watering and sewer flushing. At the present moment there are five pumping engines, one 25-horse power Robey, two 50-horse power beam engines, compound, one 25-horse power compound direct-acting, &c., and one 10-horse power special pump at work, with four steam boilers, viz.:—three 50-horse power Field patent vertical, and one 25-horse power Robey semi-fixed raising water from the several sources above referred to, the greatest depth being 320ft. from the surface of ground—supplemented when required with a supply from the Southwark and Vauxhall Company—into a service reservoir in Richmond Park, 142ft. above the old pumping station, having a total capacity for storing 750,000 gallons. The reservoir, although built upon the highest ground in the neighbourhood, will not supply the top cisterns of about forty houses on the terrace by gravitation—for that a special balanced valve, on the 14in. main leading to the reservoir, has to be closed daily while the pumping is continued to fill these high-service cisterns. The total consumption of water for the year ending March 25th, 1893, was 207,769,428 gallons, averaging 569,305 gallons per day; and, say, for 23,000 consumers, 24·7 gallons per head per day.

A contract has been entered into with Messrs. C. Simmins and Sons, of Runcorn, to fix 65ft. of new 4ft. diameter cast iron cylinders inside the original 5ft. diameter cylinders, previous to enlarging the bore hole from 2ft. diameter to 3ft. 6in. diameter to the adit. It is intended to put down new pumping plant for the purpose of pumping all the water obtained from the adits at the old works, thereby avoiding having two pumping stations, and obtaining economy in the cost of fuel and labour.

The income on the Waterworks account for the year ending Lady-day, 1893, was about £11,500, and the rateable value of property same date, £189,579. The charge for water supplied during the past year, ending Lady-day, 1893, was at the rate of 1s. 2d.—to be reduced to 1s. for the present year—in the pound on rateable value for private consumers, and 10s. per annum for use of hose; meter supplies, 1s. 6d. to 6d. per 1000 gallons.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Austria: Kreutzer tariff system.—The Austrian system for passengers termed the "kreutzer tariff," which was, more or less, forced on the Austrian Government by the action of Hungary, is a combination of the kilometre and zone systems. Under it the distances from each station are divided into certain zones, within which, in estimating the fares, each distance up to the end of the zone is calculated thus: The first 31 miles are divided into five zones, each of 6¼ miles; the next 18⅜ miles into two zones, each of 9 3/10 miles; the next 12⅜ miles consists of one zone; the next 62 3/20 miles are divided into four zones of 15 11/20 miles each. Further distances are divided into zones, each of 31 miles. The fares per mile, according to the zone division, are calculated per mile at, for ordinary trains: First class, ·9657d.; second class, ·6437d.; third class, ·3218d. Passengers by express or quick trains—Schnellzug—pay 50 per cent. additional on the above fares. The rate of fares is to be more clearly estimated from the following table (A):—

The Austrian system differs from the Hungarian in yearly "abonnment" tickets being issued over all the lines where the kreutzer system is in force, and at a cheaper rate for distances of thirty-one miles. There is no free transport of luggage, with the exception of portable articles, but for every 22·05 lb. of luggage ·6437d. is charged. Samples of commercial travellers are taken at a reduced rate.

(TABLE A.)

Zones.	Distance.	Express trains. First class.	Express trains. Second class.	Express trains. Third class.	Passenger and mixed trains. First class.	Passenger and mixed trains. Second class.	Passenger and mixed trains. Third class.
1	Up to 6⅛ miles	9d.	6d.	3d.	6d.	4d.	2d.
2—5	6⅛ to 31 miles	1s. 6d.—3s. 9d.	1s.—2s. 6d.	6d.—1s. 3d.	1s.—2s. 6d.	8d.—1s. 8d.	4d.—10d.
6	31 1/10 to 40⅞ miles	4s. 10⅝d.	3s. 3d.	1s. 7⅝d.	3s. 3d.	2s. 2d.	1s. 1d.
7	41 to 49 7/10 miles	6s.	4s.	2s.	4s.	2s. 8d.	1s. 4d.
8	50⅛ to 62 3/10 miles	7s. 6d.	5s.	2s. 6d.	5s.	3s. 4d.	1s. 8d.
9—12	62¾ to 124¼ miles	9s. 4⅜d.—15s.	6s. 3d.—10s.	3s. 1⅞d.—5s.	6s. 3d.—10s.	4s. 2d.—6s. 8d.	2s. 1d.—3s. 4d.
13	124 9/10 to 155⅛ miles	18s. 9d.	12s. 6d.	6s. 3d.	12s. 6d.	8s. 4d.	4s. 2d.
Additional each	zone of 31 miles	3s. 9d.	2s. 6d.	1s. 3d.	2s. 6d.	1s. 8d.	10d.
27	591 to 621⅜ miles	£3 15s.	£2 10s.	£1 5s.	£2 10s.	£1 13s. 4d.	16s. 8d.

Austria: Zone freight system.—The United States Consul at Reichenberg reports: The success of the zone system for passenger traffic in Hungary having been practically demonstrated, in spite of the arguments of the theorists proving it to be impossible, it was proposed to adopt the same system for freights on the Austrian Government railways. The old tariff for express goods was divided into:—General, 5·2314d.; reduced and extra reduced, 1·9291d. per ton per mile. The charges for conveyance of express goods per ton for various distances were:—

Distances.	General. £ s. d.	Reduced. £ s. d.
3 1/10 miles	0 3 10¾	0 1 6¾
9½ ,,	0 5 9	0 2 2½
15½ ,,	0 8 5½	0 3 2½
28 ,,	0 13 10½	0 5 3
34⅛ ,,	0 16 7¼	0 6 3¼
46⅜ ,,	1 2 2½	0 8 1½
59 ,,	1 7 2	0 10 2
77 7/10 ,,	1 15 6¾	0 13 2½
96½ ,,	2 7 0½	0 16 3
108¾ ,,	2 9 1¼	0 18 1½
Each additional 62⅛ miles	1 7 1	0 9 11¾
636 9/10 miles	13 19 5	5 3 1½

The new tariff is based upon a division of the country into zones of 6⅛ miles in width, and the rate of freight is the same for any distance within the zone. Rates are fixed by tables up to 31 miles, from 31 7/10 up to 93⅛ miles, from 93⅜ up to 186⅜ miles, and for over that distance. The old system of classifying the value of goods, which is the same for both Austria and Hungary, is retained in general, but with important modifications. The new tariff is primarily divided into: under 4 tons 18 cwt. 1 qr. 21 lb.; 4 tons 18 cwt. 1 qr. 21 lb.; and 9 tons, 16 cwt. 3 qr. 14 lb. The tariff for express goods per ton per mile is:—

Distances.	Ordinary. Under 4 tons 18 cwt. 1 qr. 21 lb.	Ordinary. 4 tons 18 cwt. 1 qr. 21 lb. to 9 tons 16 cwt. 3 qr. 14 lb.	Ordinary. 9 tons 16 cwt. 3 qr. 14 lb.	Reduced. Under 4 tons 18 cwt. 1 qr. 21 lb.	Reduced. 4 tons 18 cwt. 1 qr. 21 lb. to 9 tons 16 cwt. 3 qr. 14 lb.	Reduced. 9 tons 16 cwt. 3 qr. 14 lb.
	d.	d.	d.	d.	d.	d.
Up to 31 miles	3·9235	2·9626	2·6157	1·9618	1·6348	1·4713
Over 31 and up to 93⅛ miles	3·7927	2·6157	2·2887	1·8964	1·5040	1·3078
,, 93⅛ ,, 186⅜ ,,	3·66195	2·2887	1·8964	1·8310	1·3732	1·1004
Over 186⅜ miles	3·2696	1·9002	1·5040	1·6348	·9009	·8501

The tariff contains six divisions, arrangement for half and whole car loads having been provided. The single express package is carried much cheaper than before. With ordinary express goods the highest rate per ton per mile is 3·92352d. The lowest tariff falls to 1·50402d. per ton per mile, but will be somewhat dearer, as not each mile, but the distance to the centre of the zone, is taken into consideration. For reduced express goods, the tariff falls to ·8501d. per ton per mile. The following gives the rates for the carriage of a ton of express goods for certain distances:—

Distances.	Ordinary. Single. £ s. d.	Ordinary. Half car. £ s. d.	Ordinary. Whole car. £ s. d.	Reduced. Single. £ s. d.	Reduced. Half car. £ s. d.	Reduced. Whole car. £ s. d.
Miles.						
3 1/10	0 2 8½	0 2 4¾	0 2 0½	0 1 4¼	0 1 2¼	0 1 2¼
9½	0 4 0¾	0 3 4¾	0 3 0½	0 2 0½	0 1 10½	0 1 8½
15½	0 6 1¼	0 4 9	0 4 4¾	0 3 0½	0 2 8½	0 2 0½
28	0 10 2	0 8 9¾	0 7 1¼	0 5 1	0 4 4¾	0 3 10¾
34⅛	0 12 2½	0 9 5¾	0 8 5½	0 6 1¼	0 5 1	0 4 9
46⅜	0 16 3	0 12 2¼	0 10 10	0 8 1½	0 6 9¼	0 6 1¼
59	1 0 4	0 15 3	0 13 6½	0 10 2	0 8 5½	0 7 7½
77 7/10	1 6 3	0 19 3¾	0 16 11¼	0 13 2½	0 10 10	0 9 7¾
96½	1 12 2	1 3 0½	1 0 8	0 16 1	0 13 0½	0 11 6½
108¾	1 15 10¾	1 5 4¾	1 2 8½	0 17 11½	0 14 6¾	0 12 8½
Each additional 62⅛	*0 17 3	*0 9 0¾	*0 8 1½	*0 8 7½	*0 5 4½	*0 4 7¾
636 9/10	9 2 6½	5 2 11½	4 11 9¼	4 11 3	3 0 0½	2 12 1¾

* Average, the rates slightly decreasing with the distance.

For ordinary express freights, whether in single parcels or car loads, the rates are reduced from 30 to 60 per cent. For reduced express goods the old rate for sending a ton of reduced express goods from Vienna to Braunau was £1 18s. 1½d.; the new rates per ton are: For a single package, £1 16s. 2¾d.; if forming part of a half car load, £1 7s. 3¼d.; if forming part of a whole car load, £1 3s. 6½d. Here the reduction is less than for ordinary express goods. The chief difficulty in the reform lies in the "ordinary" express, whereon the introduction of car loads for transportation of goods into the great towns, is particularly favoured. The tariff for freight goods per ton per mile is:—

Distances.	Single pieces. Class I.	Single pieces. Class II.	Exceptional, IV. t. c. q. lb. 4 18 1 21	Exceptional, IV. t. c. q. lb. 9 16 3 14	Car loads. t. c. q. lb. 4 18 1 21 A	Car loads. t. c. q. lb. 9 16 3 14 B	Car loads. C
	d.	d.	d.	d.	d.	d.	d.
Up to 31 miles	1·9618	1·6348	1·4913	1·3078	1·1117	·7847	·5885
Over 31 & up to 93⅛ miles	1·8964	1·5040	1·3078	1·1444	·9482	·7193	·4904
Over 93⅛ & up to 186⅜ miles	1·8310	1·3732	1·1444	·9809	·8174	·5885	·39235
Over 186⅜ miles	1·6348	·9809	·8501	·7520	·6539	·39235	·3270

The most important change here is the creation of an exceptional class for piece freights of 4 tons 18 cwt. 1 qr. 21 lb. and 9 tons 16 cwt. 3 qr. 14 lb. For car loads the rates are exceptionally low, being often less than half the rates for single piece freights. This tariff is intended to greatly facilitate trade between great cities, as goods are only collected in large towns.

In the tariff for staple articles are new exceptional rates for cumbersome goods which deal with the space occupied, and are calculated upon the number of square yards of floor covered.

Special and Exceptional Tariff.

Distances.	Car loads. Special tariff per ton per mile. 1	2	3. Exceptional tariff. I.	II.	Exceptional tariff. a. Class special tariff per square yard of space per mile occupied. B	C	3
	d.	d.	d.	d.	d.	d.	d.
Up to 31 miles	·8501	·5885	·4904	·39235	·3499	·2691	·2153
Over 31 and up to 93⅛ miles	·7520	·4904	·42505	·3270	·3229	·2153	·1884
Over 93⅛ and up to 186⅜ miles	·6212	·39235	·3270	·2943	·2691	·1884	·1480
Over 186⅜ miles	·4904	·3270	·2616	·2616	·1749	·1480	·1211

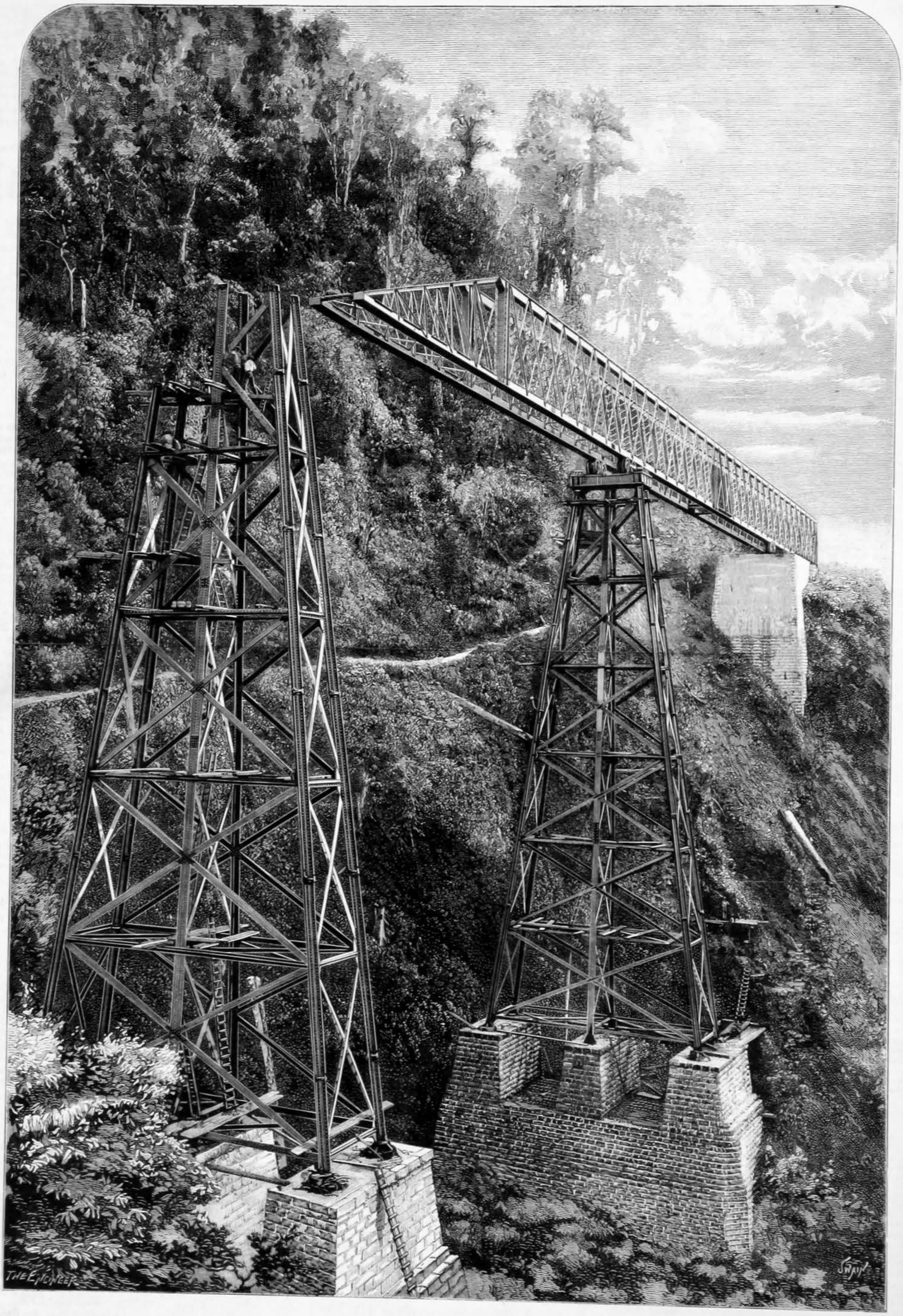
The coal tariff is included in exceptional tariff I. The previous exceptional tariff had the rates ·7193d., ·4577d., ·39235d. and ·2616d. per ton per mile. Here, therefore, is no special reduction. The exceptional tariff II. is lower, and what is quite new, includes every article which, on account of its little value, or for other reasons, can only pay low rates of freight,—building materials, ice, lignite coal, iron, sugar, beet refuse, &c. Fees for handling freight are reckoned as follows:—For transportation up to 49 5/10 miles in classes I. and II., further the delivery of piece freights in half or whole car loads—exceptional tariff IV.—as well as in car loads, class A, 6·096d. per ton. Over 49 7/10 miles, the fee for handling is 8·128d. per ton. Under the same conditions car classes B and C, and by special tariff 1, 2 and 3, pay 4·064d., 6·096d. and 8·128d., and by the exceptional tariff II. 4·064d. per ton, without regard to the distance.

Austria: Results of zone tariff.—The results of the zone tariff on Austrian railways for the year ending 30th June, 1891, compared with the results for that ending 30th June, 1890, during which the zone system was not in operation, show an increase of £13,935 or 1·023 per cent., divided into passenger increase, £3412, or ·26 per cent.; goods increase, £22,458, or 40·75 per cent. These increases were reduced by a reduction in agio of £11,395, or 39·4 per cent. The number of passengers increased by 9,000,630, or 43·3 per cent. The quantity of goods carried decreased by 2031 tons, or 4·02 per cent. Later advices state that the Kreutzer system of traffic introduced upon the Austrian State railways has not given anything like the satisfaction following the similar change in the working of the Hungarian State railways. A year back it was contemplated in Austria either to increase the charges for the conveyance of both goods and passengers upon, or to revert to, the old rates and system of working the State railways. The former course has been adopted for goods. The new rates are considerably increased for short distances. The terminal charges have been increased to 1s. 4d. and 8d. per ton for express and ordinary goods respectively.

VIADUCT OVER THE RIVER BIRRIZ.—COSTA RICA RAILWAY

MR. J. PACKMAN, M. INST. C.E., ENGINEER

(*For description see page* 43)



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—BOYVEAU AND CHEVILLET, *Rue de la Banque.*
BERLIN.—ASHER AND CO., 5, *Unter den Linden.*
VIENNA.—GEROLD AND CO., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—INTERNATIONAL NEWS COMPANY, 83 *and* 85, *Duane-street.*

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement the Index to the Seventy-fifth Volume. Also a Two-page Engraving of the Triple-expansion Engines of H.M.S. Endymion. Every copy as issued by the Publisher includes copies of the Supplements, and subscribers are requested to notify the fact should they not receive them. Price* 1*s.*

CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

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

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

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

W. D.—*There is nothing new in the principle of increasing twist in gun rifling.*

CAST IRON TRAM PLATES.

(*To the Editor of The Engineer.*)

SIR,—Can you or any reader give us the names of firms who supply cast iron trams of this ¬_____⌐ pattern, for guiding vans into a yard?

July 11th. M. S.

AIR-SPACE FIRE-BARS.

(*To the Editor of The Engineer.*)

SIR,—Some two years we bought some cross air-space fire-bars that we liked very much of Messrs. A. Milsom and Co., 28, Lesbia-road, Lower Clapton, called "Air-space Bars." We are now wanting a fresh supply. Can you tell us where the firm now is, or the name of any firm now working the patent, or whether the patent has run out?

July 7th. E. A. L.

SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

Half-yearly (including double number) .. .. £0 14*s.* 6*d.*
Yearly (including two double numbers) .. .. £1 9*s.* 0*d.*

If credit occur, an extra charge of two shillings and sixpence per annum will be made. THE ENGINEER *is registered for transmission abroad.*

A complete set of THE ENGINEER *can be had on application.*

In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive THE ENGINEER *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

THIN PAPER COPIES—
Half-yearly .. .. £0 18*s.* 0*d.*
Yearly .. .. £1 16*s.* 0*d.*

THICK PAPER COPIES—
Half-yearly .. .. £1 0*s.* 8*d.*
Yearly .. .. £2 0*s.* 6*d.*

READING CASES.—*The Publisher has in stock reading cases which will hold thirteen copies of* THE ENGINEER. *Price* 2*s.* 6*d. each.*

ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

Prices for Displayed Advertisements in "ordinary and "special" positions will be sent on application.

Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.

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

MEETINGS NEXT WEEK.

THE JAPAN SOCIETY.—Wednesday, July 19th, at 20, Hanover-square, W., at 8.30 p.m. Ordinary meeting. Paper on "Wood and its Application to Japanese Artistic and Industrial Design," by Mr. George Cawley, M.I.M.E. (late Imperial Engineering College, Tokio).

THE ENGINEER.

JULY 14, 1893.

ELECTRIC TRAMWAY TRACTION.

THE decision of the joint Committee of the two Houses of Parliament on Electric Powers Protective Clauses will be hailed as the release of some of the most important electrical engineering industries from an incubus of a most remarkable kind, which has for some years prevented nearly all enterprise in electric tramway traction. We have on numerous occasions drawn attention to the acts of interference and obstruction by the National Telephone Company, and in our impression of the 10th February showed why it was that by the decision of Mr. Justice Kekewich—in the case of the National Telephone Company *v.* Baker—the progress of electrical traction was hindered rather than helped, although that decision was nominally in favour of the tramway interests represented by Mr. Baker. Our anticipations have since been realised, and the National Telephone Company has been more active than ever in seeking the insertion of what is known as the telephone clause in every Bill in Parliament for tramways or tramway extensions, however worked. In previous years the insertion of this clause has rendered tramway Acts perfectly useless; and, in some cases, Bills have been withdrawn or the parts relative to tramways dropped, rather than have statutory powers which were rendered useless by this clause. So long as the National Telephone Company was fought by single tramway companies, most of which have very little money available for such purposes, it was able to succeed in its uselessly obstructive course. But this year it has attempted too much, with the result that a combination of electrical traction interests became absolutely necessary.

The case as between the National Telephone Company and electrical traction interests generally was set forth in THE ENGINEER on the 19th September, 1890, and we then stated that if the clause inserted in favour of the Telephone Company were repeated in the Acts of that year, it would prevent all electrical tramway development. This has been the case. The Leeds tramway was constructed in defiance of the Telephone Company, and it was only because it had statutory powers that the tramway succeeded in the case before Mr. Justice Kekewich. The case was not settled on the question of right on the part of any interest, telephone, tramway, or other, to the sole use of the earth for electrical purposes.

The first success on behalf of tramway companies as against this extraordinary claim on the part of the National Telephone Company was that of the Folkestone, Sandgate and Hythe Tramways, in which case the Committee refused to give any clause for the protection of the telephone, and made the Telephone Company pay the whole expense of the inquiry. Since that date, however (1891), the telephone companies, with the exception of the Leeds case, have practically had their own way. To prevent the recurrence of a reverse such as that at Leeds, the National Telephone Company, which now includes all or nearly all telephone interests, has sought this year the insertion of the Protection Clause in every Bill and provisional order before Parliament, and sought to make it appear that this was a Board of Trade clause. It thus became absolutely necessary that combined action should be taken on the part of electrical engineering interests. To secure this combined action, however, was no easy task, for the jealousies of various traction companies had to be overcome. Owing to the exertions of Mr. Stephen Sellon, an Electric Traction Association was formed, which was afterwards merged into a Traction Section of the London Chamber of Commerce, and it was due to the exertions of this Committee that the important questions which were the origin of its formation were brought before the Board of Trade, and subsequently before the joint Committee which was formed on the recommendation of the Board of Trade. In a letter, in February last, to Mr. Mundella, as the head of the Board of Trade, Mr. Sellon urged that to protect electric tramway interests it would be imperative that the Association should appear to defend the attempts which would be made by the Telephone Company to obtain these clauses, but that before being called upon to spend the large amount of money which would be entailed in carrying out the policy, the Board of Trade should be approached, and its assistance sought, to arrive at some reasonable understanding between the parties. A Committee of both Houses of Parliament was suggested. In reply, a letter was received from the Board of Trade, inclosing one from the National Telephone Company, in which it was stated that the Leeds case had deprived that company of any common law rights, and that it had a right to protection, This led to an interview at the Board of Trade between the contending parties, when Sir Courtenay Boyle stated that he had been advised that it was practically impossible for the traction company to work their lines electrically without some leakage, and therefore probable interference, and he adopted Mr. Sellon's suggestion, and urged the necessity for a joint Committee for the purpose of considering the matter in Parliament. It is now a matter of history that this Committee was formed, and has held an exhaustive inquiry, as reported in the recent numbers of THE ENGINEER. The decision of this Committee we shall give at length in another impression. It is sufficient now to state that no protection will be given to the Telephone Company or to telegraphs or railway companies as long as they use the earth as a common return.

As to the alleged electrolytic action, it will have been seen from the reports that the evidence was very inconclusive, but if it should hereafter be proved that such action does arise in consequence of the working of electrical tramways, the Board of Trade will have power to inquire into any cases. We might occupy considerable space with an examination of the evidence given before the Committee. To most of our readers, however, the main fact of interest is that the unjust and obstructive demands made by the Telephone Company have at last been thoroughly examined, and that the burden of fighting a company with enormous capital is no longer enforced upon the struggling companies with tramways, which, under present conditions, cannot be made to pay. The Telephone Company overleaped itself and took unwarrantable means to secure its ends. Among other, reference may be made to the evidence in the House of Lords Select Committee on the Salford Improvement Bill, one part of which related to an extension of the tramways by only three chains in lengths, statutory powers being already held by the Corporation for working the tramways by electricity. This improvement had to be postponed because the Telephone Company sought the introduction of a protective clause which would have made electrical traction impossible, not only on the three chains, but on the whole of the tramways. The Dublin Southern Tramways Company narrowly escaped the insertion of the clause, and it was only after much had been done, that the Committee of the House of Lords decided that if any clauses were inserted, they should be those, if any, which should be adopted by the joint Committee.

We are constantly being told of the great advance made by electrical traction in the United States as compared with that in this country. The chief reason for our slowness in this respect has now been removed, and it will be possible now to employ capital usefully in the development of electric traction. It should be recorded that the successful issue of this struggle, led by Mr. Sellon, is largely due to the Mayor of Leeds, Mr. Alderman Firth, and the Corporations of Glasgow, Salford, Walsaw, and Blackpool, and to Mr. Crompton and Mr. Garcke, and others. It is to be regretted that the electric lighting industry did not take similar action, and so prevent the insertion of the telephone clauses, which may yet cause considerable trouble.

ONE HUNDRED MILES AN HOUR.

IT is stated that speeds of eighty miles, ninety miles, and lastly 112·5 miles an hour have been attained on American railways, with engines having four-coupled 7ft. driving wheels. It may be taken for granted that these statements have foundation in fact; and even if we reject the last as hypothetical, we hold it by no means to be impossible that certain very big engines, racing down hill with a light train, have run for a mile or two at the rate of 100 miles an hour. Mr. George Westinghouse has already shown, in the pages of the American technical Press, what kind of brake this enormous velocity demands. The distances which trains will run after steam has been shut off varies, other things being equal, as the squares of their velocities. That is to say, if a train running at fifty miles an hour traversed two miles before coming to rest, a train running at 100 miles an hour could not stop until it had run four times as far, or eight miles. But if the time occupied in running two miles by the first train was 4·6 minutes, the time occupied in running eight miles by the second train would be 9·2 minutes. If the first train could by powerful brakes be stopped in one-fourth of a mile, equally powerful brakes would pull up the second train in a mile. It is tolerably evident from this that if anything like the regular running of trains at 100 miles an hour is contemplated on the absolute block system, very considerable changes will have to be made in all the signalling arrangements. It appears to be practically impossible, for example, to pull up a train running at 100 miles an hour in a distance less than about two miles. Therefore, something in the nature of extra distance signals will have to be adopted.

There is, however, an aspect of the question which has never yet been considered so far as we are aware, and that is the bursting effect of the engine in going round curves. The centrifugal force varies as the square of the velocity. A speed of sixty miles an hour means 88ft. per second, and the square of 88 is 7744. But a speed of 100 miles an hour is, within a very small fraction, 147ft. per second, and the square of 147 is 21,609. Roughly speaking, the bursting effort of an engine running at 100 miles an hour will be three times that of the engine running at sixty miles an hour. A very simple calculation suffices to show that the centrifugal effort of an engine and train running at 100 miles an hour round a curve of 10 chains, or 660ft. radius, would be a little more than equal to the weight of the train. Thus, if the engine weighed 65 tons, its bursting effort would be 65 tons, and so on ton for ton; and if we pursue the calculation it will be seen that all this effort may be regarded as acting in a horizontal line at the centre of gravity of the engine, and that it approaches perilously near what would suffice to overturn the engine bodily. The upsetting of an engine while on the rails is a thing unheard of hitherto, but only because the speeds on curves have been reasonable. The tendency to upset and to leave the track is provided for by raising the outer rail. We need not reproduce here the somewhat lengthy rule for ascertaining with accuracy the proper amount of super-elevation for a given radius of curvature and speed. Mr. Price's practical rule is to take a chord one chain long and stretch it from one point to another inside the outer rail, so as to make a chord to the curve. Then the greatest distance in inches from the mid-length of the chord to the rail is the proper super-elevation in inches for forty miles an hour. But inasmuch as the elevation varies as the square of the velocity, it will be seen that the super-elevation might have to be measured by feet instead of inches. Indeed, for a speed of sixty miles an hour on a 10-chain curve, the outer rail would have to be raised about 10in. The whole calculation is based on the theory that the flanges of the wheel should not be allowed to bear against the outer rail; in practice the rail is never now raised to this extent. In the early days of railways the slipping of a train off the

inside rail was by no means unknown; in such cases the speed of the train was too slow. In the present day only a moderate super-elevation is given, as a species of compromise. It is too small for high speed and too great for very low speed. But although the plan answers very well for velocities rarely exceeding 60 miles an hour we cannot think that it will suit engines running at 100 miles an hour. The shock on entering a curve from the straight at such a speed must be tremendous, the lateral push or stress being, as we have said, equal to the weight of the whole engine; while when fairly on the curve the effort to carry the whole track away sideways will equal the weight of the train. The solution of the difficulty lies in using curves of large radius, but the condition involves the specialisation of the road, so to speak; in short, no curve of much less than twenty-five chains radius should be attempted at 100 miles an hour. It goes without saying that the permanent-way, and especially the ballasting, must be kept in the highest possible condition. That such velocities have been reached without accident up to the present proves nothing. Every railway engineer knows that it is dangerous to run at that speed, because the co-efficient of safety is reduced all round, and the smallest imperfection will suffice to throw the engine off the track, and the results would be dreadful to a degree not easily imagined.

It may be taken as fortunate that the distances run at this speed have been very short, and that it has never been kept up for more than a few seconds. The risk is rapidly reduced with the speed, and eighty miles an hour would be comparatively safe on a road and round curves that could not without eminent peril be rushed over at 100 miles an hour. It is easy enough to point to a mile in thirty-five seconds as a great achievement; so it is, no doubt. We believe that speeds of 100 miles an hour may yet be regularly attained on railways; but we not only believe, but know, that they can only be reached with safety on track specially constructed for the purpose.

RAILWAY COMMUNICATION BETWEEN INDIA AND CEYLON.

On more than one past occasion we have made reference to the question of the construction of a railway across Adam's Bridge to connect the systems of India and Ceylon. Although the authorities of the latter island have, from the inception of their system, held such an ulterior object steadily in view, and, consequently, fixed the gauge of their railways to assimilate with that then prevailing throughout the adjacent continent, the proposal has never hitherto, we believe, been brought within the range of practical politics. Some years back the Duke of Buckingham when Governor of Madras, gave considerable attention to this matter. He deemed the project to be quite feasible, and one, moreover, that the course of events and the necessities of the two countries must eventually cause to be carried out. His Grace's remarks on this topic were made some ten or twelve years back, and since then until now nothing further has been publicly heard with reference to it.

Circumstances, however, seem likely to lead to serious attention being now given to the proposal. A paper relative to it has been placed in circulation to which are appended the names of Sir George Barclay Bruce, Past President of the Institution of Civil Engineers, and of Mr. William Shelford, M. Inst. C.E. Sir G. Bruce, when chief engineer of the Great South of India Railway, had large opportunity for weighing the merits and demerits of the scheme, and that he should now appear as its advocate must be accepted as a substantial guarantee of its feasibility and desirableness. Mr. Shelford has for some years closely studied the question of railway extension in Ceylon, and may therefore be presumed to have acquired a practical knowledge of the future railway requirements of that interesting and prosperous British colony. We have stated that circumstances are now existent which warrant the scheme receiving more full and detailed consideration than has as yet been accorded it. The inhabitants of the far north of Ceylon have up till now been entirely excluded from the benefits which its southern provinces have enjoyed from railway construction. They have strongly agitated for a line which shall connect Jaffua with the great Colombo and Kandy Railway, and the island Government has gone so far as to grant the money required for the preliminary survey of such a line, this being at the present time in hand. The length of line required to satisfy this aspiration of the people of the northern provinces cannot be much short of 200 miles, and it is said to be open to much doubt if traffic can be found to make the necessary expenditure for this warrantable. The gentlemen whose names have above been quoted are of opinion that by the adoption of a connecting line between Ceylon and India, and by the inclusion in the scheme of a branch of this to Jaffua, this possible cause for long delay may be overcome. Such a branch would be but scarcely half the length of the line now under survey, and the profits to be anticipated from it would largely aid towards the financial practicability of building a railway across the series of reefs known as Adam's Bridge, which, in a sense, now connects the island of Ceylon with the mainland of India.

No doubt the engineers are further induced to take up this matter owing to the renewal of proposals which have long seemed to be moribund, to cut a ship canal through the Island of Ramisseram, and to establish in connection a shipping port. Should that proposal be carried out, the doing so would, we conceive, put an end to the prime consideration upon which the linking-up of the main and island railway systems is to be advocated. It has ever been the opinion of the Ceylon Government, that, were such linking-up accomplished, a very large proportion of the produce of Southern India would find its way to Colombo for shipment. If an intermediate port be constructed, such an expectation must cease to have any justification, and the long-discussed project would of necessity fall through. Strong opposition has from the first been offered to this canal scheme. Into the grounds of that opposition we need not enter, but it has been successful hitherto in inducing the Government of India to withhold the concessions sought by the projectors. None of the great steam shipping companies interested in the trade of the Bay of Bengal have given it their support, and so long as this is denied, we may conclude that the canal would not meet any felt want. An outlet for the productions of Southern India is, however, a necessity that year by year becomes more pressing, and failing the establishment of the intermediate port we have referred to, it seems to us that that necessity can only be satisfied by the uniting of the two railway systems after the manner proposed. Since this proposal was first thought of, however, there has been a change in the railway policy of India that materially affects it. There is no longer complete uniformity of gauge in that country with that upon which all railways as yet constructed in Ceylon have been carried out. The broad gauge, at first universal on the lines of Southern India, has now been widely altered to the narrow or metre gauge. The system which would have to be connected by an extension with the proposed bridge is itself of the latter gauge, and to make the scheme wholly successful, the Government of Ceylon must consent to depart from its present policy of refusing any break of gauge. Any further extension of railway work to the northwards in Ceylon must, if this scheme of bridging between it and India be carried out, of necessity be constructed to assimilate with the present South Indian gauge. But this is a detail which doubtless the projectors have well considered. What is at present asked by them is that a concession shall be granted by the respective Governments interested, and that that of India shall afford facilities for making such a detailed survey of the twenty-seven miles or so of reef as may enable an accurate estimate of the cost of bridging it to be prepared. We are told that the proposal has secured influential support in the City, and that a firm of very high standing therein has already communicated with the Government of India, asking for a grant of the concession required. From all we can learn, the bridging of the reef will be a very simple affair, though the great length of it would make it an engineering work of much novelty.

THE THREATENED NATIONAL STRIKE IN THE COAL TRADE.

There can be no doubt, judging from the attitude of masters and men, but that the country is within measurable distance of one of the most momentous struggles ever witnessed in connection with the coal trade. This conclusion is come to from the knowledge that the coalowners throughout the Federated districts are to all appearance thoroughly combined, and determined to have some relief in order to enable them to compete with South Wales and the North of England districts, which, in addition to having obtained concessions from their men, are in a much better position to compete, being nearer the sea. On the men's side there seems not only to be a determination to hold out against any reduction, but the weapons with which they intend to fight have been to a great extent unknown in connection with previous strikes in the coal trade. Whilst the coalowners are wishful to secure unanimity of action, and to prevent a miscarriage, and have had all the forms of notice legally drawn to suit the various districts, the men are doing all they can to bring about a complete stoppage of the coal trade, with a view evidently of paralysing the industries of the country. The Miners' Federation prides itself on having on its side the Coal Porters' Union and the Seamen's Firemen's Union, who, it is assumed, will decline at the word of command to touch any coal from the Federated districts; not only so, but the men are urging the Miners' Federation to consider the question of not allowing any coal which is on the pit banks to be pulled up. Again, the men in Yorkshire seem so determined to do all they can to prevent the coal owners being successful, that even where masters are not expected to give them notice, the men have decided to themselves give notice, so that the pits can be set down at the same time as those where the owners are discharging their men. The outlook, it must be admitted, is a sad one, but there can be no doubt that if the owners are thoroughly united they will ultimately succeed, for, with two or three exceptions, the Miners' Associations have but little money in hand, whilst the amount in the coffers of the Federation would only suffice to pay the men a few weeks. But little of late has been said about inducing Durham and Northumberland miners to give notice for an advance of wages and come out until they get it. After the severe struggle which Durham waged last year, the men would doubtless demur to throw down their tools to support those districts which last year produced all the coal they could, and supplied their customers whilst they were looking on.

THE CENTRAL LONDON RAILWAY MANSION HOUSE STATION.

The report on this subject by Colonel Haywood, the engineer to the Commissioners of Sewers of the City of London, was again under consideration of the Commissioners at their last meeting, as brought up by the Streets' Committee. The report dealt at length with the application and plans of the Central London Railway Company, which obtained powers in 1891 and 1892 for the construction of a railway from Shepherd's Bush into the City of London, and to form a central station beneath the public streets lying between Queen Victoria-street, the Poultry and Cornhill. The company applied to the Commissioners in May, 1892, for their consent to form this station, and laid before the Committee plans and section showing a station which was to have eight staircases for access to the railway, entrances to seven of which were to be taken out of the footways or carriageways. It was also proposed to form in the connection of the station subways connecting the opposite sides of the near streets, so that pedestrians might cross by these means as well as gain access to the station. This scheme was generally approved by the Commission, and was referred to its officers for consideration and report. The first result was that the company obtained its second Act with clauses reserving powers to the Commission and their engineer, and the plans and sections as finally arranged are the subject of the report above mentioned. As mentioned in our last impression, Colonel Haywood has had placed in the streets, woodwork representations of the space to be occupied by the entrances shown on the plans. In the course of the discussion in the last meeting of the Committee some reference was made to the value of the land that would be occupied by the entrances; but it was very properly pointed out by Mr. Pannell that these pedestrian subways would be of great value to the public, and would cost the railway company about £60,000, and that this should be remembered when talking of the value of the bits of surface ground to be given up to the company. Finally it was decided that the plans be approved, subject to a reservation on the part of the court giving it the right to alter any of the staircases and to modify details of arrangement in any particular. Colonel Haywood's report describes at length the main features of the project, and refers to the mode of carrying out the work.

BRITISH TRADE FOR THE HALF-YEAR.

The Board of Trade returns for June, which have just been issued, are not quite so unfavourable as anticipated at the beginning of the year. At that time the rate of decline in British exports was about £2,000,000 a month. The total value of the business done with foreign countries for the six months ended 30th June last was £107,777,940, as compared with £111,861,002 for the first half-year of 1892. The decrease, therefore, is £4,083,062, which is about £8,000,000 less than the opening figures seemed to point to. In looking into the details it is found that the largest item of decrease for the half-year is in yarns and textile fabrics, which account for £2,876,185 of the whole falling-off. The rest of the decrease is pretty evenly distributed between raw materials, metals and articles manufactured therefrom, machinery and mill work, apparel and articles for personal use. Under the latter heading the shrinkage amounts to £558,535. Dealing with the half-year which has just closed the figures are more satisfactory, there being an increase in the exports to the value of £714,953. Last month there was also an increase, being the first time for a long period that the table showed that gratifying turn for the better. In the exports for June raw materials have decreased £89,740; machinery and mill work, £56,167; apparel and articles of personal use, £75,332; in all other sections there is a substantial increase, yarns and textile fabrics having gone up £235,328, while metals and articles manufactured therefrom have increased £225,098. The late Lord Beaconsfield once said that a sure sign of improved trade was when better business was done in chemicals. If this axiom holds good, the country ought to be on the verge of improvement, for an increased business has been done in chemicals during June to the large amount of £102,406. A word as to the imports for the six months. These amount to £197,676,219, which is a diminution of £15,039,504 as compared with the corresponding period of 1892. Every section shows a decrease except oils, manufactured articles, and the parcel post. On the month the imports have reached a value of £31,868,792, being a falling-off to the value of £908,687.

THE PARSONS STEAM TURBINE.

Great strides have recently been made by Messrs. C. A. Parsons and Co. in the construction of the Parsons turbo-motor and attached alternator. One set has recently been tested having an output of about 150 units when working with 120 lb. steam, and as low as 100 lb. steam, and about 4500 revolutions per minute. The trials were made by Professor Kennedy, whose figures show some remarkably high results. The steam used was superheated about 66 deg., and in one of the tests, with a boiler of 94·5 lb. above the atmosphere, an average vacuum of 13·9 lb., the water used per hour was 27·9 lb. per kilowatt hour, or 20·8 lb. per electrical horse power. In another trial, of about three-quarters of an hour's duration, Professor Kennedy gives the consumption as 20·3 lb. per electrical horse-power, the boiler pressure being 97·1 above the atmosphere, and the vacuum 14·11; the horse-power electrical being nearly 165. In the previous mentioned case the horse-power was 148·5. Even with such remarkable results as these, it is stated that there were a considerable number of small leaks taking place, but that these could not be taken into account. But it must be mentioned that the feed pump was worked by steam from a second boiler, which also supplied steam for the air-pumping engine; so that steam required for these purposes was not, of course, included in the quantities already above given.

LITERATURE.

The Naval Annual for 1893.

[Second Notice.]

Part II. of Lord Brassey's work will not require quite so extensive a notice as that devoted to Part I., for it mainly consists of a similar alphabetical list, contributed by Mr. F. K. Barnes, of "British and Foreign Armoured and Unarmoured Ships," to that which has appeared in all previous issues of the Annual corrected and brought up to date, together with plates illustrating the various classes, which are as well executed as ever; but an addition of vital importance has been made this year by Mr. W. Laird-Clowes in the shape of a very comprehensive statement of the torpedo boat flotillas of all nations. This is an entirely new idea, and its value will be most readily and clearly estimated by a glance at the following statement which is condensed from tables given by Mr. Laird-Clowes, and which demonstrates the great extent to which torpedo boat construction has been developed throughout the world. The writer of this paper deserves the highest encomiums for the patience and ability which he has displayed in arranging and cataloguing the 1329 vessels which are included in the various tables, the obtaining of definite information from the various countries involved being in itself a work of no small magnitude. Mr. Clowes has adopted length as a standard for classification, as he considers it impossible to reconcile the terms which are applied indiscriminately by the different nations to denote vessels varying so much as they do in size and other attributes. Moreover, he thinks that in a greater or less degree length is proportionate to the displacement, the steaming radius, the power of the engines, and most of the other factors which combine to form the efficiency of a fighting craft.

It is impossible to avoid the conclusion that this statement will come as a disagreeable surprise to those who have hitherto been hugging the conviction that the power of our Navy is, in every particular, minute as well as important, so immeasurably superior to that of every other naval Power, that we should experience no difficulty in encountering unaided, any combination of two of them with which we might simultaneously be brought into conflict. And so far as regards battleships

and cruisers, such a conviction appears to have been well grounded, if we refer to the comparative statements which have already been published in the columns of THE ENGINEER, as illustrating our first notice of Lord Brassey's work. But a single glance at the statement above shows unmistakeably, as tersely put by Mr. Laird-Clowes, that Great Britain only ranks second in the strength of her flotillas of sea-hornets, her superior being France, "and that, although as regards boats of over 150ft. long, she ranks first, or rather, will so rank when she has completed her present programme, she does not . . . . take the position which might be expected. Italy and Germany excel her in the number of 'sea-going'

Torpedo Boats of all Nations.

		Destroyers above 150ft.	Sea-going, 126ft. to 150ft.	Ordinary 86ft. to 125ft.	Vedettes, 85ft. and under.	Total.
Torpedo boat flotillas of all nations.	British Empire...	20	51	51	84	206
	Austria-Hungary	—	24	31	8	63
	China	—	2	28	13	43
	France	9	36	178	6	229
	Germany	10	64	63	16	153
	Italy	13	86	14	19	132
	Japan	1	—	40	—	41
	Netherlands ...	—	6	14	23	43
	Russia...	14	38	7	107	166
	Spain	—	11	27	9	47
	Other Powers ...	2	45	91	68	206
	Totals of classes...	69	363	544	353	1329

boats. . . . . Indeed, if we compare the total number of boats of all classes of 101ft. and upwards in length, we find that the premier position is held by France, the second by Germany, the third by Italy, and only the fourth by Great Britain! Yet the boats of 101ft. and upwards are the only ones which are of much use for work at sea."

The fastest boats which have yet been actually built and tried seem to be the Schichau boats of the Russian Adler and the Italian Aquila classes, some of which have done 27·4 knots. Then come in succession the Thornycroft "Ariete" class, two or three of Schichau's German Government classes, Normand's Corsaire and Pernow classes, and Yarrow's "Azor" class. Our own fastest boats rank after all these. There are building for us, however, "destroyers," which are promised, and, indeed, contracted to do 27 knots; and even this great speed is to be exceeded by a boat which M. Normand is building, and which is expected to do 30 knots, or 34½ statute miles an hour. This is the speed of an ordinary train, and it is equal to 1000 yards a minute. It opens up a possibility that in the naval actions of the future two flotillas may approach one another at a speed of 2000 yards a minute; and that, therefore, from the moment when they sight one another, at a distance of ten miles, to the moment when they are in collision, only a little more than eight minutes may elapse!

The tactics which would be necessary under such circumstances are difficult to conceive. The coolest judgment might well be bewildered. But perhaps in such conceptions, the primary object and usefulness of a torpedo-boat flotilla is somewhat lost sight of. It seems almost an unnecessary stretch of imagination to picture two flotillas of this nature engaging one another upon the high seas. Their province would rather be to lie in wait at suitable points of a coast-line, to make sudden dashes upon an unprepared vessel or squadron, and to return to their hiding places with equal rapidity, rather than to assume the *rôle* of cruisers or sea-going craft. They might also be most usefully employed, as done with the Blue Squadron in the naval manœuvres of 1892, in preventing the combination of two separate portions of a hostile fleet, by laying in wait at, or near, the expected point of junction.

It is possible that other naval Powers may attach more emphasis to the importance of a powerful torpedo-boat flotilla than that which obtains in this country. The torpedo boat—though employed offensively—is clearly a craft which enters largely into the scheme of coast defence; whereas our naval authorities unanimously agree that our objective, in the event of war, would be the enemy's coast line and not our own, when of course only the very largest class of torpedo vessel would be found to be of any service. This circumstance may influence the authorities at the Admiralty in their apparent indifference as to the superior progress of France, Germany, Italy, and Russia in this direction. But the unpleasant fact remains, that in the entire British Empire only 206 torpedo craft are to be found; whilst France alone has 229, and France and Russia combined no less than 395. There is little doubt that such a fact should be fully ventilated, and its healthiness or otherwise tested and determined. We invite the most serious consideration to it.

Before concluding our remarks upon torpedo boats, we feel it our duty to point to the fact that, whatever may be the shortcomings of our torpedo-boat flotilla, there is no doubt at all as to the stability and safety of the craft composing it. On the other hand, a very considerable section of the French boats, those of 35 metres in length, were found to be perfectly untrustworthy in a very moderate sea, and several of them "turned turtle," and drowned their crews. No similar accident has happened with British boats. But even after setting aside all the French 114·7ft. boats, which are forty-seven in number, the balance tells woefully against Great Britain. *Apropos* to this question, the debate which has just taken place in the House of Lords as to a suggestion of the Earl of Winchilsea to establish and maintain a huge food depôt in the United Kingdom for temporary relief of the country when blockaded, opens up naturally the idea that £2,800,000 per annum would be much more usefully expended in increasing the torpedo-boat flotilla, which is obviously the most effectual preventive to the success of a blockade that could possibly be devised. Lord Playfair must, however, have been ignorant of the facts set forth in Mr. Laird-Clowes' paper or he never would have stated that "there was no deficiency in our naval service." Our remarks, therefore, should have a time interest and special significance at this juncture.

Part III. of the *Annual* is particularly interesting this year. Captain Orde Browne furnishes descriptions of the appearance and drawings of steel armour plates, some combined with nickel, and "Harveyed," after having been fired at with 6in., 8in., and 10in. guns. A 14in. nickel-steel armour plate, intended as a sample of the armour for the Massachusetts, bore, without entire penetration or cracking, the shock of several 500 lb. steel projectiles from a 10in. gun. This result was, however, eclipsed by the success obtained with a Harveyed nickel-steel armour-plate made at the Bethlehem Works. It was 10·5in. thick, and received blows from five projectiles of Holtzer steel weighing 250 lb. each, fired from an 8in. gun. Three out of five rounds were shivered against the hard face imparted to the metal. Rounds three and four penetrated to a depth of 13in. and rebounded entire. The behaviour of the plate was splendid, only a single crack developing at one corner, and this was apparently due to defective hardening at that point. It had sustained a blow representing 2712·3 foot-tons per ton of plate.

In a subsequent trial of another plate at the same place five 8in. Holtzer steel projectiles broke up on its face without producing any cracks at all. Equally good results were obtained in this country with a Harvey nickel-steel plate, made by Messrs. Vickers, tested on board the Nettle. It was 10·5in. thick; two rounds of 6in. Palliser projectiles, and three rounds of Holtzer steel were fired at it, with a striking velocity of 1976ft. per second. The steel projectiles penetrated most deeply, but the plate showed no sign of cracks. The strain to which the plate was exposed was, however, clearly not to be compared with that imposed upon the similar plates in America. In January last a Vickers' Harveyed nickel-steel armour-plate, 6in. thick, was tested at Portsmouth. The 6in. breech-loading gun was used, with Holtzer steel forged projectiles. With 42 lb. of powder, and a striking velocity of 1813ft. per second, the plate was cracked, but the projectiles were all broken up. With 48 lb. of powder, and a striking velocity of 1960ft. per second, the plate was perforated, and the projectile lodged in the backing in fragments. Captain Orde Browne considers "this was a most remarkable trial, for it must be borne in mind that the resisting power of a plate is more nearly as the square of its thickness than as the first power, so that for a 6in. plate to break up a projectile which until recently was a match for 10½in. of steel, is a great triumph, and it may be seen from the account that any structure behind the backing would have been protected."

The immense importance of the improved condition of armour plates, as combined with nickel, and hardened or Harveyised, is put very clearly in the paper. Hitherto Holtzer steel projectiles have defied all efforts to restrain their penetrative powers, and wrought iron and mild steel plates were passed through like pats of butter. "How much depends on the nature of metal in such plates may, however, be seen from the fact that the same Holtzer forged steel shot which will perforate 17in. of wrought iron, and pass on uninjured with a considerable velocity, may be broken up almost like glass by the hard face of a Harvey or Tresidder plate."

(To be continued.)

BOOKS RECEIVED.

Projet de Chemin de Fer Electrique Souterrain. Bruxelles. Par Alph. Müllender. 1892-93.

Hydraulic Power and Hydraulic Machinery. By Henry Robinson, M. Inst. C.E., F.G.S. Second edition. London: Charles Griffin and Co. 1893.

A Handbook on the Steam Engine, with Especial Reference to Small and Medium-sized Engines, for the Use of Engine Makers, Mechanical Draughtsmen, Engineering Students, and Users of Steam Power. By Herman Haeder, Civil Engineer. English edition, re-edited by the Author from the second German edition, and translated, with considerable additions and alterations, by H. H. P. Powles, Assoc. M.I.C.E., M.I.M.E. London: Crosby Lockwood and Son. 1893.

THE NAVAL MANŒUVRES.

(From our Special Correspondent.)

PORTSMOUTH, July 11th.

ANYTHING more unlike the stir and bustle previous to war exhibited by the so-called naval mobilisation to-day can hardly be conceived. No longer are recruiting parties observed beating up the well-known haunts of seamen, endeavouring to complete the crews of newly commissioned ships. It can hardly be realised that only a few years ago ships were sometimes delayed for months for want of a permanent force of seamen. They embarked or not, as they felt inclined, and according to the individual reputation of the Captains. Now crews are told off previously, and are sent to their allotted ships when the order is given. Then what progress has been made in equipping the vessels with their necessary stores of ammunition and provisions. A short time ago every craft had to ship her powder and shell outside the harbour. Now they lay alongside the dockyard embarking these requisites from lighters despatched from the gun wharves. The form in which gunpowder is now made, and the cases in which it is stowed, render this operation much safer than of old, and the less frequently the explosive is handled the more reliable it is when applied to its proper use. Hence now it is possible for ships to be commissioned in the morning, and leave for their rendezvous the same evening. But on the other hand, it must be remembered that the date of mobilisation is known beforehand, and necessary preparations made to prevent delay and confusion. It is no criterion of what would happen should an emergency come unexpectedly, and our fleet require augmenting at some other period of the year. To test its real preparation for war, a mobilisation should be ordered on some winter's morning without previous warning, and it would then be seen to what extent our naval forces assimilated to the organisation which enables a Continental army to be assembled at any required point within a few days. In time we may attain such perfection with our fleet, but we are far from it at present. Every year, however, exhibits improvement in the arrangements for simultaneously despatching a large naval reinforcement, and every hour to-day ships and torpedo boats are leaving the port for the place of assembly. It has been stated that the manœuvres this year are to be of a novel character, but as a matter of fact it is impossible to alter materially the general principles of naval strategy. It all hinges on the effort to acquire or retain the command of the sea. Without this, only desultory operations can be carried out. Raids may be effected and commerce harassed, but no great achievement is possible until one side has obtained a decided supremacy. It was hoped last year an effort would have been made by a dexterous use of torpedo boats to counteract a decided superiority in big ships, but the inferior position was at once accepted by the weaker force, and, acting on the defensive, led to its speedy humiliation. It is probable that this year a similar problem will be set to the contending forces. A superior fleet may be so distributed at the outbreak of war, that energetic action may prevent that concentration which would lead to a command of the sea. No portions of any fleet can be equal to what might, under certain conditions, be brought against any one of them; and to carry out an operation with the aim of reducing a superiority by this means demands strategical talent of high order. Torpedo boats, skilfully directed and handled, with dash, may be of great assistance in these tactics, but they must not be shut up in a single harbour and await the enemy, who would naturally time his movements and select his ground for meeting them to the best advantage. The action of torpedo boats is most effective when they are met in unexpected places, and at periods when all seems safe from such an attack. The freer hand they are given the better, provided a master mind has a general direction of their distribution and radius of action. There will be the usual week's exercise, and then assembly at certain ports previous to the declaration of war. A special feature this year is the large number of cruisers attached to the squadrons. This will enable most valuable information to be acquired in scouting and keeping touch of an enemy. At present we are quite in ignorance of how this important function is best performed.

H.M.S. ENDYMION.

THE Endymion, built and engined by Earle's Shipbuilding and Engineering Co., Hull, is a first-class protected cruiser 360ft. long, by 60ft. beam, by 23ft. 9in. draft, and she has a displacement of 7350 tons. She is fitted with two sets of triple-compound inverted engines placed abreast of one another in separate engine rooms, divided by a watertight centre line bulkhead. One of these, by the courtesy of the builders, we are enabled to publish as a supplement this week. Steel has been used extensively in the construction of these engines, the main framing, back and front columns, cylinder and valve-chest covers, and piston rod crossheads being cast, and the piston and connecting rods, working barrels of the horse-power cylinders, shafting, bracing rods, valve motion, &c., of wrought steel. The cast steel front columns are I section, and these, as well as the back columns, are well braced, both athwartships and fore and aft, to reduce vibration. The cylinders are 40in., 59in., and 88in. diameter, by 4ft. 3in. stroke, and in accordance with recent practice in her Majesty's service are separate castings standing on independent supports, and connected by copper steam and exhaust pipes, and steel stay rods. The surface condensers are cylindrical of cast brass, placed in the wings. The air pumps are bolted to the engine framing and foundation, and are worked by levers from the low-pressure piston crossheads. The valves have been set for a moderately early cut-off so as to indicate 10,000-horse power, and be economical in coal consumption at cruising speeds. The four boilers are double ended, 16ft. mean diameter, and 18ft. long, each having eight Purves' patent furnaces, 3ft. 6in. internal diameter. The total grate area in these is 800 square feet, and the total heating surface, 23,620 square feet. The working pressure is 155lb. per square inch. In addition to the four main boilers there is an auxiliary boiler 12ft. 6in. diameter, and 9ft. 8in. long. The accompanying diagrams were taken on the official eight hours trial trip from Portsmouth. The results of the steam trial of the ship have been most satisfactory, as will be seen from the following report of an eight hours' steam trial in the English Channel, on May 5th, 1893:—

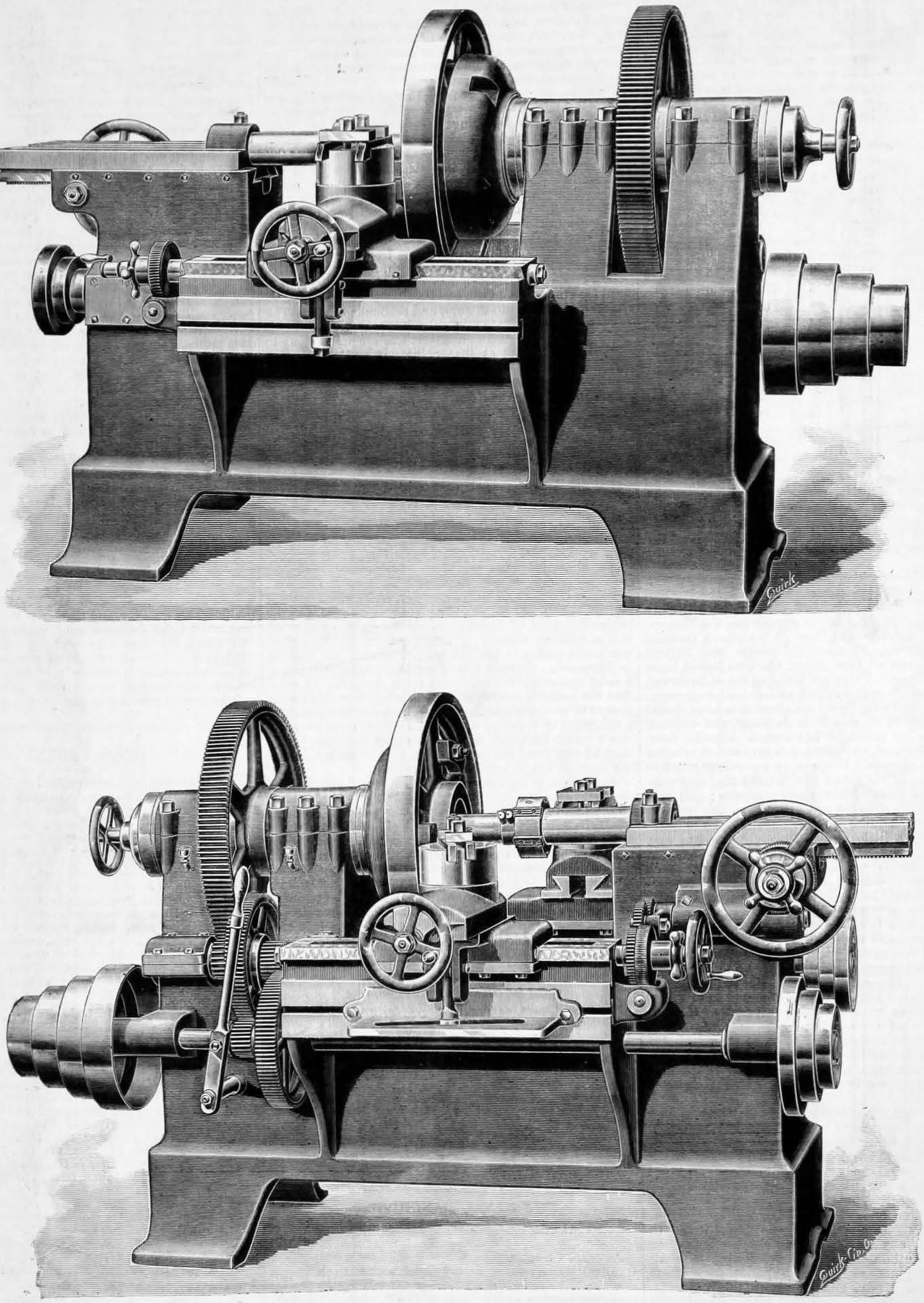
		Starboard.	Port.
Steam in boilers			152lb.
Vacuum		27·0in.	27·1in.
Revolutions per minute		99·6in.	99·3in.
Mean pressure	High	45·81in.	45·32in.
	Inter.	24·70in.	28·57in.
	Low	13·15in.	12·40in.
Indicated H.P.	High	1477	1457
	Inter.	1732	1999
	Low	2052	1929
Total I.H.P.		5261	5385
Coll. I.H.P.		10,646	
Mean air pressure		0·17	
Speed of vessel (by patent log)		20·96 knots	
Coal consumption per I.H.P. per hour		1·6 lb.	

THE BIRRIZ VIADUCT, COSTA RICA RAILWAY.

ON page 41 we give the first of some illustrations of the viaduct over the river Birriz on the Costa Rica Railway. The engraving shows the girders placed close together for launching out over the piers, the highest of which is 131ft. from masonry pedestal top to rails. The water of the river is 200ft. below rail level. The process of launching the girders was an interesting one, and the viaduct presents several features of novelty. Further illustrations will be given in another impression.

SPECIAL MOTOR GEARED LATHE AND BORING MACHINE

THE OHIO MACHINE WORKS COMPANY, ENGINEERS



SPECIAL MOTOR GEAR LATHE.

WE illustrate on this page a new machine tool specially devised to secure rigidity and accuracy in boring and turning disc or wheel forms, pistons, pulleys, and the like, with the heaviest admissible cuts. It will perform three operations at one time, with some classes of work. It is provided with two distinct saddles carrying very rigid tool boxes intended for straight or taper work with heavy tools, large sections of tool steel being used so that the cutting edges, being backed by a large quantity of metal, retain their sharpness for a great length of time. It is a 26in. swing lathe, with the coned pulley exterior to the lathe spindle, which is supported by very large and rigid bearings. The arrangement for obtaining tapers permits of forms and shapes being readily made from a forming plate of almost any design. Boring bars take a bearing in the main spindle, and where very long may be put in position either from the back end of the boring slide, or through the spindle, which has a hole through it of $3\frac{3}{4}$in. diameter. The lathe was designed by Mr. W. Lodge, of the Ohio Machine Tool Works, and is being introduced into this country by Mr. Alfred Herbert, of Coventry.

HEAVY GOODS TRANSPORT TO THE COAST.

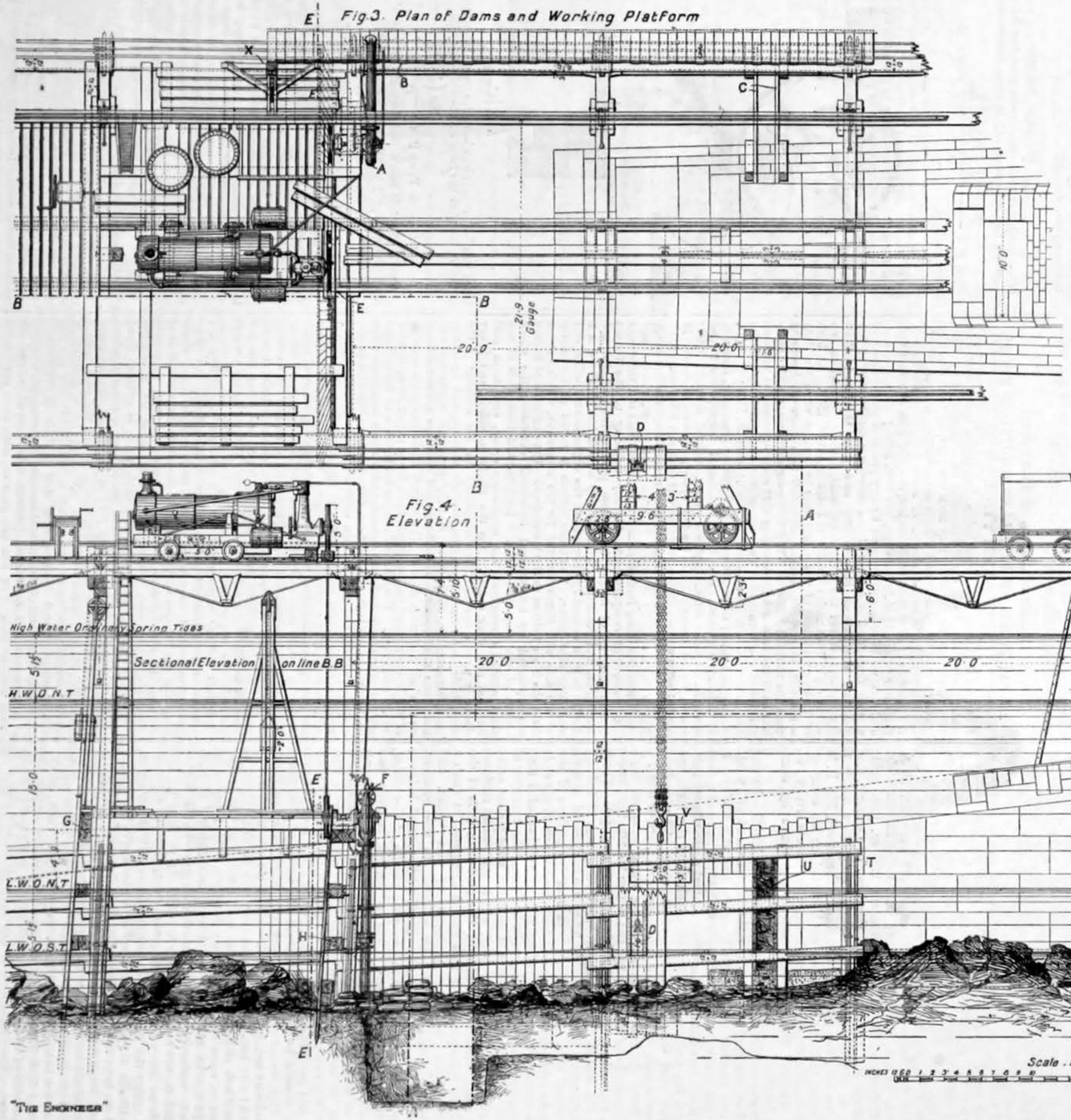
THE manufacturers of the Midland Counties continue to hammer away at the transport-to-the-coast difficulty, and their perseverance merits success. A new development is announced in connection with the water-carriage undertaking from Birmingham to Cardiff. The Severn having been deepened between Gloucester and Worcester, some of the traders are in favour of not waiting for the completion of the second portion of the scheme, namely, the improvement of the Worcester and Birmingham Canal between Birmingham and Worcester. A combination of business men has just been formed under the title of the Water Transport Company, with the object of conveying heavy goods by water from the heart of England to the Channel ports for shipment abroad, by utilising such facilities as at present exist, without waiting for the completion of the undertaking, which, doubtless, will follow later on. Designs have been prepared by Mr. Josiah McGregor, M.I.C.E., M.I.N.A., Queen Victoria-street, London, of special barges, to enable traffic to be carried from the Black Country to the sea on one bottom. These towing barges will have a capacity of thirty to forty tons each, and will be towed by specially-designed steamers, having a draught of about 9ft., and measuring 135ft. in length, with a carrying capacity of about 400 tons. The system will be similar to that used by the British East India Company on rivers and tidal waters, to which company Mr. McGregor was for many years consulting engineer. The importers at Cardiff and Bristol, and Midland manufacturers interested in outward movements to the coast, appear to be at one as to the feasibility of the undertaking. There is at present a heavy traffic from the Bristol Channel ports inland in grain, timber, petroleum, and general goods, and promises have been made of considerable outward traffic from the Midlands to the coast in machinery, boilers, heavy ironfoundry, iron and steel, minerals, and hardware.

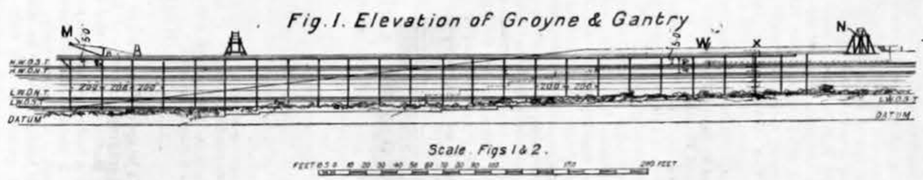
THE HOMEWARD CAPE OF GOOD HOPE AND NATAL MAILS.—The Union Steamship Company's twin-screw Royal Mail steamer Scot arrived at Southampton at 1.18 a.m. on 6th July with the homeward Cape of Good Hope and Natal mails. The Scot's net steaming time from Cape Town was 14 days and $\frac{3}{4}$ hour, which is 11 hours less than the same vessel's own fastest performance over the same distance. The average speed of the Scot was 17·7 knots per hour.

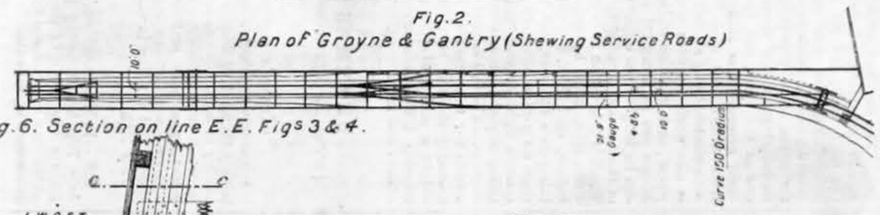
FORESHORE PROTECTION WORKS, HASTINGS

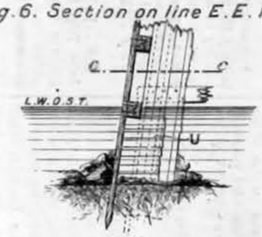
MESSRS. COODE, SON, AND MATTHEWS, MM. INST. C.E., ENGINEERS

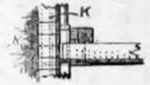
(*For description see page* 36)











THE RICHMOND LOCK AND WEIR.

Since we last published an account of the new lock and weir now building at Richmond, considerable progress has been made at these works, and the utmost advantage appears to have been taken of the unusual spell of dry weather. During the last few weeks the water has been phenomenally low in the river, falling to 10ft. 9in. and even 11ft. below Trinity high-water mark, which is a foot below the ordinary low-water level.

Last week numerous launches and pleasure craft went aground near the Richmond Town Bridge and had to wait till the tide rose. A general remark was, "I do wish they would finish that lock." These works, as most of our readers are aware, are being constructed in seven sections, five of which are entirely completed or in progress. The lock, which comprises three of the brick sections, is being built in dams, the tops of which are above the level of the highest spring tides, whilst the dams used for the weir and boat slide are only half-tidal ones, and consequently require pumping out previous to each day's work.

At the present time three of the four piers of the bridge, which also form the three openings of the weir, are finished, and the fourth is already 8ft. above the cill level of the removable sluices which will control the depth of water above the work. The cement floors between the piers, and in which the granite sillstones are laid, is complete for two of the openings. One of the three sluice-gates designed by Mr. F. G. M. Stoney, C.E., is in working order (it is shown raised in our view), and a second for the central opening is now in course of erection by Messrs. Ransomes and Rapier, of Ipswich, who are also the contractors for the superstructure of the bridge. The foundations and masonry of the lock, boat-slide, and piers are being carried out by the Thames Conservancy, and the quality of the work is very high class, the brickwork, granite gavins and cutwaters being much admired. The lock, which is 72ft. 7in. longer than that at Teddington, may be said to be completed for nearly two-thirds of its length; our view shows this portion, and the timbers that strutted the dam are now being removed. The dam for the last section is well forward of the abutments, the one on the Surrey side is complete within 4ft. of the top, whilst that on the Middlesex side is nearly up to springing. The foundations of the Lock House which will adjoin the abutments on both sides of the river are also in. The boat slide is also well forward, all the masonry and brickwork being finished. The sloping floors—1 in 8—of concrete are now being put in. On these the three parallel lines of rollers will be fixed. These rollers are of wrought iron pipe, 3in. diameter and 3ft. long, and revolve on bearings, 5ft. 3in. from centre to centre, fixed to a timber framework. At the highest part of each roller-path will be placed an iron cradle 11ft. long, carrying rollers at each end, and moveable at the centre on a rocking spindle; this cradle is for the purpose of transferring the boats from the up gradient to the down, and *vice versâ*. In a very short time, that is to say, as soon as the pier now building is sufficiently high, the girders of the central arch can be fixed, but until this is done, and the dam and staging is cleared away, it will not be possible to close the third opening with a dam, and lay the concrete floor to set the granite sills. Whilst this is in progress, it will be possible to erect the third and last sluice and complete the bridge. On the 5th inst. a very interesting visit was made to these works by about eighty-five members of the Society of Engineers; amongst those present were Mr. W. A. McIntosh Vallon, J.P. (President), Mr. Perry Ramsey, Mr. A. T. Walmisley, Mr. Joseph William Wilson, jun. (Past Presidents), Mr. G. M. Lawford (Member of Council), and Mr. G. A. Pryce Cuxson (Secretary). They were received and shown over the works by the resident engineer, Mr. P. le Neve Foster, C.E., to whom we are indebted for his courtesy and information supplied. Our photographs were taken by Mr. C. W. Harris. We may supplement the above by some further details.

The works consist of a foot-bridge—348ft. in length—having five arches, crossing the river at right angles about 400 yards below the London and South-Western Railway bridge. A lock on the Surrey, and a boat slide with three lines of rollers on the Middlesex shore. The three central arches have 66ft. span, and the end arches—one of which over the lock and the other over the boat rollers—50ft. each. The girders, which are arranged to carry a double gangway, are of steel.

The three central arches are being fitted with Stoney's sluices, capable of holding up the water to 5ft. 9in. below Trinity high-water (about half tide ordinary springs). These sluices, the largest ever constructed, are 68ft. long, 12ft. deep, and weigh about 32 tons each. They are suspended at each end by steel wire ropes, which pass over the pulleys of the lifting gear; counter-balance weights are attached to the ends of these ropes. These weights are four in number, of 8 tons each, suspended in 3ft. square wells built into the masonry of the piers. The wells, which are made of steel plates, serve also to support the vertical guides, which are planed surfaces of cast iron, between which, and the cast iron ends of the sluices, are interposed the free rollers arranged in such a manner as to take the pressure of the water, and thus can be easily moved. In addition to the counter-balance weights, they are also fitted with special balance weights to compensate for the varying weight of the sluice, when in or out of water. Thus a perfect balance can at all times be maintained, and consequently the sluices can readily be moved by hand power. When the sluices are lifted, they can, by an ingenious arrangement, be turned over flat, between the two gangways, and are hidden from view by the girders and parapet of the bridge, so as to allow a clear headway for vessels passing underneath the bridge of 21ft. above Trinity high-water mark, or about 4in. more than at Richmond railway bridge. During floods the sluices need not be lowered at all; but at other times they will be shut down at about half ebb and lifted again at half flood, and the arches will then be open for navigation, the lock only being used when the sluices are down. The counter-balancing of each sluice is so perfectly adjusted that the buoyancy of a timber float fixed on the up-stream side is sufficient to float it, and cause it to lift with the rising tide; this will also regulate automatically the flow of the stream underneath at low water, and maintain a nearly fixed level of water above the bridge.

The lock is to be 250ft. long—72ft. 7in. longer than that of Teddington—and the gates will have a clear opening of 26ft. —13in. wider—but in order to accommodate a tug and full complement of barges, it is widened out on the shore side to 37ft. for about two-thirds of its length. The sill level of the entrance is 16ft. below Trinity high-water mark, which will allow a depth of water of about 6ft. at the ordinary summer low-water level. The rollers of the boat slide will be laid on a concrete floor, with an incline of 1 in 8. The abutments and piers of the bridge, as well as the walls of the lock, are built of Portland cement concrete, faced with Staffordshire blue bricks and Cornish granite. The sluices are made of steel, with the exception of the end bearings and trunnions upon which they turn from the vertical to the horizontal position when raised out of sight. The estimated cost of the works is £61,000.

The contractors for the sluices and superstructure of the bridge are Messrs. Ransomes and Rapier, engineers of London and Ipswich. The concrete foundation of the first pier was put in on March 25th, 1892, and it is anticipated that the work will be completed by the end of the present year.

SEAMLESS STEEL BOATS.

The problem of building a boat that will be cheap in first cost, free from the effects of heat and wet, strong and light, and which will cost the least for maintenance, has found one solution, as have many other practical problems in engine and shipwork, by the employment of mild steel and the hydraulic press. Boats are now being made out of stamped steel plate. These steel boats, as made by the Seamless Steel Boat Company, are formed in two halves; each half is a thin plate of steel pressed to shape; they are then riveted to a bulb-bar, which forms the stem, keel, and stern-post. The usual equipment is then fitted, and buoyancy chambers either of galvanised iron, wood, or copper, as desired. They are also supplied completely fitted, to pass the Board of Trade requirements. They are made in all the usual sizes, either as cutters or lifeboats, and from 20ft. in length to 28ft. The weights vary from 14 cwt. to 19 cwt., and the prices from £35 to £53. This is for the Board of Trade scale, which entails an extra charge of between £7 and £10. From the seaman's point of view, these steel boats are in many ways superior to wooden boats, as owing to the smoother surface the skin friction is much less than in wood boats; they therefore sail faster and pull easier. Like all improvements in shipping, a good deal of old-time prejudice has to be overcome; but the disadvantages to the shipowner and seaman are so obvious, that in all cases where they have been supplied the reports are, we understand, satisfactory. Thus, in one case of an Australian steamer carrying six boats, two seamless steel boats were supplied. On arrival at Sydney, the captain put all the boats in the water. The wooden ones at once filled, and the only boats that were available for instant service were those of steel, from which it would appear that the captain had taken little care of his wood boats. Among others who have adopted them may be mentioned the Tyne Steamship Company, Crow, Rudolph and Co., W. Tapscott and Co., the Great Eastern Railway Company, the Amazon River Steamship Company, the North German Lloyds, Herr F. Schichan, &c. They are also supplied to the new steamers of the turret type, and are specified for on the large steamers now building for the Wilson Line. Messrs. Clarke, Chapman and Co., of Gateshead, are the agents for the Seamless Steel Boat Company.

DEPARTURE OF H.M.S. RESOLUTION FROM THE TYNE.

The new first-class line-of-battleship Resolution being now complete, leaves the Tyne for Portsmouth on Thursday, July 13th. This vessel was launched on May 28th last year, so that the time taken to complete her is only a little over thirteen months, which, considering the immense amount of work done since the launch, the drawbacks of various trade strikes, coupled with the fact that the sister vessel, H.M.S. Revenge, has been fitting out simultaneously, is, we believe, unsurpassed by any previous performance of private firms, and is a proof of the enormous capabilities of her builders, the Palmer Shipbuilding and Iron Company. The Resolution is one of the largest battleships afloat, comprising one of the eight built under the Naval Defence Act of 1889. An idea of the enormous size of the vessel may be gained when we state she is 40ft. longer, 5ft. broader, and 3680 tons more displacement than the ill-fated Victoria. The following particulars will doubtless be of interest, notwithstanding that same appeared at the time the vessel was launched. The dimentions and particulars of the Resolution are as follows:—Length, 380ft.; breadth, 75ft.; draught, mean, 27ft. 6in.; displacement, 14,150 tons; freeboard, forward, 19ft. 6in.; freeboard, aft, 18ft.; indicated horse-power forced draught, 13,000; indicated horse-power, natural draught, 9000; speed, forced draught, 17½ knots; speed, natural draught, 16 knots; coals carried at the designed load draught, 900 tons.

The construction of the ship has been made exceptionally strong. She is built entirely of steel, the stem, stern-post, rudder, and shaft brackets being formed of cast steel. The hull is divided into 220 watertight compartments, thereby reducing to the fullest extent the risk of danger to bottom plating from rocks and torpedoes, and rendering it practically unsinkable. There is a double bottom extending throughout the engine-room, boiler, and main magazine spaces. The inner bottom is raised at the centre of the ship, and forms the flat for the magazines, which extend from the inner bottom to the lower deck. The engines and boilers are separated by longitudinal bulkheads extending the whole length of the magazine space. Longitudinal bulkheads at the sides extend throughout the machinery space, and form coal bunkers and wing spaces. On the platform, *débris*, and lower decks is placed the auxiliary machinery for the working of the ship, including steering engines, electric engines, and hydraulic pumping engines, as well as a fully equipped workshop and numerous store-rooms. The officers and crew are accommodated on the belt and main decks. The officers' accommodation consists of handsomely fitted cabins situated aft, the superior being located on the main deck. The admiral's accommodation is at the extreme aft end of the main deck, and communicates with a handsome stern walk. The upper deck extends from stem to stern without a break, and above it are the shelter decks on which are the conning towers, two in number; these are surmounted by flying bridges connected with each other by a fore-and-aft bridge. The boats, of which there are twenty-one, including two 56ft. torpedo boats, are stowed amidships. A strong steel derrick is fitted to the mainmast for lifting them, and the foremast is also fitted with a derrick for working those of a lighter description. The masts, which are built of steel, are fitted with military and signalling tops, and there are two funnels on the same athwartship's lines. The barbettes project through the upper deck a few feet, and inside are powerful hydraulic turning engines and all the gear for controlling the ponderous turntables and working the guns themselves. A sloping protective deck of steel, 2½in. in thickness, extends under water from the bow for about 76ft. and from the stern for a distance of about 72ft., and between these two points there is a protective deck 3in. in thickness worked horizontally about 3ft. above the water line; from the level of this deck there is a steel faced armoured belt 18in. in thickness and 8ft. 6in. wide, extending for a distance of 250ft. of the midship part of the vessel, the thickness tapering at the ends to 14in. Immediately above this belt there is also a light belt of armour 4in. thick extending for a distance of 144ft., and terminating at the screen bulkheads at each end 3in. thick, which extend from side of ship to sides of barbettes; behind this thin belt of armour coal bunkers are arranged, whereby a large amount of additional protection is secured above the thick armour belt. The four 6in. guns on main deck are placed in casemates protected by armour plates 6in. thick. With a view of preventing water from finding its way below the protective deck, means are provided for closing the several openings by watertight covers, while in the case of those which must necessarily remain open, cofferdams have been fitted with the same object.

The main armament consists of four 67-ton breech-loading guns of 13½ calibre, with a training of 120 deg. on each side of the centre line. The auxiliary armament consists of the following, viz.:—Ten 6in. 100-pounder quick-firing guns—four in armoured casemates on the main deck, and six on the upper deck. Sixteen 6-pounder quick-firing guns—four on upper deck, and twelve on main deck. Nine 3-pounder quick-firing guns—three in military tops, and six for boats. Two 9-pounder R.M.L. field guns. Eight 45in. five-barrelled guns, and seven torpedo tubes—four on the broadside, one at the stern, and two submerged. The total weight of the main armament is 1410 tons, and the weight of the auxiliary armament is 500 tons. The Resolution is lighted throughout with electricity by an installation of about 700 electric lamps, and is also equipped with four electric search-lights of 25,000 candle-power, each of which will be worked by a dynamo under protection. Means are so arranged that the ships when in action for fighting can be fought from either of the two conning towers. The thickness of the forward conning tower is 14in. and the after one 3in. The vessel is fitted with twin-screw engines, each set having cylinders 40in., 59in., 88in. by 51in. stroke. There are eight single-ended boilers, each 15ft. 6in. diameter by 9ft. 6in. long, having in all thirty-two furnaces, 155 lb. working pressure. There are no less than sixty-nine auxiliary engines—*i.e.*, including steering engine, electric light engines and dynamos, air-compressing engines, distilling engines, evaporator engines, boat-hoisting engines, workshop engines. The 900 tons of coal carried at the designed load line will enable her to steam 5000 knots at a 10-knot speed, but in a case of necessity she will be able to stow about 400 tons more, and so obtain a radius of action of over 7000 knots. When used as a flagship the Resolution will have a complement of over 700 officers and men.

LETTERS TO THE EDITOR.

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

CARNOT'S FUNCTION OF THE TEMPERATURE.

Sir,—What Carnot, Joule, Poisson, Thomson, or anybody else merely thought, or merely think about the question at issue, is not worthy of serious consideration. Whether Carnot's function is or is not an utter absurdity, can be determined beyond possibility of doubt by strictly mathematical methods. I have in this way demonstrated that the function is an utter absurdity. Can Mr. Mansel find any flaw in the demonstration?

July 10th. William Donaldson.

Sir,—In Mr. Donaldson's letter of June 18th in The Engineer of July 7th, the following paragraph occurs: "Does Mr. Mansel dispute the truth of the statement, that the quantity of heat which may be possessed by a body in a state of absolute molecular quiescence is unlimited." I should like to know how absolute molecular quiescence is possible in a warm body. If expansion and contraction of substances is brought about by molecular agitation, surely absolute molecular quiescence can only be possible with total absence of heat. J. R. Cowell.

Southampton, July 10th.

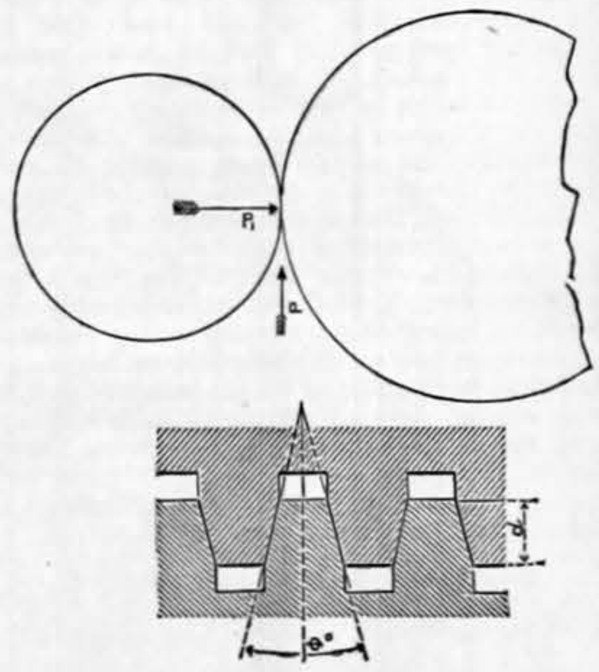
FRICTION WHEELS.

Sir,—Both Reuleaux and Unwin give the following formula for computing the force necessary to press friction wheels together.

$$P_1 = P \times \frac{\sin\left(\frac{\theta}{2}\right) + \cos\left(\frac{\theta}{2}\right)}{C},$$ where the letters have the following values.

P = force in pounds acting tangentially at peripheries of the wheels necessary to transmit the required power, viz., it is the turning moment divided by the wheel to be driven.
P_1 = force in pounds necessary to press the wheels together.
θ = angle of teeth in degrees as per accompanying sketch.
C = coefficient of friction.

Can any of your readers or Professor Unwin—should he chance



to see this letter—explain how this result is arrived at, as it appears to the writer that the formula should simply be

$$P_1 = P \times \frac{\sin\left(\frac{\theta}{2}\right)}{C} \; ?$$

Also if the first-mentioned formula is correct, should not the same formula apply to conical friction clutches? N.

July 4th.

UNEMPLOYED CIVIL ENGINEERS.

Sir, — Dockers, firemen, coal porters, and other classes of labourers, have frequently, by their champions, had their woes, during unemployment, loudly displayed in the public Press, but where is the champion of enforcedly idle civil engineers? To quote my own case, six months ago I completed the carrying out of large engineering works at a cost of £80,000, and I have been unable to obtain employment since that time, though I have credentials which should enable me to obtain employment anywhere. It is probable that some of your readers may be able to offer a suggestion as to where civil engineers can get employed. I have spent weeks interviewing leading engineers, but without success. I beg to enclose my card and my testimonials—copies—and to ask you to be good enough to insert this letter in your journal.

July 11th. Unemployed C. E.

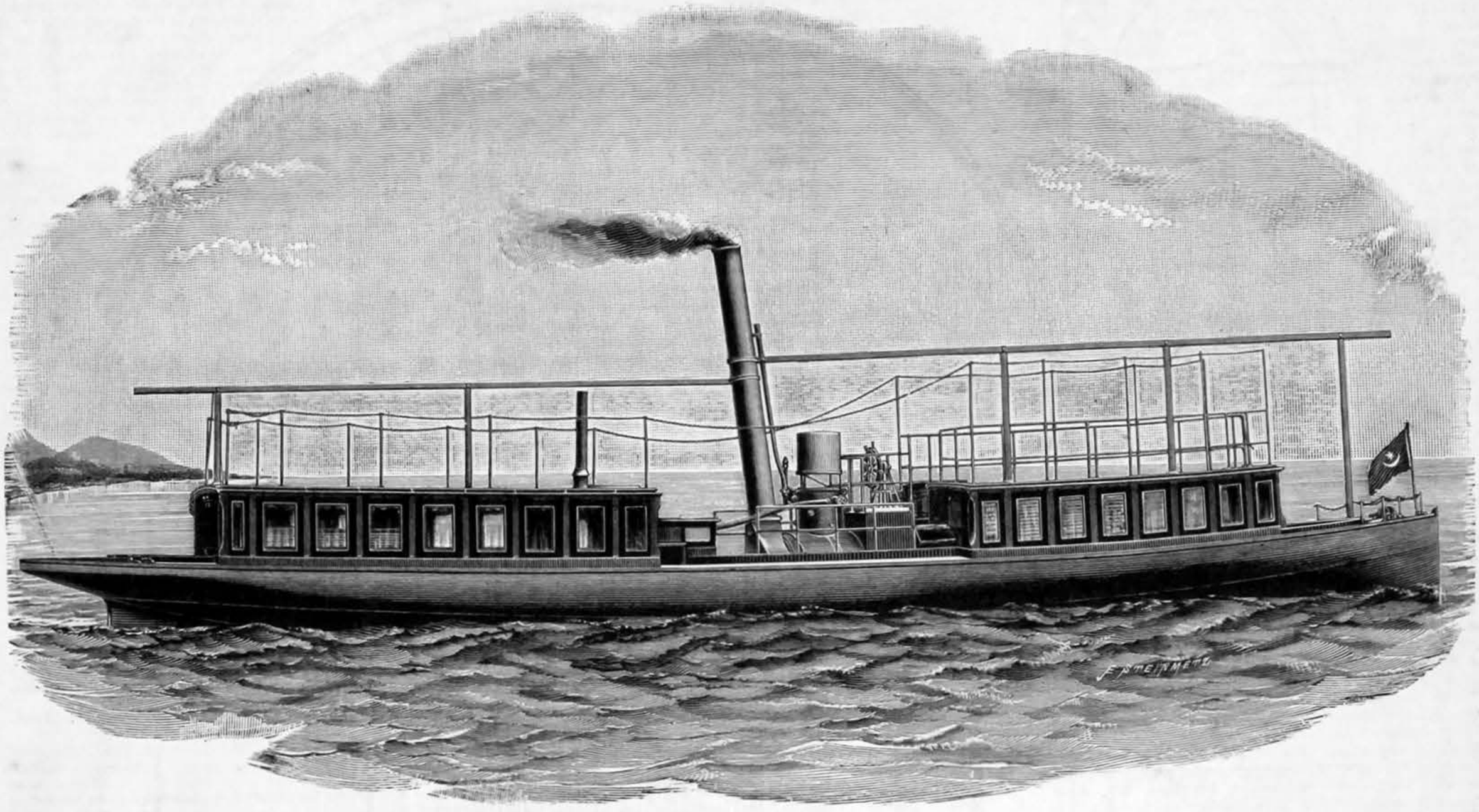
SCREWING MACHINES AT THE ROYAL SHOW.

Sir,—We note your remarks on page 18 of your issue of the 7th respecting our exhibit at the Royal Show at Chester last month, in which you state "there does not seem to be a correspondingly cheap machine for country smiths' shops." Your representative could not have noticed all the machines we exhibited, or he would have seen that we had a machine such as he suggests, viz., a hand machine for screwing bolts and tapping nuts ⅜in. to 1in., with seven pairs of dies and seven taps. John Cowley and Son.

Clarendon-street, Hyde, July 11th.

SHALLOW DRAUGHT STEAMER FOR EGYPT

MR. EDWARD HAYES, STONEY STRATFORD, BUILDER AND ENGINEER



SHALLOW DRAUGHT STEAMERS AND TUGS.

THE above engraving illustrates one of two light draught steamers built for the service of the Egyptian Government by Mr. Edward Hayes, of Stony Stratford. The vessels are 77ft. 6in. long over all, 11ft. 6in. beam, depth of hull 4ft. 8in., draught 2ft. 6in. The guaranteed speed was twelve miles, which was, we are informed, easily accomplished at their trial, and they are found to run between thirteen and fourteen miles in the hour. The officials of the Government expressed their great satisfaction at having vessels considerably over the guaranteed speed. They are twin screw vessels built of steel, with separate vertical engines having cylinders 8¼in. diameter by 9in. stroke, each engine and propeller working independently.

The boiler is of the ordinary marine type, made of best mild steel passed by Lloyd's. The saloons are of teak, with venetians and glazed windows to slide up and down, similar to the windows of a railway carriage. The forward saloon is handsomely decorated with polished teak and electro furniture, tapestry cushions and cushion backs, ceilings in Lincrusta and gold beading. It is divided into two parts, the after part being occupied by berths, reading-room and office, lavatory, &c. After saloon was also divided into two parts, having crew aft, the forward part being used for kitchen with second officers' cabin; these were also tastefully decorated. Communication is made to each compartment by electric bells.

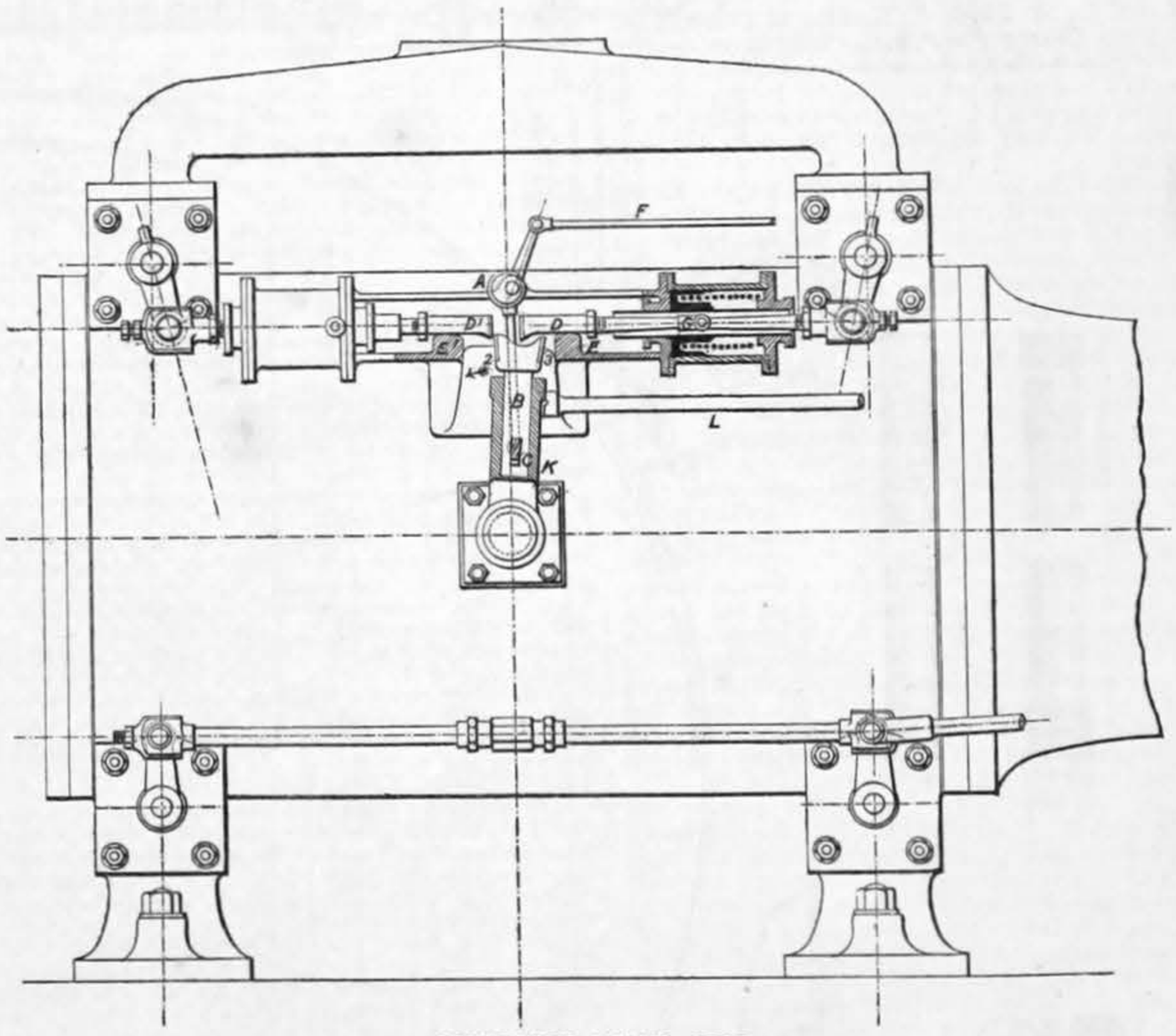
We have always understood that the builder's speciality was a small class of tug varying from 45ft. to 70ft. in length, such as he has built for the Metropolitan Board of Works and the London County Council for working on the Thames; the illustration, however, shows us that he does not altogether confine himself to tug work, and we are informed that he has been making several steel plated vessels, 50ft. long by 10ft. 6in. beam, by about 4ft. 3in. draught, for Africa, India, and South America. These vessels are fixed with compound surface condensing engines of sufficient power for towing, and are also used for carrying passengers occasionally.

LAUNCH OF THE TORPEDO GUNBOAT ANTELOPE.

ON Wednesday afternoon the new twin screw torpedo gunboat Antelope was successfully launched from No. 1 building slip at Her Majesty's Dockyard, Devonport, This vessel is one of the eighteen gunboats ordered to be built under the Naval Defence Act of 1889; and although laid down a few months after the passing of that Act, has only now been put into the water. This delay, however, is to be accounted for by the great difficulty the naval authorities experience in finding contractors willing to undertake the construction of the propelling machinery of the vessel under the conditions imposed. Although late, the Antelope is much nearer completion for sea than is usual with vessels in the launching condition, her propelling and auxiliary machinery being already in place in her. The vessel was designed by Mr. W. H. White, C.B., Director of Naval Construction, and the responsibility of fitting her with propelling machinery &c., was undertaken by Messrs. Yarrow and Co., of Poplar. The Antelope is of similar dimensions as the other gunboats of her class, being 230ft. long, 27ft. beam, and 810 tons displacement, with a mean load draught of 8ft. 9½in. The launching weight of her hull alone is 385 tons, and her coal bunker capacity 100 tons, leaving about 325 tons to cover the weight of her engines, machinery, armament, fittings, stores, &c. Her main engines are of 2500-horse power, and her armament will consist of two 4·7in. and four 3-pounder quick-firing guns; she is also to be fitted with one fixed bow and two revolving broadside torpedo tubes. The launching ceremony was performed by Miss Florence Crocker, daughter of the Chief Constructor at Devonport Dockyard, and there were present at the function Rear-Admiral Sir Algernon Lyons, naval commander-in-chief; Sir R. More Molyneux, superintendent of the dockyard; and Mr. G. Crocker, chief constructor. The Antelope is to cost £61,060, and is expected to be ready for trial in October next.

COCHRANE'S VALVE GEAR.

THE accompanying engraving illustrates a valve gear now being made by Mr. John Cochrane, engineer, Barrhead, near Glasgow. The arrangement may be briefly described as follows:—A reciprocating lever K is actuated from the excentric through the excentric rod L. The vibrating lever is bored out to receive a trunk B turned to fit. The trunk is raised or lowered by the governor rod F, by the intervention of excentric A, the said excentric A being coupled by rod to sliding cotter C. The top of the trunk, on which are the case-hardened pieces 2 and 3, engage alternately with engaging pieces formed at the end of each lifting leg D^1 and D. It will be seen that the duration of forcing out either of the said legs D^1 and D, and consequent period of cut-off, depends upon the vertical height which the trunk B may assume. The trunk B is shown at its normal position, so that the engagement for pushing out, always whereby shock is reduced to a minimum. Each leg is tilted up on the back stroke of the trunk in either direction, as the case may be. When this occurs either of the legs fall by gravitation on to the pads E^2 and E. Simplicity and fewness of pin joints are the special features of this gear, and an action is obtained which is all but noiseless.



COCHRANE'S VALVE GEAR

CAN THE VICTORIA BE RAISED?

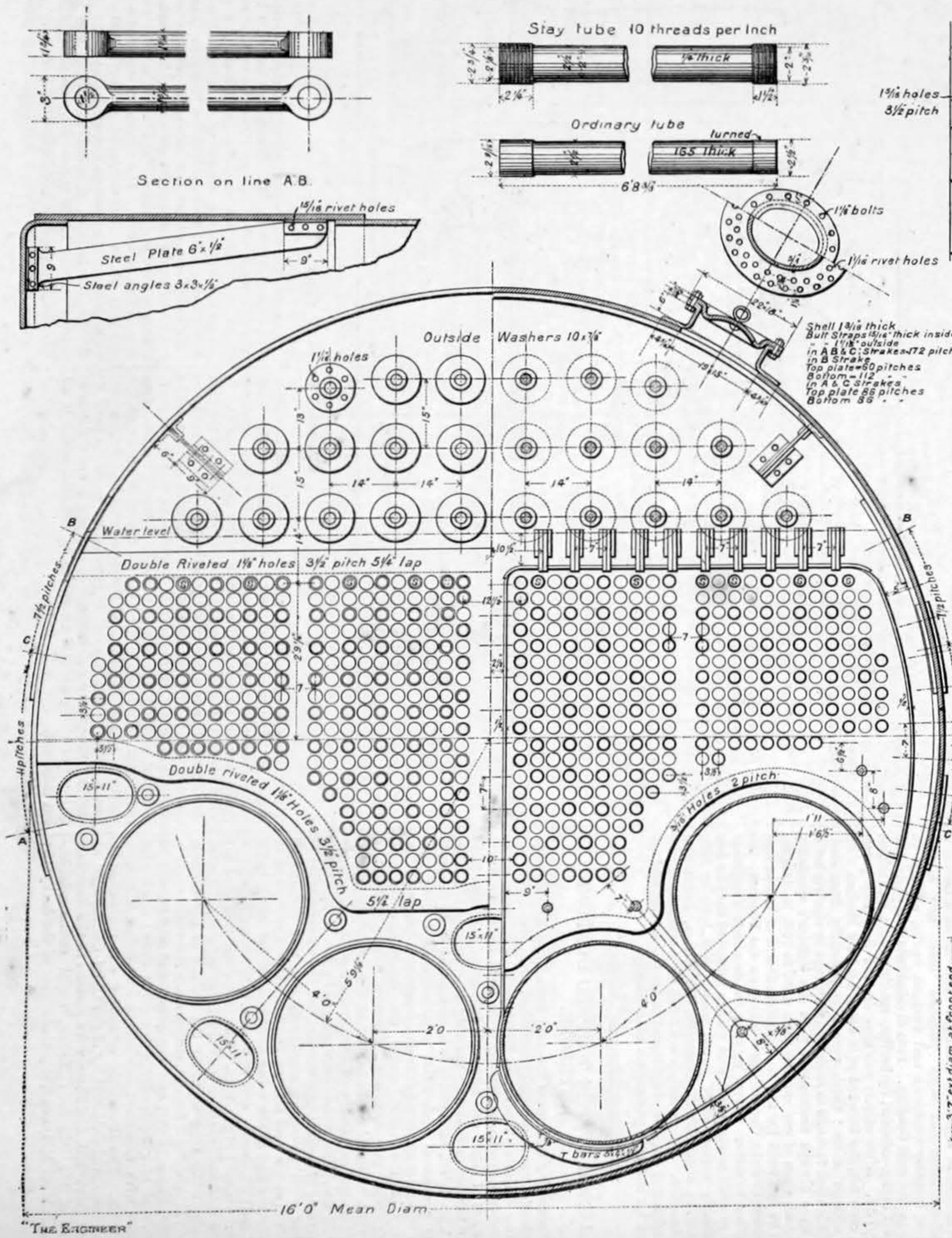
IT is generally concluded that the Victoria, having sunk in about seventy-four fathoms, that it is useless to entertain any proposal for raising her, the task involving an impossible feat. We would not like to say that it is impossible, but the question arises, is it worth while to make the attempt. Would the cost be disproportionate to the value of the vessel if raised—would the blowing up decks and the descent of the vessel have given her such a velocity on reaching the bottom as to cause her destruction? In spite of these doubts it might be worth while to look at her with a view to information, if this could be accomplished in water under a pressure approaching 200 lb. on the square inch.

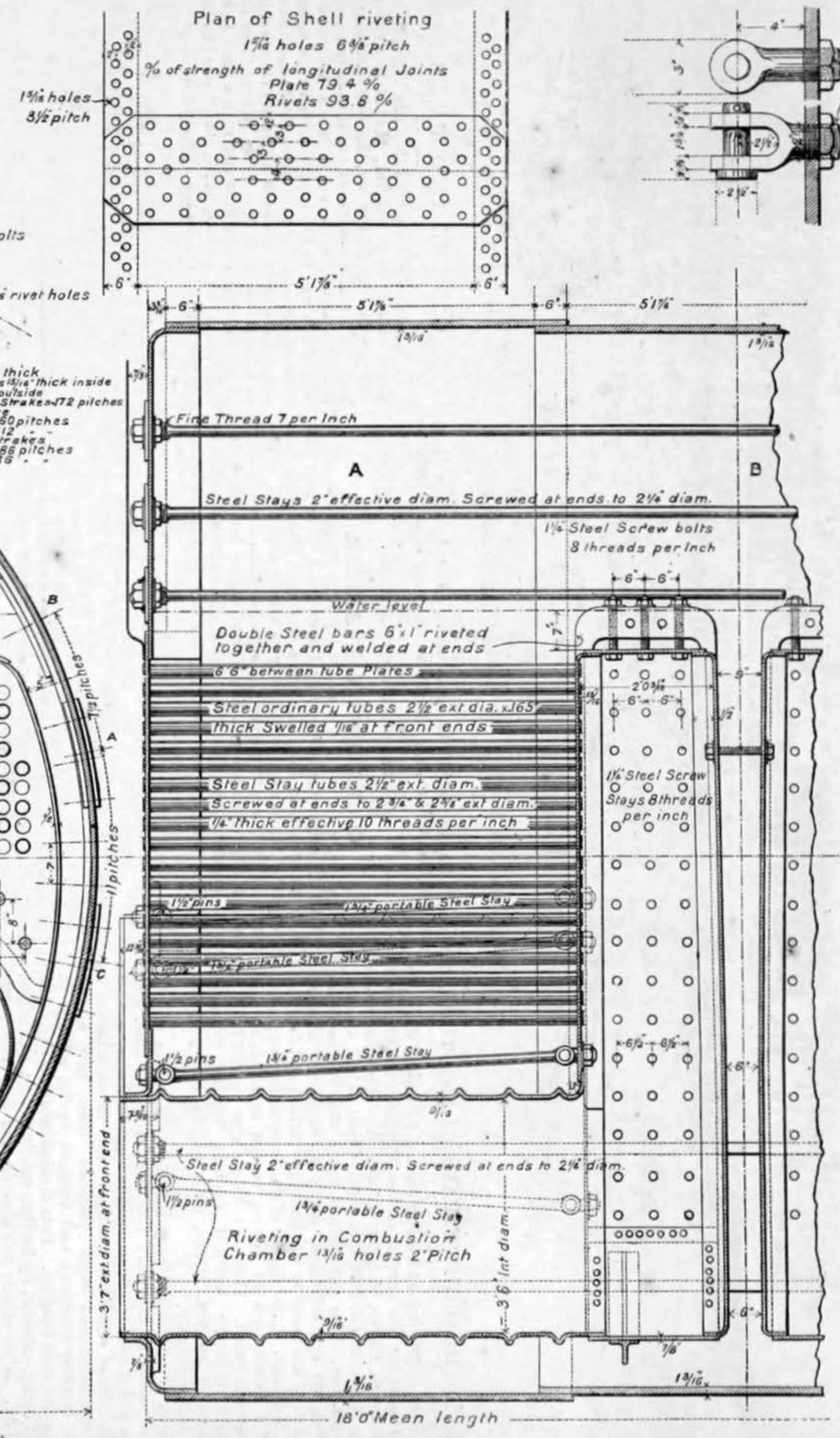
A paper was read before the Royal United Service Institution in January, 1879, by Mr. Druitt Halpin, who had recently raised the s.s. Edith. The paper was "On an Economical means of Raising Ironclads sunk in Deep Water," and illustrated apparatus for making a number of holes in the ship's sides below the armour plating, and the insertion therein of cross bars attached to the end of wire ropes pendent from an overhead floating dock of a form suitable for this work, and for the ordinary work of docking Her Majesty's ships anywhere for repairs and painting. The apparatus included a water tower of about 4ft. in diameter, open at the top, and fitted with water jacket at the bottom and air jacket at the top. A workman at the bottom, provided with light and with drilling apparatus, was to do the work under atmospheric pressure. Mr. Halpin's paper might be usefully perused.

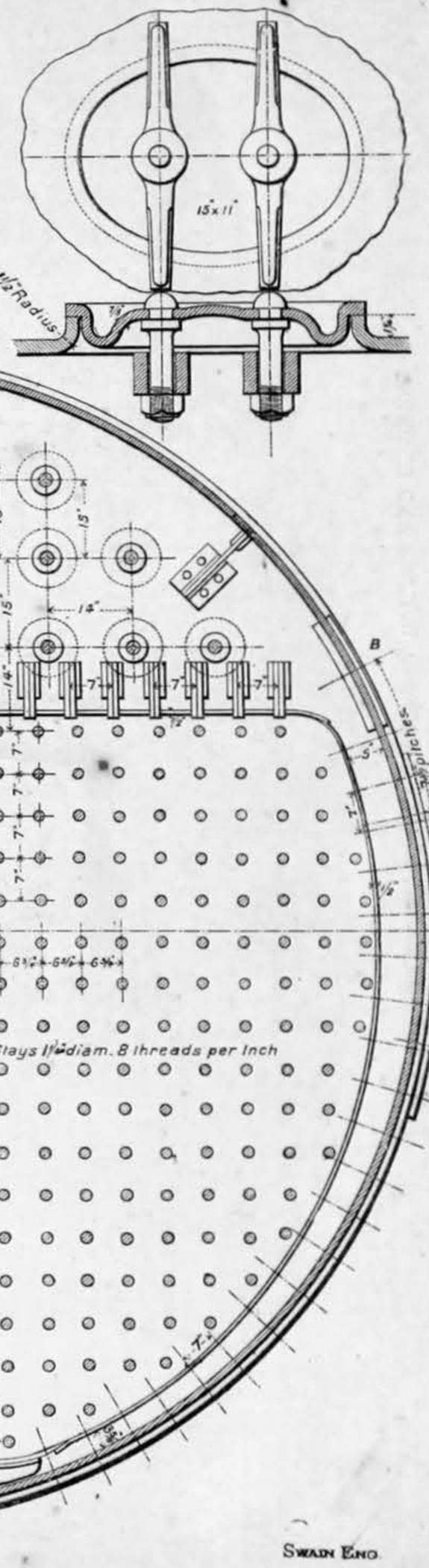
HER MAJESTY'S SHIP ENDYMION—BOILERS

EARLE'S SHIPBUILDING AND ENGINEERING COMPANY, HULL, ENGINEERS

(*For description see page 43*)



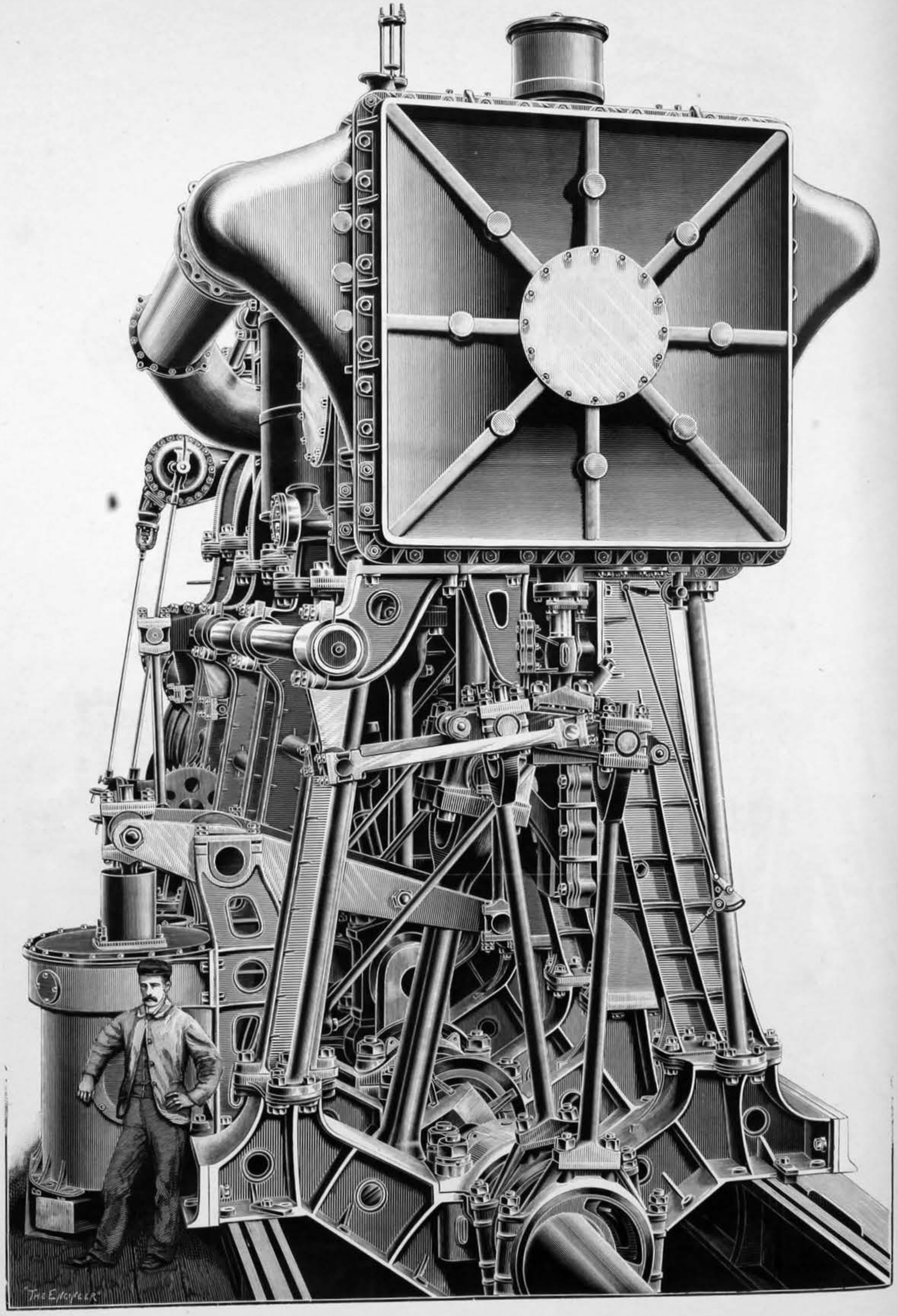


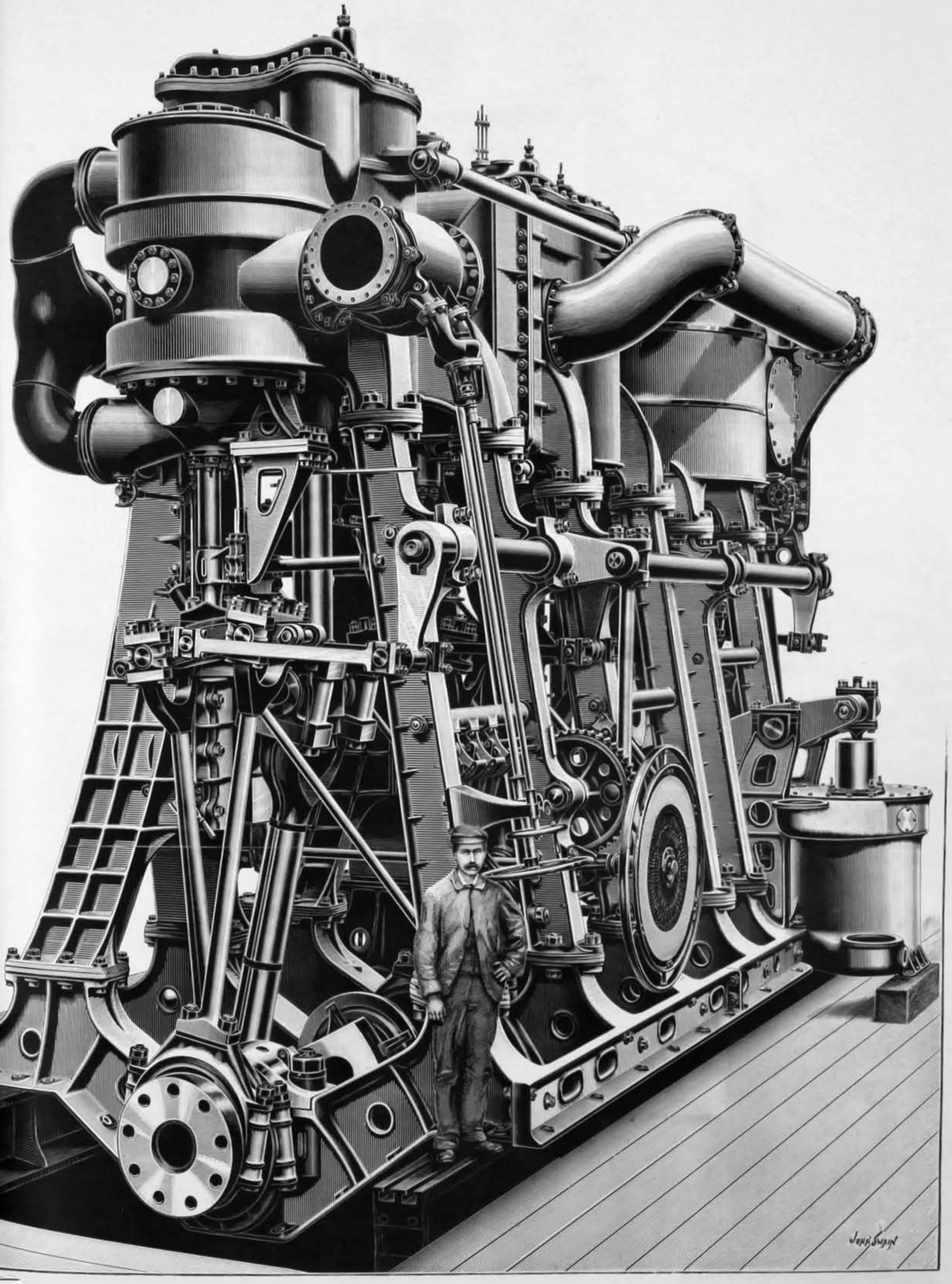


Swain Eng.

TRIPLE-EXPANSION ENGINES, H.M.S. ENDYMION

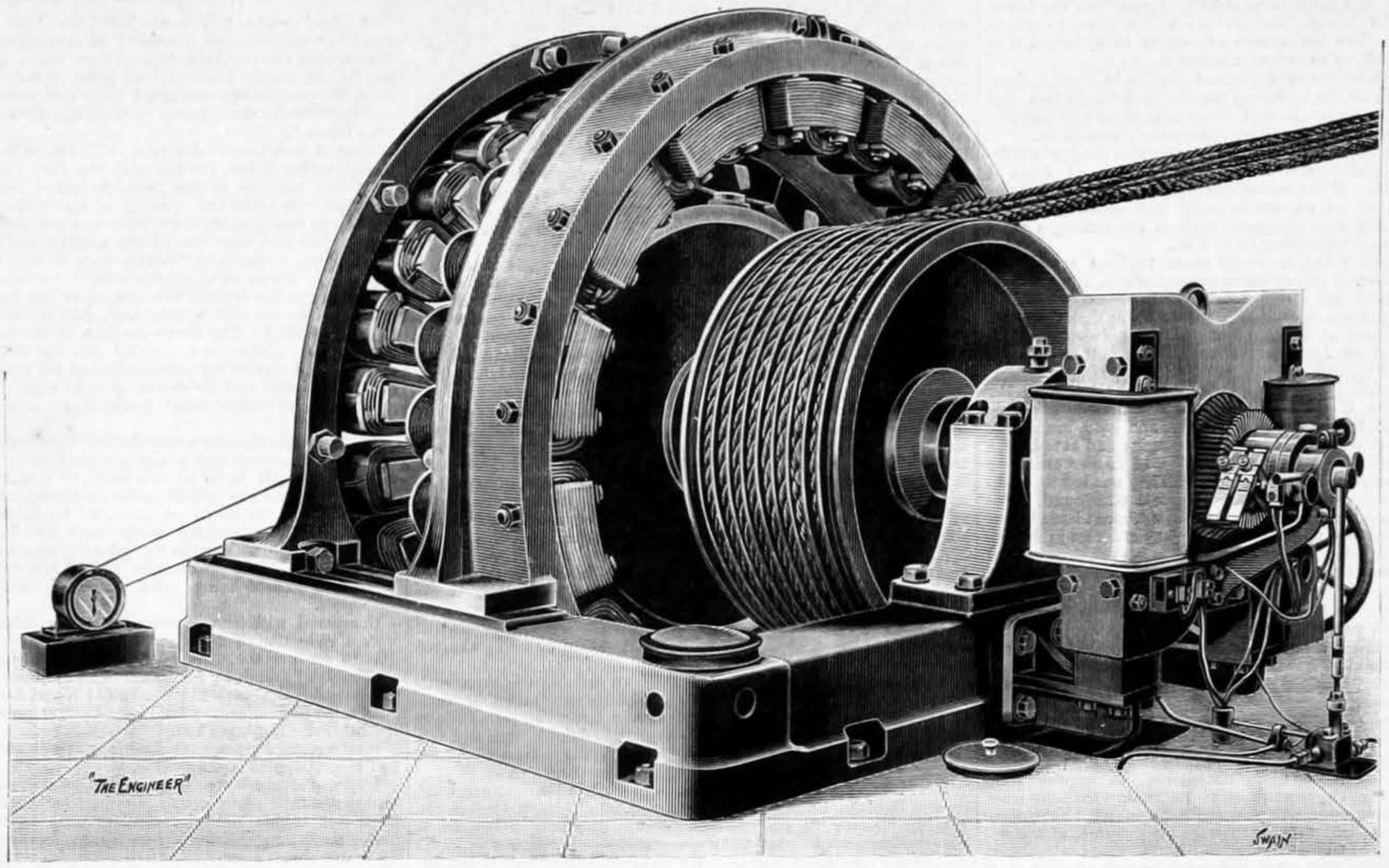
EARLE'S SHIPBUILDING AND ENGINEERING COMPANY, HULL, ENGINEERS





ELECTRIC LIGHTING OF BARCELONA—300-H.P. FERRANTI ALTERNATOR

MESSRS. S. Z. DE FERRANTI AND CO., LONDON, ENGINEERS



FERRANTI ALTERNATOR CURRENT DYNAMO.

THE above engraving illustrates a 300-horse power alternator erected in the Barcelona electric light station by Messrs. Ferranti and Co. It is similar to that supplied to the London Electric Supply Corporation, as described in THE ENGINEER of the 3rd February last, with the exception that the periodicity of the Barcelona machine is 66 instead of 83, as in the London Electric machine. This result is got by reducing the number of bobbins in the Barcelona machine to twenty-eight, whereas in the London Company's machine there are thirty-six bobbins. The speed of the machine is 280 revolutions per minute. The alternator is driven by a coupled compound condensing engine, horizontal type, manufactured by Messrs. Duncan, Stewart and Co., of Glasgow, and is the first of three similar machines which will eventually work in parallel with two 150-horse power machines (Ferranti) already at work there with the machine illustrated. The mechanical particulars are identical in both machines. The chief mechanical difference between these machines and those which Messrs. Ferranti and Co. have previously built are the different form of field magnets, which in these machines consist of stampings of sheet charcoal iron $\frac{1}{16}$in. thick instead of solid wrought iron cores, and the open nature of the design of the machine, by which it is very easily ventilated. The company using this machine is the Sociedad Espanola Electricidad de Barcelona, and the managing director and engineer is Senor Parellada. This type of machine will no doubt in future be much more used than the machine of higher frequency, as the low frequency is important in connection with the working of alternating current motors, and is equally as good for lighting. Messrs. Ferranti and Co. are interesting themselves in these motors, and we recently saw one there of the C. and L. Brown pattern which displayed all the advantages of a continuous current motor with far greater simplicity. The starting torque is not, however, as great, but such motors in combination with simple variable speed gearing, which may now be had, might be used for every purpose to which a motor could be put, including the working of tram cars.

COMPOUND LOCOMOTIVES IN THE UNITED STATES.

THE *Railroad Gazette* for June 23rd contains a report of the "Proceedings" of the Master Mechanics' Convention, held at Lakewood. The report of the Committee on "Compound Engines" is a long paper. The substance of it is contained in the following "Remarks upon Information Collected: Conclusion." The discussion which followed, it will be seen, supports the hesitating utterances of the Committee.

REMARKS UPON INFORMATION COLLECTED.

It will be seen that the information, collected from various sections of the country, tends to indicate, almost unanimously, a varying but large economy of fuel for the compound when compared with simple engines. Your committee feel obliged to state that they are not willing to accept all these results at their face value in contributing to a final solution of the question of fuel economy. Presumably, the tests were submitted as being more or less comparable, and yet in some cases they are obviously only remotely so, and not one word of explanation accompanied them. Your committee, therefore, respectfully submit the figures to the wisdom of the Association, with a few individual comments.

Referring to last year's report, in the final paragraph the prediction was ventured that with variable Western coals an average economy for compounds in freight service should approximate 17 per cent., this figure being the maximum obtainable, upon the average, with engines worked in the best manner, in perfect physical condition and in what may be called characteristic freight service of the country. It is interesting to examine the further figures here given for the same engines used for basis of last year's report, and which have had an additional year's service. The first fact to be drawn from the figures is that while the averages of nine simple engines probably give a very just and close approximation to the operating cost of that class of engines for the given conditions, a comparison of same with only one compound can hardly be called conclusive; and yet the results are valuable, taken together with the committee tests of last year, and tend to confirm the latter, particularly as an attempt was made to eliminate the effect of "individual running" by changing enginemen.

The only advantage, if this can be called an advantage, which the compound enjoyed was that it carried 20 lb. higher pressure than the simples. It is but fair, however, to repeat here, that the high-pressure was needed for the compound to put it upon an equality with the simples in hauling power, the former having been under-cylindered. In last year's tests the committee raised the pressure on the simple to 200 lb.—same as the compound—but failed to identify the resulting coal economy, and were obliged to reduce the pressure again on account of under-balance of the valves.

The increased coal economy obtained with a compound engine of the Vauclain system, under the given and average freight conditions in last year's tests—17 per cent.—is somewhat reduced in more prolonged service by a figure depending upon the amount of work expended upon the compound to keep its valves in fair condition, but that the average economy hardly falls below 12 per cent., allowing cost of repairs to still be kept within a practical figure. It will be noticed that your committee do not say, "within the average figure," as they are not prepared to say the practicable will be the average; the word is rather taken to mean an amount consistent with the ordinary regularity of performance of the engine, an important consideration.

The above is limited to apply to the Vauclain system of compounding, as the piston valves there used are, in the opinion of your committee, certain to require more careful watching than the common form of slide valve.

As to standing of the compound in respect to other operating expenses, some information may be extracted from the tables. It would appear that the amount of valve oil required for the Vauclain engine is considerably in excess of that of the simple—according to Table 13, about 20 per cent. more, the machine oil needed being about the same. The above seems a reasonable conclusion for this type of engine. Of course the valve oil question is not of very vital importance if the fuel economy stands at the figures referred to above, but the question of repairs may easily turn the scale in either direction in net results. In Table 13 the repairs per mile are given for five engines for the first 55,000 miles of their life, and including in each a general shop over-hauling. According to these figures, the compound stands just with the average. Members of the Association are at liberty to draw their own conclusions therefrom; your committee believe them not unfavourable to the compound, as far as they go; they partially dispose of the fear that a compound would prove an unserviceable machine from frequent untimely breakdowns. As the repairs above given include only the customary ones in the first period of an engine's life, such as turning tires, renewing packing, one or more new crankpins, driving box brasses and general lining-up and overhauling, they do not dispose of the question of wearing out of additional parts and surfaces of the compound nor, to offset this, the increased economy of compound in boiler repairs, as is claimed by many to exist.

CONCLUSION.

The possibility of fuel economy was first denied because, it was argued, we have only marine and stationary practice to turn to, and there the work done is fairly constant, and is consequently well adapted to compounding, in which the cylinder ratio is an all important factor. This reasoning is not sound, and the falsity of its conclusions has been conclusively shown in the past two years; for one example, see conclusions of this committee last year, where they presented tables showing an even wider range of economical performance for the compound than for the simple; of course, both types fall off seriously in economy under variable conditions, but the compound less so than the simple.

Another argument advanced against the compound is that new machines always give economical results while watched; this is emphatically true, and constitutes the most serious stumbling-block to the conscientious investigator. It is, however, not more applicable to compound engines than to any other machinery, and the economical results obtained from simples in long service should lead us to hope for the same of compounds, at least at this stage of the question, when it has been shown that they will run 50,000 miles and over without serious impairment of efficiency.

Turning again to fuel economy your committee believe the greater number of thinking and observing men in the profession to-day believe the compound will save coal, under certain conditions; some of these men deny that these conditions can be fulfilled in practical railroad service. Others say that the fuel economy will be wiped out by increased cost of other supplies and repairs. One condition referred to above is that the compound is not as powerful a machine as a like simple, and must be provided with a starting valve to allow it to work simple in starting and on hills; this valve, it is claimed, will wipe out the economy because it will be habitually used, not so much from carelessness of enginemen, as from the fact that the Operating Department will find out they have a more powerful machine at their disposal when the occasion requires, and will load the train until the habitual use of the valve becomes a necessity. From one point of view it may be with justice said that no one would expect economy under such conditions; but it can be with equal justice affirmed that master mechanics will have to meet this condition. It therefore behoves designers to strive for equal power for the compound without the use of such a valve.

As to the other question, of repairs, your committee have brought results as nearly up to date as practicable, and are not disposed to go far behind the figures in offering a definite conclusion; the compound is a new machine, it is subject to certain crudities of all new designs; these will constitute defects which will cost more for maintenance than the perfected points of the older type. But no evidence has been advanced to show that these defects cannot be remedied by time, and this part of the question resolves itself to considerable of extra cost of maintenance of additional parts in the compound. As the fuel saving possible is not an excessive amount, it points to the conclusion that we must strive for greatest simplicity and greatest reduction of number of such parts in the new type, if we are to expect a net saving in service.

Your committee offer tentatively the following opinions and suggestions:—

(1) The compound is suitable for a variable class of freight service.

(2) Its range of economy in such service is fully as wide as that of the simple.

(3) Its increased coal economy over the simple in the average freight service of the country will be found to lie between 10 and 15 per cent. when in good running condition and handled with intelligence.

(4) A well-designed compound should not be more difficult to keep in a serviceable condition than a simple; that is, its regularity of performance should not be less than the simple.

(5) The four-cylinder compound will cost more for valve oil than a simple.

(6) The running repairs of a four-cylinder compound will be somewhat more than for simple; for a two-cylinder compound they should not be more; the final comparison for repairs is undetermined.

(7) The net running cost of a compound will be less on many roads than of simple, the figure depending on the design, cost of fuel, and other local conditions.

(8) In passenger service the availability of the compound is undetermined.

(9) Complicated designs of compounds are not likely to prove successful or economical. The prevailing forms of starting valves in use in this country are especially noted as being too complicated—certain valves employed abroad seem to have more commendable points.

(10) Attention is called to the necessity of long time tests and averages of a considerable number of exactly similar engines of both types to properly establish the status of the question. In such tests the influence of higher pressure for either type should not be allowed to complicate the results, as the effect of the highest modern steam pressures on economy of the simple is undetermined.

Committee { GEORGE GIBBS. WILLIAM H. LEWIS. PULASKI LEEDS. JAMES MEEHAN. T. W. GENTRY.

In the discussion which followed Mr. Vauclain said:—Up to the present time we have some 460 compounds, all told, on order, and we have slightly more than the number given in the report in service. I take exception to the tentative opinion expressed in the report that the compound is suitable for a variable class of freight service. We consider that the compound is suitable for all classes of freight service. The second opinion is that "Its range of economy in such service is fully as wide as that of the simple." It seems to me that that would read better if it said that its range of performance or of coal consumption per ton per mile is fully as wide as that of the simple engine. I think that 10 to 15 per cent. is the minimum fuel economy on any compound engine of any type, two-cylinder, three-cylinder, or four-cylinder. On heavy grades with very heavy engines, the economy has reached as high a figure as 44·9 per cent. This was done on the Western Maryland Railroad.

The sixth opinion of the committee is that "The running repairs of a four-cylinder compound will be somewhat more than for a simple; for a two-cylinder compound they should not be more; the final comparison for repairs is undetermined." The only additional repairs that can be given to a compound locomotive

above a simple locomotive would be the repairs due to the cylinders. I am willing to concede, although it is not exactly true, that a four-cylinder compound should have twice the repairs to its cylinders and cylinder parts as a two-cylinder engine; intercepting valves, &c., of course are not included. The large item of repairs is the boiler repairs, and it has been clearly proved that the boiler repairs to compound locomotives are much less than to single expansion engines. The percentage of repairs to cylinders is so slight that you can afford to cancel it entirely.

You have the advantage of decreased repairs to your boilers, which more than offsets the increased repairs to the cylinders, and you have your fuel economy, so that there cannot be any question that there is an economy in operating compound locomotives.

The tenth statement is "That in passenger service the availability of the compound is undetermined." I object to this. I think it has been determined. If the committee would take the trouble to come to the East, where we are running high-speed passenger trains, they would find that compound engines are hauling a great many of those trains, and hauling them well.

As to the eleventh point, it would seem that we are not to encourage the builders of two-cylinder compounds in this country that necessarily must use starting valves. It intimates that the starting valves abroad are very much more desirable than the starting valves that we have at home. I am of the opinion that the starting valves used in America are very much better than the starting valves used abroad.

On several railroads that have reported fuel economy to the Baldwin Locomotive Works it has been found that those people could afford to set that engine to one side and get a brand new engine in five years on the fuel that that engine had saved. On the Pike's Peak back road, which has a grade of 25 per cent., we made three plain engines for that service. They needed an additional engine. We persuaded them to have a compound. The engine was built, and the three plain engines were sent back to our works to be changed into compounds, and they are now in service on the Pike's Peak road. What it has done is best shown by this letter:—"From the little experience we have had with this engine we think she is going to do the same work as our 28-ton engine on two-thirds of the coal, and make the run from Maniton to Pike's Peak in 33 to 35 minutes quicker time."

Mr. Barnes: I will ask if any one has ever seen a set of indicator cards from a compound locomotive at sixty miles an hour that was a credit to the engine. The indicator cards give evidence of a loss of efficiency when compared with the sixty miles an hour over any engine I have ever seen. This is in contradiction of Mr. Vauclain's statement.

Mr. Leeds: I protest against the statement going in that the compound is 39 per cent. more economical in repairs than the average of the engines on any railroad. On our own system ten or twelve engines a year are condemned. Each goes in as running repairs, distributed over all the rest, of course, and incidentally with the new engine. Next comes a class of engine which it takes very good judgment to say whether it is worth while to put the extensive repairs on them necessary to maintain them—whether it would be a good idea to condemn 25 or 30 instead of 8 or 10. That all goes in, and still we are asked to compare that with a brand new engine. I take exception to the statement that no repairs are due to the compound engine except cylinder repairs. Whenever I can get rid of a pound in my reciprocating parts I try to do it, for the very reason that it carries extra weight in the engine all the way through, and not only that, a weight that is effective only a part of the time, and the rest of the time it is more or less destructive.

Mr. Mitchell: I see by this report that on the New York, Lake Erie, and Western, the compounds show a large saving in lubricating oil. I wish to state in explanation of that that we had forty-five engines built, one of which was a compound. On the compound we had one man. We took the consumption of oil with this one engine with the regular man against the average for the forty-four which showed this saving. So this is not a correct comparison between two individual engines.

Mr. Henderson: Mr. Vauclain spoke of cylinder repairs and of a record that had been kept by a railroad. That railroad was the Norfolk and Western. We kept a record for the first four months of this year of the proportion which cylinder repairs bore to the total repairs on simple engines. In four months the cylinder repairs were about 2¾ per cent. of the total repairs to locomotives. Our annual report for 1892 showed that for 100 miles run fuel cost 3·86 dols., and repairs 6·36 dols. Now, if we assume the cylinder repairs to be 2¾ per cent. of the total amount of repairs, we have 2¾ per cent. of 6·36 dols., equal to 17½ cents for 100 miles run due to cylinder repairs. Our coal cost us 78 cents a ton. If we assume the economy of the compound engine to be 10 per cent., and finding that our fuel for 100 miles run averaged 3·86 dols., we find the saving to be 38 cents for 100 miles run for coal. If we assume the cylinder repairs of the compound to be double that of the simple, we have a deduction to make from the fuel saving of 17½ cents per 100 miles run. By deducting that from the 38 cents saved in the coal we still have a saving of 20½ cents per 100 miles; or by dividing the 38 by 17½ we find that if the cylinder repairs were three times as heavy on the compound as on the simple engines they would still barely come up to the saving of fuel. I have taken this compound saving at 10 per cent., whereas experiments show an economy in engine and passenger service of 13 to 20 per cent., and some Consolidation freight engines we have recently put in service of the four-cylinder type have shown an average economy in the neighbourhood of 20 per cent. in fuel. The firemen very much prefer to run the compound engine; they say it is a soft snap. Taking it at 6,000 miles a year as an average mileage, we find that the saving would be 123 dols. a year. That, of course, seems like a small amount, but if we take into consideration the extra cost of compounding, which is, I believe, 6 dols. an engine, that would show us still a saving of 20 per cent. interest on this extra investment.

Mr. Medway: If there were any doubts in my mind regarding the economy of the compound locomotive they have, I think, been removed during the past few weeks. With an order for a few Mogul freight engines from the Rhode Island Locomotive Works we decided to include one compound of two-cylinder type. It was built precisely like the simple engines excepting the parts due to the compounding. The cylinders of the plain engines were 20in. × 24in., and those of the compound 21in. and 31in. × 26in., thus making the engines of about equal power. The safety valves were set uniformly at 180 lb. In order to give the compound a good fair test under every-day conditions, I arranged to put it in competition with the plain engine by having it alternate daily on fast freight trains to Bellows Falls and return. The trains were of substantially the same weight, and other conditions about similar. After ten trips our coal record showed that the compound had effected a saving of 23·2 per cent., which, at 3 dols. per ton, means a saving of about 2000 dols. per year, or, as Mr. Vauclain says, about the price of the engine in five years. The cost of repairs, however, was largely against the compound, which was due to a weakness of the dashpot and large piston. These parts have now been strengthened, and if the good fuel conditions can be maintained, I see no reason why the compound is not a good permanent investment. This, however, can better be determined a few years hence.

Mr. Joughins (Norfolk and Southern): Last year we ordered from the Baldwin Works one freight and one passenger compound. Those engines have been running about eight months. The freight engine is doing what had previously been done by simple engines of exactly the same dimensions, received from the Baldwin people also. We keep an elaborate performance sheet, and rely simply upon that performance sheet, not attempting to make any tests. We find that there has been a uniform saving every month amounting to at least 20 per cent. in fuel. We do not find that the oil has been required more copiously. The repairs are practically the same; that is, the running repairs. But on the passenger engine a great many small matters have gone wrong, due partly, perhaps, to higher speed, but, I think, chiefly to undeveloped designs and a little bad workmanship.

I went to the Crewe works when in England last winter, and also to Gateshead, on the North-Eastern Railway. At the Crewe works I was surprised to find that they had not built a single compound engine for eight months, excepting the engine which was then under construction, and which is now on exhibition at Chicago. That seemed to indicate that the compound was not quite a success on that road. I then went to the North-Eastern Railway to see Mr. Worsdell's works, and he, we all know, has been a very strong advocate of the compound engine. I was still more surprised that they were building twenty locomotives for passenger service with simple cylinders, and abandoning the compound for that purpose. It was a little difficult to get a definite expression as to their reason for abandoning the compound for passenger service. But in talking to other people they said that they found the compound rather unwieldy for passenger service considering the slight advantages which it gave otherwise.

I think any report which the committee has made about the consumption of oil is thoroughly valueless. I think that we all know that the locomotive receives the amount of oil which the engineer thinks is needed, which very often is from two to five times the amount actually necessary. Notwithstanding the apparent success of those compound engines on the Reading Road and on the Jersey Central, I think that it is still a very undetermined matter about the success of those engines in passenger service.

Mr. Brown: Early this year we built a plain engine, and at the same time ordered a compound engine from the Baldwin Locomotive works. We wanted the engines for hauling heavy milk trains. We let one engine run north one day, and the other south. We did that for four days, and then they started out on four days more and changed around, so that they made the same number of miles in the four round trips. We weighed the fuel, and the simple engine used less fuel. The simple engine nozzles were 3½in. wide. The compound nozzles, when she came in, were 3¾in. But she would not steam with anthracite coal until they were shut up to 3½in. Of course, the more you close the nozzle the less satisfactory results will be shown on the engine. The result was this: that in the four days run the simple engine had saved 18,300 lb. The simple engine made about 50·9 lb., whereas the other was 66 and a decimal.

As regards repairs, we have not had an trouble whatever with the compound cylinders or valves. The heads were taken off when she came in first because the machinist had left a ½in. round file in one of the valves, and she had run from Philadelphia here and did not do any damage except breaking up the file. We got the file out, and that is the last time the head has been off.

Mr. Mackenzie: Some ten months ago we had ten engines built by the Baldwin Locomotive Works, and in placing the order the President said: "I suppose you want a plaything the same as everybody else. If you want a compound you better get it." So we got the compound engine. We assigned regular men to regular engines, and allowed those men to make thirty days during the month. Whatever time the engine may make beyond that is made by extra men, the regular man being held in all cases responsible for the condition of the engine. We made no test as to weighing the coal or the water, or measuring the oil or waste, or any other work about the engine. In the eight months the engines have made nearly 32,000 miles, or an average of about 4000 miles a month. The comparative statement would be, with coal costing 1·77 dols. per ton, a saving in favour of the compound of 31·7 per train mile. The cost of repairs of the compound over the simple engine is five mills per mile. I am not positive as to whether there were any incidental repairs made to the cylinders or not, but we have a record of extended repairs made to the crossheads. Twice during the eight months we have had to take the crossheads down and re-line them. On the eccentrics, links and rocker arms the repairs are going to be very much less than on the simple engine.

Mr. Tonge: So far as our experience goes with the Rhode Island compound, it has showed a saving of 12½ per cent., with an increase of repairs of 50 per cent.

Mr. Forsyth—answering a question put by Mr. Wells: As to the proper diameter of compound cylinders, when you want to meet the par of the simple engine, the English designers and the German designers gave us a rule quite early in the day of compound engines, which was to make the compound high-pressure cylinder 1in. larger in diameter than the simple engine that we want to make it equal to, and within the small range of diameters which we use in high-pressure cylinders, this rule seemed to have worked very well.

In regard to the experiment made with compound engines on the C., B. and Q. road last year there is an impression that the results of the tests were unfavourable to compound engines, that is, as a general statement. But the net results of the experiments and the fact that we settle for ourselves, were that in fast heavy passenger service the compound engine was not economical, and for that kind of service we would prefer a simple engine. I think that the two important conclusions to be gained from this discussion to-day and from the report of the committee are simply this, that the experience so far largely points in the direction that compound engines will not show an important economy in fast passenger service. The other fact is that up to this time there seems to be no doubt whatever from the numerous experiments that have been made, and the conclusions of the committee that compound freight engines are economical, and probably more so than the committee have stated in their report. We are now building compound freight engines at our shops at Aurora. I was very much pleased with Mr. Vauclain's discussion of this report. But the trouble is he claims too much for his engine. When he says that it has proved economical in fast passenger service, I do not think that carefully conducted tests would show that to be the case. He claims too that fast passenger speed is only possible with a piston valve. I was disposed to agree with him when he wrote a letter to that effect to the *Railroad Gazette*. But the experience of the New York Central road with a plain old-fashioned engine has shown that very high speed can be obtained with the slide valve.

Mr. Wells: Mr. Forsyth spoke of the rule given by English engineers in regard to the size of the high-pressure cylinder. They give it as 1in. over its equivalent in a simple engine. The difference between a cylinder 12in. or 13in. in diameter amounts to about 18 or 19 per cent. But the difference between a 20in. or 21in. cylinder is only about 9 per cent. So that the rule is not a correct one for the different sizes. The rule is not correct when you get up to those higher diameters.

Mr. Medway: We have obtained good results from the compound in regard to spark throwing.

Mr. Mitchell: A track sub-foreman on our road told me that with the Consolidation engine formerly used on the hill when pushing trains in the dry season it required one or two engines to watch the sparks and put the fires out. Since the compounds have been used there a fire is something never known.

On motion the discussion was closed.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Staff engineer, Josiah P. Thomas, to Devonport Yard, to date July 1st; acting engineer, Henry A. Gedge, to the Traveller, to date July 11th.

Arbitration Clause in Contracts.—In consequence of the objection which was made to the length of the arbitration clause prepared under the statutory powers of the London Chamber of Arbitration, for the insertion in specifications and contracts, the Council have re-considered the clause, and have now recommended the use of the following stipulation:—"All disputes which may arise relating to this contract shall be submitted to arbitration under the rules for the time being of the London Chamber of Arbitration."

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

(*From our own Correspondent.*)

The chief event this week has been the occurrence of the quarterly meetings on Thursday in Birmingham and in Wolverhampton on the previous day. There was a good attendance of buyers and sellers from various parts of the country. A rather more buoyant feeling prevailed than has recently been the case, and the business done fairly justified the anticipations which had been formed.

Marked bars were re-declared at £7 10s. as the basis price, which is a reduction of 10s. per ton upon the July quarterly meetings of 1892, this amount having been deducted from the previous £8 standard soon after the opening of the year. Good second-class bars were this afternoon £6 10s., and common £5 10s. A year ago marked bars were quoted £8, medium sorts £7, and common, £5 12s. 6d. upwards. Puddled bars to-day were quoted £4 to £4 2s. 6d. Prices of all descriptions of bars show but little change upon the quarter or upon the opening of the year. The L.W.R.O. ordinary bars were £8 2s. 6d.; best, £9 10s.; double best, £11; and treble best, £13. The Hurst qualities of the same makers were £7 for ordinary, £8 for best, and £9 10s. for double best. The list firms quoted also £8 for hoop angle and tee iron, and £8 10s. to £9 for boiler plates, and for sheets up to 20 w.g. Unbranded iron in all these departments could, however, be obtained at below these figures.

Better orders than for a considerable time past are being received by the galvanisers, and prices are hardening. Plain sheet prices have nearly got back to the level of this time last year, but galvanised sorts are still £1 below that time. Singles were to-day quoted £6 17s. 6d. to £7; doubles, £7 to £7 2s. 6d.; and lattens, £7 15s.; whilst galvanised sheets were £10 15s. to £11 per ton, Liverpool. Twelve months ago plain sheets were £6 17s. 6d. for singles, £7 to £7 5s. for doubles, and £7 17s. 6d. to £8 for lattens; galvanised sheets being then £11 15s. for 24 gauge delivered Liverpool.

Compared with the January quarterly meetings, black sheets were a reduction of 2s. 6d. to 5s. per ton, and galvanised sheets, 10s. to £1 per ton. At that time sheets, singles, were quoted £6 15s. to £7; doubles, £7 2s. 6d. to £7 5s.; and lattens, £8; whilst galvanised sheets were £11 10s. to £11 15s. at Liverpool for doubles, with some makers selling for less. Spelter was quoted to-day on the basis of £17 5s. per ton.

Hoops rolled by the unmarked iron firms were £6 5s. to £6 10s., and tube strips £5 15s. upwards.

Iron and steel for structural purposes was in good demand. Iron bridge and tank plates are £7, and best boiler plates are £9 to £10. Basic steel bridge and girder plates were quoted £5 15s., boiler plates £6 5s., engineering angles £5 5s., and rounds £5 10s. to £6 up to any size. These prices are a considerable drop upon a year ago. At that time the prices of steel in this district were, plates ¼in. to 1in. thick £6 10s., boiler plates £7, tees £6 10s., blooms £5 15s., channels £6 10s., and angles £6.

With reference to the crude iron trade, a fair amount of additional business was transacted, though in a number of cases consumers had previously satisfied their requirements. Producers being fairly well booked, quotations were firm. Staffordshire pigs were 57s. 6d. for hot-air all-mines, 42s. to 42s. 6d. for part-mines, and 34s. to 35s. for cinder sorts. Derbyshire pigs were 42s. to 42s. 6d. per ton, and occasional brands 43s., Northamptons 41s. to 41s. 6d., and Lincolns 45s. These prices are an advance of about 1s. 6d. per ton on the quarter, but a drop of 2s. per ton upon a year ago. At the quarterly meetings this time last year, Northamptons were quoted 43s. 6d., and Derbyshires 44s. 6d. At the April quarterly meetings this year, Northamptons were 39s. to 40s., Derbyshires 41s. to 43s. and Lincolns 44s. to 45s. Hematites continue 54s. to 55s. for forge, and 57s. 6d. for foundry sorts, delivered into this district from South Wales, Cumberland, and other districts.

A moderate business is doing in ironworks and factory coal. Forge fuel is quoted 7s. 6d. to 8s., mill coal 8s. 6d. to 9s., furnace 10s., and good slack 4s. 6d. House coal mined one way is quoted 7s. 6d., good shallow 8s., and best deep 10s. to 11s.

Iron and steel masters in this district are expressing satisfaction at the improvement in the foreign trade shown by the Board of Trade returns. They regard as encouraging the fact that the total quantity of iron and steel shipped from Great Britain to all countries during the first half of this year was an improvement of about 14 per cent. upon the first half of 1892, and that the figures for June, compared with the same month last year, are an improvement of 37 per cent. in quantity and 13 per cent. in value. The trade in galvanised sheets—about 75 per cent. of which are made in this district—has gone forward from 76,570 tons in the first half of 1892 to 84,183 tons during the first half of the present year; and for the month of June, from 12,284 tons to 15,442 tons. Whilst the value of the shipments of this class of iron to Australia declined during the half year from £296,163 to £254,506, yet the quantity is only 700 tons less than in the corresponding period of last year.

Trade between the United States and the Birmingham Consular district during the quarter ending June 30th was of the value of £207,453. This was less than in the corresponding quarter of 1892 by £23,375, or 10 per cent. Buttons, chemicals, guns, and cycles are the defaulting departments, but progress has been made in the shipments of anvils, chains, bedsteads, hardware, and iron and steel. These improvements in dollars have been—for Birmingham—anvils, from 19,891 to 25,041; bedsteads, from 61,410 to 69,044; chains, from 2561 to 3025; hardware, from 39,903 to 58,205; and steel and iron from 67,471 to 72,257.

The engineering and iron-founding trades continue fairly well occupied. Messrs. Cochrane and Co., Woodside Ironworks, Dudley, have obtained a contract from the Plymouth Corporation Waterworks for 3000 tons of 25in. cast iron pipes, of the value of £13,099. Among other competitors were Messrs. J. and S. Roberts, of West Bromwich, whosse tender was very near this, being £13,387.

Agricultural engineers speak well of the South American market, and general engineers give good accounts of the Cape demand for mining machinery.

Some good orders for various descriptions of machinery are under execution for India.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—The increased weight of buying reported a couple of weeks back has been only of very temporary duration, and in a good many cases it would almost seem that buyers have been purchasing considerably beyond actual requirements, and are not now able to take deliveries of the iron they have bought. The result is that makers in not a few instances, although fully sold, are anxious for specifications for immediate delivery, and there are here and there some low re-sellers, whilst speculative merchants in odd cases are again showing a disposition to "bear" the market. Generally, however, a steady tone is maintained, and makers of pig iron do not give way to any appreciable extent. In the steel trade hematites are showing a tendency to ease down, and finished iron remains in a more or less generally depressed condition. The threatened strike of colliers, except that it is necessarily a very general topic of conversation, has so far been treated almost with indifference in the iron trade. In odd cases users of iron are showing some anxiety about their forward requirements, and in one or two instances the damping down of furnaces is talked of, whilst finished iron makers in the present depressed state of trade will stop their works rather than pay any appreciably higher prices for fuel, but the prospect of a general stoppage of the pits certainly does not cause any anxiety generally.

The Manchester Iron Exchange on Tuesday was only moderately

attended, and a very quiet tone was reported all through. For pig iron there was very little inquiry, with merchants here and there underselling, and some very low prices are occasionally quoted for outside brands offering here, but makers' prices generally remain firm at recent quotations. For local brands of pig iron makers still quote on the basis of about 40s. for forge to 41s. for foundry, less 2½, at the works, but at these figures they are doing no business of any weight. With regard to district brands offering here, Lincolnshire makers are firm in quoting 39s. 6d. for forge, to 41s. for foundry, net cash, delivered Manchester, and although forge might possibly be bought at a trifle under this figure, in foundry, makers are in most cases indifferent about booking new business. For Derbyshire brands prices remain somewhat irregular, ordinary qualities being quoted at about 41s. 6d. to 42s. for forge, and 44s. 6d. to 45s. for foundry, less 2½, delivered Manchester, but makers in one or two cases are asking quite 1s. per ton above these figures, and for one of the leading brands quotations are altogether withdrawn for the present. For outside brands offering here prices remain without quotable change from last week. Delivered equal to Manchester, good foundry Middlesbrough is still quoted about 43s. 6d. to 43s. 10d., whilst Scotch iron averages about 44s. 3d. and 44s. 6d. for Eglinton, and 45s. 6d. for Glengarnock, net prompt cash, delivered at the Lancashire ports.

In the finished iron there is no improvement to report either as regards prices or demand. In most cases forge proprietors report only a very slow hand-to-mouth business still coming forward, and for delivery in the Manchester district Lancashire bars do not average more than £5 7s. 6d., and Staffordshire £5 10s. to £5 12s. 6d.; Lancashire sheets, £7 to £7 5s.; and Staffordshire, £7 7s. 6d. to £7 10s.; Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths, delivered in the Manchester district.

Only a very limited business is reported in the steel trade, with rather an easier tone as regards raw material. Upon small consumers' parcels of good foundry hematite makers quote about 54s., less 2½, delivered Manchester; but for quantities there would be ready sellers at under this figure. Local makers of steel billets book occasional orders at £4 4s. net cash, delivered Manchester; but they are undersold by other districts, and in steel boiler plates prices remain at about £6 5s. to £6 7s. 6d., delivered to consumers in this district—with the top figure only, however, in special cases.

The position generally throughout the engineering trades of this district remains about stationary. The returns of the engineering trades union organisations have for several months past shown very little variation in the number of unemployed members, whilst the reports received from the various districts connected with the societies show no material change in the general condition of trade. The Amalgamated Society of Engineers reports this month a slight decrease in the number of out-of-work members on the books, although not sufficient to have any appreciable effect, the percentage of 6½ to 7 out of the total membership in receipt of donation benefit remaining practically the same as it has been for some time past. Much the same report is issued by the Steam Engine Makers' Society, the returns showing about 4 to 4½ per cent. of the members in receipt of out-of-work support, and they have not varied to any appreciable extent for the last three months. The returns which have recently been collected in other quarters as to the condition of trade generally are to the effect that throughout almost all branches of engineering, the last twelve months has generally been unsatisfactory. Firms manufacturing specialities have been kept fairly well employed, but trade in other directions has been quiet, and has shown a continued falling off. So far as labour questions are concerned, there has not been much disturbance in the relations between employers and employed, but reductions in wages have been the order of the day. From what I gather amongst the engineers in this district, heavy stationary engine builders continue generally well supplied with work, and most of the large firms are fairly busy. In other branches, however, trade at the best is only moderate. Machine tool makers, where they are tolerably well off for work, are only kept going from hand to mouth, whilst many of the firms are short of orders. Boilermakers are not getting quite so much work as they have done recently, and locomotive builders continue very slack.

In the coal trade the wages question is, of course, just now the matter chiefly engaging attention, and there is a generally settled conviction that the proposed reduction of 25 per cent. will be followed by a strike. So far as the result of the pit-head meetings held by the men in this district is known, there is a strong determination against accepting a reduction of wages, whilst on the other hand most of the collieries hold exceptionally heavy stocks, which they are anxious to get rid of, and many of the colliery owners are consequently rather desirous than otherwise for a general stoppage. So far the prospect of a strike has brought forward no appreciably increased demand except for engine classes of fuel, supplies of which have been scarce for a considerable time past. During the week there has been quite a keen pressure on the part of consumers to get in extra forward supplies, and in view of these a substantial advance upon recent quotations has been readily paid. Generally, prices for all descriptions of engine fuel have been advanced 9d. to 1s. per ton, burgy now fetching 7s.; best slack, 6s., and lower qualities, 4s. 6d. to 5s. per ton at the pit mouth. Where consumers have not been able to obtain extra supplies of engine fuel, they have taken through-and-through coal, which is still obtainable at very low figures, averaging about 6s. 6d. per ton at the pit mouth. Apart, however, from the extra quantities taken off the market for engine purposes, there is no appreciably increased demand for round coal, and neither merchants nor consumers are showing much anxiety at present as to future supplies either of house fire qualities or forge coals. Prices are perhaps showing more firmness, but there has been no quotable advance, best Wigan Arley coal being still readily obtainable at 11s. to 11s. 6d., Pemberton 4ft. and seconds Arley, 8s. 6d. to 9s., with common round coals ranging from 6s. 6d. to 7s. per ton. Pits are not working more than three to four days per week, and even where colliery proprietors would be glad to run the full time with a view of getting in stocks, the miners decline to assist them in this direction, although here and there stocks have been put down pretty freely during the last week or so.

The shipping trade remains without improvement, buyers being evidently dubious about the present wages movement, and certainly they are not at all eager to place out orders. Consequently, to effect sales, very low prices have still to be taken, 7s. 9d. to 8s. being about the average figures for steam coal, delivered at the ports on the Mersey.

Barrow.—The business in hematite pig iron during the past few weeks has been of small account, as there is neither a good demand on home or on foreign account, and colonial and continental inquiries are on a small scale. There is no business doing for forward deliveries, all the sales being on prompt account. Bessemer is the only quality of iron which is at present finding a market. In forge and foundry iron there is no trade doing, and these qualities of metal are not quoted. Bessemer Mixed Nos., however, are at 46s. 6d. net f.o.b., but warrant iron is quoted at 44s. 10d. net cash, while sellers are at 44s. 8d. In the district only 35 furnaces are in blast, and 42 are standing idle. Stocks are very steady, and show no increase on the week, remaining in warrant stores at 62,811 tons. It is believed that prices will show a further decline before any improvement takes place. Makers are not disposed to increase the output, because there is no prospect of any accumulation in stocks being realised at any reasonable future date at improved values to those now ruling, and it is admitted that these do not afford any margin of profit except in cases where smelters are favourably situated.

Iron ore is in very quiet demand. Ordinary qualities are quoted at 8s. 6d. to 10s. 6d. per ton, net at mines, where the output is exceedingly small. Spanish ore is in quiet demand, with prices at 9s. 6d. per ton delivered.

Steel makers report a quiet trade in many departments. Orders are fairly sustained for heavy steel rails, and makers are fairly-well sold forward, prices this week being quoted at £3 17s. 6d. per ton. Light rails are quiet. Steel shipbuilding material is neglected, and no orders are held by makers in this district, the mills being stopped. Billets, blooms, and slabs are in quiet demand. Tin bars are in fair request, and in large output. Prices are steady at £4 per ton.

Shipbuilders and engineers are badly off for orders. They are quoting for some orders now in the market; but it is generally considered that, to secure new work, builders must be ready to work at a loss, and this they are disinclined to do.

Coal and coke are in quiet request; but prices are steady and higher rates are expected, in view of the anticipated crisis in the coal trade.

Shipping is quiet, and the tonnage of shipments is below the average.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

IT is expected on both sides that there will be a severe struggle before the wages difficulty in the coalfield is settled. All the notices in the district have now gone in, and there will be nothing more done until about the end of the month, when the time comes for the men to throw down their tools and leave work. The miners say that they are quite prepared to take this course, and the coal-owners are equally determined to adhere to their demand for a 25 per cent. reduction. The immediate result is to cause better employment at the different collieries. Manufacturers have been busy stocking for some time, and it is evident from the huge supplies which are being laid in that a long stoppage is anticipated. The result seems to suit both sides, although one would think it could scarcely do so; still the men declare that the increased work will find them funds to enable them to "play," and the large consumers say that the stocks they are accumulating will enable them to keep such departments going as they cannot well stop. At the same time, however, careful arrangements are being made to relieve as much as possible the pressure in departments of the mills which would entail any consumption of coal which could be avoided. The customers are being asked to exercise patience during the stoppage, and orders will be withheld until the pits resume working. As usual, the heaviest loss will fall on those who have nothing to do with the strike. A large number of artisans will be thrown out of employment, and in many colliery villages the tradesmen and merchants will suffer severely. The miners can scarcely husband as much of their earnings as will tide over the time of idleness, and financially strong as the Miners' Associations at present are, they could not keep their men and families a fortnight with all the funds at their command.

I have already stated the claim of the coalowners for the reduction, which is, briefly, on account of the large decline of trade in their districts, the great falling in values, and the inability to compete for contracts. It is admitted that in Yorkshire and the Midlands generally the full 40 per cent. advances are still being paid, and that in the North of England and in Wales these have been mainly cleared away. The reply to this on the part of the miners' leaders is that they are not responsible for the decline in values. They say that it is all owing to the coalowners having engaged in reckless competition, and thus played into the hands of the large consumers. They decline, to put it in their own words, to "throw away their labour because employers have thrown away their profits." On behalf of the men it is further pointed out that in June of 1890 exported coal realised an average price of a fraction under 12s. 8d. per ton; in the same month of 1891 the price was 12s. 1½d. per ton; 1892, 11s. 4¾d. per ton; 1893, 9s. 4¾d. per ton. This shows a decline of 2s. per ton on the year, of 2s. 8¾d. on two years, and of 3s. 3¾d. on three years. It is urged that the tonnage sent out of the country last month was larger than in the corresponding period of the three previous years, and the average price 1¾d. higher per ton than in the month of May. The miners, therefore, state that the decline, which had been continuous during three and a-half years, ceased last month, and that there was a turn for the better.

The railway companies continue to place their large contracts. The Manchester, Sheffield and Lincolnshire Company are still holding their hands, but the Midland have arranged for the remainder of their contracts with Derbyshire collieries on terms equivalent to those they have made with Yorkshire coalowners. These were for a supply extending over a period of twelve months at a reduction of about 2s. per ton. The Sheffield Gas Company, which requires 170,000 tons per annum, have, as usual, divided their orders among several local collieries. Supplies have been arranged for on a basis of 1s. 6d. to 2s. per ton less than last year. Quotations at the pits vary very considerably. Silkstone coal is quoted at 8s. 9d. to 9s.; and large quantities have been sold at a good deal less than that; screened Flockton coal is priced at 8s. 9d. to 9s.; ordinary qualities, 8s. to 8s. 3d.; thin seam, 6s. 6d. to 7s. at the pits. Consumers in inland towns complain of the high prices which they have to pay for supplies. Barnsley and Sheffield, which are in the heart of the South Yorkshire coalfield, pay from 12s. and 13s. to 15s. 6d. and 16s. per ton. The London demand for coal has somewhat improved since last week, and more is being done in the Midland and Eastern counties, consumers being evidently apprehensive of obtaining supplies while the strike is proceeding. There is also a better demand for steam coal, quotations for which are now fairly active. Engine fuel can be bought at from 5s. to 5s. 4d. per ton, and smudge at about half the price.

There is no improvement whatever in the heavy trades. The turn of the year brings a little more firmness in the iron markets, and several of our steel houses have been favoured with welcome orders recently. On the whole, however, not more than half time is being worked in most of the large establishments. In the file, edge tool, saw, sheep shear, and similar trades there is an average business doing. Cutlery and plated goods are in less request, although more has been done this season with the seaside and other health resorts, owing to the continued fine weather having favoured boarding-house keepers, hotel proprietors, and others, whose prosperity is chiefly dependent upon the weather.

The quantity of exports to the United States from the Sheffield consular districts, during the quarter ending June 30th, are disappointing. The total value was £115,357 as compared with £122,427 in the corresponding quarter of last year, thus showing a decline of £7070. Cutlery amounted in value to £27,780, which is a falling-off of £5310. Steel exhibits a slight improvement, the value exported during the last three months being £69,281 against £66,896 in the corresponding period of last year.

Mr. George Cooper, of the Electric Works, Wicker, Sheffield, has patented the "Acme Ventilator and Chimney Top," which, after exhaustive experiments, is declared to be the most powerful and reliable in the market. It consists of a number of shields which are riveted to a common axis, and so arranged that they cover up in a radial manner the whole of the opening at the top of the air shaft, space being left between the edges of each shield. In this way it signifies not in what direction the wind travels, a continuous and powerful up current is created. Down draught to the chimneys is prevented, and the ventilator acts effectively in increasing the up-current in the chimney-flue. Mr. Cooper has already important orders in hand for theatres and other public buildings, and as his invention is adapted for all kinds of house buildings, ships, railway carriages, as well as for drain and sewer ventilation, he is making arrangements for the production of his apparatus on an extensive scale.

Mr. R. Bennington Bedle, the New United States consul, has arrived in Sheffield, and commenced the duties of his office. Mr. Benjamin Tolson, the retiring consul, was entertained to a farewell banquet by the leading inhabitants of the town on Tuesday. The mayor presided.

Professor Ripper of the Sheffield Technical School, accompanied by Mr. R. A. Hadfield (Hadfield's Steel Foundry), leaves in the Campania for Chicago; Mr. Atkinson, the master-cutler, left on Wednesday.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

ON the whole the trade of this district shows improvement on last week, but still must be described as quiet. Buyers are slowly regaining confidence, and speculators are not so ready to offer iron for sale, but they seem to be disposed to hold what they have for the higher prices which are expected when the autumn shipping season arrives. A dull period in July creates no apprehension, for it is usual, this month being as it were between seasons, and we may look for the fluctuations in values being within narrow compass, though in the main the tendency of prices is upwards. On this account merchants will not offer to sell for forward delivery at lower prices than will be accepted for prompt, as the chances are that they would be considerable losers, and makers also will not take less for forward than for prompt delivery. It has been common for second hands to sell pig iron for forward delivery at less than will be accepted by the producers, but the "bears" find they cannot safely undersell the makers, because in the first place they, the "bears," have very little iron in their own hands, and in the next it will probably be difficult to procure any at even present prices when the time approaches for delivery. Thus the producers are able to maintain their quotations better than usual, and they are not inclined to grant concessions, because No. 3 Cleveland pig at 35s., though it is 1s. above the recent minimum, is not at a remunerative figure, and certainly it is not relatively at so high a price as coke. The ironmaster has to pay 12s. per ton, delivered in the Middlesbrough district for good Durham blast furnace coke, and it is generally reckoned that the price of No. 3 pig should be three times the rate for coke. No. 3 should therefore be at 36s., but is only 35s. at most. And the situation is worse if we look at forge qualities, for they are proportionately cheaper than No. 3, and if money is not to be made with No. 3 at 35s., there must be considerable actual loss in having to sell grey forge at 32s. 6d., for it costs as much to produce it as to produce No. 3. With No. 3 at 35s., grey forge ought to be at 34s., or 1s. less, but it is now at 2s. 6d. less, there being so little sale for it, on account of the very slack condition of the finished iron trade. And the cost of production of pig iron is likely to be higher, if the difficulty with the colliers in the Midlands and other districts affected by the proposed reduction ends in a strike, because the scarcity of fuel must lead to higher prices for it in all the districts that are working, and that being so, coke will probably go up in value, and the consumers of it will have to put up the price of their products. On this account there is more desire to buy iron for forward delivery.

Makers of Cleveland pig iron have been able this week to secure better prices for their No. 3—the standard quality—fully 35s. per ton for prompt delivery being paid, but merchants and some of the producers have also done business at 34s. 10½d. for delivery over this and next month, and buyers have been very ready to give 34s. 9d. The price of Cleveland warrants has altered very little, keeping about 35s. 3d. cash. No. 1, which is scarce and chiefly required by the Continent, is at 37s. 6d., and No. 4 foundry 33s. 9d., while grey forge can be bought at 32s. 6d., mottled at 32s. 3d., and white at 32s., all for early f.o.b. delivery. East Coast hematite pig iron is in better demand, on account of the greater activity at the local steel works, and the heavy shipments to Russia and Italy, while Sheffield consumers are buying more freely. The price of mixed numbers has therefore been firmly maintained at 43s. 6d. per ton. Pig iron exports have this month slacked considerably, as up to Wednesday night they had reached 31,070 tons, as compared with 41,856 tons in June, and 50,253 tons in May, both to 12th. One reason for the falling off is, that less is being sent to Germany, which is the chief continental consumer of Cleveland pig iron, and some part of this decrease is due to the dry season, on which account the rivers, &c., are so low, that the barges cannot be loaded to their full capacity, and it takes two or three times the number to convey to the interior that would be required ordinarily. This, of course, increases the expense of carriage, and it does not pay the consumer to get the iron. It would not pay to convey the iron by rail from the port of debarkation to the works, as they would be too costly, though railway rates are much more reasonable than in this country. Scotch consumers are taking very little Cleveland iron this month, as work is interrupted by the various local holidays which are common at this time of the year. Though the exports are quiet and production in maintained, not much iron is being lodged in Connal's warrant stores, the quantity held on Wednesday night being 70,999 tons, or 1514 tons increase this month.

The Middlesbrough Chamber of Commerce reports that at that port there are 92 furnaces erected, of which 68 are in operation, 44 producing Cleveland iron and 24 hematite, spiegel, &c. The output of pig iron for the past half year, as compared with that for the corresponding six months of 1892, has been:—

	1893. Tons.	1892. Tons.
Cleveland pig iron	629,236	268,942
Hematite, &c., pig iron	402,000	169,000
	1,031,236	437,942

The small production last year was due to the strike of Durham colliers, which paralysed trade for about three months. The stock of Cleveland pig iron held on June 30th at Middlesbrough was 186,909 tons, an increase of 83,933 tons for the half year, and they have thus doubled. The pig iron exported reached 435,013 tons, against 295,618 tons in 1892. Of manufactured iron and steel 68,415 tons were exported, and of steel 124,161 tons—total, 192,576 tons, as compared with 118,689 tons in the first half of 1892. The Middlesbrough pig iron makers imported 659,070 tons of foreign iron ore, chiefly from Bilbao, as compared with 301,472 tons in the corresponding period of last year. Middlesbrough exported during the half year 28,501 tons of basic slag 79,914 tons of salt, and 5900 tons of chemicals. The Middlesbrough shipbuilders launched eleven vessels of 12,784 tons gross-register tonnage and 1511 nominal horse-power during the half year, the record for the corresponding half of last year being 9260 tons and 1031 nominal horse-power.

The finished iron trade is still without improvement; in fact, there is less doing than there was in plates and angles, and prices have become weaker, £4 10s., less 2½ per cent., being quoted, and orders have been accepted at less than that. It is the steel plate and angle manufacturers that have derived all the benefit from the revival in shipbuilding, and their prices have advanced, while those of iron plate makers have declined. Thus it comes about that while a few months ago iron and steel plates were practically at the same price, now there is 12s. 6d. per ton difference, steel plates having increased 7s. 6d., while iron plates have fallen 5s., and yet with this difference builders prefer to take steel plates. Angles have not moved up to a like extent, and are to be got readily at £4 15s., less 2½ per cent., for steel and £4 10s., less 2½ per cent., for iron both f.o.b.

Shipbuilders are doing an improving business, and are likely to be more fully occupied during the autumn than they expected; but still their yards will be far from being fully employed. The number of orders recently given out, though considerably greater than they have been for a long time, are yet much below the capacity of the yards. As a matter of fact, to keep the shipbuilders fully employed in the North of England requires the placing of an order for a 2000-ton vessel every day on the average. The Middlesbrough builders appear to have done very well during the past half-year, and at Hartlepool there is greater activity. Messrs. R. Irvine and Co., of West Hartlepool, have secured an order for a cargo steamer of 3000 tons from Messrs. G. Pyman and Co., of that town. The Tyne Iron Shipbuilding Company will build two very large oil

steamers for Messrs. Hunting and Co., of Newcastle. Palmer's Shipbuilding and Iron Company have this week completed and despatched to Portsmouth the new first-class line-of-battle ship Resolution, the order for which they received only thirteen months ago. The Resolution is one of the largest battleships afloat, being 380ft. long, 75ft. broad, 27ft. 6in. mean draught, and 14,150 tons displacement. She is built entirely of steel, the stem, stern post, rudder, and shaft brackets being formed of cast steel. The hull is divided into 220 watertight compartments. The same builders have at the same time been constructing H.M.S. Revenge.

Messrs. Clarke, Chapman and Co., of Gateshead, have completed a new petroleum engine for the launch of the s.s. Midnight Sun. The engine is the patent of Mr. E. Butler, and although one of the largest of its kind yet made, it is capable of being instantly started. This is effected by means of a spring apparatus attached to the engine, which is wound up a few turns by hand, and when it is let go the spring is released, and the engine instantly commences its work. The engine can be got ready to start in ten minutes, and it can readily be reversed, there being provided a gear, the particular feature of which is, that it is only used for going astern. This gear is put out of action when the vessel is going ahead. The engine worked successfully at the trial trip on Saturday.

The North Bitchburn Coal Company have bought the two pits in south-west Durham belonging to the Ackland Iron Company, Middlesborough.

The Bill enabling the North-Eastern Railway Company to purchase the Hull Docks for £2,000,000 has now passed the Commons, having already gone through the Lords. The opposition to the amalgamation contended that there was danger of the railway favouring one port at the expense of other ports, by giving low preferential rates in one or other case. Provision was made to guard against this by the insertion of a clause giving jurisdiction to the Railway Commissioners.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow pig iron market has been quiet, with only a moderate business in Scotch warrants between 41s. 8½d. and 41s. 7½d. cash. The demand for Cleveland iron has been limited at 35s. to 35s. 1d. cash. Scarcely any business has been done in hematites. Cumberland hematite is quoted 44s. 8d., and Middlesbrough hematite 42s. 10½d. to 43s.

The prices of makers' iron are as follows:—G.M.B., No. 1, 42s. 6d.; No. 3, 41s. 9d.; Carnbroe, No. 1, 43s. 6d.; No. 3, 42s. 6d.; Clyde, Gartsherrie, and Calder, Nos. 1, 47s. 6d.; Nos. 3, 44s. 6d.; Summerlee, No. 1, 48s.; No. 3, 45s.; Langloan, No. 1, 53s. 6d.; No. 3, 45s.; Coltness, No. 1, 53s.; No. 3, 47s.; Glengarnock, at Ardrossan, No. 1, 48s.; No. 3, 43s. 6d.; Dalmellington, No. 1, 45s. 6d.; No. 3, 43s. 6d.; Eglinton, No. 1, 44s.; No. 3, 43s.; Shotts, at Leith, No. 1, 51s.; No. 3, 48s.; Carron, at Grangemouth, No. 1, 52s. 6d.; No. 3, 46s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 6847 tons compared with 8071 in the corresponding week of last year. There was despatched to Italy, 610 tons; Russia, 425; Holland, 420; Canada, 330; Germany, 255; Australia, 110; France, 85; United States, 50; India, 35; South America, 30; Belgium, 20; other countries, 280; the coastwise shipments being 4197 tons, against 4207 in the same week of 1892.

Since last report two furnaces have been put out in Coltness for repairs, and the total now blowing in Scotland is 69, compared with 74 in the corresponding week of last year. The number making hematite has been reduced from 24 to 22, and there are 45 producing ordinary and special brands and two basic iron.

The steel trade is fairly employed, but some of the works have already shut down for the annual trade holidays, and the whole of them will be closed before the end of the week. Several additional orders for shipbuilding steel have been placed, and prices remain steady on the basis of £5 5s. to £5 17s. 6d. for ship plates, less 5 per cent. discount for delivery in the Clyde district.

As indicative of the wide difference which may exist even in these times of low prices between the estimates of shipbuilders, it may be interesting to note that in the offers made lately for a contract to build several sailing vessels there was a disparity of no less than £15,000 between the highest and the lowest offerer.

The bar iron trade is steady with a fair amount of work, and it is expected that business will be more active after the holidays. Makers quote the lowest grade of common bars £5; second grade, £5 5s.; highest grade, £5 7s. 6d.; best bars ranging up to £5 17s. 6d.; all less the usual 5 per cent. discount.

The associated sheet makers of Scotland held a meeting the other day for the purpose of reviewing the situation and revising prices. It appeared from the statements of the makers that business in this branch is in a comparatively healthy state, and it was resolved to maintain prices on the basis of £7 5s. per ton for iron singles, and £7 15s. for steel singles. The opinion was generally expressed that the arrangement for the regulation of Indian exchange will eventually improve the demand for that market. Much was said at the meeting alluded to with reference to a practice which has grown up among certain shipping companies of invariably signing for the delivery of goods as "wet and rusty," even in the finest of weather. It is alleged that upon the strength of these entries claims have been made of an altogether unreasonable nature for abatement of price, and that some makers have lately had to pay considerable amounts in this way, wiping out any profits they had made in the transactions. The meeting resolved that certain of their number should make a strong representation to the shipping companies against this practice, and, if that should not be effectual, to transfer their shipments to other lines.

The business in malleable tubes has been steadily improving, and some good orders have been received within the last few days. The Admiralty order has gone into Messrs. Marshall and Sons, of Glasgow. The firms in the Coatbridge district are reported to be specially busy.

Messrs. R. Laidlaw and Son, of Glasgow, have obtained an order for 3395 tons of cast iron pipes, various sizes, for the new hydraulic-power system of the Glasgow Corporation. The valves of the same contract have been placed with Messrs. Blakeborough and Sons, Brighouse, Yorkshire, and the bolts with P. and W. MacLellan, of Glasgow.

The iron and steel manufactured goods shipped from Glasgow embraced locomotives worth £16,500; sewing machines, £3520; machinery, £10,425; steel goods, £6980; and miscellaneous iron goods, £27,270.

The coal trade has been very firm in the West of Scotland, owing to the restriction of the output by the miners. The small supplies coming on the eve of the holidays set up an artificial strength, which is not expected to be maintained. It is not unlikely, however, that the market may remain steady till the end of the present month. The f.o.b. prices at Glasgow are: Main coal, 6s. to 6s. 3d.; splint, 7s. to 7s. 3d.; ell, 7s. to 7s. 6d.; and steam, 8s. to 8s. 6d. per ton.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

I AM favoured with returns of the coal and iron industries for June, and one is now enabled to see really the amount of business done for the half-year.

The June coal shipments, foreign, from Cardiff totalled 909,443, and coastwise 126,367 tons; from Newport, Mon., 194,330 tons and 98,563 tons; from Swansea, 72,057 tons, and 61,559 coastwise; and from Llanelly, 10,968 and 4715 tons. The grand total of coal shipments from all the Welsh ports reached 1,471,002 tons, showing an increase of 78,109 tons over the returns for May.

In iron and steel there is a distinct improvement shown both at Cardiff and Newport. In patent fuel there was a decrease at both places, but a slight increase at Swansea. Coke shows an increase at Cardiff and Swansea, and a decrease at Newport, Mon.

The half-year's work shows well all round. Cardiff has shipped over six million tons of coal, 18,481 tons of iron and steel, 48,101 tons of coke, and 161,851 tons of patent fuel. Newport comes next with 1,454,941 tons of coal, 11,098 tons iron and steel, 2626 tons of coke, and 25,977 tons patent fuel. Swansea despatched 745,972 tons coal, 1006 tons iron and steel, 1557 tons of coke, and 157,284 tons patent fuel. The salient facts of the returns are, that Cardiff has got into first place for iron and steel, Newport having formerly held that position, and that in patent fuel there is a closer tie between Cardiff and Swansea, Swansea being formerly the shipper of the larger quantity by a good round number.

Last week being "Mabon's," there was a considerable falling-off in shipments, the total from Cardiff amounting only to 235,754 tons. Generally, the steam coal trade is active, especially as regards best qualities. Prices are well maintained, and I have heard it expressed, confidently, that the next audit is to show a small advance. Latest quotations at Cardiff were:—Best steam, 10s. to 10s. 6d.; seconds, 9s. 6d. to 9s. 9d.; inferior, from 8s. 6d. House coal prices generally are maintained, though I have heard low prices quoted for secondary kinds. Rhondda No. 3 is still at 9s. 9d. to 10s.; brush, 7s. 9d.; small, 6s. 3d.; best small steam commands 5s. 6d. Some of the larger house collieries have signified that next month there will be 1s. advance in price. It is stated that the Llanbradach men have joined the South Wales branch of the Miners' General Federation.

In steel, as shown by the June returns, there is a favourable turn, though not so strongly marked as could be wished. Home rails are in improved demand, and a good make of steel bar continues, particularly at Cyfarthfa and at Dowlais. Most of the works are fairly placed. There is no movement yet at Rhymney or Tredegar. There has been again a good deal of pig and bar imported, and the competition with the West Coast is said to be keen, though it is admitted that Welsh steel takes higher rank in regard to quality, and is found by the plate workers to be better adapted for their work.

The quotations mid-week on Swansea Exchange were as follows: Steel rails, heavy, £3 17s. 6d. to £4; light, £4 12s. 6d. to £4 15s.; these figures may probably lead to business later on. Steel sheets, £7 to £8; iron, £6 10s. to £7 10s.; Bessemer tin-plate bars, £4 7s. 6d. to £4 10s.; Siemens, £4 10s. to £4 17s. 6d. Block tin is down again; latest £82 2s. 6d. to £82 7s. 6d. Tin plates are in good demand, but with no alteration in prices; latest, Bessemer, 11s. 9d. to 12s.; Siemens, 12s. to 12s. 6d.; ternes, 21s., 22s., 23s.; best charcoal, 13s. to 15s.

That we are on the eve of a change of prices is very evident, as shipments are on the increase, and stocks visibly lowered. Last week the shipments totalled 122,797 boxes, and as the make only amounted to 93,889 boxes, stocks were lowered by close upon 30,000 boxes. With present stocks down to 169,803 boxes, it is clear that a few weeks extra run would literally sweep the warehouses.

Coke and patent fuel prices remain. Iron ore is in good demand, from 10s. to 11s. 6d., best Rubio commanding the highest figures. Anthracite is improving, Swansea last week shipped 3600 tons to San Francisco. Speculation continues to be exercised in the matter of the field of anthracite being favourable for Milford Haven shipping, and some development by Glamorganshire coalowners is under discussion, also a project for a line of steamers. Best continues to be quoted at 12s. 6d. to 13s.

Swansea shipping for June last is being unfavourably contrasted with the results for June, 1892, there being a decrease of 32,223 tons on the whole trade, coal being less by 23,751 tons, and patent fuel 7846 tons. Newport coal returns for last week were a fair average.

The theory, broached by Mr. Galloway and Mr. Herbert Kirkhouse, of the material aid given by coal dust to the increase of the volume of an explosion, was again mooted at a general meeting of colliery officials held on Saturday at Pontypridd. There was a valuable paper read on the subject by Mr. W. Thomas, of Ynyshir collieries, which is to be published. There was a consensus of opinion that coal dust took an important part in explosions. A vote of sympathy with Dewsbury bereaved was passed.

The probability of the formation of a Harbour trust for Cardiff, for the corporation acquiring the docks, and then to carry out an elaborate extension, are prominent subjects of discussion at present, advantage having been taken of the visit of the Naval Architects to again bring the subject forward. It will be remembered that some time ago I referred to an intention on the part of the Harbour Trust Committee of the Cardiff Corporation to formulate a scheme that might possibly be acceptable. I now learn that two schemes have been sketched out. One is the dockising of the whole of the East and West mud, with a low-water entrance carried out beyond Penarth Head. The other scheme is for the Ely river to be diverted into the Taff, at a point near the Windsor Slipway, and the combined waters be confined between two walls running right down to Penarth Head. This scheme would allow of the construction of two large docks, one on the East and West mud, and the other to the east of Cardiff flats. Provision for entering and leaving by two locks 1000ft. long. Probably we shall hear more of this after the visit of the Naval Architects has ended.

I am glad to hear that the electric winding at Plymouth is now very regular and perfect, and should certainly be visited by all interested in the extension of electricity to colliery working.

The visit of the Naval Architects to Cardiff for the first time in their history has been a very acceptable event. Up to Wednesday evening a good deal of work had been accomplished, in the contribution of various papers and visits to important places. Under the guidance of Sir W. T. Lewis, the East and West Bute Docks were thoroughly inspected.

There is no improvement in the outlook of the coal question in the Forest of Dean.

NOTES FROM GERMANY.

(From our own Correspondent.)

THE iron and steel trade over here remains in much the same depressed condition that has been reported for so long past. Buyers have very few requirements, and will only place the smallest orders, while at the same time makers in many cases cannot sell at the prices at which consumers are wanting to buy.

The Silesian iron market shows no new feature. There has been a slightly better feeling in the manufactured iron department, due to some fair orders for bars that have recently come in from abroad. In the sheet trade, also, the demand appears to have a little improved, but prices are, unfortunately, as bad as ever.

On the Austro-Hungarian iron market there has been a fair amount of business transacted during the week now past. There has, however, been no pressure of demand, and supplies of all descriptions of raw and finished iron are plentiful. During the month of May the import of iron and iron manufactured goods to Austria-Hungary was 14,670,600 kilos., while in May, 1892, it was 9,253,400 kilos. In iron ore import amounted to 9,676,500 kilos., against 15,372,400 kilos. in the year before. In coal 236,090,400 kilos. were imported, against 222,024,200 kilos. in the same month the year before, while the import of coke was 24,239,400 kilos. in May, 1893, against 17,087,100 kilos. in the same month last year. Export in iron and iron manufactured goods was 3,625,100 kilos. in May, 1893, while during the same month last year it amounted to 3,955,100 kilos.; in iron ore export was 9,049,400 kilos., against 10,269,500 kilos. in May last year; in coal 52,087,300 kilos., against 52,034,300 kilos., and in coke 8,236,000 kilos., against 6,515,200 kilos. during same month in previous year.

In France the condition of the iron industry is about the same as last week. Orders for railway requirements are coming in pretty freely, both for home and colonial demand, and the employment at the finished iron and engineering works, though not a brisk one, may still be regarded as fairly regular and satisfactory. Basis price for bars is 160f., for girders 170f., while plates are quoted 200f. p.t.

On the Belgian iron market the demand for pig iron is very slack; although prices have gone down so low that a profit is now quite out of the question, a still further decrease is generally expected, others have sold the production for third quarter at 43f. p.t., while up to date 44f. was the price quoted. A very general complaint is made in the finished iron and engineering branch of the excessive competition of German firms. Last week, for instance, sheets were offered at 176f. per ton, free Liège, which is only 1f. p.t. higher than the price the Belgian makers asked.

On the Belgian coal market a quiet but regular business is done. The selling of 490,000 t. engine coal for the Belgian State Railways forms the event of the week.

The price for common sorts of coal has risen 0·25f. p.t. There is much German coke selling on the Belgian market, which, naturally, does not improve prices.

The production of coal in Belgium since 1871 was:—

Year.	Productions in tons.	Value in francs.	Number of colliers.
1871	13,733,176	153,803,000	94,286
1872	15,658,948	208,559,000	98,863
1873	15,778,401	337,637,000	107,902
1874	14,669,029	240,910,000	109,631
1875	15,011,331	229,840,000	110,720
1876	14,329,578	194,119,000	108,543
1877	13,938,523	152,957,000	101,343
1878	14,899,175	147,821,000	99,032
1879	15,447,292	144,995,000	97,711
1880	16,866,698	169,680,000	102,930
1881	16,873,951	163,704,000	101,351
1882	17,590,989	175,896,000	103,701
1883	18,177,754	184,777,000	106,252
1884	18,051,499	172,032,000	105,582
1885	17,437,603	154,618,000	103,095
1886	17,285,543	142,542,000	100,282
1887	18,378,624	147,674,000	100,739
1888	19,218,581	162,018,000	104,477
1889	19,869,480	187,718,000	108,382
1890	20,365,960	268,503,000	116,779
1891	19,675,664	247,454,000	118,983
1892	19,591,908	207,675,000	117,500

The business transacted on the Rhenish-Westphalian iron market is small, and a gloomy view is almost universally taken of the present situation and the prospects for the future. Prices, low and unremunerative though they are, continue to decline, makers selling at almost any price now. Both for raw and for finished iron little inquiry has been coming forward. With prices falling every week, buyers naturally delay purchasing in order to take advantage of the reductions. Regarding the different sorts of manufactured iron, bars are reported in weak request, while for girders rather more inquiry has been experienced. Plates as well as sheets leave much to be desired with regard to price, but the activity maintained at the works has been pretty satisfactory. In hoops and wire no change has taken place since last week's letter.

In spite of the high duty which Russia has put on the import of iron, German export to Russia has considerably increased of late. It was, for April of present year, in 100 kilos., as under:—

	April. 1893.	1892.
Pig iron	2,715	4,526
Angles	8,959	4,307
Rails	204	279
Bars	37,503	16,397
Plates	18,915	4,596
Castings	789	780
Axles	—	398
Tubes	556	124
Iron manufactured goods	7,076	7,400
Hardware	684	530
Needles	15	13
Anvils, bolts	322	—
	77,738	39,350

The production of gold or silver ore in Germany, during the year 1892 is statistically stated to have been 19,319 t., worth M. 3,665,495. Of these Saxony produces no less than 19,315 t worth M. 3,619,504. In pure silver 487,784 kilos. have been produced, worth M. 57,025,584, of which 297,343·25 kilos., worth M. 34,664,601 fall to Germany; 94,829·86 kilos., worth M. 11,102,701, fall to Saxony, and 95,611·96 kilos., worth M. 11,258,282 fall to other German States. The following shows the business done to Smyrna in iron, metals, and coal during the year 1892: Lead, 2115 t., of which 697 t. came from England, 581 t. from France, 835 t. from Italy. Copper: 2639 boxes, 2239 from England, 200 from France, 201 from Turkey. Iron: 20,150 t.; 17,895 from England, 1945 from Holland, 310 from France. Iron manufactured goods: 12,474 boxes; 4801 from England, 4240 from Holland, 1199 from France, 1000 from Austria-Hungary, 599 from Belgium, 486 from Germany, 39 from Italy, 101 from America. Nails: 919 t.; 360 t. from France, 306 t. from England, 113 t. from Belgium, 73 t. from Holland, 64 t. from Austria-Hungary, 3 t. from Italy. Plates, sheets, and tin-plates, 3626 boxes: 2362 from England, 1160 from Holland, 55 from Belgium, 49 from France. Steel, 2557 boxes; 1400 from Austria-Hungary, 527 from Holland, 453 from England, 130 from Germany, 47 from France. The total import of coal was 53,975 t., which all came from England. Exported were 16,704 bags of antimony, of which 16,680 went to England, and 24 to France.

THE NEW CONTINENTAL SERVICE.—The effect of the opening of the new service between Harwich and the Hook of Holland is that two and a-half hours are saved between London and Amsterdam, as compared with the time by the Queensborough and Flushing route. The Great Eastern Railway Company has just ordered Messrs. Earles, of Hull, to construct two more twin-screw steamers, of the same speed and type as the Chelmsford, recently described in these pages, but of greater beam and length to give more passenger accommodation.

A NEW FRENCH CRUISER.—A new cruiser, the largest in the French Navy, is ordered to be built at La Seyne. She will be named the D'Entrecasteaux, being intended for service as flagship in distant seas, and will be sheathed and coppered. Her displacement will be 8114 tons; her length at the water-line, 393ft. 6in.; her extreme breadth, 58ft. 5in.; and her extreme draught, 29ft. 6in. She will have two vertical triple-expansion engines, with five cylindrical boilers, developing in all 14,000-horse power, and giving a speed of 19 knots. The normal bunker capacity is to be 650 tons; but it will be possible to carry 1000 tons of coal. The protection consists of a 3·9in. steel deck, with above it a great number of cellular compartments for coal and stores, the whole being covered by another steel deck three-quarters of an inch thick. The whole of the hull below the protection is occupied by the machinery, boilers, bunkers and magazines. Each of the heavier guns has its own separate ammunition hoist. These, and also all the auxiliary machinery, steering gear, internal lighting, loading and training engines, &c., will be electrical. The armament will consist of two 9·4in. guns of 40 calibres; 12 5·5in. quick-fire, 12 1·85in. quick-fire, and four 1·45in. quick-fire with two submerged and five above-water torpedo-tubes, two of the latter being in the bows. Each of the 9·4in. guns will occupy a closed turret covered with 9·8in. steel. Four of the 5·5in. quick-fire guns will be on the spar-deck behind 2·8in. hardened steel shields, and the remaining eight upon the main deck in sponsons behind similar shields. She will cost £620,000, and will be somewhat larger than our new first-class cruisers of the Edgar and Crescent classes, but a little smaller than those of the Blenheim type. She will also be exceeded in size by the Russian cruiser Rurik, but she will be a knot faster. In size she will most nearly approximate to the new American cruiser New York.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, July 6th, 1893.

REPORTS from all leading iron and steel centres show a larger than usual midsummer demand for pig iron, billets, sheets, plates, and material for implement and machinery manufacture. Quotations are firm, but very low. The bar iron mills are all idle for repairs, and will not generally resume until the last week of July. Southern coke iron is in good demand in the West. A more active market is assured as soon as the wages scale is fixed. Ship, bridge, and car building work is crowding capacity. Foundry work is fair. Machine shops are generally busy. Rail mills have a little more work. Sheet mills are idle and demand is low for large lots. The tightness of the money market is not interfering seriously with the iron trade as yet. Prices have gone as low as they can well go, and production has been restricted to actual orders. There have been thirty-two failures in the iron trade, big and little, during the past six months.

LAUNCHES AND TRIAL TRIPS.

At Renfrew on 5th July, Messrs. William Simons and Co. launched complete from their yard a large hopper steamer for the Clyde Trustees, the leading dimensions of which are:—Length, 205ft.; breadth, 35ft.; depth, 15ft. 6in. The hopper has a capacity for 1200 tons of material. The vessel is propelled by two sets of triple-expansion engines, and twin screws capable of steaming at a speed of 10½ knots per hour when loaded. It is built under the British Corporation requirements and survey. This makes the eleventh vessel that Wm. Simons and Co. have built for the Clyde Trust, their connection extending as far back as 1861, when they built for them two hopper barges, which were the first vessels of this class propelled by steam. A number of the members of the Trust were present at the launch, and as the vessel entered the water the ceremony of naming it No. 21 C.N. was performed by Miss Daisy Deas, daughter of Mr. James Deas, C.E., engineer to the Trust.

The second of the two twin-screw steamers ordered from Messrs. Fleming and Ferguson, Paisley, by the Clyde Navigation Trustees in February last, has now been completed, and on Saturday ran her speed trial between Cloch and Cumbrae Lights. The run was made with and against tide over a distance of 27½ knots, on which distance she attained a mean speed of 10¾ knots; being ¼ knot in excess of speed stipulated for by the Trustees. The steamer carried her load within her specified draught, and the trial was in every way a success, the machinery and everything about the vessel giving the most entire satisfaction to the representatives of the Trustees who were on board.

On the 1st inst. the final trial was made of the twin-screw tug United, built by Messrs. R. and H. Green, of Blackwall, and engined by Messrs. Alex. Wilson and Co., Vauxhall Ironworks, Wandsworth-road, London. The vessel is for service at East London, South Africa, the dimensions of the hull being 103ft. long by 21ft. beam by 9ft. draught, and the conditions of the contract with regard to speed, draught, and stability, were so onerous in order to obtain the best possible results, that Messrs. Green only secured the contract by undertaking to carry it out strictly in accordance with the terms of the specification. The hull is built of iron, as being less liable to corrosion than steel at a port where the opportunities for docking frequently are fewer than in a home port. This, however, did not apply to the boiler and machinery, which are of steel throughout, the propellers being of manganese bronze, both the vessel and machinery being also constructed under Lloyd's Survey for the highest class. A speed of 12 knots was obtained throughout a four hours' run between Gravesend and the Nore, the engines maintaining a uniform speed of 150 revolutions, indicating 710-horse power. The engines, which are two in number, are of the compound type, having cylinders 15¼in. and 30½in. diameter by 21in. stroke, with extra large cooling surface in the condensers, and are fitted with the circular-balanced and double-ported valves which Messrs. Wilson have now used for a number of years with the greatest success. The consumption of coal was only 1·9 lb. per horse-power, which is extremely low for a compound engine, and was due to the high rate of expansion, the valves being set to cut off at half stroke, the boiler pressure being 100 lb. The consulting and inspecting engineers were Messrs. John Thompson and Son, London-street, E.C., this being the sixth vessel built by Messrs. Green and engined by Messrs. Wilson under their supervision.

ONE of the 'great labour-saving devices, says the *Electrical World*, apparently speaking for itself, of the editorial sanctum and of the mediocre writer on economics is that of averages. When a subject is complex and the different factors require a laborious weighing to determine their resultant effect, it is so easy to call in the aid of "the happy mean," or to strike an average, that sometimes the temptation is almost irresistible to adopt this time-honoured and usually safe method of retreat, which often by a brave air may even be given the appearance of an advance. In most cases, particularly in editorial writing, the reader will be entirely justified in considering that this is a device adopted as an easy way out of a difficulty. In certain branches of statistics it must be admitted that the average is a legitimate recourse, but this is because the difficulty of the case may not admit of other treatment or method of comparison, or that the variations are such as to permit the proper application of the arithmetical mean. For theoretical purposes, however, and, in quite as great a degree, for practical purposes, the average should only be relied upon in the absence of everything else. In science the method of least squares, which may be denominated a scientific average, where applicable, reigns supreme, and in every-day life questions are decided on their own merits without reference to the average solution. In fact, it may be said that the successful man becomes so by the avoidance of averages, of which even nature herself seems to have an abhorrence."

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

27th June, 1893.

12,610. NEWSPAPER WRAPPING MACHINES, H. E. Newton.—(*Messrs. R. Hoe and Co., United States.*)
12,611. TABLE APPARATUS for SEAMSTRESSES, S. Nolan, London.
12,612. ELECTRIC FITTINGS, E. Priddle and N. Priddle and Co., London.
12,613. FABRIC SMOOTHING APPARATUS, W. P. Mather, London.
12,614. SHIRTS, A. J. Brodrick and H. Gluck, London.
12,615. STOPPERS for TOWING-HAWSERS, J. T. Selby, London.
12,616. STOPPERS for TOWING-HAWSERS, J. T. Selby, London.
12,617. METHOD of TREATING COFFEE, H. W. Hart, London.
12,618. WINDOW SASHES, A. A. J. Burgiss and R. Wilson, London.
12,619. CURTAIN HOOKS, M. Potter, London.
12,620. CYCLE WHEEL RIMS and TIRES, J. H. Maine, London.
12,621. PHOTOGRAPHIC CAMERAS, G. I. Spalding, London.
12,622. PIPE FITTINGS, J. McIntyre, London.
12,623. KEYBOARD for VIOLINS, E. J. de Vlaminck, London.
12,624. RECOVERING FLOAT, &c., GOLD, A. F. Seccombe, London.
12,625. ELECTRIC SEWAGE PURIFICATION, W. Walker, London.
12,626. COSMETIC LOTION, G. Kohn, London.
12,627. PLAYING MUSICAL INSTRUMENTS, A. A. Mugnier, London.
12,628. TACK DRIVING MACHINES, H. H. Lake.—(*J. H. Hanan, United States.*)
12,629. CANE and UMBRELLA, H. H. Lake.—(*F. G. Clark, United States.*)
12,630. APPARATUS for FORGING METALS, A. B. Ibbotson, London.
12,631. CHAIN and PINION for CYCLES, J. Bardet, London.
12,632. WIRE COILED FABRIC, H. H. Lake.—(*C. O. White and M. B. Lloyd, United States.*)
12,633. VIGNETTING PHOTOGRAPHIC PRINTS, E. M. Ashley, London.
12,634. DRIVING TOYS, E. Braun, London.

28th June, 1893.

12,635. TIGHTENING WEARING-APPAREL, E. Schuberth, London.
12,636. COLOURING MATTERS, Reid, Halliday, and Sons, and J. Turner, London.
12,637. SUPPORTING SURVEYOR'S LEVELS, F. F. S. Kelsey, London.
12,638. The "FRAY BENTOS" "SHEET" RELEASE, C. F. S. Bilbrough, South Wales.
12,639. CHANNEL BLOCKS for MANHOLES, E. A. Green, Sheffield.
12,640. WHEEL TIRES, A. Gadd, Manchester.
12,641. CLOSING TAP HOLES in CASKS, J. W. Phillips and J. Chalmers, Swansea.
12,642. WIRE HEALDS, H. Kitson and J. Evans, Bradford.
12,643. APPARATUS for MOISTENING AIR, J. T. Pearson, Burnley.
12,644. DIVIDING PAPER by PERFORATED HOLES, J. Watson, Newcastle-on-Tyne.
12,645. PNEUMATIC TIRES, W. Rockliffe, Newcastle-on-Tyne.
12,646. CYCLE TIRES, A. A. Haigh and R. W. Haigh, Manchester.
12,647. METALLURGY, W. Mills, London.
12,648. IMPROVED DRINKING BEVERAGES, J. C. Hall, London.
12,649. FASTENING the ENDS of WIRES, H. Payton, jun., Birmingham.
12,650. FASTENING the TIRES of CYCLES, H. Payton, jun., Birmingham.
12,651. LIGHTNING WAITER, J. Lang, Edinburgh.
12,652. STRETCHING GARMENTS, P. D. Kenny, Manchester.
12,653. HUMIDIFYING APPARATUS, A. Scott, Manchester.
12,654. MACHINERY for MAKING THREAD, J. Fulton, Glasgow.
12,655. TRIMMING PHOTOGRAPHS, A. C. Rettie, Dundee.
12,656. SATURATORS for USE in SIGNALLING, J. G. Parvin, London.
12,657. BURGLAR PROOF LOCK PROTECTOR, T. Wallace, Bradford.
12,658. APPARATUS for COLLECTING REFUSE, G. A. Schlosky, Manchester.
12,659. CUTTING OUT CLOTH, J. Philippsohn, Manchester.
12,660. MIRROR PIVOT BRACKETS, C. H. Hibbert, Manchester.
12,661. GROUND LEVELLING CYLINDERS, U. Ammann, Manchester.
12,662. ELECTROLYSIS, E. Andrioli, London.
12,663. HANGING DEVICES, J. B. Howard.—(*E. Baneth, Germany.*)
12,664. BLOW INTERCEPTING DEVICES, J. B. Howard.—(*A. Mueller, Germany.*)
12,665. COPPER, G. E. Bowen and R. B. Wilkinson, London.
12,666. STOP VALVES for STEAM, &c., R. H. Leaker, Bristol.
12,667. PNEUMATIC WHEEL TIRES, J. Markus, Manchester.
12,668. DIES for SHEET METAL STAMPING, D. Clark, London.
12,669. BUTTON FASTENER, W. W. Tambs, Birmingham.
12,670. SAFETY RIDING STIRRUP, H. Carrington, Birmingham.
12,671. GARMENT CUTTING-OUT APPARATUS, J. Wiese, London.
12,672. VAPOUR GENERATING APPARATUS, J. A. Colquhoun, London.
12,673. FURNITURE POLISH or RESTORER, E. Worrow, London.
12,674. LUBRICATING DISC for AXLE BOXES, N. Mayer, London.
12,675. ENGRAVING GLASS GLOBES, &c., H. R. Couper, Glasgow.
12,676. LOOMS, L. Bulcock and W. J. Threlfall, London.
12,677. LOOMS, W. B. White, H. Rawson, J. Myers, and J. Morrison, London.
12,678. GUIDING ROPES to WINCHES, J. S. Lakeman, London.
12,679. WINDOW SASHES, F. R. Smale, London.
12,680. "VENICE," A. Hardy, London.
12,681. BOTTLE STOPPER, A. R. Cragg, London.
12,682. JOINTING SEWERAGE PIPES, F. S. Mayo, London.
12,683. FASTENING SHEET METAL LIDS, J. F. Chapman, London.
12,684. FEEDING OPENERS and SCUTCHERS, E. Buckley, London.
12,685. BOLT NUTS, W. Heape and T. Ledward, Cambridge.
12,686. MALTING FLOORS, A. J. Boult.—(*J. Jungbluth, Germany.*)
12,687. BRAKES for SEWING MACHINES, D. Noble, London.
12,688. STOVE for HEATING SPIRALS, M. Jahn, London.
12,689. SHIPS' or VESSELS' PROPELLER, R. Wilcox, London.
12,690. DRIVING CREAM SEPARATORS, J. Struthers, London.
12,691. CONSTRUCTION of METALLIC TUBES, H. Jelley, London.
12,692. BAKERS' OVENS, M. Negus and J. Stanford, London.
12,693. KNIFE CLEANERS, J. M. Hector, London.
12,694. OIL for CURING WOUNDS, H. B. Solomons, London.
12,695. FILES and RASPS, J. S. Wallace and W. Junge, London.
12,696. BICYCLES, T. Beevers and H. B. Sheridan, London.
12,697. CUTTING PATTERNS, C. J. Ward and A. C. Bonsall, London.
12,698. OARS, A. Estivalet, London.
12,699. MEASURING INSTRUMENT, B. F. H. Helnemann and R. Proband, London.
12,700. ELECTRIC CONTACT, &c., MAKER, R. Beveridge, London.
12,701. ADVERTISING RULER, J. E. Young.—(*A. R. Hislop, New Zealand.*)
12,702. ELECTRIC CABLES, G. G. M. Hardingham.—(*Messrs. Felten and Guilleaume, Germany.*)
12,703. LATTICE or OPENWORK GIRDERS, J. Kohn, London.
12,704. DYE MANUFACTURE, J. Imray.—(*L. D. Huguenin and Co., Switzerland.*)
12,705. INDICATING the VENDOR of MEAT, F. E. Hedger, London.
12,706. DUPLICATE BILLHEAD BOOK COVER, T. Atley, London.
12,707. LOCOMOTIVES, J. Musgrave, G. Dixon, E. Field, and F. S. Morris, London.
12,708. JACQUARD APPARATUS, R. Beck, London.
12,709. TIRES, G. H. Jones, London.
12,710. LIFE BELTS, S. H. O. Bauditz and H. Rasmussen, London.
12,711. METALLIC BOXES, J. S. Stockton and the Patent Stopper and Stamp Company, Limited, London.
12,712. GAME, W. H. Harvey, London.
12,713. RAILWAY SIGNALLING APPARATUS, J. Page, London.
12,714. REFLECTOR for STREET LAMPS, W. W. Baggally, London.
12,715. STOP VALVES, C. MacLaren, London.
12,716. COIN-FREED TELESCOPES, M. Sielaff, Berlin, Germany.

29th June, 1893.

12,717. SUBMARINE BOATS and SHIPS, H. Middleton, Slough.
12,718. BED LIFT, H. G. Monkhouse, London.
12,719. HAIR CURLING DEVICES, W. G. Hay, Liverpool.
12,720. VELOCIPEDE BOTTOM BRACKET, H. P. Cook, Birmingham.
12,721. COSTUME TRIMMING, A. Nicholson and J. Hall, Leek.
12,722. AUTOMATIC ROUSER for ALE, &c., J. Prescott, Bolton.
12,723. TIRES, T. Guthrie and W. T. Hall, Newcastle-on-Tyne.
12,724. SPRING MATTRESSES, J. Horn, Glasgow.
12,725. MECHANISM of WEAVING LOOMS, G. H. Hodgson, Halifax.
12,726. HAT CONES, B. Dunkerley and J. Dugdale, Manchester.
12,727. BICYCLE BRAKES, J. Murray, Glasgow.
12,728. CORSETS and SUPPORTING BELTS, S. Fielder, Manchester.
12,729. AUTOMATICALLY CLOSING DOORS, R. Scott, Newcastle-on-Tyne.
12,730. STEAMSHIPS and PROPELLERS, W. Gray, jun., Glasgow.
12,731. FIXING ROD or POLE ENDS, C. F. Chinnery, Southport.
12,732. VAPOUR ENGINES and ACCESSORIES, T. Morgan, Birmingham.
12,733. SUBMARINE EXPLORATION and WORKING, H. E. Aldridge, Derby.
12,734. WASHING PHOTOGRAPHIC PLATES, W. Thomson, Manchester.
12,735. FILE ERASER, F. H. Batters, Heswall.
12,736. WAGONETTE BRAKE, J. Kirby and C. Wallis, Leeds.
12,737. DEVICE for DRAWING PARALLEL LINES, W. H. Parker, York.
12,738. BICYCLES, A. A. Govan, Glasgow.
12,739. SPRINKLERS, J. Gregory and J. T. Pearson, Burnley.
12,740. BRAKES, W. Radford and C. Sangster, Coventry.
12,741. SETTING the TEETH of SAWS, R. Elliott, Newcastle-on-Tyne.
12,742. LIFTING DOOR CURTAINS, E. Scruton, Stockton-on-Tees.
12,743. PUZZLE, G. Hewitt, A. Gretton, H. Rackley, and E. Burgoyne, Derby.
12,744. VULCANISING TIRES and RINGS, J. Robinson, Manchester.
12,745. SHIRT COLLAR and NECKTIE FASTENER, N. Macleod, Glasgow.
12,746. SCREW PROPELLER, A. W. Miller, A. Munro, and J. Mills, Glasgow.
12,747. BRUSH for BLACKING BOOTS, F. E. Etches, Leeds.
12,748. WHEELS for TRAMWAY CARS, G. Donachie, Glasgow.
12,749. GAME, A. Cochrane, Renfrew.
12,750. GAME. A. Cochrane, Renfrew.
12,751. CORNETS, TRUMPETS, &c., A. H. Gisborne, Birmingham.
12,752. SCREWING STOPPERS into BOTTLES, S. Bowskill, Sheffield.
12,753. PERMANENT PLANT TRAINER, H. A. Grindrod, London.
12,754. PNEUMATIC TIRES for VEHICLES, J. Green, London.
12,755. LOCKSTITCH SEWING MACHINES, B. Köhler, London.
12,756. ALARM BELLS of VELOCIPEDES, J. Baum, London.
12,757. STEAMING WOVEN FABRICS, A. T. Sarfert, London.
12,758. SPINNING and TWISTING FRAMES, S. Vickers, London.
12,759. HANGING-UP ARTICLES of CLOTHING, A. Knötgen, London.
12,760. FEEDING WATER to BOILERS, E. O'Brien, Manchester.
12,761. KNITTING MACHINES, E. J. Franck, London.
12,762. STARTING ENGINES, D. H. Felce and J. E. S. Trelawny, London.
12,763. INLAID FABRICS, A. S. Oetzmann and S. J. Narracott, London.
12,764. RIMS and TIRES for WHEELS, H. Bennett, London.
12,765. T-SQUARES, H. R. Taylor, London.
12,766. ABSORPTION of GAS in MINES, W. S. Simpson, London.
12,767. TIRES for ROAD VEHICLES, J. B. Oakley, London.
12,768. DREDGING APPARATUS, C. G. Collins, London.
12,769. PNEUMATIC SLEEPING BERTH, A. Ransome, London.
12,770. CONSTRUCTING WINDOW SASHES, W. H. Lindsay, London.
12,771. SELF-GENERATING GAS BURNERS, L. Dürr, London.
12,772. INFLATION of PNEUMATIC TIRES, J. Wormald, London.
12,773. HANGING CUPBOARD or WARDROBE, T. S. D. Wallace, London.
12,774. EVAPORATING BRINE, F. W. and E. G. Scott and F. W. Scott, jun., London.
12,775. RAILWAY SIGNALLING, W. R. Sykes, jun., and J. P. O'Donnell, London.
12,776. NECKTIE FASTENER, A. Nowak, London.
12,777. SUSPENSION WHEELS, C. K. Welch and H. du Cros, London.
12,778. CARPETS, A. R. Steudtner, London.
12,779. SELF-FASTENING BROOM, &c., W. J. Murphy, London.
12,780. DEVICE for the SOLES of BOOTS, A. T. Brooking, London.
12,781. NAIL for USE on FENCES, J. S. Horsley, London.
12,782. SUPPLYING GAS to VEHICLES, O. Wethered, London.
12,783. GLOVES, E. Fisher, London.
12,784. FITTING of RAMS to WARSHIPS, H. Richardson, London.
12,785. ELECTRICAL SWITCHES, A. G. New and A. J. Mayne, London.
12,786. SELF-REGULATING MECHANISMS for ELECTRIC ARC LAMPS, A. G. New and A. J. Mayne, London.
12,787. MANUFACTURE of COKE, &c., J. L. Dobell, C. P. Shrewsbury, F. Marshall, and J. Cooper, London.
12,788. FENDERS, G. G. M. Hardingham.—(*R. W. Wyett, Australia.*)
12,789. TREATMENT of CYANIDE SOLUTIONS of GOLD, J. C. Montgomerie, London.
12,790. APPARATUS for CUTTING VENEERS, F. Podamy, London.
12,791. PAINT, E. Edwards.—(*J. W. Overton, United States.*)
12,792. APPARATUS for TREATING SKINS, J. Pullman, London.
12,793. GRINDING MILLS, S. Schwazenberger, London.

30th June, 1893.

12,794. DISCS for PHONOSCOPES, &c., G. Demeny, London.
12,795. TRUNK LOCKS, E. Bates, Wolverhampton.
12,796. PROTECTING TROUSERS BOTTOMS, J. H. Teale, South Shields.
12,797. INSPECTING OBJECTS under WATER, H. S. Stewart, London.
12,798. INGOT MOULDS, W. Mayer, Durham.
12,799. BRAKES for CYCLES, T. M. Grant and A. Kelly, Glasgow.
12,800. TIRE for BICYCLE WHEELS, F. Richardson, Birmingham.
12,801. FRICTION GEAR for CYCLES, J. Harding, Wolverhampton.
12,802. PREVENTING EXPLOSION of BOILERS, J. H. Brindle, Manchester.
12,803. WIRE-WEAVING MACHINERY, J. Telford, J. W. Bentley, E. Breadner, and R. Clark, Manchester.
12,804. LATHS for FLOORS, &c., A. O. Wright, Birmingham.
12,805. IMPROVED FOLDING SQUARES, E. De Camp, London.
12,806. ELECTRICAL SWITCHES, F. A. Thum, London.
12,807. OPENING and CLOSING FANLIGHTS, J. Morton, Aston.
12,808. CYLINDRICAL CINDER SIFTER, G. Mitchell, Essex.
12,809. PNEUMATIC TIRE for VEHICLES, F. Seary, Monmouthshire.
12,810. SELF-ACTING MULES, W. Hopwood and J. Hilton, Manchester.
12,811. SCUTCHING MACHINES, B. Ormerod, G. Hawworth, and J. F. Davies, Manchester.
12,812. BUCKET TIPPING APPARATUS for STEAMERS, W. Morison, Glasgow.
12,813. DRAWING and like PINS, A. A. Woodward, Birmingham.
12,814. PNEUMATIC TIRES, S. Tweedale and J. Clegg, Manchester.
12,815. MECHANICAL ROCKERS, C. Thompson, Newcastle-on-Tyne.
12,816. CONNECTING TIRES to RIMS, W. Rockliffe, Newcastle-on-Tyne.
12,817. CONSTRUCTING BOILER FURNACES, J. Proctor, Manchester.
12,818. BRANCH PRUNER and FRUIT GATHERER, S. Hall, Derby.
12,819. SADDLE CLIP, H. Edwards and M. Foley, Anglesea.
12,820. PEDALS, E. Tilston, Manchester.
12,821. COLLARS, W. G. Delf, Brighton.
12,822. FASTENERS for WINDOW BLINDS, R. W. Cook, Cromer.
12,823. WINDOW BLIND CORD RACKS, W. Hitchin, Birmingham.
12,824. HYDRAULIC RAMS or ENGINES, W. A. Rife, London.
12,825. PROPELLER, C. Groombridge and W. A. South, London.
12,826. HULLS or BODIES of SHIPS, C. and G. Kropp, London.
12,827. RAILWAY CROSSINGS, J. R. Pflanz, London.
12,828. KNITTING MACHINES, H. Stoll and F. Maercklin, London.
12,829. PUZZLE for CHRISTMAS CARDS, L. P. C. J. Jacquet, London.
12,830. PADS for STAIRS, FLOORS, and the like, S. Lee, London.
12,831. DRESSING FLOUR, W. P. Thompson.—(*C. H. Stein, Germany.*)
12,832. WINDOWS, R. Hollows and J. Spencer, Liverpool.
12,833. PREVENTING SMOKE in FURNACES, J. Sadler, Manchester.
12,834. BUTTONS, A. Appleby, Liverpool.
12,835. METALLIC BRUSH, W. P. Thompson.—(*C. Zenser, Germany.*)
12,836. TUBULAR STEAM BOILERS, A. Blechynden, London.
12,837. MAKING YEAST, L. Lederer, London.
12,838. CONVERTIBLE MUSIC STAND, J. W. and J. H. Slade, London.
12,839. STANDS for CAMERAS, L. A. Marion, H. Guibout, G. and F. Bishop, and J. P. Kirk, London.
12,840. APPARATUS for STORING PICTURES, L. A. Marion, H. Guibout, G. and F. Bishop, and J. P. Kirk, London.
12,841. VALVES for PNEUMATIC TIRES, W. H. Bayley, London.
12,842. PNEUMATIC TIRES, O. A. Berend.—(*T. Roemer, Germany.*)
12,843. INTERNAL COMBUSTION ENGINES, W. D. and S. Priestman, London.
12,844. HAIR-CURLING APPLIANCES, R. H. Bishop, London.
12,845. PUTTYING KNIFE, A. Blake, London.
12,846. SHIPS, E. H. Hodgkinson, London.
12,847. PROCESS for PRESERVING OILS, E. Watel, London.
12,848. AUTOMATIC CRADLES, G. Denegri, London.
12,849. TANNING, C. Heinzerling, London.
12,850. COUNTER of ELECTRICITY, F. A. Brocq, London.
12,851. LINK MOTIONS for STEAM ENGINES, W. T. Ward, London.
12,852. DISTRIBUTING ELECTRICAL ENERGY, W. Lowrie, London.
12,853. MAIL-CART and PERAMBULATOR, W. Mortimer, London.
12,854. CRABS or WINCHES, C. C. Walker.—(*F. Weck, Australia.*)
12,855. RAILWAY SIGNALLING APPARATUS, P. M. Jamet, London.
12,856. PAPER FOLDING MACHINE, L. Peyrounil, London.
12,857. CHLORIDE of SODIUM TANKS, J. C. Richardson, London.
12,858. OBJECT DRAWING, E. P. Woodman and W. T. Whitehead, London.
12,859. BOOTS, H. W. Mason, London.
12,860. PHOTOGRAPHIC CAMERAS, H. H. von Hochberg, London.
12,861. CONNECTING ANIMALS to VEHICLES, T. H. Brigg, London.
12,862. TOOL HOLDERS for LATHES, &c., E. Turner, London.
12,863. PRINTING INK MANUFACTURE, J. and J. Bibby, London.
12,864. ELECTRIC LOCOMOTIVES, J. F. W. Featherstonhaugh, London.
12,865. MITRE BOLTS and MITRE PLATES, J. C. King, London.
12,866. ELECTRIC LIGHTER, R. W. Barker.—(*M. Sommer and B. Troop, United States.*)
12,867. WATER-CLOSETS, R. Lewis and J. J. Newman, London.

12,868. DEVICES for HOLDING NECKTIES, F. Rowley, London.
12,869. IGNITING SAFETY and other LAMPS, H. Freise, London.
12,870. MAGNETIC FASTENING for LAMPS, H. Freise, London.
12,871. FIRE-ESCAPE, C. Newman, London.
12,872. ELECTRICALLY OPERATING CLOCKS, J. Perry, London.
12,873. PRESERVATION of FRUIT, &c., G. A. Goubault, London.

1st July, 1893.

12,874. BICYCLE and TRICYCLE BRAKES, S. Phillips, Birmingham.
12,875. OELRICHS PATENT TURNSTILE, A. A. E. Oelrichs, London.
12,876. STEAM GENERATORS, G. V. Priestley, London.
12,877. VALVES for PNEUMATIC TIRES, W. Pearson, Birmingham.
12,878. FEED-WATER PURIFIER, &c., J. Robinson, Huddersfield.
12,879. MANUFACTURE of MOORING CHAINS, W. J. Cox, Tipton.
12,880. MARBLE-LIKE PLASTER COMPOSITION, R. Bammann, Manchester.
12,881. APPARATUS for INFUSING TEA, R. D. Waddell, Glasgow.
12,882. HEEL ATTACHING MACHINES, H. A. Oldershaw, Leicester.
12,883. FASTENINGS for DOORS, &c., A. H. Adcock, Birmingham.
12,884. BINIODIDE of MERCURY SOAP, C. R. Illingworth, London.
12,885. PREPARATION of MALTO-PEPTONE, O. R. Bataille, London.
12,886. SYSTEM of FORCING WATER, G. Ralston, Newcastle-on-Tyne.
12,887. FILTER, W. H. Barr, Manchester.
12,888. DRAWING PRESSES, D. Smith, jun., Wolverhampton.
12,889. HUB for VEHICLE, &c., WHEELS, R. G. Petway, London.
12,890. POULTRY FENCING, F. T. Walker, Sheffield.
12,891. TRANSPLANTING MACHINE, J. M. Sailer and J. Mole, London.
12,892. CHURN, I. Key and J. Cooper, London.
12,893. DIAGONAL FOLDING CLOTHES HORSE, G. Coker, London.
12,894. LAMINATED SPRINGS, T. Hurdley and J. Shaw and Co., Sheffield.
12,895. BICYCLE DRIVING GEAR, J. Matthews and G. B. Cruickshank, Birmingham.
12,896. TIRES for CYCLE WHEELS, &c., R. V. Ash, Fleetwood.
12,897. STOPPER for BOTTLES, W. C. Carter, London.
12,898. PORTABLE OIL ENGINES, G. W. Weatherhogg, Lincoln.
12,899. CYCLES, G. and J. H. Sands, London.
12,900. PREPARING WHEAT for MILLING, J. Higginbottom, Liverpool.
12,901. COTTON-SPINNING MACHINERY, A. Seymour-Jones, Manchester.
12,902. CIGARETTE-MAKING MACHINERY, V. Thuau, Liverpool.
12,903. COOKING PROCESSES and APPARATUS, J. Bowing, London.
12,904. NUT-LOCK, G. E. Hain, London.
12,905. ELEVATORS, W. H. Kern and W. H. Ebert, London.
12,906. BOX for BOTTLES, E. J. Vance and J. M. Leaver, London.
12,907. GARBAGE RECEPTACLE, A. H. Zenner, London.
12,908. MONEY-TILL, C. F. Goller, London.
12,909. REVERSING MECHANISM for COUNTER-SHAFTS, F. Holderman, London.
12,910. BLAST FURNACES, SHAFTS, &c., W. P. Ingham, London.
12,911. LEATHER POLISH or REVIVER, T. H. Paddle, London.
12,912. BARRIER, E. G. Edwards, London.
12,913. MULTIPLE MOTION, W. Jeffery, London.
12,914. SHAFTS for CHILDREN'S CARTS, J. W. Haselden, London.
12,915. METAL ROOFING, G. Ewart, F. Proschwitzky, F. Johann-Ditrich Hullinghorst, and R. Haywood, London.
12,916. TIRES for CYCLES, T. Pickup and J. Spencer, London.
12,917. OIL, GAS, and STEAM MOTORS, W. Pullen, London.
12,918. METAL GOLF CLUB HEADS, G. Murray, Fife.
12,919. ELECTRICAL ARC LAMPS, W. Jeffrey, London.
12,920. PNEUMATIC TIRES, G. Turner and J. M. H. Venour, London.
12,921. ALARM BELLS, C. E. Challis, London.
12,922. DRIVING GEAR for BICYCLES, F. A. Ellis, London.
12,923. MECHANICAL CARRYING of MATERIALS, T. P. Mannock, Catford.
12,924. HOLDER for VELOCIPEDIST'S ACCESSORIES, J. F. Dodon, London.
12,925. ROLLING METALLIC ALLOYS, H. Hewitt, London.
12,926. SCREW PROPELLERS, H. F. Fullagar, London.
12,927. UTILISING the LYES of SULPHITE CELLULOSE PRODUCTS, A. Mitscherlich, London.
12,928. PRODUCTION of a DIAMIDOPHENOLESTER, P. Monnet and M. C. Traub, London.
12,929. YARN-WINDING MACHINES, D. Young.—(*F. J. Warmer, Austria.*)
12,930. IMPROVED PORTABLE SWING, F. Nicholas, London.
12,931. METALLURGICAL FURNACES, C. James and W. Griffiths, London.
12,932. PNEUMATIC WHEEL TIRE, A. E. Spangler, London.
12,933. SHELLING COCOA BEANS, E. W. Begrie, London.
12,934. APPARATUS for DRYING COCOA BEANS, E. W. Begrie, London.
12,935. PREPARATION of COCOA BEANS, E. W. Begrie, London.
12,936. POLISHING COCOA BEANS, &c., E. W. Begrie, London.
12,937. CLAY for COLOURING COCOA BEANS, E. W. Begrie, London.
12,938. APPARATUS for MAKING BUTTER, E. W. Begrie, London.
12,939. ADVERTISING, S. Gurney, London.
12,940. IMPROVED POCKET FILTER, R. G. Westphalen, London.
12,941. PURIFICATION of WATER, L. and C. Maiche, London.
12,942. MANUFACTURE of ORTHO-HALOGEN-PHENOL, H. Baum, London.
12,943. WOMEN'S CAPS, G. Ridgard, Nottingham.
12,944. IMPROVED LITTER or STRETCHER, E. Sémal, London.

3rd July, 1893.

12,945. WINDOW-CLEANING DEVICES, W. C. Morison, Lympstone.
12,946. METALLIC MOULDS for CASTINGS, D. P. G. Matthews, Newport, Mon.
12,947. MACHINES for IRONING LINEN, S. Barrett, Keighley.
12,948. PROPULSION of VESSELS, W. Cochrane, Glasgow.
12,949. SAFETY HOLES for GOLF, &c., J. Grant, Stafford.
12,950. ROLLERS of COMBING MACHINES, J. C. Walker, Bradford.
12,951. PAINT BOXES, A. Whitehead, Halifax.
12,952. WINDOW-BLINDS, J. W. Bentley, R. Clarke, and E. Breadner, Manchester.
12,953. MARINE DINING TABLES, G. Hollinwood, Glasgow.
12,954. CUTTING WOOD, IVORY, &c., G. A. Newton and J. Fell, Liverpool.
12,955. CIGARETTES, C. and N. Jacobi, London.
12,956. IMPROVED PNEUMATIC TIRES, J. Harrison, Lincoln.
12,957. CRICKET BATS, A. Beaumont and E. Ainley, Huddersfield.
12,958. BRANCH PRUNER and TWIG CUTTER, S. Hall, Derby.
12,959. PUNCTURE PROOF PNEUMATIC TIRE, H. R. Meyer, Liverpool.
12,960. AIR VALVES of PNEUMATIC TIRES, L. R. Whitehead, Birmingham.
12,961. TOOLS for USE on WORK BENCHES, W. Sircom, Birmingham.
12,962. MACHINES for SORTING GRANULAR MATERIALS, G. F. Thompson, Liverpool.
12,963. SELF-FEEDERS for CARDING MACHINES, O. Liebscher, Manchester.
12,964. BOOT and SHOE PROTECTOR, R. J. Wood, Glasgow.
12,965. SOLES and HEELS of BOOTS, J. Milnes, Huddersfield.
12,966. PROPULSION of RAILWAY TRAINS, W. Cochrane, Glasgow.
12,967. METALLIC PACKING for GLANDS, J. Boddy, Monmouthshire.
12,968. LOCKS of WINDOW SASHES, H. G. Lazenby, London.
12,969. PNEUMATIC TIRES to PREVENT PUNCTURES, T. Ash, London.
12,970. ELASTIC PULLEYS and DRUMS, R. G. Bennett, London.
12,971. ALTERNATING CURRENT MOTORS, O. Dahl and S. L. Phillips, London.
12,972. IMPROVED COOLING APPARATUS, A. Horn, London.
12,973. "HOME RULE" TIRE, R. J. Martin, London.
12,974. PNEUMATIC WHEELS, J. Philipson, jun., London.
12,975. MANUFACTURE of PARAPHENETOL-CARBAMIDE, W. L. Wise.—(*The Firm of D. F. von Heyden, Nachflg, Germany.*)
12,976. MANUFACTURE of GLASS, H. Lepersonne, London.
12,977. ADVERTISING through TRANSFERS, W. H. Schwartz, London.
12,978. MAKING HAIR BRUSHES, &c., J. S. Toppin, Uxbridge.
12,979. TREATING REFRACTORY ORES, J. W. Hall, London.
12,980. RATCHET BRACES, R. Cŭntz, London.
12,981. SIGNAL and TELEGRAPH POSTS, I. A. Timmis, London.
12,982. GAME of WHIST, D. Balsillie, London.
12,983. ADVERTISING, J. Kendall and J. A. Hutton, London.
12,984. STOP CHAMFERING MACHINES, J. Jones and A. Leach, London.
12,985. BOTTLE STOPPERS, J. E. Bousfield.—(*J. Spear, Germany.*)
12,986. LAMP BURNERS, S. Falk, London.
12,987. IMPROVED SPIRIT STOVE, P. Kindermann, London.
12,988. PRESSES for STAMPING HORSESHOES, A. W. Knight, London.
12,989. STOPPERS for BOTTLES or JARS, J. J. Varley, London.
12,990. GAS APPARATUS, G. Winstanley, London.
12,991. TRANSFERRING PHOTOGRAPHS, A. J. Boult.—(*C. F. Josz, Belgium.*)
12,992. BINDERS for EDGES of BOXES, E. Heynen, Liverpool.
12,993. FIRE-GRATES for BURNING COAL-DUST, J. Kudlicz, London.
12,994. FACING TILES, BRICKS, &c., J. E. Hughes, London.
12,995. MAKING CARBONIC ACID GAS, H. Lane and J. Pullman, London.
12,996. STEAM BOILERS, H. P. Parkes and J. McAlpine, London.
12,997. CALCINING APPARATUS, La Société Marcheville, Daguin, and Co., London.
12,998. WORKMEN'S TIME RECORDERS, J. C. English, London.
12,999. HAIR CURLER, S. H. Crocker, London.
13,000. BUCKLES, H. Sandilands, London.
13,001. UMBRELLAS, R. Waples, jun., London.
13,002. MACHINES for FILLING BOTTLES, D. Watson, London.
13,003. DETACHABLE COVERS for TIRES, R. R. Gubbins, London.

4th July, 1893.

13,004. PAPER FILES, W. Tilley, London.
13,005. FENCING, J. Parker, Birmingham.
13,006. VENTILATOR, P. Lomax, Bolton.
13,007. MAKING LINOLEUM FLOOR-CLOTHS, J. C. Lyon, London.
13,008. MOVABLE MANTLET, W. R. Ashfield, London.
13,009. CONNECTING TIRES to CYCLES, W. Rockliffe, Newcastle-on-Tyne.
13,010. BICYCLE and TRICYCLE LAMPS, H. A. Ward, Birmingham.
13,011. JACQUARD MACHINES, C. Hahlo, C. E. Liebrich, and T. Hanson, Bradford.
13,012. ZITHER HARP PIANO, H. Carter and H. Cooper, Bristol.
13,013. HEALD MACHINES, W. Deighton, Bradford.
13,014. PROPELLER, B. W. Maughan, London.
13,015. ACCOMMODATION or SEMI TIRE, C. Davies, Manchester.
13,016. REGISTERING DIRECTION of SHIPS, J. W. Ray, Liverpool.
13,017. NOVELTY in CHARMS, A. E. Pinfold, Cleckheaton.
13,018. TOBACCO CONSUMERS, A. Sutcliffe, Blackburn.
13,019. LOOMS, J. Hibbert and J. Marsden, Manchester.
13,020. PROTECTING CYCLE TIRES, C. T. Powell, Birmingham.
13,021. FOOD, G. W. Richards and J. W. Hodgson, Sheffield.
13,022. TWISTING FIBROUS SUBSTANCES, S. E. Asquith, Bradford.
13,023. FILES, W. H. Blackwell, Manchester.
13,024. INDICATING ELECTRICAL ENERGY, G. Cheffey-James, Sheffield.
13,025. RAILWAY RAILS and CHAIRS, A. W. Green, Dublin.
13,026. BUILDING BLOCKS, J. B. Howard.—(*T. W. Arold, Germany.*)
13,027. SEALING WAX MANUFACTURE, G. Kressel, Manchester.
13,028. MACHINES for WASHING POTATOES, F. Nuttall, Lancashire.
13,029. IMPROVED LASTING MACHINES, J. T. Avery, London.
13,030. EMBOSSING DESIGNS, &c., T. E. Baird, Glasgow.
13,031. BELLS for USE on BICYCLES, E. D. Rockwell, London.
13,032. SAFETY STIRRUP HOLDERS, J. J. Rooney, Manchester.
13,033. PNEUMATIC TIRE, R. G. Sanders and H. Edwards, Birmingham.
13,034. CLOSING WATER TAPS, J. H. Landgrebe, Manchester.
13,035. COMBINED GLOVE and PURSE, T. G. Dorning, Essex.
13,036. IMPROVED RIMS of WHEELS, E. Warwich, Birmingham.
13,037. ADVERTISING BINDER FILE, T. Easton, Coventry.
13,038. CRUSHING MACHINES, R. McCully, Glasgow.
13,039. STORMS and other VALVES, T. Sim, Glasgow.
13,040. INVALID CARRIAGES and CYCLES, S. Kemp, London.
13,041. SPRING MOUNTING for WINDOW-BLIND ROLLERS, J. Allison, London.
13,042. GAUGE for WOODWORKERS, H. J. Jones, London.
13,043. HANDLES for CHEESE CUTTERS, W. J. Denney, London.
13,044. PNEUMATIC TIRES, G. Turner and J. M. H. Venour, London.
13,045. AUTOMATIC ADVERTISING, G. Webb, sen., and G. Webb, jun., London.
13,046. CONNECTING VEHICLES to TRAMWAY ROPES, G. Batchelor, London.
13,047. CONNECTING PEDALS to CYCLE CRANKS, W. J. Lloyd and W. Priest, London.
13,048. UMBRELLAS and PARASOLS, E. B. Podmore, London.
13,049. METAL BARS to be CAULKED, W. Grant, London.
13,050. TOOLS for TURNING and the like, H. G. Held, London.
13,051. ATTACHING PNEUMATIC TIRES to CYCLES, A. H. Bond, London.
13,052. DRIVING WHEELS for MACHINERY, W. L. Wise.—(*G. D. Munsing, United States.*)
13,053. REGISTERING APPARATUS, J. C. Fell.—(*The Lewis and Fowler Manufacturing Company, United States.*)
13,054. RAIL JOINTS, C. U. Fisher.—(*The Heath Rail Joint Company, United States.*)
13,055. IMPROVED DIVING APPARATUS, G. Anderson, London.
13,056. NAILS, E. R. Butler, London.
13,057. MANUFACTURING SOAP, D. Nagy and J. Block, London.
13,058. BOXES for PATTERN CARDS, C. F. G. R. Schwerdt, London.
13,059. SELF-OILING CAR WHEELS, J. H. Watt, London.
13,060. IMPROVED BEDSTEADS, A. G. Goodwin, London.
13,061. CREAM SEPARATORS, A. J. Boult.—(*J. J. Berrigan, United States.*)
13,062. MECHANICAL MOVEMENTS, W. P. Thompson.—(*E. M. Kellogg, United States.*)
13,063. MAGAZINE CAMERAS, A. J. Boult.—(*E. R. Andrews, United States.*)
13,064. PREVENTING RETARDATION in ELECTRIC CABLES, S. P. Thompson, London.
13,065. TWO-WHEELED VEHICLES, M. D. Rucker, London.
13,066. INCANDESCENT LAMPS, A. J. Boult.—(*O. H. Steuer, Germany.*)
13,067. CYCLE PEDALS, J. R. Trigwell, London.
13,068. FURNACES, C. Wagener and P. Baumert, Liverpool.
13,069. MANUFACTURING GAS, A. J. Boult.—(*E. Coreen, United States.*)
13,070. PARALLEL RULES, W. E. Postlethwaite, London.
13,071. ELASTIC TIRES for CARRIAGES, F. H. L. Shipton, London.
13,072. BRAKE for CARRIAGES, &c., G. T. Mackley, London.
13,073. EXHIBITING ADVERTISEMENTS, A. W. Loveland, London.
13,074. MEASURING the HUMIDITY of the ATMOSPHERE, A. Heil, London.
13,075. SHIFTING DRIVING BELTS, E. Edwards.—(*E. Babel, Germany.*)
13,076. DRIVING MECHANISM of CYCLES, &c., E. Wood, London.
13,077. STOVES, S. Wilson, London.
13,078. KITCHEN RANGES, S. Wilson, London.
13,079. PROCESS for MAKING PAVING STONES, A. Typlt, London.
13,080. PRODUCING ARTIFICIAL MARBLE, &c., A. Typlt, London.
13,081. PLATES for SECONDARY BATTERIES, J. Pitkin, London.
13,082. CARRIAGE, &c., VENTILATORS, E. T. Hayman, London.
13,083. BRAIDING MACHINE, A. M. Clark.—(*C. Raffloer, Germany, and C. H. Schott, United States.*)
13,084. INKSTANDS, G. R. Weed and A. M. Mitchell, London.
13,085. STARTING ENGINES, W. D. and S. Priestman, London.
13,086. COLLAPSIBLE HEADS for ROAD VEHICLES, G. S. Thompson, London.
13,087. SMOKE-CONSUMING FURNACES, E. Herbst, London.
13,088. WHEELS and TIRES of CYCLES, M. Svagrovsky, London.
13,089. CASTING the TEETH on GEAR WHEELS, S. E. Maxwell, London.
13,090. MACHINES for MAKING NAILS, W. M. Severance, London.
13,091. BURIAL CASES, J. A. Lakin, London.
13,092. FOUNTAIN PENS, W. A. Leary and J. R. Callahan, London.
13,093. NUT-LOCKS, H. H. Lake.—(*B. Porter, United States.*)
13,094. NECKTIES, T. C. Robinson, London.
13,095. MEMORANDUM BLOCKS and PADS, G. W. Brown, London.
13,096. DUST-PROOF HAT and UMBRELLA CABINET, T. M. Ellis, London.
13,097. AIR MOTOR, V. I. Feeny.—(*The Foulkes Accelerating Company, United States.*)
13,098. ROLLING MILLS, A. Raze, London.
13,099. REGULATING CARRIAGE BALANCE BLOCKS, T. A. Witham, London.

5th July, 1893.

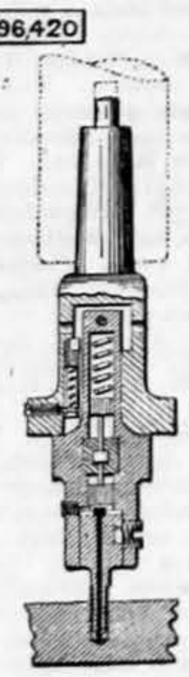
13,100. FERRULE, C. Binks, York.
13,101. METHOD of WINDING DYNAMOS, D. Urquhart, London.
13,102. WIRE-MATTRESS BEDSTEADS, L. H. Brierley, Birmingham.
13,103. RAISING and LOWERING WINDOWS, A. Sanderson, Sheffield.
13,104. PNEUMATIC TIRES for CYCLES, J. W. Dunn, Stoke-on-Trent.
13,105. FURNACE STOKER, B. D. Healey, Preston.
13,106. HAIR CURLING APPLIANCES, E. Linnett, Birmingham.
13,107. CYCLE SADDLE CLIPS, D. A. Martin, Birmingham.
13,108. TIRES, H. E. N. Mason and W. H. Peters, Birmingham.
13,109. DOUBLING YARNS, L. Hargreaves and T. Gordon, Accrington.
13,110. LUBRICATING APPARATUS, W. Vallance, Overtown-by-Wishaw, N.B.
13,111. TRAVERSE MOTION of DYNAMOS, &c., J. Pease, Yorkshire.
13,112. PNEUMATIC TIRE REPAIRER, J. J. B. Jones-Parry, Dublin.
13,113. SHUTTLE BOX SWELLS of LOOMS, R. Slack, Manchester.
13,114. CONSTRUCTION of EYELETS, R. Whitaker, Birmingham.
13,115. FIRE-ESCAPE, C. P. Mitchell, Keighley.
13,116. PLASTERING WALLS, J. C. Sellars, Liverpool.
13,117. PRODUCTION of CHROMIUM, A. Sternberg and A. Deutsch, Manchester.
13,118. DRYING CYLINDER SUPPORTS, J. J. Sumner, Manchester.
13,119. PLASTERER'S, &c., MOULD RUNNER, E. Main, Leicester.
13,120. SEWING NEEDLES, W. P. Thompson.—(*H. A. Blanchard, United States.*)
13,121. LOOM SHUTTLE GUARDS, E. Smith, Bradford.
13,122. TRAMWAY SWITCH ADJUSTER, J. J. Carter, Dublin.
13,123. MOVABLE IRON or STEEL RAM, J. B. Herbert, Suffolk.
13,124. BROOCH PIN JOINTS, J. Grove, Birmingham.
13,125. APPLIANCES for BUTTER-MAKING, F. T. Bond, London.
13,126. APPARATUS for PRODUCING GAS, W. Young, Glasgow.
13,127. CHEMICAL HANDBILLS, T. P. Jary, London.
13,128. SECURING PNEUMATIC COVERS to RIMS, T. Ash, Walsall.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

496,420. SELF-ACTING TAP HEAD, *S. D. Leland, Holyoke, Mass.—Filed April 2nd*, 1892.

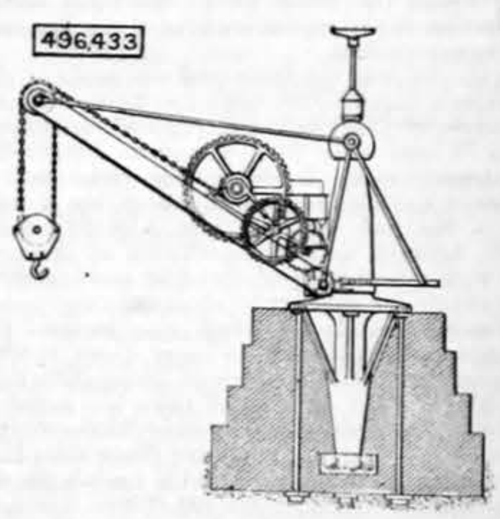
Claim.—(1) The self-acting tap head herein described consisting of an upper member having at its lower end downwardly projecting lugs, and a lower member having at its upper end radially movable dogs adapted to be engaged by said lugs on the upper member and to be withdrawn from said engagement, a vertically movable cam block located within said lower member and having positive engagement with said dogs, whereby movement of the former will be transmitted to the latter, a tap carried by said lower member, and a gravity device carried by said tap in position to engage the material in which the tap is operating as the latter approaches the bottom of the surface to be tapped, said gravity device at its upper end abutting against said cam block, combined and operating substantially as and for the purpose described. (2) In the self-acting tap head herein described, member B



having the transverse opening b^3 therein and having dogs b^8 located within said opening and adapted to have free movement therein, said dogs having the slots or grooves 6 therein, in combination with block b^5 located within a central bore in said member, said blocks being composed of the ends 4 united by stem 3, and having the inclined ribs 5 projecting from opposite sides of said stem within the grooves in said dogs, spring b^6 and stop screw b^7 arranged and operating substantially as described. (3) In a tap head, member A having lugs a^2 in combination with member B having dogs b^8 and cam block b^5, said dogs being provided with the detachable bearing plates 7, substantially as described.

496,433. PILLAR CRANE, *W. H. Morgan, Alliance, Ohio.—Filed June 13th*, 1892.

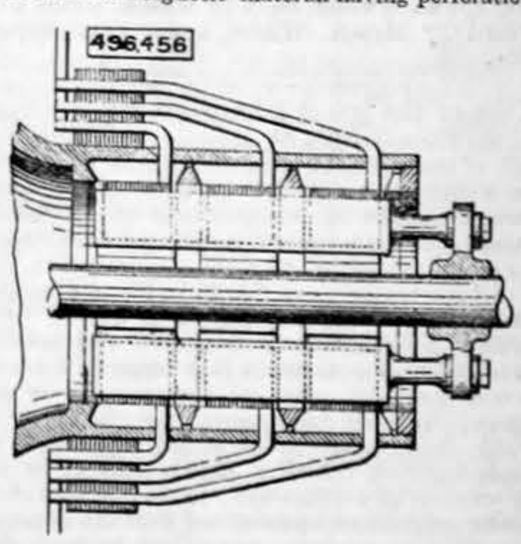
Claim.—(1) In a jib crane, the combination with a stationary pillar or standard, and a jib bearing against said pillar or standard at or near its base and attached to said pillar or standard at a point above its base, of an electric motor on the jib, gearing connecting said motor with the winding drum, a conductor and sliding contacts between said motor and conductor, substantially as set forth. (2) In a jib crane, the combination with a post or standard, an electric conductor, and stationary contacts connected with



said conductor, of a cap loosely mounted on the post or standard, a box carried by said cap, contacts carried by said box, a jib supported by said cap and electric motor carried by said jib. (3) In a jib crane, the combination with a stationary post and stationary contacts located above the post, of a movable cap mounted on the post and carrying contacts, the latter bearing against the stationary contacts, a jib, stay rods connecting the jib and cap, and a motor carried by the jib, substantially as set forth.

496,456. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES, *E. Thomson, Swampscott, Mass.—Filed December 2nd*, 1891.

Claim.—(1) The combination with the commutator and the armature connection therefrom of a mass of magnetic material in inductive relation to such connection. (2) The combination with the commutator, and its armature connections, of a mass of magnetic material in inductive relation to such connection. (3) The combination with the commutator, and its connections, of the laminated mass of magnetic material in inductive relation to such connections. (4) The combination with the commutator and its connections, of the mass of magnetic material having perforations



through which such connections pass. (5) The combination with a single armature lead, of two or more sub-leads therefrom, separate insulated commutator segments connected respectively to such sub-leads, and two or more brushes bearing respectively on such segments. (6) The combination with a single armature lead, of two or more separate insulated commutator segments lying in the same axial plane and connected with said lead. (7) A commutator composed of two or more sets of separate insulated segments, the corresponding segment in each set lying in the same axial plane. (8) The combination with a single armature lead, of two or more sub-leads therefrom, each having a portion of large self-induction, separate insulated commutator segments connected respectively to such sub-leads, and brushes bearing on such segments.