THE MANUFACTURE OF COKE.

No. III.

It is with considerable gratification that we find ourselves in the position of being able to record the fact that the recognition of the importance of the employment of more economical methods in the production of coke has made, and is making, considerable progress in this country, and we look forward to recording, before these articles are completed, some good examples from independent practical experience in this country of the many advantages accruing from the adoption of the long narrow oven with the recovery of by-products. As an example of this spirit of approval we quote the following from the *North Star* of January 26th, 1897:—"Cleveland coke industry.—In March, 1895, it was announced in the *North Star* that a new departure was taking place in the Durham coke industry, and that the Carlton Iron Company, Limited, had arranged to erect retort ovens for the recovery of the valuable by-products, tar, sulphate of ammonia, and benzol, in conjunction with their blast furnace plants, so as to enable them to gain the advantage of a regular supply of first-rate coke close to the blast furnaces. We now hear that the Carlton Iron Company's experiment has been so successful and the quality of the coke produced so superior, that the proprietors have determined to put down another battery of Semet-Solvay ovens and complete recovery plant. This will make in all for the Carlton Ironworks a plant of Semet-Solvay ovens which is expected will produce about 1400 tons of coke per week. There is every reason to believe that the new coke industry with recovery of by-products has taken a firm hold in the Cleveland district, and the Carlton Iron Company, as pioneers of the latest and most improved development of retort ovens, are to be highly congratulated." It must be borne in mind constantly that any haphazard adoption of any system will almost certainly lead to failure; therefore, when it has been decided to replace any old wasteful method by a new and improved method, the first step is to determine which system or combination of systems is to be adopted, and this should not be done hastily, but should be considered with due deliberation, coupled with careful inquiry into all the merits and demerits of rival systems, on no account relying solely on the statements of interested parties *pro* or *con*. Having ascertained these factors, the evidence accumulated should be cautiously weighed and precisely applied to local circumstances; bearing in mind particularly the quality of the coal from which the coke is to be made, and the modifications in the ovens that would be required to suit such coal. When these investigations are completed, and not before, should the system to be adopted be selected. Moreover, having decided on the system, every precaution should be taken to have it installed and operated in an efficient manner, working it regularly, systematically, and continuously, otherwise again failure may be encountered. Quite recently we have had submitted to us two samples of coke, both from retort ovens, one of a most wretched description and the other just as good as one could wish to see; the former would lead us to the conclusion that retort ovens are to be avoided, the latter to the determination of employing no other than retort ovens. This is just one demonstration of the fact that care is required before forming a decisive opinion on this subject.

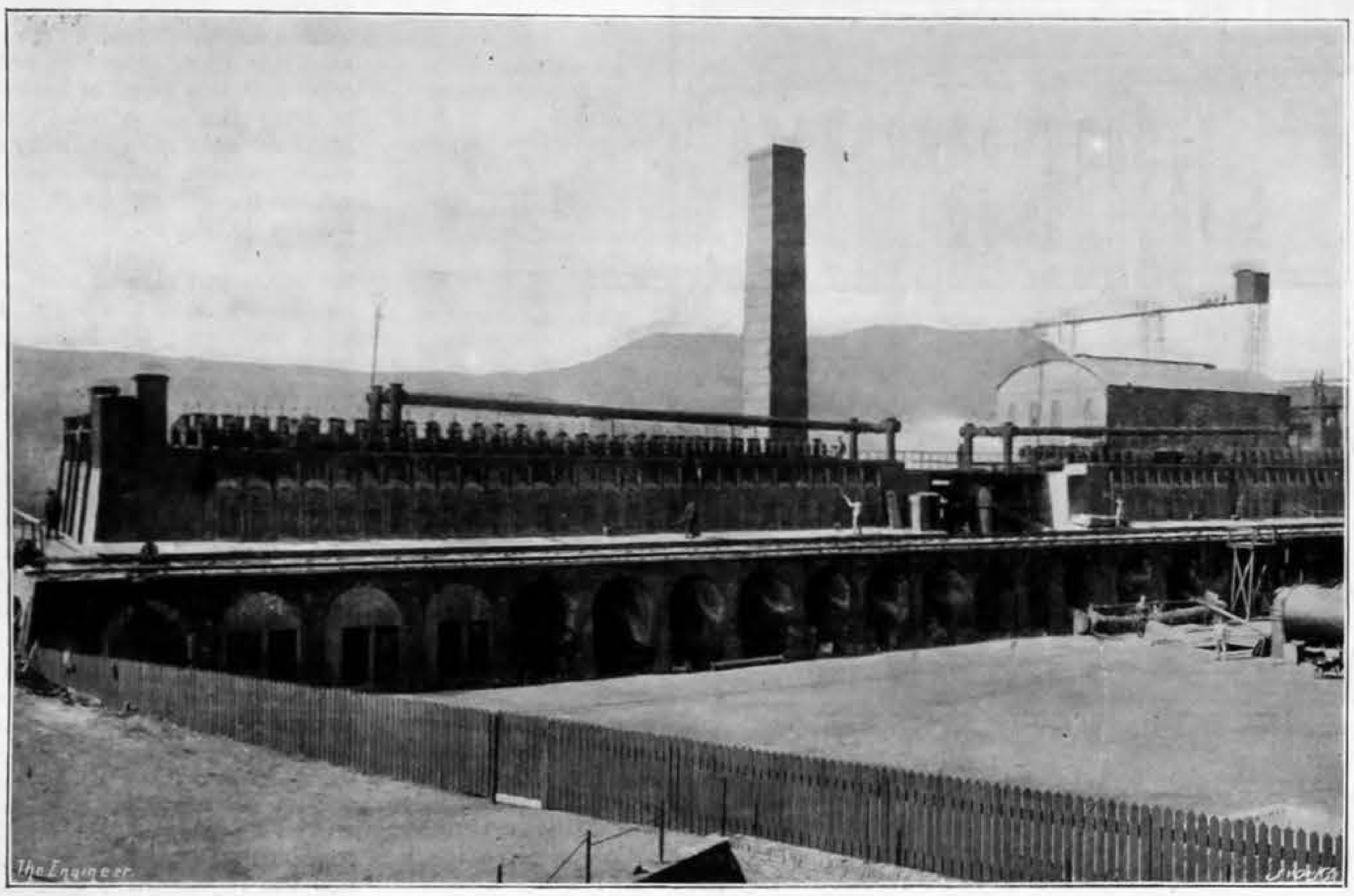

Fig. 24—VIEW OF A BATTERY OF 60 OTTO-HOFFMANN COKE OVENS FROM THE RAM SIDE

It is perhaps well to draw attention to the fact that in the great iron-producing countries of Western Europe the beehive oven has practically disappeared, and even in the central countries is being rapidly displaced by retort ovens. The remarkable effect that this has exerted on the German iron industry is too well known to all interested to need further comment from us, and all must acknowledge that German opinion on and example in the practice of industrial operations are not to be discarded without mature consideration, which will generally lead to the conclusion that the opinion and the example are worth putting to the test on a practical scale.

Turning to America, we have at hand the facts recently published, from the pen of Mr. Joseph D. Weeks, to whom we have referred previously, and whose regretted death has removed a prominent authority from the metallurgical circles in the United States. These facts relating to coke-making are contained in a Government report, and include data relating to the introduction and establishment of retort ovens into the States up to the end of 1895. The position recorded is, that at the close of 1895 there were in operation in the United States, in addition to the 12 Semet-Solvay ovens that have been in operation for the previous two years, 60 Otto-Hoffmann ovens; whilst in course of construction there were 100 Semet-Solvay, 60 Otto-Hoffmann, a large number of Slocum ovens—a modification of Carvés ovens—and a bank of Huessener ovens, moreover, other blocks of retort ovens were in contemplation. The Semet-Solvay record is as follows:—

Average of coke per oven per year	1543 tons
Percentage of coal obtained in coke from all coals	83·4
" " from Morris Run coal (analysis below)	84·5
Per cent. of the yield of coke in Semet-Solvay oven yielded in beehive oven from the same coal	41

Analysis of Morris Run Coal and Coke.

	Coal. Per cent.	Semet-Solvay coke. Per cent.
Moisture	0·42	0·47
Volatile matter	20·04	1·97
Fixed carbon	70·98	85·17
Ash	8·84	12·39
Total	100·28	100·00
Sulphur	1·30	0·91

The company declined to place a value either on the coke made or the coal used. It may be observed, however, that the actual yield of coal in coke throughout the United States in 1895, taking the actual weight of coal charged into the ovens and the actual weight of coke drawn, is put down as not exceeding 60 or 61 per cent. Then with regard to the Otto-Hoffman ovens, they had not been sufficiently long in operation to have passed the experimental cokings, and therefore no record of their performance appears in the report. With regard to the Connesville region, it is remarked that probably "the character of the coke is so good that the oven owners do not see any necessity for attempting to improve its quality. It is probable that the quality of the coke would not be improved in a by-product oven, but certainly the enormous waste of material that passes out with the gases would be avoided were the by-product ovens used."

It will now be opportune to call attention to a British view of the question, which, although, judging from the imperfect and guarded statements made in reference to this subject, it is apparently based on very casual observations, is, nevertheless, of significance. We refer to the comments made by the delegation organised by the British Iron Trades Association to report on the iron and steel industries of Belgium and Germany, which were to the following effect: Their attention was repeatedly called, in both Belgium and Germany, to the value and economy of the system generally adopted in both countries for the recovery of the by-products of the coal in the process of manufacturing coke. So far as they could ascertain, this system was being carried out almost universally on the Continent, where the beehive oven had been displaced by the Coppée, the Appolt, the Otto, the Solvay, or some other system specially designed to enable the ammonia, tar, benzol, &c., to be recovered in the process of coking. They found the effect of this system was to enable the coke to be sold or charged to the furnace at a lower cost than was possible in the absence of such a system. But they do not venture to express any opinion on the technical question of whether the quality of the coke is in any way deteriorated by this process, as appeared to them to be either apprehended or ascertained in English practice. Finally, they restricted themselves to asserting that this difference in practice was an element in giving to continental countries fairly cheap supplies of coke—a safe, but important admission. Nevertheless, in spite of being left in the dark as to the actual systems in vogue, their relative merits, the quality of the coke produced, the proportion of coal regained as coke, the actual economy effected, and a multitude of other significant points, the admission that some economy is effected must be regarded as offering fair encouragement to those who hesitate about changing from the beehive to the retort oven.

At the close of the second article of this series, which appeared in THE ENGINEER of September 25th of last year, we said we hoped to draw attention to other forms of ovens and their modifications, an intention we intend to carry out, but for the present we shall continue our remarks on the systems already noticed, for the simple reason that they are the only two that are prominently before the public at the present time, and, moreover, one of them has made some further progress since we wrote about them.

Firstly, we will draw attention to the illustrations numbered respectively Figs. 17, 18, 19, 20, 21, 22, and 23 in the issue just referred to, pages 305, 306, and 316, and about which statistics are given in the table on page 306. Fig. 17 is a representation of an installation erected in 1891, and numbered 3 on the table; it gives a very good idea of the general appearance of a Semet-Solvay battery of forty-eight ovens, with the recovery plant belonging thereto. The view is from the discharging side of the ovens, and the various details may be observed. The charging tubs and the three sets of rails upon which they run; the ascension pipes, bridges, the hydraulic main, and other pipes carrying away the volatile products, whilst the main conveying the washed gases to the ovens is seen following along the top of the ovens on the side towards the spectator. The magnitude of the various parts may be judged by comparison with the men standing about. The structure to the right of the figure is a storage hopper where different qualities of fuel are mixed and ground before filling into the small charging tubs. Fig. 18 shows a corner of the plant at Brymbo—No. 11 in the table. The washer to the left is the first ammonia washer and tar extractor; the round apparatus in the centre is the benzol absorber; and the square washer on the right near the round tower is the final ammonia washer. Fig. 19 gives a view from the discharging end of a plant erected in England as far back as 1886, and numbered 2 on the table. Fig. 20 depicts the bench numbered 5 on the table. It may be observed that the vertical lines in the background have nothing to do with the plant, but represent an avenue of trees as reproduced in engraving. This is a bench of twenty-five erected

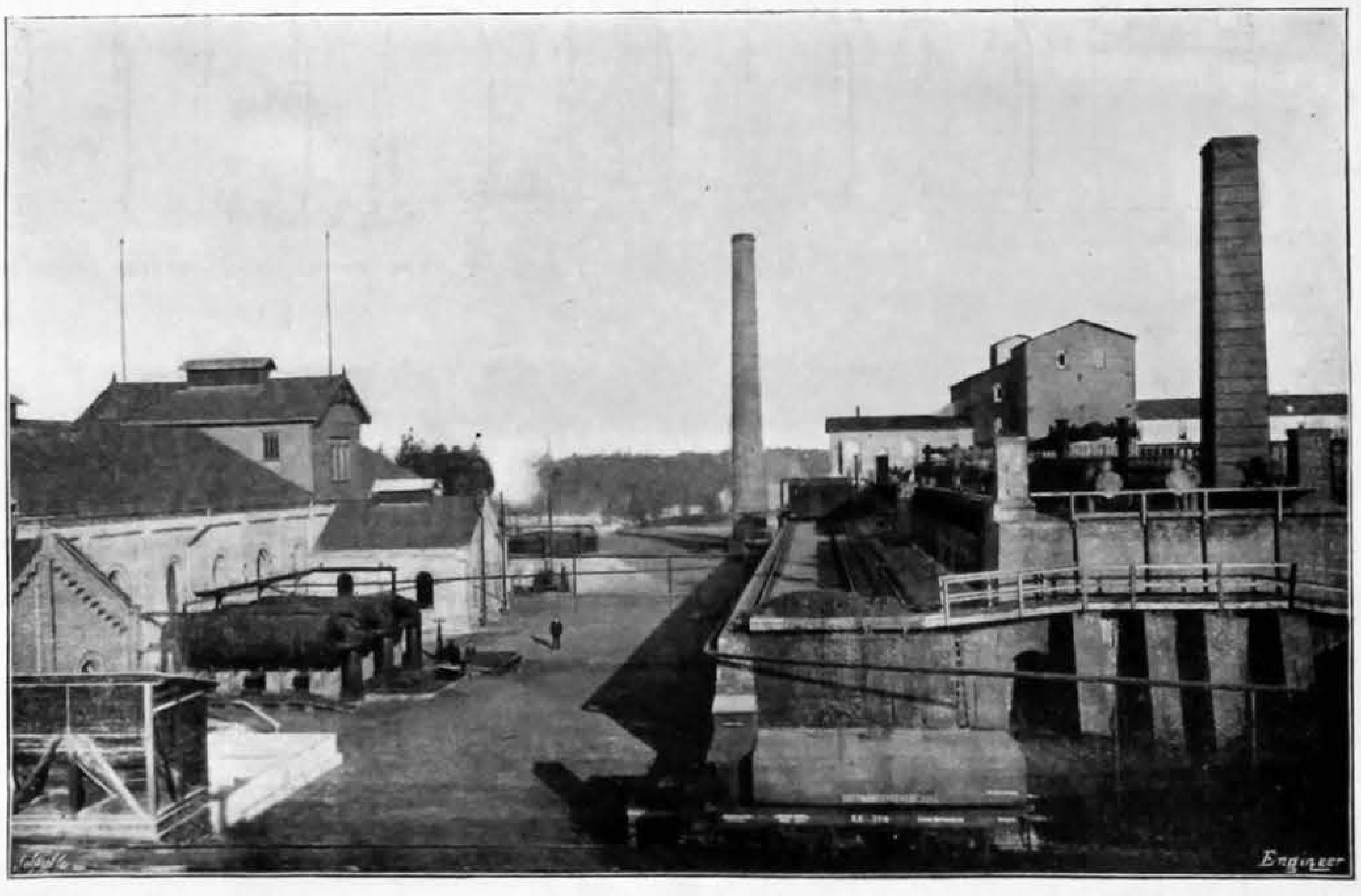

Fig. 25—END VIEW OF BATTERY OF 60 OTTO-HOFFMANN COKE OVENS

in 1892. The methods of closing the doors and the arrangements for taking off the gases are distinctly shown, as are also the washed gas return pipe and cooling the coke outside the oven by jets of water, whilst part of the recovery plant towers up at the back. In Fig. 21 the battery numbered 9 is set forth, with an old form of coke oven in course of demolition on the left of the figure and the colliery buildings and accessories at the back. The plant numbered 10 on the table is shown in Fig. 22, and, amongst many other points, shows an arrangement for utilising the waste heat under boilers for raising steam. There are two distinct batteries of 25 each, having separate boiler installations and recovery plant; one set being in course of erection. Fig. 23 in a similar way presents to view four batteries of 25 each. Here again may be seen the operation of the coke cooling by men directing jets of water on to the wall of hot coke just ejected from an oven. This is the plant numbered 1 on the table, and is at once the most ancient and the most imposing of all we have shown.

We have at present nothing further to record in connection with the Semet-Solvay system, as their system is found to work to their entire satisfaction.

In the meantime the Otto-Hoffmann system has been making progress, and has undergone very considerable modification since the period represented in the issue of THE ENGINEER already referred to, and, therefore, calls for further notice and illustration. We publish also—what could not be obtained before—a general view, which will give an idea of the character of the structure required for this system; this is shown in Figs. 24 and 25, which represent two views of batteries of Otto-Hoffmann coke ovens from the ram side, showing the accompanying substructure as well as the arrangements at the top for taking off the gas. In Fig. 24 the method of closing the ovens can also be seen, and in the front to the right the dust arresters; the latter can, however, be seen better in Fig. 25 to the left outside the by-product recovery house; in this view, too, the ram for discharging the ovens can be observed. The magnitude of these structures may again be gathered from the men about and from the coal truck in front of Fig. 25, which is a continental and not a British truck.

We may now refer to some of the modifications that have been effected in the Otto-Hoffmann ovens, firstly comparing Fig. 26 with Fig. 4, p. 303, of the issue already frequently alluded to; the most conspicuous alteration is that connected with the regenerative system, for not alone have the regenerative surfaces and areas been very much reduced, but also the regenerative chambers have been set in front of instead of under each end of the ovens; the latter are consequently supported

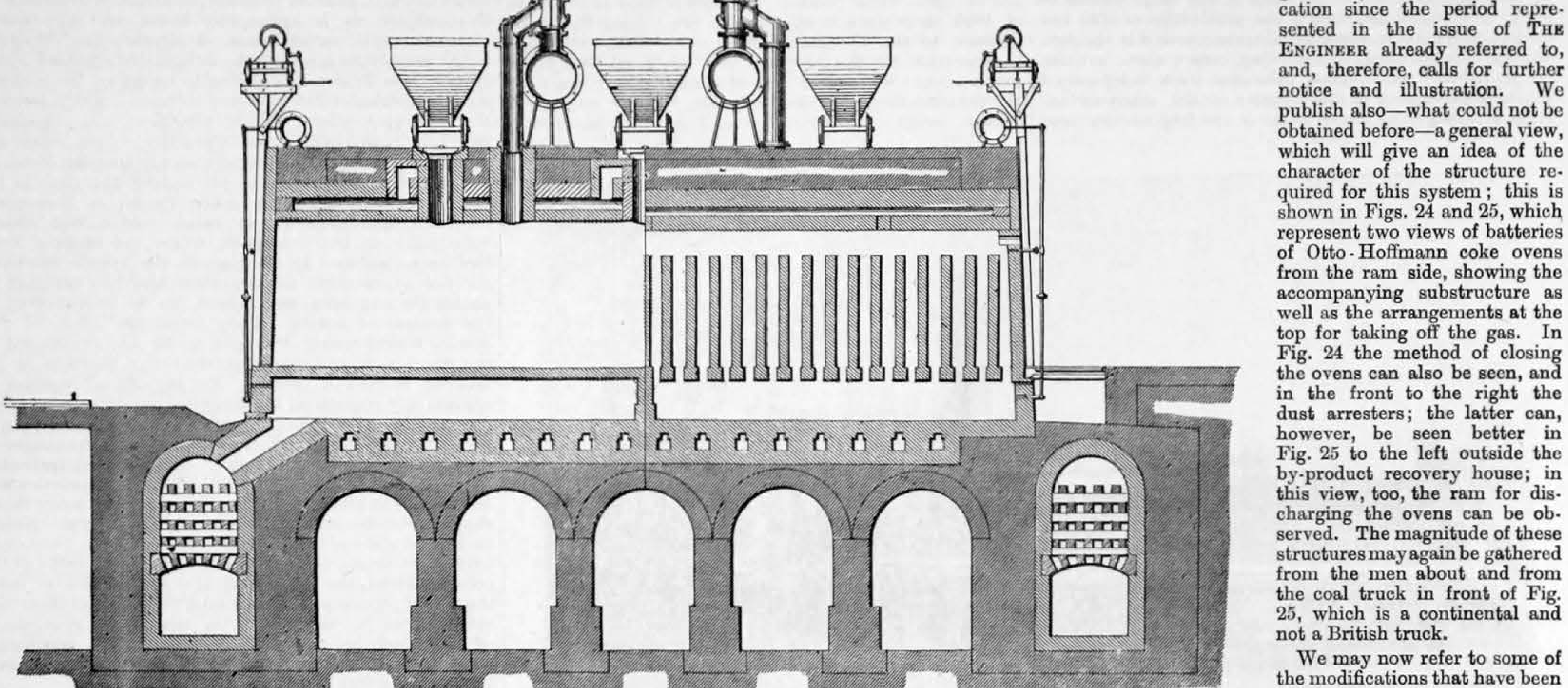

Fig. 26—IMPROVED OTTO-HOFFMANN COKE OVEN

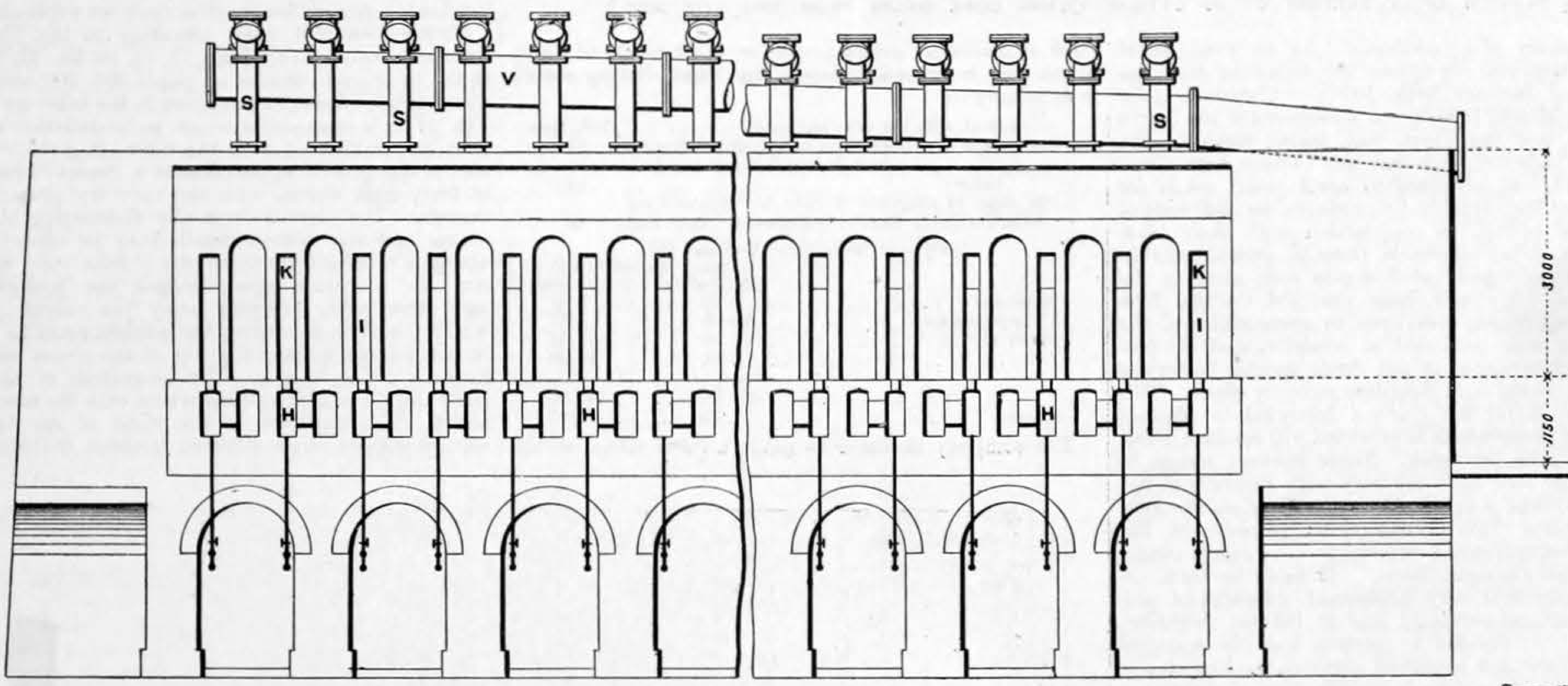

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Fig. 27—RECENT TYPE OF OTTO-HOFFMANN COKE OV.N

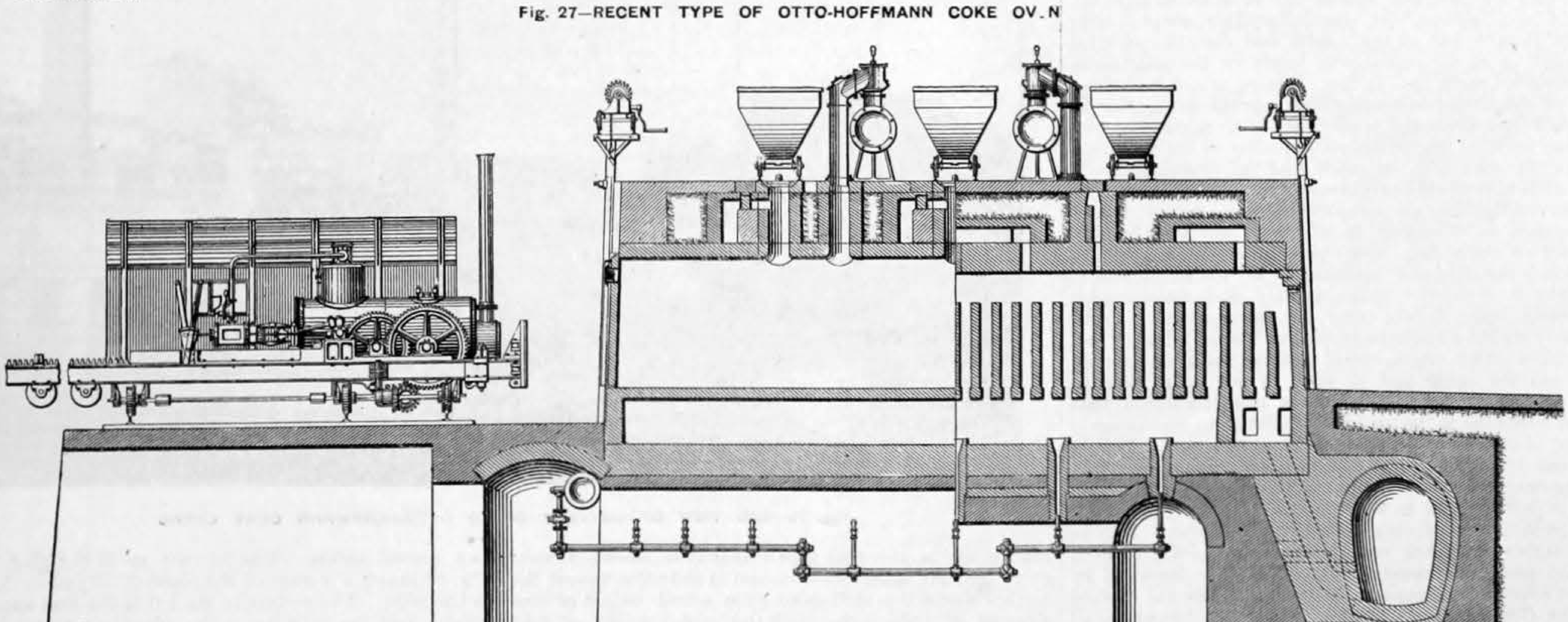

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Fig. 28—LONGITUDINAL SECTION OF Fig. 27

on five, instead of three arches, and air can circulate freely under the whole length of each oven. The whole of the sole of the oven, therefore, can by this means benefit by the cooling influence of the air, and not as hitherto be partially cooled, and partially not only not cooled, but even subjected to the by no means desirable influences of the heat from the regenerators. Then the reduction of the size of the regenerating system has enabled a simplification to be effected in the conduit that carries waste gases from and fresh to the regenerator; this conduit here appears as a single larger chamber instead of two smaller ones. Another important modification is shown in reference to the gas for heating the ovens; instead of being conveyed in mains running below and in front of each end, as shown in Fig. 4, in Fig. 26 it will be observed that these gas mains run along the top, and the gas is supplied to the ovens only in the side flues, but both at the top and at the bottom, thus providing for a distribution of the area of actual combustion, in somewhat the same manner as the disadvantage of overheat in the sole flue was overcome in the case of the transformations of the Carvés and Simon-Carvés ovens in days gone by. The cooling flues below the sole only appear in one direction; whilst the mode of making the connection between the interior and exterior of the ovens for the preliminary heating has undergone some change, and the flue over the arch and the flue or flues connecting it with the side flue considerable alteration. The travelling winches represented as working over the gas mains are for the purpose of raising and lowering the doors. The Otto Company is, however, not content to remain stationary, but is still progressing, and as late as August 27th, 1896, a patent of its own was published by the German Patent-office. This newest modification is shown in Figs. 27, 28, and 29. Here we find a complete revolution has taken place, the Hoffmann characteristic has entirely disappeared, and a reversion to the single main for the waste gases below the ground level in front of one end of the ovens is observable. The same remark applies to the connection of this main with the sole flues by means of inclined ducts—Figs. 27, 28, and section 3, Fig. 29. But the sole flues have quite altered in character and function; near the entrance to the outlet duct there is a small parting wall that shuts off the other part of the sole flue, in which part there is no arrangement for any regular circulation of gas, air, or heat; consequently the lower cooling flue has become unnecessary, and has been abolished. The lower longitudinal side flue is, however, divided into compartments by the continuation downwards of some of the walls separating the vertical flues, and each of these compartments is connected by a duct, or ducts, with the sole flue. In this way, moreover, it will be seen that the vertical wall flues become divided into groups, but only the group at the waste main end is in connection with that portion of the sole flue that connects with the waste main, see Fig. 28; consequently, the current of gas is downwards in the last group of side flues and upwards into the upper longitudinal side flue in all the others. Now we come to the special feature of the present modification, indicated in all the cuts, that is the method of burning the waste gases. Instead of admitting them unburnt into the flues, they are in the new arrangement led by piping beneath each parting wall and from Bunsen jets rising from the piping are burnt in orifices opening beneath each group of side flues, except that group that serves for the escape of the products of combustion. To ensure thorough combustion arrangements are made for injecting air above each gas jet. The continuous flue over the vault of the ovens has gone, and only a few short flues connecting with the charging holes are shown in Fig. 28, and in the patent drawing, Fig. 29, there are no flues whatever over the arches of the ovens, the necessary connection between the side flues and the inside of the oven being made by a junction with the ascension pipe provided with a valve, so that when this valve, v^1, is open and that in the bridge, v, is shut, the gases pass into the side flues, which can also be connected with the air by special ducts, as in the old Coppée. These arrangements are required in the preliminary heating of the Otto-Hoffmann ovens, which in all its modifications takes place by working them as Coppée ovens until they are raised the proper temperature, which once being obtained, is, of course, maintained uninterruptedly until repairs necessitate a cooling down. When this stage is attained the ducts leading to the charging holes are blocked up, as shown in Figs. 26 and 27, or in the case where the valves are used, the valve controlling the entrance to the side flues is closed, and that leading to the hydraulic main opened. The tubes p p—Fig. 29, above—conduct air from a main at the top to the air ducts shown in sections 2 and 3, under the sole flue in the former and in the latter in the side flue, to be out of the way of the spent gas ducts.

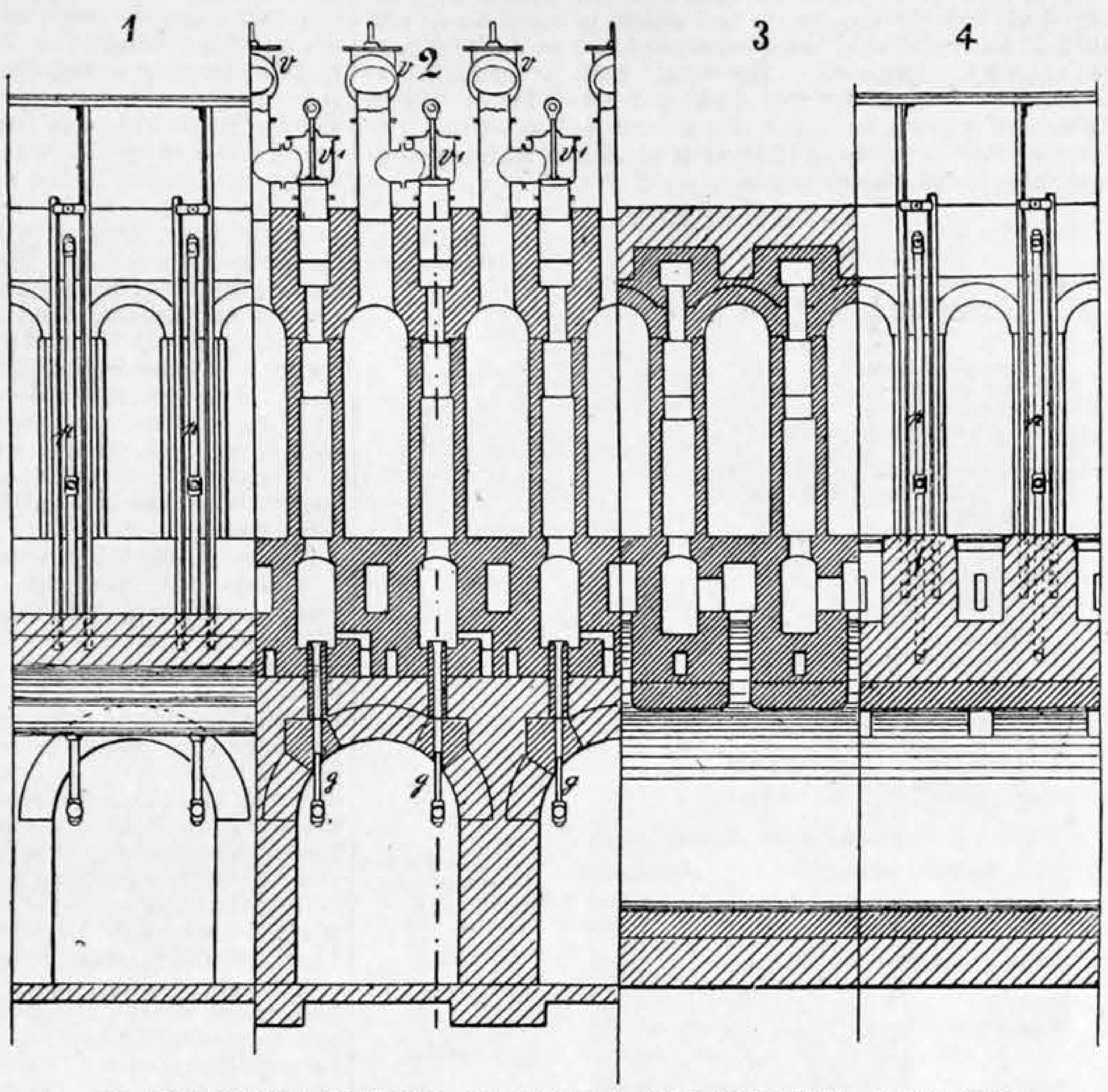


Fig. 29—TRANSVERSE SECTIONS OF RECENT OTTO-HOFFMANN COKE OVEN

In the new arrangement the substructure and foundation have undergone considerable change, the ovens being mainly supported on longitudinal vaults instead of transverse vaults as in former cases; these vaults are made high enough for a man to enter—and probably will become hot enough to keep him out—and in them are arranged the gaspipes, jets, and cocks; the gas main running under ground at one end. The air supply is now heated as in most other systems by recuperation, although no complications for the purpose are introduced as is done in many of the other systems. Fig. 27 shows a transverse section of the new arrangement, as designed for working purposes; H are the lower side flues, I the vertical side flues, K the upper longitudinal side flues, S the ascension pipes, and V the hydraulic mains; the arrangement of the gas pipes and the connections between the sole and lower side flues, and between the latter and the vertical flues, are shown. Fig. 28 gives four sections as set forth in the patent specification, and distinctly illustrates all the points referred to above. Fig. 28 represents a sectional elevation in part through the length of the oven, and in part along the separating wall, from a special drawing, and, with the exception of the dividing walls in the lower longitudinal flue, shows very clearly the new arrangement, with all accessories, including the ram; in this instance too, the arrangements for the preliminary heating are included in the structure itself, and the air ducts, as well as the connections between the side flues and the interior of the ovens, by the way of the charging holes, and the modes of working these, may be readily followed. Then, too, the ascension pipe, bridge, and hydraulic main are again displayed, also the tubs and the winches, and the little cooling channels below the great waste main.

The advantages claimed for this new scheme are many. Of course, the usual one claimed for having the gas main underground and out of the way of the ovens; then the better distribution of the gas and the exposure of the lower part of the ovens, instead of the upper part to the highest temperature, are the main advantages, the latter one increasing the yield of by-products, as they are not decomposed to the same extent as when the combustion takes place in their vicinity; and, furthermore, an equalisation of the pressure of the gas is to result from the proposed subdivision, so leaks through cracks inwards or outwards from the coking chamber are, it is claimed, to be obviated. These are the advantages claimed, but it remains to be proved whether they are substantiated or not, and what is more, whether the newest order of things is economical or otherwise; anyway, we are informed, it is not intended to displace the usual form, as yet, by the new one.

(To be continued.)

THE NEW WHITE STAR MAIL STEAMER.

In our last impression we gave all the information then available concerning the new White Star boat, the Oceanic. We have since received an authoritative statement from Messrs. Ismay, Imrie, and Co., which runs as follows:—That there is no such thing as finality in modern shipbuilding is strikingly evidenced in the announcement that Messrs. Ismay, Imrie, and Co. have arranged with Messrs. Harland and Wolff, of Belfast, for the construction of a new and very remarkable addition to the White Star fleet of Atlantic liners. This steamer will exceed in length by 65ft. any vessel, either afloat or in course of construction. Nor will her claim to distinction stop at this point; she will break the world's record for length, which hitherto has been held by the Great Eastern. The Great Eastern was 679ft. in length; the Oceanic will be 704ft., or 25ft. longer, and her gross tonnage will exceed 17,000.

In the construction of the new vessel the White Star Company adhere steadily to the principles which they have followed with such signal success during the whole of their career. Due attention will be given to the matter of speed, but extreme speed will be subordinated to the comfort and convenience of passengers of all classes; and in her internal arrangements the new vessel will be an enlarged reproduction of the Teutonic and Majestic, except in so far as improvements may have suggested themselves in the size and fittings of the rooms, and which may be rendered practicable by the increased dimensions of the ship herself.

Upon the question of speed the company announce that although a much higher sea speed than that now contemplated is quite practicable from an engineering point of view, it has been determined as far as possible to aim at a regular Wednesday morning arrival, both in New York and in Liverpool, making the Irish land and Queenstown by daylight, and enabling passengers who may be travelling to places beyond the port of arrival to proceed to and in the majority of cases reach their destinations with comfort during the day.

It is expected that the new Oceanic will be launched in January next. Her advent will undoubtedly be regarded with interest not only from a commercial, but also from a naval point of view, as a valuable addition to the nation's fleet of mercantile armed cruisers, which contains at this moment only four vessels with twin screws—of which two are the White Star steamers Teutonic and Majestic—fulfilling all the Admiralty requirements, and capable of maintaining a sea speed of 20 knots or over; whilst the United States and Germany, thanks to the fostering care of their Governments and the liberal subsidies allowed, can with just pride enumerate between them no less than eight such steamships afloat, with others larger and faster in course of construction. The new White Star liner will be able to transport a large body of troops, with stores and ammunition, to the most distant points with ease and unusual rapidity; while in the matter of coal endurance it will be noted that her powers are to be most exceptional, inasmuch as after making liberal allowance for the weights of stores, ammunition, and troops, this steamer will be able to steam in case of need 23,400 knots at 12 knots per hour, or practically round the world without coaling.

The new steamer will be named the Oceanic, after the pioneer vessel of the company, which has recently been withdrawn after a most successful career of over a quarter of a century, and in the construction and arrangements of which were introduced for the first time many improvements, then regarded as luxuries, which the traveller of to-day takes as a matter of course and as essentials to comfort in ocean travel.

With the construction of the new Oceanic a chapter of additional interest is added to the history of the White Star Line. For a number of years its fleet consisted of sailing ships engaged in the colonial trade, and many persons now well established in Australia have been safely carried across the ocean under its flag. As time passed, however, a change took place and in the comparatively short period of five years from 1870 to 1874 the steamships Oceanic, Baltic, Republic, Celtic, Adriatic, Britannic, and Germanic were introduced by the company into the Liverpool and New York trade, and the lead thus obtained by means of these vessels was so strong that it was not until the year 1889 that the company, keeping in view the comfort and convenience of passengers rather than the attainment of the highest rate of speed, brought out the twin-screw steamer Teutonic, and a year later her sister the Majestic. These two vessels, together with the Britannic and Germanic, have since performed with regularity the mid-week mail service from Queenstown to New York, and their popularity with the travelling public has been unmistakeable. The Germanic, which was re-engined and renovated in 1895, has more than maintained her early record, and the Britannic, after twenty-two years of continuous service, during which she has travelled not less than 1,500,000 miles with her original engines and boilers, made her fastest voyage of seven days seven hours to New York in the month of August, 1896.

It is well known that all the steamers of the fleet have been built by Messrs. Harland and Wolff, of Belfast. The tonnage hitherto turned out from their famous yard for the White Star Line reaches a total of 155,195 tons; and the same builders have now in hand new steamers for the same company, amounting to no less than 103,885 tons. The capital expenditure of which Belfast has thus enjoyed the benefit represents the striking total of over five millions sterling.

YORKSHIRE COLLEGE ENGINEERING SOCIETY.—At the last ordinary meeting of the above Society, Mr. Wm. Cleland, B.Sc., Sheffield, and late of the Yorkshire College, read a paper on "Microscopy of Iron and Steel." He said that this subject was coming more and more to the front, and in time would be almost entirely relied upon for testing purposes. In one case a flaw had been discovered in the skin of a rail, which, when removed, rendered the whole rail its proper strength, which it had not had previously. He prophesied that in the near future no ironworks would be without its microscopist. The preparation of slides was fully explained, as well as the methods for distinguishing the properties of the metals under examination. An interesting discussion followed, Messrs. Henry McLaren (chairman), Scott, Wilson, Hartnell, Whitehouse, Cornock, Falshawe, Watson, and Bullock, taking part in it. By kind permission of Mr. Jas. Holroyd, managing director, several members visited the Burmantofts Works of the Leeds Fireclay Company, Limited.

ROYAL METEOROLOGICAL SOCIETY.—At the meeting of this Society, on Wednesday evening, the 17th inst., Mr. Edward Mawley, F.R.H.S., president, read a report on the phenological observations during the past year. He showed that throughout the flowering season wild plants came into bloom much in advance of their usual time, and were, as a rule, earlier than in any recent year since 1893. The wealth of blossom on nearly all kinds of trees and shrubs was a noteworthy feature of the spring and early summer, while the abundance of wild fruits in the autumn was even more exceptional. From an agricultural and horticultural point of view, the one great drawback of the year, which must otherwise have proved one of the most bountiful on record, was a drought that lasted almost without break—at all events, as far as vegetation is concerned—from March to September. The wheat crop proved the largest and best for many years, while there was a good yield of barley and potatoes. The small fruits were also good. With these exceptions, all the farm and garden crops were more or less indifferent, the crop of hay being especially scanty. The Hon. Rollo Russell gave the results of some observations on "Haze and Transparency," which he had made at Haslemere, in Surrey. From these it appears that the clearest hours at a good distance from towns are from about noon to 3 p.m. The clearest winds are those from S. to N.W. inclusive, and especially W.S.W., W., and W.N.W., the haziest are those between N. and E. On bright mornings, with a gentle breeze or calm, from autumn to spring, the haze or fog which has lain on the low ground frequently covers the hills in the course of its ascent a few hours after sunrise. At any distance within 100 miles of London or of the Black Country, observations requiring clear views are likely to be interfered with when the wind blows from their direction, and should therefore be taken early.

THE GERMAN NAVAL ESTIMATES.

THE ordinary recurring expenditure for 1897-8 is estimated at £2,946,263, an increase of £177,148 over the budget of 1896-7; the non-recurring ordinary expenditure is estimated at £1,587,546, an increase over the budget of 1896-7 of £335,206; the extraordinary expenditure is estimated at £1,934,167, an increase of £1,642,627 over last year's budget. The total increase over the sum allowed in the budget of 1896-7 is £2,154,981. The principal items in the ordinary expenditure of the Admiralty are:—

Description.	Amount. £
Admiralty	50,800
Naval Cabinet and Commander-in-Chief	1,800
Lighthouses and observatories	14,000
Pay	668,400
Ships in commission	654,700
Rations	37,900
Garrison administration, &c.	67,300
Lodging allowances	53,700
Travelling	96,200
Maintenance of fleet and dockyard expenditure	880,200
Guns and fortifications	249,900

The number of officers and men provided for in the estimates is as follows:—

	Number.
Officers	1,013
Doctors	122
Men	22,167
Total	23,302

This is an increase over the number allowed for in last year's budget of 1566, including 54 officers. The chief features in the estimates for the non-recurring expenditure are as follows:—

Item.	Description.	Amount £
1	For the building of a 1st class ironclad (Kaiser Friedrich III.) to replace the Preussen. The estimated cost was £706,000, of which £325,000 have already been voted.	231,000
2	Third instalment for 1st class cruiser to replace the Leipzig. The total cost was estimated at £312,500, of which £112,500 have already been voted.	200,000
3	Third and final instalment for 2nd class cruiser "K". The estimated cost is £375,000, of which £175,000 has been voted.	200,000
4	Third and final instalment for 2nd class cruiser "L"	200,000
5	Third and final instalment for 2nd class cruiser to replace the Freya. The cost of the three 2nd class cruisers is the same and the same amount has been voted for each.	200,000
6	For renewing machinery and boilers of two ships of the Sachsen class, as well as for the thorough repair of the hulls, addition to the final instalment of £82,000 in the estimates of 1896-97. The necessary work was of a more costly character than had been estimated.	100,000
7	Second instalment for 1st class armoured ship to replace the Frederick the Great. The estimated cost is £706,000, of this £50,000 has been already voted.	200,000
8	Second instalment for 2nd class cruiser "M"	200,000
9	Same for 2nd class cruiser "N". The total cost of these two cruisers is estimated at £370,000 each, of which £87,500 has been voted for each.	200,000
10	For a 4th class cruiser, "G," second instalment. The total cost is estimated at £130,000, of which £25,000 has been voted already.	55,000
11	Second and final instalment for building a torpedo divisional boat. The total cost is £58,000.	14,550
12	Second and final instalment for torpedo boats. The total cost is £159,200.	69,200
13	Second instalment for the renewal of the boilers of the third and fourth ships of the Sachsen class, and for repairing the hull. Total cost, £273,000.	100,000
14	First instalment for an armoured ship of the 1st class to replace the Kaiser Wilhelm. The Kaiser Wilhelm is 29 years old, and a new ship is urgently required. She will be of the Kaiser Friedrich III. model, and will cost the same, *i.e.*, £706,000. She will take four years to build.	50,000
15	First instalment for the 2nd class cruiser "O"	50,000
16	First instalment for the 2nd class cruiser "P". These are the sixth and seventh of the protected cruisers of the type Gefion, of which one ship is already built and four building. The cost of each is estimated at £400,000, including £7000 for expense of trial trips. Each takes two and a-half years to build (*see* under Nos. 3, 4, 8, and 9).	50,000
17	First instalment for dispatch boat to take the place of the Falke. Total cost, £150,000.	25,000
18	First instalment for gunboat to take the place of the Hyæna	25,000
19	Gunboat to take the place of the Itlis. These two gunboats are to have a shallow draught for use on foreign river service. The cost of each is £50,000, including cost of trial trips. The latter ship is to be built in one year, as it is urgently needed, in consequence of the loss of the Itlis. The former vessel will take two years building.	50,000
20	First instalment for a torpedo division boat. This vessel is destined for service with the torpedo division, for which the necessary means were voted in the budget of 1896-97. The cost will be £58,200, exclusive of guns and torpedoes. The construction will take a little over one year.	43,650
21	First instalment for torpedo boats. Eight new torpedo boats are required to replace old ones no longer in good condition. The total cost will be £154,400 (without guns or torpedoes) and £4800 for trial trips. They will be finished in two years.	90,000

The total vote asked for for construction amounts to £2,353,400, against £961,650 voted last year, an increase of £1,391,750. A sum of £494,800 is asked for for armaments. A final instalment of £55,000 is asked for for guns for the first-class battleships, Wörth, Weissenburg, Brandenburg, and Kurfürst Friedrich Wilhelm. The total cost of arming these ships is £845,600. A final instalment is asked for for guns for the Aegir and Odin (fourth-class battleships) of £27,500. The total cost is £153,000. A third instalment of £50,000 is asked for for guns for the first-class battleship Kaiser Friedrich III.; total cost of the guns to be £150,000.

The vote asked for for guns is £244,800 in excess of the sum voted last year (£250,000). The vote asked for for torpedoes is £185,100; the sum voted last year for this same purpose was £109,250. A sum of £75,000 is asked for for arming older ships with machine guns; the total cost will be £198,000. The sum, already twice asked for and twice refused by the Reichstag, of £50,000, as a first instalment for a dry dock at Kiel (to cost £262,500), is again demanded. A sum of £10,000 is asked for as the seventh and final instalment for arming forts on the Lower Elbe; total cost, £160,000. £37,500 is asked for for steel shrapnel for forts and ships; the total cost is £97,500. £46,700 is required for the final contribution to expense of building a dry dock at Bremen; the total amount contributed by the Empire will be £900,000. A sum of £262,500 will be required for strengthening the fortifications of Kiel, for which a first instalment of £50,000 is asked for in the estimates. It appears that the dry dock accommodation in the Baltic is insufficient, and that, in the opinion of the Government, a new dock for Kiel is urgently demanded. The total cost is estimated at £429,500. A grant for two docks was asked for in vain in 1892, and a grant for one dock only refused in 1894. The German fleet is divided as follows (exclusive of training ships and ships for particular service):—

1.—*For Home Service.*

Description.	Months in commission.
First squadron—	
4 battleships, 1st class	12
2 ,, 2nd class	12
2 ,, 3rd class	12
2 despatch boats	12
Ironclad reserve—	
(1) Baltic—	
2 battleships, 4th class	12
2 ,, ,,	2
(2) North Sea—	
2 battleships, 4th class	12
(3) Dantzig—	
2 armoured gunboats	6
2 ,, ,,	2
Intelligence ships—	
1 cruiser, 2nd class	12
1 ,, 3rd class	12
Torpedo boats—	
1 despatch boat, 1st flotilla	6
2 "D" boats, 1st flotilla	6
12 "S" boats, 1st ,,	6
2 "D" boats, 2nd ,,	2
12 "S" boats, 2nd ,,	2
2 "D" boats, reserve flotilla	6
2 "D" boats, ,, ,,	10
2 "D" boats, ,, ,,	12

2.—*Ships for Foreign Service.*

Name of station.	Description.	Months in commission.
Cruising division	1 battleship, 2nd class	12
	1 cruiser, 2nd class	12
	1 ,, 3rd class	12
Australian station	1 ,, 4th class	12
	1 ,, ,,	12
China	1 ,, ,,	12
West Africa	1 gunboat	12
	1 ,,	9
	1 ,,	6
East Africa	1 cruiser, 4th class	12
	1 ,, ,,	6
	1 ,, ,,	9
Mediterranean	1 stationnaire	12
East and West America	1 cruiser, 2nd class	12

ELECTRICAL AND ENGINEERING EXHIBITION, NEWCASTLE-ON-TYNE.

ON the 15th inst. an Electrical and General Engineering Exhibition was opened at Newcastle-on-Tyne by the Mayor of that city (Councillor J. Goolden, J.P.) The Exhibition, which promises to be very successful, was promoted originally by the committee of the Royal Infirmary, with a guarantee of £10,000; but difficulties arose, and eventually the scheme was taken in hand by Mr. J. Engel, and carried out on his own responsibility. Mr. Engel, who is already well known as a promoter of similar successful Exhibitions in the North of England, including those at Sunderland, Shields, Middlesbrough, and elsewhere, has acquired a reputation for organisation in connection with these undertakings; and if anything apart from its intrinsic merit were required to commend it to the interest of the public, it is the fact that 20 per cent. of the money taken for tickets sold previous to the opening ceremony on Monday has been promised by Mr. Engel to the New Infirmary Building Fund at Newcastle.

The Exhibition building, which has been erected by Messrs. Bruce and Still, Limited, of Liverpool, is 300ft. long and 120ft. wide, with an annexe, which became a necessity in order to accommodate the demand for space for exhibitors. One good feature of the regulations is that the retail sale of goods is prohibited, and the Exhibition is therefore protected from the risk of becoming a great shop.

The greater portion of the floor space is occupied by machinery, which is not confined to the exhibits of local firms, and a great portion of this is in motion, the electrical machinery and other appliances predominating. There is no system of shafting, the idea of resorting to which having been abandoned in favour of the motor system. The bulk of the motors are driven by steam power, and pressure will be supplied by two "Petersen" water tube boilers by Messrs. Clarke, Chapman, and Co., Limited, of Gateshead. These two boilers are arranged to occupy a special annexe at the east side of the building. Each boiler stands upon a ground space of 8ft. 10in. long by 7ft. 10in. deep, the height of the top of the steam drum being 12ft. 6in., and is capable of evaporating 5000 lb. of water per hour, having a grate area of 34 square feet and beating surface of 1000 square feet. The heating surface consists of small straight tubes, called "compounds," from the fact that each nest of nine tubes is an independent construction, having wrought iron boxes, with tube plates at each end, which are furnished with means of fixing them to pipes serving for the supply and delivery of water to and from them. Each nest of nine tubes can be taken out by removing four bolts, without disturbing the others, when required. Sufficient circulation is maintained, it is claimed, in the compounds to prevent formation of deposit from the water, this being swept out by the current, and finally reaches the lower feed drum, where it remains. It is claimed for these boilers that freedom from priming is characteristic of them, and that they possess it in greater degree than any other boiler of its type. The only brickwork required is the necessary fire-brick lining to the furnace. The boiler is lighter than the ordinary high-pressure marine type, and is specially adapted for transport.

Messrs. Clarke, Chapman, and Co. also supply Horne's patent single-cylinder direct-acting feed pumps, containing several unique features. In place of the flat side valves, or piston valves, which are commonly found in this class of pumps, four small mitre valves of very hard bell metal are used. Each valve has a separate communication passage to the steam cylinder, two of these passages being steam, and two exhaust, as in case of the Worthington type of pump. This pump is specially designed for a working pressure of 300 lb. per square inch, and is capable of running at a speed of fifteen strokes per minute and of feeding boilers developing 1300 indicated horse-power.

The same firm also exhibit a one-ton electric winch, consisting of an electric motor driving two warping ends or lifting barrels by means of worm and spur gearing, and developing 8 electrical horse-power at a speed of 840 revolutions per minute. The whole of the worm gearing is encased in a complete cast iron dust-tight casing, carried on the bed-plate, the casing forming a complete oil bath for the gearing. We may also mention, in addition to the dynamos, a 24in. search-light projector—in accordance with the English Admiralty requirements—and a 20in. projector, more simple in detail than the Admiralty type, specially designed for use on merchant vessels for the passage of the Suez Canal by night or for river navigation. Dispersion lenses are fitted to these projectors when required for the Suez Canal passage, so as to give a wide, flat beam of light at a distance of 1000 yards, and also special lenses to give the dark interval in the centre, as required by the regulations.

Messrs. Ernest Scott and Mountain, Close Works, Newcastle-on-Tyne, have a large exhibit of their specialities in electrical engineering. They supply the vertical high-speed electric light engines driving the dynamos which supply the current for lighting the Exhibition. These consist of two "Tyne" compound-wound dynamos, with drum bar armatures for arc and incandescent lighting, also transmission of power work. Amongst the exhibits of the firm are a set of 7in. by 12in. three-throw ram pumps, capable of delivering up to 250 gallons per minute against a head of 250ft.; also an electrical coal-cutting machine of disc pattern, designed to cut 3ft. deep, and fitted with an electric motor of 12 effective horse-power.

Messrs. J. H. Holmes and Co., electric light engineers, Portland-road, Newcastle, exhibit a Lundell patent slow-speed electric motor, driving printing machines direct without gearing and fitted with a controller for starting and stopping and varying the speed; also a Lundell standard electric motor, driving printing machinery by belting. The electrical driving of printing machines and other apparatus peculiar to the printer's trade is comparatively a new departure in this country, although much has been done in this direction on the other side of the Atlantic. In direct driving the armature of the motor is attached directly to the driving shaft of the machine, thus entirely dispensing with gears or other power-transmitting mediums; the speed of the armature is thus the same as that of the driving shaft, which, of course, is much lower than that of an ordinary electric motor. The Holmes-Willans steam dynamo exhibited by the firm consists of a 60 indicated horse-power Willans compound single-acting high-speed steam engine, mounted on a cast iron bed-plate and coupled direct to a "Castle" dynamo, size No. 14 R.A., having an output of 115 volts and 325 ampères at 470 revolutions per minute. On Messrs. J. H. Holmes and Co.'s stand the generators and motors receive power from the Holmes-Willans plant, and their arrangement demonstrates the ready manner in which energy can be transformed. All the separate machines, it may be noticed, are of the same type, the well-known Lundell machine, of which the firm of J. H. Holmes and Co. are the patentees and manufacturers for the United Kingdom, British Colonies and Dependencies. The dynamo, forming part of a coupled set, drives the motor nearest to it, the current being conveyed through insulated cables. This motor—20-horse power—in its turn drives the next size machine of 15-horse power, as a generator, by belt. This generates the current by which the second motor—a 10-horse power—is driven, which in turn drives the second belt-driven dynamo. This method of transforming electrical energy into mechanical, and from mechanical again to electrical, is continued throughout the series, down to the smallest dynamo of $\frac{1}{15}$-horse power, which, however, is sufficiently large to supply current for the running of one 16-candle power lamp.

The Sunbeam Electric Light Company, Ltd., Gateshead-on-Tyne, has an exhibit of every description of electric incandescent lamps, from 3000-candle power—the largest incandescent electric lamp made—down to small lamps of one candle power. The company claims to enjoy the distinction of being the only manufacturers of electric incandescent lamps in this country outside of the city of London. A number of X ray photographic tubes are also shown.

Messrs. Easton, Anderson, and Goolden, Erith Ironworks, Kent, exhibit an electric bar coal cutter, intended for use in fiery mines, and an electric rotary rock drill—Bell, Steavenson, and Clough's patents. Eight of these machines are now working in the ironstone mines of Messrs. Bell Bros., Ltd., to their entire satisfaction. The average output of ironstone per drill is 1200 tons short weight, and has reached as much as 1450 tons in one week.

The Roller Bearings Company, Ltd., 1, Delahay-street, Westminster, S.W., exhibit their patent roller bearings for railways, tramways, road vehicles, &c. These bearings consist of a series of rollers placed between the journal of the axle and the casing or box. They are designed to effect large savings in motor power, either steam or electrical, and also in the use of lubricants. It is also claimed that they give great relief to horses, due to the reduction of starting and traction effort.

Messrs. George Tyzack and Co., South Shields, exhibit a patent triple grip stockless anchor, about $3\frac{1}{4}$ tons, and it is stated that last year about 500,000 tons of shipping were supplied with Tyzack's anchors. A 5 cwt. steam hammer and a 3 cwt. ditto, suitable for ordinary smiths' shops, and requiring very simple and inexpensive foundations, are exhibited by Mr. Peter Pilkington, Accrington, Lancashire, and fitted with Pilkington's valve gear, which can be worked both self-acting and hand motion, or controlled by the smith's foot, leaving both hands at liberty to manipulate the forging, thus dispensing with a striker.

The exhibits of cycles and cycle fittings, as might have been expected, are a very important and interesting feature of this Exhibition. The local industries display a very creditable collection of machines.

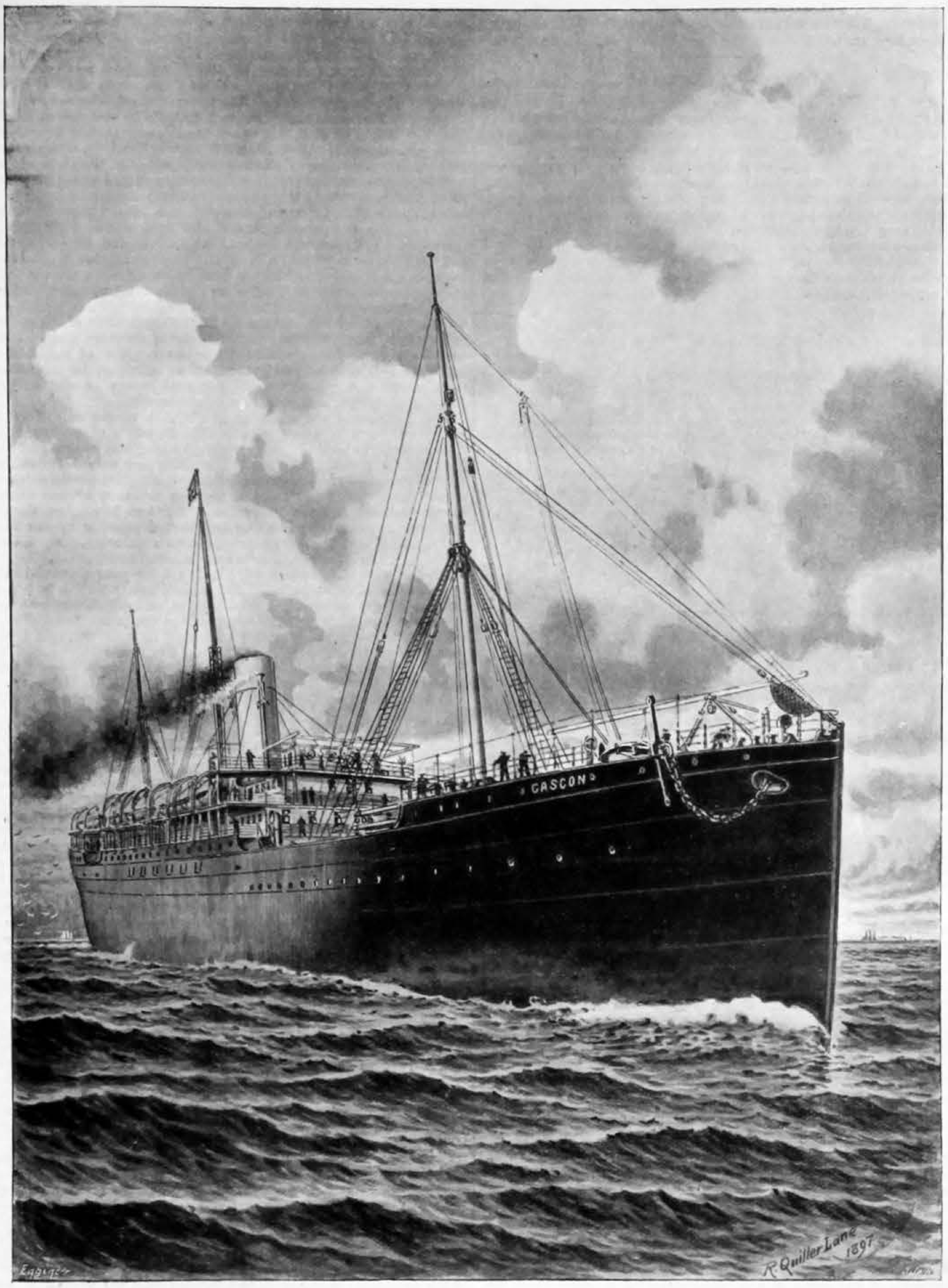
The Exhibition building is warmed by Messrs. Henry Walker and Son, Limited, Newcastle-on-Tyne. Steam at a reduced pressure is conveyed by hot iron pipes to powerful radiators manufactured by the American Radiator Company, the water of condensation being returned to the boiler, by a Worthington automatic pump.

One of the most interesting features of the Exhibition is the working coal mine, which has been carried out by the Elswick Coal Company.

In addition to those above described, the objects of interest are very numerous. The household and sanitary appliances, articles relating to food and drink, occupy a large space.

THE UNION STEAMSHIP GASCON

MESSRS. HARLAND AND WOLFF, BELFAST, BUILDERS & ENGINEERS



THE UNION S.S. GASCON.

THE twin-screw steamer Gascon, illustrated above, the sixth vessel built by Messrs. Harland and Wolff, Limited, for the Union Steamship Company, left her moorings at nine o'clock on the morning of Saturday week, and proceeded down Belfast Lough for trial trip and adjustment of compasses. The Gascon, which is over 6000 tons gross register, and which is propelled by twin screws driven by two sets triple-expansion engines, is the first of three new steamers Messrs. Harland and Wolff have at present in hand for this company, of somewhat similar type to the well-know "G.'s." built by them, and largely running in the same service, but of considerably larger dimensions, and with unusually complete accommodation for first, second, and third-class passengers. The length of the ship is 430ft., breadth 52ft., and depth 33ft. Electric light and refrigerating apparatus, with cold chambers for the conveyance of fruit, and also all the latest and most improved machinery for working cargo, have been provided, and the vessel is so arranged as to provide a very large carrying capacity for cargo on a light draught of water. The saloon is done in oak and teak, and the ladies' room in dark mahogany, with marquetrie panels, satinwood, and other wood. The smoke-room is done in oak, second saloon in mahogany and satinwood, and the library is handsomely fitted up with book-case and writing desks, and surmounted by a handsome dome, with richly decorated glass. In addition to the sister ships, Messrs. Harland and Wolff have in hand a much larger vessel for the Union Steamship Company, which, when completed, will be the largest steamer in the South African trade. Captain Walter Martin is in command of the Gascon, which, while being built, has been under the supervision of Captain A. M'Lean Wait, the marine superintendent, and Mr. Du Sautoy, superintendent engineer.

THE NEW CRUISER NIOBE.

OF the four first-class protected cruisers of a new type laid down in 1895 for the British Admiralty, of which the typical ship is the Diadem, built by the Fairfield Shipbuilding Company, of Govan, the Niobe was on Saturday last successfully launched from the shipyard of the Naval Construction and Armaments Company at Barrow.

The hull of this ship, like that of her prototype, is—with the exception of her stem, sternpost, and propeller shaft brackets, which are of phosphor bronze—built entirely of Siemens-Martins steel; the principal dimensions being:—Length between perpendiculars, 435ft.; extreme breadth, 69ft.; depth to upper deck, 39ft. 9in.; and displacement, 11,000 tons, at which the water draught is 26ft.

Throughout the length of the machinery and boiler spaces the vessel is double bottomed, and beyond these, both fore and aft, water-tight flats at a lower level continue this bottom to the extreme ends of the ship. The vessel having no side armour, the protection of her vital parts is secured by a steel protective deck of arched form, having a maximum thickness of 4in., and running throughout her entire length. The stem of the vessel is ram shaped, the protective deck being carried down to, and effectively secured to it, at the level of the nose of the ram. Bilge keels are fitted to the ship's sides for about half her length, and she is steered by a rudder of the balanced type, actuated by steam-steering engines. The plating of the hull is sheathed up to well above the water-line with teak 4in. thick, which is covered with sheet copper. At the load draught of 26ft. the quantity of coal carried is 1000 tons, but provision is made for about twice this amount, if required.

The armament of the Niobe, which is of a most powerful description, will consist of sixteen 6in., twelve 12-pounders, and three 3-pounder quick-firing guns, two 12-pounder boat guns, and eight ·45in. Maxim machine guns. Twelve of the 6in. guns will be mounted in casemates on the sides, and two in the forecastle, and in the poop, behind shields. Three torpedo tubes are fitted, two of which are submerged forward, and one aft above the water line.

The propelling machinery, which is constructed by the shipbuilders, will consist of two independent sets of four cylinders, four cranked triple-expansion engines; the diameter of the cylinders being, high-pressure, 34in.; intermediate pressure, 55½in.; and low-pressure cylinders, 64in. each, all having a piston stroke of 48in. The high and intermediate pressure cylinders will be fitted with piston valves, and the low-pressure ones, with double-ported slide valves, actuated by double excentric and link-motion gear. The crank shafts are made interchangeable, and, together with the thrust and propeller shafts, are of steel. The propellers have three adjustable blades, and are designed to work inwards.

Steam for the engines will be supplied by thirty water-tube boilers of the Belleville type, arranged in groups in separate water-tight compartments, and designed for a steam pressure of 300 lb. per square inch, reduced to 250 lb. at the engines. The total heating surface in the boilers is 45,900 square feet, the fire-grate area being 1450 square feet. The propelling engines are designed to develope a maximum of 16,500 indicated horse-power, which it is estimated will give the ship a speed of 20½ knots.

The ceremony of naming the Niobe was performed by Lady Harris, wife of Lord Harris, the chairman of the shipbuilder's company, there being present on the occasion, among others, Sir W. H. White, Director of Naval Construction, Admiral Boys, and Mr. A. Adamson, Managing Director of the Barrow Company.

The Niobe will have a complement of officers and crew to the number of 600.

LETTERS TO THE EDITOR.

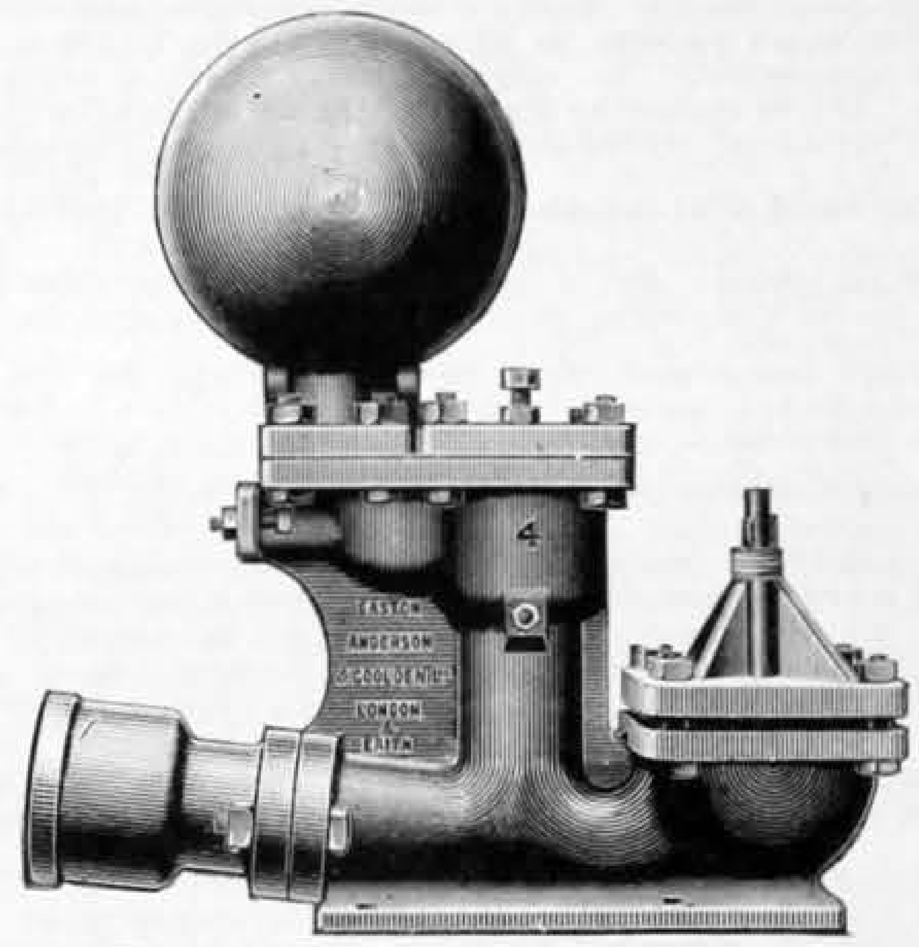
(*We do not hold ourselves responsible for the opinions or our correspondents.*)

HYDRAULIC RAMS.

SIR,—Owing to absence from home I have only just read the article you reprint in your issue of January 29th on the "Rife Hydraulic Ram;" and if you will allow me the space I should like to make one or two remarks thereupon. I may claim to write with some authority on the subject, as the founder of the company with which I am connected—Messrs. Easton, Anderson, and Goolden, Limited—the late Mr. James Easton, sen., originally introduced the Montgolfier automatic hydraulic ram into this country about the year 1827. A great number have been installed by us since that time, and till recently the original pattern was still in use.

About fourteen years ago I had the privilege of conducting a very extensive series of experiments on rams, in consequence of which a new pattern was designed—of which I send an illustration—in many ways superior to the old one, and which is at present in use. I found that the design of a ram was a thing which, though apparently a very simple matter, was, in fact, not by any means so; and that a considerable practical experience was required to make one that was reliable and efficient.

The points to which I wish to draw attention are the statements made as to efficiency, and the ratio of the height to which the water may be raised to that from which it falls to the ram. The efficiency is stated to be 82 per cent. according to Rankine's formula, but no mention is made of the circumstances under which that efficiency is obtained. I infer that the maximum ratio of lift to fall which can be obtained, is 30 to 1, and it might also be inferred from the description that, when working at that ratio, an efficiency of 82 per cent. is obtained. I feel, however, quite sure that this is not the case, and that this efficiency is obtained only when working at a low ratio, say about 5 to 1.



THE EASTON AND ANDERSON RAM

All experiments show that the efficiency is not a constant quantity, and that it attains its maximum at a low ratio of lift to fall, say about 5 to 1, and gradually decreases as the ratio increases. It is evident, therefore, that a point must sooner or later be reached when the efficiency approximately becomes zero, and the ratio corresponding to this gives the limit at which the ram will work. If a ram were a perfect machine, or if it even had a constant efficiency, it is evident that there would be no limit to the ratio of lift to fall theoretically, except the strength of the machine to stand the pressure produced.

It may be worth pointing out that the formulæ usually found in text-books and pocket-books are as a rule based upon an assumed constant efficiency, and are therefore worthless.

Now, the maximum ratio at which a ram of ordinary construction will work is somewhere about that stated by the article; but by dint of much experimenting I have so modified the design that while at low ratios the efficiency is not greatly in advance of that obtainable by an ordinary ram, yet the falling off as the ratio increases is much more gradual, and I am consequently able to work up to much higher ratios than usual. I have records of experiments which go up to a ratio of 46 to 1, and the efficiency at such time has only been reduced to about 44 per cent.—Rankine's formula—so that evidently a much greater ratio could have been obtained before the efficiency would have been reduced to zero. The experiments were not prolonged simply because the pressure became too great for the safety of the machine. Also, it follows that a ram of this construction will be increasingly superior to one of the ordinary kind as the ratio of lift to fall with which it has to work becomes greater. The subject is very interesting, but it would take up too much of your valuable space to go into it any further.

The arrangement for delivering pure water is ingenious, but I can hardly think that the pure and impure waters can be completely prevented from mixing, and I do not imagine that many of your readers would care to drink the so-called pure water as delivered by the ram, if the working water were obtained from a doubtful source of supply. E. W. ANDERSON, A.M.I.C.E.

Erith Ironworks, February 15th.

SIR,—I have just seen an American article in your issue of Jan. 29th headed "A Hydraulic Ram Plant for a Public Water Supply." Taking the machine illustrated and described as a hydraulic ram pure and simple, it cannot be said to be an improvement on the best English practice—in fact, rather the reverse. As to the pumping or double-action ram, I refer to this later on.

There is nothing whatever new in the escape valve shown. Several English makers show in their catalogues adjustable weighted valves, and of a design certainly superior to the one illustrated, which appears to be very crude.

It is claimed as an improvement—and as if it were a novelty—that the escape valve is very light, and the extraordinary statement is made that in many machines the escape valve is made heavy enough to overcome the static pressure due to the fall. If this were so the machine could not work, even neglecting the fact that the full static pressure due to the fall could never be obtained owing to the loss of pressure due to the head required for velocity of entry and friction of water in the drive pipe. Under such conditions the ram and its drive pipe would be simply in the position of a long pipe running full, the water having the velocity due to the size and length of pipe and the fall.

For instance, an 8in. pipe 80ft. long, under a head of 8ft., would give a maximum velocity of about 14ft. per second, corresponding to a head of, say, 3ft., so that the weight of the escape valve to work at all could not exceed 1·3 lb. per square inch, whereas the weight due to the head of 8ft. would be about 3·45 lb. per square inch.

While there is some divergence between makers in the best English and American practice, the escape valves appear to be made of such weight that they will lift when the velocity of flow is between the limits of about $5\frac{1}{2}$ft. and 8ft. per second, corresponding to a head of from 0·50ft. to 1ft.

In other words, the weight of the escape valve should be from 0·21 lb. to 0·43 lb. per square inch of area. The heavier the valve the greater the capacity of the ram and the smaller the number of beats, but the greater the losses due to pipe friction. Taking the ram illustrated in your article, the area of the escape valve is 254·47in. and the weight 50 lb., or 0·196 lb. per square inch, corresponding to a head of 0·45ft. and a velocity of 5·388ft. per second. It does not, therefore, greatly differ from the usual practice, and, with the sliding weight applied, would certainly fall within the limits named. The maximum weight which can be obtained by means of the sliding weight is not stated.

Assuming for convenience that the valve be so loaded as to weigh about 55 lb., which would correspond to a head of 0·5ft. and a velocity of 5·67ft. per second, the approximate theoretical calculations as to duty, &c., of this ram would be as follows:—Drive pipe, diameter 8in., as stated in article; valve weight = 0·216 lb. per square inch; fall, assumed at 10ft.; drive pipe, length assumed at 100ft.

From Eytelwein's experiments the beat of an escape valve may be divided into four periods:—(1) Period during which valve is open = approximately 0·60 of beat. (2) Period during which valve lifts to close. (3) Period during which valve is closed = approximately 0·25 of beat. (4) Period during which valve falls to open. The valve weight being 0·216 lb. per square inch, the corresponding velocity is 5·67ft. per second. Hence the mean velocity through the escape valve during the opening is 170·34ft. per minute. But as the valve is only open during 0·6 of the beat, we have as the waste water capacity of ram in cubic feet per minute:—Valve area +, mean velocity × 0·6. The valve area should be the same as that of the drive pipe, viz., 50·26 square inch, and I assume it to be so. The coefficient of contraction need not here be considered.

We have, therefore, as the waste water capacity of the ram per minute $\frac{50 \cdot 26}{144} \times 170 \cdot 3 \times 0 \cdot 6 = 35 \cdot 675$ cubic feet = 222·32 gallons.

From your article the three rams used 810 gallons (American) = 648 English gallons, or 216 gallons each, so that the agreement is fairly close.

Omitting losses due to the head required for velocity of entry and friction of water in pipes, the theoretical work which this body of water would perform on 10ft. fall would be 2223·2 × 10 = 22,232 foot-pounds. The weight of water contained in the drive pipe = 2175·35 lb., and as the velocity at which the valve closes is 5·67ft. per second, the theoretical work done per beat by this body of water would be at the rate of $\frac{2175 \cdot 35 \times 5 \cdot 67^2}{64} = 1095 \cdot 81$ foot-pounds per second. But as the work is only performed during the closed period of the valve, or during only one quarter of the whole time, the actual work done per beat would be $\frac{1095 \cdot 81}{4} =$ 273·95 foot-pounds.

Hence the number of beats per minute would be $\frac{22{,}232}{273 \cdot 95} = 81 \cdot 15$.

The quantity of water flowing through the escape valve = 35·675 cubic feet per minute, but as the valve is only open during 0·6 of the whole beat, the delivery is at the rate of 59·46 cubic feet per minute. If, therefore, x be the required area of escape valve opening, and the mean speed, as before stated, 170·3ft., we have $x \times 170 \cdot 34 = 59 \cdot 46$. $\therefore x = 0 \cdot 349$ square feet = 50·26 square inches, or the same area as the drive pipe. The circumference of the valve being 56·54in., we have for the theoretical lift of valve required, $\frac{50 \cdot 26}{56 \cdot 54} = 0 \cdot 88$in.

Allowing for contraction, the actual lift to be given to the valve would be about 1·33in.

Each beat of the valve takes $\frac{60}{81 \cdot 15} = 0 \cdot 74$ seconds nearly. The escape valve is open during 0·6 of this period or 0·443 second.

The amount of water vented by the escape pipe per beat is, therefore, 0·349 × 2·839 × 0·443 = 0·439 cubic feet, and the number of blows $\frac{35 \cdot 675}{0 \cdot 439} = 81 \cdot 15$ nearly, as before.

If the sliding weight be so applied as to double the weight of the valve, the velocity of water, quantity used, and work done will increase theoretically as $\sqrt{2} : 1$, while the number of blows will decrease as $1 : \sqrt{2}$, or in this case to about fifty-seven.

If the drive pipe be lengthened or shortened the work done will remain the same, but the number of blows will decrease or increase in direct proportion to the increase or decrease in the length of the pipe.

If the escape valve area be increased, say, to double—weight of valve and length of drive pipe remaining the same—double the water will be used. The speed of water in drive pipe will be doubled, and the work done by such blow will be increased fourfold; consequently while the work done would be doubled, the number of blows would be halved. The losses due to velocity of entry and friction in pipes would, of course, increase and the efficiency decrease.

Of course, there are various other things to consider in fixing hydraulic rams, such as a suitable ratio between length of drive pipe and head, so as to secure a velocity sufficient to lift the escape valve, and also to give sufficient momentum to overcome that of the column of water in the delivery pipe. The size of delivery pipe also requires careful consideration. Snifting valves, as shown in your illustration, are of doubtful utility, as with dirty drive water they are apt to get blocked. A good cock just above the delivery valve is much better.

As regards the pumping, or double-action ram, it is difficult to imagine how the arrangement shown can be effective.

As I understand it, the pure water must be at a slightly higher level than the ram—the height being dependent on the power of the ram, and the height to which the pure water is to be forced—so as to insure the proper amount being supplied to the ram at each recoil. Apparently, at each recoil of the drive water, a certain portion of pure water gravitates into the ram and fills the vacant space under the delivery valve, and is then delivered into the air vessel at the next forward stroke of the drive water. But I question whether it is possible to adjust the machine so as to allow the exact quantity of pure water to be delivered. Either a lot of pure water will be wasted, or a lot of impure water will be delivered with it. In any case, I should imagine the water would get pretty well mixed.

If I understand the description of the West Reading plant correctly, pumping rams, as made by several English makers, would have been much more efficient, would have enabled the plant to be simpler, and would have avoided all risk of impure water being delivered with the spring water. A point is made of the size of the ram which can be made under this system, but several English makers advertise larger sizes, and I know of at least one maker who has made and fixed larger ones than that described in your article. I understand he also now uses an ingenious diaphragm valve, which renders the working practically noiseless.

My excuse for this letter is that I have always considered the hydraulic ram has not had fair play. Properly made and fixed, it is an efficient and durable machine, and one which ought to be much more largely used than it is, especially in the Colonies.

February 18th. SIDNEY H. FARRAR.

MOMENT OF RESISTANCE.

SIR,—I should like to have the opinions of some of your readers as to the best method of calculating the moment of resistance of girders whose cross sections vary between that of a flanged girder with a thin web-plate and that of a rectangular beam.

It is not so much the actual strength of a girder of a given section, obtained by some particular modulus of rupture, as the value of its cross section that I wish to arrive at, so that, knowing the tensile strength of the material, the transverse strength of a beam of any section may be calculated.

The following formulæ, given by the authorities mentioned, I have applied to the cross section shown, which is selected merely for its convenience in calculating, but the results cannot be said to agree very well:—

N A = Neutral axis.
M R = Moment of resistance in inches.
M I = Moment of inertia.
S A = Sectional area.
R A = Resistance area.
D = Depth.
E D = Effective depth.
E F = Distance of extreme fibre from N A.
$e\ f$ = Distance of extreme fibre from N A on nearer side

Professors Rankine and Fidler:—

$$M\,R = \frac{M\,I}{E\,F} = \frac{130}{5} = 26.$$

(NOTE.—M I = 130 by graphic method in "Molesworth.")

Mr. Fidler states that a rectangular beam of cast iron will break at $2\frac{1}{4}$ times the calculated load.

Sir Benjamin Baker:—

$$M\,R = R\,A \times E\,D + 70 \text{ p.c.} \times \frac{\text{Area of section}}{\text{Area of rectangle base and height}}$$

$$= 5 \times 5 \cdot 28 = 26 \cdot 4 + \frac{26 \cdot 4 \times 7}{10} \times \frac{1}{1}$$

$$= 26 \cdot 4 + 18 \cdot 48 = 44 \cdot 88 \quad \text{Table uppermost.}$$

$$26 \cdot 4 + \frac{26 \cdot 4 \times 7}{10} \times \frac{24}{48} = 35 \cdot 64 \quad \text{Web uppermost.}$$

Trautwine's pocket book:—

$$M\,R = \frac{S\,A \times D}{6} = \frac{24 \times 8}{6} = 32.$$

A. E. Sharp, in paper before North-East Coast Institution of Engineers:—

M R of $\frac{1}{2}$ section remote from N A

$= R\,A \times E\,D = 5 \times 5 \cdot 28 = 26 \cdot 4$ M R of web.

M R of $\frac{1}{2}$ section near N A

$= R\,A \times E\,D \times \frac{E\,F}{e\,f} = 5 \times 5 \cdot 28 \times \frac{5}{3} = 44$ M R of table.

It will be noticed in some of the above formulæ that the increase in strength due to adhesion or diagonal resistance is entirely neglected.

Swindon, February 16th. C. B. COLLETT.

COMPARATIVE COST OF ROAD PAVEMENTS.

SIR,—In your last issue you refer to a report recently presented by myself to the Wolverhampton Town Council upon road pavements, and mention the comparative cost during a period of thirty years therein given of different kinds of pavements as exemplified in a particular street having an area of 7292 yards.

The cost of Australian hard wood pavement during this period is given at £17,442, as compared with creosoted deal £14,760, but these figures are somewhat misleading, unless considered together with the data given in the tables annexed to my report. May I, therefore, be permitted to say that in arriving at these sums, the annual cost in each case in respect of scavenging and watering is the same, and that although the first cost in this town of the hardwood is 50 per cent. in excess of creosoted deal, yet the life of the latter would only be two-thirds that of the former, *i.e.*, the ratio of life to first cost is the same in each case.

The apparent difference arises from the fact that no distinction is made by the Local Government Board when fixing the period of repayment of loans in respect of the two classes of pavement. Up to the present time the Local Government Board have with commendable caution placed all wood paving on one basis, namely, that originally decided upon with respect to deal pavements.

Until late years little was definitely known of the durability of hard wood pavements, and in the early periods of its use some engineers had a certain amount of fear of its unknown properties. One thing feared was that with combined exposure to weather and heavy traffic they might after a time tend to break up on receiving shocks, such as often occur with a heavy miscellaneous street traffic; and, indeed, some of these woods have a character which, to borrow a geological term, might be described as approaching semi-conchoidal, but which experience proves affects only the surface, and is shown by "ripple marks," an expression first used, I believe, in this connection by the present surveyor to the St. Martin's Vestry.

Fearing that its peculiar properties might bring its life to an end much earlier than its great density and other beneficial characteristics would seem to indicate, the Local Government Board officials wisely refused to advise the granting of a longer period for repayment of borrowed money than they had always allowed for in the case of ordinary creosoted soft wood.

I venture to think, however, that the time has now come for some distinction to be made by the Board, otherwise their action will act adversely against the use of what has been proved to be a valuable addition to our paving materials, as many local authorities, especially those whose rates are rather high, will refuse to burden themselves with the cost of an improvement of which much of the benefits will be reaped by those who have contributed nothing towards it.

The London County Council have already acknowledged the justice of this differentiation by granting loans to the metropolitan vestries for longer periods when hard wood pavement is proposed, than where creosoted deal is in question, the ratio being generally, I think, as 10 to 7, the number of years' basis, of course, depending upon the amount and weight of traffic over the particular street. J. W. BRADLEY.

Wolverhampton, February 12th.

SULPHATE OF AMMONIA.

SIR,—Recent discussions at meetings of societies connected with the gas industry, with chemical manufactures, and with metallurgy, have brought into prominence a fact that is a national misfortune, but which it appears possible to remedy. The fact in question is that many home farmers are using nitrate of soda, an imported article, of which 5 cwt. are required to produce the same effect on crops that 4 cwt. of sulphate of ammonia, a home manufacture, are capable of doing. As the two manures have been for some time at about the same price, it is plain that the farmer complaining as he does of agricultural depression largely contributes to his sad condition by want of knowledge. Some portion of the requisite knowledge could be very effectively conveyed by following the advice of Mr. James O'Sullivan, who, at the recent Burton meeting of the Nottingham section of the Society of Chemical Industry, said that the name nitrate carries the idea of nitrogen to the ordinary man's mind, whereas sulphate does not. He considered the great obstacle to the spread of the use of sulphate of ammonia was its name, and that if it could be rechristened, so that the name would convey this idea, it might be a good thing. Presiding at the meeting, I joined in the smile evoked by the suggestion, but thinking the matter over, I was struck with its great force, so that though received in jest it soon became to me a true word. In accordance with this idea, I would propose that sulphate of ammonia should, for agricultural purposes, be known as "nitrogenous sulphate," which it is, and the farmer will not be able to say that he is in any way misled, for a substance that contains upwards of 25 per cent. more nitrogen than nitrate of soda, and which is besides the richest nitrogenous manure available, is surely entitled to be so-called.

When one considers how successful the application of suggestive names has been in other departments of industry and of commerce, it must be admitted that the neglect of sulphate of ammonia with its nearly $21\frac{1}{4}$ per cent. of nitrogen, for nitrate of soda which barely contains $16\frac{1}{2}$ per cent., may be due to prejudice that only a change of name can remove.

The Fertilisers and Feeding Stuffs Act makes no difference between the unit of nitrogen present in sulphate of ammonia and that in nitrate of soda. This should go a long way to convince the farmer how great is his loss. Were the loss only his own, we might keep silence; but as the whole community participates in it, not only by the enormous sums that are sent abroad for an inferior article, when a better one is made at home, but also by making gas dearer, by tending to cause depression in the iron trade, and also by injuring a great Scottish industry, viz., the oil works, the case is one that calls for combined action.

In this spirit I trust you will kindly render your powerful help to this national cause by publishing this letter, which it is hoped may incite gas authorities, ironmasters, and all others who are interested in sulphate of ammonia to adopt the name "nitrogenous sulphate," which must tend to increase its sale amongst home farmers, and thus gradually put an end to the anomaly of sending most of our sulphate abroad, and bringing nitrate from South America to take its place. F. J. R. CARULLA.

Sharon Chemical Works, Derby, February 9th.

THE THWAITE STEEL FURNACE.

SIR,—While agreeing with "Vulcan," in your last issue, that the Siemens furnace is "hard to beat," still, if some of the "very objectionable features" can be removed by a modification of construction, as in the Thwaite steel furnace, then increased economy should result. Any leakage of air past the butterfly valve in the Thwaite furnace involves no loss of an appreciable character. In a Siemens furnace such a loss may prove serious:—(1) Because it reduces the pull of the chimney on which the combustion action of the furnace depends. (2) Because this air may meet an escape of gas from a leaky gas valve, and an intense character of combustion is established by the expansion of the gases due to this combustion; the chimney pull on the furnace is still further reduced. (3) This flue combustion tends still further to warp both the gas and air valves.

In the Thwaite furnace such combustion cannot occur. The air is introduced under pressure, and maintains the flap valve in a comparatively cool condition—if leakage occurs, as the furnace is worked under the positive and uniform pressure that a chimney pull never gives, the leakage therefore does not appreciably affect the working of the furnace. There is little likelihood of a gas escape past the gas valve, because (1) the combustion described above cannot occur; (2) it is not exposed to the varying temperature of the products of combustion; (3) because the temperature to which it is subjected is fairly uniform, and should never exceed 900 deg., Fah.

Should a leakage, however, occur, it can only involve a comparatively inappreciable loss of heat, because, as the furnace is worked with a slight excess of air, the gas, in passing through the air heat-restoration chambers, is burnt, and the heat is more or less completely transmitted to the checkers. There is no such action as regeneration in either the Thwaite or the Siemens furnace; there is only heat restoration. In the Siemens furnace, however, a leaky gas valve means a possible loss of a considerable volume of gas direct to the chimney, and not through any portion of the furnace. Any one who has studied the question of chimney pull by high temperature *versus* the employment of heat thermodynamically utilised to propel or displace gas or air, knows that the latter method is by far the most economical.

As to the possible difficulty in using air blast machinery, "Vulcan" cannot be serious in referring to this. He knows as well as I do that furnaces working with forced draught have worked for half a century without any difficulty whatever being found in actual practice. Steam-driven or electric-driven fans can be guaranteed to work twelve months without being once stopped. Besides the economy of forced draught, the power of control—and variation is most comprehensive, and the fact that all the heat transmitting surface is brought into useful service should be considered of very great value. In a Siemens furnace the gas accumulated in the chamber and flues between reversal is lost, because there is no air to consume the gas present in the chamber, this gas loss is repeated at each reversal.

When furnaces depend upon the pull of the chimney, it is often found that the products of combustion take the most direct course to the valve, and in Siemens furnaces, with both air and gas heat-restoration chambers, the products of combustion may for the most part traverse the gas chamber, and there not being sufficient checker work to absorb the heat, pass off to the chimney at an excessive temperature, while only a small portion of the products of combustion pass through the air chamber, which therefore keeps comparatively cool.

The record of the working of a charge, published in the *Iron and Coal Trades Review*, shows that the reduction of the carbon down to 0·65 per cent. can be effected in $5\frac{1}{4}$ hours. If this reduction of time is a ratio of the reduction of fuel on ordinary Siemens furnace practice, "Vulcan" can himself calculate the money value of the saving of this system of melting 10,000 tons.

Leyton, February 24th. HORACE ALLEN.

PETROLEUM VAPOUR LAUNCHES.

SIR,—We read with much interest in your issue of the 5th inst., page 150, the article on "Petroleum Vapour Launch Engines," and beg to inform you that the design of the engine you publish is that of the well-known shipbuilding and engineering company, Escher-Wyss and Co., of Zürich, Switzerland. This firm has during eight years introduced with great success many improvements and additions to this originally American patent.

We are of the opinion that the boat referred to in your article is one made by us, and delivered to the North of France. This 6-horse power boat can carry not only *two* persons, as stated in your article, but from thirty to forty; and has made, on an official trial trip of three continuous hours in the Channel, a mean speed of 7·3 knots, and not 5·5 as mentioned by you.

The cost of the boat is only 8000 francs (£320), and not 11,000 francs (£440), as you state. The improvements introduced by Escher-Wyss and Co., in the engine construction enable them to use petroleum oils having a greater density than 0·70.

If you require any further information respecting the engines and boats made by this firm, they may be obtained from the accompanying catalogue.

R. H. CAMPBELL,
W. REITZ,
Naval Architects.

Zürich, February 17th.

FORCED v. SUCTION DRAUGHT.

SIR,—I have read with pleasure and profit the articles on "Suction Draught for Marine Boilers" and on "Induced Draught," in your issues of February 5th and 19th. Both are full of instruction. I regret that induced draught should have been compared with forced draught on the closed stokehold system, because with such it is so easy to make a favourable comparison. Before I venture on a comparison, I would like to touch upon the closed stokehold system, which has so often failed.

Given an air pressure of 3in. in a closed stokehold, fire-grates 5ft. by 3ft. 9in., on these grates to an uniform depth 9in. of burning fuel, a chimney 80ft. high above the mean fire-grate level, then for about seven or eight minutes the following conditions would obtain:—Air pressure in the ashpits 3in., above the fire ·5in., in the combustion chamber a little less, and in the smoke-box there would be a vacuum about ·75in. The temperature in the combustion chamber would be something over 2000 deg.; in the stokehold it would be, say, 110 deg., not a bit too much. At this moment a fire needs to be charged. The furnace door is opened, and immediately air at 110 deg. and 3in. pressure rushes over the fire into and through the tubes *ad libitum*, at the same time playing havoc with that 2000 deg. The little tubes, which only a moment before were expanding all they were fit, now shrink, and ultimately they leak. The whole system is condemned. An Admiralty ferrule is tried. Some one proposes to put the fan in the chimney, and pull the air through the fire. It is done; and it is said that the little tubes leak no more. This is the kind of forced draught with which I regret that induced draught should have been compared.

But, given two examples, one induced draught with hot air drawn through closed ashpits, the other forced draught with hot air forced through closed ashpits, and see what takes place.

I can give you figures from practice, which I propose to put in parallel, thus:—

	Induced Draught.	Forced Draught.
Ashpit, air pressure	− 0·3in.	+ 1·5in.
Above the fire, air pressure ..	− 1·2in.	+ ·5in.
In smoke-box, air pressure ..	− 2·2in.	− ·25in.
At the fan, air pressure	− 3·5in.	+ 3·12in.
Smoke-box, temperature	675 deg.	490 deg.
Air going into ashpits	265 deg.	239 deg.

Examine these figures, and what takes place can readily be seen.

In the first example, the hot gases are hurried out of the boiler as though they had no business to be there; in the second example they are not hurried, but allowed to flow out of the boiler under the gentle influence of − ·25in. of a pull in the chimney. The speed of the gases from the furnace to the chimney must not, and need not, be the same. In fact, the speed is not the same.

A boiler is a structure which is intended should absorb heat. The element of time favours the absorption of heat. The element of time is favoured in the second example, but it is not favoured in the first, and the effect is seen in the difference between the smoke-box temperatures. In consequence of which I pin my faith on the forced draught, hot air, closed ashpit system.

Liverpool, February 23rd. ALEXANDER DALRYMPLE.

SIR,—In the last paragraph of your article on "Suction Draught," in your issue of the 19th inst., you say, "It may, for instance, be pointed out that in all the experiments that have been made on the transmission of heat through plates, next to nothing has been done to ascertain the effect of forcing flame against a surface to be heated." It may interest you to know that I have been experimenting in this direction during the last three years, and I fully agree with you "that the result, when published, will be a little surprising to many persons."

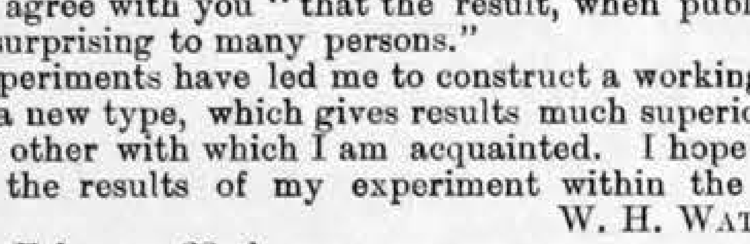
These experiments have led me to construct a working model of a boiler of a new type, which gives results much superior in every way to any other with which I am acquainted. I hope to be able to publish the results of my experiment within the next few months. W. H. WATKINSON.

Glasgow, February 22nd.

CHIMNEYS FOR CEMENT KILNS.

SIR,—In your issue of the 12th inst. a correspondent—whose initials I forget, and have not got my paper by me—asks the question as to the proper size of a chimney stack for Portland cement kilns.

The height of the chimney—if in the country and away from any chance of causing annoyance to near residents—is quite optional, and a chimney, say, 28ft. to 30ft. high answers the purpose well, providing the area of chimney at top is in proportion to the size of kiln, or kilns, and their areas. The proper internal area of such chimneys at their upper orifice is:—$C\,A = \frac{K\,A}{11 \cdot 5}$ Both in square feet. Where C A is area of upper orifice of chimney, and K A is area of kiln at its widest part. This rule



applies equally to those kilns with and without drying floors in connection therewith, as in the Johnson and Bachelor kilns. Note: In cases where the short chimneys are adopted it is advisable to erect two to each kiln or drying floor—dividing the total area required, of course—and placing one on each side of the floor, as in the rough sketch below. PORTLAND.

(Manager for Messrs. B. J. Forder and Son).

Sundon Cement Works, Dunstable, February 22nd.

OBSERVATIONS IN HIGH LATITUDES.

SIR,—The world is full of Nansen now, all honour to him, but I am a little puzzled, and venture to hope some of your readers can help me. How did Nansen, when he had left the Fram, know where he was? In the first place, the magnetic needle had little or no directive power, it was all dip. Parry, I think, found the magnetic pole, and he complained that his compasses were almost useless.

How did Nansen take his latitude? During the winter he could work by the stars, but in the summer the sun never sets, and the stars are, I take it, invisible. He lost his longitude when his chronometer ran down, but that is comparatively a small matter. He could make noon I suppose with a sextant and an artificial horizon, but noon would not help him much as to his latitude. Any hint on these points would be much valued by

Putney, February 17th. A GEOGRAPHICAL STUDENT.

POUNDS AND POUNDALS.

SIR,—In a short note, Professor Greenhill refers to the fact that in equation (7) of an article on "Superficial Tension and Lubrication," I have expressed the force resulting from a mass of matter under the influence of gravity in such a way that it gives us its value in poundals. This, of course, is quite true, but I must confess that I prefer to state it in dynes, our system of weights and measures not being a very inviting one.

As a mechanical engineer engaged in railway work, to whom, therefore, the results of acceleration are by no means novelties, the exact method adopted of stating the case appeared to be satisfactory. Indeed, the article is by an engineer, and was written for engineers, and I am inclined to think that engineers will be able to follow it.

It may be that there is still room for improvement in our system of measuring forces. But even if this be the case, engineers will rather resent the imputation that it is necessary to formulate some very simple system, so that the subject may be brought within the sphere of their intelligence.

Engineers really view with interest the discussion which is now taking place, and will not be slow, I think, to make use of any good points that may be brought out. R. M. DEELEY.

10, Charnwood-street, Derby, February 23rd.

SIR,—I read with much pleasure Professor Greenhill's short note in your last impression. Permit me to say a few words on the question raised.

For many years engineers were left to themselves, used those terms which they found suited their purpose, enabled them to communicate their ideas, make their calculations, and carry on their business. They found ready to their hands the square inch, the pound, the foot, the second, and so on. I have not heard that any of the mechanical engineers of this country, who have done and do so much for the world's advancement, have found these units inadequate.

Of late years there has sprung into existence a class composed of men who are not engineers at all; they would be called, if right names were always given, schoolmasters. I do not intend to use this as a term of reproach, because the schoolmaster has a great work to do, and does it well. But the world is very apt to be led astray by grand titles, and consideration is given to the dictum of the Professor that would not be given to the word of the schoolmaster.

Now it has occurred to the schoolmasters that an improvement in nomenclature is needed, and each man who writes a text-book goes one better than his predecessor in inventing new names for units. It is an easy and simple type of invention, and there is really no limit to it, because we may combine units almost without end. Thus, for example, we might call a train mile a "tranal." Piston speed per minute, might be written as "pispm," to which we may add an "e" for euphony, and write "pispem." Anyone with a little time on his hands can compose a dozen such words without trouble. These things have, however, no real value or importance at all. The engineer who sees the word "poundal" smiles and passes on. It would not be necessary to say anything about the subject if it were not for the sake of the student who, coming out of the technical college into the works, finds that he makes himself ridiculous when he speaks the jargon of the schoolmaster.

The engineer has no complaint to make concerning the foot-pound or the square inch. They are quite good enough for him, and it is a pleasant thing to see a man like Professor Greenhill, who certainly is only in the very highest sense of the term a schoolmaster, speak out and tell the plain truth.

Engineers are a very long suffering lot, they have too much serious work to do to worry about Professors with their little inventions of units which none of their fellows will accept. But the worm will turn sometimes, and the engineer may even go so far as to tell the Professor to attend to his own business and leave the engineer to mind his. SEXTUS.

25, Great George-street, February 23rd.

A QUESTION OF ADHESION.

SIR,—We notice under the heading "Locomotive Adhesion," your correspondent "W. M. A." appears to doubt the assertion of a Midland driver as to the quantity of sand used during a run from London to Nottingham. As makers of the steam sanding apparatus with which these engines are fitted, we may say that it is quite possible so to regulate the amount of sand delivered to the point of contact between the wheel and rail to any quantity, varying from a few ounces to several pounds per minute.

Craven Ironworks, Manchester, February 19th.

H. E. GRESHAM.
(Gresham and Craven, Ltd.)

TRACTION ENGINES IN SOUTH AFRICA.—Mr. Alfred Mosely, who is largely interested in the Koffyfontein diamond properties, is in Kimberley for the purpose of making arrangements to try the experiment of running traction engines between Honeynestkloof Station and Koffyfontein for transport purposes. The engines have been specially constructed for use on South African roads, and Mr. Mosely is confident that by means of them the present transport difficulties will be overcome. The engines proposed to be used will have 7ft. driving wheels, 2ft. wide, and a large drum will be attached to each engine. This drum holds 400 yards of ⅜in. steel rope, which, on a sandy or other bad place being reached, is released from the drum. The engine is then moved forward by itself and converted into a stationary winding engine, the rope, with the load attached, being pulled up to it by re-winding on the drum. The engine is then re-coupled, and if necessary the operation may be repeated until the bad part of the road has been got over. In the event of the sand being too heavy for the traction engine to be able to go over by itself—a contingency not likely to arise—it carries with it a long steel screw. This screw is carried forward. The steel rope is then attached to it, and the engine winds itself up to that point. The wire rope is then returned, and allowed to wind up the load. Thus any possibility of sticking in sandy or other bad places is avoided. At a meeting of a local committee the request of Mr. Mosely to be allowed to use the engines was referred to Dr. Hutcheon for report.—*Cape Times.*

IMPERFECT COMBUSTION DUE TO HEAVY FIRES.—When heavy fires are carried in a boiler furnace, the conditions are apt to approach to those which pertain to the operation of gas producers. In these a thick bed of incandescent coal is provided, and the supply of air is reduced, the object being to convert the carbon in the coal to carbonic oxide, and not to completely burn it. These conditions are more likely to occur in boilers which have the heating surface directly above the fire, as in those of the vertical type and many forms of water-tube boilers. In boilers like the horizontal return tubular, where the products of combustion do not rise directly from the bed of coal, but mingle with those generated in the other parts of the furnace, there is rather less opportunity for these conditions to exist. We have an instance reported by Mr. Barrus where a 12in. fire in a vertical boiler using semi-bituminous coal gave a flue gas analysis, showing 6·8 per cent. of carbonic oxide, 1·7 per cent. of free oxygen, and 11 per cent. of carbonic acid. When the thickness of the bed of coal was reduced to 6in., the same boiler showed a falling off in carbonic oxide to half of one per cent., an increase in the free oxygen to 3 per cent. and an increase in the carbonic acid to 16 per cent. In this example the loss of heat from the imperfect combustion of the carbon to carbonic oxide represents with the heavy fire 25 per cent. of the total heat of combustion of the coal; while in the case where the bed of coal was reduced, the loss is below 2 per cent. This improvement was not attended by a serious increase in the amount of surplus air, for in neither case did it exceed 25 per cent. Incidentally these examples furnish an instance where gas analysis reveals certain facts which showed that the firing of the boiler was improper; and, moreover, they increase our store of knowledge in regard to the folly of carrying heavy fires, if steam is to be made economically.—*Engineering Record.*

ALFRED BLECHYNDEN.

WE announce with much regret the death, at the early age of forty-seven, of Mr. Alfred Blechynden. He died rather suddenly on Saturday afternoon from syncope. Mr. Blechynden served his apprenticeship with Messrs. Morisons, Ouseburn Engine Works, and Messrs. Thompson, of Spring Gardens Engine Works, Newcastle-on-Tyne. Subsequently he became draughtsman at the Ouseburn Works, and afterwards filled the same position at Messrs. Thompson and Boyd's. He then went to the Forth Banks Works, of Messrs. R. and W. Hawthorn, as leading marine draughtsman, and became successively head draughtsman and engine works' manager at their St. Peter's Works. While there the Esmeralda was engined. She was the first of the protected deck fast cruisers. In 1884 he became the general manager of the Rio Tinto Copper Mines, a position which he had to relinquish after two years on account of ill health. In 1887 he joined the Barrow Shipbuilding Company as manager of the engineering department, and retained the position on the re-organisation of the company into the Naval Construction and Armaments Company, until the end of 1895. In February, 1896, he became general manager of Messrs. John Penn and Sons, Limited, Greenwich.

While at Barrow, Mr. Blechynden designed and constructed the engines of the Oratava and Oruba of the Pacific Line; Malacca and Formosa of the Peninsular and Oriental; the Empress of India, Empress of China, Empress of Japan, and many other large mail boats; and of the battleship Majestic, and the second-class cruisers Latona, Naiad, Melampus, and Flora, and of the third-class cruisers Jasseur, Jason, and Niger. He also designed and constructed the machinery of the torpedo-catchers Sturgeon, Skate, and Starfish; and designed and erected on board the engines of the Powerful, but he did not carry out the trials. At Penn's, at present, they have in hand from his design the engines of the Pomona and Pactolus, each of 7500 indicated horse-power, and those of the battleship Goliath.

He was the inventor and patentee of the Blechynden water-tube boiler, which has been fitted in several of the catchers, and is being fitted in the Pomona and Pactolus, and in several foreign war vessels. He was a member of the Institute of Naval Architects, and of the North-East Coast Institute of Shipbuilders and Engineers, and has read papers on various professional matters.

HENRY CHARLES FORDE.

THE sudden death of Mr. H. C. Forde, on Sunday last, deprives the profession of telegraph engineers of one of its few remaining pioneers.

Mr. Forde commenced his busy and distinguished career in Ireland, the country of his origin, where he was engaged sometimes on behalf of the late Mr. C. B. Vignoles, C.E., F.R.S., sometimes with others, or alone, in a variety of engineering work. Thus he came to be employed in 1846 upon different public works for the relief of the terrible Potato Famine. It was then that his relations with the late Mr. Lionel Gisborne commenced, leading in the first place to their joint visit of prospection and investigation to the Isthmus of Panama—the first attempt ever made to ascertain the practicability of a ship canal across that isthmus—and afterwards to their telegraphic partnership.

They had now struck fresh, and practically virgin, ground, upon which both of them established their reputation of pioneers in the craft; and one of them, the subject of this notice, accomplished a long career of useful and excellent work. In 1859 this firm represented H.M. Government in the engineering department of the Malta and Alexandria cable, supervising the work of Messrs. Glass and Elliot, the contractors. Mr. Forde subsequently—in 1862—read an interesting description of this enterprise before the Institution of Civil Engineers.

In 1860 Mr. Forde gave his evidence to the Joint Committee on the construction of submarine cables. One of the most useful tables prepared on this occasion was that of Mr. Forde and Mr. C. W. Siemens. He associated himself with several other eminent consulting engineers from time to time, including Sir Charles Bright, Mr. Fleeming Jenkin, Mr. Charles Hockin, and Mr. Latimer Clark. With the latter and Mr. Herbert Taylor he finally entered into a more permanent partnership. The success of this firm—practically the only one covering the entire field of work which it has done—is well known through the whole engineering and electrical world.

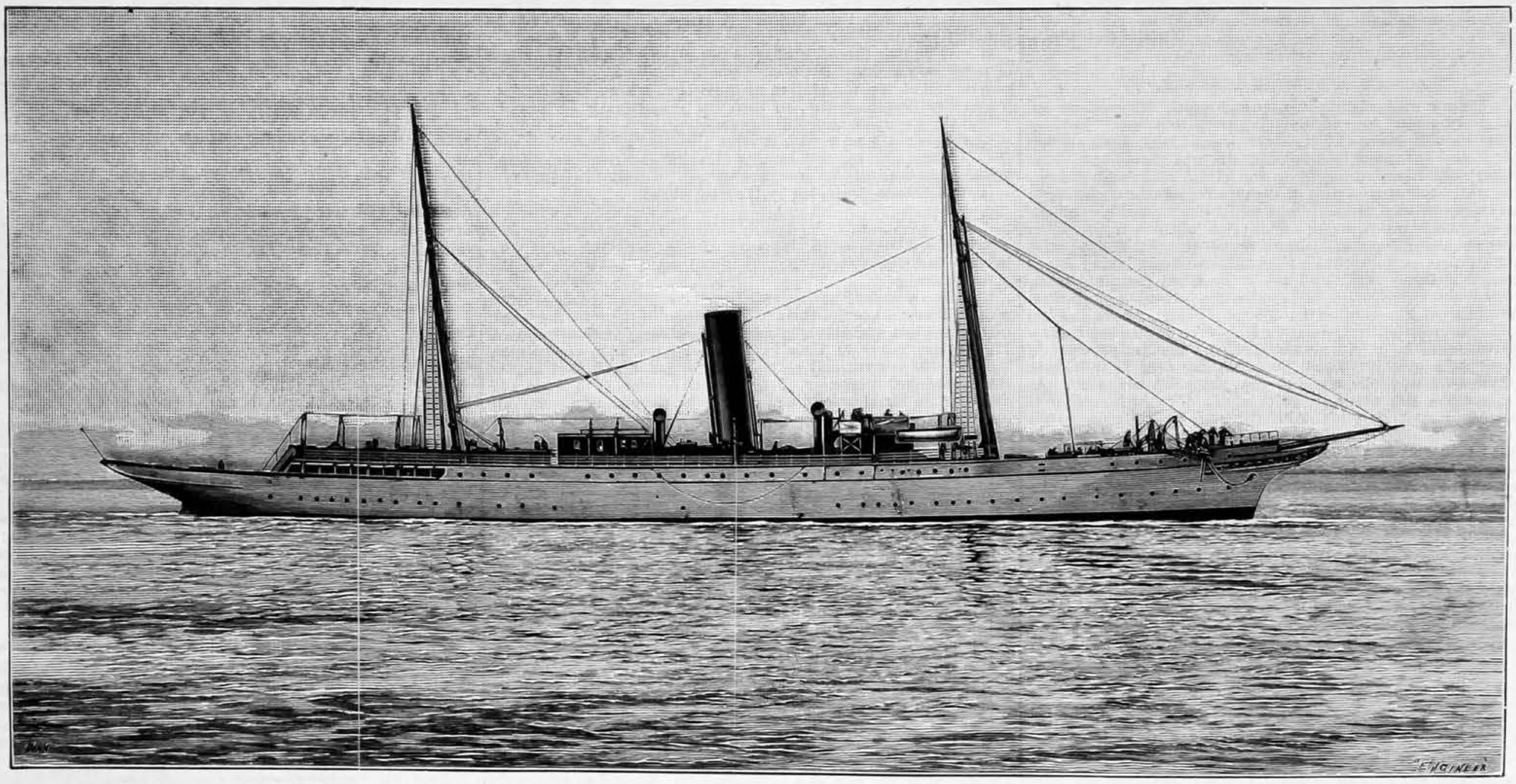
In the Institutions of Civil and Electrical Engineers, as well as in private life, where he always upheld the character of a genial host, Mr. Forde's death will be sincerely lamented by all who have known him.

A RUSSIAN ARMOUR TRIAL.

IT is reported that in last November a remarkable trial of armour took place at Ochta, near St. Petersburg. An 8in. gun, 45 calibres long, is said to have driven a shot through a Krupp 10in. steel plate with a hardened face. The striking velocity is given as 2850 foot-seconds, and it is stated that the projectile emerged at the back with a velocity of 700 foot-seconds. This is in all respects a valuable experiment. The very high velocity, the hard-faced plate, and the register of the shot after perforation are the very elements to be desired. The projectile must have been an admirable one if it held together intact. We do not know its weight. Russian 8in. armour-piercing projectiles exist weighing 192·3 lb., and also 172 lb. Both are light for this calibre; the British 8in. shot weighs 210 lb. This makes the velocity more easy of achievement. Nevertheless it is very high for plate-firing. With the heavier shot, the striking energy and perforation through iron would be 10,820 foot-tons and 27·3in., and with the lighter 9685 foot-tons and 26·7in. The shot emerged with an energy, on the supposition of the heavier weight of shot, of 653 foot-tons and of the lighter, of 584 foot-tons. From this it follows that either 10,167, or else 9101 foot-tons energy was expended in perforating the plate. The projectile in this case exerted a power of perforation equal to 27·0in. or 25·5in. of iron. This means that the figure of the Krupp 10in. plate was 2·7in. or 2·55in.; that is, it represented a thickness of wrought iron bearing this proportion to it in thickness, which argues a very excellent plate. Altogether we could wish that we had more complete data connected with this trial. We need scarcely add that on service such a plate might be safely depended on to defeat the gun. A projectile quickly loses some of its velocity, and so close a range, so direct a blow, and so excellent a shot would form a combination of favourable circumstances that would hardly occur on service.

THE TWIN-SCREW YACHT VARUNA

MESSRS. A. AND G. INGLIS, GLASGOW BUILDERS & ENGINEERS



THE TWIN-SCREW YACHT VARUNA.

NOTWITHSTANDING the rapid advances in steel steamship construction which our Transatlantic cousins claim they have recently been making, and despite the fact that in regard to the production of racing yachts they have so far succeeded in beating us, it is yet a circumstance worthy of notice that when a wealthy American wants a first-class steam yacht he generally builds her in the "old country." Of late many such orders have been placed with Clyde shipbuilders, and in each case the design of the yacht has been entrusted to the skilful hands of Mr. G. L. Watson. The Varuna, recently built by Messrs. A. and G. Inglis, of Glasgow, for Mr. Eugene Higgins, a New York millionaire, is one of Mr. Watson's designs; and the fact that her owner sought not only the plans of the vessel, but the yacht herself, from the Clyde, is a tribute to British shipbuilding skill, which counts for a great deal more than the tall talk often indulged in by the newspaper press on the other side.

The Varuna is a steel twin-screw yacht 260ft. in length on the water line, 35ft. extreme breadth, and 28ft. in depth to the bridge deck; having a Thames measurement of 1564 tons. Her length over all is 300ft., her depth in hold 18ft.; while her registered tonnage measurements are: under deck 1026 tons, gross 1573 tons, and net 595 tons.

Our illustration is from a photograph of the Varuna when ready for crossing the Atlantic. As will be seen from this and the profile plan, she has a topgallant forecastle which is 42ft. in length, and beneath it are fitted bathrooms for petty officers and crew, galley, lamp-room, &c. There is also a bridge deck 168ft. long, of which 40ft. at the after end is supported by the casings and by stanchions at the bulwarks. The remaining length of 128ft. extends from side to side of the yacht. At the fore end of the bridge is the owner's room, which is 15ft. long by 32ft. broad, being lighted and ventilated by seven large circular ports on each side. The fittings of this apartment are of mahogany, but the character of the material is concealed through being everywhere covered with a perfectly smooth enamelled white. Indeed, the whole of this and the adjacent apartments are enamelled white throughout, both in regard to furniture and fittings. The owner's room is divided by a partition into a bedroom and a sitting-room, the fittings of which in each case are of a most luxurious description. A commodious bathroom and lavatory adjoin the bedroom, the walls and floors of which are in white porcelain tiles.

On the after side of the apartments just described are two large state-rooms, measuring 15ft. by 14ft. and 12ft. by 14ft. respectively, one of which communicates with the owner's room, and both with a stairway to bridge deck. These state-rooms are decorated similarly to the owner's room, viz., in enamelled white, and each room has a bath-room in communication with it, the floors and walls of which are of white tiles, and the fittings of white marble.

Alongside the machinery and boiler casings on starboard side are rooms for maids and valets, also bath-rooms and lavatories for guests. The library, measuring 17ft. by 11ft. is situated on the after side of these state-rooms, and may be entered from the dining-room, which apartment is 18ft. by 34ft., and extends across the yacht between the casings of engine-room and those of the boiler space. The library is panelled and fitted with dark oak, and is upholstered in leather, the shelves in it being sufficient to receive upwards of 2000 volumes. The walls, furniture, and fittings of the dining-room are also of dark oak, but relieved with panelling in stamped leather and upholstered in morocco. Sitting accommodation is afforded at the dining table for twenty persons, and at the centre of the table is a handsomely carved oak pillar, to which is attached a well-designed arrangement of electric lamps fitted so that they may be varied in height from the table as may be required. At the sides of the room are couches, swinging tables, cabinets, and cheffoniers, while at the centre of the forward bulkhead is a tiled fire-place with a finely carved oak mantelpiece.

At amidships, and a little forward of the engine casing on the starboard side of the yacht, there is a water-tight gangway door, 6½ft. by 3ft., reached by the aid of an accommodation ladder, and by means of which entrance is obtained by the owner and his guests to this floating mansion. On the inside there is a door of polished oak, admitting to the vestibule, from which a stairway on the opposite side leads to the smoking-room on the bridge deck above, and a door at the right to the dining-room already described.

Within the vestibule, further inboard, are the two engine casings over the twin-screw engines, and between them is a passage-way leading to the drawing-room, which is situated abaft the machinery space. Much skill is shown in the arrangement and ornamentation of this part of the yacht. An engine casing is not generally a sightly object, but here it is a distinct feature of interest and adornment to the vestibule. The fore end of the starboard casing is rounded in a bold curve. The lower part, to a height of about 3ft. above the deck, is panelled in oak to correspond with the walls and sides of the vestibule, and above this the whole of the casings are fitted with large bevelled glass panels, whereby a view may be obtained of the engines working beneath. In this way, too, the whole of the vestibule and the passage-way to drawing-room is lighted from the engine-room skylights. At the after end of the passage-way access to the drawing-room is obtained by means of two doors. On entering the apartment, we find it relatively small when compared with the dining-room, as the bridge house at this part does not extend the entire breadth of the yacht, but leaves a passage way on each side, whereby both ventilation and lighting are afforded to the state-rooms below. The fittings in the drawing-room are partly of dark-polished mahogany, and the remainder in enamelled white, the panels being of silk tapestry. The semi-grand piano, which is placed at the fore end of the room, was sent over by the owner from New York. Without entering into a detailed description of the drawing-room furniture and decoration, it may be sufficient to say that the whole is of a very tasteful and elegant character.

The profile sketch which we show of the yacht illustrates the general arrangement of rooms as already described, as well as other rooms of a subordinate description. Mention must, however, be made of the fencing-room, which is situated at the after end of the bridge house, and entered either from a companion way above, or by a door from the drawing-room. The fencing-room, like the drawing-room, is lighted and ventilated by means of square windows at the sides, and by a skylight above, the latter being in this case of circular form. The fencing-room is plainly yet conveniently fitted in polished oak, and contains four concealed beds, constructed after the manner found in Pullman cars, but with the addition of wash basins, &c. Around the walls are seats with glass doors for holding foils, boxing gloves, and other athletic appliances. Abaft the fencing-room and below the upper deck are the bachelors' quarters, and rooms for valets. The crew accommodation and the spaces set apart for store-rooms and other purposes are shown in our illustration. The entire arrangement is excellently designed, and shows that Mr. Higgins knows what is required, and that Mr. Watson is well able to give a practicable and workable expression to those requirements.

For the rest, it is of importance to note that the Varuna is subdivided by no less than eight transverse water-tight bulkheads; and what that means in regard to safety from disaster at sea it is not necessary for us to point out. Two double-bottom cellular compartments are constructed for water ballast purposes, having a collective capacity of 66 tons, and the fresh-water tanks will hold 9000 gallons. Eight boats are supplied, including 33ft. and 28ft. steam launches. The larger of these was built by the Liquid Fuel Engineering Company, of Cowes, Isle of Wight. As will be seen by our illustration, both electric lighting and refrigerating appliances are provided, the latter being by Messrs. Hall, of Dartford. A system of hot-water heating is also carried throughout the yacht, radiators being placed in the apartments for both guests and officers. The rooms are also ventilated by electric fans.

The twin-screw engines, of which illustrations are given, are triple expansion, with four cylinders to each—two low pressure—of 22½in., 38in., 40in., and 40in. diameter, and 27in. stroke. Two single-ended cylindrical boilers, back to back, are of 17½ft. diameter and 11⅝ft. long, with four furnaces to each, and loaded to a steam pressure of 160 lb. per square inch. Forced draught is obtained by means of fans. On the trial trip of four runs between the Cloch and and Cumbrae lights, when at a mean draught of about 15¼ft., a mean speed of 16·73 knots was obtained by an indicated horse-power of 3995, the engines working at 158 revolutions per minute.

On leaving the Clyde the yacht presented a handsome, well-outlined form, with an excellence of finish such as always characterises the work turned out by Messrs. Inglis. She will, without doubt, fully satisfy the desires of her owner, and probably afford his New York friends, who would like a steam yacht of their own, a good idea of where to get such an article designed and built.

GREAT EASTERN RAILWAY. — LIVERPOOL STREET STATION WIDENING.

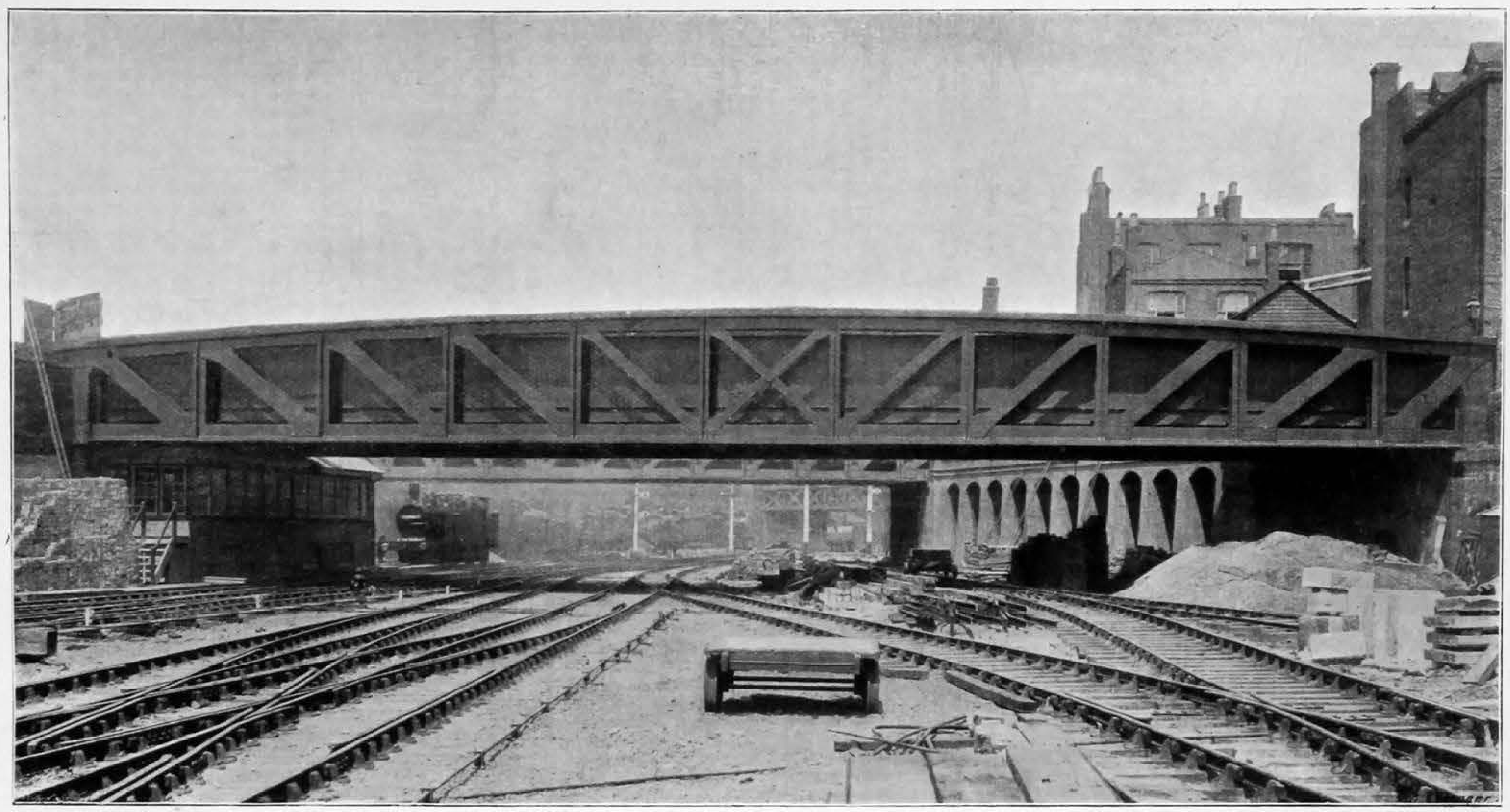
EXTENSION OF SKINNER-STREET BRIDGE.

THE subject of description and illustration in our present article, is the largest and the most important structure of the kind, rendered necessary in the vicinity of Bishopsgate-street by the extension of the terminal station of the Great Eastern Railway. Owing to the fact that the abutments of Skinner-street bridge have their faces inclined towards each other at acute angles of 73 deg. and 81 deg. with the overhead line of road traffic, the respective spans of the north and south main girders are by no means identical. This discrepancy is also augmented by the erection of two columns underneath the south girders on the station side of the bridge, which are wanting on the north side, as shown in the general plan and elevation, Figs. 1 and 2, and in one of the engravings accompanying this article. Commencing from the old bridge—Figs. 1 and 2—we find a plate girder 29ft. in span, resting at one end on the abutment, and at the other at Y Y on the column P. The distance of 15ft. between the small and large columns P and P_1 is spanned by an underneath plate girder, which is joined on to the south main girder over the column P_1, and forms the cab approach to the terminus, of which further details will be given. An elevation of the columns and of their brick pedestals and foundations, which are carried down to the blue clay, is given in Fig. 2. For the principal dimensions of the bridge we have the following:—Span of north main girder, 159ft.; span of south main girder, 185ft. 4in.; width of bridge between centres of north main girder and plate girder, 32ft. 8in.; width of bridge between centres of north main girder and south girder, 33ft. 7in.; width of bridge between centres of parapets, 30ft.; depth of north main girder at centre, 15ft.; depth of south main girder at centre, 12ft.; depth of north and south main girders at ends, 9ft.; breadth of the booms of both girders over all, 3ft. 7in. This total breadth includes the 1in. clearance between the twin main girders. There are fourteen cross girders connected by intermediate girders, all of the plate description, upon which are carried the buckled plates supporting the roadway.

Details of the smaller column P are shown in Figs. 3, 4, and 5. It is 11ft. 5⅜in. high from the upper surface of the pedestal to the top of the capital, which measures 3ft. by 2ft. by 2in. in thickness, which last dimension is that of the metal of the column throughout, except at the base where the fillets or ribs occur, and where for a height of 9in. it is increased to 2½in. Holding-down bolts, four in number, 4ft. long and 1½in. diameter, with washers 1ft. square, fasten the column to its foundation, Fig. 5, into which it is sunk to a depth of 1ft. 6in. Fig. 2. The particulars of the larger column P_1 are similar to those of the other P, but the diameter is 3ft., and the thickness is increased to 3in., the dimensions of the capital to 4ft. by 3ft. 8in., the base to 6ft. by 6ft., and the diameter of the holding-down bolts to 2in. A difference is to be noticed, although not shown in the drawings on account of the smallness of the scale, that while in the smaller column the shaft and base are all in one casting, in the larger they are cast separately, and bolted together through flanges 3in. in thickness by twelve bolts 1½in. in diameter. All bearing surfaces of the columns are truly turned. The plate girder shown in elevation in Fig. 2, connecting the abutment, to which it is bolted down, with the smaller

SKINNER-STREET BRIDGE, GREAT EASTERN RAILWAY

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

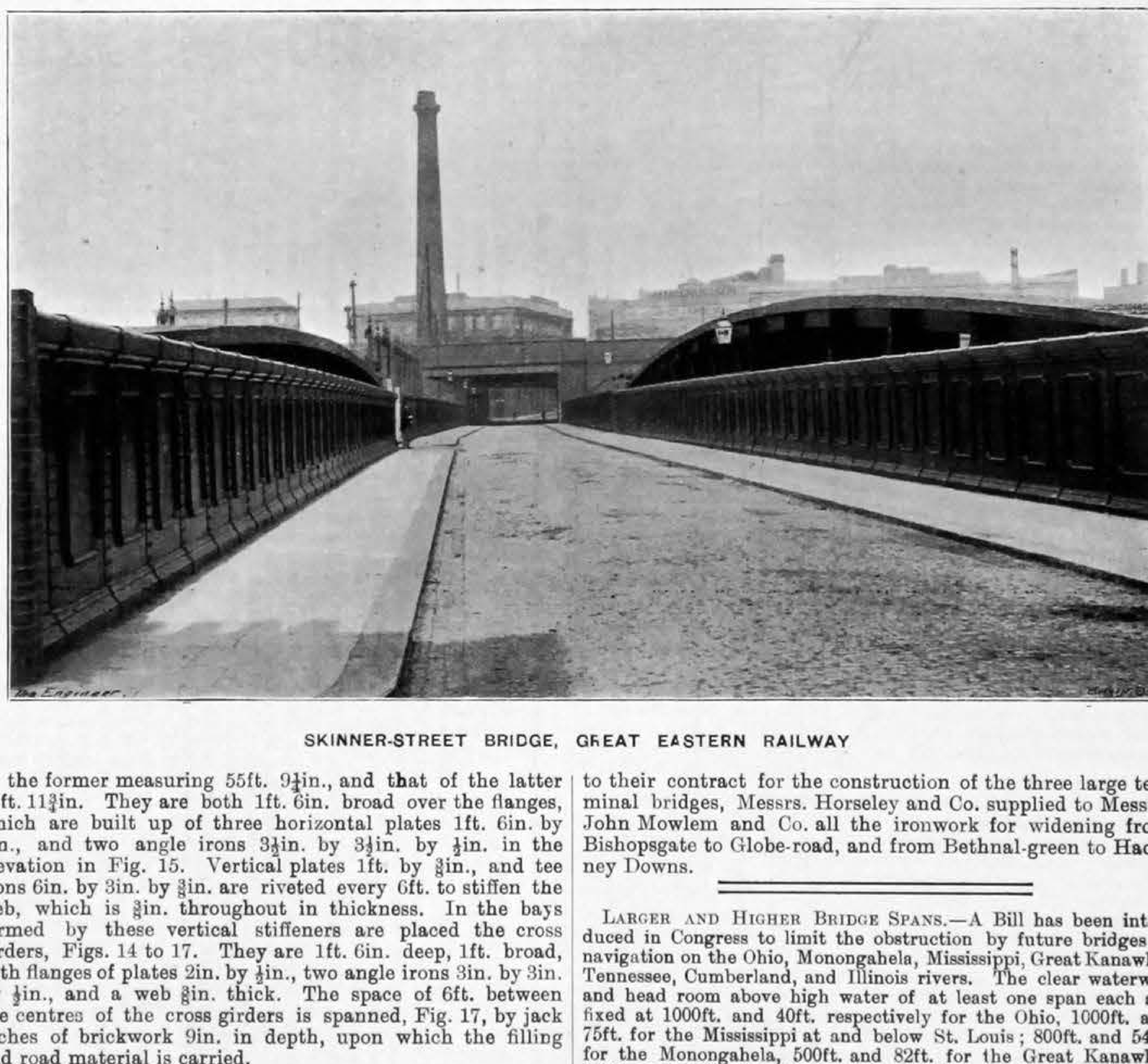


column P, has a depth of 7ft., and is built up of equal upper and lower flanges consisting of one plate 1ft. 9in. by ½in., and two angle irons, each 4in. by 4in. by ½in., and a web of a uniform thickness of ⅜in. It is connected over the capital of the pillar P, with the girder E to be subsequently described. Fig. 3, which is an enlarged sectional plan at Y Y in Fig. 2, explains the method of connection. Over the larger column P_1 the attachment of the girder F to the south main girder takes place at X X, and is shown in Fig. 2, where the small underneath plate girder B is riveted up to one of the fourteen cross girders of the bridge.

The elevation of the north or larger main girder in Fig. 6 indicates that the type of construction adopted is similar to that employed for the structure at Primrose-street, previously described and illustrated in our columns. It will not be necessary to describe or refer further to the south main girder, which on a somewhat smaller scale is designed on the same lines as its neighbour. There are fourteen bays, the two central of which are counterbraced, in the total length, 173ft., of the girder, twelve of which are spaced 12ft. apart from the centres of the double strut diaphragms, which, as in the former instance, brace together the separate or twin girders composing the entire one. The two end bays are rather longer than 12ft. At the centre of each of the twin girders there are ten plates, as seen in the diagrams, in the upper and lower flanges, all 1ft. 9in. by ½in., having a maximum length of 30ft. 2in. The arrangement of the joints in the plates of the flanges is well shown in the diagrams in Fig. 6, in which one long cover plate covers them all. A half sectional plan and a half plan in elevation of the full width of the flanges, showing the position of the cross girders and the ties and struts, is given in Fig. 7. From the details in Fig. 8, which is an elevation on a larger scale of part of the north main girder, it appears that the diagonal tie bars vary in scantling from 10in. by ½in. in the central counterbraced bays to 1ft. 10in. by 1½in. at the ends. Each strut, while the four angle irons, 3in. by 3in. by ½in., and the two vertical plates in the cross section of the girder forming the diaphragms, ½in. in thickness, retain these constant dimensions, has the two other vertical plates increasing in size in the elevation of the girder from 5in. by ½in. to 8in. by 1½in. It should be noticed here that these two plates are not always of the same thickness, the one nearer the end of the girder being thicker than the other, so as to agree with the increased thickness of the diagonal tie bar riveted to it, and thus provide for the augmentation in the amount of the stresses acting on the bars of the web. The ends of the main girders are strongly stiffened by the web over the bearings being strengthened by plates ⅜in. thick and a pair of tee irons 6in. by 3in. by ½in. In the cross section just over the bearings of the girder in Fig. 10 it will be seen that there are two longitudinal angle irons covering the space of one inch between the twin girders, and also a couple of angle irons, all 4½in. by 4½in. by ½in., riveted to the inner and outer edges of the upper flanges. The general cross section of the bridge is represented in Fig. 11, and an enlarged detail of a part of it in Fig. 12. Cross girders 2ft. 6in. at the centre, and 2ft. 1½in. at the ends, with a slightly concave lower flange, carry the intermediate girders. The intermediate girders shown in Fig. 13 support the cast iron floor plates, upon which the filling concrete and stone setts forming the roadway are placed. All the sets are 12in. by 7in. by 3in., and the surface of the footpath is covered with asphalte, which is raised 4in. above the level of the roadway, and separated from it by a granite curbstone 12in. by 6in. A small plate girder runs along the whole length of the footpaths on the inside of the main girder, and acts as an earth plate or ballast board. It may be observed that there is no joint in the cross girders, all the plates and angle irons being in one length. There are three plates in each flange 1ft. 6in. by ½in., two angle irons 3½in. by 3½in. by ½in., and two longitudinal corner ones, to which the flanges of the cast iron arched plates are bolted, Fig. 13. The web has a width of ⅜in., increasing to ½in. at the ends of the girders. Between the cross girders, at intervals of 4ft., are the small intermediate girders 1ft. deep, consisting of a pair of angle irons 3½in. by 3½in. by ½in., and a web plate ⅜in. in thickness, extending up above the angle irons of the upper flange to form a ledge for the bolting through it of the flange of the cast iron arched plates, which are 4ft. by 3ft. 6in. of ⅝in. metal.

The entrance to the cab approach to the terminus from Bishopsgate-street and Norton Folgate, which takes off at right angles from the bridge over the railway at Skinner-street, is shown in Fig. 2, carried upon a pair of main plate girders E and F. A general plan of the approach is given in Fig. 14, and the junction of the longitudinal approach girders E and F with the south main girder making a total length from out-to-out of 54ft., the cross girders being placed 6ft. apart from centres. Girders E and F are of the plate type, similar in design and construction, 7ft. deep at centre, but of different span, as can be seen in Figs. 14 and 15, that of the former measuring 55ft. 9½in., and that of the latter 53ft. 11⅝in. They are both 1ft. 6in. broad over the flanges, which are built up of three horizontal plates 1ft. 6in. by ½in., and two angle irons 3½in. by 3½in. by ½in. in the elevation in Fig. 15. Vertical plates 1ft. by ⅜in., and tee irons 6in. by 3in. by ⅜in. are riveted every 6ft. to stiffen the web, which is ⅜in. throughout in thickness. In the bays formed by these vertical stiffeners are placed the cross girders, Figs. 14 to 17. They are 1ft. 6in. deep, 1ft. broad, with flanges of plates 2in. by ½in., two angle irons 3in. by 3in. by ½in., and a web ⅜in. thick. The space of 6ft. between the centres of the cross girders is spanned, Fig. 17, by jack arches of brickwork 9in. in depth, upon which the filling and road material is carried.

Over the cross girders runs the earth plate girder shown in Figs. 18 and 19, to which it is, by angle iron gusset pieces 6in. by 6in. by ½in., riveted over their upper flanges. Upon the prolongation of the web of the earth girder or ballast board are riveted the vertical plates 4ft. by 7ft. by ½in. thick, of the parapet or screen, to which are fixed the cast iron mouldings, of which the details are shown in Figs. 19 and 20. The joints of the screen plates are covered by wrappers of plate 6in. by ½in., and the screens are stiffened at intervals by angle iron 2½in. by 2½in. by ⅜in. In Figs. 21 and 22 are given the details of the free end of the main girders, which has a roller and rocker arrangement, which, with the exception of a few details, is similar both in design and construction to that adopted for the Worship-street and Primrose-street bridges, previously published in THE ENGINEER, and which therefore requires no further description. For the drawings accompanying our article we are indebted to the courtesy of Mr. John Wilson, M. Inst. C.E., Engineer-in-Chief of the Great Eastern Railway, and for much information to his resident engineer, Mr. H. A. G. Sherlock, M. Inst. C.E., now stationed, we believe, at Cambridge. The photographs, which are self-explanatory, were very kindly placed at our disposal by Mr. H. L. Batting, of the well-known Horseley Company, Limited. In addition to their contract for the construction of the three large terminal bridges, Messrs. Horseley and Co. supplied to Messrs. John Mowlem and Co. all the ironwork for widening from Bishopsgate to Globe-road, and from Bethnal-green to Hackney Downs.



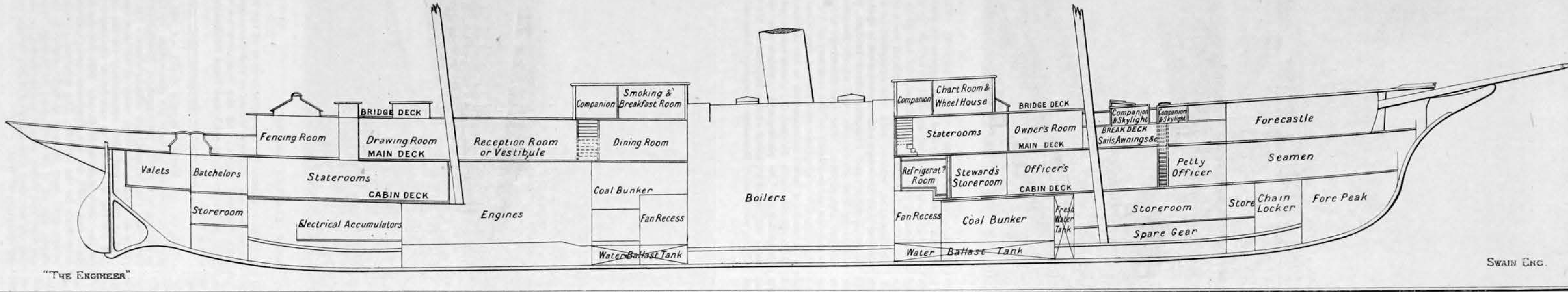
SKINNER-STREET BRIDGE, GREAT EASTERN RAILWAY

LARGER AND HIGHER BRIDGE SPANS.—A Bill has been introduced in Congress to limit the obstruction by future bridges of navigation on the Ohio, Monongahela, Mississippi, Great Kanawha, Tennessee, Cumberland, and Illinois rivers. The clear waterway and head room above high water of at least one span each are fixed at 1000ft. and 40ft. respectively for the Ohio, 1000ft. and 75ft. for the Mississippi at and below St. Louis; 800ft. and 54ft. for the Monongahela, 500ft. and 82ft. for the Great Kanawha, 250ft. and 100ft. for the Tennessee and Cumberland, and 250ft. draw-spans for the Illinois. The reported provision that "every bridge shall have its axis at right angles to the current at all stages, and all of its spans shall be through spans," is obviously arbitrary and unfair, even if not impracticable, and seems to overlook the fact that final approval of any design must be given by the Secretary of War.

THE TWIN SCREW YACHT VARUNA

MESSRS. A. AND G. INGLIS, GLASGOW, BUILDERS AND ENGINEERS

(*For description see page* 214)



THE FEDERATED INSTITUTION OF MINING ENGINEERS.

MANCHESTER MEETING, 1897.

The week before last we announced a forthcoming meeting of this energetic amalgamation of institutions, now we record some of the business transacted at the meeting announced. This was the twenty-third general meeting; it was held in Manchester on Tuesday, Wednesday, Thursday, and Friday of last week, and amongst the papers presented at the meeting were the following:—

"Railway Nationalisation in Relation to the Coal Trade" was treated by Mr. Clement Edwards; recognising the paramount importance of cheap fuel, he first demonstrated that the railway rates amount to a charge of 25 per cent. in the selling price of minerals; then commented on the higher railway rates in England as compared with the continental railway rates; he also argued the question as to the exhaustion of our supply of coal, and the cost of, and limits of profitable working, summarising the position to the effect that our coal supply is nearly certain to give out before that of our chief competitors, but that long before the period of final exhaustion has been reached the cost of mining will have become much higher than in the case of competing nations. Some reduction of expenditure will therefore have to be made to help us as a nation to hold our own against foreign competitors, and this compensatory reduction can best be met by the institution of a much cheaper cost of carriage, which could be effected by putting the railway rates on a just basis from a national standpoint. As we are not likely to get this satisfactory rearrangement of rates out of the present railway system, Mr. Edwards believes that the remedy is to be found in the nationalisation of the railways. He advocates nationalisation because he realises that there are wastes incident to our system—a definite waste estimated at £10,000,000 a year—and that we have all the disadvantages of competition without any of its advantages; such, for instance, as the carrying of foreign produce at a cheaper rate than British produce. Then he finds that the acquisition by the State of the railways has been attended by improved services, cheaper rates, and very great advantages to the community in Germany, Belgium, Austria, Holland, India and Australia, having failed only in one instance, that of Italy.

No discussion was taken on this paper, which we think is to be regretted. The paper was founded on statistics for the year 1889, which are rather out of date in 1897. It would, however, have afforded a basis for a discussion on a very important subject by practical men. The question of inland transport is undoubtedly of prime importance to the community, but we should be sorry to think that the only remedy was to place the carriage of goods throughout the country as well as of passengers in the hands of the Government. It is more than a commercial, in fact, it is a great political question.

The next paper read was on "The Cost and Efficiency of Safety Explosives as Compared with Gunpowder," by Mr. H. Hall, H.M. Inspector of Mines, who said that in view of the recent order issued by the Secretary of State, which would shortly come into operation, reliable information as to the cost and efficiency of permitted explosives would be of interest, and he had obtained full statistics for actual comparisons between gunpowder used as the blasting agent and safety explosives used for the same purpose. Some twenty firms have been included in the inquiry, and in each case the last whole year in which gunpowder was used is compared with the year 1896 for the safety explosives; the same seam, or the same colliery as a whole, is in each instance compared for the two periods. The inquiry embraces mines giving an annual output of 5,000,000 tons, and in several instances the experience with safety explosives extends to eight or nine years; full details are given in the paper, and will appear in the "Transactions" of the Federated Institution of Mining Engineers, a remark that also applies to the other communications we notice. From these data it is deduced that the average cost per ton for explosives is 0·61d. for gunpowder and 0·92d. for safety explosives, or one-third more for the latter explosives than for the former. In the table given the safety explosives used at a cost of one penny or less per ton of coal raised include:—Ammonite, Ardeer powder, bellite, carbonite, electronite, and roburite. Dealing with the yield of round coal, the average percentage with gunpowder was 62·2, with the safety explosives 62·0—remarkably near. But in stonework, the safety explosives show an advantage of at least 25 per cent. over gunpowder.

The general conclusion drawn from the statistics is that the new "Explosives in Coal Mines Order" will by no means prove so formidable from a commercial point of view as has been represented by some people, inasmuch as it is estimated that less than one penny per ton will defray the whole cost.

Moreover, the question of safety is also considered, and a notoriously fiery district where safety explosives, safety lamps, and an official shot firer is compared with a district, presumed to be safe, where candles, gunpowder, and collier shot fires prevail. Taking West Lancashire as the fiery district and Northumberland as the other district, it is shown that during the last five years one death in every 76,700 in the former district, and one death in every 23,130 in the latter district, and of persons injured, we have respectively 1 in 4602 and 1 in 1735. That is, there have been more than three times as many persons killed in Northumberland through accidents with explosives in proportion to the number of persons underground than there have been in West Lancashire, and nearly three times as many injured from the same cause during the last five years. Then turning to fire-damp explosions during the same period there is shown to have been an average of 1 death per every 27,760 persons in Northumberland, and 1 in every 115,050 in West Lancashire, the average injuries from this cause standing at 1 in 5552 and 1 in 11,505 respectively. Of course, the numbers again refer to the underground population; so there have been four times as many killed by explosions of firedamp in Northumberland as in Lancashire, and twice as many injured in the last five years. It would thus appear that by obstinate adherence to antique methods of mining a district naturally safe has become less free from accident than one naturally dangerous. The argument that the use of candles tends to diminish the risk of accidents liable to cause fall of roof and side is shown to be untenable by statistical comparison between a district using candles and another using lamps, from which it is concluded that the different methods of lighting in two districts has no bearing on the frequency or otherwise of falls of roofs. It is furthermore remarked that in a list of 37 accidents all the firedamp explosions (six) were caused by candles, and out of 31 accidents with explosives 29 were due to gunpowder mostly in conjunction with candles. Mr. Hall thinks the adoption of the "Explosives in Coal Mines Order" will minimise the risk of explosions both of fire-damp and coal-dust.

The chairman considered that the cost of working with safety explosives would be greater than Mr. Hall supposed. If all the men were taken out of a pit whenever a shot was fired, the cost would be prohibitive. It was pointed out that 1d. per ton on the whole output amounted to £790,000 a year. Mr. Prest, of North Staffordshire, said that at the colliery he managed, where a high explosive was used, it was found to cost double that of gunpowder, and produced more slack. He should have supposed that the Home Secretary would have had more faith in the so-called safety explosive, and not ordered the removal of all the men except ten from a mine.

"Various Types of Ropeways" were described, with remarks as to their proper selection by Mr. W. Carrington, who is of opinion that inasmuch as wire ropeway transport can do thoroughly efficient and satisfactory work, and compete well with the ordinary ground railways of the class found in mines, it is not used to the extent that it should be. This lack of appreciation of this system of transport is attributed to indiscriminate application of the many types of wire ropeways, and to the adherence to one type for doing all kinds of transport work, whereas circumstances should decide as to the type of ropeway to be adopted, the chief considerations being the character of the country which has to be traversed, the class of material to be transported, the manner in which such material can be packed, the motive power available, the incline to be surmounted, the spans to be crossed, the quantity to be carried per day, &c. Taking these matters into consideration, he reviewed various types of ropeways, and pointed out in which direction they may most appropriately be applied. He described five different arrangements of wire rope transport from which to select. The five are:—The endless running rope; the endless running rope with carriers rigidly fixed in position on the rope; the two fixed ropes, with many carriers, drawn by one endless hauling rope; the single fixed rope, with one carrier, drawn to and fro by means of an endless hauling rope; and the double fixed ropes, with an endless hauling rope, having one carrier travelling in one direction while another runs on the parallel rope in the opposite direction. The further consideration of this paper and the notice of Mr. W. Galloway's paper on "Appliances for Winding Water" will be reserved for a future occasion. Gas testing was treated by Mons. J. Coquillion and Professor Clowes.

An excursion was made to the locomotive works of the Lancashire and Yorkshire Railway Company at Horwich. The president was accompanied by about forty members, who were met and shown over the works by Mr. J. A. Aspinall, the locomotive superintendent. The land enclosed for works includes 85 acres, and the covered area of workshops 16¼ acres, comprising offices, stores, boiler-shop, smithy, forge foundry, machine-shops, and erecting and repairing-shops, &c. &c. There are five miles of tramways 1ft. 6in. gauge, and a number of small locomotive engines are used for hauling materials to and from the stores, and of work to and from the various departments. The works were commenced in 1886, and were erected for the purpose of repairing and renewing the locomotive stock and carrying out mechanical engineering work on the railway. The company have 1300 locomotives, and build about forty annually. Almost everything in connection with the business and the manufacture of engines, signals, &c., is done on the premises; steel plates and rails are purchased, but the steel tires and springs are forged at the works. Interlocking frames and levers, signals, and the requirements of the telegraph service are all provided for. The raw material is dealt with at one end of a parallelogram and follows its course to the end across the short side, and emerges at the end of the second long side a finished locomotive. Between 3000 and 4000 men and boys are employed.

Messrs. Wm. H. Bailey and Co.'s Albion Works, Salford, were also visited, where Davidson's direct-acting steam pumps were shown. These pumps are described as being suitable for pressures varying from 50 lb. to 4 tons per square inch. The Denaby sinking pump was also shown. This type was designed for sinking two large shafts, over 600ft. in depth, by the Denaby Main Colliery Company at Cadeby, near Doncaster. It has the Davidson piston and valve motion, and works when suspended by chains or steel ropes. As the sinking proceeds extra lengths of pipes are added to the top of the shaft, and a telescopic suction pipe enables the sinking to proceed for a depth of 9ft. without necessitating the lowering of the pump. It can be fixed permanently in the shaft after the sinking is completed. Eight of these pumps were supplied to the Denaby Main Colliery Company. The Aquathruster pump was also shown; it is an improved pump of the pulsating type.

Trade and Business Announcements.—Messrs. Dick, Kerr, and Co., Limited, of 101, Leadenhall-street, London, and Britannia Engineering Works, Kilmarnock, have inaugurated their new electrical traction department by securing the contract for the electrical equipment of the Dover Corporation tramways.—Mr. W. T. Parrack, 171, Queen Victoria-street, E.C., intimates that he is relinquishing the representation of Messrs. George Turton, Platts, and Co., Savile-street, Sheffield, as from March 12th next.—The Beaman and Deas Syndicate, Limited, have opened new head offices in London at 32, Victoria Mansions, Westminster. The Warrington office will remain open as a northern district office.—Ley's Malleable Castings Company, Limited, Derby, has been reconstructed, owing to increase of business. No shares, however, are being offered to the public. — On January 1st, 1897, Messrs. Hale Brothers established themselves at 18, Fenchurch-buildings, Fenchurch-street, as manufacturers of electrical apparatus.—The Caledon Shipbuilding and Engineering Company, Limited, of Dundee and London, has just received a further order from the Cork Steam Shipping Company, Limited, of Cork, to build for it a vessel 239ft. by 32ft. by 15ft. 8in., fitted with engines of about 1000-horse power; the steamer to have cranes and winches for the quick handling of general cargo. This will be the eighth steamer built by the Caledon Company, Limited, for the Cork Steam Shipping Company, Limited.

RAILWAY MATTERS.

THE mileage of the Pennsylvania Railroad system at the end of 1896 aggregated 12,859·97 miles.

THE *Electrical Engineer* states that the Diatto surface contact electric tramway is to be tried at once at Tours. At present the tramways there are run with Serpollet steam tramcars.

TWO compressed air cars of the American Air Power Company were given a trial run in New York recently, the trip being from Fort Lee ferry to Broadway and the Grand Central Station. The cars carry air at 2000 lb. pressure in the reservoirs.

THE promoters of the City and West-End Railway Company, and of the Brompton and Piccadilly Circus Company, have agreed to insert a clause in their Bills undertaking to insulate their return along its whole length "to the satisfaction of the City and Guilds of London Institute."

EXPRESSED in terms of hundreds of square miles, of the leading railway countries Belgium has 29·1 miles of road per 100; Great Britain, 16·6 miles; Netherlands, 13·5 miles; Germany, 13·6; Switzerland, 13·1; France, 11·5; Italy, 7·8; United States, 5·7; Canada, ·4; Mexico, ·7; British India, ·9; Argentine Republic, ·7; and Australia, ·6.

AN alternative proposal for a railway line from Noakhali to the Assam-Bengal Railway has been put forward. The original idea was to connect it with Feni, a sub-divisional town in the district, while the scheme now put forward is to make it pass along the centre of the district, and eventually link it to the Assam-Bengal Railway somewhere near Laksam Junction.

FROM reasons at present unexplained, the London and South-Western up London mail train crossed the junction points near Dorchester, on Sunday night, and ran on to the Great Western main line. The train was pulled up in the Great Western station, and, after some delay, the officials got it on to its own line. A Board of Trade inquiry into the incident will probably be held.

THE Government of India has approved the Port Commissioner's proposals for spending 20 lakhs of rupees at Kidderpur in improving the docks with coaling berths and golahs, or salt repositories in the boat canal adjoining, and has authorised the raising of a loan of 15 lakhs of rupees at 3½ or 4 per cent. According to Reuter, the Government has agreed to the proposal as the only feasible solution of a serious practical difficulty.

THE company of the Chemin de Fer de l'Ouest has been experimenting with the Chapsal electric air brake between Paris and Mantes. The brake is designed to obviate the troubles which arise when it is attempted to apply without modification the ordinary air or vacuum continuous brake to goods trains, owing to the time the impulse takes to travel along the train. It is claimed that in the Chapsal brake an electrical apparatus starts the braking pistons simultaneously.

AN old brick bridge which carried the Manchester, Sheffield, and Lincolnshire Railway over a drain at Lincoln collapsed on Sunday. The bridge had been under observation since the recent floods, and the down siding was strengthened by timbers. On Sunday a gang of seventy men were engaged in demolishing the structure to make way for a girder bridge. When the main lines were removed the centre arch collapsed, and twelve men were precipitated into the water. The stream, swollen by the floods, was flowing very rapidly, but fortunately a lifebuoy and boat were provided for such an emergency, and the men were quickly rescued.

ON the Eastern Bengal State Railways the work of doubling the line from Poradaha to Naihati is rapidly approaching completion; the additional ghat sidings and extension to Faridpore are well in hand; the Sultanpore-Bogra-Kaliganj branch line is being taken up; the extension of the Cooch Behar section to Santrabari and Buxar has been commenced; the Teesta bridge is in hand, and on the Mymensingh line the important prolongation to Jamalpore and beyond to a point opposite Serajganj is under way. The project for extending the Bengal-Central Railway—which is now about to work independently of the Eastern Bengal State Railway—from Singhia to a point opposite Chandpore is one that is being reconsidered, and, says an Indian contemporary, is likely to be brought into practicable shape.

THE Secretary of State for Foreign Affairs has received a despatch from H.M. Acting Consul-General at Christiania stating that notice has been published by the Norwegian Board of Works inviting foreign as well as Norwegian engineers to draw up competitive plans of station arrangements for certain railways having their termini in that city. The *Contract Journal* says:—Four prizes, worth about £555 10s., £222 4s. 6d., £111 2s. 3d., and £55 11s. respectively, are offered. Plans of intending competitors must be sent in before 2 p.m. on March 31st, 1897. Further particulars can be had on application to the Railway Office, Board of Works, Victoria-terrace 6, Christiania, where also maps and sections, &c., can be obtained on depositing 50 kroner, £2 15s. 6d. Such further particulars as have been received may be seen at the Commercial Department of the Foreign-office any day between 11 a.m. and 6 p.m.

NEVER in the history of railway construction in India have so many important bridges been in hand at the same moment. The East Coast line, which is making satisfactory progress, for instance, claims the Godavery Bridge, which will possess fifty-six spans of 150ft., the Mahanuddy Bridge sixty-four spans of 100ft., and three smaller bridges over the delta of twenty spans of 150ft., nineteen spans of 150ft., and sixteen spans of 100ft., respectively. Then there are the three important bridges over the Damuda, the Rupnarian, and the Cossye, on the Midnapur line, the two first of these being tidal. Finally, there is the large bridge over the Indus at Kotri, which will be constructed with five spans of 350ft.; the Sone River bridge, on the Mogal-Serai-Gaya line, and the Gogra bridge, in the North-West Provinces, of twenty spans of 150ft. It is interesting to note, too, that the plenum process, by which the work of sinking is carried out by compressed air power, is being adopted for the first time in the construction of the Godavery and Indus bridges.

THE dispute which has been pending for some time between the North-Eastern Railway Company and their employés reached a climax on Wednesday night, when, at a crowded meeting of the men held at Newcastle, it was decided by Mr. Harford, the general secretary of the Amalgamated Society, to declare a general strike all over the North-Eastern system. Mr. Harford said sixty goods checkers had an intimation that their hours of labour were to be increased, and the general body of men had grievances of their own. He had seen Mr. Gibb, who had made certain proposals. The speaker desired to be fair to both sides. He understood the seven men were discharged for refusing hours of labour which were contrary to an award. He had seen Mr. Gibb, and Mr. Gibb laid down three propositions. The first was that the company declined to enter upon any decision of any matter while the men were on strike. Mr. Harford's recommendation that the men should adopt this course was at once cried down. By this reply, he said they had told him exactly what to do. They had a fund of £200,000. He did not want to waste money, but there should be a proper understanding with the North-Eastern Railway Company before they returned to their work. By numbers and combination they could settle the matter in two days. In that locality 95 per cent. of the men were society men, and he wanted those 95 per cent. to declare that they were not going back to work, no matter whether they had been right or wrong in ceasing work, until they had a fair understanding as to what the issue was to be for all grades of service.

NOTES AND MEMORANDA.

THE steamers on the Official Register of the United Kingdom have increased by 144 vessels, and 289,981 tons, during 1896, while sailing vessels have decreased by 342 vessels, and 138,173 tons.

THE flags to be hoisted at one time in signalling at sea never exceed four. It is an interesting arithmetical fact that, with eighteen various coloured flags, and never more that four at a time, no fewer than 78,642 signals can be given.

ACCORDING to a special census report on the occupations of the people of the United States at the eleventh census, 1890, just issued by the government, there were in the United States nearly 140,000 engineers and firemen, apart from those employed on locomotives.

THE PRINCE OF WALES, President of the Society of Arts, last week presented Professor David Edward Hughes, F.R.S., with the Albert medal "in recognition of the services he has rendered to arts, manufactures, and commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and microphone."

As showing the development of trade with Uganda, it may be stated that the value in rupees of imports and exports at Kampala by the south route during the years 1894, 1895, and the first ten months of 1896, have been as follows:—Imports in 1894, 70,549 R.; in 1895, 178,429 R.; and in 1896—ten months—291,200 R. Exports in 1894, 47,016 R.; in 1895, 76,272 R.; and in 1896, 161,023 R.

HERR LAUR argues that petroleum originates in the decomposition of subterranean carbides by water, so that the process must be a continuous one. Such carbides as that of aluminium would favour the formation of natural gas; such as that of uranium would favour that of liquid products. The nitrogen in crude petroleum would, on this view, not be of animal origin, but would be due of nitrides.

RECENT experiments on argon by Messrs. Trowbridge and Richards show that argon—at low pressures—fluoresces (blue) under the action of the Hertzian waves. The spectrum given by the gas depends, says the *Electrical Engineer*, upon the voltage of the discharge through it. An oscillatory discharge will give the blue of high-voltage spectrum; but if there is self-induction in the circuit, this is converted into the lower or red spectrum. It is suggested by the investigators that it might be possible to use an argon discharge tube as an inductometer.

DURING 1896, 558 new vessels of 920,961 tons were classed by Lloyd's Register. Of these vessels, 498 of 853,579 tons are steamers, and 60 of 67,382 tons are sailing vessels. Compared with the similar figures for 1895, the present return shows an increase of 33,000 tons as regards steamers, and 15,000 as regards sailing vessels. Only 98·6 per cent. of the tonnage classed has been built of steel; and 1·1 per cent. of iron. Sailing tonnage, which formed 25 per cent. of the total tonnage classed in 1891, 31 per cent. in 1892, and 18 per cent. in 1893, forms only about 7 per cent. of the present total

OF the tonnage classed by Lloyd's Register during the year, 877,174 tons, or 95¼ per cent., have been built in the United Kingdom. Among foreign countries, France contributes the largest amount of tonnage. 645,345 tons, or 70 per cent., have been built for the United Kingdom, and 275,616 tons, or 30 per cent., for other countries. Among the latter, Germany leads with 84,365 tons; Russia has 49,190 tons; and France 26,956 tons. Denmark and Norway have about 17,500 tons each; various British Colonies, 12,560 tons; and Holland, Sweden, and Japan about 10,000 tons each.

NOTWITHSTANDING hostile tariffs which have reduced the export of tin-plates from Swansea to the United States by 57,182 tons, or 57·6 per cent. during 1896, the shipments to St. Petersburg last year increased from 3590 tons, to 6164 tons, or 71·6 per cent.; Germany, 7284 tons to 19,921 tons, or 173·4 per cent.; Italy, 4820 to 7303 tons, or 51·5 per cent.; Austria, 1279 to 1726 tons; France, 9745 tons to 12,153 tons, or 24·7 per cent.; Straits Settlements, 231 tons to 5493 tons, or more than 2000 per cent. The total shipments in the month of January of the current year were 15,770 tons, as against 11,482 tons, or 20 per cent. more.

LIEUTENANT HUGH D. WISE, of the United States Army, has made a successful ascent by kites. In his experiments at Governor's Island, he used four kites, a modification of the Hargrave invention, and weighing about 16 lb. each. The kites were attached to a windlass running out a ½in. manilla cord connected with an iron ring drawn up 50ft. above the ground. From the ring the kites ran up on two 1in. cords. Two kites, one above the other, were attached to each of the latter cords. To the ring was also attached a tackle and block, running a heavy rope to the ground. On this rope, says *Nature*, Lieutenant Wise was drawn up, and remained for a considerable time at a height of about 42ft., surveying the environment on all sides with his field glass. The wind was blowing fifteen miles an hour, and the pull of the kites was about 400 lb.

THE total addition of steam tonnage classed by Lloyd's Register during the year 1896 has been 710,247 tons gross; and of sailing tonnage, 61,200 tons gross; or in all 841,447 tons gross. Over 96 per cent. of this addition consists of new vessels, not one of which has been built abroad. The gross deduction of steam tonnage from the register amounts to 490,266 tons; and of sailing tonnage, to 199,373 tons; or in all to 689,639 tons. About 40 per cent. of the steam tonnage, and 59 per cent. of the sailing tonnage, included in these figures have been removed on account of loss, breaking up, dismantling, &c. The tonnage sold to foreigners during 1896, although less by 20,000 tons than the similar figures for 1895, is still exceptionally large. The steam tonnage, which has been deducted on this account, amounts to no less than 261,189 tons, and the sailing tonnage to 78,086 tons, or about 53 and 39 per cent. respectively of the total deductions.

THE total tonnage of vessels entered and cleared at the harbour of Ruhrort last year was, according to the *Rhenish-Westphalian Gazette*, 5,562,222, against 4,507,047 in 1895, which is equal to an increase of 1,085,174:—

Arrivals.

	1896. tons.	1895. tons.
Pig iron and scrap iron	78,586	47,013
Precious metals	3,093	1,756
Manufactured iron	1,333	51
Iron ore	663,062	456,707
Barley	33,517	50,997
Corn and codded grains	17,797	6,737
Linseed	6,801	7,940
Drapery	85,795	54,113
Flour	6,610	2,150
Petroleum and other mineral oils	1,241	79
Tar, pitch, resin, asphaltum	597	130

Departures.

	1896. tons.	1895. tons.
Manure of all sorts	45,156	18,430
Raw and scrap iron	5,026	1,039
Manufactured iron	153,762	159,142
Cement, lime	2,253	613
Clay, gravel, sand	2,403	90
Drapery	870	169
Flour	3,741	2,972
Pit coal	4,231,933	3,471,074
Coke	44,431	31,392

MISCELLANEA.

As her Majesty's ship Blake was leaving Portland for Portsmouth on Sunday, an explosion occurred in the engine-room through the bursting of a separator pipe. Four men were injured.

THE Admiralty has decided that H.M. first-class cruisers Powerful and Terrible are to have their masts lengthened for signalling purposes. The engines of the Powerful have undergone so satisfactory an opening out that the contractors' representatives have left the ship. Our congratulations to the Naval Construction and Armaments Company.

ANOTHER section of the African Trans-Continental Telegraph Company's line has been opened between Chiromo and Chikwawa. This new piece fills in the blank which hitherto existed in the direct line of communication between the East Coast of Africa and Zomba. There is now an uninterrupted line from Chinde and Quilimane and the East Coast to Zomba. Owing to the troubles in Mashonaland there does not appear to be much prospect of the line from Salisbury to Tete being completed during the present year.

THE export trade of Uganda still consists exclusively of ivory, but the more intelligent Waganda are now fully alive to the importance of fostering native products, such as coffee, rice, cotton, tobacco, ground nuts, castor oil, and semsem and sunflower plants for the production of oil. Further examination of the natural products of the country, which cannot be said to have yet been really tested, has indicated also that vanilla and indiarubber, which are known to exist in fair quantities, may offer a good field for enterprise.

WE are glad to see that the Temperley transporter, which has been successfully adopted in H.M. Navy for the coaling, especially at sea, of battleships and first-class cruisers, is now to be supplied to second-class cruisers, and this in the British Navy is a large order. Undoubtedly, Mr. Temperley has made a very palpable hit. In peace, as well as in war time, rapid coaling is always a distinct desideratum, as it must materially increase the fighting value of every ship in which it can be carried out, as well as contribute to the health and good humour of the entire ship's company.

THE attention of manufacturers at home cannot be too frequently called to the value of the diplomatic and consular reports on trade and finance which emanate annually from the Foreign-office. We have just received the consular report compiled by Mr. Ernest J. L. Berkeley on the trade of Uganda, which states that trade generally has increased recently, and that a larger and more varied demand has sprung up for goods of a better class than mere cloth twine. The market now calls for manufactured clothing, boots, shoes, household utensils, provisions, soap, writing materials, tools and a variety of manufactured articles.

A TENDENCY is apparent among the peasantry in certain districts of the Caucasus to abandon the system, now generally in vogue, of using buffaloes and oxen for ploughing and other field labour, in favour of horses. The arguments adduced in favour of this innovation are:—(1) That horse work is more thorough and rapid; (2) that a horse is less liable to the attacks of epizootic disease; (3) that a horse is also a more useful animal, when not employed in field work, for transport purposes; (4) the gradual decrease, in those districts, of the area of available pasture lands; and (5) the introduction of improved and lighter ploughs and other European agricultural implements.

THE consular report for the year 1896 on the agriculture of the district of Batoum says:—"The Ministry of the Interior, by arrangement with the Ministries of Finance and Agriculture, has, during last summer, been engaged in collecting information in respect to the timber trade, and as to the firms and individuals who are employed in exploiting Government and private forests. Inquiries have also been made with reference to the agencies through which the timber is placed on the market. These steps have been taken with a view to the adoption of measures for putting a stop to certain irregularities which exist in the trade. It is further proposed to introduce stringent rules for regulating the transactions of timber merchants in general, and more especially for the purpose of introducing a system of control applicable to firewood dealers."

ALTHOUGH all new ships for the United States are required by law to be constructed of American material and by American labour, the same patriotic and independent policy cannot apparently be adhered to in the matter of the design of the vessels. Considerable interest, says a New York correspondent, has been evolved by the announcement that the two torpedo boats for which the Bath Ironworks, of Bath, Maine, recently received the contract, will be constructed from plans drawn by Professor Biles, the English expert, and designer of the American Line steamships Paris and New York. This has been openly admitted by General Hyde, president of the Bath Ironworks, and it is recalled that on the recent visit of Professor Biles to the States he spent considerable time at Bath, as also that last year General Hyde spent considerable time himself in Great Britain in consulting with eminent shipbuilders and naval architects.

A DISASTROUS explosion of dynamite, resulting in the death of six men, took place on Wednesday morning at the Ardeer Factory of Messrs. Alfred Nobel and Co., near Stevenston, Ayrshire. At a distance of five miles from the scene of the disaster, on the high ground between Irvine and the village of Dreghorn, a sheet of flame was seen shortly after six o'clock to shoot up into the air above the sandhills at Stevenston. This was followed by the roar of an explosion, which shook the houses and bridges as if an earthquake had occurred, and in the town of Irvine and the neighbouring villages spread intense consternation. The explosion took place in what is called the "final washing house," the last of a group of houses in which the nitro-glycerine is washed and is made chemically pure. The quantity of nitro-glycerine in the house is said to have amounted to 2400 lb. The process of mixing the nitro-glycerine with the due proportion of nitro-cellulose in order to constitute blasting gelatine having been completed, a bogie was laden with the blasting gelatine in front of the hut, and where it stood there is now a great hole in the earth, every vestige of the conveyance and its load having disappeared. These bogies carry six boxes of 150 lb. each. Sir Vivian Majendie visited the scene of the accident yesterday, with the object of investigating the cause of the explosion.

IN view of the additions which are at present being made to the recruiting and training ships in connection with the Navy, it is of interest to learn that elaborate additions are also being made to the educational facilities on board these vessels. These take the form chiefly of large-scale working models of features on board ship, for the proper understanding and manipulation of which practice and skill are required. Thus a Glasgow firm of model makers is at present engaged upon six sets of working models to a fairly large scale, of such details as anchors and cables, stoppers, anchor davits, capstans, &c., all the outstanding features, in fact, on the forecastle head, where so many of the important operations involved in "working" the ship are carried out. All the fittings, which are of solid brass, will be fitted in a dummy fore body of an actual ship made to a large scale. Other matters, such as the working of the steering wheel, rudder, &c., are being treated similarly. Some time ago the firm which has this work on hand—Messrs. Kelso and Co., 55, Oxford-street, Glasgow—provided an elaborate model on a scale of ½in. per foot of an entire ship, the model being built actually in the manner of the real ship, and showing all interior compartments and fittings in section. This interesting model, with all the parts minutely labelled, is now in use as an educational object on board H.M. training ship Worcester.

TWIN-SCREW TRIPLE-EXPANSION ENGINES, STEAM YACHT VARUNA

MESSRS. A. AND G. INGLIS, GLASGOW, ENGINEERS

(*For description see page 214*)

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THE ENGINEER, February 26th, 1897. PAGE

TO CORRESPONDENTS.

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

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

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

REPLIES.

A. W. (Pentonville.)—The story is untrue from beginning to end.
W. E. B.—We have used Davis's slide rule for many years, and have found it fulfil all requirements. It is the one most generally in use in this country.

INQUIRIES.

HEATING BY HOT AIR.

SIR,—I shall be obliged by the addresses of firms making a speciality of heating buildings with hot air from a heating chamber in the basement. RECTOR.
February 23rd.

FILLING PAPER BAGS.

SIR,—We require to purchase machinery for filling paper bags with washing powder If any reader can give us the names of the manufacturers of this machinery we shall be glad. J. C.
Warrington, February 24th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF JUNIOR ENGINEERS.—Saturday, March 6th, at 7.30 p m.: Conversazione at the Westminster Palace Hotel, reception by the President, Mr. A. R. Binnie, M. Inst. C.E., and Mrs. Binnie.

GEOLOGISTS' ASSOCIATION.—Friday, March 5th, at 8 p.m.: Lecture, "Some Properties of Precious Stones," by Professor Henry A. Miers, M.A., F.R.S

SOCIETY OF ENGINEERS.—Monday, March 1st, at 7.30 p.m.: Paper to be read, "Notes on the Proposed Bye-laws of the London County Council with respect to House Drainage," by Mr. J. P. Barber, member of Council.

CRYSTAL PALACE.—Wednesday, March 3rd, at 8 p.m.: Course of Victorian Era Lectures, "Sixty Years of Astronomical Research," by Sir Robert S. Ball, LL.D., F.R.S., Lowndean Professor of Astronomy at the University of Cambridge.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 2nd, at 8 p m.: Papers to be further discussed, "The Main Drainage of London," by Messrs. J. E. Worth and W. Santo Crimp, MM. Inst. C.E. "The Purification of the Thames," by Mr. W. J. Dibdin. Thursday, March 4th, at 2.30 p.m.: Students visit the works of the Incandescent Electric Lamp Company, Brook Green, Hammersmith.

SOCIETY OF ARTS.—Monday, March 1st, at 8 p.m.: Cantor Lectures, "The Industrial Uses of Cellulose," by Mr. C. F. Cross, F.C.S. Tuesday, March 2nd, at 8 p.m.: Applied Art Section, "Gesso," by Mr. Matthew Webb. Wednesday, March 3rd, at 8 p.m.: Paper, "English Orchards," by Mr. George Gordon. Thursday, March 4th, at 8 p.m.: Howard Lectures, "The Mechanical Production of Cold," by Professor James A. Ewing, M.A., F.R.S.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, March 2nd, at 3 p.m.: Lecture VII., "Animal Electricity," by Professor A. D. Waller, M.D., F.R.S. Thursday, March 4th, at 3 p.m.: Lecture I., "Greek History and Extant Monuments," by Professor Percy Gardner, Litt. D., F.S.A. Friday, March 5th, at 9 p.m.: Discourse, "Some Curiosities of Vision," by Mr. Shelford Bidwell, M.A. LL.B., F.R.S., M.R.I. Saturday, March 6th, at 3 p.m.: Lecture 1., "Electricity and Electrical Vibrations," by the Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., F.R.S., M.R.I.

DEATHS.

On the 20th inst., at Roxburgh, Vanbrugh Park-road west, Blackheath, suddenly, ALFRED BLECHYNDEN, C.E., aged forty-seven.

On the 21st inst., at West-hill, Epsom, suddenly, HENRY CHARLES FORDE, M. Inst. C.E., M. Inst. E.E., of St. Brendan's, Wimbledon Park, Surrey, aged sixty-nine.

THE ENGINEER.

FEBRUARY 26, 1897.

CONSULS AND COMPETITION.

IF English manufacturers lose their trade, it certainly will not be the fault of our consuls. In season and out of season they warn, advise, and exhort. They repeat, each after each, the same tale. By dint of iteration they have succeeded in attracting a certain amount of attention; and the first and natural development of that attention takes the form of criticism. We are told certain things. The foreigner, and above all the German, has done, is doing, and will continue to do, that which English traders will not do. If these last do not alter and improve their practices, then they will lose their trade. It is curious that while these warnings are being uttered our trade appears to be augmenting in every direction; but, of course, appearances may be deceptive. Consuls are on the spot, so to speak; they know what is taking place abroad. It is part of their duties to advise and instruct. But we cannot avoid the suspicion that, in some directions at all events, they manifest more zeal than discretion. They have in a measure lost the sense of proportion. They do not quite appreciate the qualities, so to speak, of trade; and they may convey the impression that they are not quite as competent to give advice as is desirable. This would be a matter for regret, and it may be useful here to endeavour to place consular warnings in their proper position.

One of the most interesting and able reports that we have seen for some time is that just issued by the Foreign-office on the trade of the Canary Islands in 1895. The Canary Islands are a small group belonging to Spain, 1400 miles south of England, and 650 miles from Cadiz. Their principal value lies in the fact that they form a port of call for large numbers of steamers. They lie, indeed, in the direct route of all southward bound shipping, and constitute an admirable coaling station. Insignificant as the islands are, our consul sends home some pages of excellent general advice on the subject of England's trade at large, and German rivalry in particular. We are told that "the chief cause of success in foreign competition is the greater attention paid abroad to the art of exactly suiting the foreign customer's pocket, taste, and convenience, an art in which foreign nations pre-eminently excel. "The importance of pleasing the customer in these essential points has been too much ignored and neglected at home; and our neglect has been profitably turned to account by others to our present detriment."

Unfortunately, our Consul does not give us any specific instances of what he means by "suiting the foreigner's pocket." But he does give some explanations which are good and suggestive so far as they go. They raise certain very important questions, which merit and should receive careful consideration and adequate discussion. In the first place, we are told that the foreign customer likes long credit, and that he gets it more freely from our rivals than he does from us. "Terms Cash, are often not possible, and are never palatable to foreign purchasers, especially among those of small standing and capital." It appears to us that the benefit to be derived from pushing trade on the long credit system must be highly problematical. It is very easy indeed to do business if we tell the purchaser of our commodities that he need not afflict himself to pay for them; but judging from the difficulties which the English trader usually experiences in recovering money long due abroad, we think that he has some excuse if he lets a long credit business with people of small standing and capital severely alone. Of course it may be urged that it would be worth while to incur considerable losses in this way with a view to ultimate gain, on the principle of risking a sprat to catch a salmon. But this must be a matter of opinion and judgment; and we think it is safe to say that English traders are quite as able and willing to give credit as those of any other nation. This question of credit is, however, so closely bound up with trade methods, and presents itself in so complex a form, that we cannot venture to speak positively on the subject. The middleman and the agent have to be considered, besides many other conditions. There is no difficulty, however, in expressing opinions on another question—to wit, the supply of just what the customer wants. "'Suiting the customer's taste,'" says our consul, "is a most essential requisite of successful trade. The great and minute attention paid abroad to the particular form, design, quality, 'showiness,' colour, look, or peculiarity of the article exported, in order *exactly* to suit the customer's perhaps fastidious taste, is deserving of close attention on the part of the English manufacturer and exporter. That taste may be barbarous, inexplicable, and unreasonable; but the mere fact of satisfying it, in whatever trivial form it may be, supplies a want and pleases the buyer; and those who are practicable and sharp enough to adapt their goods exactly to the customer's fantastic wishes are, naturally, those who get all the orders." Ostensibly this is sound information, and excellent advice. Yet we doubt that it will, after all, stand the test of careful examination. Taken with the context, it means that the British manufacturer, if he wants to do trade, must be willing to sell second and third-class goods at a cheap rate. Possibly our consul does not mean to go quite so far as this; but that is the impression conveyed by his words. If, for instance, the foreigner wants cheap table knives with cast iron blades and wooden handles, why not make them and let him have them? The answer is that by doing so we should run the risk of injuring the reputation which English cutlery now possesses all over the world; while the value of the trade secured in return would be almost infinitesimal. The truth is that we in Great Britain have not hitherto found it pay to make rubbish; and it would be by no means easy to get the rubbish made even if we did. This is a very large and important question. It is easy to understand how people like the Germans, who are fighting for trade, and must have trade of some sort at any price, can find it worth while to produce goods with cheap labour which no English manufacturer could—or indeed would—turn out at the price. People who have no reputation to lose can do things impossible for those of higher standing. On the other hand, however, it must not be forgotten that the manufacturer may easily lose good trade by refusing to consult the tastes of his customers. A case which occurred some years ago may be cited to illustrate this argument. A demand arose in a province of Asiatic Turkey for a handkerchief of a particular red tint. The trade was lost to this country simply because the English manufacturers would not supply the particular shade demanded. It was not a question in any way of price or quality. Various other cases of the same kind suggest themselves as we write. It is unnecessary to state them. We may sum up the argument so far by saying that there is a class of trade which appears to be acceptable enough to German manufacturers, which it would not be worth while for Great Britain to touch; while we undoubtedly do not pay sufficient attention to the desires of our customers in the branches of trade which are really suitable to our system of working and methods of production. An interesting example of this is given by our consul. It may be taken for what it is worth. It seems that whereas we for a long time supplied the Canary Isles with nearly all the bottled beer consumed in them, of late the Germans have ousted the English brewers. Not, it would seem, because the German beer was liked better than the English, but, marvellous to relate, because the English bottle of beer was too big. Here are the precise words of Mr. Reid, Vice-Consul at Orotava:—"Beer is another import in which the Germans have secured almost a monopoly in the islands. Their bottles are considerably smaller, but this does not affect the sale, and makes some small difference in the bulk, and results in economising on freights of packages. One English firm which at one time shipped very largely to the Canary Islands, refused to change the size of bottle."

On one point remaining for consideration there can be neither question nor dispute. "Our manufacturers do not sufficiently consult the convenience of the foreigner. The foreigner does everything in his power to save his customer trouble. He quotes him a fixed price for goods delivered duty free practically at his own door—at the quay of a port, or in any particular town abroad—which includes freight, shipping charges, packing, &c., up to that point. He states that price—or the catalogues do—in the language of the country where the sale is effected, and in the currency of that country, instead of in that of the export market—an inestimable advantage. A purchaser abroad is thereby enabled to see at a glance what the article ordered and delivered at his own door will cost him, and can exactly calculate if he can buy cheaper elsewhere, and what profit he could make if for re-sale."

We are told that if only we had the metric system nothing of this kind could happen. But the adoption of the metric system in Great Britain would not settle the question at all. The metric system is very far from being universal. It would not help us to deal with China or Japan, nor with Turkey, nor with Russia, nor with India, nor even with the Canary Islands. There is no possible reason why English manufacturers should not state prices and weights and give information generally in the language of the country where they do, or try to do, business. Many of our leading houses, it is true, leave nothing to be desired in this respect. Their example should be followed and extended. Before, however, we hasten to condemn the British trader, it is well to ascertain the precise nature of the conditions under which he is trading abroad, and the method of trading adopted. In many cases the English manufacturer does no direct trade whatever. He simply consigns his goods to his agent on the spot, or to a man who sells on commission. In either case the agent, or middleman, is, as a rule, well acquainted with the language of the country in which he resides, and with its methods of doing business. We conclude from the numerous consular reports which reach us that this is not the method of trading most in favour with Germans, who appear to prefer the direct system, employing travellers to effect sales. This aspect of the subject is well worth more consideration than it has yet received.

It is somewhat satisfactory to find from the report which we have been considering that, notwithstanding the skill and energy of our German competitors in the Canaries, they have been losing ground and we have been gaining it. The returns for all the islands are only available up to 1893. But we learn that in that year Great Britain exported goods to the value of £344,000, as against £338,000 in 1891. In 1893 Germany exported to the islands goods to the value of £33,767. In 1892 the value of her exports was £84,140, and in 1891 it was £91,021. Our consul attempts to show that the increase in British imports is due to the influx of more coal; but even if we conceded this point, it leaves untouched the fact that German trade is apparently steadily declining at a very rapid rate.

CERTIFICATED ENGINEMEN.

It is impossible to read the debate which took place last week in the House of Commons on the Steam Engine and Boilers Bill, without realising the fact that none of the speakers, either for or against it, was competent to deal with the subject on its merits. The discussion was carried on by amateurs, and this we say with the full knowledge of the fact that Mr. Burns was brought up as an engine-fitter, a highly respectable avocation which does not involve any boiler work. The speakers in favour of the Bill, indeed, seem to have failed to understand what its provisions were, or the way in which the proposed Act of Parliament would operate. The fundamental idea is that engine-drivers and firemen should pass an examination and obtain a certificate from the Board of Trade. We may concede, for the sake of argument, that it would be an excellent thing to employ none but certificated engine-drivers and firemen; but it would remain to be proved that the objects of those promoting the Bill would be secured. The theory of these gentlemen appears to be that boilers—we may leave engines on one side—are caused to explode by the ignorance of the engineers and firemen in charge of them. We say ignorance advisedly. Boilers are no doubt injured, and even caused to explode now and then by negligence on the part of those in charge of them; but it is obvious that no Act of Parliament or legislation of any conceivable kind could prevent this. All that the Board of Trade could do by examination would be to satisfy itself that the men in charge of boilers knew something about them. It remains to be proved that the provision of this knowledge would prevent boiler explosions. No attempt whatever worth the name has been made to do this. The example selected by Mr. Samuel to illustrate his arguments was ludicrously inapplicable. He took the celebrated Redcar explosion, when a dozen boilers gave way and a number of men were killed. To this day the true cause of that explosion remains unascertained; for the conclusions arrived at by the Board of Trade inspectors have not been universally accepted as sound, and we have ourselves drawn attention to points which seem to have been quite overlooked by them. But be the cause what it may, the official finally held responsible would have passed with ease any examination to which the Board of Trade could submit him under the provisions of the suggested Act of Parliament. Those who spoke in favour of the Bill appear to think that every engine-driver and fireman in the kingdom possesses the power either to blow up a boiler or preserve it intact. Of course, those who are rightly informed know that their powers for good or evil are extremely limited. The most that they can do in the way of harm is to let a boiler run short of water, or overload the safety valve. The explosions which occur from these causes are few and far between, and could not possibly be prevented by legislation of any kind.

When the subject is next brought up for discussion in Parliament the facts should be clearly and copiously set forth. It will not do to touch on them in a perfunctory fashion, or to assume that every member of Parliament knows all about boilers. The two main points on which to insist are, first, that while a certain small percentage of explosions is brought about by negligence, that no Act of Parliament could make men careful. Secondly, the advocates of legislation should be compelled to prove, if they can, that explosions are caused by ignorance, and that of a kind that the Board of Trade could eliminate. The mere granting of certificates to engine and firemen might prove very vexatious, and even offensive, while it would be wholly incapable of doing any good, and that simply because the engineers and firemen have little or nothing in their power—little or nothing, that is, that could be affected in any way by an Act of Parliament. So long as a boiler is in good condition, and properly supplied with water, it will not explode. No legislation could secure the latter condition; and the owners of the boiler and not the engine-driver and fireman are responsible for the first. It is on the owners, and on them alone, that the work of keeping the boiler in repair must devolve, and any attempt to remove responsibility from their shoulders and place it on those of the men would be extremely objectionable.

It may, perhaps, be conceded that some further legislation is necessary, and would diminish the number of explosions; but it must take an entirely different form from that of granting certificates to engine men and stokers. As was very properly pointed out by Mr. Collings, what was wanted was a Boiler Inspection Bill, not one for granting certificates to engine men. Much may be said in favour of Government inspection, the strongest point for it being that it must do good by providing for those cases in which reckless users of steam power refuse to have their boilers properly periodically examined by competent men. We have on several occasions during a period extending over many years pointed out the direction that legislation ought to take, and on no occasion has a dissentient voice been raised. We advocate the principle of regarding every boiler owner as guilty of manslaughter when a death results from explosion, until he has proved that he is not guilty. Our argument in favour of legislation of this kind is obvious. It is well known now that boilers which are in good condition and well kept do not explode. It is as certain as any fact within the range of human knowledge that when a boiler explodes it does so, in nine cases out of ten, because it was weakened by corrosion, and in the tenth case it was allowed to get short of water. Ostensibly the man to whom the boiler belongs ought to know its condition, and whether it is safe or not. It is part of the business of the steam user to take such measures as will secure the safety of his men, and of those living in his neighbourhood. In the present day there is no difficulty whatever in keeping himself posted up as to the condition of his boilers. If, then, a boiler explodes, that explosion is *primâ facie* evidence that the owner of it has entirely failed in his duty. All the facts, so far as they are general and common, go to show that he is guilty of manslaughter if anyone is killed. It then remains for him to adduce such facts not obvious or common, as will go to prove that he is not guilty. Thus, for example, he might order certain repairs to be made. These might have been made improperly, and an explosion follow. Such things have happened ere now, and will happen again. Judging, moreover, from the Board of Trade reports which are published periodically, a percentage of explosions does no doubt result from causes which may be directly traced to the parsimony or negligence of the boiler owner, and in such cases he ought to be severely punished.

Acting somewhat in this direction, the existing law virtually places the boiler owner on his trial whenever a fatal boiler explosion takes place, and more or less heavy damages are given. But although the system of fining may do some good, it seems to us to be wholly inadequate to the offence. When, for example, we find that the owner of an old portable engine has been warned that the boiler is not safe, and nevertheless lets it out for hire, hoping to make a few pounds out of it before it goes to the scrap heap, can it be said that costs of ten or twenty pounds are sufficient punishment when the boiler explodes in a crowded stackyard, and kills and maims a number of people? We do not lose sight of the fact that such an owner may also be prosecuted for manslaughter with more, or rather less success; but if he had clearly understood that his conviction to a long term of imprisonment would be more likely than it is, he would have thought twice before he allowed it to be used. Again, when we come to consider the case of the large companies or wealthy millowners, it is obvious that costs to the extent of even a couple of hundred pounds is a matter of small importance. The destruction of their property involves an outlay of thousands of pounds, and a few sovereigns more or less, "as a contribution to the expenses of the Board of Trade inquiry," is a matter of very little importance.

It is only necessary to put the question in the way we have done to show how wholly inadequate the granting of certificates to enginemen would be to secure the intended object. Indeed, so obvious is the inadequacy of the means to the end, that we cannot avoid the conclusion that many of those most eager to promote the Bill have done so with an ulterior object. The desire of a considerable number of individuals to make Government or "The State" interfere continually between the employer and the workmen has long formed the subject of observation and comment, and the Engine and Boilers Bill seems to us to have been not inaptly described as the thin end of a wedge intended to open a way for an extension of Socialist aims.

HOW TRADE IS LOST AND KEPT.

SIR FREDERICK THORPE MAPPIN, who is the head of the well-known firm of Thomas Turton and Sons, Ltd., Sheaf Works, Sheffield, has a most interesting letter in the Sheffield papers respecting the use of machinery in scissor manufacturing. Sir Frederick had noticed a paragraph, headed "American and German Competition with England," in which it was stated that samples of scissors had been obtained from Australasia by Colonel J. E. Bingham, head of the firm of Messrs. Walker and Hall, Electro Works, Sheffield, and stating that these samples had been placed in the hands of the Cutlers' Company, with statements of their prices and those of English makers, it being mentioned as well that 90 per cent. of these goods were supplied by German and American manufacturers. This led the member for Hallamshire to inquire into the cause of the decrease in the production of scissors, razors, and pocket cutlery in Sheffield. He found that in Solingen there were four large establishments, each employing thirty to forty men, entirely occupied in stamping out steel scissor blanks, and that the Solingen manufacturers of scissors would purchase these blanks, made either from Bessemer steel or cast steel, at prices which enabled them greatly to reduce their cost of production. Sir Frederick ascertained at the same time that in Sheffield there were no scissors manufactured by machinery in this manner. He saw samples of razor blades forged by machinery far superior to anything that could be made by hand forgers, and he states, "That at this moment there is not a single razor blade made by machinery in Sheffield." "I am not surprised," he adds, "at the above facts when I know there is so much opposition by the working men of Sheffield to the introduction of machinery in place of hand labour, and it reminds me of the struggle there was years ago to introduce machinery in the file trade, the success of which is acknowledged on all sides, and the result has been to retain this trade, and to cope successfully in Sheffield with any foreign competitor, either in Germany or America." Sir Frederick holds the opinion that prison-made goods have no influence on the trade of this country, but that the use of machinery in America and Germany has enabled these countries to compete successfully with us in the markets of the world. His letter has given rise to a deal of local controversy. One Sheffield firm writes to say that they have been making scissor blanks for the trade for some years, but adds significantly that scissor manufacturers may not think it policy to publish the information that they use machine-made blanks, because of the prejudice against machine-made goods in general. This firm quite endorse what Sir Frederick says about the opposition by the working men of Sheffield to the introduction of machinery in place of hand labour. That opposition, they say, has hindered them considerably. So much so that they would have been making the razor blades too, but for the fact that certain razor manufacturers told them it was no use trying to make the blades quicker for the men, because they would not abate one jot from their statement prices, although there might not be a quarter of the work to do. The practical outcome of the whole matter is virtually a confirmation of Sir Frederick's position. He was one of the first, if not the first, to use file-making machines in his extensive establishment. He had to encounter organised opposition, but he put his foot down, and when Sir Frederick puts his foot down everybody knows it *is* down. A gentleman of rare resource and decision, he has always been master in his own establishment. It is about the best thing that could have happened, not only for his own file workers, but for the file trade generally, for it is, as Sir Frederick says, owing to the energetic, sensible introduction of machinery that the file trade has been retained in this country.

SUGAR MACHINERY PROSPECTS.

SUGAR machinery engineers on the Clyde have been anxiously awaiting any indication of the probable nature of the report of the Sugar Commission. While it is yet too early to gauge with any pretence to accuracy the character which that document will assume, great interest yet attaches to the course which the inquiry is taking. According to the accounts which have come home of the Commissioners' proceedings, the testimony which is being adduced at Demerara, whatever course the West Indian planters proper may take, is calculated to impress the Commissioners that everything that can be done in the way of bettering the condition of the industry by the adoption of improved machinery and extracting apparatus has been done. The only salvation for the cultivators, it is professed, lies in the adoption of the special measures of assistance which have been the subject of petition to the Colonial Office. Sugar machinery engineers will learn of this declaration somewhat with surprise. Admitting that British Guiana is more advanced in the matter of machinery than the West Indies, and has kept itself better equipped in the matter of plant and accessories, it had been thought that were the cultivators in a position to spend more money on the most modern productions of Clyde engineering works, help of certainly not inconsiderable sort would be administered. The testimony of the Demerara witnesses called before the Commission, however, is that after visiting France, Belgium, Holland, Russia, and Austria, for the purpose of finding out if anything could be done to lessen the cost of production, the conclusion had been formed that the process of manufacture in British Guiana is as economical as that of the best beet factories in Europe. Mechanical experts informed on the machinery question were called to support this view. Three estates are mentioned on which in the past fifteen years a sum amounting to something like £229,769 has been spent in machinery and agricultural improvements, and yet without effecting the desired object of placing them in a position to compete successfully against bounty-fed competition. The attempts to introduce other industries, such as cocoa, rice, coffee, or timber, to take the place of sugar, are said to have been equally ineffectual to convert loss into profit. This being the position which British Guiana takes up, Clyde engineers will be anxious to ascertain the exact testimony of West Indian Colonies on the machinery subject. Additional orders would certainly be very welcome to our sugar machinery engineers, and in some form or other they may be forthcoming as one of the results of the Commissioners' inquiries.

LIGHT IRISH RAILWAYS.

WE have already referred in THE ENGINEER to the excellent results that the great Irish railways have had for the past half-year; but it needs to be added that there is another side to the question, and that is seen in the experience of some of the smaller railways. The Ballycastle Railway may be taken as an instance of the latter class. It was incorporated in 1878, its authorised capital being £135,000, part of that capital being "baronial guarantee shares." At the meeting of the company held a few weeks ago it was stated that the loan by the Board of Works of £20,000, with £4118 arrears of interest, has been arranged to be satisfied by the payment of £12,000, and that the prospects of the company are thus improved. It is quite clear, then, that the line had allowed the interest on the loan to fall into arrears, and that an arrangement has been come to. There are other of the light railways and similar lines in Ireland in circumstances that prove that, though the making of some of the smaller lines in Ireland is cheaply effected, yet they are unable to make traffic sufficient to pay the requirements even of interest on loans; and it is probable that it will only be when there has been first a reduction of the capital, and then that further growth in the traffic which time brings, that the lines will be remunerative as independent undertakings. There is the alternative of inclusion in the system of some of the great lines of the country, which can pay good dividends, and which seem slowly adding to their length by the absorption of neighbouring small lines. In this way the Bundoran line of thirty-five miles long is being now amalgamated with the Great Northern of Ireland, after its existence some thirty-six years as an independent undertaking, but one that was not very remunerative. Thus the number of the lines in Ireland is decreasing. They are slowly falling into a few well-defined systems, whilst recent additions to the mileage of the country are either light railways made by the great companies, or constructed largely by grants to companies contingent on their efficient working. The policy enunciated long ago by Mr. Robert Stephenson, that where "combination is possible, competition is impossible," is a policy that is finding effective illustration on the Irish railway system.

NEW COLLIERIES IN DERBYSHIRE AND NOTTS.

THE development of the Derbyshire and Notts coalfield is proceeding at a rapid rate, and furthered by the East and West-Coast Railway, the districts named will soon rank amongst the most important in the country. The Shirebrook Colliery, near Mansfield, which is being sunk under the superintendence of Mr. Arnold Lupton, of Leeds, is making satisfactory progress. Two 18ft. shafts are being put down, and coal is expected to be reached about the month of May next. Those having charge of the concern are preparing for a large output of coal, appliances of the most modern description having been ordered. Four-head gear pulleys, 18ft. diameter, each weighing five tons, are being made at the Borough Foundry, Barnsley, by Messrs. Needham, Bros., and Brown, whose new method of construction is attracting a good deal of attention. The firm are making a speciality of this class of work, most of the pulleys at work at the leading South Yorkshire pits being of their construction.

LITERATURE.

The Engineering Works of the Gódávari Delta; A Descriptive and Historical Account. Compiled for the Madras Government by GEORGE T. WALCH, M.Inst. C.E. Vol. I. Printed and published by the Superintendent Government Press, Madras, 1896.

AT the present moment, when the spectre of famine, as it were, stands at the door of our Eastern Empire, the record of any irrigation work in India assumes a peculiar interest; but apart from this a narrative description of the great engineering works of the Gódávari Delta, told with all the personal interest of an actor by one of the staff, who had long been engaged in their construction, supervision, and direction, must command the attention of the profession.

The plates are specially attractive, some of the photograph prints of views on the river Gódáveri reminding us strongly of the scenery of some parts of Scotland. Although the author gives us the history of the work with due official reticence, we read between the lines of the record the oft-repeated story of the engineer of foresight and energy battling with the inert mass of a public body. In the present case it is Major—now Sir Arthur—Cotton, R.E., forcing on the reluctant Court of Directors of the Hon. East India Company a scheme which has since proved itself of the greatest advantage to the country; and we see how nearly the ultimate success of the work of which the author's compilation is the record, was jeopardised by the short-sighted parsimony of the Honorable Court.

The author opens with a physical description of the Gódávari, a great river rising in the Western Ghauts, 70 miles north-east of Bombay, and after a south-easterly course of 900 miles, falling into the Bay of Bengal, about 25 miles north of Madras. It drains an area greater than that of Great Britain, and discharges a volume of water three times greater than the Nile. As it nears the coast, it has forced its way through the Eastern Ghauts by a narrow gorge, the views in which form the interesting plates already mentioned. When within forty miles of the sea, the river divides itself into two branches, forming a delta of about 2000 square miles; and at this point is situated the weir, or "anicut," which constitutes the head works of the canal, the subject of the author's monograph. A small map at the end of this first chapter shows the whole system of the canal and the delta of the river.

Chapter II. deals with the history of the scheme, and from it we learn that over a hundred years ago a Mr. Topping had brought to the notice of the Madras Government the facilities for irrigation presented by the Godaveri and its delta; but the time and the man had not then come, and did not do so for yet half a century. Not, indeed, till in 1843 the district, after having been visited by a famine succeeded by a series of calamitous years, had fallen into a sad case; and Sir H. Montgomery, one of the ablest servants of the Government, was deputed to report on the state of things, and devise a remedy. He also emphasised the irrigational resources of the delta, and advocated the deputation of Major Cotton, a Royal Engineer who had obtained practical experience on similar works in Tanjore, to examine the case and draw up a scheme for the irrigation of the district.

Voluminous extracts from the official correspondence on the subject follow, from which it appears that Major Cotton reported in sanguine terms on a scheme for the irrigation of the delta. This he estimated roughly to cost the modest sum of 12 lakhs of rupees—£120,000—of which 4¾ lakhs was for the weir and headworks of the system of canals. The sequel proved that these amounts were totally inadequate; for in the end the expenditure on the whole scheme reached a total of 109 lakhs, and more than 6 lakhs for the weir and headworks only.

The design of the weir and headworks forms the subject of the next chapter, but space does not permit of mention further than that the problem was to construct a masonry weir, 2¼ miles long and 12ft. high, across the sandy bed of a river, down which swept enormous floods of 25ft. deep. This was no easy task, but we must refer the reader to the author's account in Chapters IV. and V. for its solution, and for an interesting description of the operations of construction. Suffice it to say that after much anxiety, several failures, and many vicissitudes, success eventually attended Major Cotton's unceasing efforts, and in 1852 were virtually completed the weir and headworks which he had commenced in 1847. During this time arrangements were being made by him for carrying the water to various parts of the delta by other works. These, however, with the exception of the Gunnaram Aqueduct, are of minor importance and without special interest. This aqueduct is half aqueduct, half sluice, being submerged in floods, and its description will be read with interest, as an example of the rapid execution of a large work founded on sand. It is 2248ft. in length, divided into forty-nine arches of 40ft. span, and carries 500 cubic feet of water per second, and occupied only three months in construction. The prints of this work are clear and interesting, one showing a river flood passing over the structure. Chapter VI. is devoted to its history and description.

Chapter IX. deals in a very unsatisfactory manner with the "Materials, Design, &c." of the works, disposing of the whole subject in five pages of letterpress. Two short chapters are devoted to "Irrigation" and "Navigation," and the volume closes with a similar one on "Results;" thus bringing the reader to an appendix containing the usual official statement of the "Capital Account" of the system, and showing the financial results of the work.

The general result has been that the works estimated to cost 12 lakhs have cost 109 lakhs, the population has increased 47 per cent., the imports have advanced tenfold, and the exports twentyfold in value; the area of irrigation has increased from 150,000 acres to over 721,000 acres; and the revenue has risen from 24 to 88 lakhs of rupees yearly.

The reader will look in vain for the application of mathematical science to the author's subject, only one formula appearing in the whole volume, where we are told that after a certain date, Bazin's formula—given—and co-efficients were adopted in designing the canals and distributaries.

The vexed question of the combination of irrigation with navigation in canals is very fairly discussed, and the author rightly admits that as circumstances alter cases, a compatibility of the two interests will depend on local conditions.

Major Cotton's methods were largely experimental, and much may be learned from his success—and by his failures, too—in dealing with foundations in the sandy beds of alluvial rivers. The element of makeshift in the designs of his locks and sluices, and the ill effects of haste and false economy in adopting the badly aligned old native channels, as distributaries under the new system, are very noticeable. His justification of the large and constant excesses on his estimates lie in the certainty that had he raised the alarm at an early stage, and before financial success had become apparent, by indicating the larger sums that would be eventually required to carry out his great schemes, the works would never have been commenced. Nevertheless, one's patience is exercised by the constant iteration of official plaints over inadequate estimates, unforeseen expenditure and dilatory or insufficient sanctions; but this is the usual routine in Indian engineering, where insufficient establishment leads to sketchy plans and approximate or piecemeal estimates, and without a statement of the fact the record would not be true.

SHORT NOTICES.

The Slide Rule.—Mr. C. N. Pickworth's capital little book on the "Slide Rule" has gone into a third edition, which is sufficient guarantee of its merits. We do not note that anything new has been added. This little book contains all the information that is of really practical importance to the slide rule user, and so fulfils its title of a practical manual. The table of conversion factors is particularly useful. A great number of examples, showing the application of the Gravet rule are given. It is a book which every slide-rule user should possess.

Wire Mining and Hauling Ropes, their Manufacture and Applications. By J. Bucknall Smith, C.E., 1897. London: Bullivant and Co., Limited.—This is a revised abstract from the copyright series of articles which appeared in the *Mining Journal* in June and July of last year, and will be read with interest in its present form by those interested in the technology, manufacture, and numerous applications of steel wire ropes. The pamphlet contains some excellent illustrations—chiefly reproductions from a contemporary—and Messrs. Bullivant have supplied useful data concerning the weights and breaking strains of steel wire ropes.

Tresidder's Rapid Reckoner.—We have received from the inventor a sample of his simple and cheap slide rule. It consists of two cardboard scales, which are worked in the manner of an ordinary slide rule, and can be obtained from Hall and Sons, Sheffield, for the small sum of sixpence. The rule was originally designed for the use of stockbrokers and investors, but is, of course, applicable to a variety of calculations in which very great accuracy is not a necessity. A sheet of observations and examples of working is supplied with the rule, and on the scales themselves are printed instructions for the principal manipulations. The rule has a wide field of usefulness, not least in an educational direction, and its cheapness puts it within the means of everyone. It is scarcely necessary to say that it has not been produced with a view to making profit.

"*The Electrician" Electrical Trades' Directory and Handbook for* 1897. London: Offices of *The Electrician.*—This is the fifteenth annual issue of this well-known work of reference for the electrical and kindred trades. Of the important matters dealt with, the following, amongst other features, appear for the first time in the 1897 issue:—A large sheet table, giving technical particulars of the electric railways and tramways of the United Kingdom; regulations regarding the free supply of incandescent electric lamps; the new regulations of the London County Council for electric meter testing, issued February, 1897; a number of useful tables relating to water power, British coal, dry saturated steam, hydraulic heads, feed-water heating, rope gearing, &c.; a new section of the directorial division, dealing with Japan and the Far East, which contains the names, professions, and addresses of all persons in those parts of the world associated with electrical work; a carefully compiled sheet table, giving exhaustive particulars of the electricity supply stations of the United Kingdom, compiled up to February, 1897; revised digests of the laws of electric lighting and electric power for traction purposes; the latest revised rules of British, American, Canadian, French, and German Fire Insurance Corporations, relating to electrical risks. In addition to the above—which appear for the first time in the new edition—all the old well-known features of the book have been brought thoroughly up to date, the revision having been very exhaustive. The statistics relating to the engineering and finance of electricity supply undertakings—both municipal and private—are unusually complete on this occasion.

BOOKS RECEIVED.

Journal of the Royal United Service Institution. February, 1897. London: J. J. Keliher and Co. Price 2s.

Practical Hints for Light Railways at Home and Abroad. By F. R. Johnson, M. Inst. C.E., F.R.G.S. London: E. and F. N. Spon. 1896.

The A B C of the Differential Calculus. By William Dyson Wansbrough. Manchester: The Technical Publishing Company, Limited. 1897. Price 3s. net.

Metals: their Properties and Treatment. New edition. By A. K. Huntington and W. G. McMillan. London: Longmans, Green, and Co. 1896. Price 7s. 6d.

Modern Cycles: A Practical Handbook on Their Construction and Repair. By A. J. Wallis-Taylor, C.E. With over 300 illustrations. London: Crosby Lockwood and Son. 1897.

Handbook for Mechanical Engineers. By Henry Adams. Fourth edition. Revised and further enlarged, with copious index. London: E. and F. N. Spon, Limited. 1897.

The Slide Rule: A Practical Manual. By Charles N. Pickworth Wh. Sc. Third edition. Manchester and London: Emmott and Co., Limited, and C. N. Pickworth, Fallowfield. Price 2s.

The Mechanical Engineering of Power Plants. By Frederick R. Hutton, E.M., Ph.D. First Edition. First Thousand. New York: John Wiley and Sons. London: Chapman and Hall, Limited. 1897.

Marine Engineers and How to Become One: With Notes on the Board of Trade Examinations. By E. G. Constantine. Manchester: The Technical Publishing Company, Limited. 1897. Price 5s. net.

South Australia Public Works Report. Report of the Public Works Department for the year ending June 30th, 1896. Ordered by the Assembly to be printed, December 9th, 1896. Adelaide: By Authority: C. E. Bristow, Government Printer, 1896.

Proceedings of the Sixth Annual Convention of the Association of Railway Superintendents of Bridges and Buildings; held in Chicago, Illinois, October 20th, 21st, and 22nd, 1896. Concord, N.H.: Printed by the Republican Press Association. 1896.

Retaining Walls for Earth, including the Theory of Earth Pressure as Developed from the Ellipse of Stress. With a Short Treatise on Foundations, Illustrated with Examples from Practice. By Malverd A. Howe, C.E. Third Edition, Revised and Enlarged. First Thousand. New York: John Wiley and Sons. London: Chapman and Hall, Limited. 1896.

Gas and Fuel Analysis for Engineers. A Compend for those interested in the Economical Application of Fuel. Prepared especially for the use of students at the Massachusetts Institute of Technology. By Augustus H. Gill, S.B., Ph.D. First Edition. First Thousand. New York: John Wiley and Sons. London: Chapman and Hall, Limited. 1896.

THE JAPANESE BATTLESHIP FUJI.

DURING the past two years we have from time to time recorded in our columns the progress of an armoured battleship, subsequently named the Fuji, building by the Thames Ironworks and Shipbuilding Company for the Imperial Japanese Navy.

This vessel, as we noted in our issue of April 3rd, 1896, was successfully launched on the 31st of last March, and on the same day taken round to the Victoria Docks for completion. On Wednesday last, at the invitation of the shipbuilders, a party numbering about two hundred had the pleasure of inspecting this splendid battleship, which is now completed prior to her removal from the docks, for her preliminary steam trial on Tuesday next.

As the Fuji is without exception the largest and finest warship ever built on the Thames, and as only few particulars of her have been made public, we may here state that she is an improvement on the Admiral class of the British Navy, and that her principal dimensions are:—Length between perpendiculars, 374ft.; moulded breadth and depth, 73ft. and 44ft. respectively, with a displacement of 12,450 tons, giving a mean water draught of 26ft. 3in. She was designed by Mr. G. C. Mackrow, naval architect to the Thames Ironworks Company, and her keel plate laid on September 1st, 1894.

At the time of the launch of the Fuji her weight was nearly 7500 tons, so that within the short space of eleven months nearly 5000 tons have been added to her displacement, she now being completely armed, engined, and equipped, thus making, we think, notwithstanding many unforeseen delays, one of the best "completion records" in the kingdom. The propelling machinery of the Fuji is by Messrs. Humphrys, Tennant, and Co., of Deptford, and is to develope 14,000 indicated horse-power on trial, with moderate forced draught to the boilers, which are of the ordinary marine type.

As we intend to fully describe—on the completion of her trials—this first battleship ever possessed by the Japanese nation, in a subsequent issue of our journal, we will only now say that the work put into the vessel from her keel to the mast heads is the best that could possibly be desired, and reflects the highest credit on her builders.

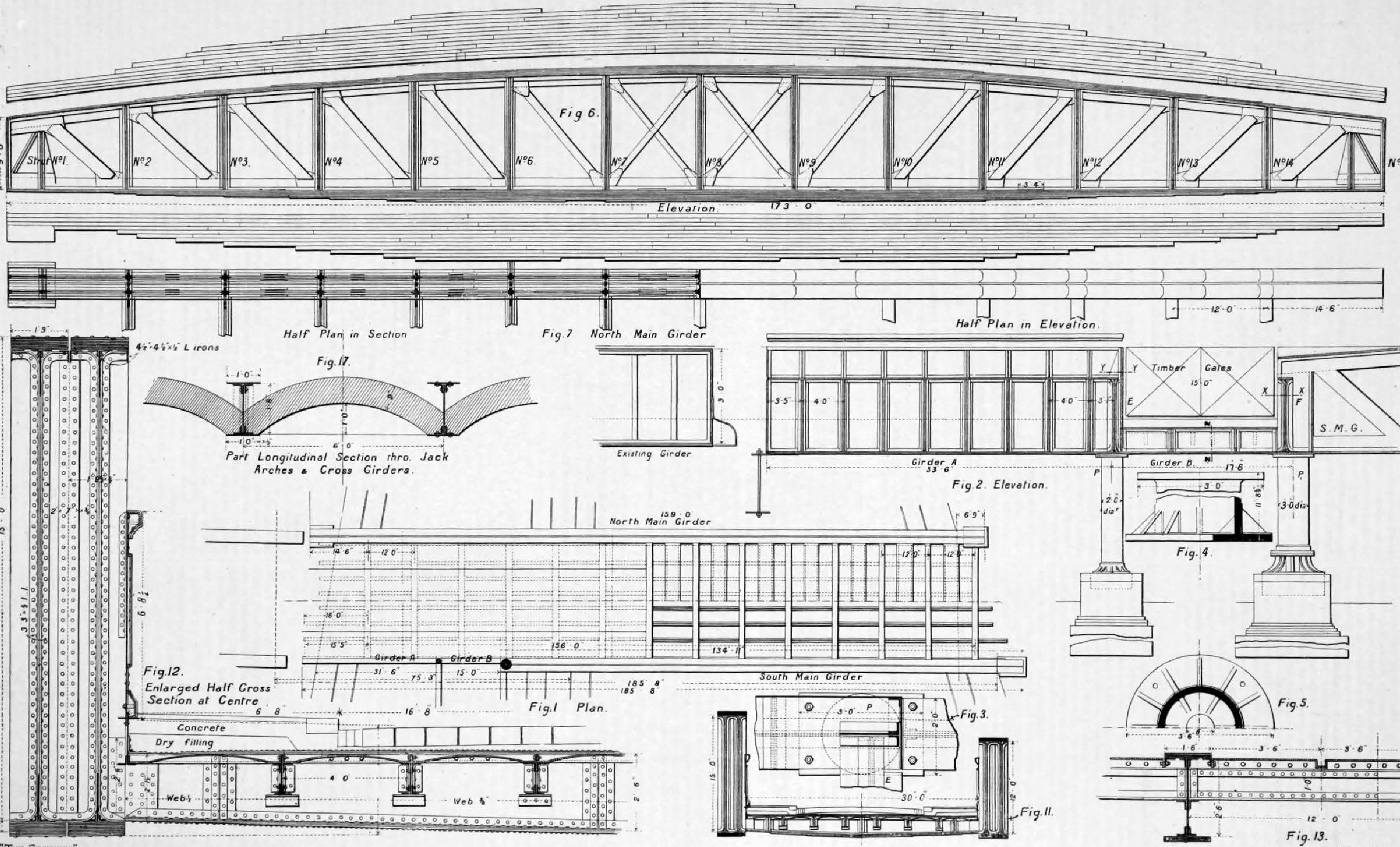
INSTITUTION OF NAVAL ARCHITECTS.—The following resolution has been passed by the Council:—"That the Council will be willing to present a gold medal to any member or associate of the Institution, not being a member or associate member of Council, who shall at the forthcoming spring or summer meetings read a paper, which, in the judgment of the Council, shall be deemed to be of exceptional merit. The Council will also be willing to present a premium of books or instruments to the reader of any paper, not being a member or associate member of Council, which paper shall, in the judgment of the Council, merit this distinction."

SHIPPING INDUSTRY IN SOUTH WALES.—The following figures illustrate the development of this trade. The tonnage of vessels which cleared Swansea Harbour in 1879 was 761,708; while last year the tonnage was 1,638,393, an increase of 115 per cent. The extension of this dock is now being carried out by Sir John Jackson, and it is to be completed in the current year. The extension gives five additional acres of water area, and increases the tipping capacity quite 50 per cent. The dock has one of the finest locks in the Bristol Channel, and accommodates the largest type of vessels engaged in commerce, is electrically lighted throughout, and the entrance channel is illuminated by Pintsch's system of gas buoys. The Harbour Trustees have obtained parliamentary powers, and are about to carry out works and improvements representing an expenditure of £285,000.

SKINNER-STREET BRIDGE, GREAT EASTERN RAILWAY—DETAILS

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

(*For description see page* 214)

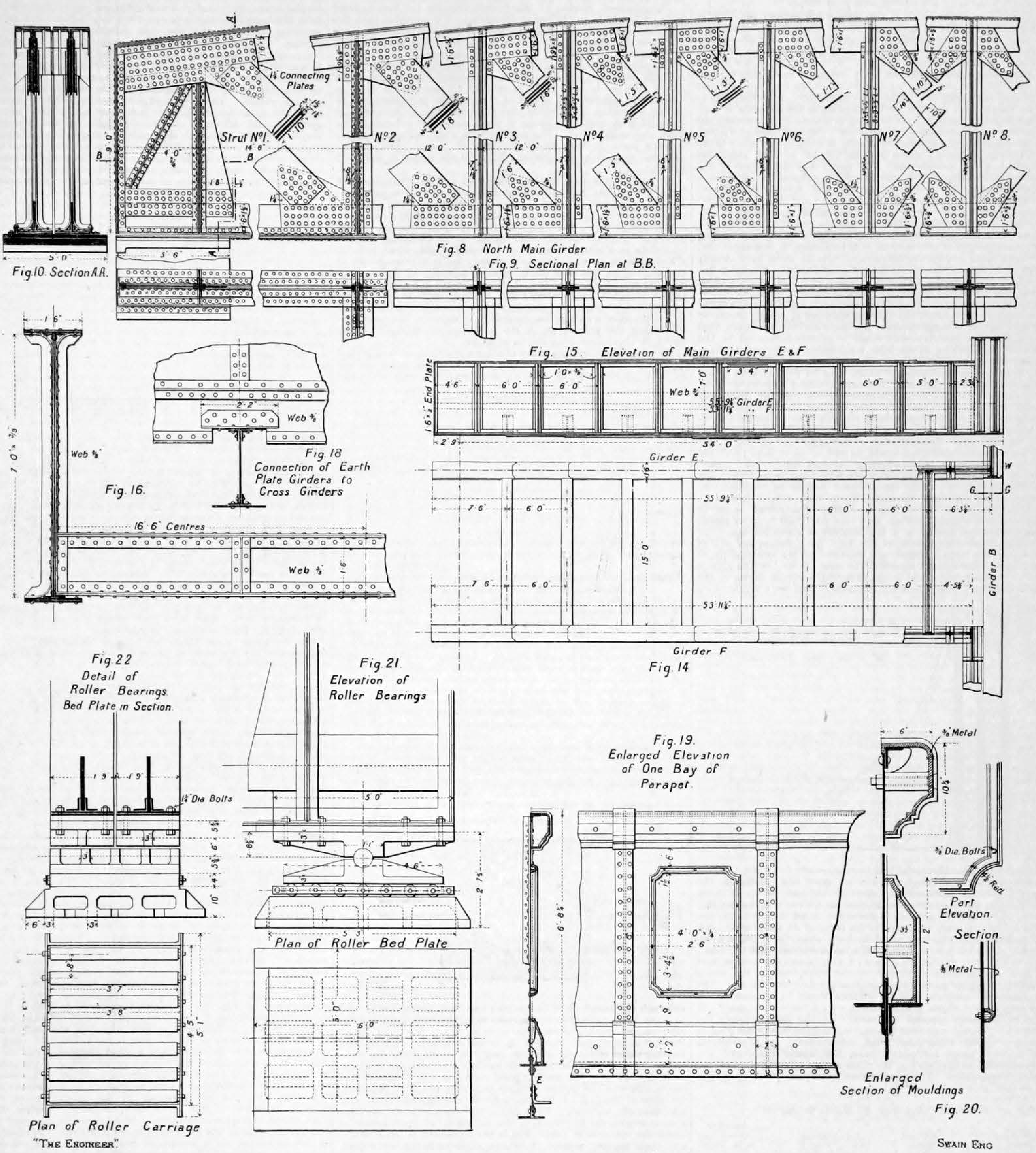


THE ENGINEER

FEB. 26, 1897

SKINNER STREET BRIDGE, GREAT EASTERN RAILWAY—DETAILS

(For description see page 214)



MANCHESTER ASSOCIATION OF ENGINEERS.

THE members of the Association held their forty-first annual dinner on Saturday week at the Grand Hotel, Manchester, Mr. Joseph Nasmith, the President, occupying the chair, and amongst the visitors present were Mr. W. H. Holland, President of the Manchester Chamber of Commerce; Mr. W. H. Collier, traffic manager of the Ship Canal Company; and Mr. G. S. Allott, President of the Manchester Association of Civil Engineering Students.

Sir Wm. H. Bailey, in proposing the trade of the district, referred specially to the question of foreign competition, just now so much a matter of discussion. Although this cry of foreign competition was more than a bogey, yet there was no reason why they should sit by the waters of Babylon, and imitate the daughters of Jerusalem. It would be well, he thought, if those in a state of despair would look not only at their own bank balances, but also study the national balance-sheet; if they did this, he was sure that although particular trades might perhaps feel the severity of foreign competition, they would find many things to make them hopeful. No doubt certain rough industries were suffering from competition from abroad, and that certain common goods were being got from the United States and Germany. He might mention that his son, who had recently visited the United States, had found that for certain goods their own firm made, and which were also made in the United States, the workmen in America could be paid 60s. per week in wages and yet produce a cheaper article than when they paid 36s. to 38s. per week to the workmen in England. The fact was that in the United States they used finer and more expensive tools in certain industries. By the use of these tools, by dividing labour, and making larger quantities, the United States manufacturers had been able to beat us in some things. Manufacturers in England must take a lesson from this fact, and supply themselves with the more modern tools, that would tend to minimise the cost of labour. The general training of this country was also a matter which demanded attention. Although they were doing something different in Manchester, Liverpool, and Leeds, the high-class education of the country seemed to be devoted chiefly to training parsons and lawyers, and leaving engineers out in the cold. It would be necessary, to maintain themselves successfully against foreign competition, that both the employers and the workmen should have the advantage of the best training possible.

Mr. W. H. Holland, in responding, said he was glad to know that the engineering trades of the district were in an exceptionally prosperous condition, and he thought the recent history of Manchester testified to the marked progress that had been made in the above industries. They might, he thought, fairly hope that the advent of a new and highly important firm like that of Sir W. Armstrong to the district would also give some further new impetus to the industry. He would also take that opportunity of strongly urging that the important engineering trades of the district should become a section of the Manchester Chamber of Commerce.

Mr. W. H. Collier also responded to the toast, and spoke very hopefully with regard to the prospects of the Manchester Ship Canal; although he could not go into details, yet he could say they were fully justified in taking a very cheerful view of the outlook for the future.

Mr. Frank Hazelton, the secretary, presented the annual report, which stated that there had been added to the membership roll during the year two life hon. members, nine hon. annual members, and fifteen ordinary members, and after taking into account the loss by death, resignation, and erasure, the total number of names of all classes on the roll amounted to 381, as against 368 in the previous year, viz., 28 hon. life members, 128 hon. annual members, and 225 ordinary members. The balance standing to the credit of the Association, after payment of all accounts due up to 31st December, amounted to £3849, as against £3645 at the close of the preceding year, thus showing a surplus of £204 on the year's working.

The toast of prosperity to the Association was proposed by Mr. C. Haworth, who remarked that the day had long passed when an engineer could work by the rule of thumb; the engineer of the present day must be a man of ability and training.

The President, in responding, referred to the wonderful extent and variety of the engineering trades of the district. There was not a district anywhere that possessed so many engineering establishments as were to be found within thirty miles of Manchester Exchange. As to foreign competition, he was convinced that in spite of all they heard about the superiority of the German trained youth, there was that in the English youth which only required developing in order to make the engineering trades of this country more prosperous in the future than they had ever been in the past.

Other toasts followed, including "Our guests," proposed by Mr. A. Saxon, who remarked that one reason for some of the successful competition of the United States was the organised system of labour, and the speciality of production there carried out.

Mr. S. Z. D. Ferranti and Mr. G. S. Allott responded, after which the toast of the health of the chairman closed the proceedings.

INSTITUTION OF MECHANICAL ENGINEERS.

FOURTH REPORT TO THE ALLOYS RESEARCH COMMITTEE.

By PROFESSOR W. C. ROBERTS-AUSTEN, C.B., F.R.S.

(*Concluded from page* 191)

Diffusion of metals.—When two metals are melted together, or when a fresh metal is added to two or more metals which have already been melted together, the question has often arisen, why is it that the resulting mass when solid possesses the uniformity which experiment proves it to have? If, for instance, a few pounds of ferro-manganese are thrown into a converter containing ten tons of fluid iron, the resulting ingots into which the fluid metal is cast are found to be singularly uniform in composition. Liquation may to some extent have affected the distribution of the elements in each ingot; but any one ingot will be found to contain approximately the same amount of manganese as any other. The fluid mass in the converter cannot have owed its uniformity in composition solely to the mechanical agitation, which in one way or another aided the blending of the constituents. The result was influenced by the molecular mobility of the metals, which when dissolved in each other become, by a spontaneous process, spread or diffused uniformly. This is true of many alloys; and the spontaneous spreading or diffusion may be studied best in those in which the uniformity of composition does not become disturbed by liquation when the solidification of the mass is taking place. In approaching the consideration of this subject, it is important to remember that the laws which govern the diffusion of salts in water have already been carefully examined, and are well understood. Common salt or sugar placed at the bottom of a vessel of water would soon be dissolved, and would spread, in virtue of its own molecular movement, through the mass of the water with absolute uniformity; but, as Graham showed, the rate of diffusion is greatly increased by a small rise in temperature. It seems evident, therefore, that the diffusion of molten metals would be greatly influenced by the necessity for working at the high temperatures required to keep them melted; and certain experiments made by myself fourteen years ago had to be abandoned at the time for want of some means of measuring and recording the temperatures employed. The provision of the recording pyrometer, which was the direct outcome of the work of this committee, enabled the investigation to be resumed; and the results have recently been communicated to the Royal Society, and formed the subject of the Bakerian lecture[20] for the past year. A description of the apparatus employed and of the precautions adopted would be out of place here; but the subject possesses so much industrial interest that a brief indication of the nature of the experiments should not be omitted. The various metals of which the diffusion had to be studied were placed at the bottom of tubes afterwards filled with molten lead; and the results of the diffusion, during twenty-four hours, of platinum and of gold through fluid lead contained in tubes placed side by side and heated to a temperature of about 500 deg. C. or 900 deg. F., are represented in Fig. 14. The columns Au and Pt represent the actual length and diameter of the two columns of fluid lead. The spheres represent the sizes of the buttons of gold and of platinum extracted from the several sections, shown by the horizontal lines, into which the columns of lead were divided by a cutting tool after the metal had been allowed to solidify. In the curves which are marked respectively gold and platinum the vertical ordinate represents the distance through which diffusion takes place, and the horizontal abscissa the degree of concentration. Each of the metals, gold and platinum, which diffused into the fluid column of lead, occupied, in the form of an alloy with lead, the length $a\ d$ of the tube; and in both cases the initial concentration of the alloy from which diffusion proceeded was the same, denoted by $a\ c$; so that the area $a\ c\ e\ d$ represents the total amount of gold or platinum employed in the experiments, the whole quantity of either metal being originally below the line $d\ e$. The final state of complete uniform diffusion would be represented by the area $a\ b\ g\ f$, which is the same as $a\ c\ e\ d$, since the quantity of gold or platinum remains unaltered. In the same manner the area $a\ y\ x\ f$ would represent the varying distribution of the gold at the end of the experiment; and, consequently, in experiments which have lasted for equal times, the nearer the curve $y\ x$ approximates to the line $b\ g$, the more rapid is the diffusion of the metal it represents. The general results may be grouped in the following Table 2.

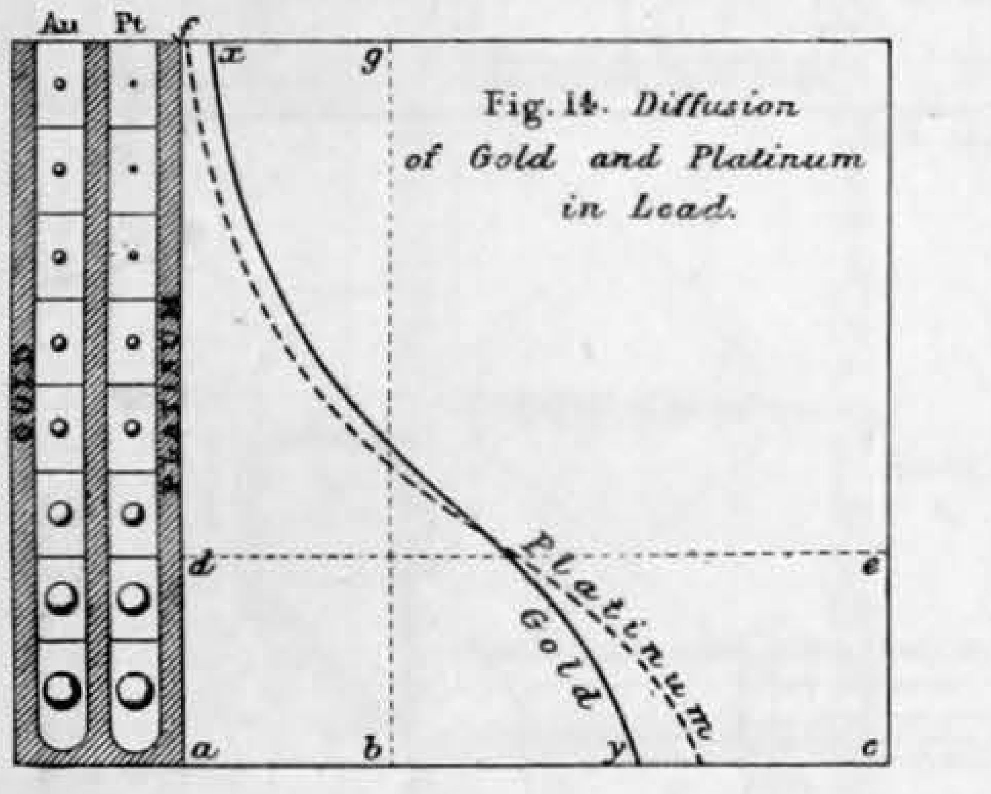


Fig. 14. *Diffusion of Gold and Platinum in Lead.*

TABLE 2.—*Diffusion of Metals in Metals.*

Diffusing Metal.	Solvent Metal.	Temperature Deg. C. Deg. F.	Relative Diffusibility in 24 hours.
Gold	Lead	493 = 918	3·00
Gold	"	"	3·07
Platinum	"	"	1·69
Platinum	"	"	1·69
Gold	"	550 = 1022	3·18
Rhodium	"	"	3·03
Gold	"	555 = 1031	3·19
Gold	Bismuth	"	4·52
Gold	Tin	"	4·65
Silver	"	"	4·14
Lead	"	"	3·18

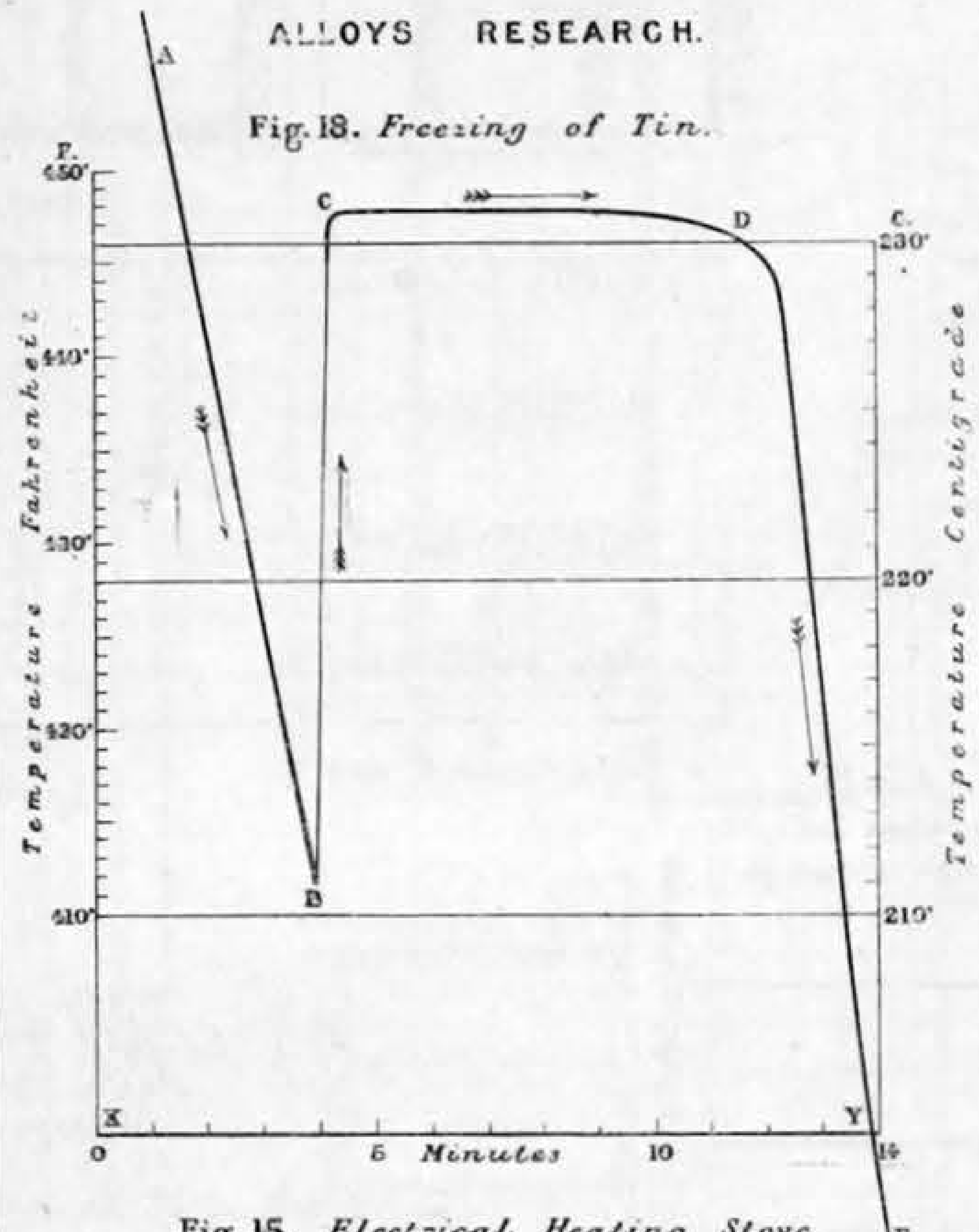
It will be seen that gold diffuses more rapidly in bismuth and in tin than it does in the heavier metal lead. The continuation of these experiments has led to the recognition of the remarkable fact that diffusion of metals can readily be measured not merely in molten but in solid metals. It is certainly remarkable that gold—placed at the bottom of a cylinder of lead 3in. high, and heated to 200 deg. C. or 400 deg. F., which is far below its melting point, and while it is to all appearance solid—will have diffused to the top in notable quantities by the end of three days. Even if lead be heated only to 100 deg. C. or 212 deg. F., the diffusion of gold in it can be readily measured, notwithstanding that it is only $\frac{1}{100000}$th of what it is in fluid lead.

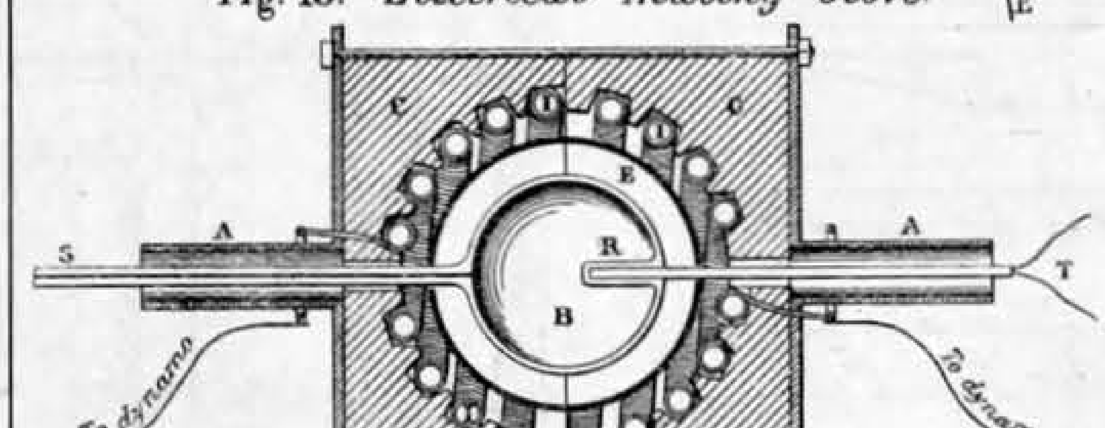
The diffusibility of one metal in another is a property just like the electrical conductivity of a metal. The figures given in the last column of Table 2 are the number of grains of the diffusing metal which would pass in twenty-four hours through each square centimetre of cross section of the tube, if assays made at two points one centimetre apart along the tube showed a difference of one grain per cubic centimetre of alloy. The diffusibility is not directly indicated by the curves in Fig. 14, from which it can be obtained only by elaborate mathematical treatment. The curve marked platinum indicates a diffusibility of 1·69, and that marked gold a diffusibility of 3·1; while if complete diffusion took place, the distribution would be represented by the vertical line bg, and the corresponding figure of diffusibility in the table would be infinity. Thus the more nearly vertical the curve is, the greater is the diffusibility which is indicated thereby.

The practical bearing of this investigation is not remote, and may be sought in the following direction. It is admitted that the mode of action of an added element is one of the most important questions in metallurgy; and it is hoped that experiments on the diffusion of metals will go far to enable the problem to be solved. Many physicists hold what may be called the "gaseous theory" of metallic solutions, which supposes that, when the amount of the added element is very small in relation to the mass of metal in which it is hidden, the atoms of this foreign ingredient are so widely separated by dilution that they act with no more mutual restraint than would the atoms of a gas, and exert pressure in the same way as the latter. The rapidity with which diffusion appears to take place in very dilute solutions of molten metals lends material support to this gaseous theory of the action of an added element.

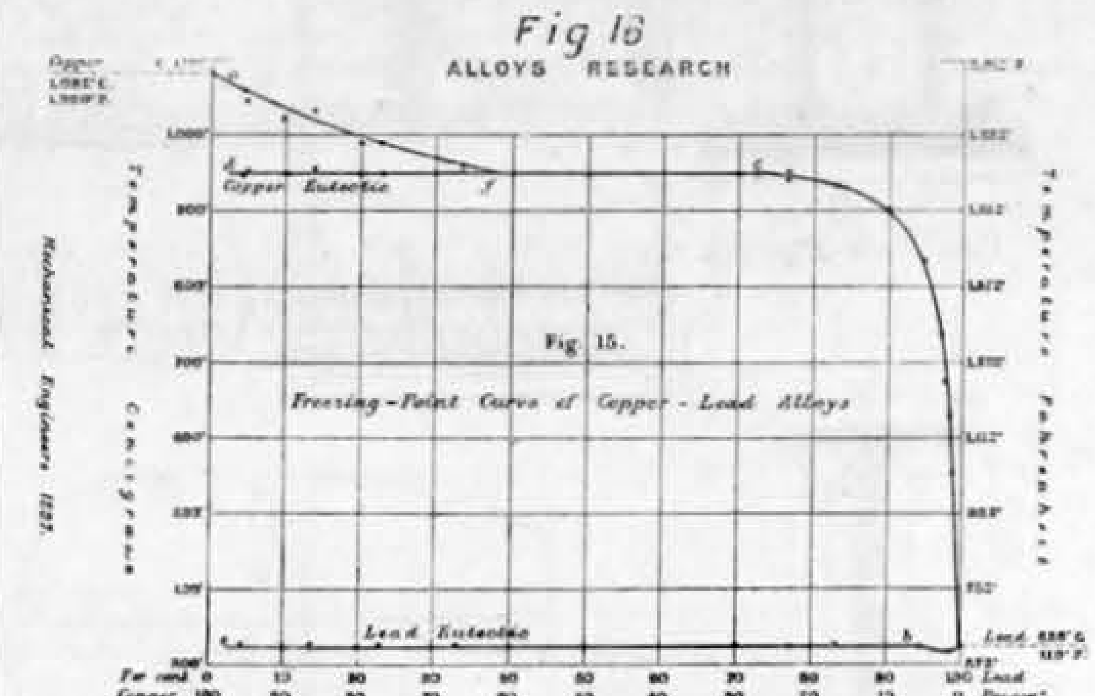
As regards the diffusion of solid metals in each other, it should be observed that the action of solids upon solids has long been known in industrial practice; the penetration of solid iron by carbon in the cementation process will at once occur to every steelmaker as a case in point, even though a gas may intervene in this process. The experiments summarised in the foregoing Table 2 constitute an attempt to measure the velocity with which metallic diffusion takes place. They have already led to the recognition of the undoubted fact that it is possible actually to observe and measure the migration of the constituent atoms in a metal or alloy at the ordinary temperature; and as this points to unexpected possibilities of structural change in metals used in machinery and to engineering construction generally, it enforces the need for continuing the prosecution of the investigations which the Alloys Research Committee have still in progress.

Relation between melting points of alloys and atomic volumes of their constituent metals.—This is a subject to which brief reference was made in the third Report of the Committee (1895, page 251); and although the threshold of the inquiry can hardly even now be said to have been passed, it is desirable to indicate the nature of the information which the research reveals. Many years ago Raoul Pictet[21] showed that there is an intimate relation between the melting point of metals and the length of their molecular oscillations, namely, that the length of oscillation at ordinary temperatures diminishes as the melting point rises; and it is known that the metals with the highest melting points are the most tenacious. He showed that this is the case with the well-known metals, and also that for all metals there is a simple relation between their atomic weight, the amplitude of the movement of their molecules under the influence of heat—that is, the coefficient of expansion—and their melting point. It follows, as stated in the last report, that "the absolute temperature of the melting point of a metal must be closely connected with its atomic volume, because the former is inversely proportional to the rate at which the amplitude of the oscillations of the molecules increases with temperature; and the rate of increase of amplitude at any given temperature is obtained by multiplying the ordinary thermal coefficient of linear expansion by the cube root of the atomic volume.[22]





Since the last report was presented many alloys have been examined from this point of view, in which tenacities and melting points are co-ordinates. It is not for a moment contended that identity of condition has been attained in all the specimens examined; but the alloys as cast have all been made as strong as was found to be possible by carefully working the rods by hand under the hammer, and some approach to a standard condition has, therefore, been realised. Nearly all the rods were 6in. long and $\frac{1}{10}$in. diameter. The relation between the melting temperature and the tenacity appears to be much more definite in worked alloys than in the pure metals. This may be because an alloyed metal is in a more definite condition than one which is nominally pure. The alloy is less radically changed by traces of impurity than a metal is. Matthiessen,[23] in his classical paper on the electrical conductivity of alloys (1860) pointed out that many metals probably undergo an allotropic change when another metal is added to them; and the addition of the first 5 or 10 per cent. of one metal to another usually sets up greater relative changes in its properties than do subsequent additions. The fact that metals are hardened both by alloying and by mechanical "work" suggests that in hammered alloys the metals would be in the most suitable condition for showing whether there is, or is not, a general connection between melting points and tenacities. Experiment proves that many alloys do fall on a curve, with melting point and tenacity as co-ordinates; and this strongly supports the view that there is such a connection. The pure metals have also been similarly plotted, and are found to lie generally on a different curve. For the latter curve the tensile strengths plotted have been gathered from various sources, which may partly account for the irregularity observed; and there appears, moreover, to be more difficulty in bringing pure metals than alloys to a standard condition; hence metals are quite unsuitable for accurate comparison. It will be seen that, considered in relation to their melting points, the pure metals are consistently weaker than alloys. When this question was brought before the Institution at the end of the last report, one or two alloys had been tested, which proved to be much weaker than might have been anticipated from their melting points. These were at first thought to be anomalous; but closer examination showed that they really afford fresh insight into the influence of atomic volume on the strength of alloys. It was observed that all the alloys whose behaviour appeared to be exceptional were composed of two metals whose atomic volumes were identical or nearly so. Several other alloys of metals having nearly the same atomic volumes as each other were accordingly tested, and were all found to possess lower tenacities as compared with their melting points than alloys of metals having different atomic volumes. When the atomic volumes are identical or nearly so, the alloys appear to behave much as pure metals do; but as the identity of atomic volume of the constituents is never perfect, they cannot all be expected to fall on a curve. It should also be observed that true compounds of metals, which, as is well known, are mostly very brittle, do not fall on either line. Certain aluminium-gold or silver-cadmium alloys, or some of the brasses, present such examples; but this, as Fessenden has pointed out, is probably not because the union of the molecules of the compound is not strong, but is owing to the fact that in normal sized test pieces inability to yield leads to fracture, if the load is applied with the least divergence from uniformity; although if the test pieces could be produced as fine threads, they might be expected to possess great strength. Thus quartz is weak enough when tested in rods, but is strong in the form of quartz fibre produced by Professor Boys. Steel is of such varied composition that it is difficult to say what would be a typical steel.



The foregoing observations are offered tentatively. All the members of any one series of alloys do not admit of classification in connection with these curves, although the exceptions may usually be accounted for as being brittle "compounds." The general results as yet obtained appear, however, to be highly suggestive as affording a basis for a broad classification of alloys.

Improvements in the recording pyrometer.—In the last report of this committee a series of three curves were given, which at that time marked the latest stage of manipulation then attained. In those curves the freezing points of bismuth, of tin, and of standard gold containing 1 per cent. of bismuth, were successfully recorded by a method fully described in that report. The result afforded evidence that great delicacy in recording could readily be obtained; but the method was open to the objection that it involved a large angular deflection of the galvanometer mirror, whereby its suspending wires were severely strained; consecutive readings, therefore, could not be expected to correspond. It thus became a question to combine sensitiveness in the indications of the galvanometer with constancy of its zero. This was effected by the use of the following device. A galvanometer, specially constructed by Dr. Muirhead, was supported on a slate slab let into the wall in an underground vaulted chamber at the Mint, in order to ensure steadiness. This current, produced by heating the thermo-junction attached to the galvanometer, would deflect its mirror through a large angle, say 50 deg. This current from the thermo-junction, however, is never allowed to pass unchecked through the galvanometer. It is opposed by a current from a large Clark cell, the amount of which, by the aid of a specially constructed "potentiometer," could be readily adjusted and accurately measured, so that only a small portion of the current, which would be generated by heating the thermo-junction, really passes through the galvanometer. The general result is well exemplified in Fig. 18, in which the curve A B C D E is a faithful reproduction of the photographic record obtained for the freezing of tin. In this case the thermo-junction was really heated to the melting point of tin, 231 deg. C., or 448 deg. F.; but the galvanometer was deflected only a short distance from its zero line X Y by a portion of the current corresponding at the point C to 27 deg. C. or 49 deg. F. The current produced by the remaining 204 deg. C. or 399 deg. F. was neutralised by the current from the Clark cell, and was measured by the potentiometer. The angular deflection of the mirror may, therefore, be quite small, even at the highest temperatures. It must not be supposed that the sensitiveness of the galvanometer is diminished; its resistance is not increased, but a portion of the current from the thermo-junction is balanced. The curve shows that in fact the galvanometer is highly sensitive; for the distance B C, which represents the surfusion of tin, is only 20 deg. C. or 36 deg. F. This delicate method of recording demands special arrangements for actuating the sensitised photographic plate which receives the record. The astronomical clock hitherto employed was, therefore, replaced by a water clock, consisting of a float moving upwards between guides, and bearing a photographic plate. The whole was enclosed in a light-tight case, provided with a horizontal slit, through which the ray of light from the galvanometer mirror has access to the plate. This plan is a convenient one, as it enables the chamber, which corresponds with the camera of the old recording instrument, to be illuminated without fear of "fogging" the plate. The progress of the spot of light along the slit can be observed by the operator, who, provided he does not obstruct the ray of light from the galvanometer, moves about freely in the chamber. In this system of recording it is absolutely necessary that he should be able to do so, because the electrical balancing has to be effected during the operation.

Comparison of the thermo-junction with the air thermometer.—The question as to the degree of confidence which may be reposed in the numerical values of high temperatures is a most important one; and in connection with the last report—"Proceedings," 1895, page 283—it was stated that the temperatures which had been accepted might be some 17 deg. C. or 31 deg. F. too low. Since that report, however, much work in this direction has been done. The determinations made by Professor Carl Barus,[24] who compared the air thermometer with thermo-junctions of different metals and alloys, are well known. More recently Holborn and Wien[25] have

20 "Philosophical Transactions of the Royal Society," 1896, vol. 187 A, page 389.

21 "Comptes Rendus," vol. 88, 1879, pages 855 and 1315.
22 Ibid., page 856.
23 "Philosophical Transactions of the Royal Society, 1860, page 161.

24 United States Geological Survey, 1889, Bulletin No. 54.
25 "Annales de Chimie et de Physique," vols. 47 and 56, 1892 and 1895, Bulletin de la Société d'Encouragement, 1895, page 1012.

instituted a new investigation, and they also compared directly the air thermometer with the thermo-junction. The experiments, which were very elaborate, were conducted with great care, and have done much to satisfy physicists as to the delicacy and trustworthiness of thermo-junctions. Still more recently Heycock and Neville, whose work has been so often referred to in these reports, have re-determined a series of melting points by the aid of the resistance pyrometer, and their results give for the melting point of gold 1061·7 deg. C. or 1943 deg. F., while Holborn and Wien give 1072 deg. C. or 1962 deg. F.; and Messrs. Holman, Lawrence, and Barr assuming the temperature for the melting of pure gold to be 1072 deg. C. or 1962 deg. F., find that of copper to be 1095 deg. C. or 2003 deg. F. which is 13 deg. C. or 23 deg. F. higher than Holborn and Wien made it. Other results might be quoted as having been obtained severally by Violle, H. le Chatelier, Callendar, Erhard, and Schertel, and by Barus. Results obtained by a new method of observation are also promised by M. Daniel Berthelot,[26] who in 1895 communicated to the Académie des Sciences the principle of a system of measuring high temperatures, based on the change which is produced by heat in the index of refraction of gases.

The general result of recent pyrometric work still leaves uncertain a range of some 10 deg. C. or 18 deg. F. in the melting point of gold, which is to be regretted, because this metal affords a highly convenient standard of reference. Differences of temperature, however, in the neighbourhood of 1100 deg. C. or 2000 deg. F. can be registered by the improved recording pyrometer with less error than one-tenth of a degree C. or one-fifth of a degree F. It therefore seemed well to employ the air thermometer in a series of new determinations of the melting point of gold. A number of preliminary experiments have already been made; and although the results cannot be completed in time for insertion in this report, it may be well to describe the method which has been adopted. A porcelain bulb B, Fig. 15, having an internal capacity of 360 cubic centimetres or 22 cubic inches, is made of porcelain glazed externally, and is provided with a long tubular stem S, by which it is connected with a suitable apparatus for measuring the expansion of the air or gas contained in the bulb. A re-entrant tube R, closed at its inner end, affords the means of introducing a thermo-junction T into the centre of the bulb, though not of course directly into the air space of the bulb. The thermo-junction is supported by a suitable insulating tube. The receptacle consists of a clay chamber C, divided into two halves, which are held together by iron plates and bolts. The heating is effected by passing a current from a dynamo through the coils of iron wire I I, which are placed inside the clay chamber; and in order to insure uniformity of temperature the clay chamber is made to revolve on axles A A. An inner shell of iron E is provided, in order to render the heating regular. The heat is steadily maintained for some time; and the readings of the thermo-junction and of the air thermometer are made simultaneously.

Some uncertainty as to what is the exact melting point of any given metal no doubt arises from the varying conditions under which different experimenters have worked. Thus while Heycock and Neville[27] find that copper melts at a temperature which is 19·8 deg. C. or 35·6 deg. F. higher than that at which gold melts, Holborn and Wein find a difference of only 10 deg. C. or 18 deg. F., the divergence being probably due to the presence of dissolved oxygen in the copper. Another cause of discrepancy between the observations of different experimenters arises from the fact that the temperature of a freezing mass of metal is not constant, from the beginning to the end of the solidification. It seldom happens, for instance, that the freezing of a metal is represented in the cooling curve by an absolutely horizontal line; hence it is important to know whether the beginning or the end of the freezing has been noted; and it is evident that autographic records render it possible to state accurately what phase of the melting or freezing of a metal or alloy occurs at any particular temperature. It is to be hoped that, before this report is discussed, it may be possible to tabulate in an appendix some comparisons of temperatures as indicated respectively by an air thermometer and by a thermo-junction.

Conclusion.—It will be seen that the range covered by the work of the committee during the past two years has been largely diversified; and the evidence which has been gathered that there is constant and active molecular movement in solids can hardly fail to be of importance in all industries in which metallic alloys are employed.

APPENDIX.

TABLE III.—*Freezing Points of Copper-zinc Alloys.*

Figures in brackets indicate small halts in the cooling curves.

Percentage of		Temperatures of freezing points.	
Copper.	Zinc.	Centigrade.	Fahrenheit.
100·0	0·0	1082	1980
96·2	3·8	1075	1967
94·7	5·3	1076	1969
86·1	13·9	1032	1890
80·1	19·9	1008	1846
76·3	23·7	980	1796
75·4	24·6	980, (473)	1796, (883)
71·7	28·3	958, (900)	1756, (1652)
70·9	29·1	952, (896)	1746, (1645)
68·6	31·4	935, 883, (450)	1715, 1621, (842)
66·4	33·6	918, 893	1684, 1639
66·2	33·3	913, 882	1675, 1620
63·0	37·0	908	1666
62·6	37·4	892, (450)	1638, (842)
59·7	40·3	886	1627
59·7	40·3	894, (460)	1641, (860)
59·6	40·4	889, (450)	1632, (842)
52·1	47·9	878, 463	1612, 865
50·2	49·8	880	1616
48·1	51·9	855, 460	1517, 860
47·4	52·6	870, (470)	1598, (878)
47·0	53·0	852, (462)	1566, (864)
45·8	54·2	855, (470)	1571, (878)
41·2	58·8	840	1544
38·5	61·5	823	1513
34·6	65·4	816	1501
32·8	67·2	803	1477
29·2	70·8	786, (682), (531), (450)	1447, (1260), (988), (842)
27·3	72·7	766, 680, (535)	1411, 1256, (995)
24·3	75·7	740, 680, 565, 554	1364, 1256, 1049, 1029
24·0	76·0	741, 691, 569, 550	1366, 1276, 1056, 1022
23·2	76·8	732, 680, 587, (554)	1350, 1256, 1089, (1029)
22·8	77·2	729, 586, (555)	1344, 1087, (1031)
20·9	79·1	712, (683), 590, (477)	1314, (1261), 1094, (891)
20·0	80·0	705, 590	1301, 1094
19·1	80·9	695, 590	1283, 1094
17·9	82·1	680, 591	1256, 1096
16·6	83·4	666, 584, (470)	1231, 1090, (878)
15·0	85·0	657, 596	1212, 1105
14·3	85·7	633, 590, (440)	1171, 1994, (824)
12·2	87·8	609, 586, 419	1128, 1087, 786
12·1	87·9	592, 419	1098, 786
11·1	88·9	588, 583, 420	1090, 1081, 788
10·9	89·1	583, 570, 420	1081, 1058, 788
10·6	89·4	579, 419	1074, 786
7·9	92·1	547, 418	1017, 784
7·2	92·8	537, 420	999, 788
3·6	96·4	(465), 419	(869), 786
1·9	98·1	(425), 419	(797), 786
1·8	98·2	420	788
0·0	100·0	419	786

In concluding the report I would offer my warmest thanks to Mr. Alfred Stansfield, B.Sc., and Mr. Merrett, who so ably assisted me in its preparation. The work of Mr. Merrett appears in this series of reports for the first time, and he has proved himself to be a careful experimenter. To Mr. Stansfield the thanks of the committee are specially due, for owing to the many claims upon my time, I have been obliged to entrust the conduct of certain portions of the research entirely to him, and I knew that I could do so with confidence.

Professor Roberts-Austen said: On page six of the report I refer to the necessity for the simultaneous use of the pyrometer and microscope before we attempt to explain how structure is built up of molecules. I had fully hoped that the micro-structure of alloys would have taken a prominent place in the present report, and the members of the committee who visited the Mint some weeks since saw the elaborate arrangements for conducting micro-photographic work with high magnification, which I have made under the guidance of my friend M. Osmond, whom I may justly call the greatest living student of the micro-photography of metals. I am, however, compelled to leave out until the spring the publication of my results. Thus it is that, save for brief incidental references, micro-structure does not find a place in the present report. I specially regret this, for there is important work of other experimenters with which I shall hope on a future occasion to deal fully. These workers are numerous, and among them may be mentioned M. Behrens, of Delft, and M. G. Guillemin, who gave some years ago some beautiful micro-photographic studies of the structure of copper and copper alloys. I would also specially mention the work of M. Charpy, who in the report of the Société d'Encouragement, to which I have referred, systematically attacks the micrographic study of the brasses, of which he gives no less than forty-eight admirable micro-photographs. Had I dealt with microscopic work in connection with alloys, I should have shown full appreciation of the work of Professor Arnold, on whom, so far as Sheffield is concerned, the mantle of Sorby may be said to have fallen. In previous reports I have shown that the presence of a fusible eutectic alloy can be detected by the aid of the recording pyrometer, as the fusible eutectic is revealed by a low-down point of arrest on the cooling curve. Professor Arnold has shown in a paper published in *Engineering* in February of last year, that the presence of these eutectics in gold and in copper may be revealed by the microscope, if the specimens have been subjected to certain thermal conditions, which he carefully defines. I trust that he will furnish an abstract of his results for the use of the committee. It is such results as these which I trust will not be lost sight of in future work. Micrographic work demands a long apprenticeship, and although I and my assistants have only recently attained the degree of proficiency in micro-photography, which gives us confidence to proceed to publication; still for some time past the micrographic installation has been devoted to departmental uses, hence the absence of microsections in the present report.

[26] "Comptes Rendus," vol. 120, 1895, page 831.
[27] Chemical Society, *Journal*, vol. lxvii., 1895, pages 160 and 1024.

AUSTRALIAN NOTES.

THROUGHOUT the Australasian Colonies the official returns for the year are of a satisfactory character, and show that trade is decidedly improving.

In Victoria the net gain on the half-year amounts to £118,827, of which the railways contribute an increase of £52,700.

New South Wales shows a nominal decrease of £228,075, but as the remission of Custom duties represents a decrease of £447,538, the revenue has gained from other sources £219,463, of which railways and tramways show an increase of £65,661.

A strike is threatened in connection with the Australasian Institute of Marine Engineers. At the time of the great maritime trouble in 1890 an agreement was entered into with the Shipowners' Association under which both sides worked amicably for three years. At the end of that period the engineers accepted a reduction of 10 per cent. in their wages, on the understanding of a return to their former rates as soon as prosperous times returned. This, they consider, has now come, as with the West Australian trade shipping is very active.

It is considered by some of the engineers that oversea boats coming into Sydney pay higher rates than that obtained by the Sydney engineers, and they also object to men coming from England under two or three years' engagements at lower rates than what obtains on the coast.

The following is the rate of wages asked for by the engineers:—

	Chief.	2nd.	3rd.	4th.
	£	£	£	£
Within 100 N.H.P.	20	16	14	—
100 and within 150	21	16	14	—
150 and within 200	22	17	14	12
200 and within 250	24	18	15	12
250 and upwards	25	18	15	12

As regards the invitation for tenders for the supply of 150,000 tons of steel rails for the New South Wales Government, only one local tender has been received, which is from Messrs. G. and C. Hoskins, of Sydney, pipe manufacturers. The terms of their tender have not transpired.

Messrs. Linzloherger and Estermann are visiting the principal centres of the frozen meat trade in Queensland with the object of establishing trade in frozen meat between that Colony and Austria.

The following return shows the principal articles of export from New South Wales from 1st January to 31st December, together with comparisons for the previous three years:—

	1896.	1895.	1894.	1893.
Wool, bales	638,259	677,133	684,576	648,829
Skins, packages	19,649	28,314	24,460	30,127
Hides	220,511	367,871	130,408	145,943
Tallow, casks	57,916	114,672	106,720	82,802
Tin, ingots	78,889	87,232	110,953	107,952
Copper, ingots	367,156	354,961	161,715	196,701
Leather, packages	14,115	12,018	9,986	7,050
Gold, coined £	3,523,576	2,339,092	1,891,353	2,480,890
Gold, uncoined	355,479	571,979	336,112	40,561
Silver	35,596	40,418	53,200	95,126

Mr. J. Davies, traffic manager of the West Australian Railways, has been appointed general manager.

An impetus has been given to Kalgoolie, West Australia, through the discovery of the valuable product telluride of gold, this deposit being found only in one other place in the world, viz., South Carolina.

Mort's Dock and Engineering Company, Sydney, has decided to lengthen its dry dock to 640ft. It was the intention of the company to build a new dock of larger dimensions, but satisfactory arrangements could not be made with the local council.

The Government of South Australia propose to enlarge a graving dock at Port Adelaide, so as to accommodate the largest vessels visiting Australian waters.

Mr. Richard Speight, ex-Commissioner for Victorian railways, as advising engineer to a West Australian syndicate, proposes to lay down light tramways for the carriage of ore from mines which are at a distance from the railway service. This scheme, which is well supported financially, should pay well, judging by the returns of the Government railways.

The Victorian Railway Commissioner—Mr. J. Mathieson—has published a return showing the cost of working and revenue received from the various branch railways in that colony, for the year ending June last. Of 48 branch lines shown, 33, with a mileage of 515, do not pay working expenses, the figures being:—Revenue, £63,858; working expenses, £105,148; capital cost, £3,489,479; interest on capital, £137,981; total loss (including interest) for year, £179,271. Thirteen lines, comprising 630 miles, pay working expenses but not interest, the return showing:—Revenue, £143,935; working expenses, £96,034; capital cost, £2,972,566; interest on capital, £24,884; total loss (including interest) for year, £72,785.

On the 21st May last a commission was appointed by the Parliament of New South Wales to inquire into certain allegations made by Mr. Parney Parkes, M.P., against certain officers in the Public Works Department for undue preference to a firm of contractors—Messrs. Carter, Gummon, and Co. Judge Murray was appointed to inquire into the charges made; 114 witnesses were examined, involving 21,860 questions and answers. The summing up of the report is as follows:—

"None of the charges brought against Mr. Hickson have been proved by the evidence that has been produced. Your commissioner has failed to discover in that evidence any grounds for further inquiry; and in your commissioner's opinion Mr. Hickson and the other responsible officers of the Works Department stand exonerated from all suspicion of improper conduct in relation to the matter into which your commissioner has been instructed to inquire."

The Victorian Parliament has passed loan votes to the amount of £215,356 for the following railway works:—Engine shed, &c., at Benalla, £13,500; increased accommodation for dairy produce, £10,065; re-grading and station yard works, £37,000; equipment of vehicles with Westinghouse brake, £15,000; improved carriage lighting, £10,000; new rolling stock, £40,500; North Melbourne carriage repair shop, £8000; cattle pits, £5000.

The first trial of acetylene gas in Australia was recently made on one of the New South Wales suburban trains, when an American invention of a Mr. T. L. Wilson was tried.

The difficulty with the marine engineers has been settled, but not with satisfaction. When a determined stand was made by the engineers the Steamship Owners' Association agreed to revert to the old standard of pay, which means an increase of about 10 per cent., also to the twenty-four hour hours' notice clause; the other items in dispute were to be settled by conference, these being as follows: "Pay of engineers on chartered steamers" to be made the same rate as those on Australian-owned boats. "Fourth engineer for steamers of 200 nominal horse-power, running 400 miles between terminal ports." This was the custom of the profession until 1893; since then the custom has been gradually infringed. "Overtime: how it can be equitably paid, instead of allowing time off." "Improved accommodation for engineers." "Sailing with incompetent crews." "The mode of calculating nominal horse-power." "All engineers under the grade of fourth to be paid not less than £10 per month." On submitting these points to the Steamship Owners' Association a lengthy reply was given in each case, but none of their claims conceded. As the most important points in the dispute had been agreed upon before the conference met, the Engineers' Association have certainly gained something, but the general feeling appears to be one of discontent at not gaining the points put forward at the conference.

The Department of Public Works of the New South Wales Government are inviting tenders for the supply and erection of pumping engines and boilers for Marriskville—Sydney—Contract No. 145, Western suburbs sewerage. Tenders to be in by 30th June. Also, for a truss bridge on iron piers over the river Murray at Albury. Tenders to be in by 17th March. Conditions of contracts furnished in the Government *Gazette*, which, together with specifications, can be obtained at the office of the Agent-General for New South Wales, Westminster, London.

Referring to the only local tender given in for the supply of 150,000 tons of steel rails manufactured in the colony of New South Wales, as submitted by Messrs. G. and C. Hoskins, of Sydney, the price quoted is at £7 14s. per ton for the rails, and £9 4s. per ton for fish-plates, bolts, &c. This price is about 25 per cent. higher than what the rails can be imported. The last supply of steel rails supplied to the department was about eighteen months ago, at a cost of £5 16s. per ton landed in Sydney. The Minister for Works appears to think the price quoted is too high, even as a means of establishing the iron industry in the colony.

The largest steamer ever in southern waters arrived in Sydney this week, the Friedrich der Grosse, of the North German Lloyd line, sailing between Australia and Southampton, Antwerp and Bremen. This vessel, together with the s.s. Barbarossa, due to arrive here in a month, are intended for the Australian service. The former is built by the Vulcan Company's Works at Bredon-on-the-Oder, while the s.s. Barbarossa is from the works of Messrs. Blohm and Voss, of Hamburg. The s.s. Barbarossa is 525ft. between perpendiculars and a beam of 60ft., with an inside depth of 34ft., and is 10,000 tons register, with a draught of 28ft., and has a displacement of nearly 20,000 tons. Accommodation is provided for 100 first-class, seventy-six second-class, and 2300 steerage passengers. In both fore and aft parts of the ship are four large hatches, which are provided with sixteen cranes worked by hydraulic power. These vessels have two promenade decks, one immediately over the other, the lower one being used by the second-class passengers, and the upper one by the first-class. The midship structures stand upon a spar deck, and are 256ft. in length, and stretch the whole width of the ship. At the ends of the ship there is a poop about 66ft. in length, and a turtle back 80ft. long. Besides a double bottom running from end to end, the ship is built with twelve water-tight bulkheads extending to the upper deck, and divided into thirteen water-tight compartments. No particulars whatever respecting the engines will be supplied by the chief engineer of the Friedrich der Grosse, now in Sydney.

CATALOGUES.

Tangyes Limited, Birmingham.—Illustrated unrevised price list of machinery in stock.

W. B. Haigh and Co. Ltd., Oldham.—Illustrated price list of dynamos and electric motors.

Robert D. Stewart, London.—Price list of paints, colours, oils, varnishes, brushes, tallow, waste &c. This is a very comprehensive pamphlet.

Campbells and Hunter, Hunslet, Leeds.—This is an admirably appointed catalogue of machine tools. The illustrations, letter-press, paper, and binding are all of a high class.

The Jandus Arc Lamp and Electric Company, Old Charlton, Kent.—Illustrated price list, containing expert opinions of this lamp, a notice of which appeared in our issue of January 28th, 1896.

Louis Harper, A. M. Inst. C.E., Aberdeen, steel rope suspension bridges.—The bridges illustrated and described in this pamphlet are suitable for spans up to 300ft. Quotations are given for bridges having spans varying between 50ft. and 300ft., and from 4ft. to 6ft. wide.

John Davis and Sons, Derby, electric mining.—In this catalogue are described and illustrated various types of plants for coal cutting, and drilling, hauling, pumping and lighting by electrical power. A feature of interest is the apparatus for firing shots in mines, a subject to which the makers have given close attention.

Hills and Jones Company, Wilmington, Delaware, U.S.A.—Illustrations of new special machine tools with recent designs for working iron and steel plates, bars and structural sections. Some exceedingly interesting appliances are illustrated in this catalogue, but the size of the book and the binding are not in accordance with our conceptions of an ideal catalogue.

Thomas Firth and Sons, Ltd., Sheffield.—Album of views of this firm's works at Sheffield, together with their history and some of the more important manufactures. The business of Messrs. Firth and Sons was founded in 1840 by Mr. Mark Firth, and its growth has been a rapid one. The works now find employment, we are told, for 2000 hands, cover nearly 20 acres of ground, and have an average yearly output of some 6000 tons of crucible steel. The views of the works are excellently reproduced.

Mr. W. D. Houghton, of the Sankey Wire Mills, Warrington, who has long held an enviable reputation for the manufacture of wire for the construction of ropes, has now taken up the manufacture of complete wire ropes. We have received from him a little catalogue containing some useful notes on the employment of wire ropes, and including a number of tables giving the strength and weight of various types and sizes of ropes. The figures show that very great strength in proportion to the weight and diameter is attained.

LAUNCHES AND TRIAL TRIPS.

On Thursday afternoon, the 18th inst., the s.s. Tunstall was launched from the yard of Messrs. Craig, Taylor, and Co., Thornaby-on-Tees. The dimensions are 280ft. by 41ft. by 18ft. 9in., and she is a duplicate of the s.s. Urania, which was launched a short time ago by the same builders. This vessel will carry 3100 tons on a very light draught of water, and will be fitted with powerful steam winches, patent direct steam windlass, steam steering gear, and all modern improvements. The engines are being constructed by Messrs. Sir Christopher Furness, Westgarth, and Co., Limited, Middlesbrough, the cylinders being 20in., 32½in., 53in. by 36in. stroke, with two large boilers to work at 160 lb. pressure. The vessel has been built to the order of Messrs. Furness, Withy, and Co., Limited, West Hartlepool. The vessel was named by Miss Bessie Craig, daughter of one of the builders.

On Wednesday, February 17th, Messrs. Furness, Withy, and Co., Limited, launched from Middleton Shipyard, Hartlepool, a large steel screw steamer of handsome design. She is a fine type of a modern cargo boat, measuring over 350ft. in length, and built throughout of Siemens-Martin steel, with a large measurement and deadweight capacity of about 6300 tons, built to the highest class at Lloyd's. The vessel is of the single deck type, with poop, bridge, and forecastle. The holds are fitted with iron grain divisions, and all deck erections, skylights, bulwarks, &c., are constructed of steel and iron. Cellular double bottom, fitted fore and aft for water ballast, the after peak being also available as a tank. The greater portion of the plates are in 24ft. lengths, making the structure of the ship very strong. Four large powerful winches, donkey boiler, patent steam steering gear amidships, screw gear aft, direct steam patent windlass, stockless anchors hauling into hawse pipes, and other modern appliances are fitted for the handy working of the ship. The saloon and cabin providing accommodation for the captain, &c., is handsomely finished in polished hardwood. The vessel will be rigged as a two-masted fore-and-aft schooner, and will be fitted with triple-expansion engines of massive design, with every provision for economical working, by Messrs. W. Allan and Co., Limited, Sunderland. On leaving the ways she was named Ohiwa, by Mrs. Henry Withy, Brantford House, West Hartlepool.

On Friday afternoon, the 19th instant, there was launched from the West Yard of Messrs. C. S. Swan and Hunter, Limited, a steel screw steamer built to the order of Messrs. Elder, Dempster, and Co., for their transatlantic trade. This vessel has been designed to carry a deadweight cargo of 5600 tons on a moderate draught, and to carry a very large measurement cargo. Her dimensions are 330ft. between perpendiculars by 45ft. 3in. by 28ft. 9in., moulded, built to the highest class at Lloyd's, spar deck rule, under special survey. She has a poop, long bridge, and topgallant forecastle. On the top of the bridge, in steel houses, are placed the accommodation for the officers, engineers, &c., whilst the crew are located in the forecastle. Water ballast will be carried in the cellular double bottom; six powerful steam winches by Messrs. Wilson, of Liverpool, are supplied, with a full complement of derricks and discharging gear. The steam windlass is of Messrs. Emerson, Walker, and Co.'s latest design, whilst a special type of steering gear by Messrs. Bow, McLachlan, and Co., placed aft, and controlled from the bridge, will be fitted. The machinery is of the latest type of triple-expansion engines, built by the North-Eastern Marine Engineering Company, Limited. Her cylinders are 24in., 40in. and 64in. diameter by 42in. stroke, supplied with steam by two large single-ended boilers 15ft. 3in. diameter, by 10ft. 6in. long, working at a pressure of 170 lb. per square inch. During the construction the steamer has been surveyed by Captain Evans, the company's marine superintendent; whilst the construction of the machinery has been supervised by Mr. Lees, the engineer surveyor for Messrs. Elder, Dempster, and Co. On leaving the ways the steamer was named the Ashanti by Mrs. Henry H. Aitchison, of Port Villa, Wallsend.

The Civil and Mechanical Engineers' Society. — On Thursday, February 18th, a paper was read by E. H. G. Brewster, A.M.I.C.E., M.I.M.E., on "Refrigeration." The author drew attention to the great importance of the subject at the present time, and gave statistics in support of his contention that the science of reducing temperature was second only in importance to that of increasing it. He then gave a brief history of the subject, and afterwards dealt in detail with the various systems in use for the production of ice and for cooling purposes.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet-engineers: W. J. Maudling, to the Royal Oak; George J. Fraser, to the Collingwood; and David J. Gyles, to the Dreadnought, undated. Staff-surgeon: Alfred M. Page, to the Brisk, to date February 16th. Surgeon: Albert X. Lavertine, to the Pembroke, additional, when Dreadnought pays off. Engineers: John E. Vibert, to the Royal Oak; Walter F. Mitchell, to the Collingwood; and James Mountifield, to the Melpomene, to date February 15th. Assistant engineers: Robert Spence, to the Royal Oak; Walter S. Hill, to the Sans Pareil; Ivor E. S. Roberts, to the Collingwood; Lewis J. Cook (probationary), to the Royal Oak; Thomas A. Venning (temporary), to the Undaunted, to date February 4th; Albert D. Byrne (temporary), to the Blenheim, to date February 15th.

Engineering Society, King's College, London.—A general meeting was held on February 16th, the president in the chair. Mr. Lecuona read a paper on "Harbours and Docks." He first gave the history, construction, and maintenance of the principal harbours of Europe, North Africa, and America, describing the result which tides, prevailing winds, and currents had on their position and shape, and the reasons which caused the adoption of peculiar forms of construction. The author then proceeded to the description of docks, giving details as to their extent, use, depth, and construction; and explained the influence of the tides, currents, and peculiarities of the sea and river beds on all the most important docks. He also gave some details as to buildings on pile foundations, and the weight which a pile driven into soft mud would support without further sinkage. The meeting terminated with a vote of thanks to Mr. Lecuona for his interesting paper.

Manchester Ship Canal.—The half-yearly report of the directors shows an expenditure on capital account during the half-year, after deducting £4523, the proceeds of sales of land and plant, of £14,592, making a total expenditure out of capital of £15,168,795, and leaving a balance on the account of £235,559. Interest for the half-year on first and second mortgage debentures amounting to £44,742 has been paid; the total amount of interest now due to the Manchester Corporation, but not paid, is £393,750. The gross receipts from ship canal traffic during the six months amounted to £101,116, an increase of £26,679. The weight of toll-paying merchandise over the canal gives totals of 1,003,158 tons during the six months ended December last, as compared with 758,775 tons during the half-year ended December, 1895. A comparison is also given of three years' traffic, which shows totals of 825,659 tons in 1894, as against 1,358,875 tons in 1895, and 1,826,237 tons in 1896. The directors add that there has been on the average a steady and continuous increase in the volume of sea-going traffic. Efforts are being persistently made in every possible direction to secure a continued and augmented increase of traffic. The greater portion of the increased traffic has consisted of imports, and the recent largely-augmented imports of cotton and grain have emphasised the necessity for the early provision of increased transit shed and warehouse accommodation and general equipment at the Manchester Docks. The directors have deposited a Bill in Parliament in the present session to enable them to mortgage the surplus lands of the company

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

(*From our own Correspondent.*)

For most descriptions of iron home orders represent a satisfactory amount, but the over-sea demand is weak. Owing to the good buying which has characterised this district until very recently, most of the works have plenty of orders to go on with, and in nearly all departments prices are well upheld.

The demand for heavy angles, squares and rounds for construction purposes is much above the average of previous years, and there is no lack of orders for steel sheets. Sheet quotations to-day—Thursday—in Birmingham were £5 to £5 5s. for Siemens billets, £4 15s. for blooms and billets of Bessemer make; ordinary sheets, £7 2s. 6 d.; and cold rolled sheets, £10 10s.; bars, £6 5s. to £6 10s.; angles and girders, £6 15s. for small, and £6 for large sections.

Steel consumers are inquiring why it is necessary to import such large quantities of Bessemer billets and tin bars into this district as is now being done from South Wales, the North of England, the West Coast, and other districts, for local consumption, instead of producing the steel locally. At present none of the Staffordshire steel works are laid out for going into this trade on any large scale or at prices which could at all compete with the imported material. What is really necessary is a works purposely designed for blooms and billets and tin bar making and nothing else. The question is being asked why such a works should not be founded in this district. The subject is the more attractive since it is stated that the Bessemer basic system could be utilised for working siliceous pig for common steel, and the open hearth basic system for the better qualities. Such a plant to combine the two systems could, it is stated, be put down at a very moderate outlay, and would pay well. Concerning this latter point there could be little doubt, since at the present time billets delivered into this district from South Wales, the North of England, and other centres are making something like £5 per ton, and supplies are so scarce that buyers can hardly obtain deliveries. The suggestions which have been thrown out for the establishment of such a works for blooms, billets, and tin bar making as is here sketched should be well considered.

Pig iron continues in very good demand. The current production of Staffordshire metal is readily absorbed at the forges and foundries. The Midland pig iron agents report large deliveries, especially of forge iron, and the rates for these are still much higher than they were at this time last year. Stocks of pig metal at the furnaces are now described as being lower than at any time during the last three years. Staffordshire cold blast pig to-day was 90s.; all mine, 52s. 6d. to 55s.; part mine, 45s. to 47s. 6d.; and cinder, 39s. to 40s. Northamptonshire forge was 44s. to 45s.; Derbyshire and North Staffordshire, 45s. to 46s.; and Lincolnshire, 46s. to 47s. Hematites were quoted at 58s. to 60s.

The Unmarked Bar Makers held a meeting last week, and confirmed £6 5s. as the Association's figure for common bars. Merchant bar iron is firm at £6 10s. to £6 15s., and marked bars adhere to their £7 10s. to £8 2s. 6d. quotation. There is no improvement in galvanised sheets, which to-day were £10 7s. 6d. for 24 gauge, f.o.b. Liverpool. Black sheets were £6 5s. for singles, £6 7s. 6d. to £6 10s. for doubles, and £7 10s. for lattens, and some of the mills are being put on short time. It is hoped by some of the Midland black sheet manufacturers that the Welsh mills will shortly be put to a greater extent on tin-plates, and the sheet competition relaxed. The last Board of Trade returns gave evidence of an improvement in tin-plates.

Tube strip is quoted £5 17s. 6d. to £6; hoop iron, £6 10s.; angles, £5 15s. to £6; stamping sheets, £9 10s. to £10; and nail rods, £6 10s. to £6 15s.

Great assistance is ministered to trade by the continuance of harmonious relations between the ironmasters and the ironworkers—a result largely attributable to the good offices of the Wages Board. At the annual meeting of this body this week, the chairman, Sir Benjamin Hingley, congratulated the trade that the Board had now had an unbroken history of twenty-one years, and had done work of untold value. During the last year wages at the mills and forges had been advanced 2½ per cent., making the remuneration for puddling 7s. 6d. per ton, and a further advance would be certain to early occur, now that trade and prices had entered upon a period of undoubted revival. It was explained, however, that whereas unmarked bars had advanced in price 15s. or £1 per ton, and marked bars 10s., sheets had dropped to an equal extent, and this it was which at present kept down the average selling price as declared periodically by the accountants. The ironworkers must bear in mind also, that there was a great difference in declaring an advance in selling prices and actually getting it from iron consumers. In this connection the declaration by the Unmarked Bar Association had not always been realised. The membership of the Board now represented 90 per cent. of all the ironworks, and in the 10 per cent. remaining outside there were only about three important firms. Sir Benjamin Hingley complained that an attempt had been made by outside agitators to create trouble by sowing dissention among the enginemen, stokers, and foremen drivers connected with the Board, but the Committee had taken prompt steps to repress the interference, and they had been happily entirely successful. He counselled moderation in the raising of selling prices, declaring that in face of present competition from the whole world nothing could be more unwise, and nothing more hurtful to trade than to run up prices unreasonably.

An active demand is reported for all kinds of engineering and machinery, and the makers of shafting, pulleys, presses, and stamping appliances have plenty of work on the books, and increasing activity is marking the bridge building and gasometer departments. The heavy ironfounders continue to receive additional orders for iron, steel, and other metal rolling plant, and some are unable to deliver the work in time, while the light ironfounders are actively employed. Chainmakers are doing a good trade, and vices, anvils, safes, nuts, and bolts are selling in good bulk.

The statutory gathering of the Patent Nut and Bolt Company, Birmingham—uniformly one of the most prosperous engineering concerns in the whole country—is always regarded with exceptional interest. At the thirty-third annual meeting this week, the chairman remarked that there was no decline in the remarkable success of the concern, and that a 10 per cent. division would again be made, besides which £10,000 would be placed to reserve, and £30,000 carried forward. Last year's profits had amounted to £45,822, as against £42,832 in 1895. The company now own a large reserve, which is set aside for the express purpose of keeping up the 10 per cent. dividend, and in addition the directors have now been authorised to create a separate internal reserve to protect the interests of the company against any competition that may arise. Such competition, the chairman explained, "of a very serious and important character, was now well-nigh at their door."

An important new colliery is being opened at Astley, near Bedworth, in Warwickshire, and about five miles from Coventry. It is on the estate of Mr. F. A. Newdegate, M.P., and the first sod has been cut this week. Boring operations, carried out by Vivian's Rock Boring and Exploration Company, Limited, have disclosed a splendid bed of coal, and it is computed that 1500 acres of an average thickness of 18ft. are available for working. Under the engineering of Messrs. S. and L. Bailey, Birmingham, two fine shafts are being sunk to a depth of 500 yards, and of a diameter of 16ft. in the clear. The shafts will be the largest in Warwickshire, and will allow of the passage of 10,000 tons of coal weekly. The work of sinking has been entrusted to Mr. E. Ward, of Sheffield. A branch railway of two miles' length is to be constructed to connect the colliery with the London and North-Western Railway and the Coventry canal, and altogether the venture seems likely to prove a notable one.

The Light Railways Commission have just held an inquiry at Newcastle-under-Lyme into the application of the British Electrical Traction Company, Limited, to construct additional tramways for the Potteries and Newcastle district. The company propose to adopt a 4ft. gauge, and overhead electric traction will most probably be the motive power employed. The application was opposed by the North Staffordshire Railway Company, on the grounds of competition and that the proposed lines were not necessary. Most of the local authorities in the district concerned, however, approved the application. Lord Jersey said the Commissioners were unanimous in thinking the order should go on, but it must be dependent upon the clauses being drafted in a way satisfactory to all parties. The Commissioners would not sanction compulsory running powers over any other tramway company's lines, but would not object to any agreement between the promoters and existing companies.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester. — The indications I have recently noted of a weakening tendency in the iron market here, have, since my last report, become much more pronounced. The giving way in prices is not now confined to speculative merchants, and "bear" operators, but makers find themselves unable to maintain the position they have for some time taken. The opinion, however, still prevails generally in the market that the present depression is not likely to be more than temporary, and certainly there has been no retrograde movement in the iron-using trades to sufficiently account for the fall in prices. In some directions, as I have previously pointed out, there is a quieting down as regards the weight of new work giving out amongst engineers, but this has no appreciable effect upon the general activity throughout the trade, which is fully maintained upon orders in hand, which will keep most of the engineering firms fully going well over the year. No doubt pending labour disputes at home, and a somewhat disturbed outlook abroad, have contributed towards unsettling prospects for the immediate future, and these have been taken full advantage of by the powerful "bear" element in speculative iron markets, which has been further assisted by recent considerable importations of American pig iron.

The Manchester Iron Market on Tuesday brought together about an average attendance, but there was again a general sluggishness of demand both for raw and manufactured material, consumers being just as indifferent about placing further orders as makers were very recently about entertaining new business. In pig iron buying continues extremely slow, and makers have at length been compelled to follow the downward movement in warrants. For local brands quotations remain nominally unchanged, but both Lincolnshire and Derbyshire makes are lower. The official list prices for Lincolnshire have been reduced 1s. per ton, and for foundry numbers now range from 45s. 6d. to 46s. 6d., with 49s. to 50s. about the average figures for Derbyshire foundry, net, delivered Manchester, and Lincolnshire forge iron, delivered in the finished iron-making centres, obtainable at about 44s. net. For good-named foundry Middlesbrough makers in some cases still quote 50s. 4d., but this figure is quite out of the market, ordinary brands being obtainable without difficulty at 48s. 10d. to 49s. 4d. net, delivered by rail Manchester, and 48s. is now about the quotation at docks. Scotch iron is also easier, and both Eglinton and Glengarnock can be bought through merchants at 48s. to 48s. 3d., delivered Lancashire ports, and 50s. 3d. to 50s. 6d., delivered Manchester Docks. It is now recognised in most quarters that the shipments of American pig iron to this country have largely contributed towards weakening the market, and some low prices are just now being quoted, 47s. 6d. net being the general quotation for foundry qualities at the Manchester Docks, whilst forge descriptions are reported to have been offered at about 44s., delivered finished iron-making districts, although 47s. would seem to be about the price that manufacturers have recently been paying.

In the finished iron trade makers hold firmly to their recent quoted rates of £6 for Lancashire and £6 5s. for North Staffordshire bars, delivered here, but they are being undersold in the open market by merchants, who are offering Lancashire bars at £5 17s. 6d., and manufacturers consequently are not just now booking any great weight of new orders. Sheets and hoops are only in slow demand, with prices unchanged.

Generally a rather easier tone is reported in the steel trade, and ordinary foundry hematites do not average more than about 60s., less 2½; billets have to be cut low in face of American competition, local makers would accept about £4 13s. 3d., whilst it is reported that American billets can be bought at about £4 5s. delivered Warrington. Bars are steady at £6 5s., but boiler plates are without improvement, under £6 10s. being still taken by some of the Scotch makers, whilst local plates are quoted £6 12s. 6d. to £6 15s., delivered in this district. An exceedingly strong tone is maintained in the metal market, and during the past week manufacturers have had under consideration the advisability of advancing prices upon both brazed brass and copper tubes and copper plates, but any upward move is being held in abeyance for the present. They are, however, very cautious about quoting on the existing basis of prices.

An interesting discussion has been going on in the Manchester Press on the question of foreign competition and our patent laws, which was brought under the notice of the Manchester Chamber of Commerce by Mr. Ivan Levinstein, who advocated that no invention should be granted protection unless the patent were worked in this country. Sir W. H. Bailey, in commenting upon Mr. Levinstein's suggestion, writes that such a proposal was so reasonable that it must be a wonder to many why they had failed in rousing our Legislature to a proper sense of its duty to our commercial interests, and especially to the interests of the working classes. The bye-products of the gasworks of the kingdom were sent abroad by thousands of tons, and employed many thousands of workmen in Germany and other countries, and this stuff was sold back to us by the ounce. He did not object to a patentee receiving the reward of his labour, but in many cases patents had been granted for the most vague and shadowy improvements; but, backed by large capital, no small chemical manufacturer dared question the monopoly, and we stood as a commercial community convicted of voluntary servitude to stereotyped conditions of our own invention, legalised by process of law.

During the past week I had an opportunity of inspecting, at Messrs. William Rose and Co.'s Metropolitan Works, Salford, a couple of steam fire-engines they had just completed, according to a new design, for the King's Norton District Council. In these engines, each of which has a capacity for delivering 350 gallons of water per minute, special attention has been devoted to simplicity of construction, and the arrangement of the working parts, so that they shall be readily accessible in case of necessity. A not infrequent cause of breakdown in fire engines is the blockage of the valves by grit or other matter drawn up with the water, and in these new engines both the intake and discharge valves have been so designed that they can be readily got at for inspection or the removal of any foreign substance which may be interfering with their operation. The suction valves are placed inside the the stuffing-box, so that by simply unscrewing four nuts, the stuffing-box casing can be drawn up, and these valves at once exposed, whilst to render the delivery valves similarly accessible the delivery box has been placed right in front, and the covering of this box can be readily taken away, thus allowing the valves to be open for inspection. In numerous other details, various improvements have also been introduced. Very efficient lubricating arrangements are provided, and the condensed water taps are all manipulated simultaneously through one lever; every joint is secured by a locking arrangement, so that no part can be worked loose. The pump is all formed of one solid gun-metal casting, and it may be added that the plates used in the construction of the boilers are throughout of Low Moor iron, and made extra thick to ensure durability. The boilers are also larger than usual, good continuous steaming powers being considered of greater value than thin boilers with small tubes, which, although perhaps good for getting steam quickly, are very liable to break down when put to severe strain. The air vessels are placed in convenient positions out of the way, and the injector also is well away from the boiler to prevent the water becoming hot, whilst the gauge glasses are of novel design. On Tuesday, these two engines, which, I may add, were built under the supervision of Mr. A. Tozer, the chief officer of the Birmingham Fire Brigade, were put through a trial in the presence of a number of authorities interested in fire brigade equipment, on the banks of the Manchester Ship Canal. In the tests made each engine threw single jets of water 1in. and 1¼in. diameter to a distance of 213ft. and 210ft. respectively, whilst two jets of ⅞in. were thrown 195ft., afterwards each engine delivered the water through four ⅝in. jets, which ascended in a line to a height of 100ft. above the ground. Finally the delivery pipes of both engines were coupled together, when a jet 1½in. diameter was delivered to a distance of 219ft. Another interesting exhibition was given by attaching the nozzle to the top of one of the firm's patent fire escapes just completed for Liverpool, and which reaches to a height of 72ft.—the loftiest escape they have yet turned out, and then both engines working together sent a jet 1½in. diameter to a distance of about 200ft. from the ground. During my visit to the works I had an opportunity of inspecting other specialities of the firm, including various types of fire escapes and a powerful bucket-and-plunger pump fire engine, a noticeable feature of their engines being the great care devoted to every detail to secure strength and durability, and the high-class finish throughout. They have also at their works a very complete plant for weaving canvas hose pipes, for which specially designed machinery of their own has been put down.

After an extensive course of experiments, Messrs. W. T. Glover and Co., of Salford, are introducing a new electrical resistance wire—the "Roestene"—which is specially adapted for large currents, as it can be raised to a very high temperature without permanently changing in resistance. The special feature of this wire is that its resistance is about forty-five to forty-six times that of copper at 15·5 deg. Cent., whilst its weight is 0·917 times that of copper. The new alloy has a temperature coefficient of 0·11 per cent. per degree Cent., and is very easy to solder or braze, whilst it can be supplied covered in silk, cotton, or non-ignitable material, or in any other manner which may be found desirable. The firm has also made arrangements to supply insulating cement for electrical heating apparatus, &c. This cement has a high melting point and a coefficient of expansion very similar to that of iron. It sets very quickly, so that in making electrical heating apparatus the wires can be readily cemented down as they are got into position.

The coal trade continues to quiet down, and it is becoming increasingly difficult to keep pits on full work, stocks here and there accumulating both in round coals and engine fuel. House coals are only in limited request, but prices are without quotable change, the only easing down being in some of the best descriptions, which have receded slightly from the top prices that were being quoted during the winter months. A fair demand is still reported for the lower qualities of round coal for iron-making, steam, and general manufacturing purposes, but with more plentiful supplies offering in the market prices are barely maintained at late rates, good quantities of steam and forge coals only in exceptional cases averaging more than about 6s. at the pit. Engine fuel also continues plentiful, and where collieries have to get rid of surplus stocks low prices are taken for clearance sales; but quoted rates generally are unchanged, averaging 3s. to 3s. 6d. for common, 3s. 9d. to 4s. 3d. for medium, up to 4s. 6d. and 4s. 9d. for best qualities at the pit mouth.

There is a fair demand for shipment, but prices are rather low, common steam coal being obtainable at 7s. 6d., with better qualities quoted about 8s., delivered at the ports on the Mersey.

Barrow.—The hematite trade has shown rather a weaker tone during the past few days. Makers have booked but little new business, but they have no need of new orders, as they are well sold forward, and have their hands so full that they can afford to wait until the lull in the market has passed away, as they have plenty of evidence afforded on every hand that the demand must return soon in order to ensure regularity of supplies to consumers of pig iron, whose engagements are more fully made than are those of smelters generally. Warrant iron is easier at 48s. 11d. net cash sellers, 48s. 10½d. buyers. Makers have reduced their quotations to 51s. per ton net f.o.b. for Bessemer mixed numbers. Stocks of warrant iron have been further increased during the week by 930 tons, and now stand at 298,229 tons, being an increase since the beginning of the year of 2283 tons. Thirty-six furnaces are in blast.

Iron ore is being raised on as large a scale as is possible with the present facilities at command, but the requirements of smelters are far from being met, and Spanish ores are therefore liberally imported. Prices remain firm at 12s. for native ores net at mines, and 15s. 6d. for Spanish sorts net at West Coast ports.

Steel rails are in fair request, and, of course, makers are already very busily employed on the orders in hand. Prices remain steady at £4 12s. 6d. per ton net at mines. Ship plates are in better inquiry, and other descriptions of shipbuilding material command a good market. Billets, hoops, and merchant qualities of steel are in very full request.

Shipbuilders and marine engineers are fairly well off for orders, but new work will soon be needed if the usual activity at the Barrow yard is to be maintained. It is reported that one new order has been booked during the week, but it requires official confirmation. Other new work of importance is pending.

Coal finds a steady market, but low prices are still ruling, and likely to do so, so long as colliery proprietors so keenly compete with each other. Coke is brisk, in large consumption, and at full prices.

Shipping is again busier. During last week the exports of pig iron from West Coast ports reached 8145 tons, and of steel 6573 tons, as compared with 6573 tons of pig iron and 6241 tons of steel in the corresponding week of last year, making an increase of 1572 tons of pig iron and 3100 tons of steel. The exports of pig iron this year have reached 59,452 tons, and of steel 66,072 tons, as compared with 48,073 tons of pig iron and 49,683 tons of steel in the corresponding period of last year, an increase of 1379 tons of pig iron and 6389 tons of steel.

The funeral at Barrow on Wednesday of Mr. A. Blechynden, general manager of Messrs. John Penn and Co.'s engineering works, Greenwich, who died suddenly at Blackheath on Saturday last, was attended by a vast concourse of mourners, a worthy tribute of the high esteem in which he was held at Barrow, where from 1887 to 1895 he held the post of manager of the Naval Construction and Armaments Company, and produced some of the finest work ever put into either Admiralty or ordinary commercial steamers. Mr. Blechynden, who was 47 years of age, had made his way to the front of engineering science, and his death cannot but be regarded as a great loss to the engineering world.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

ALTHOUGH there has been during the last week rather a diminished demand in the coal trade, and in several instances a portion of the output has gone to stock, the pits in the South Yorkshire district continue to work good time, the average being five days a week at present, while in several cases six days are worked. As a rule, a heavy tonnage of hard coal is thrown down during the winter months, but this has for the most part been avoided during the present season. There are less accumulations at the collieries than is customary at the end of the second month of the year. The London demand for house coal has been well maintained, but the requirements for the Eastern Counties have been somewhat reduced, and the local business is not quite equal to what it was. A reduction of 6d. per ton was noted in the official quotations in the metropolitan market during last week. That may be taken as an indication that householders and merchants are buying from hand to mouth, and the expectation that the moment coalowners show signs of weakness they may obtain supplies at lower rates. At present these hopes are not being realised to any extent, such concessions as have been made applying to special lots, which it is desired to clear off. Quotations are in the main fully maintained, and the quotations stand at former rates. Best Silkstones are fetching 8s. 6d. to 9s. 6d. per ton; ordinary, from 7s. 6d. per ton; Barnsley house, 8s. to 9s. per ton; thin seam coals from 7s. per ton; nuts from 6s. to 7s. per ton. In steam coal it is usual at this time of the year, when the Baltic ports are closed, for hard coal to be stocked at the pits. At present there are practically no accumulations, and the demand is fully kept up. Such a gratifying feature of the steam coal trade in the second month of the year is due to the export having been more satisfactory than at the corresponding periods of previous years, as well as to the increasing requirements of the ironmasters, whose call for coal has been very steady. A favourable opinion is entertained as to the future of the trade, and improved values are in many quarters confidently looked for. The railway companies are taking a full tonnage. Barnsley hards are making 7s. to 7s. 6d. per ton, while secondary qualities are in brisk request at 6s. per ton and upwards. Gas coal, which is in large demand, remains at 6s. to 7s. per ton. An improvement in values is, however, being obtained. Although July is a long way off, prices, in view of next contracts, have gone up from 6d. to 1s. per ton; and it is at these higher rates that further supplies must be arranged for. A steady market is reported for engine fuel of all qualities, values remaining steady at old quotations. Engine nuts, 5s. to 6s. per ton; screened slack, from 4s. per ton; pit slack, from 2s. to 2s. 6d. per ton. In coke a very extensive business is being transacted at 8s. 6d. to 9s. 6d. per ton for ordinary sorts, and washed cokes make up to 12s. per ton.

The heavy industries of the town continue to be well employed, more especially in the railway material, engineering, and boiler-making branches. Marine shafting is being largely produced. War material is also in considerable request, although the daily-expected orders for armour plates required by the British Admiralty have not yet come to hand. It is stated that the authorities are waiting for the completed results of the experiments which have been made in the United States. The first portion of the new work for the Admiralty programme was placed with one local firm some months ago, and the delay in placing the other portions is put down to this account, it being, we hear, the desire of the Admiralty to have, if possible, something even better than what is now produced. In the Sheffield district there is talk of nickel steel plates probably becoming the armour of the future. Significant proof of the vitality of the heavy industries is the fact that extensions are going on very largely in most of the principal East-end establishments, where the productive capacity is being very greatly increased.

Hematite pig iron is now at 60s. for West Coast and 59s. for North-East Coast; common forge iron, about 41s. 6d., all at Sheffield.

In the lighter industries of the city there has been rather less doing during the last few week. Orders are coming in very slowly in the cutlery and white metal branches, and as "the lines" brought over from last year have been pretty well cleared off, there will be lack of employment for the workers unless trade rapidly picks up. The special demand for expensive goods in commemoration of the Diamond Jubilee of her Majesty is not likely to be important. In 1887 our manufacturers prepared very elaborately what were known as "Jubilee goods," but the demand was not at all equal to what was anticipated; in fact, if it had not been for the excessive loyalty of the Colonies in their requirements for such goods, local manufacturers would have suffered very heavily.

A somewhat serious fire occurred on Sunday morning at the Hecla Works—the Hadfield Steel Foundry Co., Ltd. A very exaggerated account of the damage was freely telegraphed to the newspapers, but the loss was confined to only a portion of this large and important establishment, and, although it will amount to several thousand pounds, it has not materially interfered with the business carried on, or in the provision of the shot and shell of smaller calibre, which were manufactured at this particular part of the works.

How prosperous the year 1896 has been is now being abundantly indicated by the reports of public companies connected with the iron, steel, and cutlery trades. Messrs. Vickers, Sons, and Co., Limited, the substance of whose report report appeared in THE ENGINEER last week, held their annual meeting on the 24th inst., Mr. T. E. Vickers, J.P., the chairman, presiding. The report and statement of accounts were adopted. The dividend is 15 per cent., being at the same amount as last year, carrying forward £42,261. The chairman stated that the total cost of acquiring the Naval Construction and Armaments Company, Barrow, including the freehold site, which was to be bought from the Duke of Devonshire, would be £430,000. The shareholders in the Naval Construction Company would be paid in cash at the par value of their shares. The money required for this purpose would be raised by means of debentures, which would be issued through London bankers, with a priority of allotment to shareholders. Mr. Edwin Gray and Mr. Douglas Vickers were re-elected directors.

The twenty-sixth annual meeting of the shareholders of Messrs. Joseph Rodgers and Sons, Limited, cutlery manufacturers, was held on the 23rd inst., when the usual dividend—12½ per cent. for the year—was declared and confirmed. Mr. Joseph Ruston, J.P., D.L., and Col. Edward Snow Watson, both of Lincoln, were re-elected directors. Brown Bayley's Steel Works, Attercliffe, again pay 20 per cent. for the year on the original £10 shares, and 12½ per cent. on the new shares of £5 each. The Midland Iron Company pays 7½ per cent., the directors reporting that there has been an increased demand for iron manufactures at better prices, and they regard the outlook for the present year as favourable.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE most absorbing subject of attention in this district at present are the labour troubles that have sprung up, not only in the shipbuilding and engineering industries, but also in connection with the railway service; this last, in fact, almost overshadowing the other difficulties, as it practically affects all branches of commerce in the district, causing a curtailment of business all round. The detrimental effect upon trade has been all the more keenly felt as no opportunity was afforded the manufacturers and other freighters to prepare for the stoppage, and so mitigate its inconveniences, for the men struck work without giving notice and entirely dislocated traffic. Such high-handed and overbearing tactics as the strikers have adopted have undoubtedly alienated the sympathies of the general public from them, more particularly as the public are keen sufferers from this conduct, seeing that not only the goods traffic but also the passenger traffic has been sadly interfered with this week, the regular service being suspended in the Tyne and Wear districts, and the North-Eastern Railway Company has run its trains at such times as have been found practicable. The company gave notice on Tuesday to the local colliery owners that it could not guarantee to get coals down to the docks and shipping places; and where they have been got down they could not in all cases be loaded for the Staithness at Tyne Docks and Dunston—the North-Eastern Company's shipping places—have made common cause with the strikers. The inception of the strike was due to seven rolleymen at the Forth Goods Station, Newcastle, who on Saturday morning last did not turn out at five o'clock as they had been ordered to do, and when they did put in an appearance at seven o'clock they were suspended from duty for disobeying regular orders. Thereupon the other men in the goods department refused to continue at work, and since then large numbers of porters, signalmen, guards, engine drivers, &c., in passenger and goods departments have struck work without notice, ignoring altogether the inconvenience, loss, and annoyance resulting to the unoffending general public and to their fellow-workmen employed in the various industries carried on in the district. It is evident that the suspension of the rolleymen has been only a pretext, and that each section of men is availing itself of the opportunity to endeavour to force from the railway company concessions which under ordinary circumstances they could not obtain. The leaders of the men have in their communications with the representatives of the company adopted a very peremptory and unconciliatory tone. The manifesto of the men claims that victory is already assured to them. The leaders say that this is the climax of the agitation which has been going on for some time for improved conditions of service. The consequences of the strike to the commerce of the district promise to be very grave, and business is to a large extent paralysed.

One labour difficulty, which was very threatening last week, has been adjusted. The labourers and other unskilled men at the shipyards demanded a 10 per cent. advance of wages, and determined to strike if this were not conceded. The employers offered 5 per cent., which the men accepted, and decided to continue at work. About 13,000 men were concerned in this dispute. But it is probable that they will have to cease work after all, for the engineers at the shipyards on the North-East Coast have come out on strike to enforce their claim for an advance of 2s. on time and 10 per cent. on piece, and also in sympathy with the Amalgamated Smiths, some of whom struck work and others were locked out by the employers. The question of the wages of engineers in engineering establishments in the North-East of England is also under the consideration of masters and men, the latter requiring advances on time and piece, and also an amendment in relation to the overtime question. On Tuesday, at a conference, the employers made an offer to the representatives of the Amalgamated Society of Engineers, and this is to be placed before the men, their decision to be communicated to the employers at another conference, which will take place early next week. The details of this offer have not yet come out, but there is a probability that this dispute at least will be amicably arranged. On account of the difficulties with regard to labour in the shipyards, the manufacturers of steel plates and angles have in several cases had instructions to suspend deliveries to local yards, but, having plenty of orders for other districts and for export, they are as yet keeping their mills in full operation. At the Walsingham-street Works there has been a strike of the gas producers for an advance of wages; part of this has been granted, and the men have resumed operations.

Trade is detrimentally affected, not only by these labour difficulties, but also by the political complications, and also by the reports that are in circulation relative to American competition in the rail trade. There can be no doubt that in regard to the latter there is a great deal of exaggeration. It was reported from America that the London and North-Western Railway Company had ordered 50,000 tons of American rails, but such a rumour carried contradiction on the face of it, for the London and North-Western Company has its own steel rail mills at Crewe, capable of turning out 1000 tons a week. It was then stated that another leading company was the buyer, but in the first place there is no new work of any importance being undertaken by any British railway, and the rails needed now are only those required for repairs and renewals, and such a heavy quantity as that referred to above would scarcely be bought for this purpose. Moreover, it is reasonable to suppose that a British railway company would not have bought in America without first asking the leading British rail manufacturers for quotations, especially when such a large quantity was in question, and such inquiries have not been made. There can be no doubt that there is a good deal of "bunkum" in the reports telegraphed from the States, as to the success of American competition in rails in this country. It is not to be denied that they are sending considerable quantities of billets, rods, and bars to Lancashire and the Midlands, and partly on this account one of our leading North of England steel works is only running four days per week. Nothwithstanding the American competition, North of England steel manufacturers keep their price of heavy steel rails at £4 12s. 6d. net at works, and billets at £4 7s. 6d.

There is not much doing in the pig iron trade, both sellers and buyers being afraid to operate in the present unsettled state of the labour market, but prices have recovered a little from the low rates of last week. At the close business in No. 3 Cleveland G.M.B. pig iron was done at 40s. for prompt f.o.b. delivery, but the sellers were merchants, and makers refused to accept any such figure, and simply looked on, letting merchants undertake the little business that was passing, as 41s. was their price. Cleveland warrants on Monday touched a lower price than has been known since the middle of October—39s. 7d. cash, this showing a decrease from the best price of this year—41s. 9d. on January 13th—of 2s. 2d. per ton. But by Wednesday there was a recovery of 9½d. in warrants, and, and makers' iron in merchants' hands was raised to 40s. 6d. The stock of Cleveland iron in Connal's warrant stores on Wednesday evening was 171,878 tons, or 4653 tons increase this month. The prices of the lower qualities of Cleveland iron are more firmly maintained because of their scarcity, No. 4 foundry being at 40s., grey forge at 39s. 9d., and mottled and white 39s. 6d. Pig iron exports are much above a February average; from the Cleveland district up to Wednesday night they reached 75,035 tons, against 56,888 tons last month, and 56,784 tons in February, 1896.

The demand for Cleveland hematite pig iron is quiet, and merchants are taking lower prices than makers are prepared to accept, buying warrants to enable them to carry out their contracts. Producers hold to 50s. and even 51s. for mixed numbers, but merchants have been selling at 49s., but are now asking 49s. 6d. The stock of hematite in Connal's stores on Wednesday night was 107,969 tons, a decrease of 10,296 tons this month. Rubio ore is somewhat easier in price, as is also coke.

The finished iron and steel industries are well employed, but few fresh orders are forthcoming. Prices, however, are maintained, but consumers are not willing to give them, preferring to wait in order to see if the suspension of shipbuilders' orders brings about an easing of quotations. The plant of the Wear Steel Co., at Castletown Works, Sunderland, is shortly to be sold by auction. It was in use only eighteen months, and includes six 23-ton steel furnaces, as well as plate and bar mill machinery. Col. Ropner, shipbuilder, Stockton, has offered £2000 towards purchasing Pemberton House, Middleton, St. George, near Darlington, as a permanent convalescent home for working class patients from Stockton and Thornaby. The death is reported this week of Mr. Edwin Graham, of the firm of Osbourne, Graham, and Co., shipbuilders, North Hoylton, Sunderland.

The Redheugh Bridge, at Newcastle, which was opened in 1871, is to be reconstructed at a cost of £80,000, by the firm of Sir Wm. Arrol and Co. The bridge will not be closed to foot passengers during the reconstruction. The question of erecting a new high-level bridge between Pilgrim-street, Newcastle, and Gateshead is still attracting attention, and it is stated that if the Corporations of the two towns do not take the matter up it is likely that private enterprise will carry out the work.

The traders of the Hartlepools are dissatisfied with the extent of the improvements which the North-Eastern Railway Company proposes to make there, and on Tuesday a conference of representatives of the Hartlepool and West Hartlepool Corporations, the Shipowners' Society, and the Hartlepools Chambers of Commerce was held to discuss the improvements that should be made. These include the straightening of the deep water entrance to the harbour; a new fish harbour; a new entrance to Victoria Dock, 65ft. wide and 26ft. deep; and the deepening of the dock to accommodate ships up to 6000 tons deadweight; a new dock in the Slake, with entrance 85ft. wide and 33ft. to 35ft. depth of water; reconstruction of the Central Dock; widening the entrance to No. 4 graving dock, so as to accommodate an ironclad at the western end; laying the Jackson Dock to the coal dock; the construction of a new railway station at Hartlepool, &c. A committee is to be appointed to mature a scheme to be submitted to the directors of the North-Eastern Railway Company by a deputation. It was resolved that the needs of the port require much better facilities for its trade, and its shipbuilding, engineering, coal and timber traffic, than at present exist, and the North-Eastern Railway Company are to be urged to take prompt action to remedy present deficiencies.

The directors of Messrs. Bolckow, Vaughan, and Co., Limited, Middlesbrough, &c., at their meeting in London, on Wednesday, decided to recommend to the ordinary shareholders the payment of a dividend at the rate of 5 per cent. per annum for the year ended December 31st last, less the interim dividend paid in October last. They also recommend the expenditure out of the profits of the year of £35,000 on new plant, and the addition of £40,000 to the reserve fund, carrying forward £51,112. The above-named interim dividend was at the rate of 2 per cent. per annum. The dividend for 1895 was 3 per cent.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been unsettled, but in the main rather better prices have been obtained for warrants. Indeed, in view of the different causes for lack of confidence, it is remarkable that the market showed so well, especially in the early part of the week. The report of increasing American competition cabled a few days ago was calculated to produce a bad effect, for although the large sales reported there for Europe consist for the most part of steel rails, with which Scotch manufacturers have scarcely anything to do, it is apparent that whatever diminishes the orders of the English works must indirectly affect the trade in Scotland. The disturbances in the labour market are likewise sufficiently disturbing. On the other hand, whatever sympathy may be felt for Greece, the assurance that the Great Powers are acting with complete unaminity has certainly had a good effect in the markets. A considerable quantity of pig iron changed hands in the last few days. Business was done in Scotch warrants from 45s. 10½d. to 46s. 2d. cash, and 46s. 0½d. to 46s. 4d. one month. Cumberland hematite was quiet at the opening, but subsequently a fair business took place at 48s. 8d. to 49s. 1d. cash, and 48s. 10½d. to 49s. 6d. one month. Middlesbrough hematite was done at 48s. 8d. for delivery in eighteen days, and at 48s. 2d. to 48s. 8½d. cash, and 48s. 5d. to 48s. 11d. one month. The demand for ordinary Cleveland pig iron has shown considerable improvement, and the transactions have taken place at 39s. 5d. to 40s. cash, and 39s. 7½d. to 40s. 2½d. one month.

The output of pig iron is fairly maintained, there being one furnace less in blast. The output of hematite pigs has been gradually decreasing in the last few weeks, the explanation of this being the difficulty that has been experienced in obtaining supplies of Spanish ore except at higher prices than the smelters feel justified in paying in the present state of trade. The cost of bringing the ore to the Clyde has been reduced in the last few days by a return to more moderate freights, and this may possibly induce the makers in Scotland to maintain the output of hematite pigs at its present rate. There has certainly been a disposition of late to purchase Middlesbrough hematite more freely for use in Scotland, and its prices are in favour of its increasing use. The price of Scotch-made hematite is 53s., delivered on rail trucks at the steel works. Two furnaces have been withdrawn from the manufacture of hematite, but an additional one has been placed on the manufacture of ordinary iron, and there are now 40 making ordinary, 35 hematite, and 6 basic iron, the total of 81 furnaces now in blast comparing with 79 at this time last year.

The prices of Scotch makers' pig iron are 6d. to 1s. per ton lower. Govan and Monkland, f.o.b. at Glasgow, Nos. 1 are quoted 47s. 3d.; Nos. 3, 46s.; Carnbroe, No. 1, 47s. 6d.; No. 3, 46s. 3d.; Summerlee, No. 1, 51s. 6d.; No. 3, 48s. 6d.; Calder, No. 1, 52s.; No. 3, 48s. 6d.; Gartsherrie, No. 1, 52s. 3d.; No. 3, 49s.; Coltness, No. 1, 53s.; No. 3, 49s.; Glengarnock, at Ardrossan, No. 1, 50s. 6d.; No. 3, 46s. 6d.; Eglinton, No. 1, 48s. 9d.; No. 3, 46s. 9d.; Dalmellington, at Ayr, No. 1, 48s. 6d.; No. 3, 46s. 6d.; Shotts, at Leith, No. 1, 52s.; No. 3, 49s. 6d. per ton.

The shipments of Scotch pig iron are rather better than in the last week or two, but still leave much room for improvement. They amounted to 4541 tons, against 7332 in the corresponding week of last year. There was despatched to Australia 760 tons, South America 130, India 85, France 126, Germany 130, Holland 340, Belgium 130, Spain 20, China and Japan 80, other countries 320, the coastwise shipments being 2400, against 5623 in the corresponding week of last year.

The imports of English iron into Scotland from the East Coast are increasing, and for the past week they were 11,400 tons, an increase of 3399 tons.

Finished iron has been quiet, the demand having fallen off considerably in the last few weeks. Makers are of opinion that the reaction is not likely to be of long duration, as it is supposed to be largely due to the depression in warrants, and therefore likely to pass away as the pig iron market recovers. The steel works are well employed, chiefly in shipbuilding material.

In the coal trade there is a better feeling generally, the demand being good both for home use and export. The week's shipments have been 129,004 tons, compared with 127,342 tons in the preceding week, and 121,925 tons in the corresponding week of last year. Prices are steady, main coal being quoted at Glasgow Harbour, 6s. 9d.; ell, 7s. to 7s. 3d.; splint, 7s. 6d.; and steam, 8s. per ton.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE close of last week witnessed a fairly strong steam coal trade, and firm retention of prices. The beginning of this week, to use the expression of a gentleman on 'Change, Cardiff, things were unaccountably flat, and prices for prompt shipment drooped about 3d. per ton. One would have thought that the gravity of the Eastern question upon which the "Powers" are sitting in judgment would have prompted more business, and the only conclusion one can draw is that the marked unanimity of the Powers yields confidence in a peaceful solution. If one only kept aloof, conditions would change rapidly. There is also the fact to be considered that coaling stations are fairly stocked.

This week substantial cargoes of steam coal, exceeding 4000 tons, left Cardiff for various destinations, Rio de Janeira, Las Palmas; and some large ones to Marseilles, Genoa (6800 tons), Buenos Ayres (4500 tons), and Constantinople. The demand for dry coal has fallen off materially, and the semi-bituminous coals of Monmouthshire, for shipment at Cardiff, have been rather slow of sale.

Swansea coal trade has been fairly good, and about an average shipment took place last week. Newport totals were 58,934 tons to foreign and 22,788 tons coastwise. Mid-week prices on 'Change, Cardiff, this week were as follows:—Best steam coal, 10s. 6d. to 10s. 9d.; seconds, 10s. to 10s. 3d.; drys, 9s. 6d. to 9s. 9d.; best Monmouthshire, 8s. 9d. to 9s. 9d.; seconds, 8s. 7½d. House coal keeps very firm, and in all probability coalowners have yet a good month's trade on hand before the usual signs appear indicating that the close of the season has begun. Latest Cardiff prices are: Best households, 10s. 6d. to 11s.; No. 3 Rhondda, 11s. to 11s. 3d.; brush, 9s. 9d. to 10s.; small, 8s. to 8s. 6d.; No. 2 Rhondda, 8s. 9d. to 9s.; through, 6s. 9d. to 7s.; small, 5s. to 5s. 3d.

Swansea prices:—Best anthracite, 11s. to 11s. 6d.; second quality, 9s. 6d. to 10s.; ordinary large, 8s. to 8s. 6d.; culm, 3s. 6d. to 4s. Steam coals: Large, 9s. 6d. to 10s.; seconds, 8s. 9d. to 9s. 3d.; bunker, 7s 9d. to 8s.; small, 4s. to 4s. 6d. Bituminous coals: No. 3 Rhondda, 10s. 3d. to 10s. 9d.; through coal, 9s. to 9s. 6d.; small, 7s. to 7s. 9d.; No. 2 Rhondda, 9s. to 9s. 6d.; through, 7s. 6d. to 8s.; small, 5s. 9d. to 6s.

The small steam coal market is stiffening, and a good demand setting in at Cardiff. Patent fuel at that port is also subject to brisk inquiry, prices 10s. to 10s. 6d., and some large cargoes have been despatched, one of 2600 tons to Rio. Swansea total last week was 6735.

At Cardiff there is an excellent demand in coke from home trade; foreign has slackened. Prices are well maintained. Pitwood is coming in abundantly, chiefly from France, and prices are not so strong, 16s. being about the highest figure at Cardiff, 17s. to 17s. 6d. Swansea.

Freights at Cardiff continue firm, especially those for higher Mediteranean. No alteration in French, Spanish, or coasting rates.

Satisfactory reports are to hand of the output at Felinfrau, and Grargola Collieries, also of Dowlais, Cardiff, and the ironworks' collieries generally.

The tin-plate trade in the Swansea district has been exceptionally busy, and the comment on 'Change this week was consequently very gratifying to hear. The total shipment last week was 50,000 boxes in excess of the quantity sent in the corresponding week of last year. The upward bound in American business was quite the feature of the week, the clearance exceeding 20,000 tons, and in addition another good "line" was an excess of 2000 tons, also to the East. What with improved American business, a steady Russian trade, and the new openings to the East, there is decidedly a more hopeful outlook in the trade. Last week the total shipments of plates amounted to 63,419 boxes, while the receipts from works only totalled 39,989 boxes. Total stock is down to 168,625 boxes.

The tin-plate works are going on fairly well, the most regrettable case of stoppage being at the Worcester and Forest Works, where sad cases of absolute want are taking place. To meet this active schemes of a charitable nature are being floated, the chief daily newspaper of Wales advocating a sympathetic poll tax of one shilling per head, which would well meet the case.

The Morriston, Midland, and Beaufort Works are fortunately in full drive, but the Foxhole Works have suffered from want of water. Landore, Bark, and Clydach are busy, and at Briton Ferry the whole of the tin-plate works in the mill and finishing department were in full force all the week. It is expected that the new blast furnace at Briton Ferry Works will be lit up on Monday.

There has been no decrease in the arrival of iron ore from Bilbao, and the open weather of late has been of great service in aiding the replenishment of stocks. Most of the principal works have received large cargoes during the week, and La Société Commercial alone received at Newport on one day over 4000 tons. Cardiff prices remain much the same; best Rubio is quoted at 14s. 6d. to 14s. 9d.; Tafna 14s. to 14s. 3d. During the week 700 tons manganese ore came to Newport consigned from Vizagapalam to the Pyle and Blaina Company.

On 'Change, Swansea, this week, it was reported that pig iron had indicated a decline of from 9d. to 1s. This was attributed to temporary influences, and the impression is strong that there will be a speedy recovery.

Present prices on 'Change, Swansea, iron and steel, are as follows:—Pig iron, Glasgow warrants, 46s. 0½d., 46s. 2d., 46s. 1d., cash buyers; Middlesbrough, No. 3, 39s. 9½d., 40s., 39s. 10½d.; hematite, 48s. 6d., 48s. 7½d.; Welsh bars, £6 to £6 2s. 6d.; iron and steel plates, £6 15s. to £6 17s. 6d. Bessemer steel: Tin-plate bars, £4 10s.; Siemens, £4 12s. 6d.; steel rails, heavy sections, £4 12s. 6d. to £4 15s.; light, £5 12s. 6d. to £5 15s. Tin-plates: Bessemer cokes, 10s. 4½d. to 10s. 6d.; Siemens coke finish, 10s. 6d. to 10s. 9d.; ternes, 28 by 20 C., 18s., 18s. 6d., to 22s. Block tin, £61 7s. 6d. to £61 10s.

Swansea quotations iron ore are as follows:—Tafna, 14s. 6d.; Rubio, 15s.; ex-ship, cash 30 days.

The demand for rails, billets, and bars at the leading works continue.

In the neighbourhood of Dowlais at the beginning of the week the lines leading into the works and out-forming connection with the principal railways were simply gorged, accumulations of bars and rails being strongly in evidence. Indications are strong that, notwithstanding the extent and variety of the make at Dowlais-Cardiff, the old works are not to be allowed to fall off, and the latest additions of electric power, and the erection of the largest blast furnace in Wales, appear to be proof positive of this.

At the Cyfarthfa Works a large make of steel rails is going on, and considerable additions to the Bessemer, and other departments, have been necessitated by the existing demand.

One of the results of the calamitous explosions in Welsh collieries is to be seen now and then in the failure or falling off in dividends. I note that at the eighth general meeting of the Ferndale—D. Davis and Sons—the sum of £2047 was directed to be applied in the payment of a dividend at the rate of £6 per annum upon the preference shares of the company, and the balance, £667 2s. 5d., brought forward into current account.

At the meeting of the Rhondda and Swansea Bay Company this week, it was intimated that the rumour of its possible absorption by the Great Western Railway Company, was not an authorised one.

Sir W. T. Lewis, has given another striking proof of his interest in the wellfare of the working community of the Merthyr, Dowlais, Cyfarthfa, and Plymouth district, by bearing the expense of a large additional wing to the hospital, forming a new accident ward. This was opened on Wednesday, by the Governors of the Hospital in the presence of the donor. The cost of furnishing it has been volunteered by the Cyfarthfa and Dowlais Companies.

The latest report of the Brecon and Merthyr Line foreshadowed a number of good signs in the form of additions of new coal business extensions, &c., all promising well for the future.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

To judge from accounts that are received from the various iron-producing districts, an improving tendency seems to prevail all round.

In Silesia the iron trade is progressing favourably, both local and foreign demand having further increased upon the week. The slight advances that have here and there been ventured in prices have, on the whole, been willingly accepted by consumers, and this, as well as the slow but steady improvement in demand, speaks well for the tone of the iron industry.

For the present only few large contracts are being secured, but makers and manufacturers generally entertain a most hopeful view with regard to the development of the spring business. Plates and bars are very firm in price, and so are sheets. The blast furnace works are trying hard to raise their output, and as the demand for forge pig and for iron for steel making is steadily improving, and will continue to do so, most likely on account of the uncommonly active employment at the steel works, makers in pig iron may be considered as having excellent prospects for at least a great part of the year.

There is no change to be reported in connection with the iron business in Austria-Hungary. For structural iron a fair demand continues to come forward, and the trade in merchant iron is also reported to be a trifle better than in previous weeks, but, on the whole, the tone of the iron market remains dull. The majority of the machine factories are in tolerably satisfactory employment, only in a few special cases complaints have been heard regarding the insufficient amount of new work.

The French iron market has continued pretty lively during the last few weeks; in some departments prices have been showing a fair tendency to improve, owing to a rather increasing demand that is beginning to be generally experienced.

The Belgian iron trade has maintained its former healthy position, current output meeting with ready demand at prices that may be generally considered remunerative. Only for some sorts of iron, where competition is particularly strong, export prices have to be reduced if makers wish to do any larger business.

The majority of the iron and steel works in Rheinland-Westphalia are pretty regularly, but not very briskly employed, the improvement in activity which was reported towards the middle of January having here and there given place to a certain dulness. This is to some extent due to the unfavourable weather which has during the last few weeks prevented all active business in the building line, and has, consequently, put a stop to the brisk demand that was already coming in for structural iron of all descriptions. Dealers show, as a rule, much inclination to purchase freely. The iron ore trade continues exceedingly animated; in spite of a steady rise in output, the Siegerland ore mines are unable to cover the existing demand, and imports in all sorts of foreign ore are consequently very heavy. The following quotations are at present ruling:—Red minette, M. 4 p.t.; inferior sorts, M. 3·20 to 3·40 p.t.; Nassau red iron ore, 50 p.c. contents, M. 11 p.t., free Dillenburg. The pig iron trade remains in a pretty lively state, the demand for the different sorts having been fairly strong upon the week. Nearly the total make of the third quarter of present year is reported to have already been sold. Prices are firm, and perhaps inclined to rise; but the Pig Iron Convention has wisely deferred an official advance in quotations until the iron trade is showing symptons of a general and lasting improvement. Only iron for steel making has been raised M. 1 p.t., and is standing on M. 60 p.t.; German Bessemer is quoted M. 67 p.t.; foundry pig. No. 1, M. 67 p.t.; No. 3, M. 60 p.t.; basic, M. 60·50 p.t., free place of consumption; forge pig, Rhenish-Westphalian and Siegerland qualities, fetches M. 58 to 59 p.t.; Luxemburg basic, 62f. p.t., free Luxemburg.

Billets and blooms are in exceptionally good request. Old rails and scrap iron continue to be sold at very high rates; at a late tendering rails were paid with M. 80 p.t. Bars are, on the whole, in moderate request; bars, in basic, now stand on M. 130 p.t.; the same in Bessemer, M. 140 to 150 p.t., free Dortmund. Dealers in girders have begun to fill their stores, and are buying largely; heavy plates are decidedly more animated than during former weeks, and prices have met with an advance of M. 2·50 to M. 5 p.t., boilers plates now realising M. 180 p.t.; best qualities, M. 210 p.t. Tank plates cost from M. 142·50 to 165 p.t. An irregular employment is going on at the sheet mills, those in the Siegerland being well off for new work, while the Rhenish-Westphalian sheet mills, as a rule, complain of an insufficient amount of orders; especially foreign contracts are very scarce, and makers have to go down in price if they wish to obtain orders. Siegerland qualities sell at M. 150 to 160 p.t. Hoops are in fairly good call generally. The business in light section rails is tolerably satisfactory, and the works have hitherto well maintained the price of M. 110 to 112 p.t. Drawn wire and wire nails are in slightly improving request, the latter realising M. 137 p.t., while for drawn wire M. 120 to 122 p.t. is given. Rivets are very dull. The wagon factories have received sundry small orders for narrow gauge and electric railways, and more work is expected to come forward. Prices and demand in the tube business have not altered, and are weak generally, owing to the unfavourable weather.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, February 16th.

THE crash in the steel rail market has been the topic of conversation for ten days. The Illinois Steel Company has been underselling for months. A Pennsylvania mill, not satisfied with its scanty percentage, made this secret selling below the rate the pretext for withdrawing. Thereupon the house of cards fell, and rails tumbled from 25 dols. at Pittsburgh to 14 dols. They advanced to 17 dols., and are now 18 dols., and may reach one dollar higher. The entire trade is unsettled. The Carnegie interests control the situation, having all the advantage of ore and coke, and transportation at cost price. There is a daily rush of orders, and none can tell where the demand will stop, possibly not until it has reached nine hundred thousand tons or even more. Already the rail mills have sold more rails than they did all of last year, and the market has only opened. There is a struggle for orders at the out rates, but the current business is only for requirements which have been pigeon-holed for several months. There is a great deal of projected work, and if this work is pushed it will alter the situation very much. A year ago it was shown that surveys had been made for the construction of some thirty thousand miles of road. If but 10 per cent. of this were built this year, the demand in addition to that of repairs would pretty well occupy our rail-making capacity, although by no means crowd it. The Carnegie road will be completed by August, and then rails will be made cheaper at Pittsburgh than anywhere on the face of the earth. That which next engages the attention of observing minds is the money market. Should capital be unlocked and flow without restraint, with reproductive channels it will bring to the States an era of prosperity like that enjoyed by other countries. The Government fiscal affairs are not much better, and cannot be until the new President rips up things with a new tariff, the passage of which is not altogether assured. There are a good many sore men to be pleased. The silver men are lurking in the dark. The deficit is nearly fifty million dollars in eight months. This is a piece of business the people will not put up with.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

LARGE attendance at the annual general meeting of members. Continued demand for steam coal, with stems fairly well filled. House coal shipments have lessened from the mild weather. Tin-plates in moderate demand. The iron and steel works are all fully employed.

Coal: Best steam, 9s. to 9s. 3d.; seconds, 8s. 9d. to 9s. 6d.; house coal, best, 10s. 6d. to 11s.; dock screenings, 5s.; colliery small, 4s. 6d. to 4s. 9d.; smiths' coal, 6s. 6d.; patent fuel, 10s. Pig iron: Scotch warrants, 38s. 1d.; hematite warrants, 40s. 0½d. f.o.b. Cumberland; Middlesbrough No. 3, 40s. 1d. prompt. Iron ore: Rubio, 14s. 8d.; Tafna, 14s. 3d. Steel: Rails, heavy sections, £4 12s. 6d. to £4 15s.; light ditto, £5 7s. 6d. f.o.b.; Bessemer steel tin-plate bars, £4 12s. 6d.; Siemens steel tin-plate bars, £4 15s.; all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 10s. 3d.; Siemens, coke finish, 10s. 6d.; Pitwood: 16s. 3d. London Exchange Telegram: Copper, £51 7s. 6d.; Straits tin, £61 11s. 3d. Freights steady.

THE ALBERT MEDAL.—The professors and students of the Polytechnic School of Engineering, Regent-street, presented their president for this year, Professor D. Hughes, F.R.S., with an illuminated address, congratulating him upon the distinguished honour which was conferred upon him on Tuesday, the 16th inst., when he received from the hands of H.R.H. the Prince of Wales, at Marlborough House, the Albert Medal, bestowed upon him by the Council of the Society of Arts, of which H.R.H. is president, in recognition of the great services he has rendered to arts, manufactures, and commerce, by his numerous discoveries and inventions in electricity and magnetism, especially the printing telegraph, the microphone and long-distance telephone.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

10th February, 1897.

3488. Secondary Batteries, E. Schattner, London.
3489. Teaching Model Drawing, J. Tomlinson, Brighouse.
3490. Pneumatic Tires, B. H. Thwaite and T. J. Denny, London.
3491. Tank, J. V. Paterson.—(*J. Paterson and A. J. Oke, Cape Colony.*)
3492. Communicating Motion, L. Armanni, London.
3493. Self-propelled Vehicles, T. and W. Toward, J. Meek, and J. Philipson, jun., Newcastle-on-Tyne.
3494. Driving Chains, A. Bagshaw, Birmingham.
3495. Hat Adjuster, E. Ashmore, Sheffield.
3496. Bedstead Attachment, E. Hitchon and J. Lucas, Accrington.
3497. Oil Cups of Cycles, S. B. Haskard, Derby.
3498. Thread-cutting Appliance for Spools, W. Ward, Bristol.
3499. Nitride of Carbonyl, W. Mills, London.
3500. Nitrides, W. Mills, London.
3501. Urea, W. Mills, London.
3502. Boot Protectors, J. and E. Reeson, Stockton-on-Tees.
3503. Trays for Ink Wells, G. W. Jelfs, Birmingham.
3504. Incandescent Gas Burners, J. Wilson, Birmingham.
3505. Vehicles for Traffic on Frozen Lakes, H. W. Verdon, London.
3506. Cycle Brake, W. J. R. Wray, Holywood, Co. Down.
3507. Shoe Brush, C. Watt, C. Watt, jun., and E. Watt, Plymouth.
3508. Twisting Machinery, J. Dawson and S. T. Wheater, Bradford.
3509. Cycle Frames, H. Lawson, jun., and H. M. Scott, Glasgow.
3510. Door-mats, J. Craig and W. H. Eastwood, Manchester.
3511. Motor Engines, T. and L. Dunn, Newcastle-on-Tyne.
3512. Tools for Producing Nuts from Iron Rods, W. Gwinnett, London.
3513. Treating Waste Iron Ores, G. Haycraft, London.
3514. Tramway Points, W. Towler, Leeds.
3515. Balls, R. Collinson, Manchester.
3516. Tires, S. Bunting, Birmingham.
3517. Can Opener, J. W. Otter, Staveley Town.
3518. Closing Tins, H. Schlesinger.—(*Messrs. O. F. Schaefer Nachfolger, Germany.*)
3519. Brake, W. Richards, Portsmouth.
3520. Solitaire, J. T. Nichols, London.
3521. Safety Pins, W. Pearce, Birmingham.
3522. Cranks, J. Marston, Ltd., and C. A. Noton, Wolverhampton.
3523. Step-ladder, A. L. Kneale, Douglas, Isle of Man.
3524. Bicycle Rest, W. U. Coates, Falfield, Glos.
3525. Fluid Pressure Reducing Valve, E. Makin, jun., and D. Speirs, Manchester.
3526. Electro Deposition of Metals, J. E. Hartley.—(*F. W. Zingsem, United States.*)
3527. Cycle-steering Locks, C. T. B. Sangster, Birmingham.
3528. Seat Attachment for Cycles, E. Goold, jun., and D. Roberts, Leamington.
3529. Starting Blowing Engines, J. Procter and E. Crowe, Oakengates, Shropshire.
3530. Brushes for Cleaning Sieves, C. H. Stubley, Mansfield.
3531. Water-closets, J. Wright, London.
3532. Shuttle Guard, T. Graham, London.
3533. Ashpit Doors, J. Duckett and Son, Ltd., and J. Duckett, London.
3534. Driving Chains, T. R. Voce and B. Drysdale, Birmingham.
3535. Belts for Conveyors, T. F. Ennis and F. S. Green, Birmingham.
3536. Raising Nap on Textile Fabrics, J. Schofield, Manchester.
3537. Carriage Lamp Socket Clip, G. I. Randall, Bristol.
3538. Starting Gear, P. McL. Baxter and D. Donald, Penryn, Cornwall.
3539. Burners for Incandescent Lights, A. Rose, Birmingham.
3540. Brackets for Displaying Goods, S. P. Ming, Liverpool.
3541. Tires, S. S. Walker, Knowle, Warwickshire.
3542. Heald Operating Mechanism, A. Lockwood, Keighley.
3543. Milk Cans, C. A. Percival, Manchester.
3544. Lids of Vessels, C. M. King, London.
3545. Nursery Gates, S. C. Holmer, C. Lundvall, and P. Holmer, London.
3546. Permanent Way of Railways, J. C. Barton, London.
3547. Seed-sowing Apparatus, E. K. Clover, London.
3548. Protector for the Foresights of Small-arms, J. E. Martin, Glasgow.
3549. Window-cleaning Apparatus, T. M. Houghton, London.
3550. Trousers Stretcher, E. M. Ginders, Liverpool.
3551. Steering Handle-bars of Cycles, A. Barr, Glasgow.
3552. Adjustable Blind or Screen, E. P. Beaufort, London.
3553. Chimney Glasses for Lamps, T. Hill-Jones, London.
3554. Combined Coffee and Milk Pot, A. H. Morris, London.
3555. Tobacco Pipes and Cigar Tubes, T. Gough, London.
3556. Guarding Trousers from Mud, C. L. Lamotte, London.
3557. Body Rollers, J. J. Wilson, London.
3558. Capes, J. Lindey, London.
3559. Violin and Viola Chin Rest, J. Latham, London.
3560. Transmission of Power, P. Auriol, London.
3561. Case for Storing Newspapers, S. von Gerlach, London.
3562. Steering Mechanism for Auto-cars, N. Vincke, London.
3563. Brakes, N. Vincke, London.
3564. Window Blind Guides, G. Bland, London.
3565. Travelling Trunks, S. M. B. Gyde, Birmingham.
3566. Obtaining Heat, L. Gunn, London.
3567. Funnel, G. F. Hughes, London.
3568. Lock-nut, G. F. Hughes, London.
3569. Fire-arms, W. J. Jeffery, London.
3570. Dental Engines, E. L. Shattuck, London.
3571. Fire-proof Buildings, A. H., H., and G. van der Vygh, London.
3572. Displaying Pictures, G. Haydon and Haydon and Urry, London.
3573. Movable Screens or Partitions, E. Phillips, London.
3574. Bell Apparatus, T. E. G. Cronin, London.
3575. Railway Signalling, J. W. Lee, London.
3576. Anti-fouling Compositions, J. C. Mewburn.—(*J. C. Taylor, Grand Canary.*)
3577. Lawn Billiards, J. Donkin, London.
3578. Radiators, B. Russell, London.
3579. Glass Lens for Pavement Lights, B. Russell, London.
3580. Driving Gear of Velocipedes, H. P. During, London.
3581. Garden Hose and Rose Combination, J. H. Spencer, London.
3582. Fans, A. H. Harrison, London.
3583. Signalling, C. H. Hayes, London.
3584. Aerating Liquids, H. V. R. Read, London.
3585. Scaffolding, J. Whittaker, London.
3586. Rocking Cradles, W. H. Cummings, London.
3587. Fire Escapes, W. H. Tayler, London.
3588. Match Holder, M. J. Richter, London.
3589. Furnaces, F. Eisler, London.
3590. Direct-acting Pump, W. P. Thompson.—(*J. Chaput, France.*)
3591. Cleaning Rests for Bicycles, L. Jackson, Liverpool.
3592. Concentration of Sulphuric Acid, J. E. Campbell, Manchester.
3593. Cycle Saddle Attachment Bar, F. J. Rowsell, Birmingham.
3594. Telephone Switch Device, J. H. West, Liverpool.
3595. Cycle Brake, H. Williams and J. H. Jones, Liverpool.
3596. Washing Tumblers, O. R. F. Minck, Liverpool.
3597. Tapered Tubes, F. J. Seyfried, Liverpool.
3598. Corsets, F. C. Mahon.—(*J. D. Belcher and J. C. Mahon, Nova Scotia.*)
3599. Horseless Carriages, C. E. Henriod, London.
3600. Brake Mechanism for Cycles, T. A. Borham, London.
3601. Surgical Knitting Machines, M. B. Moreton, London.
3602. Speed Mechanism, N. Roser and J. Mazurier, London.
3603. Cycle Saddles, W. Radermacher, London.
3604. Ladies' Dress Guards for Cycles, G. Lyons, London.
3605. Circular Warp Machines, H. Hill, London.
3606. Kettles, J. D. Hawkins, London.
3607. Gas Burners, A. Franke, London.
3608. Aerial Machines, F. W. Lanchester, London.
3609. Aluminium Alloy, J. Robson and C. A. Joël, London.
3610. Lubricators, W. J. H. Jones, London.
3611. Cycle Gearing, H. Y. Dickinson, London.
3612. Toy Motor Car, S. J. Tonks, Birmingham.
3613. Bicycle Home Exerciser, G. L. McKay, Ontario, Canada.

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3614. Cycle Brakes, B. Whiteley, Sheffield.
3615. Working Water-tight Doors, W. and A. R. Crawford, Glasgow.
3616. Beetling Machines, E. W. Hunt, Bolton.
3617. Wrapping Barrel Taps, W. J. Fox, Norwich.
3618. Combs, A. K. Diver, Norwich.
3619. Wet Spinning Frames, J. Barbour, Belfast.
3620. Folding Heads of Carriages, C. E. Harrison, Smethwick.
3621. Aiming Stand, C. G. Burton and G. H. Lister, London.
3622. Copper Furnace Doors, G. Honeyball and J. Smith, Ipswich.
3623. Type-writing Machines, S. B. Shelton, St. Ives.
3624. Cooling Butchers' Safes, W. H. Coppen and W. J. Woodward, London.
3625. Ribbed Wheeling Pants, T. D. Fraser, Glasgow.
3626. Driving Gearing of Engine Flats, R. Tyack and Howard and Bullough, Accrington.
3627. Condensing Steam, J. Whiteley, Manchester.
3628. Horse-clipping Machines, G. Cox, Walsall.
3629. Auto-revolving Gas Shade, D. McDonald and J. T. Keiller, Perth.
3630. Cleaning Streets, W. Harley and J. Duggan, Liverpool.
3631. Slipper Brakes for Road Vehicles, T. J. Davies, Liverpool.
3632. Axle-bushes for Wheels of Vehicles, T. J. Davies, Liverpool.
3633. Receptacles for Billiard Table Chalk, E. L. Marsden, Liverpool.
3634. Railway Fog-signalling Apparatus, H. Watson, Keighley.
3635. Fitting Artificial Teeth, E. Hulme, Kingston-upon-Hull.
3636. "Safety" Cycle Brake, W. Walker, Halliwell, near Bolton.
3637. Corks for Bottles, W. H. Parry and F. O. Hart, Birmingham.
3638. Extinguishing Fires, R. Dawson and J. T. Clarke, Keighley.
3639. Motor Engines, J. E. S. Thornhill, Manchester.
3640. Indicating Temperatures, H. Ramsden, Manchester.
3641. Preventing Spilling of Liquids, T. W. Allan and A. G. Adamson, Glasgow.
3642. Shaft Fastener, R. S. Hunter, Leeds.
3643. Photographic Cameras, J. and A. Wilkinson, Manchester.
3644. Water-proof Cloth, W. H. Douglas, Fallowfield, near Manchester.
3645. Oil Cans, J. W. Kaye, Bradford.
3646. Treatment of Fabrics, J. Waugh.—(*The New Augsburger Cotton Mill Company, Germany.*)
3647. Joint for Auto-car Frames, C. Kenyon and J. Pogson, Manchester.
3648. Electric Incandescent Lamps, F. Ridyard and W. Wardle, Manchester.
3649. Steam Boilers, C. Burrell, jun., and W. C. Wilson, Thetford.
3650. Water-tight Metal Bar, A. Fry, London.
3651. Pen Wiper, D. F. Basden and J. Davidson, London.
3652. Ceiling Roses, H. M. Darrah, Manchester.
3653. Rotary Motion, W. E. Heys.—(*Schaffer and Budenburg, Germany.*)
3654. Paraffin Lamp Frames, F. Sherwood, Birmingham.
3655. Lamps, F. A. Pyke, Bolton.
3656. Cycle Bags, W. J. Goddard, London.
3657. Cycle Hub Cleaner, L. C. Harvey, Manchester.
3658. Cycle Race for Stage Effect, W. D. Hanbury, London.
3659. Shuttle Guard, T. and J. G. Ivers, Manchester.
3660. Rag Engines, T. Horrox, Manchester.
3661. Ribbons, P. Philpot, Manchester.
3662. Planetone, T. Middleton, Glasgow.
3663. Ships' Rudders, J. M. Ramsay, Glasgow.
3664. Hydrocarbon Vapour Lamps, R. Henderson, Glasgow.
3665. Tires, H. Huber, London.
3666. Cycles, C. Lansdown, London.
3667. Incandescent Gas Burners, H. A. Kent, London.
3668. Internal Combustion Engines, E. T. Carter, London.
3669. Electric Lamps, F. Harrison and H. S. Deacon, London.
3670. Violin Machines, J. Baumgartner, London.
3671. Railway Vehicle Couplings, M. L. Mardis, London.
3672. Coin-freed Delivery Apparatus, A. Pincus, London.
3673. Detecting Potassium Compounds, G. S. Newth, London.
3674. Telephonograph, J. Clark and J. H. Calcott, London.
3675. Bicycle Tires, T. V. H. Obelt, London.
3676. Phonographs, T. V. H. Obelt, London.
3677. Naves, H. Schmidt, jun., Berlin.
3678. Driving Gear for Velocipedes, T. Moy, London.
3679. Knives for Skinning Animals, S. Price, London.
3680. Expeditiously Blocking Tunnels, F. Barnett, London.
3681. Signalling or Alarum Apparatus, C. Meissler, London.
3682. Rims for Wheels of Velocipedes, J. F. Barlow, London.
3683. Automatically Illuminating Box, W. Elborne, London.
3684. Supporting Sliding Doors, M. H. Spear, London.
3685. Hauling Devices for Vehicles, G. T. Harrap, London.
3686. Socks, O. J. Bomborn, London.
3687. Saddle Supports, J. Lane, London.
3688. Threshing Machines, E. J. Pennington, London.
3689. Tire, W. H. Percival, T. R. Clifford, and S. W. Tomkins, London.
3690. Furnaces, P. R. Wilde, London.
3691. Typewriters, H. J. Horseman, London.
3692. Horseshoeing, W. H. Steer, London.
3693. Lamps, U. Beaton, London.
3694. Walls, J. Hamblet and J. Stanford, Birmingham.
3695. Fuel Economising Contrivances, J. M. Dame, London.
3696. Chain, S. Pastor and C. Muston, London.
3697. Bells, A. S. Vose.—(*Nutter, Barnes, and Co., United States.*)
3698. Doors, G. S. Goad, London.
3699. Grinding Cutlery, The Wilkinson Sword Company, Ltd., and H. W. Latham, London.
3700. Acid, J. David, London.
3701. Pumps, W. S. Simpson, London.
3702. Soap, F. J. Billingham, London.
3703. Mantels, The Incandescent Fire Mantel and Stove Company, Limited, and A. W. Hughes, London.
3704. Puzzle, N. P. Hibbit, London.
3705. Clothes Brushes, R. E. Hadow and E. Peyton, London.
3706. Differential Driving Gear, J. Küster, London.
3707. Handle bars, J. W. Deans, W. D. and R. J. Foster, London.
3708. Down Machine, W. Robinson and A. G. Cull, London.
3709. Bedstead Frames, E., L. A., and B. R. Peyton, London.
3710. Pipe Joint, T. C. P. Jenkins and C. F. Archer, London.
3711. Folding Cycle Handle Bar, C. F. Archer, London.
3712. Adjusting Picture Frames, W. S. Simpson, London.
3713. Word-recording Apparatus, E. S. Flint, London.
3714. Liquid Measures, C. C. Hull, London.
3715. Sealing Punctures in Tires, A. J. Ell, London.
3716. Electric Cables for Telegraphy, W. A. Price, London.
3717. Stamps, P. Krause, London.
3718. Tires, F. A. S. Reid, London.
3719. Trawl Nets, A. J. Pardy, London.
3720. Feeding Printing Machines, E. T. Cleathero, London.
3721. Wheels, J. A. and T. G. Drinkwater and F. J. T. Haskew, London.
3722. Supports, W. P. Thompson.—(*The firm of C. W. Kayser and Co., Germany.*)
3723. Disinfecting Apparatus, W. E. Thursfield, London.
3724. Steam Boiler Furnaces, W. Brothers, Manchester.
3725. Coin-freed Apparatus, R. Lane, Liverpool.
3726. Locating Tire Treads, J. H. Glew, London.
3727. Toy, J. H. Homeister, London.
3728. Ships, A. J. Boult.—(*L. Dulac, France.*)
3729. Pack Saddles, H. R. Newburgh-Stewart, London.
3730. Slotting Metal Plates, W. W. Hulse, London.
3731. Inflating Tires, B. R. Adkins and C. Windsor, London.
3732. "Boards" for Trawl Nets, G. R. Purdy, London.
3733. Gate Opening, R. E. D. Rudman, London.
3734. Cleaning Surface of Ships, E. F. W. Agatz, London.
3735. Geysers, J. Winterflood, London.

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3736. Joints of Earthenware Pipes, J. Farley, London.
3737. Cleaning Windows, E. M. Jackman, London.
3738. Motors, H. Rogers, London.
3739. Game, J. Bland, London.
3740. Preparing Fowls for Dinner, R. R. Burt, London.
3741. Oars, J. Cotter, London.
3742. Bags, H. F. Smith, Sheffield.
3743. Bicycles, T. Blackmore, Birmingham.
3744. Ink and other Stain Removers, S. Learoyd, Huddersfield.
3745. Driving Gear of Velocipedes, T. Cowper-Coles, London.
3746. Ploughs, H. Lees and R. Henderson, Clontarf, Dublin.
3747. Eyelet Holes, W. T. Shore, London.
3748. Making Branch Pipe Connections, J. Gemmell, London.
3749. Knitting Machines, G. F. Sturgess, Leicester.
3750. Self-measuring Taps, J. H. Stubley, Aughton, near Ormskirk.
3751. Sporting Implements, C. O. Weber, Crumpsall, near Manchester.
3752. Communicating between Trains, H. Biermann, Manchester.
3753. Method of Driving Capstans, J. Hannan, Glasgow.
3754. Transmitting Electric Current, D. K. Tullis, Glasgow.
3755. Water Tube Boilers, F. E. Rainey, Glasgow.
3756. Bicycle Tires, A. E. Lillie and J. Cockburn, Glasgow.
3757. Motor Cycles, W. Davy, Ryton-on-Tyne, Co. Durham.
3758. Pneumatic Tires, A. Rollason, Attleborough, Nuneaton.
3759. Combing Machine Circles, M. Firth and F. Davy, Bradford.
3760. Coal Cutting, W. E. Garforth, R. Sutcliffe, and W. Buxton, Leeds.
3761. Sweeper for Billiard Tables, J. Boothman, Leeds.
3762. Reflectors, A. Nicol, Hampton, Middlesex.
3763. Holding Appliances, L. R. Doran, Glasgow.
3764. Developing Lamps, E. J. B. Scratton, Glasgow.
3765. Card Clothing, J., W., and H. Platt, Halifax.
3766. Manufacture of Weft Pile Fabrics, J. Farran, Manchester.
3767. Mortising Machines, D. Pont, Manchester.
3768. Electric Traction Motors, R. Kennedy, Bradford.
3769. Steam Receiver, H. L. P. Boot, Tunbridge Wells.
3770. Anti-incrustation Fluids, J. Gemmell, London.
3771. Heel-plate for Revolvers, R. Gordon-Smith, Birmingham.
3772. Portable Electric Lamps, S. F. Walker, Cardiff.
3773. Wedge, R. Hindle and J. Newman, Helton-le-Hole, R.S.O.
3774. Flexible and Pneumatic Tires, J. R. Cooper, Birmingham.
3775. Obstetric Belt, M. A. Dunning, London.
3776. Production of Designs in Metal, R. J. Simpson, Birmingham.
3777. Labels, F. Waite and Waite and Saville, Bradford.
3778. Motors, H. Lentz, J. Weigl, and A. Herschmann, Bradford.
3779. Aprons, W. Eastham and Howard and Bullough, Ltd., Accrington.
3780. Oil Feeding Suspension Lamps, A. J. Riley, Birmingham.
3781. Purifying of Feed-water, F. W. Wheadon, London.
3782. Coke Stove, H. Beuge, Brussels.
3783. Wheel, H. Süss, Brussels.
3784. Graining Tool, W. S. Turner, London.
3785. Fertiliser, E. D. Mead, London.
3786. Cycle Support, E. Farnsworth, London.
3787. Ball Bearings, J. Fleming, London.
3788. Printing Machines, G. H. Hooper and W. C. Horne, London.
3789. Puzzle, H. E. D. Lloyd, London.
3790. Throstle Machine Counterfallers, A. Gutleben, London.
3791. Coverings for Wire Mattresses, J. Hubbert, London.
3792. Locking Wheels of Bicycles, J. F. W. Holt, London.
3793. Caps, M. Schneiders, London.
3794. Holding Candles, H. Jones, London.
3795. Treatment of Sulphide Ores of Lead, G. G. M. Hardingham.—(*T. Huntington and F. Heberlein, Italy.*)
3796. Toboggans, A. A. Herd, London.
3797. Lamps, E. J. Shaw, London.
3798. Economising Motive Power, P. Jerrard, London.
3799. Brakes, T. A. Hearson, Englefield Green, Surrey.
3800. Pressing the Brims of Straw Hats, A. Lay, London.
3801. Valves, R. Boland, Birmingham.
3802. Jars, F. W. Needham, Birmingham.
3803. Automatic Spray Diffusers, H. Helbing, London.
3804. Fixing Heads to Pins, W. P. Thompson.—(*R. Neuss, Germany.*)
3805. Tires, E. Hayle, Liverpool.
3806. Gear Wheels, W. Morris and J. J. Baxendale, Manchester.
3807. Tire, W. Heyden, London.
3808. Corsets or Abdominal Belts, C. Irvine, Liverpool.
3809. Hooks, J. H. Ross and R. Cunningham, Manchester.
3810. Lupines, H. Schowell, London.
3811. Fluid for Impregnating Bodies for Incandescent Lighting, B. Puchmüller, Liverpool.
3812. Current Collector, A. Heusch and P. Brandt, London.
3813. Hackling Flax, R. C. Sundberg, London.
3814. Flat-wick Lamp Burners, J. Schneider-Dörffel, London.
3815. Winding Wires on Armatures, J. C. Grant, London.
3816. Rims for Cycle Wheels, J. C. Grant, London.
3817. Pneumatic Tire Valves, J. C. Grant, London.
3818. Raising Liquids, W. A. Hills, London.
3819. Boot Trees, T. Jennings, London.
3820. Suspended Tramways, R. St. G. Moore and W. J. Brewer, London.
3821. Bottle Stoppers, T. Jennings, London.
3822. Dispensing Composite Liquids, R. W. Vining, London.
3823. Heating System of Kilns, J. P. van der Ploeg, London.
3824. Heating Incandescent Burners, J. P. van der Ploeg, London.
3825. Air Supply for Furnaces, E. H. J. C. Gillett, London.
3826. Affixing Scarves, J. Cryer, London.
3827. Marine Construction, I. Chiera and C. Gabellini, London.
3828. Locking Bicycles, J. Haag, London.
3829. Preventing Fraudulent Introduction of Liquids into Bottles, E. J. Biggs and H. Fisher-Spencer, London.
3830. Preserving Butter, B. Iribarnegaray, London.
3831. Electric Batteries, A. R. Adams, London.
3832. Spinning Artificial Silk, R. W. Strehlenert, London.
3833. Taps, W. T. Sugg and W. G. H. Mattock, London.
3834. Gathering Sheets, J. B. Mercer, London.
3835. Wrench, J. F. Tiner and T. Tinsley, London.
3836. Driving Gear, M. S. Napier, London.
3837. Utilising Waste Heat, H. M. Robinson, London.
3838. Holding Device, E. B. Betham and W. White, London.
3839. Screw-stoppering Bottles, E. Handslip, London.
3840. Securing Ships' Boats, C. Wendt and E. Sauer, London.
3841. Fixing Inside Tubes, E. J. Hearnah and G. R. Bate, London.

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3842. Corsets, T. E. Mansfield, Bedminster.
3843. Egg Cutter, G. Lewis, Pendleton.
3844. Pneumatic Tires, J. C. Barker, Brighouse.
3845. Lever Wheel Gear, J. W. Hart, London.
3846. Belts, G. E. Stead, Manchester.
3847. Warp Beams, G. E. Stead, Manchester.
3848. Electric Arc Lamps, H. M. Darrah, Manchester.
3849. Making Joints, J. Birtwisle, Manchester.
3850. Railway Signalling, A. Dyson, Halifax.
3851. Floors of Rooms, M. Hall, Halifax.
3852. Oscillating Tipplers, J. Rigg, London.
3853. Revolving Letter Case, J. Frankland, Norwich.
3854. Handles for Velocipedes, W. Handley, R. Graham, and H. Lowe, Birmingham.
3855. Bedsteads, G. Whitfield, Birmingham.
3856. Lever Gear, D. Clark, London.
3857. Mud-guards, E. D. Hopcroft, Kidderminster.
3858. Spring Tires, J. Stewart, Edinburgh.
3859. Cycles, J. M. Landon, London.
3860. Refuse Destructor, F. F. Bennett and J. Phythian, Manchester.
3861. Fastenings for Sheets of Paper, E. M. Payn, London.
3862. Motor Vehicles, A. W. Brightmore, Knighton.
3863. Fire Escape, J. S. Gatland, Dorking.
3864. Bicycle Rest, R. F. Mallam, Banbury.
3865. Net Attachments for Otter Boards, J. R. Smith, Hull.
3866. Breech-loading Cartridges, H., E., and F. Hammond, Winchester.
3867. Cylinders for Sorting Grain, C. E. Mumford, Lavenham, Suffolk.
3868. Saucepan Lids, H. Drake, Norwich.
3869. Neckcloth, H. Malet, London.
3870. Buttons, J. N. Gardner and L. T. Slayden, London.
3871. Brakes for Baby Carriages, H. W. Morgan and R. Spence, London.
3872. Pillar and other Letter-boxes, F. G. Gaschlin, London.
3873. Cigars, J. Kealey, Stockton-on-Tees.
3874. Churn, O. Thomas, London.
3875. Stair Rods, H. Richmond, Manchester.
3876. Handles of Cycles, F. W. Stroudley, Manchester.
3877. Pneumatic Tires for Vehicles, W. B. Thompson, Manchester.
3878. Spanner and Tire Lifter, T. P. Willcox, Sheffield.
3879. Coal Grids, H. Gibbon and W. Tyrer, Liverpool.
3880. Window Frames, H. Gibbon and W. Tyrer, Liverpool.
3881. Frames for Suspending Lamp Vessels, &c., B. Edmonds, Birmingham.
3882. Urinals, J. Shanks, Glasgow.
3883. Cisterns, J. Shanks, Glasgow.
3884. Locking Nuts on Bolts, E. J. Mills, Glasgow.
3885. Tobacco Pipe, W. H. Tapp, Frome.
3886. Soldering Appliances, C. E. Bacon, London.
3887. Lighting Warehouses, F. H. Royce and Co., Ltd., and W. G. Inglefield, Manchester.
3888. Cycle Stand, T. Shoreman, R. Johnson, and J. G. Dodd, Manchester.
3889. Imitation Tiles on Metal, F. L. Saniter, Durham.
3890. Gas Engines, P. Auriol, London.
3891. Preparing Petroleum, J. W. Leadbeater, Leeds.
3892. Briquettes, J. W. Leadbeater, Leeds.
3893. Cycle Saddles, W. F. Muller, Havre.
3894. Vehicle Wheels, N. D. and J. N. Coe, London.
3895. Blind Rollers, S. Y. Davis, London.
3896. Incandescent Gas Lamps, W. F. Sharp, London.
3897. Raising, &c., Cycle Saddles, J. Longmore, Glasgow.
3898. Calcium Carbide, F. Richard, Liverpool.
3899. Targets for Rifle Practice, T. B. Ralston Glasgow.
3900. Utilising Brewery Refuse, A. Weickmann, London.
3901. Velocipedes, W. G. Hartnoll and J. B. Jones, Barnstaple.
3902. Cuff Holder, J. C. Vickers, Manchester.

3903. Wheel, H. O'Reilly, Dublin.
3904. Facing-up Spinning Rollers, J. Wishart, Leven.
3905. Breeches, J. L. Rossiter, London.
3906. Switch Tongue, E. Andre and A. Silbermann, London.
3907. Lamp Shades, A. H. Entwistle and H. J. Stephens, London.
3908. Fire Lighters, C. Andrews, London.
3909. Desk, J. Booth and A. Stone, London.
3910. Drop Stamps for Crushing Ores, J. L. Kirkbride, Birmingham.
3911. Handles, E. Taylor, Birmingham.
3912. Junctions of Cycle Frames, E. Taylor, Birmingham.
3913. Cycle Brakes, T. W. H. Partridge and E. J. Abbot, Birmingham.
3914. Signalling, A. Ginisty, London.
3915. Braces, G. Buckley, London.
3916. Machine Bands, W. Macdonald and W. A'Violet, London.
3917. Window Sashes, R. Silverwood, London.
3918. Saddles, E. A. Handford, London.
3919. Coupling Devices, J. Villard and J. Bonnaffous, London.
3920. Non-slipping Attachment for Boots, S. Davey, London.
3921. Wool Winders, E. A. Collie, London.
3922. Spectacle Cases, C. E. M. Newman, London.
3923. Ranges, E. M. F. Toozs, London.
3924. Gloves, H. C. Wright, London.
3925. Driving Gear, J. T Hanson, London.
3926. Iron, H. Niewerth, London.
3927. Furnaces, C. Wegener, London.
3928. Lock, A. May, Liverpool
3929. Cycle Chain, F. J. Cox, Birmingham.
3930. Securing Panes to the Window Frames, F. Sagebiel, London.
3931. Milling Machines, D. Baker, Birmingham.
3932. Applying Leaf Metal, M. Hinzelmann, London.
3933. Velocipedes, J. H. Knight, London.
3934. Mechanical Motion, E Kohler and F. G. Bate, London.
3935. Ornamenting Cigarette Cases, W. F. Wright, London.
3936. Stoppering Bottles, J. Cartwright, London.
3937. Brushes for Carriage Cleaning, J. M. Parish, London.
3938. Tobacco Pipes, W. Thrist, London.
3939. Files, S Maier, London.
3940. Motive Power Engine, W. A. B. Tibbits, London.
3941. Tobacco Tins, T. Hart, London.
3942. Bearings, F. Wynne, London.
3943. Adjustable Chairs, F. Vogel, London.
3944. Cycle Saddles, O. and B. Saupe, London.
3945. Making Thread, W. Clark, London.
3946. Yarn Winding Machines, W. Clark London.
3947. Frames of Tandem Bicycles, L. H. Houdsfield, London.
3948. Cycle Frames, L. Barnes, sen., and C. O. Barnes, London.
3949. Cycle Crank-shafts, L. Barnes, sen., and C. O. Barnes, London.
3950. Cycle Handle-bars, L. Barnes, sen., and C. O. Barnes, London.
3951. Cycle Wheel Hubs, L. Barnes, sen., and C. O. Barnes, London.
3952. Fastening Girders, C. F. Archer, London.
3953. Pneumatic Wheel, J. A. Mays, London.
3954. Cycle Support, W. Cochrane, London.
3955. Hot Appliances, R. W. Barker.—(*The Hot Appliances Company, United States.*)
3956. Terrestrial Telescopes, C. Pulfrich, London.
3957. Dichloroxypurine, J. Y. Johnson.—(*C. F. Boehringer and Soehne, Germany.*)
3958. Drawn Wrought Iron Tubes, C. Burnett, London.
3959. Showcards, P. Jensen.—(*O. Kalb, Germany*)
3960. Ventilators, H. Hauser, London.
3961. Bottles, T. W. M. Scambler, London.
3962. Bottles, T. W. M. Scambler, London.
3963. Joints, J. Hollis, London.
3964. Handle Bars J. Hollis, London.
3965. Heel Tips, Taylor and Challen, Ltd., and W. B. Challen, London.
3966. Filters, F. Candy and The International Water and Sewage Purification Company, Ltd., London.
3967. Toy, J. W. A. Eskdale, London.
3968. Cycle Gear, J. Murrie, Glasgow.
3969. Weighbridges, T. C. Finney, Glasgow.
3970. Baths, D. G. Prinsep, jun., London.
3971. Dropping Liquid, J. Magg, London.
3972. Cycles, B. Corrick, London.
3973. Arc Lamps, I. H. Hegner, London.
3974. Trawl Nets, W. H. Dodds, Glasgow.
3975. Gas Generator, E. L. Browne, Glasgow.
3976. Furniture, M. S. Shearer, Glasgow.
3977. Sash Fastener, W. M. Bryson, Glasgow.
3978. Printing Presses, J. Y. Johnson.—(*The Cornwall Printing Press Company, United States*)
3979. Boilers, E. W. and S. P. Fraser, London.
3980. Locks, F. A. Clarry, London.
3981. Supplying Gas, A. V. Cristiani and O. Schölzig, London.
3982. Gun Sights, T. A. Watson, London.
3983. Prepayment Meters, W. Webber, London.
3984. Steam Engines, F. W. Reeves, London.
3985. Envelopes, H. H. Lake.—(*J. A. Sherman, United States.*)
3986. Bottle Closing Devices, O. Lelm, London.
3987. Lace-making Machines, A. Mattitsch, London.

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3988. Drop-down Guns, J. W. Smallman, Camp Hill Grange, near Nuneaton.
3989. Hoist Safety Lock, R. Wright, Ardwick.
3990. Brushing Machinery, R. Kelly, jun., and J. S. D. Shanks, Belfast.
3991. Brakes for Bicycles, H. Maudsley, Accrington.
3992. Detachable Fastenings, W. Birtwisle, Hartford.
3993. Piston Valves, F. W. Webb, Crewe.
3994. Jointed Holder, C. Allen, Birmingham.
3995. Stuffing-box Lubricator, J. Allan, C. B. Crowe, and T. A. Reed, Blyth.
3996. Telephone Apparatus, W E. Langdon, Derby.
3997. Looms, W. R. G. Farey and R. Langhorne, Manchester.
3998. Looms, W. R. G. Farey and R. Langhorne, Manchester.
3999. Fuel Economiser, F. Eveleigh and P. H. Mellor, Derby.
4000. Derailment of Tramcars, E. J. Jenkins, Bristol.
4001. Lubricators, H. N. Bickerton, Manchester.
4002. Camp Stools, J. Davidson, Manchester.
4003. Brackets, A. Doman, Kate's Hill.
4004. Fenders, J. and T. A. Jones, Smallheath.
4005. Cranks, J. N. Lester, Wolverhampton.
4006. Cycle Support, G. L. W. Hepenstal, Mount Nugent.
4007. Toy Squirts, S. E Statham, Manchester.
4008. Protectors for Boots, F. J. Palmer, Dawlish.
4009. Pneumatic Tires, A. A. Wade, Bramley.
4010. Driving Mechanism, W. Snelgrove, Shirley, near Birmingham.
4011. Alarm Devices, J. S. Napier, Glasgow.
4012. Toy, W. Snelgrove, Shirley, near Birmingham.
4013. Jars, R. S. Brownlow, Manchester.
4014. Pneumatic Boxing Glove, H. J. Dwight, Barnsley.
4015. Saddlery, E. Chatham, Ruabon.
4016. Packing Tea, J. Aitken, London.
4017. Fog-signalling Apparatus, M. Chapman, Kent.
4018. Air Valve, L. Barnes, sen., and C. O. Barnes, London.
4019. Device for Teachers of Cycle Riding, J. West, W. West, and H J. W. Raphael, Teddington.
4020. Locks, A. G. Voigt and E. F. Cooke, London.
4021. Registering Thermometers, A. G. C. Davies and H. Allen, Croydon.
4022. Bicycle Supports, E. Amphlett, London.
4023. Eye Protectors, C. S. Elliot, London.
4024. Jointed Metallic Pipe Connections, J. M. Doran, London.
4025. Game, J. E. Brooks, London.
4026. Bottles, W. H. Schmied, London.
4027. Covering Ships' Bottoms, P. A. Mears and L. Hirch, London.
4028. Fasteners for Gloves, F. Warrener, London.
4029. Holders for Papers, R. R. Burt, London.
4030. Combined Brakes, F. E. B. Beaumont, London.
4031. Shoeing Horses, N. Loring, London.
4032. Metal Cutting Machines, S. Broadbent, jun., London.
4033. Gauging Apparatus, T. Messenger, London.
4034. Castor Bowls, J. A. Crane, Handsworth.
4035. Conductors, F. Bathurst, London.
4036. Fixing Windows, W. Griffiths, London
4037. Cameras, C. Phillips, Birmingham.
4038. Tires, J. W. Cooper, Birmingham.
4039. Gas Meters, J. Reid and S. Temperley, Sheffield.
4040. Purification of Sewage and Polluted Water, F. P. Candy, Cheshire.
4041. Furnace, H. Broers, London.
4042. Draught Indicator, F. Dittmar, London.
4043. Index, P. M. Gyselman, London.
4044. Dredge, G. Poll, London.
4045. Rack, E. J. Taylor, London.
4046. Batteries, E. Zappert.—(*T. Bergmann, Germany.*)
4047. Making Rubber Tubing, A. Dewes and A. C. Squires, London.
4048. Cement, W. S. Robinson and S. M. Brookfield, London.
4049. Chain Mortising, D. Parry and J. M. Kelly, London.
4050. Cooking Apparatus, D. Grove, London.
4051. Conduits, H. H. Lake.—(*E. S. Perot, United States.*)
4052. Life-saving Apparatus, H. H. Lake.—(*B. Carlsen, Norway.*)
4053. Fans, J. Reichmann, London.
4054. Cycle Handles, J. M. Gell, London.
4055. Bottle Washing Apparatus, T. Merry, London.
4056. Tying Mails, A. G. Chapman, London.
4057. Cycle Gear Cases, N. A. Phillips, London.
4058. Skating Rinks, W. A. Robinson, London.
4059. Ship's Compasses, L. Rellstab, London.
4060. Tires, T. Smith, London.
4061. Harmonicas, H. Paris, London.
4062. Explosives, S. A. Rosenthal.—(*J. S. von Romocki, Germany.*)
4063. Harness, A. H. Southwell and H. H. Humphrey, London.
4064. Insulators, R. Deléry, London.
4065. Drabbet Cloth, T. Burberry and F. D. Unwin, London.
4066. Syphon Bottle, H. Peter, London.
4067. Cutter Heads, F. W. Harrison, London.
4068. Wheels, S. C. Davidson, London.
4069. Gas Burners, H. A. Kent, London.
4070. Valve Gearing, L. Turner and H. V. Pegg, London.
4071. Coilers, J. T. Meats, London.
4072. Engines, E Dagnall, London.
4073. Vanillin, A. Mosticker, London.
4074. Smoke Apparatus, A. Palla, London.
4075. Chimney Draught Shield, C. B. Tully, Sligo.
4076. Stoves, C. J. Oliphant and A. Cunnew, London.
4077. Carriage Mechanism, C. and J. Richardson, London.
4078. Locking Devices, A. E. Bromell, J. W. Collin, and H. Collin, jun., Liverpool.
4079. Hat Protectors, A. Pemberton, Manchester.
4080. Cycle Mechanism, A. Ganderton, Birmingham.
4081. Air Guns, W. P. C. Beattie, Manchester.
4082. Printing Presses, C. Werkmeister, Liverpool
4083. Furnaces, W. Brothers, Manchester.
4084. Blotting Paper, E. J. Pape, London.
4085. Plate Glass, H. G. Harris, London.
4086. Paranitraniline Red, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
4087. Separating Heavy from Light Particles, L. Maiche, London.
4088. Connecting Telegraphic Cables, L. Maiche, London.
4089. Purification of Spirit, L. Maiche, London.
4090. Draw-off Valves, S. Wilkerson, London.
4091. Chimney Flues, A. J. Boult.—(*J. C. Granderath and Co., Germany.*)
4092. Box Locking Device, A. J. Boult —(*H. Tzschucke, Germany.*)
4093. Boots, A. Pearse, London.
4094. Sailing Boat, F. Bühnemann, London.
4095. Valves, H. Howell, London.
4096. Wheels, R. T. and C. Bellemy, London.

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4097. Obtaining Motion, R. C. Sayer, Bristol.
4098. Cutting Eggs, B. H. Watson, London
4099. Drying Paper Machines, A. A. Hunting and E. A. Leigh, London.
4100 Tires, J. Watson, Wilmslow, Cheshire.
4101. Balancing Valves, J. Shenton, Oldham.
4102. Bread, B. F. Bryant, Ramsgate.
4103. Confection, W. A. Williams, London.
4104. Bobbin Wheels, H. Meadowcroft and G. B. Schofield, Newhey, near Rochdale.
4105. Transformers, G. Adams, London.
4106. Hair Curlers, F. H. Shaw, Birmingham.
4107. Adjusting Bearings, R. Chambers and F. Hawley, Birmingham.
4108. Attachment for Ladies' Hats, F. J. Jones, Birmingham.
4109. Drive Chain, M. A. H. Rongler, Birmingham.
4110. Banjos, G. Houghton, Birmingham.
4111. Oil Burners, E. R. Weston, London.
4112. Lemon Squeezers, C. B. Carter, London.
4113. Boxes, H. A. Cobleigh, London.
4114. Bottles, E. Towers, J. Gibney, and J. C. S. Weills, London.
4115. Collar Attachments, G. Ward and J. E. Dodgshun, London.
4116. Grips, J Eakins, London.
4117. Bake Pans, W. G. Blair, London.
4118. Switch, R. C. Hart and R. S. Field, London.
4119. Railway Switches, G. M. Hilbert, jun., London.
4120. Shaping Metals, W. Hall, Birmingham.
4121. Wheels, E. Scally, Dublin.
4122. Cycle Saddles, C. E. Vail, London.
4123. Cycle Stand, R. Blacklock, Sunderland.
4124. Match Box, W. W. Williams, Tranmere, Cheshire.
4125. Artificial Light, J. R. Wigham, Dublin.
4126. Cotton Gins, H Jones, Manchester.
4127. Boot Sole, W Oakes, Northampton.
4128. Gas Engines, W. Sayer, Derby.
4129. Spanners, C. L Parkin, Sheffield.
4130. Locks, J. Brown, Dudley
4131. Electric Traction, C. Douglas, Leicester.
4132. Hair Curlers, A. S. Gilmore, London.
4133. Catching Rats, T. Thompson, Manchester.
4134. Lamp Burners, W. Bourke, Manchester.
4135. Punching Steel Plates, M. H. Cameron, Manchester.
4136. Casting Metals, W. B. Johnson.—(*The Pennsylvania Salt Manufacturing Company, United States.*)
4137. Heating Water by means of Gas, T. Fletcher and Fletcher, Russell, and Co., Ltd., Manchester.
4138. Electric Furnaces, F. J. Patten, Manchester.
4139. Sheet Metal Cans, J. W. Hill and R. P. McKay, Manchester.
4140. Pile Fabrics, J Morton, Glasgow.
4141. Window Glass, T. W. Horn, Glasgow.
4142. Cycle Handle-bars, T. Parker and H. C. Smith, Birmingham.
4143. Carding Engines, G. Andrews and J. Haley, Halifax.
4144. Teaching Typewriting, G. Ager, Halifax.
4145. Detergent Fluids, R. Stewart, Glasgow.
4146. Sash Locks, H. D. Fitzpatrick.—(*Miller Lock Company, United States.*)
4147. Cycle and Vehicle Wheels, D. Mannion, Birmingham.
4148. Mud and Dress Guard, W. H. and B. H. Jones, Wolverhampton.
4149. Miniature Practice Cartridges, M. Mullineux, London.
4150. Chimneys of Gas Burners, H. Walker, Bradford.
4151. Tubular Vaporisers, H. W. Aitken.—(*H. Kidd, New South Wales.*)
4152. Tobacco Pipes, E. H. Morley and S. Wilkinson, Manchester.
4153. Pump, W. Wheeler, Langley Green, Worcestershire.
4154. Stop Valves, M. Culligan, Dublin.
4155. Handles for Cycles, W. F. Muller, Havre, France.
4156. Suet Cutter, W. Stabb and F. Little, London.
4157. Driving Cycles, G. H. Bond, London.
4158. Waterproof Fabrics, J. and H. Markus, Manchester.
4159. Automatically-locking Sash Holders, R. K. Brown, London.
4160. Revolving Bar and Ropes, T. H. Vol Becque, London.
4161. Printing Pictures, H. H. Light, jun., J. A. Hoyle, and H. Holt, Manchester.
4162. Stopping the Pumps of Hydraulic Presses, J. W. Garrett, London.
4163. Valves, F. J. Hadfield, Sheffield.
4164. Advertising Sign, L. Gorer, London.
4165. Textile Vegetable Fibres, R. J. Eke, London.
4166. Rotary Meter, J. Readman, London.
4167. Cigar-shaped Tube for Smoking Tobacco, W. H. Allery, London.
4168. Organs, S. Howard, Manchester.
4169. Sock, A. Botting, London.
4170. Collision Mat, N. Douglas, London.
4171. Lamps, W. Ackroyd and W. Best, London.
4172. Vehicles, J. A. Jansson, London.
4173. Paper Pattern, M. A. Heyn, London.
4174. Tires, S. Bunting, Birmingham.
4175. Preserver, E. Thomson, London.
4176 Printing Presses, C. G. Harris and J. F. McNutt, London.
4177. Feeding Printing Presses, C. G. Harris, London.
4178. Cash Registers, D. W. Harper, T. R. Farnsworth, and R. L. Matthews, London.
4179. Lead, A. J. Boult.—(*S. Ganelin and J. B'ock, United States.*)
4180. Refrigerating Apparatus, W. F. Singer, London.
4181. Valves, S. Forter, London.
4182. Hoisting, J. G. Speidel, London.
4183. Lamps, C S. Dolley, R. Hawkins, T. M. Lightfoot, and H. T. Goodwin, London.
4184. Bearings, The Goold Bicycle Company, Ltd., and W. S. Wilson, London.
4185. Bookbinding, G. Hayes, London.

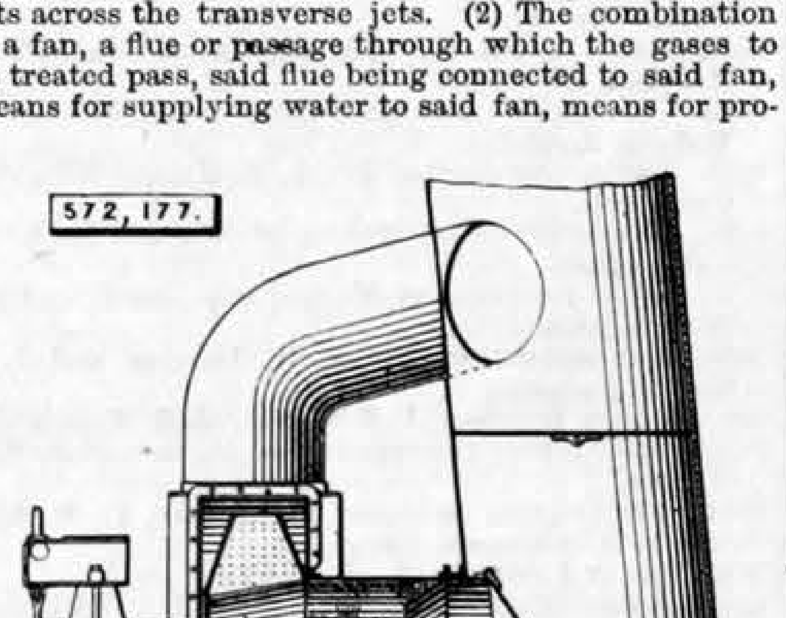
SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

572,177. Apparatus for Treating Fire Gases, *J. Patterson, Gourock, Scotland.—Filed August 31st, 1895.*

Claim.—(1) The combination of a flue for smoke and gases, a fan casing, a rotary fan in said casing, a passage connecting said flue and fan casing, means for discharging jets of water into said connecting-passage transversely of the current of gases passing there through, and means for discharging inducing jets across the transverse jets. (2) The combination of a fan, a flue or passage through which the gases to be treated pass, said flue being connected to said fan, means for supplying water to said fan, means for producing a jet or jets of water through which said gases pass, an inducing nozzle disposed in the passage leading to the fan, and a perforated ring surrounding said nozzle through which water under pressure is caused to pass in the direction leading to the fan. (3) The combination of a fan, a flue or passage through which the gases to be treated pass, said flue being connected to said fan, means for producing a jet or jets of water through which said gases pass an inducing nozzle disposed in the passage leading to the fan, and jet devices disposed around said nozzle through which water under pressure is caused to pass in direction towards the fan.

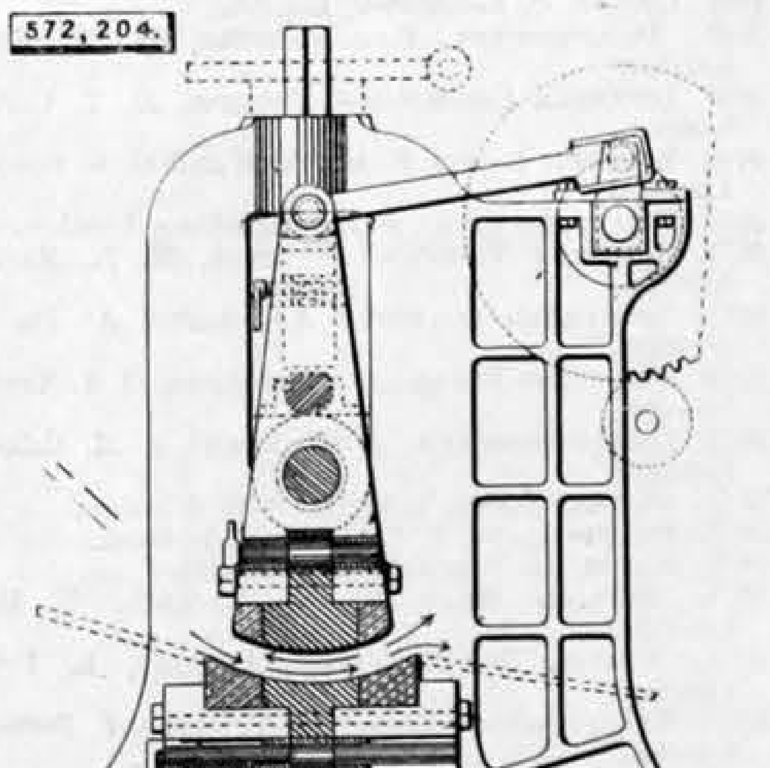
572,177.



572,204. Apparatus for Manufacturing Axles, &c., from Iron or Steel, *T. Higgins, Pittsburg, Pa.—Filed August 20th, 1896*

Claim.—(1) An apparatus for the purpose of shaping or forming car axles and other cylindrical-shaped bodies of metal, consisting of a stationary concave die, a convex die operating in conjunction therewith, a means for giving said convex die an oscillating movement, and a means for automatically feeding the same downward to place the pressure upon the blank between the dies, as described. (2) A means for rolling axles and other like shapes from bars of metal consisting of a stationary concave die, an oscillating rocker arm provided with a convex die at the base, the axis of which is parallel to that of the stationary die, a means for automatically feeding the convex die downward, a means for rapidly lowering or raising the same die, the journal formers arranged in each of the said dies, and means for operating the same towards or away from each other, all arranged and combined for service, substantially as set forth.

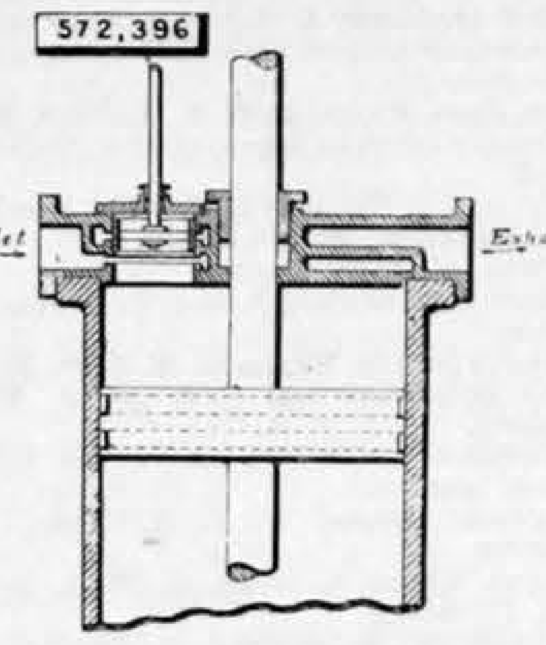
572,204.



572,396. Valve for Power Motors, *J. Anderson, Newcastle-upon-Tyne, England.—Filed April 12th, 1895.*

Claim.—(1) A power cylinder having a piston adapted to operate therein, a head or cover for said cylinder provided with a steam space D and an exhaust chamber E, a cylindrical chamber C provided with ports communicating with the steam space and exhaust chamber and opening into the cylinder, and a valve adapted to operate into the said cylindrical chamber and comprising a ring C' split or open at one side, a wedge G arranged in said split or opening and a bolt H securing said wedge in place, substantially as described. (2) In a power cylinder, a ring valve having a hub, a peripheral rim and radial arms connecting said hub and rim, said rim and one of the arms being split to receive a wedge G, and a bolt H passing through the split arm to secure the wedge in place, substantially as described.

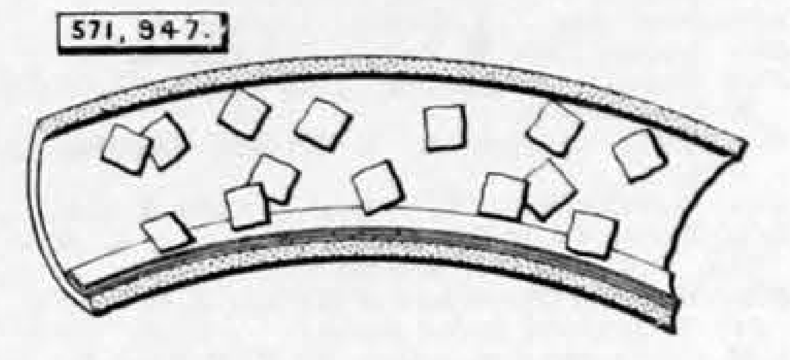
572,396



571,947. Pneumatic Tire, *H. Faulkner, Leicester, England.—Filed June 8th, 1896.*

Claim.—(1) A pneumatic tire containing within the air chamber, small pieces of puncture-closing material and a liquid, the puncture-closing pieces being free to move in the liquid and to distribute themselves automatically, substantially as set forth. (2) A pneumatic tire having the inner wall of its air chamber lubricated, and inclosing loose puncture-closing pieces within such air chamber, said puncture-closing pieces being free to shift about, substantially as set forth.

571,947.



572,051. Motor Vehicle, *J. F. Duryea, Springfield, Mass.—Filed March 6th, 1896.*

Claim.—In a motor vehicle, a main axle through which the propelling force is conveyed to the wheels thereof, a suitable motor, a main shaft driven by said motor, a cone pulley fixed on said main shaft, combined with a counter-shaft having a belt-pulley thereon, supported in axial alignment with said main shaft and main axle, gear connections between said counter-shaft and axle, one or more loosely-running driving belts uniting said cone and counter-shaft pulleys, idler pulleys applied to said belts, toggle lever frames supporting said idler pulleys in pairs in proximity to said belts, a cam shaft extending across the vehicle near said toggle frames having cams thereon for engagement with said frames, whereby said idler pulleys are moved against and from said belts, the operating lever, and connections between said lever and cam shaft, whereby the latter-named shaft is reciprocally rotated, substantially as set forth.

572,051.