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THE ENGINEER.

THE RAILWAY CLEARING HOUSE.

PROBABLY every one of our readers has heard of the Railway Clearing House, and may even have some vague notion as to its duties. There is, however, we have found, very little known about its precise functions outside railway circles, and the following notice has been prepared with the object of giving as briefly as possible a definite account of an institution upon which many of our facilities in transit and commerce depend.

When a passenger takes a ticket at King's Cross to carry him to some station on the Highland Railway, say Pitlochry, he pays 69s. 7d. if he be travelling first-class, or 38s. 9½d. if he intends to travel third. Should he be performing the journey by a night train, and is going first-class, he will probably pay an extra 7s. 6d., so as to enjoy the comforts of a sleeping car. Having paid his fare and secured his ticket, he considers that he has contracted with the Great Northern Company to carry him safely to his destination, and he feels satisfied that, barring accident, it will surely do this. The possibility of his being disturbed on his journey from some incident or other may pass through his mind, but one thing will not occur to him, and that is the likelihood of any further financial demand being made upon him by the railway, for his fare at least. Further, having secured his seat in a through carriage, he knows that unless something unforeseen occurs, he will go straight through to his destination without any change. It does not concern him in the least that when he paid the amount of his ticket at the King's Cross booking-office he was concluding a contract in which at least seven Corporations were interested. In his journey from London to Pitlochry he will travel first over the Great Northern from King's Cross to Shaftholme Junction, north of Doncaster; secondly, over the North-Eastern to Berwick; thirdly, from Berwick to Hilton Junction, Perth, on the North British; fourthly, during this portion of his journey he would pass over the Forth Bridge, a separate undertaking; fifthly, Perth is a joint station; sixthly, the Caledonian from outside Perth to Stanley Junction; and, finally, the Highland Railway to Pitlochry. In addition to this apparent complication the North-Eastern Company requires an extra rate for carrying him over the high-level bridge at Newcastle, the North British for the Border Bridge at Berwick, and the Forth Bridge Company for the Forth Bridge. Nor will this imaginary passenger concern himself that the carriage he is riding in is the property of the Great Northern Company, which company is, therefore, providing the necessary accommodation for conveying him over the lines of other companies. Or it may be that the carriage is the joint property of the East Coast companies—the Great Northern, North-Eastern, and North British—so that, as far as Perth, he is in a carriage belonging to the company over whose line he is then riding, but after reaching Perth not one, but three companies, are interested in obtaining from the Perth Joint Station Committee, the Caledonian Company, and the Highland Company, whatever sums are due to them for having provided the vehicle in which the passenger has been riding. The benefits of these through facilities, as shown in the example quoted, are conferred on the public by the co-operation of the railways operating through the Railway Clearing House, an establishment that was brought into being in 1842 through the instrumentality of Mr. Kenneth Morison, then an auditor of the London and Birmingham Railway, and subsequently the first secretary of the Clearing House; Mr. Robert Stephenson, son of George Stephenson; and Mr. Carr Glynn, afterwards Lord Wolverton, the then chairman of the London and Birmingham Railway. Previous to its foundation passengers travelling any journey involving the passage over two or more companies' lines had to purchase a fresh ticket at the junction of each line, and change carriages, as there were then no such things as through tickets or through carriages.

All that has been changed, and through the instrumentality of the Railway Clearing House one can book from all large towns to nearly any railway station in the kingdom, and in many cases a passenger can exercise his own inclination as to the route by which he will travel. Through carriages are now run between Halifax and Kingswear by the Great Central and Great Western routes, which touch eight different properties:—Halifax Joint Station; Lancashire and Yorkshire from Halifax to Bradley Wood Junction; London and North-Western from Bradley Wood Junction to Huddersfield Junction (through Huddersfield Joint Station—a separate property); over the Lancashire and Yorkshire to Penistone; thence Great Central to Nottingham, passing through Nottingham Joint Station—a separate undertaking; Great Central again to Banbury and Great Western to destination, which includes Bristol Joint Station—another separate institution. The Great Central Company also runs through coaches from Leeds to Bristol which touch seven different bodies, and the through carriages in the summer from Sheffield, Nottingham, and Leicester to Blackpool *viâ* the Midland and Lancashire and Yorkshire affect six corporations. There are hundreds of cases that appear simple to the traveller, but which are complex in the relations they bear to one company or another from the varied interests that are affected as the vehicles make their journeys. Take a well-known instance, which appears quite simple:—The through coaches that are run several times a day to Leeds from King's Cross and *vice versâ*. These affect four different concerns:—The Great Northern, the West Riding and Grimsby, Wakefield—Westgate—Joint Station, and Leeds Joint Station. As some of these trains also travel through the Kirkgate Joint Station at Wakefield, a further division has to be made on behalf of those interests and of the Lancashire and Yorkshire, whose line has to be passed over to get through Kirkgate station.

All these complicated workings, which enable a traveller to make his journeys with so much less discomfort and with greater speed than formerly, are only possible by means of the arrangement made with the Railway Clearing House by the companies interested.

Then what is true of passengers is true of goods, minerals, parcels, horses, cattle, &c. &c. They can all now be sent through to their destination without change of vehicle, no matter what the distance nor how many companies are interested, and in most cases they can be carried on through rates. But if the passenger bookings and the movements of through carriages provide food for thought and meditation, the problems revealed by the through rates for goods, &c., and the journeys of goods wagons provide still more. The number of goods rates are far in excess of those for passengers, and whilst through passenger vehicles simply run between centres for which there is a frequent and regular traffic, goods vehicles have, of course, to go anywhere and any way.

But it is not only the passenger who does not concern himself as to the proper proportion and disposal of the fare he has paid and the ownership of the vehicle in which he has travelled, but the railway companies themselves do not worry in the least. They leave all that to the Clearing House which apportions out the amount due to the various companies for their share of the fare paid by the passenger and due from them for the accommodation provided by the originating company.

And now it will be interesting to ascertain how this is achieved. No through booking for either passengers, parcels, animals, goods, or minerals can be put into force until the companies concerned have agreed thereto, and in the event of the rate being competitive, until the competing companies have been advised. This latter is done owing to an agreement amongst all the companies, and it allows competing companies to adopt a similar rate for their routes, or if they already have a rate in force, to reduce it to suit. All rates for whatever class of traffic are limited by statutory powers. When a through rate has been agreed to the Railway Clearing House is advised, and it is put on record.

It perhaps hardly need be said that when a journey is made or a load is carried that is wholly on one company's line, the Railway Clearing House is not called upon to do any work, nor is it when only two companies are interested, so far as passenger traffic is concerned. What are called local fares belong entirely to the issuing company, and two companies' tickets are dealt with by the audit offices of the two companies, except in certain special cases which need not here be referred to. The procedure when the Railway Clearing House has to act is as follows:—At the end of each month a return is sent to the Railway Clearing House from every station in the kingdom showing those "foreign" stations to which there are through bookings from that station, and in which more than two companies—the home and one "foreign" company—are interested. The progressive numbers of the tickets, as they were at the end of the preceding month, must be shown, and the numbers as they are at the end of the current month. The details of the tickets issued must then be given, whether first, second, or third class, single or return, and all tourist and cheap rate tickets of all kinds must be included, the rate added and the amount shown. The route must also be given, and the issues to each company must be kept together. This return is sent to the Clearing House within the first few days of the month, and on arrival there the commencing numbers are checked with the closing numbers of the preceding month. For children's tickets only one-half of the ordinary fare is charged, and only one-half is entered on the list. The other half of the ticket, or the triangular piece that is cut out of it, is sent with the return, as credit, to the Railway Clearing House. From collecting stations there are sent at the end of the month all "end-number" foreign tickets that have been collected, as well as the whole of certain special series, except where only two companies are interested. These are put together by the collecting stations in progressive order and each station separately, and are a check on the booking clerks' returns. It has already been said that all through rates are agreed to by the companies interested, and there is on record at the Clearing House the agreed proportions due to each company. With these proportions before them the clerks at the Railway Clearing House apportion out the amounts on the returns. Any discrepancy is pointed out at the time, and an effort made to dispose of it forthwith. At junctions where tickets are examined the nippers bear a symbol which is impressed on the ticket when it is nipped, so that the clerks at the Railway Clearing House can see if the passenger has travelled by the route he was booked. If he did not, then the company which carried the passenger is credited with the sum due, instead of the company which would have received the amount had not the error been discovered. These regulations apply to all tourist and cheap fare tickets, the prices of which must necessarily have been agreed to by the companies concerned, and the Clearing House advised. As payment is made on the outward halves of return tickets—ordinary, tourist and excursion—the return halves are not required at the Railway Clearing House unless the passenger has travelled by a wrong route, in which case the ticket must be sent in so that the payment may be adjusted; this may possibly have to be done in a subsequent month. Excess fares in which two other companies are interested must be reported to the Railway Clearing House so that the amounts may be apportioned.

In due time all the various returns are dealt with, and then a balance between company and company is struck, all the credits for one company are added together with the debits, the total of one deducted from the other, the whole resulting in a sum being either due to or from each company. An advice of this is sent to the company, and in the former event—a sum being due—the Railway Clearing House bankers send a cheque, and in the latter the company pays the amount due, to the credit of the Clearing House at its bankers.

All parcels, fish, horses, dogs, carriages, &c., sent by passenger trains are entered on a way bill, which shows amongst other items the weight and rate and the total charge which has either been paid by the consignor, in which case the amount is entered in the "paid" column, or left to be paid by the consignee, in which event it is entered in the "to pay" column, or the sending company may have paid some charge in connection with the consignment, which amount has to be collected from the consignee, in which case the amount is entered in the "paid on" column. At the end of each month a return is sent to the Clearing House of every consignment of parcels, fish, horses, dogs, carriages, &c., despatched to or received from a foreign station, a separate return being used for each station—but these returns are not to be sent in if the total between two stations is less than 5s. for a month, a summary form being used instead. These are filled up from the way bills, the sending stations using forms that are printed in black and the receiving stations using red. On receipt of these forms at the Railway Clearing House the two are compared, and if they agree—and if they do not agree, then after a settlement has been arrived at– the items are apportioned out to the various companies. On parcels, but not on horses and dogs, the sending company gets a terminal charge of 1d. per package and the receiving company of 2d. per package. The remainder is divided according to the mileage each company has carried the consignment. The Railway Clearing House prepare tables of the distances between all points on which these divisions are made, unless there be a special rate under agreement. Any extraordinary tolls are deducted along with the terminals. Where the monthly total between two stations is less than 5s. a separate return is sent in, but with a view to reducing the clerical labour these are apportioned *pro rata* with the heavier traffic. For the carriage of mails and Parcels Post hampers the sums paid to the railways by the Postmaster-General are divided according to the amount of parcels traffic—both local and foreign—carried by each company, for which purpose the Audit Department furnishes the Railway Clearing House with information as to the receipts from local parcels traffic.

Different from the passenger fares and the goods receipts—which are paid for monthly—a balance for parcels traffic is only struck half-yearly—in June and

December—but a monthly payment on account is made, or collected as the case may be, which is determined by taking as an average the figures for the corresponding month of the previous year. Interest at 4 per cent. per annum is paid on those amounts that are found to exceed the sums paid to the companies when the half-yearly balance is arrived at.

What has already been said will give an idea as to how the goods, cattle and mineral traffic is dealt with. It is practically dealt with in the same way as parcels traffic, even as regards the totals under 5s., except that 20s. is then the limit. The terminal charges, however, differ considerably, and there are different charges for traffic that is collected and delivered—"carted" and "not carted."

All insurance premiums paid for value parcels, &c., and all claims for loss, damage, or delay, and the various bad debts, are adjusted by the Railway Clearing House on receipt of authority from the companies interested.

A very important part of the work of the Clearing House is carried out in what is known as the Mileage and Demurrage Department. This department provides for the payment to the owning companies for the services rendered in providing stock for the carriage of goods, horses, and carriages, as well as for passengers. After what has already been said, it will be understood that when a company—say the North Stafford—sends some crockery from Hanley to Dunbar on the North British Railway, *viâ* Egginton, and the Great Northern and North-Eastern, and it is carried in a North Stafford truck, that company should get a rebate from the Great Northern and North-Eastern Companies, because it—the North Stafford—provides the wagon. Therefore the Clearing House sees that the charges are regulated accordingly. But it does more. In order to encourage a speedy return of the North Stafford wagon to its owners ready for further use, if required, it places a penalty on its late return. According to the distance to be travelled, and the companies whose lines have to be gone over, a certain time is allowed for the return of the vehicle to the parent company, and if this time is exceeded, either at the arrival end or *en route*, the company delaying the return has to pay a demurrage charge to the Railway Clearing House, by whom the owning company is credited. These penalties are, however, modified to meet certain conditions, such as re-addressing forward, loaded back with traffic for the parent company, damaged stock, &c. The Railway Clearing House keeps touch of all these vehicles by means of its number-takers, who are stationed at every junction at which exchanges of vehicles are made from one company to another, and it is aided in this by weekly returns from the railway stations giving details of the foreign stock that has arrived and been despatched. The Railway Clearing House has about five hundred number-takers. Demurrage and mileage balances are paid quarterly.

Perishable goods, if not carried in covered trucks, have to be sheeted over. A record is kept of all the sheets that pass on to and off all foreign lines, and charges are made if these are not returned to the owning company within a certain time.

The Railway Clearing House plays a leading part in the recovery of lost property on railways. It is advised of all missing luggage, &c., and of all luggage that has apparently gone astray, and by comparing the one with the other—as, for instance, a hat box found at Plymouth on the Great Western with an inquiry for one by a Midland passenger at Birmingham, due to the owner having an old label still on his property—missing articles that cannot be fully traced by the railway companies are frequently found and returned to their owners.

Finally, the Railway Clearing House is the centre of all legislation and agreement amongst railway companies. Quarterly meetings are held there of the general managers of all the companies, and to them are submitted the minutes of the meetings of the traffic superintendents and goods managers, who meet at least quarterly, and generally oftener, and to whom in turn committees report on rates and fares, excursions, claims, rules and regulations for working the line, and questions referred to the Arbitration Committee for settlement in dispute. The locomotive and carriage and wagon superintendents meet there, also the engineers—civil—the accountants, and the telegraph superintendents.

It is the Railway Clearing House which is responsible for advising the railway companies as to the variations other companies make in their loading gauges. It prepares the tables of distances already referred to, and publishes a handbook of stations and sidings, saying where situated, on which railway, and if there be a loading dock and crane, and, if so, the lifting capacity of the latter, whilst the maps issued by the Clearing House showing the various railways and connections, colouring them according to ownership, are very valuable.

The following data with reference to the year 1905 will give a sufficient idea of the performances and expense of the Clearing House:—

Number of pairs of stations in the merchandise traffic (= number of settlements from same traffic)	7,363,304
Number of pairs of stations in the passenger traffic (= number of settlements from same traffic) ...	7,844,913
Number of pairs of stations in the parcels and miscellaneous (= number of settlements from same traffic)	6,336,089
Number of journeys for which mileage was calculated	12,115,860
Number of days for which demurrage was charged ...	647,942
Number of junctions the traffic of which was reported to the Clearing House	105
Number of entries at junctions of stock exchanged...	18,289,553

Amounts accounted for in the same year.

	£
In the merchandise department	19,849,485
In the passenger department	4,885,507
In the parcels, &c., department	2,439,321
In the mileage department	1,151,699
Total ...	£28,325,912

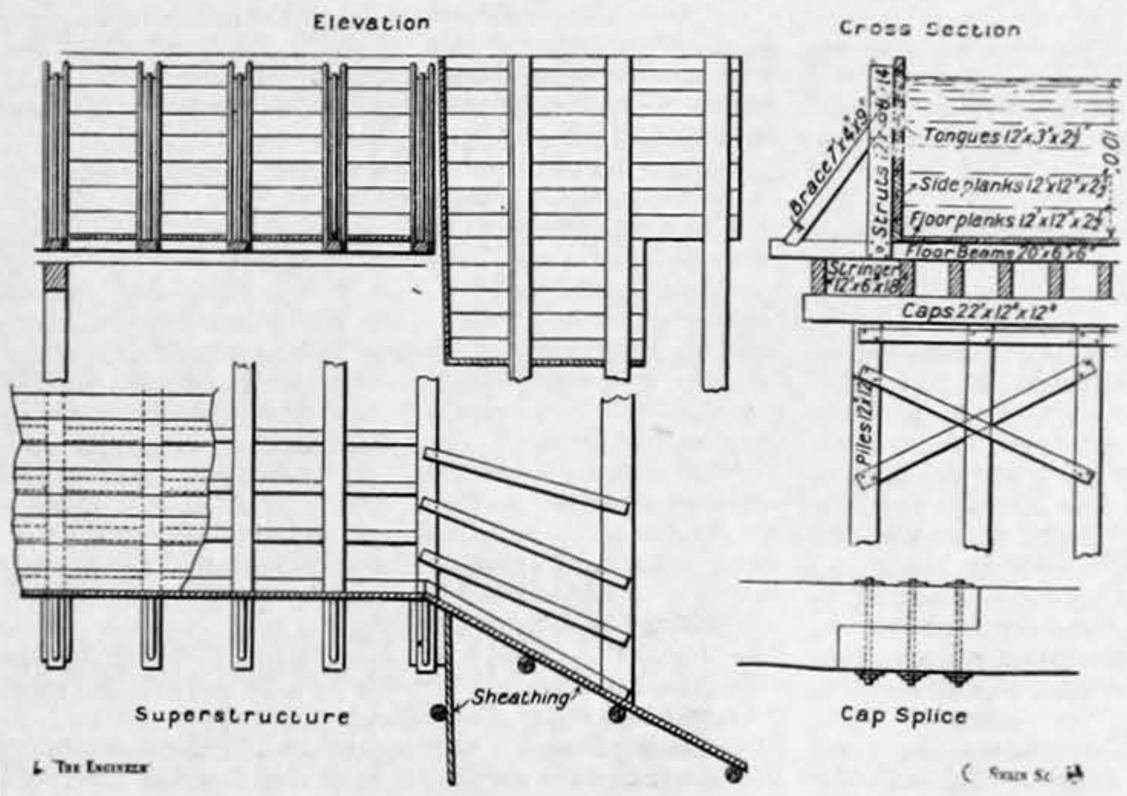
The expenses of the Railway Clearing House are borne in proportion by the companies, according to the actual work done. The actual time taken up in the preparation of each company's account is charged to that company, and to this is added the expenses of the number-takers, which are apportioned according to the wagons that each company has passed on to a foreign line.

The offices of the Railway Clearing House are situated in Drummond-street, London, N.W. It was established in 1842, received certain powers by Act of Parliament in 1850, and obtained the rights of a corporation by a further Act in 1897. Each company is represented by a delegate—generally the chairman of the company—on the Clearing House Committee, which elect a chairman and a Managing Committee of seven. The present chairman is Lord Claud Hamilton, and the secretary is Mr. Harry Smart.

THE UNITED STATES RECLAMATION SERVICE.

IN the Western States of America are immense tracts of land upon which so little rain falls that they are not cultivated. These lands, which are owned by the State, are chiefly used by the ranchers to graze their stock during the mild part of the year, reserving the grass on their homesteads for the hard winter months, using wind pumps to supply them with water. In the districts where small irrigating ditches have been built and the ground cultivated, splendid results have been obtained. For instance, near Mitchell, Nebraska, three crops of alfalfa and oats, running 50 or 60 bushels per acre, are raised, and are nothing out of the common.

The most advantageous manner by which the lands can be irrigated is by the construction of very large canals, bringing the waters of some river many hundreds of miles, costing, with the necessary dam and reservoir, &c., millions of dollars—far too great an expense for any private enterprise. As a matter of fact, private companies have constructed canals, but with one or two notable exceptions they irrigate very small areas in comparison with the land left not irrigated. The United States Government, therefore, decided to build the canals themselves for the people, and then to sell land thus irrigated in homesteads of eighty acres, the price per acre being fixed by dividing the actual cost of construction, plus 5 per cent. interest, by the total number of acres irrigated. But no project would be considered feasible if the cost per acre amounted to more than 24 dols.—roughly, £4 18s. The price usually ranges between 15 dols.—£3 2s. 6d.—and 24 dols.—£4 18s. The scheme is that the Government works and maintains the canal for ten years after its completion, and then turns it over to the farmers in thorough working order and repair. The farmers then have to work and maintain it themselves.



FLUME FOR IRRIGATION CANAL

To put all this concisely, the Reclamation Service was created by law on June 17th, 1902, authorising the survey and construction of irrigation works for reclaiming arid lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, Wyoming, and Texas, from the proceeds arising from the sale and disposal of public lands. Immediately this law was brought into force Civil Service examinations were held throughout the country. No difficulty was found in obtaining experienced Civil Engineers and graduates of engineering colleges. Thus a very efficient body of men was soon brought together. When a possible irrigation project has come to the notice of this department, an engineer is detailed to examine it. He is given considerable authority and discretionary powers as to the lines of investigation.

Engineers' examination.—The engineer first satisfies himself that there is sufficient water available for the land, either by perennial flow or by storage. The former is determined by taking a few rough measurements of the main drainage channel, and the latter by studying any maps showing the drainage areas tributary to the district to be irrigated, as well as in some cases the adjacent areas which might be made to contribute part of the water required. If the engineer considers it a "storage proposition," he looks up all records of rainfall and of run-off in the drainage lands. If there are no such records he must form some idea of the quantity of water which passes a given point on the main drainage line by examining on the ground all high-water marks, and getting all the information possible as to the duration of floods from the people who have lived in that neighbourhood. He will then establish gauging stations and make arrangements for as complete a system of records of them as possible. Then the nature of the drainage area, whether forested or otherwise, is noted. And in order to ascertain its general physical features, an examination extending over some days is made. In this way a general idea of the possibilities of the drainage area is formed. The engineer also examines any other possible reservoir site in a rough way, using a hand level and an aneroid barometer, and makes a careful note of the nature and availability of material for construction of dams.

Reconnaissance.—Assuming that the engineer's examination has shown the water supply to be sufficient for the reclamation of an area of land, and that the relative position of the land and water are such that the project seems practicable, a reconnaissance survey is made. The object of this reconnaissance is to determine whether or not a preliminary survey should be made, and the character and extent of such a survey. To determine this the reconnaissance finds approximately the relative elevations of the controlling points and the area of the land to be reclaimed. The reconnaissance is started from some controlling point, which may be either the proposed point of diversion or the outlet from the reservoir, the highest point of the irrigable land, or the lowest pass of a ridge through which the canal must go. The survey consists simply of running one or more traverse lines through the area, so set out that they will give the necessary information. The survey is made with one instrument only, the transit-theodolite. Distances between the stations are obtained by stadia, directions by the magnetic needle, and difference of elevation by vertical angles. In work of this kind three men are required—a transit man, a rodman, and a teamster. If the character of the country permits, the transit man travels between stations in a light wagon, and the rodman travels on horseback. In this manner a reconnaissance is rapidly and cheaply made, and provides sufficient data for the determination of the questions in hand at a minimum expense.

During the progress of this survey the engineer makes a careful examination of the land and notes all its advantages and disadvantages. The principal points to be settled are:—The fertility of the soil, the difficulties of preparing the land for irrigation, the crops most suitable for the soil and climate, the number of crops which can be counted on annually, and the probable value of such crops. From the information obtained, a rough estimate of the cost of construction is made, and thus determines if the cost per acre for conveying the water to the land will enable the farmer to keep himself and pay back the cost of the works to the Government in ten years.

Preliminary survey.—The results of the reconnaissance being found favourable, a preliminary survey is made. The object of this survey is to be the guide of the location survey, and as such it makes all trial lines and maps all the necessary topography, and eventually marks the ground through which the location survey will follow. The party organisation for a preliminary survey usually consists of one chief of party, a transitman, a levelman, a plane-table man, and the necessary rodmen and camp assistants. The chief of the party gives the direction of the line, keeping a few miles ahead of the party. The transitman follows with an angle line, leaving stakes at every 100ft. The number of the station is marked on each stake, and the distances are chained. The levelman follows and marks the elevation on each stake. These levels are run with great accuracy, the limit not being allowed to exceed $0{\cdot}05\sqrt{\text{distance in miles}}$. Permanent bench marks are established every half mile. The transit notes are plotted in camp from day to day to a scale of 100ft. to the inch, and plotted upon the plane-table sheets, and the points marked with the stake number and elevation. These sheets are then taken into the field by the plane-table man, and the topography in 5ft. contours is mapped with the alidade and stadia for a distance varying, according to the country, from 300ft. to 500ft. on each side of the line. Solar observations are taken every day, and observations upon Polaris are taken at each change of camp.

Location survey.—The engineer makes a paper location upon the plane-table sheets that were made on the preliminary survey, and by their help he decides the number and nature of the structures required on the canal. He then takes the sheets into the field and transfers the points of intersection of the curves marked on the sheets, with the aid of a tape, to the ground. The transitman follows, putting in stakes at every 50ft., and at the beginning and end of curves leaving hubs with tack points driven flush with the ground, so that nothing will displace them. The levelman follows and marks the elevation on each stake. B.M.'s are left at every 1000ft. Then follows the cross-section party, cross-sections being taken at each stake unless the ground is very uniform, when it is taken in the middle and where the ground changes. The transit notes are plotted in camp from day to day upon the plane-table sheets, the preliminary and location survey being shown in different coloured inks. The cross-section notes are also plotted and computed from day to day, and a profile map is also kept up. At the end of the survey very little remains to

be done, and the engineer's estimate is very soon sent in to the consulting board of engineers for their approval, and then the contracts are ready to be let.

One of the most important matters to be decided in the final location is the velocity which the water must have for a given material. It involves changes of gradients and changes of cross-sections for different classes of materials; for if the velocity is too high the material of the bottom and sides will be eroded and carried to places where it will be deposited, and where it will have to be removed at some expense every year; and, again, if the velocity is too low there will be an unnecessary outlay in first cost of excavation. The following limiting values for velocity are generally used:—

2ft. to 3ft. per second in ordinary soils.
3ft to 3·5ft. „ „ „ firm soils.
5ft. to 7ft. „ „ hardpan and soft rock.
8ft. to 10ft. „ „ cement work.
15ft. „ „ solid rock.

And for the side slopes of canals the following limiting values are generally used:—

¼ horizontal to 1 vertical in rock cuts.
1 „ „ „ firm soil.
1½ „ „ „ ordinary soil.
2 „ „ „ very light soils.

In the determination of the velocity and discharge of water in open channels Kutter's formula is used:—

$$V = \left(\frac{41{\cdot}6 + \frac{{\cdot}00281}{s} + \frac{1{\cdot}811}{n}}{1 + \left(41{\cdot}6 + \frac{{\cdot}00281}{s}\right) n} \right) \sqrt{r s}.$$

and $Q = A\ V$.

Where $r = \frac{\text{Area}}{\text{Wetted Perimeter}}$,
s = Grade,
n = Constant, varying with the ground through which the water flows.

The value of the constant "n" has often been in dispute, but the following values are the result of a series of practical experiments by one of the U.S. Government engineers, and is used by the U.S.G.S. in preference to the values given for "n" by Trautwine, Wilson, and others.

$n = 0{\cdot}175$ for canals in earth in excellent condition, well coated with sediment, regular in cross-section, and free from vegetation, loose pebbles, &c.
$n = 0{\cdot}020$ for canals in earth in good condition, lined with well-packed gravel, partly coated with sediment, and free from vegetation.
$n = 0{\cdot}0225$ for canals in earth in fair condition, the wetted surface being lined with sediment, and an occasional patch of algæ or loose gravel without vegetation.
$n = 0{\cdot}250$ for canals in earth in fair condition, few sharp bends, fairly uniform cross-section, water slopes and bottom lined with sediment or loose, coarse gravel free from vegetation.
$n = 0{\cdot}0275$ for canals in earth, below average in grade alignment. Cross-section having indentations in the sides, the edges in places partially filled with earth and gravel. Also applies to a smooth, regular surface if the channel be partially filled with aquatic plants.
$n = 0{\cdot}300$ for canals in earth in rather poor condition having the bed partially covered with *débris*, with smooth sides and bottom.
$n = 0{\cdot}050$ for canals in earth with about two-thirds of the channel filled with aquatic vegetation.
$n = 0{\cdot}040$ for canals in earth with about one-half of the channel filled with aquatic vegetation.
$n = 0{\cdot}0350$ for small ditches with a rough, uneven bed and for canals in earth in fairly good condition, but partially filled with aquatic plants.
$n = 0{\cdot}0300$ for canals in earth in rather poor condition, bed partially covered with *débris*, comparatively smooth sides and bottom; bunches of grass and weeds projecting into the water and aquatic plants growing in the channel.

Reservoir and dam site surveys.—The surveys of reservoirs and dam sites are made by plane-table methods, except where the site is densely wooded, when transit and stadia methods are used. In cases of reservoirs the scale generally adopted is 1000ft. to the inch with 10ft. contours. In the case of a dam site the scale generally used is 50ft. to an inch with 5ft. contours, except in some cases where the detail of topography is not great, and then a scale of 100ft. is sometimes used. One or more permanent B.M. are established near the proposed dam site, and the elevation determined with reference to the river bed if a permanent B.M. of the topographic is not available, and a line of levels connect the B.M. with the top contour of the survey. A line of levels is run up the valley of the reservoir, stakes are driven and flags erected at every point where a 10ft. contour crosses the line. If the reservoir be wide or on timbered ground, so that the angle connections cannot be frequently made with the contour crossings, points on the top contour are also established. Then from a carefully laid out base like a plane-table, triangulation is extended; and where the reservoir site covers more than three consecutive plane-table sheets, all the angles of the triangulation are measured by the transit; and the relative position of the stations computed and plotted on the plane-table sheets before beginning the plane-table surveys. Secondary points for the control of the sketching are fixed by stadia methods.

The transit and stadia method.—Generally the method used is to run a traverse line up the valley of the reservoir site, and one along the top contour of the survey, and then connect these points by traverse lines, differences of elevation being obtained by hand level, and distances by the stadia.

Flumes.—The engraving on page 2 shows the type of wooden flume used. It is intended to put up concrete flumes in the future, as past experience has shown that the cost of maintaining a wooden structure for ten years would have been sufficient to have built a permanent structure in concrete in the first instance.

Quantities.—Wooden Flume.

	No.	Size.		B.M.
Floor planks	16	12ft. by 12in. by	2½in.	480
Side planks	22	12ft. „ 12in. „	2½in.	660
Tongues	36	12ft. „ 3in. „	⅝in.	54
Floor beams	3	20ft. „ 6in. „	6in.	180
Floor beams	1	26ft. „ 6in. „	6in.	78
Stringers	7	12ft. „ 6in. „	8in.	756
Caps	1	22ft. „ 12in. „	12in.	264
Struts	8	12ft. „ 8in. „	14in.	896
Braces	2	7ft. „ 4in. „	4in.	19
Tie beams	8	20ft. „ 2in. „	4in.	107
Foot plank	1	12ft. „ 12in. „	2½in.	30
Block	2	12in. „ 12in. „	4in.	8
Blocks	2	6in. „ 18in. „	6in.	9
				3541

	No.	Size.	Lbs.
Drift bolts	28	—	14
„ „	28	—	29
„ „	5	—	9
„ „	2	15in. by ⅞in.	1
„ „	400	40 d. spikes	24
			77

The estimated cost of this flume was obtained thus:—

	Dols.
3541ft. B.M. at 22·50 dols.	79·67
77 lb. iron at 5 cents	3·85
Labour at 15 dols. per 1000ft.	52·80
10 piles at 8 dols.	80·00
12	216·32
Per running foot	18·02 dols.
	= £3 14s.

The flume was constructed of Oregon pine.

ITALIAN INDUSTRIES.

(By our Special Representative.)

No. IX.*—TEXTILE INDUSTRIES.—PART II.:—COTTON.

THE spinning and weaving of the produce of the cotton plant in Italy may be called an industry of yesterday. Fifty years ago it was, comparatively speaking, non-existent, and only as lately as 1880 Italy was one of Manchester's best customers for yarns. The cotton industry here is an upstart when compared with that of the silk, but the upstart is endowed with a bodily vigour and an energy of purpose which have enabled it now to take the second post in the list of the financial enterprises of this country, and to begin to menace the supremacy—I may call it almost monopoly—of which England has been for so long so justly proud.

Were it not, in fact, for climatic reasons, this supremacy would be even more endangered than it is. The dry air of Italy renders the spinning of the very highest counts a practical impossibility, and even in those of from 80 to 100 English—the highest turned out here—expensive machinery has to be used to produce, artificially, the moist atmosphere with which Lancashire is endowed by Nature. For this reason it is not likely that Italy will ever compete with England in cotton goods of the finest qualities, though in the case of the great majority of articles in which a coarser thread is employed, she is beginning to be a serious rival, and the competition will be ever keener. It is true to say that English spinners and weavers, who have the means of knowing the state of the cotton industry here, and the miraculous progress made by it only in the last few years, may well have grounds for apprehension.

Industries, like countries, have their epoch-making monarchs, and men of the type of Baron Cantoni, or of Signor Cristofero Crespi, may well be said to have the right to bear the title of "The Great" after their respective names, when they are spoken of by future generations of cotton-spinners who reap what they have sown. Czar Peter and King Frederick possessed, by the chance of birth, a wider sphere of action, and consequently took the opportunities offered them of exercising that action over a wider zone, but even these great monarchs were not endowed with more energy, patriotism, and desire for new outlets to the dormant energies of their countries than were such men as Cantoni and Crespi, two of the principal pioneers of the now potent cotton industry of Italy.

Born in 1833, and educated originally for the bar, Cristoforo Benigno Crespi was already a man of thirty-two years old when he took the tide at the turn which "led on to fortune." Study and travelling in Lancashire had taught him that the systems in vogue in the few and lately-established little cotton mills of his native country were antiquated, slow, and unproductive. So, with the derisive material capital of £200, coupled with the inexhaustible moral capital of his iron tenacity of purpose, he set to work on a tiny cotton mill of his own, and soon after won one of his greatest commercial victories, a victory which, like all great discoveries, seems simple and easily achieved to those who constitute themselves "prophets of the past." This victory of Crespi was nothing more than in his being the first to put Italian cotton spinners into direct communication with Egypt, India, and America for the importation of their raw material.

A few years passed, and he had put away enough money to be able to rent the cotton mill of Vaprio, into which he introduced the new ideas which he had learnt in England. Again a few years, and he had bought the spinning factory at Vigevano and built the weaving establishment at Ghemme. These concerns he sold, in a flourishing state, in 1877, to his brothers, and set his hand to the colossal enterprise with which his name is connected, the "Stabilimento e borgata Crespi"—Crespi's mills and model town.

As a proof of his success, it is enough to say that at the Paris Exhibition he was awarded not only the "Grand Prix" for the articles which he exhibited, but also three medals for his practical humanitarian efforts to ameliorate the condition of his workmen. Praise was unanimous from the commercial and from the philanthropic point of view. Such is a short story of one to whom Italian cotton spinners may well award the title of *pater patriæ*, one whose firm now employs about three thousand workmen, and whose *borgata*—model town—is possessed of church, schools, ambulance hall, washing houses, bakery, kitchens, workmen's cottages, a theatre, and a band.

I have drawn the above sketch of the life of one of the pioneers of this great industry merely to illustrate the lives of many others like him, and to deduce, as a consequence of the energy of men like this, the phenomenal development which has taken place in the cotton industry in Italy in so short a time. The statistics of the actual production of the country are extremely hard to arrive at. The desire to escape, as far as possible, from a short-sighted and dangerously burdensome system of taxation, professional jealousy and ever-increasing aspirations gradually to rival the colossus of Lancashire in the cotton trade of the world, all these factors combine to create a state of diffidence of outside investigation, and to oblige the manufacturer in this branch of trade courteously to deny all information, or wilfully to understate the data which he gives. For reasons, however, which I am not at liberty to publish, I believe that I am right in calculating that at the present moment there are in Italy nearly 150,000 looms—hand looms not included. On this basis, and reckoning on a daily production of 25 m. to 30 m. per loom, there would be a yearly output of over 1,000,000,000 m. There are probably about 5,000,000 cotton spindles giving work to about 300,000 men, and rendering necessary an importation of the raw material to the extent of about 700,000 bales, of which about 500,000 are American, 100,000 East Indian, 30,000 Egyptian, and the rest from other quarters of the globe.

To an Englishman who reads these statistics the figures may seem as pygmies in comparison with the giant of Lancashire, but the pygmy is growing with a precocious rapidity little short of miraculous, the exports are increasing, the imports are diminishing, and, given the comparative cheapness of Italian water power as against English steam power, and of Italian labour as against English labour, the cotton industry of this

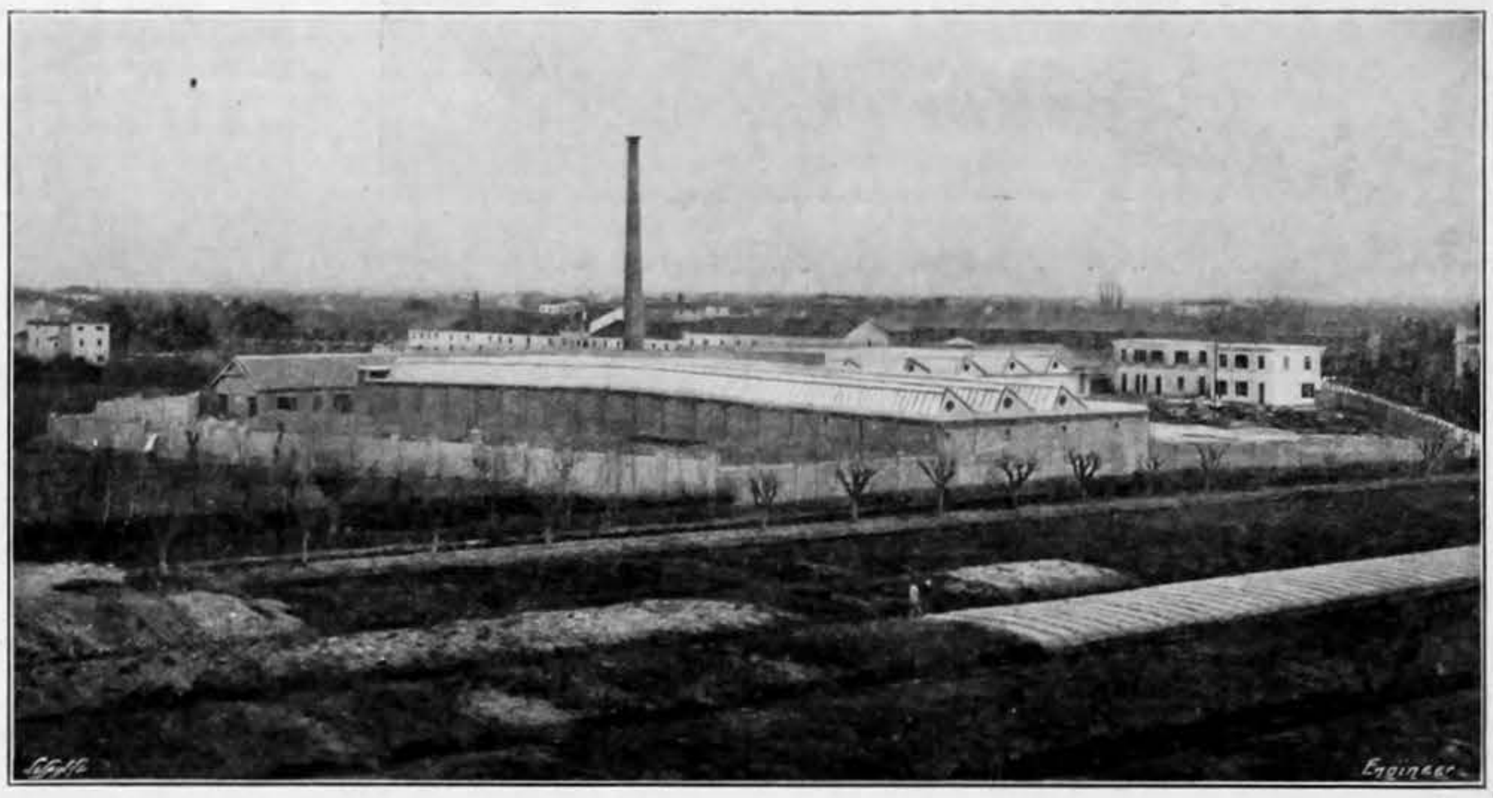


Fig. 1—SPINNING MILL AT CONEGLIANO

* No. VIII. appeared June 29th.

country will, I repeat, have to be reckoned with in the very near future as a serious rival to England.

There is, however, as yet, a "blot on the board." The Italian cotton industry is not in the favoured position of its much older sister the silk industry, *i.e.*, dependent on home production for the manufacture of all the machinery and other implements necessary to its existence. It has no great firms who make specialities of these articles, firms such as exist in England, Germany, Austria, Switzerland, France, and America. The present machinery for Italian cotton mills is almost entirely of foreign origin, 90 per cent. being imported from England —Messrs. Platt, Dobson and Barlow, and Howard and Bullough being the chief suppliers—and the rest coming from Mulhouse and Winterthur. But in this minor industry also, Italy is beginning to lift up its head; a firm has already started at Monza with this object in view, and it is probable that before long this country will make her own cotton looms as she now makes her own turbine wheels.

In the statistics given above, it may be noticed that the quantity of cotton used seems high in comparison to the number of spindles; but Italy spins with East Indian cotton many counts which, in Lancashire, are made with waste. Besides which, for the climatic reasons mentioned before, they do not spin very fine yarns, 80 to 100 English being the highest count. Most of the cotton mills are in Lombardy and Piedmont—there are also some important ones near Genoa and Venice, and three or four in the neighbourhood of Naples. The richest firms are, perhaps, Cantoni and Co., Muggiani and Co., the "Valseriana," Ottolini, Furter, and Signor C. B. Crespi and Co., mentioned above. The shares of these companies, which are conducted on the limited liability system, are all much above par, and are reckoned as a sound investment to bring in the present purchaser 4¼ per cent. to 5 per cent. The principal markets for the export trade are Turkey, Roumania, Bulgaria, Egypt, South America, and of late India. New outlets for the ever-increasing production are being actively sought for and will soon be found, and, before a few years have passed, the cotton industry of Italy will undoubtedly make itself felt as a worthy antagonist to Lancashire. Fig. 1 accompanying this article represents the exterior of the spinning works at Conegliano; Fig. 2 shows the interior of one of Signor Furter and Co.'s mill.

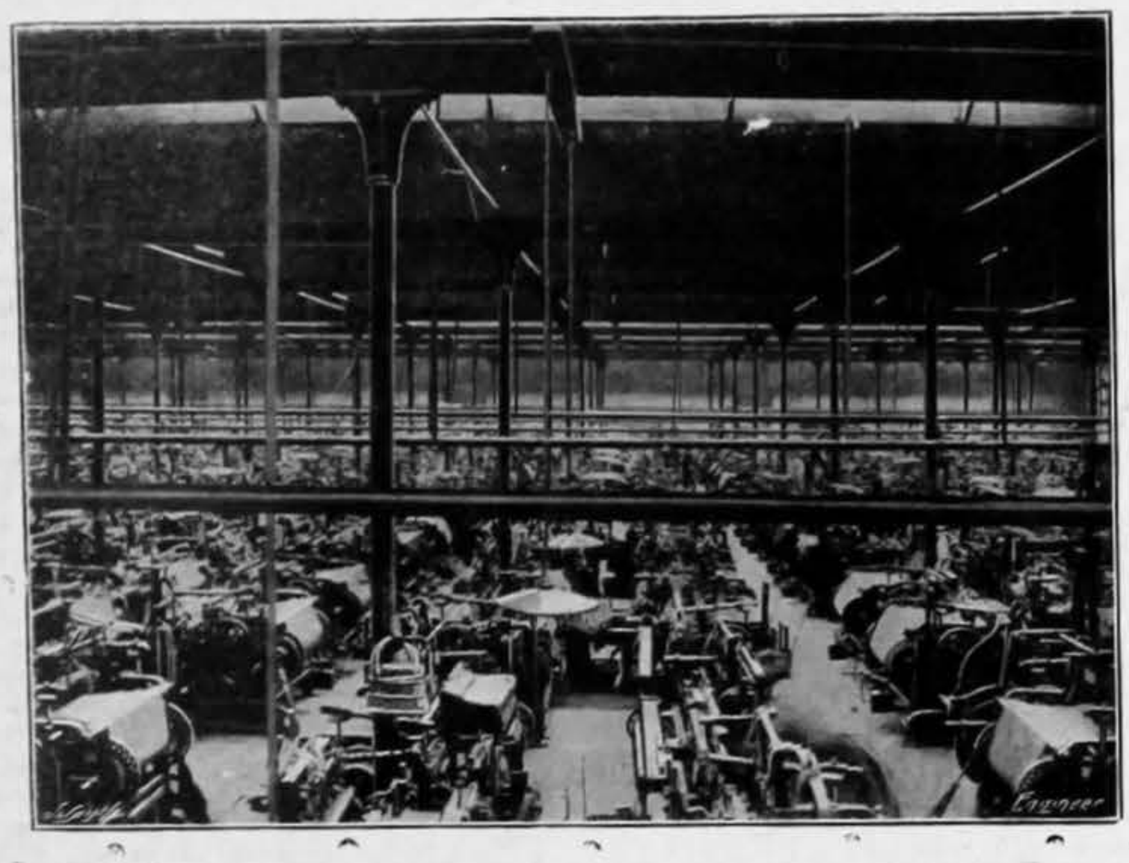


Fig. 2—INTERIOR OF FURTER AND CO.'S COTTON MILL

THE INSTITUTION OF ELECTRICAL ENGINEERS.

In our last issue we gave some account of the doings in London of the party of foreign electrical engineers who are visiting this country at the invitation of the Institution of Electrical Engineers. We now continue the description of their tour through England and Scotland.

On Thursday morning, the 28th ult., at 8.15 a.m., the party left Euston by special train for Birmingham, where an extensive programme had been arranged for them. An alternative excursion was planned, which enabled a large party to visit Stratford-on-Avon, and to reach Birmingham in time to attend the Lord Mayor's reception at the Council House. Arrangements had also been made whereby those members who wished to break their journey at Rugby could do so. The object of this was to allow a visit to be made either to the works of Willans and Robinson or to the new works of the British Thomson-Houston Company. Those who stopped here continued their journey on to Birmingham, in time for the afternoon visits in that city.

Our readers are familiar with the works of Messrs. Willans and Robinson, and with the enclosed type engine made by this firm, and they will remember that recently the manufacture of steam turbines has been taken up with excellent results.

The site occupied by the new works of the British Thomson-Houston Company is close to the London and North-Western station. It comprises some 25½ acres, of which about 11½ are at present covered by roads and buildings, thus leaving ample room for extension. The new works were commenced in 1900. The situation of the railway tracks and sidings determined within certain limits the position of the principal buildings. The total ground covered in square feet by buildings is 263,528, and the total floor space in square feet is 337,855. The works consist of fifteen substantial steel and brick buildings, which have been so planned that extensions can be readily added as required, and that without interfering with production, both operations being carried on simultaneously. The London and North-Western and Midland Railways have sidings running into the works, so that heavy raw material entering the grounds can be brought direct to the stores receiving section, ironfoundry, and machine shop. The Great Central Railway also is but a short distance from the works; the company has, therefore, three great traffic systems conveniently at its disposal. This firm's chief manufactures comprise alternating and continuous current stationary motors and generators, tramway and railway motors, arc lamps, open and enclosed, and the B.T.H. Edison incandescent lamp and Curtis steam tubrines.

Those who travelled direct to Birmingham had the choice of visiting two of six firms. In the morning the works visited were Bellis and Morcom; Summer-lane electric supply station of the Birmingham Corporation and the works of Elkington and Co., of Newhall-street; the works of the Metropolitan Amalgamated Carriage and Wagon Company, Limited, Saltley; and the works of the Wolseley Tool and Motor Company, Adderley Park. The party was divided into three groups. The first group, which visited Bellis and Morcom's works, were shown over the completely reorganised buildings at Ledsam-street. The manufacture of auxiliary machinery and small engines for ship and house lighting is carried out here. The larger engines for use in factories and electricity stations, which form the greater part of the firm's output, are constructed at the main works in Icknield-square.

The manufactory of Elkington and Co., Ltd., is situated in Newhall-street, Birmingham. The show-room is approached by a handsome staircase lined on either side by life-sized bronze statues. The show-room is well-proportioned and tastefully decorated. In numerous cases are displayed every conceivable article made by a silversmith, from a huge centrepiece to a silver thimble. The firm has found it necessary to enlarge and rearrange its factory in order more readily to cope with the ever-growing requirements of its customers, and owing to the structural alterations in progress the visitors were unable to make a complete tour.

The works of the Wolseley Tool and Motor Company, which was visited by one section, are situated at Adderley Park. The shops occupy about 11 acres, and comprise departments which cover every stage in the manufacture of motor vehicles, both for pleasure cars as well as for those intended for industrial purposes.

In addition to the motor car industry, a full range of machine tools, shop gauges, gas furnaces, &c., are manufactured. In the main building, offices occupy the whole of the first floor in a long range of buildings which form the street frontage. The stores for rough and finished material are below the offices. The other departments comprise a pattern shop, foundry, machine shop, erecting shop, and testing shop. On the opposite side of the road is situated the east works. These are chiefly devoted to heavy vehicle manufacture, and motor omnibuses were seen at all stages of construction. The carriage body-building shops are on higher ground at the rear of the main building. Attached to this are the coachsmith's painting and finishing shops. A special testing track for the purpose of trials and adjustment of cars has been laid down round the east works, and at one point there is a short stiff gradient of 1 in 5.

After the morning visits the members were entertained at luncheon at the Grand Hotel. At three o'clock carriages were in attendance to convey the visitors to the University and to more works. Those who did not visit the new University buildings had the choice of inspecting the General Electric Company's works at Witton, or the Birmingham Small Arms Factory at Sparkbrook. The General Electric Company, towards the end of 1900, found that the works which it had established were inadequate for dealing with the increase in the demand for its various classes of manufacture. It was therefore decided to centralise the works in one large centre. The site chosen was at Witton, a district within three miles of Birmingham. It occupies about 106 acres, through which the Thame Valley Canal runs. Rapid progress was made with the erection of the buildings, and the engineering works, together with the foundry, were set in operation in April, 1902. The carbon works followed within a short period, and the conduit factory on the 1st January, 1903.

There is a central station for supplying power to the whole works. The system adopted is direct current on the three-wire system. The station is run, so far as distribution is concerned, on lines identical with modern central stations for which the company supplies so many units. Alternating current for testing purposes is provided by motor generators. The transmission of power to the various works is made by overhead lines.

The engineering shops consist of two bays, 350ft. long by 70ft. wide by 55ft. high. There is also another bay, a recent addition, which runs the whole length of 350ft. by 30ft. The shops have been designed on the most up-to-date lines, and careful attention has been paid to lighting, heating, and ventilation. All three bays are served by a standard gauge railway track, inside of which is another set of rails, 2ft. gauge, for dealing with light traffic. The foundry building contains the smithy and the pattern shop. The building is 200ft. long, 100ft. wide, and the height from the floor to the crane rail is 25ft. The carbon works is said to be the only one of its kind in Great Britain. Here the manufacture of carbon rods, battery plates, &c., is carried on. Much more of interest was seen in these works, but space will not permit us to enter into further details now.

Those who visited the Birmingham Small Arms Factory at Sparkbrook could not have helped being struck with the excellent manner in which the firm's products were being made. It is just about forty-five years ago since the business was first established. In 1861 the company was formed to manufacture military rifles. However, progress was rapidly made, and the manufacture of carbines, sporting rifles, in fact, rifles of every description, was subsequently undertaken. Later on the manufacture of bicycles was taken up, but for some years the firm has simply confined its attention to making the component parts instead of the whole machine. The capacity of the works at the present moment is said to be 2000 rifles per week, and that, if necessary, this output could be increased to 2500. The works cover 22 acres. The actual floor space is 520,000 square feet, and there are 5000 machines employed of all descriptions. The number of hands employed under ordinary conditions is 3000, though when there is an extra stress of work this number is increased to 4000. The works are mostly driven by electric power, the generating plant consisting of three units, each 150 kilowatts capacity.

At 5.30 the Lord Mayor of Birmingham held a reception at the Council House. Then in the evening the party journeyed by special train to Manchester. Here they made the Midland, the Queen's, and other hotels their headquarters until Sunday. The visit to the greatest manufacturing centre and to the leading seaport of the North was favoured by beautiful weather, and both Manchester and Liverpool were seen under most favourable conditions by these visitors from other lands.

In each city the municipalities and other bodies joined with the Committee of the local section of the Electrical Engineers in providing entertainment for the guests, and the success of the two days' proceedings was no doubt largely due to this circumstance. Below we give some account of the visits to works and social festivities in connection with this tour in South Lancashire.

Friday, June 29th—The Stuart-street station of the Manchester Corporation Electricity Department.—After a reception by the civic authorities in the Town Hall, Manchester, the visitors were taken in the private tramcars of the municipality to the largest station of the Manchester Electricity Committee. The Stuart-street station has a plant capacity of 16,500 kilowatts, and is claimed to be the largest municipal generating station in the United Kingdom. Lighting, tramway, and power users are all supplied from this station. The feature which seemed to specially strike the visitors was that, although a modern and up-to-date station, only reciprocating engines were to be found in it.

The steam generating plant consists of two sets of Babcock and Wilcox water-tube boilers, provided with chain-grate stokers, and with coal and ash conveying machinery. The older set consists of twenty-four 750 horse-power boilers, ranged in two series of twelve, while the more recently erected boilers are of 1500 horse-power, and number twelve. One Krell and one Ados automatic CO_2 recorders are in use, and an average of 10 per cent. CO_2 in the exit gases is stated to be obtained.

The engine plant consists of six 2500 horse-power Yates and Thom cross-compound vertical engines, and two 6000 horse-power cross-compound vertical engines, built by the Wallsend Slipway Company. These latter are the largest reciprocating engines erected in an electricity station. One engine was already running, and the other was started up for the visitors, in order that they might witness the starting machinery in use, and method of synchronising. These engines run at seventy-five revolutions with a steam pressure of 165 lb., and are stated to be more economical in steam consumption per kilowatt generated than the smaller Yates and Thom engines. The visitors, while much interested in these engines, expressed the opinion that turbines would have been more wisely installed in this station—and it is, in fact, generally understood that, when the next increase in engine power is required, a turbine set will be installed. The generators in this station are all by the Electrical Company (agents for the A.E.G.), and generate three-phase current—with a periodicity of 50, at 6500 volts.

A subway, stated to be nearly one mile in length, carries the cables towards the city sub-stations, where it is transformed to direct current at 400 volts.

The cooling towers are of the Bernard and Wheeler type, with fan draught, and canal water is used for cooling purposes. The summer load of the Stuart-street station is 7000 kilowatts, while the maximum winter load is 10,000 kilowatts, and this is rapidly increasing. Further additions to the power plant at this station will therefore soon be required. The working costs are under ·75d. per kilowatt hour. On leaving Stuart-street station the visitors were taken by the special cars back to the Town Hall, where they were entertained at luncheon by the Mayor and local Institution of Electrical Engineers' Committee. The luncheon was served in the large hall of the Municipal Buildings, and was presided over by the Lord Mayor of Manchester, Mr. G. H. Thewlis.

The afternoon of Friday was devoted to a visit to the

works of the British Westinghouse Company at Trafford Park. This works is the largest devoted to the manufacture of electric plant in this country, and employs about 4000 workpeople. The manufactures carried on cover electrical machines and apparatus of every description, gas engines, and steam turbines—the latter under a licence from the Parsons Company. The chief building in the works is the large machine and erecting shop, nearly 1000ft. long by 430ft. wide, and divided into five aisles. An idea of the immense area covered by the works is gained from the fact that nearly 20 miles of standard gauge railway are laid within it. The main machine and erecting shop building has three galleries, each running the entire length of the building, and in these the lighter branches of the electrical engineering industry are carried on largely with women and girl labour. The other two aisles are open to the roof of the building, and each is spanned by a 50-ton electric travelling crane.

Among the more noteworthy machine tools in the motor-erecting shop are a three-spindle vertical drilling machine, three double-headed two-spindle horizontal boring machines, and one light spindle drilling machine for drilling motor cases. In the other erecting shop, devoted to larger work, a lathe with a length of 45ft. between centres, taking work up to 10½ft. in diameter, a vertical boring mill with a revolving table 18½ft. in diameter, and a planing machine capable of taking work 14ft. square are worthy of mention.

The large planing machine is driven by a constant speed motor, geared to the machine bed by a special device, consisting of a countershaft, two loose pulleys, and a jockey pulley, which is put into action by pneumatic cylinders. Another feature of the machine shop is the portable tool bed, 64ft. long by 24ft. wide, to which large castings can be attached; portable milling, slotting, or drilling machines, carrying their own motors, are then brought up to the work. Most of these machines are of American manufacture. The power for driving the works is obtained partly from the works' own generating sets, and partly from the Trafford Power Company. The works' generating sets consist of two 1000 horse-power Westinghouse vertical engines, and two three-cylinder Westinghouse gas engines, each of 270 horse-power. The steam and gas-driven dynamos are all run in parallel, Mond gas from a producer plant situated in the works being used for the gas engines. The works are almost entirely operated by three-phase 440-volt 25-cycle motors.

The steel and iron foundries are upon a similar scale of magnitude to the machine shop, and the former is equipped with two Wellman-Seaver rolling furnaces of the most recent design.

The Westinghouse-Parsons steam turbines, a special type of rotary converter working in conjunction with an alternating current booster, a special form of compounded turbo-alternator with constant field, and a full-sized railway car fitted with single-phase motors, were the exhibits to which attention was specially drawn on Friday's visit to the works.

Short runs with the single-phase experimental car were made upon the track laid down near the works, the line voltage being 3000, and the maximum speed attained being 40 miles per hour. Afternoon tea and light refreshments were provided for the visitors by the Westinghouse Company, and on the return journey from the Westinghouse Works a stop was made at the Trafford Park Wharf of the Manchester Ship Canal, and a trip down the canal was taken by a large proportion of the visitors.

A very large installation of electric lighting and power machinery is found in connection with the various docks and warehouses in the dock estate, but limits of space will not permit this to be described at any length. The lighting of the extensive docks and warehouses is entirely carried out by electric arc and incandescent lamps, while the capstans and cranes on the quays and transit sheds roofs are likewise dependent upon electric power. The Ship Canal Company's own generating station, the Trafford Park Light and Power Company, and the Salford Corporation Electricity Works provide between them the current for the Ship Canal Works.

On the evening of Friday the foreign guests, and a large number of the local members of the Institution of Electrical Engineers and of other scientific societies, were present at a conversazione held in the Whitworth Hall of Victoria University, Manchester.

Saturday, June 30th.—The visitors travelled to Liverpool on Saturday morning by the London and North-Western Railway, and were received at Lime-street Station by the Lord Mayor and Lady Mayoress, and by a large number of City Councillors, officials, and local members of the Institution of Electrical Engineers. The train conveying the visitors from Manchester arrived half an hour late, but this delay was not allowed to curtail the programme for the morning, which was carried through with commendable despatch under the management of Mr. T. L. Miller, the chairman-elect of the Manchester Section of the Institution of Electrical Engineers.

The first visit was to the Lester Drive tramway and power station of the Liverpool Corporation, the guests being taken to this station in the four decorated tramcars used by the Liverpool Tramways Committee on gala occasions. The Lester Drive Station contains both reciprocating and turbine engines, and the visitors were most interested in the appearance and working of the latter. These machines are of the Westinghouse-Parsons type—two being 1600-killowatt generators and two of 2000-kilowatt.

The speed at which they run is 1500, and at full load a steam consumption of 17·5 lb. per kilowatt is guaranteed. The resident engineer states that this is slightly lower than the results obtained with the reciprocating sets in the older portion of the Lester Drive power station, and that further additions to the power plant at this station will most probably be of the turbine type.

The other features of interest at this station were the cooling tower plant for the turbine installation, and the arrangement of all the auxiliary engine plant under the main building containing the turbines. The visitors seemed much impressed with the newer portion of this station, and expressed themselves as much pleased with their visit to it. The next item of the morning's programme was a journey by the Liverpool Overhead Railway, from the Dingle Station at the south end to the Seaforth Station on the Lancashire and Yorkshire Railway at the north end of the docks, the visitors being conveyed from the Lister Drive Station to the Dingle on the special tramcars reserved for their use. Many of the principal streets of the city were passed through, and a good opportunity was thus afforded for seeing St. George's Hall and other important buildings from a point of vantage.

Arriving at the Dingle, Mr. Cottrell—general manager—and other officials of the Overhead Railway Company took the party in charge, and the journey to Seaforth was made in a special train in remarkably quick time. The two features of this railway which impressed the visitors were the fine views of the dock and river obtained during the run, and the fact that this was the first overhead electric railway in Europe, it having been opened for traffic thirteen years ago, in 1893. Although the electrification of the Lancashire and Yorkshire Railway Company's Southport line, has diminished the profit-earning character of the Overhead Railway, its interest to electrical engineers remains undiminished, and these will hope that the extension projects now under discussion may help to restore its earlier financial prosperity.

The trains on this line are controlled by automatic electric signals, and no collision has ever occurred upon it, the only serious accident being due to a fire—in the tunnel at the Dingle end of the line—some years ago.

On arrival at Seaforth the visitors were transferred to a special Lancashire and Yorkshire train, and were run into the Exchange Station in Liverpool in ample time for the luncheon at 1 p.m. to which they were invited by the Corporation Electric Power and Lighting Committee at the Exchange Station Hotel. The Lord Mayor, Sir Charles Petrie, and other leading members of the municipality were present at this function.

In the afternoon the visitors left Exchange Station at 2.30 p.m. by special train for the Formby power station of the Lancashire and Yorkshire Railway Company, and were obviously much interested in this journey upon one of the first suburban passenger line to adopt electricity as motive power, and also in the Formby power station which supplies the current. At Formby they were received by Mr. G. A. F. Aspinall, general manager, and by other officials of the company.

The issue of THE ENGINEER for June 30th contains a full account of the newer carriages and electrical equipment of this line, and it is therefore not necessary to repeat the information here. Very handsome souvenirs of this visit were given to all taking part in it. At 3.45 p.m. the foreign engineers and other guests returned by the same special train to Liverpool, where the majority attended an "At Home," given by the Lord Mayor and Lady Mayoress, in the Town Hall, before joining the special train which conveyed them back to Manchester on Saturday evening. Special provision was made by ladies' committees in Manchester and Liverpool for the entertainment of the forty foreign ladies accompanying the party of engineers on tour, and a trip from Manchester to Buxton by motor car on Friday afternoon, and a visit to one of the Atlantic liners lying in the river Mersey on Saturday, were much enjoyed.

Sunday was by no means a day of rest for the party. By 8.55 in the morning the members had started from the Exchange Station on their long journey to Glasgow. However, this somewhat tedious ride was relieved by a pleasant drive through the Lake District. On reaching Windermere coaches were in readiness to convey the visitors to Keswick. The route was through some of the prettiest scenery in the district. Leaving Windermere, the visitors went through Ambleside and Rydal to Grasmere. Here a halt was made for luncheon, after which the drive was continued to Thirlmere, skirting the base of Helvellyn to Keswick. Two hours and a-half were spent here, enabling those who so desired to spend some time on Derwentwater. The party left by the train for Glasgow, dining *en route*.

PROGRESS OF WARSHIPS AND MACHINERY UNDER CONSTRUCTION IN ENGLAND.

THE most important event in the progress of warships during the last six months was the launch from Portsmouth Dockyard, on the 10th of February, of H.M.S. Dreadnought. Her keel, according to the authorities, was laid, on the 2nd of October, 1905, and hence a rate of construction that, viewed superficially, has had no parallel in warship building, was attained. As an actual fact, however, work on the vessel had begun some five or six months before the keel-laying. She has since February 10th made rapid strides, although we learn that not much "overtime" has, or is now being worked upon her; nevertheless, work is being pushed on at the same pressure as when the ship was on the building slip. All the boilers are now on board, and their monster funnels have been erected, great celerity having been exerted in getting them into place. The heavy main turbines have also been shipped. Of these there will be two high-pressure and two low-pressure, driving separate shafts. The steam pressure to be used in them will be higher than in any previous turbine-propelled vessel. The construction of the propelling machinery—consisting of several turbine engines besides those just mentioned—is entrusted to Messrs. Vickers, Sons and Maxim, and it is anticipated that with her four propellers running at 300 revolutions a minute the power developed will equal 23,000 indicated horse, and the speed of ship realised 21 knots.

The new battleship to follow the Dreadnought, and to be built at Portsmouth, will now very shortly be commenced, it not being intended, as was at first proposed, to wait for the extension of the slip on which she will be built. The new vessel will be similar to her prototype, but her construction will not be so rapid. It was intended, according to the Navy Estimates, to build two Dreadnoughts this year, but it seems not improbable that one will be abandoned.

A second launch from a Royal dockyard has taken place during the past six months, the armoured cruiser Minotaur having taken the water at Devonport Dockyard. This vessel is the longest ever built in this yard, being 490ft. between perpendiculars, or 60ft. longer than the Hibernia, launched last June, and now in course of completion. The displacement of the Minotaur is 14,600 tons, while that of the Hibernia is 16,300 tons; the launching weight, however, was 6600 tons, which, with the launching gear, weighing 400 tons, gave a total of no less than 7000 tons.

Of other ships in the "building" stage in the Royal dockyards there now remain but two, viz., the first-class cruiser Shannon, being built at Chatham, which was to have been put afloat very shortly, but whose launch has been postponed, and on which work is consequently progressing very slowly, and the armoured cruiser Defence at Pembroke, which continues to make satisfactory progress, the framing of the ship being now practically completed and the plating of the top sides well in hand. Of internal work the compartments are in a very forward state; the boiler and engine seatings in all the rooms are complete, and the coal bunkers with the patent fuel chambers over them—a new feature in this class of ship—well advanced.

The vessels now "completing" are the Britannia and Dreadnought battleships at Portsmouth, the Hibernia battleship—which had her basin trials in the middle of May—and the Minotaur armoured cruiser at Devonport, the Warrior cruiser at Pembroke, and the Africa first-class battleship at Chatham. This last-mentioned vessel has lately been on her trials, having completed her thirty hours' coal consumption trial at four-fifths power, and returned to Plymouth on June 2nd. The result was a mean consumption of 1·79 lb. per indicated horse-power per hour. The trial at 3600 horse-power had to be abandoned—unfinished—on account of the fog, but will be carried out after the manœuvres. The excellent results obtained so far have afforded much satisfaction to the officials in attendance at the trials; and the machinery contractors, Messrs. John Brown and Co., of Glasgow, are to be congratulated on the satisfactory manner in which they have been carried out, as the actual speed of ship attained with her engines was 18·95 knots, the designed speed being but 18½ knots.

In private shipyards and engine works in England we find that since the end of last year, of the vessels then in hand at the works of Sir W. Armstrong, Whitworth and Co., at Elswick, the fleet scout Attentive underwent her official trials very successfully, and has since been handed over to the Admiralty; that the first-class armoured cruiser Achilles is now ready for her trials; and that the construction of the Afridi, first-class ocean-going 33-knot torpedo boat destroyer, and of the first-class armoured cruiser Invincible has been commenced in the shipyard at Elswick. The first-class battleship Kashima, built by the firm for the Imperial Japanese Navy, underwent her official trials very satisfactorily, and is now on her way to Japan.

At Hawthorne, Leslie and Co.'s works at St. Peter's, Newcastle-on-Tyne, the opening up, prior to final acceptance of, the machinery of the cruiser Duke of Edinburgh has been completed, and the vessel handed over to the Admiralty; she took part in the recent Naval Manœuvres. The mooring trial of the Achilles, sister ship to the Duke of Edinburgh, also engined at the St. Peter's Works, took place a fortnight ago, when the whole installation worked satisfactorily. The machinery of the scout Attentive, also constructed at St. Peter's, after being opened out and examined, was taken over by the Admiralty on the 7th of February. The engines of the battleship Agamemnon, sister ship to the Lord Nelson, which are of 16,750 indicated horse-power, are almost finished in the erecting shop; the boilers, fifteen in number, of the latest improved Yarrow type, have already been despatched to, and are now fitted on board the ship, which was launched on the 23rd inst. The castings and forgings for the Ghurka, one of the 33-knot destroyers recently ordered by the Admiralty, being built at the Hebburn shipyard, are being pushed forward in the shops at St. Peter's, and the boilers—of the latest Yarrow type—have also made good progress. The turbines for both the Ghurka and Afridi, sister ships, are being made by the Parsons Marine Steam Turbine Company.

At Palmer's Shipbuilding works at Jarrow the only warship work on which the firm have been engaged during the past six months for the Admiralty is the first-class battleship Lord Nelson. This vessel is now well advanced, and it is intended to launch her about the end of August. Several of the boilers intended for her are ready for fitting on board, and her engines are erected in the shops. The ship is now being armour-plated, so that when she takes the water she will be in a very advanced state. The new fore-end of the destroyer Syren—mentioned in our last record—which has been built at the Jarrow shipyard, was successfully joined to the after part of the vessel at Haulbowline, the whole contract being completed within four months. The first-class cruiser built at the Thames Ironworks, the Black Prince, after the series of successful trials detailed in our record of January 12th, returned to the Thames to be completed, where, in the Victoria Docks, after the bearings of the main and auxiliary machinery, cylinders, and boilers had all been opened out, examined, and found in perfectly good condition, they were closed up, the engines cleaned and painted, and on March 3rd she passed her examination for the Fleet Reserve, prior to her "acceptance," which means a final trial of her machinery. For this trial the ship left the

Albert Dock on the 6th of March, and steamed down the river to the Nore; on the 7th, the trial—of twenty-four hours' duration—commenced, working the first twelve hours up to 17,920 indicated horse-power, and running the last twelve hours at 12,000 horse-power. This trial being quite satisfactory, the ship was delivered over to the authorities at Chatham to be put into commission. One thing worthy of remark in connection with the building and trials of the Black Prince is the consistent good weather that has prevailed, when bad might have been expected, which would have been very detrimental both to progress and success.

With the completion of the Black Prince her builders, the Thames Ironworks and Shipbuilding Company, have now little warship work in progress at their shipyard at Blackwall. What is at present in hand there are eight torpedo vedette boats for the Roumanian Government for service on the Danube, which are well in hand; their frames being in position and a considerable portion of the plating finished. These boats are 100ft. long, 13ft. beam, and 6ft. 10½in. deep, and they have a displacement of 45 tons. The machinery for them is also well advanced, more than half the forgings and castings being completed. The company has also in hand for the British Admiralty four 40ft. steam pinnaces, which are well in hand, the engines, pumps, &c., being practically complete; two of the four boilers for them are being tubed, while the remaining two are well forward.

The 1000-ton coal bagging lighter, built at the Thames Ironworks on the Mackrow-Cameron system, which was at the date of our last report waiting for her hoisting machinery, our readers will have noticed by our issue of March 2nd has since been completed and tried at the company's works at Blackwall, and is now undergoing her official trials at Devonport, which it is expected will in every way be satisfactory. At the company's engineering works at Greenwich there are in hand eight sets of twin-screw torpedo boat machinery, the engines being of the compound type, running at 500 revolutions a minute, supplied with steam by water-tube boilers of the Thames Ironworks type, arranged for burning petroleum residuum.

At Yarrow and Co.'s works at Poplar, since our last report of progress, the nineteen Yarrow water-tube boilers for the armoured cruiser Warrior have been delivered, while the twenty-four similar boilers for the cruiser Shannon will shortly be completed, both vessels being built at Pembroke. The construction of the coastal destroyers Mayfly and Moth is well advanced, and their trials are expected to be run very shortly. Of the two destroyers—Nos. 1199 and 1208—building at the Poplar yard for the Greek Government, each having a length of 220ft. and a beam of 20ft. 6in., the former will shortly be launched, and the other in a few months' time.

At the Chiswick works of Sir J. I. Thornycroft and Co. the progress of warship work since the end of December last is as follows. Of the five coastal destroyers—viz., the Gadfly, Gnat, Glowworm, Grasshopper, and Greenfly being built for the British Government, each of which is 168ft. long, 17ft. 6in. beam, and has a water draught of 5ft. 11in., the Gadfly was launched on the 24th of May, and the four others are rapidly approaching completion. The whole of these vessels are to be fitted with turbine propelling machinery, that for the first completed—the Gadfly—being now in hand by the Parsons Marine Steam Turbine Company, the remaining sets being made at the Woolston Works, Southampton, where the building of the 33-knot British ocean-going destroyer Tartar is proceeding satisfactorily. The engine shops at Chiswick are busy with two sets of internal combustion submarine engines for a foreign Government, while the boiler shop has been fully engaged on an order for thirty Thornycroft-Schulz water-tube boilers for the Italian Admiralty, twelve of which have been delivered; the remainder, together with eight boilers for first-class torpedo boats, ten for coastal destroyers, and four for the Tartar, are making good progress.

At Cammell, Laird and Co.'s works at Birkenhead, since last December, the sea-going destroyer Cossack—for the British Government—whose keel was then reported as laid, is now plated, and her turbine machinery of 14,000 indicated horse-power is in a forward state. A further order for a similar vessel, but of 36-knot speed, fitted with turbine machinery, has lately been received from the Admiralty.

DREDGER FOR THE EGYPTIAN GOVERNMENT.

THERE was launched on June 25th from the works of Wm. Simons and Co., Limited, Renfrew, a powerful twin-screw stern-well 1000-ton hopper dredger, which they have constructed to the order of the Egyptian Government for the improvement of the Port of Alexandria. The dredger, which is named Cleopatra, was complete when launched, and ready for work. The bucket ladder, which is constructed of the best form of girder work, in accordance with the builders' latest practice, is designed for dredging to a depth of 40ft. below water level. Owing to the varied nature of the material to be dredged at Alexandria two sets of buckets are provided, one set of large cubic capacity for raising free material, and one set of smaller buckets of exceptional strength and special design for rock-dredging. The dredger is propelled at 8 knots speed by two sets of compound surface-condensing engines, each driving its own propeller, steam being supplied by two steel multitubular boilers, constructed to Lloyd's requirements for 120 lb. working pressure. Suitable clutches are provided for engaging to and from the propelling and dredging machinery. The dredging wheel gearing is of very strong and massive construction. Each set of engines is arranged to give two speeds of buckets, so that either set of engines is available for driving the dredging gear, irrespective of whether the material is of a hard or soft nature, a constant piston speed being always maintained. Steam hoist gear fitted with the builders' friction arrangement is provided for controlling the bucket ladder. The hopper doors are closed by steam appliances, and powerful winches are arranged at bow and stern for manœuvring and regulating the cut of the dredger. A donkey boiler is fitted in the stokehold for supplying steam to the auxiliaries and electric light installation when the main boilers are at rest. The dredger has been built to the requirements of the British Admiralty, under the direction of Colonel Raban, Director of Works, Admiralty, assisted by Lieut. John F. James and Engineer-Commander W. D. Chope, who have acted as resident Admiralty Overseers over the hull, engines and boilers respectively.

LETTERS TO THE EDITOR.

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

MARINE ENGINEERING.

SIR,—What may be regarded as the triumph of marine engineering is the successful launching of the new Cunarder, the Lusitania. The magnitude of the work already accomplished is an object lesson of surpassing interest, because the new vessel is 80ft. longer than the Great Eastern, 5ft. more beam, and 3ft. deeper, and the anticipated speed of 25 knots per hour as an average performance represents the expenditure of power beyond anything ever yet attempted in engineering steamship annals. The dimensions of this leviathan eclipse all previous records, with 785ft. length, 88ft. width, and 33ft. floating depth. The estimated displacement, loaded, on 33ft. draught is 38,000 tons, and it is calculated that from 66,000 to 68,000 horse-power will be required to drive the vessel at the required speed.

A further matter of interest is the courageous adoption of the turbine system of propulsion, which involves the use of six turbine units, four for ahead, and two for astern driving. The enormous nature of these turbines, in which the outside diameter is nearly 20ft., and the speed 182 revolutions per minute, coupled with the boiler installation involving 192 furnaces, gives but a faint idea of the magnitude of the power installation, working under a pressure of 200 lb.

At one time it seemed a doubtful question whether the suggestions of the Admiralty Committee would ever result in actual work, because much diversity of opinion existed in regard to the proper proportioning of size, speed, and power. The striking difference between the vessel just launched and the Admiralty Committee's design is of a very marked character, and the truth of this is evident when the dimensions are compared. The length of the vessel and the speed intended are practically equal for both designs, but there is a notable departure in every other respect. The Lusitania's displacement is 50 per cent. greater, and the power 30 per cent. more than the Admiralty Committee's design.

The adoption of the steam turbine cannot influence the final result; therefore the disparity can only be accounted for by assuming that the Committee's method of calculation was found to be incorrect by the subsequent results obtained in the final tank experiments at Haslar on models of the intended vessel. Whether it be pleasant reading or not, it points to the fact that, in spite of the marvellous progress made in shipbuilding, marine engineering is, after all, largely a matter of experiment and trial and error methods.

It is obviously true in regard to the latest addition to our passenger fleet, because the Admiralty Committee's suggestions were for a vessel 750ft. length, 25,000 tons displacement, and 52,000 indicated horse-power, whereas the Lusitania is 785ft. long, 38,000 tons displacement, and 68,000 indicated horse-power.

The resistance per ton of displacement as given by the Committee was 25 lb., and the Cunarder is, presumedly, influenced by a similar resistance, if referred to the Admiralty deduction, and yet for an increased tonnage displacement of 50 per cent. only 30 per cent. of extra power is arranged to meet it.

Now, the length of the new vessel and the original design are, practically, equal, and, even if the difference is assumed to be all midship section, it only represents about 2500 tons, leaving 10,000 tons still to be met; therefore the cross sectional area of the new vessel must be much in excess of the Committee's suggestions, resulting in an enormously augmented head resistance, and this still further widens the disparity between the two sets of powers relative to their displacements.

Methods of comparison must incorporate the relative fineness of the bow lines, but it is obvious that the lines of the Lusitania, due to increase of beam and depth, must be more bluff than the Committee's suggested vessel, though the lines of the two vessels may be similar.

The speeds in both cases are equal, therefore the relative powers must be such that the given speed can be attained against every resistance, including skin friction, head resistance, and cavitation effect, and whatever the power may be it must cover engine friction, thrust, slip, and skin friction of propellers; in fact, every resistance inside and outside of the vessel as a reaction against the total power of the engines.

Skin resistance is influenced by area of immersed surface, and immersed surface is directly affected by the weight of the vessel; therefore, in two vessels of similar outline, but of different displacements, the area of surface increases with the amount of water displaced, then the power required to meet the conditions of speed should be in proportion to the displacement.

The work accumulated in the vessels at the given speed is proportional to their respective weights, and these are, properly, referred to their displacements.

Now, the Lusitania is the outcome of calculation and tank experiment; therefore, we may regard the conditions and expectations as being nearer the mark than the calculations of the Admiralty Committee; but it only accentuates the truth that marine engineering is far away from being an exact science, even if it be science at all. We have still to await the issue in regard to the power required to drive the Lusitania at an average speed of 25 knots per hour, with engines of an assumed 63,000 indicated horse-power; but there is a method of comparison by which relative values may be ascertained, and that is, the work accumulated in any vessel at a given speed.

Now, it is obvious that any vessel attaining any given speed must arrive at the critical moment, after every resistance has been overcome; therefore, it must account for the whole power absorbed in driving the vessel to attain the speed, because it may be assumed that vessels of similar design are subject to similar resistance, using up power in proportion to their displacement.

Perhaps the most uncertain factor in regard to the correct proportioning of power is the uncertain action of the screw as a propelling agent. Mr. Griffiths, in 1882, regretted that half a century had passed without any real improvement in the screw propeller, and the same may be said for the year 1906. In fact, propeller action is still a mystery, and so long as it remains as such the wide disparities between the theory and reality of driving efficiencies will continue.

In the case of the Lusitania, the driving will be by four propellers, 17ft. diameter, the two centre shafts being probably 21ft. below the surface, and the two wing propellers 18ft. to centres. Each propeller is three-bladed, with a large surface driven at 182 revolutions. The true pitch, due to 2533ft. per minute advance of vessel under 182 revolutions, equals in round numbers 14ft.

The Admiralty Committee's estimated resistance in pounds per ton of displacement was 25 lb., but the Lusitania's estimated power being less by 20 per cent., then, on this basis, the resistance of the vessel is also 20 per cent. less, or 20 lb. per ton; therefore, the total resistance equals 760,000 lb., or 190,000 lb. that each propeller has to overcome. The active blade length cannot be more than 6·5ft., and the total screw surface may be 36 square feet, but for action without slip the area per blade should be 51 square feet, or 152 square feet per propeller acting under a pressure of 1248 lb. per square foot, due to an average head of, say, 20ft.

To meet the conditions of want of surface, equal to 30 per cent., the pitch must be increased to, say, 18·5ft., and this represents 30 per cent. of slip. The speed of the vessel is 42ft. per second, whilst the velocity of the head water above the propeller, under atmospheric conditions, is only 35ft. per second; therefore, the vessel, driven at the speed, causes cavitation equal to 7ft. of water, or nearly 3 lb. per square inch, or 432 lb. per square foot, and this pressure has to be added to 1248 lb., making a total pressure of 1680 lb. per square foot, against the back of the propeller blades, and this measures the required thrust to propel the vessel at the speed against a given resistance with 30 per cent. of slip.

Now, 760,000 lb. resistance, overcome over 2533ft. = 58,305 horse-power, and assuming the efficiency or brake-horse effort to be 85 per cent., then 68,000 horse-power indicated will meet the required speed of the ship under the given conditions, because the tank experiments take into account any frictional resistance due to slip and blade friction.

If the efficiency is not equal to 85 per cent. of the power, then it is quite an easy matter to increase the speed of the turbines to meet the demand. Undoubtedly it would increase the percentage of slip; but, on the other hand, it would augment the value of the pressure effect on the blades, and as, practically, 58,305 horse-power would constitute the driving power, the increased revolutions would provide the difference of power to meet the internal conditions.

Should the Lusitania attain an average speed of 25 knots per hour, with 68,000 indicated horse-power, which she is quite likely to do, then it is quite probable that the reason for the disparity between the two designs will be traced to a finish, thereby getting nearer to a clear understanding of how the science of shipbuilding and engine power may be resolved into a law.

Coventry, June 12th. JOHN BATEY.

IRISH LIGHT RAILWAYS.

SIR,—Permit me to refer to the leader under above title which appeared in your issue of 22nd instant.

You are so invariably right that your readers have learned to accept your views without question, and it is largely for this reason that I venture to enter a strong protest against some of the statements contained in the article. Had it appeared in some obscure print my directors would have allowed it to pass unnoticed, but they are naturally anxious that a journal so influential as yours should not mislead its readers, however unwittingly, in such a wholesale manner without an attempt being made at correction.

With the view that the Board of Trade might with advantage relax some of its rules in order to encourage the cheaper construction and simpler working of light railways I have no quarrel. The subject is an interesting one, and much might be said on both sides. What I wish to traverse is the statement that the maintenance of the Donegal light railways is poor, and the engines and rolling stock neglected, and that the condition of the ironwork of the bridges points to great neglect and want of funds. Those responsible for the control of the Lough Swilly railway would very much like to know the source from which such wholly inaccurate information came. The maintenance is fully up to the standard of broad-gauge practice. A permanent-way staff on the basis of one man to the lineal mile is kept constantly employed, and, in addition, a flying squad for new and emergency work, whilst the regular and systematic expenditure on the maintenance of the engines and rolling stock by both companies shows that there is neither neglect nor want of funds in this connection.

My company employs two gentlemen—one an M. Inst. C.E., and the other an M. Inst. M.E., both with large railway experience in England and Ireland—to take charge of the permanent way and locomotive departments respectively.

As regards our bridges. Although the Burtonport railway is only three years open for traffic, one-third of the ironwork of the new bridges has been repainted, and although this should not have been necessary, it indicates the efficiency of the maintenance. Both the Donegal Railway Company and the Lough Swilly Railway Company have short trunk lines originally built, over thirty years ago, on the broad-gauge system, but afterwards altered to the 3ft. gauge, and both are dividend paying lines.

My own company has paid 7 per cent. on the small original capital of the line for the past seven years.

No doubt the traffic on the extension lines, built out of the public funds under Mr. Balfour's Acts of 1889 and 1896, is sparse and quite insufficient to yield an adequate return on the capital expended, but the parent companies and the Government are very well satisfied when they pay working expenses, which they invariably do. As a result the former have the extension railways as feeders for the main line, and the Government has a return in the commercial and social advantages conferred on the congested districts and the contentment and prosperity that follows the opening up of a country by railway communication.

Again, it is quite a mistake to say that the three trains per day each way run on these railways are in excess of the requirements of the traffic. My company when it began to work the Burtonport line attempted to carry on the traffic with two trains per day, but found it impossible to do so. A three train service had to be arranged for, and the rolling stock provided by the Treasury being for a two train service only, this company had to make good the shortage out of its own resources, and has so far been unable to get any recoupment or other assistance from the Government in that connection.

It was also found that the engines provided by the Board of Works for the Burtonport line were inadequate in number and deficient in power, and this gave rise to a good deal of trouble and much complaint in the early history of the extension.

All this is, however, another story. At the same time it may be interesting to mention that this company recently put on the line the first two narrow-gauge tender engines to be used in this country. These are 15½in. cylinder, eight-wheeled coupled tender engines, the total weight of engine and tender being 50 tons. They run 150 miles per day, giving splendid results, and their working in no way differs from main line practice.

I enclose copies of our last two half-yearly reports, from which you will see that 68·2 per cent. and 69·4 per cent. of the receipts was spent in working and maintenance, and that the receipts per train mile were 2s. 4·7d. and 2s. 7·7d., and the expenditure 1s. 7·6d. and 1s. 9d. per train mile respectively.

On our two extension lines—both the Carndonagh and the Burtonport—there was a profit in working for division with the Treasury, and this represents the small interest earned by the free grant.

My company welcomes inquiry both into the working and the finance of the system, and I might say the same for the Donegal line, except that they have now been taken under the wing of the Midland of England and Great Northern of Ireland jointly, and are on that account perhaps indifferent to criticism.

ANDW. SPENCE, Secretary,
Lough Swilly Railway Company.

Londonderry, June 29th.

(For Continuation of Letters see page 18.)

NAVAL ENGINEER APPOINTMENTS.

THE following appointments have been made at the Admiralty:—

Engineer Commander.—E. Cornish, to the Powerful.

Engineer Lieutenants.—W. H. Crichton, to the Pegasus; A. Brown, to the Vivid, for the Kennet; A. W. Coleman, to the Powerful; and H. C. D. Barker, to the Canopus.

OPENING OF THE GREAT WESTERN'S NEW MAIN LINE.

By CHARLES ROUS-MARTEN.

ON Friday last there occurred the most important event in the modern history of the Great Western Railway. A new main line, connecting London with Exeter, Plymouth, and the Far West, was formally opened. It is no exaggeration to call the line a new one or a main line. True, a series of short branch-lines has long existed, serving various country towns and villages in Berkshire and Somersetshire, and only a comparatively short length of new line was needed to connect them. But that process of construction has now given the Great Western a fresh route, 20 miles shorter than before, from London to Exeter and Plymouth, combined with a far better road. Such sources of possible delay as the important junctions at Didcot and Swindon and Wootton Bassett, the Box and Wootton banks—each at 1 in 100, and extending for 3½ miles in all—the bad slowing through Bath and round Bristol, all are avoided, and the distance from London to Taunton and all places westward of that station, is shortened by almost exactly 20 miles. Nor is this all. By the new opening, the Great Western has been placed in a greatly improved position as regards its competitor for the Far-Western traffic. Hitherto the distance from London to Exeter has been 193¾ miles by the Great Western *viâ* the Bristol Avoiding line; 171¾ by the London and South-Western, the latter having the advantage by 22 miles, but with the discounting drawback of far heavier gradients west of Salisbury. By the new route the Great Western distance is reduced to 173¾ miles, still with far easier grades than those of the London and South-Western. One immediate result is seen in the fact that, although full speed cannot yet be run over the newest of the fresh construction, the Great Western is able this month to book its expresses from London to Exeter in 3 h. 3 min., 3 h. 5 min., and 3 h. 8 min. respectively, whereas 3 h. 25 min. was previously the quickest time by the Great Western, and 3 h. 15 min. by the London and South-Western. And even now the Great Western has two miles farther to go than its rival.

Briefly, it may be explained that travelling from London by the Great Western's new route, the old line is used as far as Reading, 36 miles. Here the new route turns off to the left, using the old branch from Reading to Hungerford. By means of the short modern connections which have linked up Newbury, Hungerford, Savernake, Patney, Westbury, Frome, Castle Cary, Langport, and Taunton, a through main line is obtained from Reading to Taunton, with a distance of 107 miles, as against 127 miles by the old route *viâ* Bath. Thus, after the old familiar line has been left at Reading, it is not rejoined for nearly 130 miles. The gradients of the new route are, as a rule, very moderate, the only hard length being about three miles near Witham, where the grades are steeper than 1 in 200, and there are bits of 1 in 82 and 1 in 83 for about a mile. So it is a distinctly easy route.

It was decided to open the new main line on Friday last by running a special non-stopping train from Paddington to Plymouth, and a similar return train from Plymouth to Paddington, both on the same booked timing that will be given to the best regular expresses on and after the 21st inst. By the courteous invitation of the general manager, I was present and took full notes of the journey. The down train was timed to leave Paddington at 9.30 a.m.; to pass Exeter at 12.33 p.m., and to reach Plymouth North Road at 1.40 p.m. The up train was to leave Plymouth North Road at 4.20 p.m., to pass Exeter at 5.30 p.m., and to arrive at Paddington at 8.30 p.m., these being the booked times for the summer limited express between London and Cornwall, which will begin to run on the 21st inst. The special train comprised seven eight-wheeled vehicles, including two restaurant cars, and the total weight, empty, behind the tender is given to me officially as 193½ tons. Including passengers, staff, and stores, the total weight was slightly over 200 tons.

The engine which took the down train was No. 2902, one of a new batch of ten recently out of the Swindon shops, numbering 2901-2910. No. 2902, which was designed by Mr. G. J. Churchward, the able locomotive superintendent of the Great Western line, is virtually identical with No. 100, William Dean, in her present shape, or No. 171, Albion, in her original shape, viz., as 4-6-0, instead of 4-4-2, as at present. Or I might say that No. 2901, &c., are practically the same as Nos. 98 and 173-178. The sole difference of any moment is that her boiler is coned throughout its entire length instead of the coning or outward "tapering" beginning about half way along the barrel, and extending thence to the fire-box. In other words, it has an "extended wagon-top" boiler, instead of a "wagon-top." The cylinders, placed outside, are 18in. in diameter, with a 30in. piston stroke; the six-coupled wheels are 6ft. 8in. in diameter, and the weight of the engine in working order is 70 tons, exclusive of tender.

The "dead" start was made in Paddington Terminus at 9.32·4, and from the platform at 9.32·44. Speed was rapidly attained, Ealing Broadway, 5¾ miles, being passed in 7 min. 9 sec. from Paddington platform, and West Drayton, 13¼ miles, in 14 min. 6 sec., while the 7½ miles from Ealing to West Drayton occupied only 6 min. 57 sec. The time from Paddington platform to passing Slough, 18½ miles, was 18 min. 45 sec.; to Maidenhead, 24¼ miles, 23 min. 58 sec.; and to Reading, 36 miles, 33 min. 58 sec., or from the dead start, 34 min. 38 sec. I may add that the 11¾ miles from Maidenhead to Reading, almost all on a continuous though slight ascending grade, with a slack to 15 miles an hour at the latter station, occupied precisely 10 minutes, representing an average rate of 70·5 miles an hour. This would seem to be a convincing answer to those who still believe that six-coupled express locomotives are deficient in swiftness. At Reading, as I have said, we slowed down. This was for the curve to the left by which the old Hungerford branch—now become the first length of the new main line—is entered upon. The running continued to be very smart, and at the same time admirably steady. Newbury, 53 miles, was passed in 51 min. 6 sec. from the Paddington platform; Hungerford, 61½ miles, in 60 min. 45 sec.; Savernake, 70 miles, in 67 min. 20 sec.; Patney, 81 miles, in 76 min. 32 sec.; Edington, 90½ miles, in 85 min. 1 sec.; Westbury, 94½ miles, slackening, in 88 min. 58 sec.; Frome, 100¼ miles, in 95 min. 16 sec.; Witham, 105½ miles, the same distance as from King's Cross to Grantham, in 100 min. 25 sec.; and Castle Cary, 115¼ miles, in 108 min. 12 sec. It will be observed that our average speed to this point was just 64 miles an hour.

Here we entered upon one of the newly-made lengths, and had to slow down several times to 25 miles an hour; nevertheless the 125½ mile-post was passed in exactly ten seconds under the two hours from Paddington platform, or in 2 h. 30 sec. from the "dead" start. The 14½ miles of new road from Castle Cary to Langport occupied 18 min. 38 sec., and the other 8 miles from Langport to Cogload Junction, where the old main line is rejoined, 12 min. 46 sec.; Taunton, 143 miles from Paddington by the new route, 163 by the old one, was passed at full speed in 144 min. 40 sec.—2 h. 23 min. 40 sec. from Paddington, and then came the ascent of the one remaining "pinch" between London and Exeter, the Wellington bank. No. 2902, however, made very light of it, covering the 5 miles 5 chains between Norton Fitzwarren and Wellington in 4 min. 52 sec., and the final 3¾ miles from Wellington to Whiteball summit in 4 min. 13 sec., the absolute minimum at the top of the long rise at 1 in 80 to 1 in 90 being exactly 45 miles an hour. The 11 miles from Taunton to the summit took only five seconds over the even number of minutes, viz., 11 min. 5 sec. This was certainly a very fine achievement by Mr. Churchward's new engine.

At this point we were so much in front of booked time that we had to "ease down" the rest of the way, but, nevertheless, passed Exeter at a walking pace, 2 h. 57 min. 12 sec. from the Paddington platform, or 2 h. 57 min. 52 sec. from the dead start. The remainder of the run over the old road to Plymouth calls for little comment, being made wholly under very easy steam, so that the time taken from Exeter to Plymouth North Road was as much as 75 min. 23 sec. for the 52 miles, which length has been done in 14 minutes less, going the same way. Accordingly the full time from Paddington to Plymouth was 4 h. 23 min. for the new shortened distance of 225¾ miles, as against the former 245¾ miles. It will be remembered that the Prince of Wales' special three years ago accomplished the run by the older and longer route in 3 h. 53 min., so it will be seen that the Great Western has still a good deal in hand when it shall be deemed desirable to accelerate. Apart from the necessary slowing over the new part of the road and the easing down on the latter part, the run was a very smart one, reflecting credit upon everyone concerned. The steadiness and smoothness of the travelling were perfect.

For the return journey, engine No. 104, one of the two newer and larger French locomotives of the "Atlantic," or 4-4-2 type, with 6ft. 8in. coupled wheels, designed by Monsieur du Bousquet on Monsieur A. G. de Glehn's balanced four-cylinder compound system, was used, Rolfe being the driver. The load was reduced by 50 tons, as the visiting German editors who travelled by the down train had left at Plymouth, and so two vehicles were cut off. The load behind the tender was therefore a little over 150 tons. No. 104 soon gave proof of her mettle, ascending the dreaded Hemerdon incline—2¼ miles at 1 in 42 continuously—at a sustained minimum speed of exactly 30 miles an hour, the best I have ever recorded on that bank, better even than the feat of No. 3440, City of Truro, on the same bank when with a slightly less load the minimum rate was 28 miles an hour, which I considered excellent work. The later mile at 1 in 40 and 41 was "rushed" at a minimum speed of 34 miles an hour—also a very fine performance; but then there was easing down to avoid reaching Exeter too early. As it was, we passed punctually at 5.30 p.m. at greatly reduced speed. Then came another remarkable feat. From a dead slow start at Exeter, No. 104 ascended the 20-mile bank to the Whiteball summit in the unprecedented time of 19 min. 23 sec. The speed was steadily maintained uphill, even up the 2½ miles of 1 in 115, at over 60 miles an hour until just before the summit, when it temporarily dropped to 56·3, recovering immediately afterward. The engine was worked full compound all the way. The Wellington bank was descended at a rapid rate, the 11 miles from Whiteball to Taunton occupying only 8 min. 37 sec., and Taunton being passed in exactly 28 minutes from Exeter, a distance of 30¾ miles, while Cogload Junction—36 miles from Exeter—was reached in 32½ minutes. Here we had to slow down for the new road, which was passed over at a very cautious pace. When, however, we got on to the old road east of Castle Cary, we again made good progress, and the six-mile rise from Castle Cary to Witham summit—which has a mile in 1 in 101 to 1 in 106, a mile at 1 in 93 to 1 in 97, and a mile at 1 in 81 and 1 in 83—was ascended at a minimum of 52·8 miles an hour, the time between the two stations—Castle Cary and Witham—being only 10 min. 32 sec. for the distance of 9 miles. Thenceforward the running was somewhat leisurely, the 70½ miles from Witham to Reading occupying 78 min. 7 sec., and the 36 miles from Reading to Paddington 35 min. 14 sec. The total time from Plymouth North Road to Paddington was 4 h. 22 min. 29 sec. from dead start to dead stop, 4 h. 21 min. 31 sec. from platform to platform. The travelling again was absolutely smooth and easy.

It will be seen from these notes that the running was extremely fine whenever the engine could be fairly "let out," as was also the case on the down journey. So soon as the respective lengths of new road shall have thoroughly settled down, no difficulty whatever will be experienced in running between Paddington and Exeter in 2 h. 45 min., or between Paddington and Plymouth in 3 h. 50 min., if this shall be deemed desirable.

In connection with this latest movement in the direction of shortening transit times, the question of high speed has been brought to the front with painful prominence by the recent disaster on the rival London—Plymouth line, the London and South-Western, whose "Ocean Special" booked to run from Devonport to Waterloo—230 miles—in 4 h. 20 min.—*i.e.*, at an average rate of 53 miles an hour—when passing through Salisbury new station at full speed—probably at a rate of between 60 and 70 miles an hour—suddenly left the rails and was totally wrecked, deplorable loss of life attending the disaster. At present the cause of the derailment is absolutely unknown, but appearances point to some hidden flaw in a wheel or axle, or in the permanent way. The truth has yet to be ascertained. Unfortunately, numerous irresponsible and ill-informed writers, in some non-technical journals, have jumped instantly to the conclusion that because the speed was undoubtedly high, therefore the speed must have been the cause of the derailment, and have rushed headlong to the deduction that consequently high speed must needs be dangerous and improper, and ought to be strictly prohibited.

For that assumption and deduction alike there is not even the slightest shadow of foundation. I think I may claim to have had more experience on this head than most other engineers, and to have made more special speed experiments in various parts of the world than the majority of my brethren, at any rate. Now I do not hesitate to assert—writing with all due sense of responsibility—that there is no peril whatsoever in high speed *per se*. If the road and rolling stock be suitable and in good order, a train may be safely run at any speed at which it is possible for any locomotive to haul it. I have travelled over and over again with trains or on engines that were experimentally driven as fast as they could possibly be made to go. And not only am I yet alive and uninjured to tell the tale, but, also, I am able to say that on all these occasions there was a marked diminution of oscillation as the higher rates were reached. I have accumulated many records of speeds exceeding 90 miles an hour, and in one instance a maximum of 102·3 was unmistakably touched on a falling grade. In all these cases the motion was as if the train were gliding upon runners over the smoothest ice. Indeed, on one occasion when the speed of 90 miles an hour was exceeded, a high official of the railway who was with me exclaimed that we were slackening, being deceived by the enhanced smoothness of the movement. Over and over again I have had a similar experience. It is at the moderate speeds, such as 50 to 60 miles an hour, that the greatest oscillation—if any—is met with, and this often gives, even to experts, and especially at night, the erroneous impression of excessive speed.

As I have already remarked, a road and rolling stock both suitable and in good order must be postulated in asserting the safety of high velocities. A too sharply curved road would not be suitable. I have not before me at the moment the precise radius of the Salisbury Station curve, but I have no reason whatever to suppose that it is of too great sharpness to warrant high speeds being run over it. Two years ago, just after these "Ocean Specials" were started, I went down to Plymouth by express invitation to test their working.* On that occasion the "record" was set up, the journey from the Stonehouse Junction start to Waterloo being accomplished in 4 h. 3 min. 11 sec. to the dead stop, or in 4 h. 1 min. 30 sec. from Devonport Station. The load then was identical with that of the train wrecked last Sunday, and the locomotive was virtually of the same type. We ran through Salisbury practically at full speed. We were going at 75 miles an hour just westward of the station, and if we slackened at all—which was not perceptible—we certainly were not doing much, if anything, below 70 miles an hour. Yet we passed with perfect smoothness and steadiness round that curve about which there has been so much hysterical rant. Whether the road and rolling-stock were in good order on Sunday last, I am at present unable to say. It is, of course, quite conceivable that there may have existed some latent and undiscoverable flaw somewhere—like that which, after forty years of safety, caused the collapse of Charing Cross Station—but this has yet to be ascertained. The great point now is for the public to be reassured and made clearly to understand that no danger whatever exists in the high speeds that are run now-a-days, but, on the contrary, enhanced safety is often secured, as in the case of the St. Neots and Bytham accidents, when the high speed—70 miles an hour—caused the trains to glide over the weak rail in the one case, and the unsettled road in the other, as does a skilful skater over thin ice, so that each train, excepting only the last coach, escaped, whereas at a slower speed both would have been totally wrecked. Given the conditions above postulated, the highest modern speeds are entirely consistent with safety.

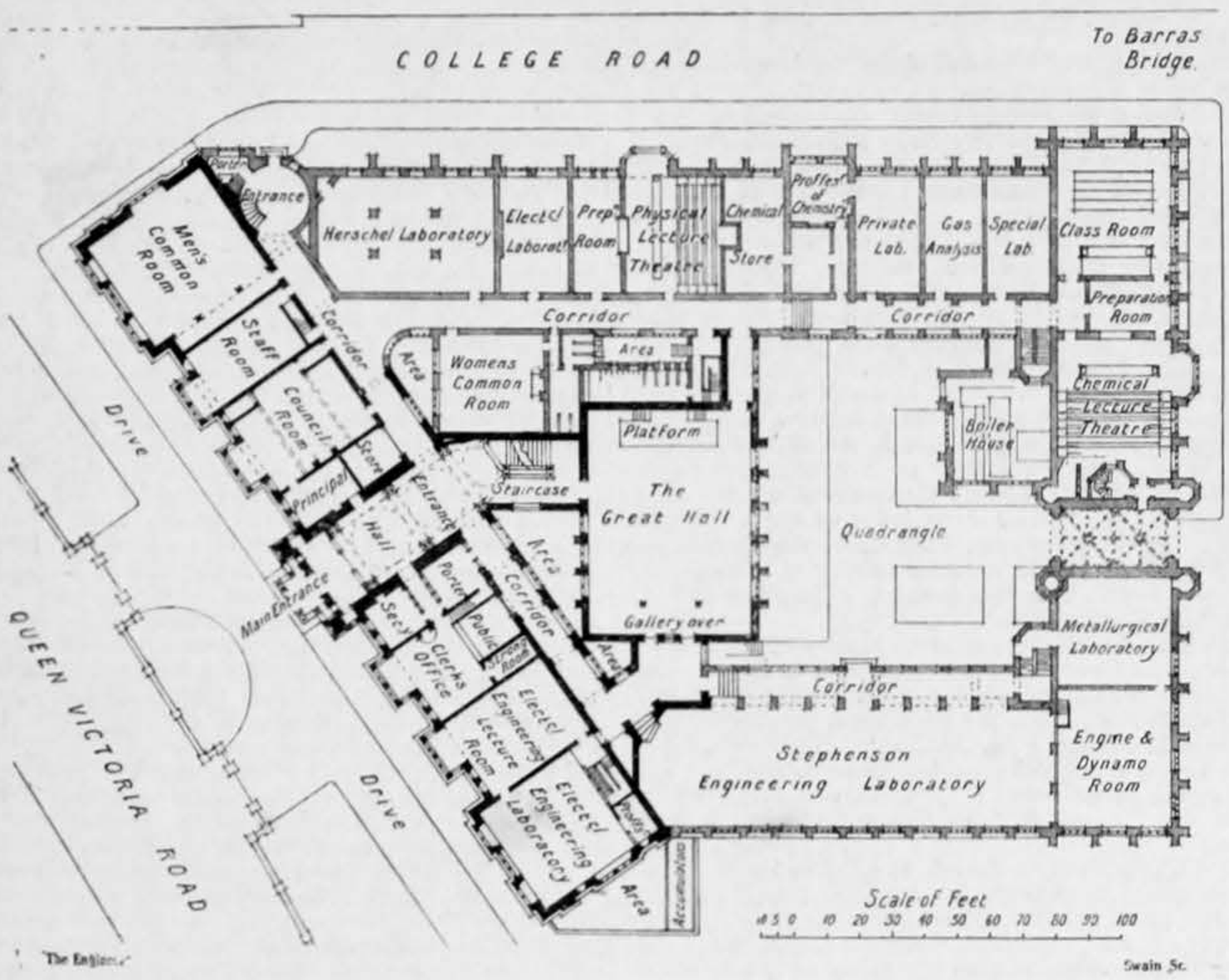
THE JUNIOR INSTITUTION OF ENGINEERS

FOR the summer meeting of this Institution this year, Manchester and district, with headquarters at Southport, has been selected. On Saturday, 14th July, the members will be received at the Town Hall, Southport, by the ex-Mayor, Mr. Councillor Trounson, and will inspect the Corporation's gas and electricity estates and tramway depôt. The Lord Mayor of Manchester will receive them at the Town Hall, Manchester, on the following Monday, and visits will be paid to the Municipal School of Technology, the works of the British Westinghouse Electric and Manufacturing Company, and the calico printing works of Messrs. S. Schwabe and Co. An excursion to Scarisbrick for a visit to the hall takes place on Tuesday, and on Wednesday the National Gas Engine Works, at Ashton-under-Lyne, are to be inspected in the morning, and the Tudor Mill and Atlas Mill in the afternoon. Thursday will be devoted to places of local interest at Southport, and Friday the members visit Wigan for an inspection of a colliery and a cloth-weaving factory. In the evening the Institution's summer dinner takes place at the Queen's Hotel, Southport.

* See THE ENGINEER, April 29th, 1904.

THE ARMSTRONG COLLEGE, NEWCASTLE-ON-TYNE.

DURING the course of a short visit to the North of England early this month his Majesty the King will formally open, on July 11th, the new extensions to the Armstrong College, Newcastle-on-Tyne. The buildings which now form the Armstrong College—originally founded on 24th October, 1871, by the University of Durham, jointly with the North of England Institute of Mining and Mechanical Engineers—have been erected at three different periods, and make up the four sides of an irregular figure. The first block, the foundation stone of which was laid by the late Lord Armstrong on June 15th, 1887, comprises the physical and chemical laboratories, and was opened by H.R.H. the Princess Louise on November 5th, 1888. The second block, to the east and south, accommodates the engineering laboratories, drawing and lecture-rooms and the School of Art, and was opened in October, 1894. The third block, just recently completed, forms the north-western side of the quadrilateral, on which the plan is based, and possesses, inclusive of the "Sir Lowthian Bell" tower, a frontage of some 300ft. towards the new Queen Victoria-road, and looking over the Leazes, a public common of Newcastle-on-Tyne. The approximate cost of the first and second blocks was £20,000 each, but taken together, they do not equal the floor area, or the cost of the latest building scheme, which, including the administrative apartments, the great hall, library, electrical engineering, botanical, and zoological laboratories, &c., represents an outlay of about £60,000. The building to be formally opened by his Majesty is four storeys in height, and has been designed in plan to provide the precise accommodation which experience has suggested to the staff and council; and although the character of the old buildings erected nineteen years ago has not been allowed to dominate the latest scheme, consideration has been given to ensure that the whole shall agree architecturally in style. The south and west boundaries are enclosed by tall wrought iron railings, that on the west being divided by panelled and moulded stone pillars, broken at two points by wide gates. The carriage drive is semicircular in form, and leads to the main entrance, which occupies the lowest stage of the "Sir Lowthian Bell" tower, and is placed in the centre of the west elevation. This entrance gives access to a spacious vestibule hall, communicating by means of corridors with the north and south wings, with the principal staircase, and with the large lecture and examination hall. The outer entrance is placed under an open portico and the entrance hall, 23ft. in width, is arranged in two bays. The northern half of the ground floor is occupied by the principal's room, the Council room, the junior staff room, and the students' common room. The Council room is a very fine apartment, and measures—including a large square bay at one end and a deep recess at one side—about 40ft. by 30ft. Adjoining the Council room is the staff room, and beyond, and occupying the north-west angle of the building, is the union or students' common room. On the south side of the main entrance is the general office, with strong and store rooms; the secretary's office, a minor committee room, and the electrical engineering department. Beyond the main staircase is the public lecture and examination hall, accessible by corridors on the north, south, and west sides, and intended for use during convocation and for examination and lecture purposes. The hall is 70ft. by 50ft., and, with a small gallery at the south end, accommodates about 750 persons.



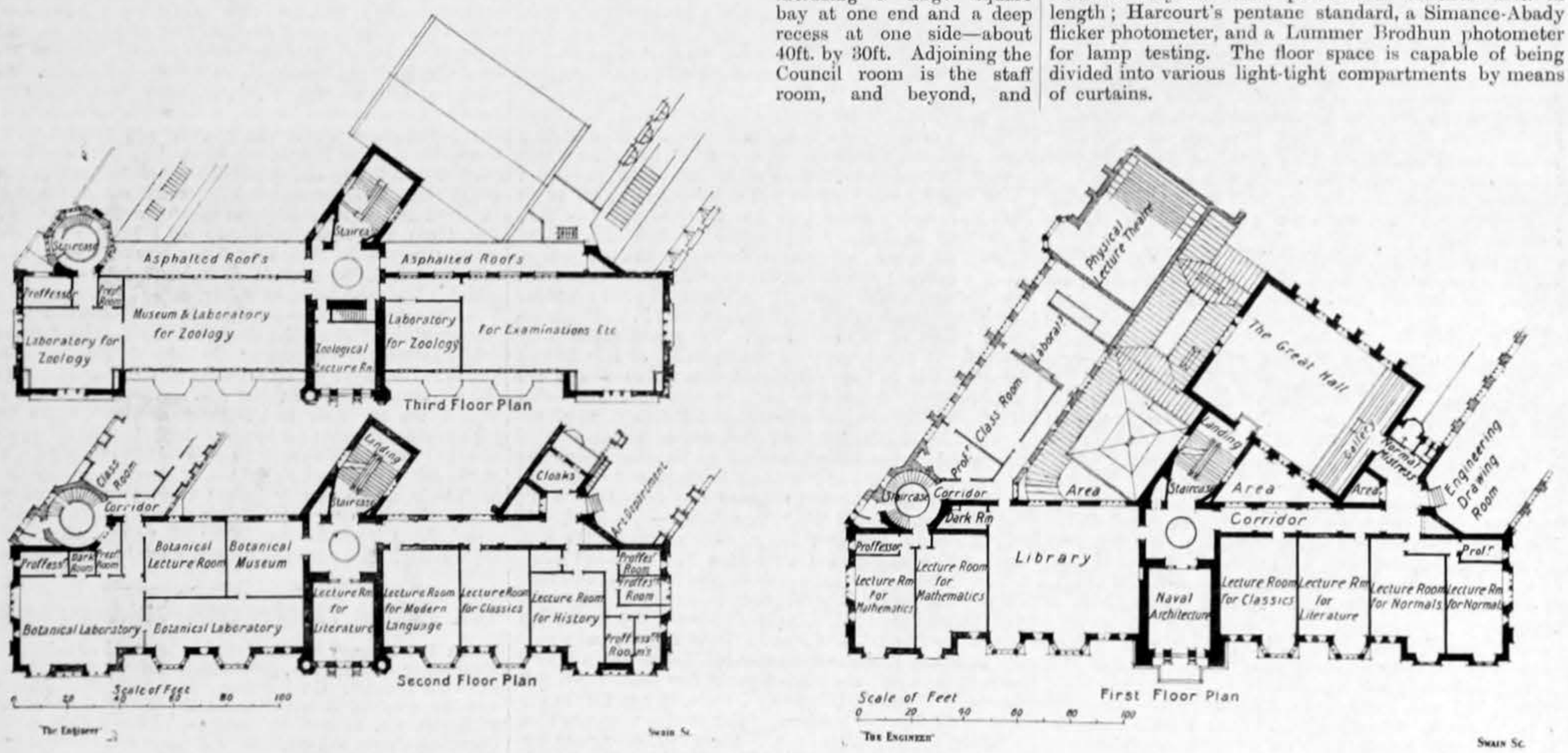
ARMSTRONG COLLEGE—GROUND PLAN

The lecture and examination hall is lighted by a series of two windows set over the dado and divided by two moulded transomes, the mullions being wrought in the shape of columns with moulded capitals and bases. From the middle of the ceiling depend two large electroliers, and at the sides ten smaller ones, all specially designed. The floor is of oak boards in narrow widths, together with a platform of the same material. Below the great hall, and lighted from the quadrangle, is a refectory, or dining-room for students, a dining-room for the staff, and the usual kitchen offices, together with a range of lockers and lavatories. During recent years the mechanical and electrical sides of engineering at the Armstrong College have been developed side by side, and the plants have not, as at other similar institutions, been entirely separated, as advantage has been taken of the extensive use made of electricity for lighting and power purposes at the College to place the central electrical power-house in close proximity to the boilers in the engineering department. Owing to a lack of the necessary funds, it has not been possible to establish a new building devoted exclusively to electrical engineering, but a suite of seven large rooms, with a floor area of about 10,000 square feet, has been set aside in the new building for this branch of study.

On the ground floor there is the junior laboratory, a well lighted room, which contains two sets of machines built by the Westinghouse Electric and Manufacturing Company. Each set consists of four machines, two motors and two generators, in line on one bed-plate, each machine being of about 6 kilowatts. The switchboards for these sets are by J. H. Holmes and Company, Limited, of Newcastle-on-Tyne, and contain all the necessary starters, rheostats, and instruments. In this laboratory there is also the central board, from which leads are taken to every part of the building, and for all the experimental tables. Opening off this laboratory is a lecture theatre, 40ft. by 27ft., provided with demonstration table complete, and capable of seating 120 students. Below the junior laboratory are situated the alternating and research laboratories, photographic rooms, and, in an excavated annexe, a battery of secondary cells. A lift runs from the top of the building to the bottom, and it is made sufficiently strong for the conveyance of heavy machinery, being capable of carrying up to four tons weight. There is also an extensive system of underground corridors for use in connection with special experiments. The machines in the senior laboratory consist of a motor generator of 30 kilowatts capacity by the General Electric Company, of Schenectady, and comprising a direct-current motor coupled to a single-phase generator of the revolving field type, the armature coils of which are so arranged that they can be coupled in series or parallel. There is also a three-phase set by Messrs. J. H. Holmes and Company, of Newcastle-on-Tyne, the continuous-current motor and three-phase generator being mounted on the same bed-plate, which also carries a three-phase induction motor and direct-current generator for taking up the load. There is also a belt-driven 6-kilowatt, six-pole double-current generator, presented to the College authorities by the Sunderland Forge and Engineering Company, Limited.

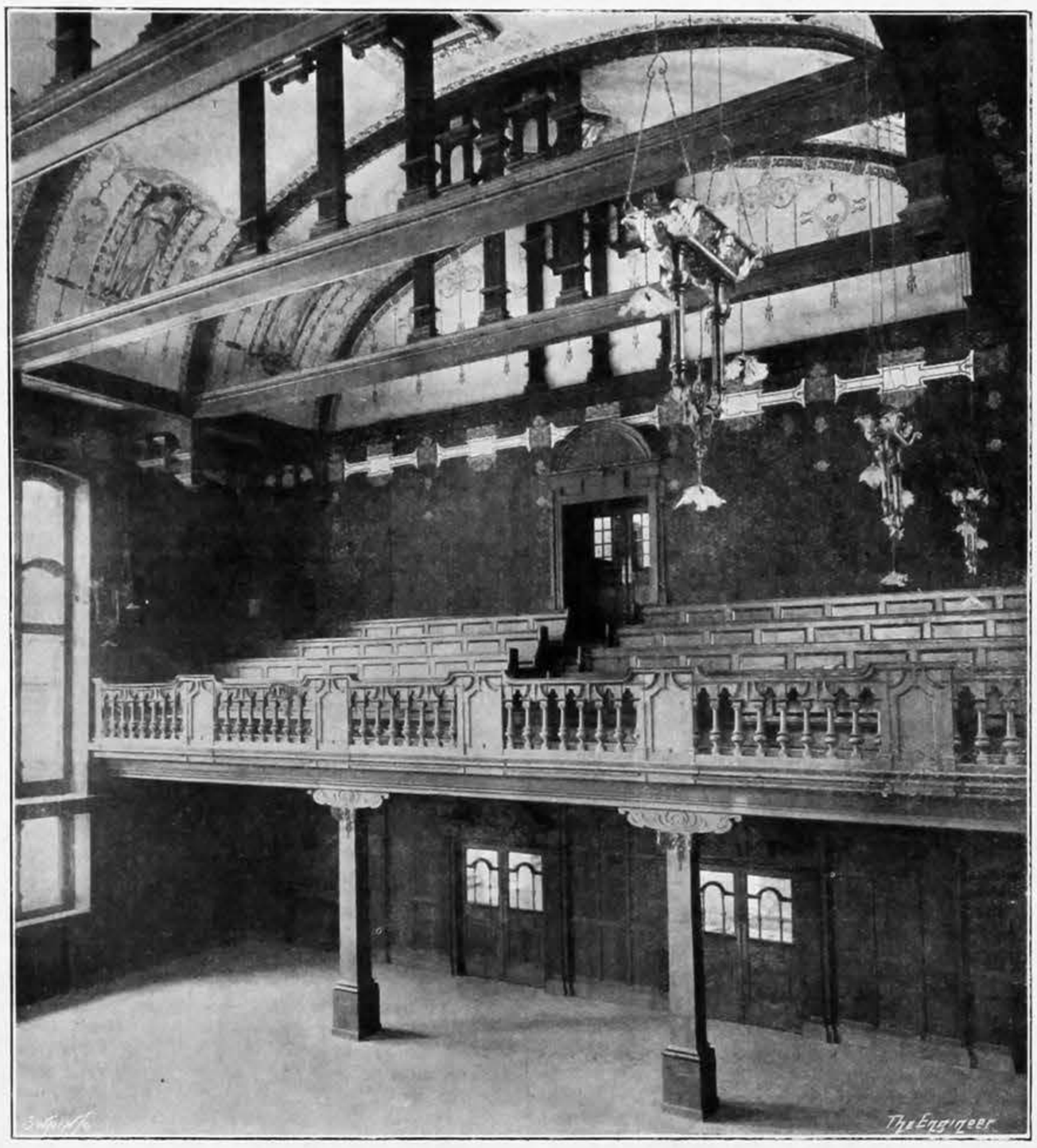
On a mezzanine floor is the standardising laboratory containing an Addenbrooke testing set, oscillographs, &c.; a photometric room, 120ft. in length, fitted with Wright's National Physical form photometer benches 12ft. in length; Harcourt's pentane standard, a Simance-Abady flicker photometer, and a Lummer Brodhun photometer for lamp testing. The floor space is capable of being divided into various light-tight compartments by means of curtains.

The electrical engineering laboratory is being fitted with all varieties of electrical measuring instruments for instruction and research, at a total cost of about £3500. The laboratories in this department will accommodate some sixty day students working at the same time. On the first floor is the library, 60ft. by 45ft. with two large bays on the side towards the Leazes. Large double doors open into the north and west wings. The remainder of this floor is occupied by lecture-rooms for mathematics, literature, and naval architecture, &c. On the second floor are two botanical laboratories, with a research room,



ARMSTRONG COLLEGE—FLOOR PLANS

lecture, professors', preparation and dark rooms. In the botanical department there is a good set of apparatus for bacteriological investigation, and electric response in plants. In the southern half of the second floor are lecture-rooms for history, literature, and languages, and a number of small rooms for professors. On the third floor is the zoological department, comprising a large laboratory, 36ft. by 31ft., and a combined museum and



NEW LECTURE AND EXAMINATION HALL

laboratory, 72ft. by 34ft., together with a private laboratory, lecture, professors', and preparation rooms, contiguous to which are flat asphalted roofs intended to receive glass conservatories.

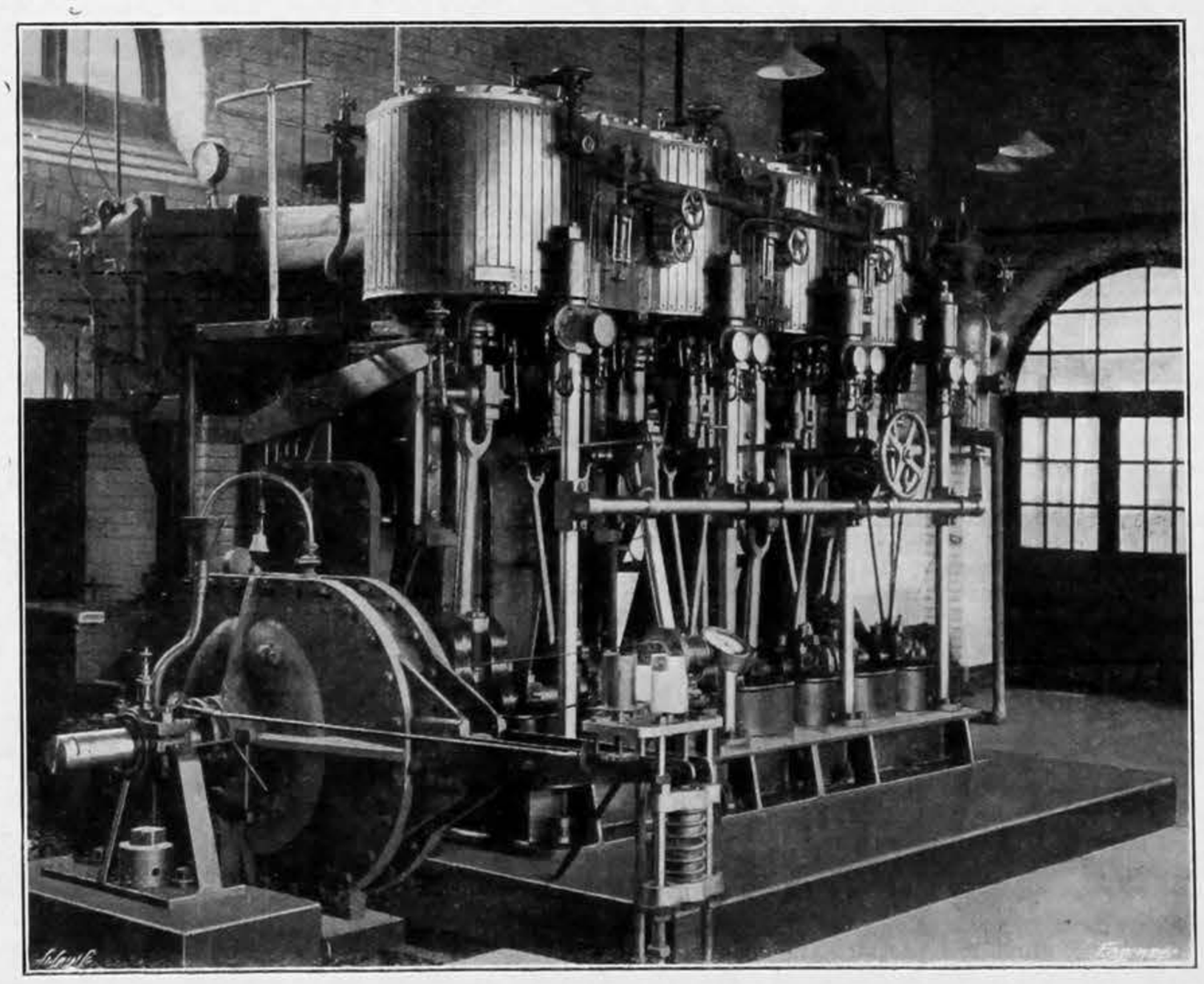
The principal entrance to the older buildings has been at the north-west extremity, where a door leads to a circular staircase contained within an octagonal tower, which forms one of the chief architectural features. On the other side the tower opens on to the principal corridor, which is carried round the greater part of the quadrangle. Beneath is a basement corridor, through which passes the main ventilating shaft, carrying the exhaust air to the fan, by which the principal portion of the building is ventilated. This system of ventilating was designed so that the whole of the air in the building might be removed each hour, but by means of suitable valves the whole power of the fans, each of which has a diameter of 5ft., can be concentrated on one room if desired. Next the tower is the Herschel physical laboratory, intended mainly for first-year students, and built without iron girders and with the tables supported on brick piers independent of the floor. The adjoining Armstrong electrical laboratory is similarly furnished, the heating apparatus being also constructed of copper. Opposite is the women's common room. From the electrical laboratory a door opens into the preparation room, and beyond is the physical theatre, accommodating 200 students, although, at an ordinary meeting, 300 people can be conveniently seated. A passage from the principal corridor leads to the private room of the Professor of Chemistry, which communicates with his private laboratory, beyond which are rooms for gas analysis, a laboratory for advanced students, and the large chemical lecture theatre. Opposite the latter a stone staircase leads to the Johnstone chemical laboratory.

This apartment has a floor area of 4100 square feet, and affords accommodation for more than 100 students working at one time. The roof is of pitch pine, and rises to a height of 30ft. above the floor. Water, gas, and vacuum are supplied to the benches, and fume-closets and facilities for distillation and evaporation are also provided. The equipment of this laboratory—one of the finest and most spacious in Great Britain—was provided by the executors of the late Professor Johnston, the author of "The Chemistry of Common Life," and after whom the laboratory is called. The fire-proof combustion room and the balance room lie between the laboratory and the upper part of the physical theatre. The combustion room, which looks out upon the quadrangle, is open to the gabled roof, and by means of a fire-proof door communicates with the gallery of the lecture theatre. Crossing this by a gallery is entered the apparatus room, above the preparation room, and beyond it there is a physical laboratory for advanced students, between which and the private room of the Professor of Physics will be found the physical lecture theatre, which is entered from a passage communicating with the circular staircase. Ascending thus to the second floor, a passage gives access to three lecture rooms intended for the department of agriculture, and three others used for physics, one being a dark room for optical experiments.

The south-east and south-west wings of the Armstrong College form together two sides of the quadrangle. They comprise a large central tower and the chemical lecture theatre, along with the whole of the buildings devoted to the engineering and art departments. Over the chemical theatre are five rooms for private chemical research, and, on a still higher floor, a large room which was previously used as the college library. Adjoining this block is the great gateway, affording access to the quadrangle, and surrounded by four sentinel towers rising to a height of about 96ft., the first serving as a chimney shaft for the boilers and metallurgical furnaces, the second as a ventilating shaft, the third as an experimental tower for testing pressure gauges against a column of mercury, and for other experimental work, and the fourth affording space for a hoist. The tower contains six rooms on three floors, and forms the Newcastle memorial of the Jubilee of the reign of her late Majesty Queen Victoria, the cost of the erection having been defrayed out of the surplus of the Royal Jubilee Exhibition held in Newcastle-on-Tyne in the year 1887. The gateway forms a noble entrance to the quadrangle, the roof being groined in stone, with red brick filling the spandrels.

Between the north-east wing and the gateway is the boiler-house, the latter containing three large experimental boilers of the Lancashire marine and the Stirling water-tube types. These supply steam to the engineering department for experimental purposes, for heating the buildings, and for two engines to which reference will be made later. Adjoining the gateway is the metallurgical laboratory, with muffle, assay, and other furnaces. The engine-room—where, as previously remarked, the electricity for lighting and power purposes is produced—is adjoining, and occupies the south corner of the building, and next to it, forming the ground floor of the south-west side of the quadrangle, is the George Stephenson Engineering Laboratory. In the engine-room are the heavier machines, comprising a 50-kilowatt direct-current Castle dynamo. rope-driven from a Robey horizontal compound engine, also a vertical compound high-speed set, with Professor Weighton's special valve gear, direct coupled to Brown-Boveri 240-volt direct-current generator of 50-kilowatt output. This machine has also three slip rings for three-phase currents. There is also a 25-kilowatt motor-generator set. One machine has a double armature, and is capable of being used as a 480-volt motor with the armature in series, or 240-volt generator with the armatures in parallel. This is coupled to a double-current generator giving a 100 volts on the direct-current side, and a single or three-phase current on the alternating side. In the engine-room there are three switchboards by J. H. Holmes and Co., Limited, of Newcastle-on-Tyne, for various experimental connections, whilst for lighting the building power is available from the mains of the Newcastle-on-Tyne and District Electric Lighting Company at 100 volts alternating with a frequency of 80, and 480 and 240 volts direct current. This supply can be drawn on to the extent of 300 kilowatts if desired.

The George Stephenson Engineering Laboratory has a length of 123ft. and a width of 44ft., supplemented throughout the greater part of its length by an annexe 9ft. wide. It is well equipped with experimental engines, lathes, testing machines, &c. There are two experimental machines, one 5 kilowatt capacity by J. H. Holmes and Co., Limited, of Newcastle-on-Tyne, and the other of 9 kilowatt capacity by Ernest Scott and Mountain, Limited, of Gateshead-on-Tyne, from which direct, or one, two, or three-phase alternating current can be obtained. These may run together as synchronous motors, or can be independently driven by a countershaft by 20-kilowatt direct-current Siemens motor. There is also a small Wilde generator and several small single-phase and direct motors and generators. Amongst the other engines in this laboratory mention should be made of a set of vertical quadruple-expansion surface-condensing experimental steam engines. These engines are capable of working up to 200 indicated horse-power, at 160 revolutions per minute, with a boiler pressure of 210 lb. per square inch. They are surface condensing, and are so constructed as to be capable of being worked quadruple, triple, double, or single expansion under any required conditions of steam pressure or total expansion of steam. The cut-off in each cylinder and the crank axles may also be altered at will. The dynamometer is of the hydraulic type, and is fitted with automatic recording gear for both the brake horse-power and the revolutions in a given time. The small condenser behind



EXPERIMENTAL STEAM ENGINE

the low-pressure cylinder is of the "Contraflo" pattern, presented to the College by Richardsons, Westgarth and Co., Limited, of Hartlepool. It is interesting to note that the several parts of the engine and boiler were supplied by no fewer than forty-six different firms and presented to the Armstrong College, and erected under the supervision of Professor Weighton. There is also a vertical

testing-machine, capable of testing materials up to 100 tons in tension, compression, shearing, and cross-breaking, worked by a hydraulic intensifier, and fitted with autographic apparatus for recording the relation between stress and strain. The amount of work performed by this machine is affirmed to be in excess of that done on any other similar machine in Great Britain or Continental Europe. The George Stephenson laboratory of the Armstrong College also contains various other steam engines, double cylinder gas engines of 26 indicated horse-power, a Parsons turbine motor and dynamo, as well as lathes, drilling machines, and other smaller tools. Below lies an underground gallery used for photometric work, and above is the engineering drawing room, whilst adjoining it, filling the first floor of the south corner, is the engineering lecture room, between which and the Jubilee Tower is the mineralogical lecture room. The whole of the upper floor of the south-west wing and of that portion of the south-east wing which lies to the south of the Jubilee Tower is devoted to the study of the fine arts, including all branches of that important work, one of them being that of ornamental metal work and enamelling. The Armstrong College is an incorporated society, registered under the Companies Acts, and the executive of the College is vested in a Council, consisting of the Warden of the University of Durham, who is President of the College, and forty-two other members, five of whom are members of the Chapter of Durham, or of the Senate, or of the Convocation of the University of Durham, elected out of and by the Governors. Of the others, ten are elected out of and by the Governors, and the remainder, including three nominated by the Corporation of Newcastle-on-Tyne, and two by each of the County Councils of Northumberland and Durham, by the other members of the Council. The present Principal of the College is Sir Isambard Owen, D.C.L., and in making a selection of the names of the heads of the various departments, one is naturally inclined to turn to those whose spheres of labour are more closely associated with the work of engineers, and mention should therefore be made of Mathematics, under Professor C. M. Jessop; Physics, under Professor Hy. Stroud, with Professor A. S. Herschell, F.R.S., as hon. professor; Chemistry, under Professor P. Phillips Bedson; Metallurgy, under Professor Hy. Louis; Engineering and Naval Architecture, under Professor R. L. Weighton; and Electrical Engineering, under Professor W. M. Thornton. The whole of the new extensions to the Armstrong College were designed by and carried out under the supervision of Mr. W. H. Knowles, of Collingwood-street, Newcastle-on-Tyne, and to him, as well as to Professor W. M. Thornton, and to Mr. F. H. Pruen, the secretary of the College, we have to express indebtedness for much valuable data incorporated in this description.

A NEW SLIDE RULE.

THE slide rule under consideration is the invention of Lieut.-Col. Anderson, and is designed to meet the requirements of those who want to obtain more accurate results than can be reached with the ordinary instrument. It is claimed by the makers, Messrs. L. P. Cassella and Co., of 11, 13, and 15, Rochester-row, Westminster, S.W., to be eight times as accurate as the ordinary slide rule length for length. The general characteristic and construction of the rule is similar to others in that there is a slider working between two limbs. Instead, however, of having one single scale on the top and bottom limbs, and two on the slider, the logarithmic divisions are marked on four parallel lines on the top limb and eight on the bottom. There are also four parallel lines on the slider. The top two on an ordinary slide rule are marked from 1 to 10 and then from 10 to 100, or, taking the first reading as 10, the scale gives 10 to 100, and 100 to 1000, and so on. In the Anderson rule each scale is only graduated to 10. In other words, if the scale in the Anderson rule was all in one length, as in an ordinary rule, instead of being in four or eight rows, one placed under the other, it would be eight times the length it now is. The rule is clearly marked, the whole numbers being painted red, and the sub-divisions in large black figures; these are again sub-divided.

Referring to the illustration, it will be noticed that on either side of the top scale, and also on the slider, there are four columns of bold black figures, which read as follows:—

0	4	8	12
1	5	9	13
2	6	10	14
3	7	11	15

While on the left of this table there is an additional column of red line numbers, reading − 4; − 3; − 2; − 1. These are placed one under the other. They are called "line numbers," and are provided to enable the position of the decimal point in any calculation to be ascertained without any mental calculation. Every calculation must be worked out with the aid of these line numbers. Suppose we take the line number 0. Then the numbers on the top scale will represent 1, 1·1, 1·2, 1·3, &c. Had it been necessary to use the second "line" number, *i.e.*, 4, then the readings would have been 10, 11, 12, 13, and so on. Similarly for the last line number 12 he would read, 1000, 1100, 1200, and so forth. The readings on all the scales are treated in this manner. Numbers below unity can be dealt with in exactly the same way. Line number − 4 would give graduations ·10 − ·11 − ·12, &c. Only one column of minus line numbers has been provided, and this is given in red. However, by always subtracting the constant difference − 4, other columns can be worked out. The use of the line numbers can be most clearly explained by the aid of a few simple examples. Suppose it is required to multiply 3·4 by 45. The rule, as shown in the engraving, is set for this operation, the procedure being similar to that of working the ordinary slide rule. The "1" of the slider has been brought to the 3·4 on the upper limb, the 3·4 being in the third line from the top. The answer is read off on the top limb opposite to the 45 on the second line of the limb. Now, to obtain the answer we look for the line number belonging to 3·4. It is found at the end of the row in which 3·4 appears, and as 3 is a unit, the line number will be in the first column, reading from left to right, and therefore "2." The line number for 45 must be sought for in the "tens" column, *i.e.*, the second column. Glancing along the line of the limb in which the number 45 appears, the second figure in the "line number" column is taken, *i.e.*, 6. These two numbers are then added together, the sum being 8, and the answer will be on the line on the top limb, in which the figure 8 appears in the "line number column"—that is row 1. The answer is 153, and we know it is 153 and not 1·53 or 15·3, or any other number, because the figure 8 appears in the "hundreds" column of the line numbers. The rule for multiplication may be stated to be "the line number of the product is the sum of the line numbers of the factors so long as the left index is used. If recourse be had to the right index this sum must be increased by one." In division the line number of the answer is the difference of the line numbers of the dividend and divisor if the left index be read, but this must be reduced by 1 when the right index is read. In other words, the right index carries a value of + 1 in all operations involving multiplication, and of − 1 in all operations involving division. Square roots, areas and radii of circles, cubes, cube roots, proportion, &c., can all be worked out with equal facility with the aid of this slide rule. The rule will no doubt commend itself to those requiring accurate results, and presents a praiseworthy solution of one of the objections that the slide rule presents to the inexperienced. The rule before us is scarcely suitable for the pocket, as it measures $14\frac{1}{2} \times 2\frac{1}{8} \times \frac{5}{8}$. An unfortunate feature of the arrangement is that the hair line on the slider is $\frac{1}{8}$in. or so above the rules, and parallax interferes with accuracy of reading. This position is necessitated by the raised transparent triangles at each end of the rule, by means of which the rows of figures not immediately adjoining the slider are read. With so large a rule the error is small, but we trust the inventor may see some way both of removing the objection and of providing a rule with the excellent feature this rule has and less bulk.

OBITUARY.

MR. CHARLES BURRELL.

WE have to record with regret the death of Mr. Charles Burrell, of Thetford, Norfolk, on June 28th, at the age of eighty-nine years.

The business in which he succeeded his father when he was only nineteen years of age had been founded in 1770, and consisted chiefly of the manufacture of agricultural implements, but under the enterprise of Mr. Burrell it was soon extended to the manufacture of other classes of machinery. Mr. Burrell may be considered as one of the pioneers of the introduction of thrashing machinery, he having in the year 1848 produced the first successful combined thrashing and dressing machine. It was exhibited at the Royal Agricultural Society's Show at York in that year. At the same time he commenced the manufacture of portable engines. About the year 1857 Mr. Burrell became interested in self-moving engines, and in the following year he commenced the manufacture of the Boydell traction engine, of which many successful examples were built. These were used not only for ordinary road transport, but also for ploughing and cultivating by direct traction. Later on, in 1870, he took up the manufacture of the Thompson road steamer, and, in the course of some years' successful experience with it, built engines for many countries.

During all this time the design of traction engines generally had been going through a period of transition, but after this period it seems to have settled into a type which was practically the basis of that now in use, and the firm of Charles Burrell and Sons, which Mr. Burrell founded, has been intimately associated with the production and development of the modern traction in all its applications.

Mr. Burrell, for some years prior to his death, had practically retired from the business of his firm, which had been converted into a limited company, and the management of it has been in the hands of his sons.

He was a magistrate of his native town, and in private life he was held in the highest esteem by a very large circle of friends and acquaintances.

CHARLES C. NEWTON.

THE death of Mr. Charles C. Newton, president and treasurer of the Newton Machine Tool Works, Incorporated, Philadelphia, took place at Bremen on June 13th. Mr. Newton was born February 9th, 1846, at Cambridge, Washington County, N.Y., and at the age of nineteen he indentured himself as apprentice to the Brooks Locomotive Works at Dunkirk, N.Y., spending most of his time in the tool room, where the foundation of his successful after career was laid. After serving his apprenticeship and working in various shops, he returned to Dunkirk in 1875, and, in partnership with Mr. J. D. Cox, manufactured twist drills, reamers, cutters, &c., removing to Cleveland, Ohio, in 1876, to broaden the scope of their work, which had largely increased, and operating under the firm name of Newton and Cox. In 1880 Mr. Newton sold out his interest to Mr. Cox, who formed out of the old firm the Cleveland Twist Drill Company. Removing to Philadelphia, Mr. Newton laid the foundation for the present Newton Machine Tool Works, Incorporated, in a little shop in Callowhill-street, with only himself and an assistant as the working force; in this shop he designed the first heavy railroad tools, and as the demand grew for his various designs he was several times forced to seek larger quarters. Mr. Newton was the sole proprietor of the works until July 14th, 1897, when articles of incorporation were taken out, and the firm became the Newton Machine Tool Works, Incorporated, with Mr. Newton as president and treasurer.

His death will be deeply felt, especially by those with whom he was most closely associated in business.

MR. LOUIS CASSIER.

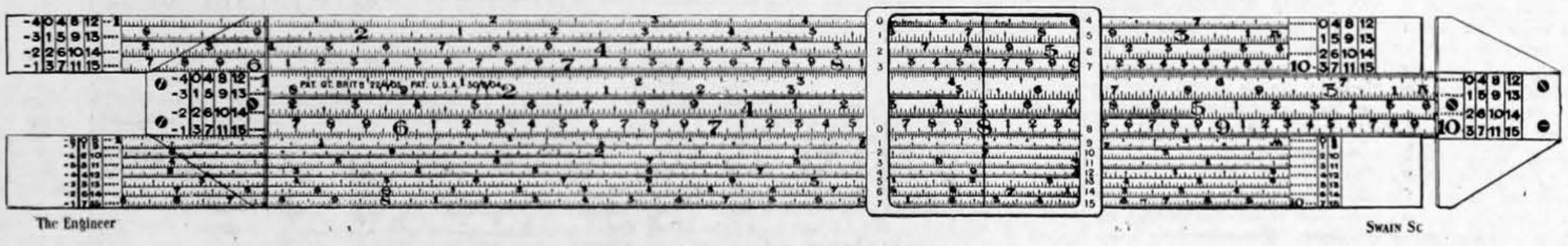
THE appalling disaster on the South-Western Railway at Salisbury, in the early hours of Sunday morning last, claimed among its victims Mr. Louis Cassier, of the Louis Cassier Company, Limited, and editor of the magazine bearing his name.

Mr. Cassier was only just forty-three, having been born in Boston, Mass., in June, 1863, and everyone believed and hoped that he had many years of active and useful life ahead of him. He was connected with several of the learned societies in England and in America, being an associate member of the Iron and Steel Institute, and an associate of the Institution of Electrical Engineers, and of its American contemporary, as well as a member of the American Society of Mechanical Engineers, and an Associate of the Institute of Junior Engineers.

By his wide circle of friends Mr. Cassier will be remembered chiefly by his personal attributes. He was an interesting companion, an excellent host, and had one of the kindest and most generous natures. Mr. Cassier was not accompanied by his wife, who is at present in New York, and we believe we are right in saying that the whole engineering profession will sympathise with her in her grievous loss under such painful circumstances. Mr. Cassier died in the infirmary into which he was admitted in an unconscious state.

ENGINEERING EXPERIMENT STATION.

THE University of Illinois has established an engineering experiment station for the purpose of carrying on investigation work, and also to make studies of problems of importance to the profession, as well as to railway, industrial, and manufacturing interests. It is believed that this experimental work will result in contributions of value to engineering science and to the interests above noted; while, at the same time, the pursuit of the investigations will give inspiration to the students and add to the educational value of the college of engineering. The staff consists of a director and seven members representing the different departments of the college of engineering; a corps of assistants will give their entire time to the work, and special encouragement will be given to any of the University instructors who may desire to take up some line of research work. The first work undertaken was an investigation of armoured concrete and the properties of concrete affecting armoured concrete construction. This was one of the most extensive and systematic investigations on this subject ever made in the United States, and it aided in clearing up a number of controverted points. The measured deformations in plain concrete beams showed that up to the breaking point in tension the modulus of elasticity for tension is practically equal to that for compression, instead of being one-half as great, as had been assumed by many writers on this subject. In reinforced concrete beams the action of the steel and concrete during flexure was studied, and it was shown that the concrete failed in tension at its usual breaking limit instead of carrying stress to ten times that limit, as had been claimed by some experimenters, and the added stretch in the steel at this point was clearly shown on the diagrams. These investigations are being continued. A systematic series of tests of high-speed tools and tool steels has also been made, and numerous other lines of investigation have been started or planned by the various departments of civil, mechanical, and electrical engineering, architecture, railway engineering, &c.



ANDERSON'S SLIDE RULE

BIRTHDAY HONOURS.

AMONG the birthday honours which were published on Friday last we notice the names of the Right Hon. W. J. Pirie, Sir J. J. Jenkins, and Sir James Kitson, Bart. Mr. Pirie, on whom a peerage has been conferred, is well known for his connection with the firm of Harland and Wolff; Sir J. J. Jenkins, who is also to be made a Peer, has all his life been identified with the Welsh tin-plate trade; while Sir James Kitson, who is to be sworn of the Privy Council, is head of the Leeds engineering firm which bears his name.

THE municipality of Fiume has under consideration a scheme for the erection of a large electrical plant for the supply of electricity for industrial and domestic purposes at a small cost to consumers. Water power will supply something like 10,000 horse-power for the purpose at a cost of something like £40,000 to £50,000 initial cost, and the work is to be carried out within the next two years.

RAILWAY MATTERS.

THE Erie Railroad management has authorised the immediate electrification of about 35 miles of the line between Rochester and Mount Morris, New York, in accordance with the plan to electrify the Rochester division.

THE first tramway line in New York was constructed in 1833. There are now 1300 miles of lines in that city, carrying the population 266 times over in each year. The fares are all 5c. (2½d.) for any distance. "Workmen's fares" on American tramways are non-existent.

THE *Gaceta de Madrid* of 22nd June contains a notice to the effect that a concession has been granted provisionally to D. Baldomero Rato, representing the towns of Ribadesella, Caravia, Colunga, Villaviciosa, and Gijon, for the construction of a railway from Ribadesella to Gijon.

THE Madras Railway and the Southern Mahratta Railway are both falling in for purchase by Government next year. It is likely that one or more members of the Railway Board will visit those lines during the monsoon, in order to see for themselves their condition and up-keep.

ALL records for railway wagon construction were broken recently, when the employés of the goods wagon department of the Pullman shops completed a contract for 1500 cars in twelve days. This is 300 more cars than were ever before built by one concern in the same length of time.

THE New York Central, the Boston and Maine, and the New York, New Haven, and Hartford Railroad Companies have agreed upon plans for a union station in Worcester, Mass. It is stated that the new building will be constructed as soon as the approval of the plans by the Worcester City authorities has been obtained.

THE Prussian State Railroads have adopted the Nagel system of investigating sensitiveness to colours, instead of the Holmgren yarns heretofore used. The railroad physicians are required to receive instruction in the methods of this system, and, moreover, they must themselves be tested for colour blindness, which seems a reasonable requirement.

A DESPATCH has been received at the Foreign-office from H.M. Embassy at St. Petersburg reporting a recent announcement in the *Novo Vremya* to the effect that a plan is now being worked out for uniting the Finnish railways with the main Russian railway system. It is noted that the scheme involves the building of a railway bridge over the river Neva.

FOR the convenience of travellers from Scotland and the Northern and Midland counties of England by the Harwich route to the Continent the Great Eastern Railway Company has placed a new type of train on the service between Doncaster-Lincoln and Parkeston Quay-Harwich. The train is corridor throughout, and dining and breakfast cars are provided.

IT has been authoritatively announced that the Uruguay Great Eastern Railway will be prolonged from its present terminus, La Sierra, to San Carlos, in the Department of Maldonado, a distance of about 30 miles. In the south-eastern part of Uruguay the country is rugged and broken, and the construction of the line will be expensive, costing £7000 per kilometre.

Box tunnel, on the Great Western Railway, between Bath and Chippenham, has been closed to traffic since Sunday. A portion of the brick lining has given way at a point about three-quarters of a mile from the Box end of the tunnel, which is here some 300ft. below the surface. The service between Bath and Corsham is completely suspended, and all traffic between Paddington and Bath has to be conducted *viâ* Holt Junction, causing a delay of about ten minutes.

THE construction of a railway to British Central Africa is stated on good authority to have been approved by the Portuguese Government, and that construction will probably be commenced within the next year. Such a railway would, says Mr. Frei, entirely alter the present financial outlook, lend an impetus to local trade, and open up the vast hinterland beyond, which is rich in minerals and agricultural produce, and only awaits the advent of a railway to develop rich natural resources.

MEANS of transport are greatly lacking in Paraguay. The Central Railway runs from Asuncion to Villa Rica, and has an extension to Pirapo, in all a distance of 155 miles. It is thought that the company will, however, shortly increase their rolling stock, and possibly construct new branch lines. Two concessions for railways were applied for during the past year, and a short narrow gauge line is being constructed on a large property belonging to a British company in the Chaco. Experiments are also shortly to be made with automobile traction.

THE profit-sharing arrangement between the city of Paris and the Metropolitan Railway Company seems unique. The city built the line, providing, however, track, generating station, and equipment at the company's expense, about two-thirds of the total capital expended being paid by the city, which leased the railway to the company for thirty-five years. The fares are: First-class, 25c.; second-class, 15c.; and second-class return, 20c. The city receives 10c. on each first-class and 5c. on each second-class ticket. At the end of the thirty-five years the city is entitled to the railway, and, if it chooses, to the rolling stock at a valuation.

A SPECIAL cable from its Victoria Falls correspondent has been received by the *African World*, reporting the opening of the railway bridge over the Kafue River of the Cape to Cairo Railway, the first train having passed over. The bridge, which is the longest in South Africa, has been completed in the record period of five months. It consists of thirteen spans, each 100ft., with pillars resting on a bed 16ft. under the water. The Kafue River is 266 miles north of the Victoria Falls, and the distance from Cape Town is 1908 miles. The railhead, however, is now at Broken Hill, 347 miles beyond the Falls, the line having been pushed on simultaneously with the building of the bridge.

WHAT is said to be the heaviest passenger locomotive ever built has been delivered to the Lake Shore and Michigan Southern Railroad. It weighs nearly 190 tons, of which 76 tons are on the driving wheels. The engine and tender weigh 403,700 pounds, and the capacity for water is 7800 gallons, while that for coal is 15 tons. This powerful locomotive was designed as a step in the development of large passenger locomotives on the Lake Shore road, which began about seven years ago, as a result of which this road has a series of successful designs. The Walschaert gear has been generally adopted, because of favourable experience in both freight and passenger service. The new locomotive is entirely free from untried devices or principles.

THE High Commissioner for Southern Nigeria, Sir Walter Egerton, has arrived in England in order to confer with the Government in conjunction with Sir Frederick Lugard on the question of the contemplated extension of railways to the Niger, the improvement of Niger transports, and other questions. In the matter of railway construction the Lagos line from Lagos to Ibadan, a distance of 124 miles, is now being prolonged to Oshogbo, 63 miles further in the interior, from which place another section of 60 miles will bring the line to Ilorin; and, by a further extension of 56 miles, the rails will reach the Niger at Jebba. The unofficial members of Council in Lagos have unanimously asked that the railway shall be extended at once to the Niger, a work for which the Colony is prepared to raise a loan. It is estimated that £700,000 will be required to complete the railway system of Southern Nigeria to the Niger at Jebba.

NOTES AND MEMORANDA.

BRITISH tonnage through the Suez Canal last year decreased 476,988 tons, as compared with 1904, while German tonnage increased 143,923 tons.

THAT all common metals and rocks have an internal temperature due to radio-activity has been discovered by Professor Charles Burton Thwing, of Western Reserve University. The heat thus being constantly generated is sufficient to maintain the earth at its present temperature for many millions of years, he says.

THE hardest metal, with the exception of steel, is tantalum, which will scratch glass and quartz. This metal has a specific gravity of 12·79, being heavier than lead; it is white and has a crystalline fracture. By the use of the electric furnace Moissan has succeeded in producing metallic tantalum in the reguline condition.

A GOOD idea of the extent of the cotton industry in Lombardy may be gathered from the fact that the total number of engines in the cotton mills and factories is 596, with an aggregate horse-power of 38,701. Of the engines 340 are steam, 195 hydraulic, 6 gas, &c., and 55 electrical. The total number of boilers is 559. The workpeople employed number 63,267.

AFTER the ceremony last week, when Mr. Haldane opened the electrical laboratory of the National Physical Laboratory, Sir John Brunner most generously placed the sum of £5000 at the disposal of the Committee towards the completion and equipment of the additional buildings for engineering, metrology, and metallurgy now in course of erection.

IN point of numbers the total manufacturing institutions of St. Louis last year aggregated 2480 and the total capital employed amounted to £53,178,277 as compared with £30,102,170 in 1900, or an increase of £23,076,107, or 76 per cent. in five years. The cost of raw material used by manufacturers amounted to the sum of £27,515,429 as against £20,378,550, or an increase of 35 per cent. over 1900.

TESTS have been made in California to determine the relative heating value of crude oil and local coal. One American ton of coal was found to be equivalent to 718 lb. of oil. As this oil weighs 7·6 lb. per gallon, and one barrel holds 42 gallons, the above quantity is expressed as 2¼ barrels. For locomotive purposes, where a better quality of coal is used, the requirement of oil to equal 2000 lb. of coal is 1037 lb., or 3¼ barrels.

UNDER conditions where a weir could not be built, a novel way of measuring the flow of an artesian well has been devised, says the *Iron Age*. Forty feet of 10in. pipe was screwed into a 90 deg. elbow on the pipe where it came out of the ground, and a hand force pump attached to a small hole tapped into this pipe. The force pump drew a red aniline liquid from a pail and injected it into the stream, where it was carried along with the water and at the same rate. By means of a stop watch and the known carrying capacity of the pipe the flow of the well was easily determined.

ACCORDING to the self-recording seismographs of the University of San Francisco, and of the United States Weather Bureau at Washington, the first shock of the earthquake at the former city was felt on April 18th at 1 hour 12 min. 38 sec., and at Washington at 1 hour 19 min. 20 sec., Greenwich time in both cases. The distance between the two stations is 2435 miles, so that the tremor was transmitted 2435 miles in 402 sec., or rather over six miles per second. It was propagated to Cheltenham, Maryland, at the same velocity, and to Sitka, in Alaska, at the rate of 5·6 miles per second.

IN 1829 the first London omnibus was put in service by the inventor, George Shillibeer, who had learnt the art of building the new vehicles in Paris. He started two vehicles from the Yorkshire Stingo at Paddington to the Bank, the fare for the whole route being 1s., half-way, 6d. In less than nine months Shillibeer had twelve omnibuses running from Paddington to the Bank. These omnibuses had to contend against much prejudice and the existing law, which rendered them liable to prosecution for loitering, even when stopping to pick up or set down passengers, and this law, at the instigation of the local shopkeepers, was frequently put in force.

REPRESENTATIVES of the Glasgow Corporation have interviewed the Postmaster-General concerning the Government purchase of the Corporation's telephone system. The terms which Mr. Buxton has offered to Glasgow will result in a loss to the Corporation of £15,000 on capital expenditure, but they include the transfer of all their plant and stores, whereas if the Council waited until its licence expires in 1913 the Postmaster-General would only take over such of the plant and stores as might suit his requirements, the advocates of disposal are recommending that the sale be effected now. Financially, the enterprise is a success. It has over 12,000 subscribers, and yielded last year a profit of £1500, although the rates are only about one-half the usual. The price asked by the Corporation is £305,000.

THE annual statement prepared by the principal accountant to the Mersey Docks and Harbour Board showing the number and tonnage of vessels which have paid rates to the Board, with the amount of rates and dues received on vessels and goods in the two years concluded on the 1st inst., has just been issued. The number of vessels has decreased from 26,065 to 25,773, but the aggregate tonnage increased from 15,996,387 to 16,147,856 tons, and the total receipts increased from £1,344,560 to £1,374,042. Thus, there were 151,469 more tons, and an increase of £29,481 in the receipts. The increasing size of ships is indicated in the circumstance that, while there is a decrease of seventy in the number of foreign-going steamers paying dock tonnage rates, the aggregate register shows an increase of 50,620 tons.

AT the inquest on the body of the seaman, George Malcomson, who was killed by the gun explosion on the Essex recently, it was stated by one witness that the vessel was engaged in stopping a merchant ship, and one 6in. blank cartridge had been fired. Malcomson then received the second cartridge, and was standing with it about 3ft. immediately at the rear of the gun, opposite the breach; No. 2 of the gun's crew opened the breach for sponging before firing the second charge. At that moment there was a "back fire," caused by the vessel's steaming ahead, and a consequent strong head wind. The effect of the "back fire" was to explode the cartridge in Malcomson's hand before the gun had been sponged out. Malcomson was killed and others were injured. The jury returned a verdict of "Accidental death."

THE thirty-sixth annual report of the Deputy-Master and Comptroller of the Mint, which has been issued as a Blue-book, states that during the year 1905 the work of the department, so far as indicated by the number of pieces struck, was almost exactly the same as in 1904, but there was a considerable decrease in the value of the coins produced, owing to the smaller gold and silver coinages. The issue of gold coin was less than that of 1904 by £4,542,000, while a falling off of about £95,000 in the issue of new Imperial silver coin reduced the total issue to £510,491, a smaller amount than in any year since 1886. The figures for 1905 were:—Gold, £6,500,000; silver, £510,491; bronze, £100,325; a total of £7,110,816. The average price paid for silver bullion purchased for coinage was $27\frac{7}{16}$d. per ounce standard, or $\frac{3}{8}$d. less than that of the metal in the London market during 1905. The average price of silver in the London market for the year 1905 was $27\frac{13}{16}$d. per ounce standard, showing a rise of $1\frac{7}{16}$d. per ounce as compared with 1904.

MISCELLANEA.

LAST week's takings on the London County Council steamboats amounted to £1286, and as the Council have to pay £3180 out of maintenance account, the loss resulting is about £1800 a week. The receipts were £500 less than during the corresponding week of last year.

THE plans for the lengthening of the dry dock at Fort-de-France, Martinique, have been sent home, and it is expected that the work will be begun this year. The present length of 120 metres is to be increased to 200 metres. More powerful pumps are also to be installed, able to pump out the enlarged dock in five hours.

THE Council of the Institution of Mechanical Engineers have appointed their president, Mr. Edward P. Martin, as one of the representatives of that Institution upon the Main Committee of the Engineering Standards Committee in place of Mr. E. Windsor Richards, past-president of the Institution of Mechanical Engineers, who has retired.

IN reply to a question asked in the House of Commons on Wednesday, it was stated that the prospects of floating the Montagu are good, if the weather continues favourable. The local operations are under the directions of the Commander-in-Chief of the Channel Fleet, and it is not proposed to make any alterations in the existing arrangements at present.

THE town of Honolulu is lighted by electricity, but during the past year gasworks have been started and pipes laid in many directions, the main ducts being 2in. pipes with a high-pressure system. Crude oil is used for fuel in the generation of the gas. There is a considerable demand for gas for use in kitchen ranges, of which the supply is regulated at each register by a coin-in-the-slot mechanism.

APART from certain tramway works, there seems little ground for encouragement to those desirous of introducing horseless traction into Malaga, says the British Consul. The roads here are exceedingly bad, and whilst several of the principal firms interested in the question of local transport have considered the whole matter thoroughly, in no instance has it been decided to replace the present methods.

THE Swansea Waterworks in the Cray Valley in Breconshire are now completed. The masonry dam will impound 1,000,000,000 gallons of water when the reservoir is full. The total length of the dam is 1250ft., and the height from the foundations 144ft., whilst the width at the base is 75½ft. From a number of streams the water flows in a gathering ground of 2680 acres, and the height of the reservoir above sea level is 1000ft.

THE experiences of the recent earthquakes have forcibly emphasised the marked advantages of the short steel stack, which is all that is essential with a mechanical draught installation. According to the *Iron Age*, high brick chimneys have proved to be sources of danger. Their wrecking on all sorts of buildings in the stricken region was no inconsiderable factor in the general destruction. There is much to be said for short stacks and forced or induced draught.

THE motor car industry in Lombardy has become very important, and is in a flourishing condition, says the British Consul. New works have been constructed or are in course of construction, companies have been formed, and hundreds of cars and motor cycles are in use, besides a fair number of cabs, vans, omnibuses, and lorries. Many cars are still imported, and there might possibly be a market for others and for heavy motor vans or lorries, as well as for motor boats for cargo work on the lakes.

A LARGE reservoir with 450 million gallons capacity, a most important addition to the public waterworks system of Honolulu, is in course of construction, and will probably be in working order by the middle of 1907. Honolulu at present obtains its water by gravity from mountain water stored in reservoirs and also from artesian wells, whence the water is raised by pumps to reservoirs and tanks at suitable high levels. With this new reservoir it is expected to have a constant supply sufficient for all purposes, without the help of the existing pumping stations.

ON Friday, June 29th, the coastal destroyer Gadfly, built by Messrs. John I. Thornycroft and Co., Limited, of Chiswick, made a satisfactory preliminary contractors' trial on the measured mile at the Maplin. This is the first of the twelve boats of this new type to make a steam trial, and although the weather was very unfavourable, wind and sea both being high, a speed of 26·05 knots—the contract speed being 26 knots—was, we understand, obtained, with a load on board rather in excess of that which she will have in the middle of the eight hours' official trial. The vessel, it will be remembered, is fitted with Parsons' turbines and oil fuel apparatus, and considerable interest, therefore, attaches to the trial.

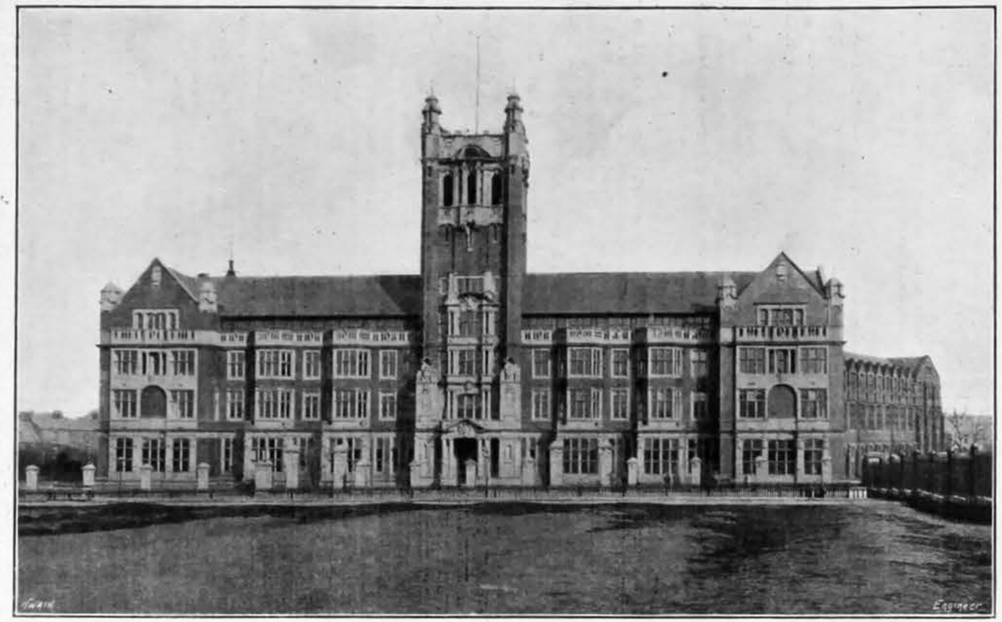
THE Commercial Intelligence Branch of the Board of Trade have received from H.M. Consul-General at Antwerp copy of a specification issued by the municipal authorities of that port calling for tenders for the supply of material and the construction of four railway bridges to be erected on the fortification surrounding the new "Bassins Intercalaires" at Antwerp. The cost of the work is estimated at £8920, and a deposit of £400 is required to qualify any tender submitted. Tenders should be sent in sealed registered envelopes, addressed "A Monsieur le Bourgmestre en l'Hotel de Ville d'Anvers," and should reach the Hotel de Ville on August 2nd. A copy of the specification may be seen at the offices of the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall-street, London, E.C.

AT Southwark County-court on Tuesday last the Coaling Syndicate sought to terminate an award of 15s. per week made in 1903 under the the Workmen's Compensation Act, in favour of Michael Dwyer, a coalheaver. It was stated that Dwyer had a small floating tumour in his right elbow, which he suggested was the result of an accident, and incapacitated him from work. His employers contended that he had fully recovered from the injury; and that the tumour could be removed by an operation, which, however, the man refused to undergo. Deputy-Judge Layman said the Act did not compel a man to undergo an operation, but as a means of inducing Dwyer to do so he would reduce the award to 1d. per week. If he chose to undergo the operation and he was not cured, then he could come back and ask for the award to be increased.

WE are pleased to note that the Motor Union is taking steps to prevent the annoyance to the public caused by the use of exhaust cut-outs on motor cars. The Union is appealing to manufacturers of cars and secretaries of clubs all over the country, pointing out that this is an undesirable contrivance and one that is of no practical value on a touring car, and, considering it is often the cause of considerable offence to the public, asking the co-operation of the firms and clubs referred to to discourage its use. The Union suggests that manufacturers should take every opportunity of preventing the adoption of this unnecessary adjunct when advising their clients, and that the committees of clubs should advise their members to refuse to take delivery of cars which are fitted with exhaust cut-outs. Advantage is also taken by the Union to draw attention in the circular to the objections to exhaust pipes which are pointed downwards, and to suggest that the influence of manufacturers and clubs should be used to discourage the downward exhaust in the manner suggested for the exhaust cut-out, as there is no doubt that when the discharge is carried downwards it tends to intensify the dust nuisance.

THE ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE

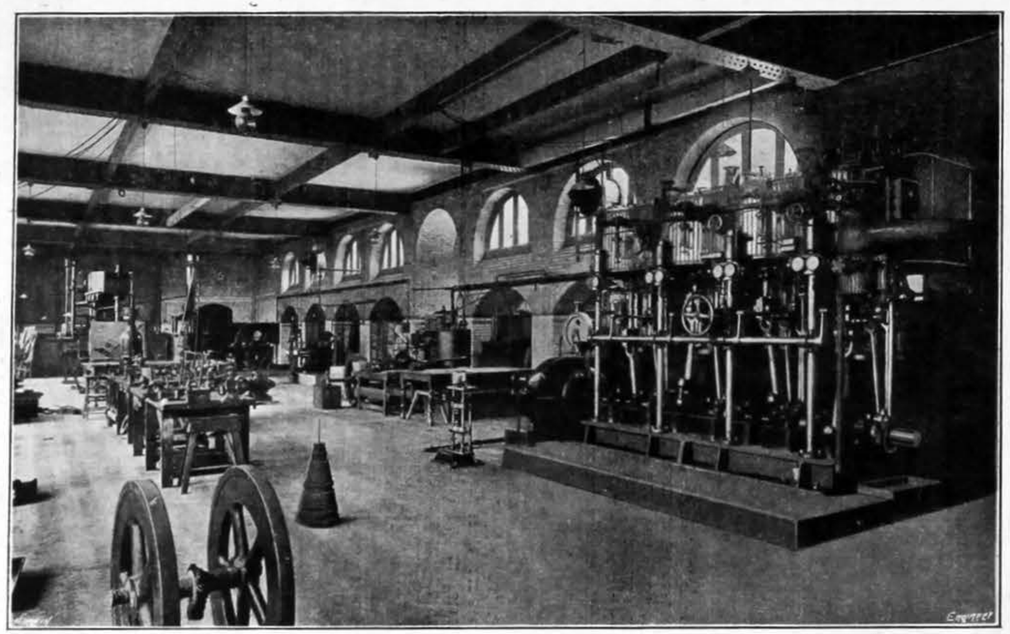
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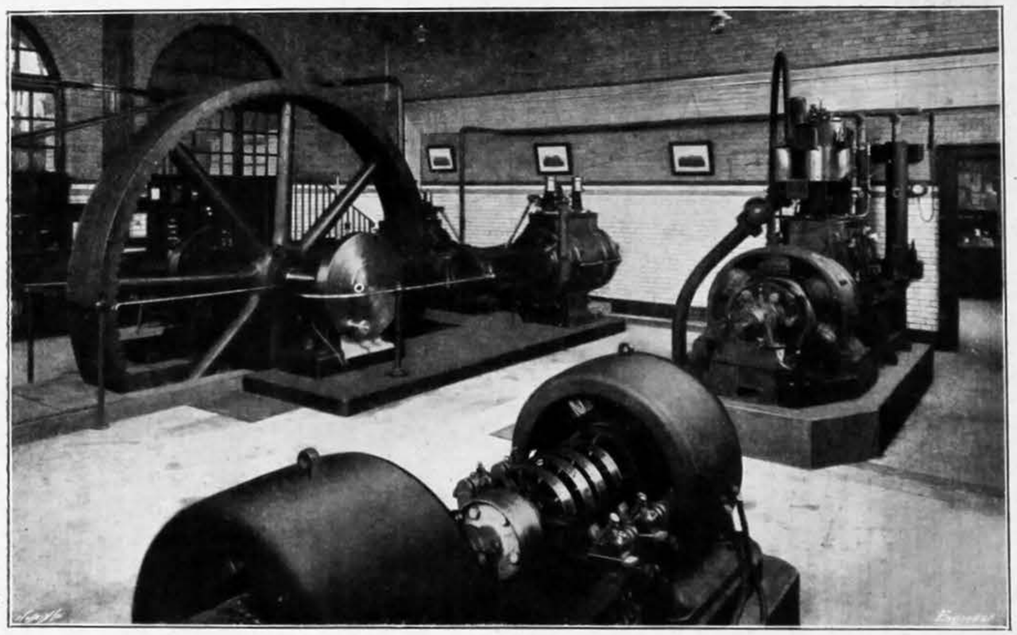
ELEVATION OF THE NEW FRONT



THE ENTRANCE HALL

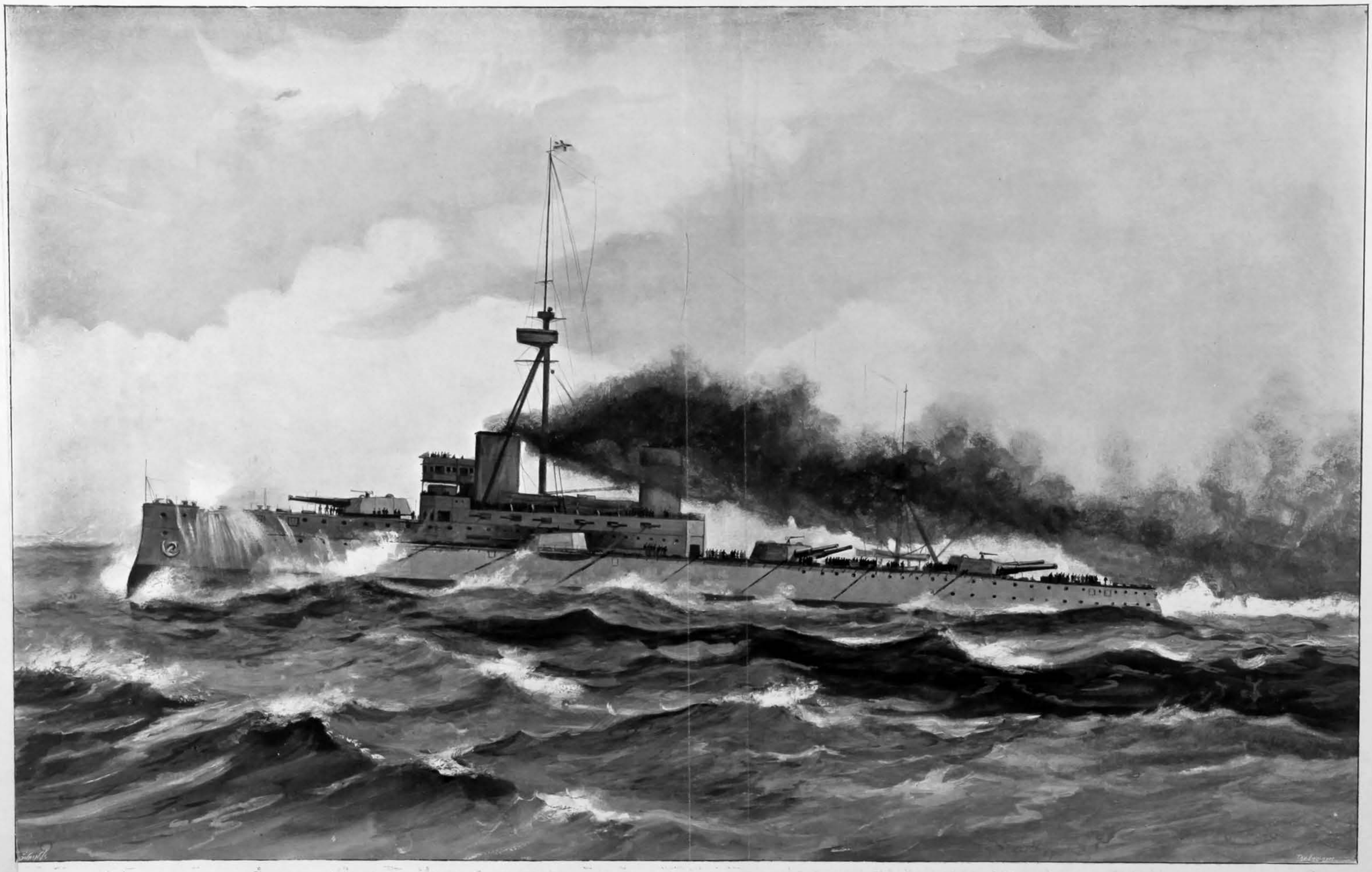


STEPHENSON ENGINEERING LABORATORY



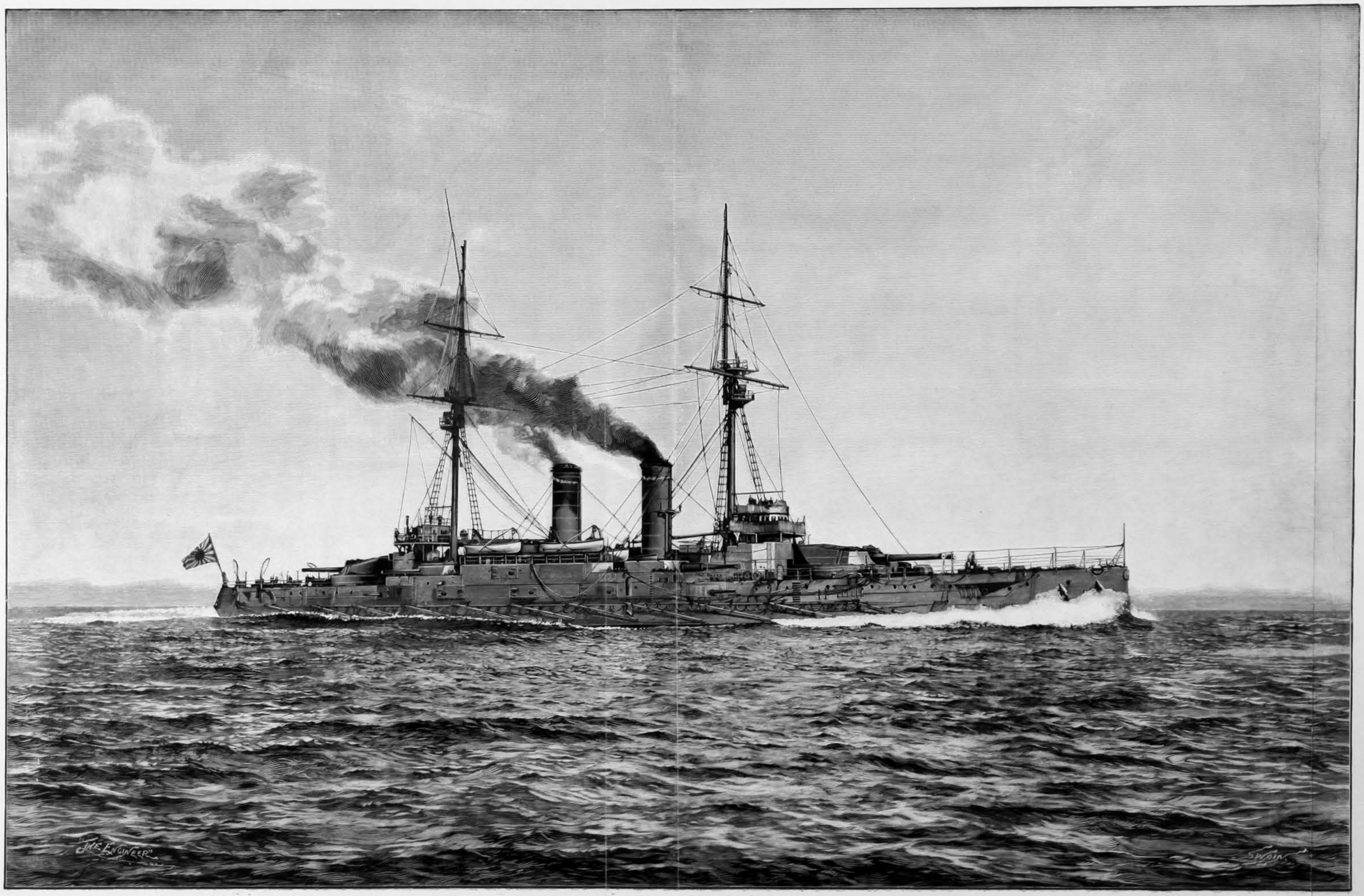
THE ENGINE ROOM

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THE FIRST-CLASS JAPANESE BATTLESHIP KASHIMA

SIR W. G. ARMSTRONG, WHITWORTH, AND CO., LIMITED, NEWCASTLE-UPON-TYNE, BUILDERS



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

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

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PUBLISHER'S NOTICE.

*** *With this week's number is issued, as a Supplement, a Two-page Drawing of the First-class Japanese Battleship Kashima. Every copy as issued by the Publisher includes a copy of this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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TWO-PAGE SUPPLEMENT—THE FIRST-CLASS JAPANESE BATTLESHIP KASHIMA.

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. B. (Brussels).—The address of the firm is the Lead Wool Company, Snodland, Kent.

HUSTLER.—If you will refer to our issue of 22nd June, page 633, you will see all about the committee appointed to inquire into the use of automatic couplings and either side brakes. These is little doubt that if good designs can be found they will be recommended for adoption.

INQUIRIES.

DOG BISCUIT MACHINERY.

SIR,—Can any of your readers give me the names of some firms who make and supply machinery for the manufacture of dog biscuit? S. July 4th.

DEATH.

On the 28th June, at his residence, St. Mary's House, Thetford, Norfolk, CHARLES BURRELL, J.P., aged 89.

THE ENGINEER.

JULY 6, 1906.

The Salisbury Derailment.

THE most serious and deplorable accident that has occurred on English railways for many years happened early on Sunday morning last at Salisbury Station on the London and South-Western Railway. With the facts our readers are already well acquainted, but it is desirable to put them on record in as few words as possible. The train was a small special, conveying a limited number of the passengers of the liner New York, who had landed at Plymouth, to London. It consisted of three large first-class coaches and a kitchen car. Its total weight behind the tender probably did not exceed 120 tons, and it was hauled by one of the new four-coupled locomotives—No. 421. A picture of a similar engine, No. 415, appears on page 18. The train left Plymouth about eleven, and should have reached London some four hours and twenty minutes later. As it cleared Salisbury Station the engine left the line, crossed an intermediate road, and dashed into a milk train approaching in the opposite direction. It, or part of the train, struck also a stationary engine, and finally collided with the parapet of a bridge, which brought it to rest. That it could do so much is sufficient indication that it was travelling at a high speed. It was, needless to say, completely wrecked; twenty-seven persons were killed, whilst a number were injured. The smallness of the train conduced, no doubt, to the large proportion that the injured and dead bore to the whole number of passengers, which appears to have been only forty-seven.

Until more information is forthcoming it would be fruitless and improper to seek for a definite cause for the accident. There are, unfortunately, many reasons why a train may leave the rails, but until the official inquiry is concluded all that can be done is to guess or conjecture. Much has been said as to the speed of the train, and the popular opinion has spread that it was excessive, and was the immediate cause of the accident. It is wiser to forbear such hasty judgment. The train is no new train running for the first time. It has held a position in the London and South-Western time-table for more than two years. If anyone will turn to THE ENGINEER of April 29th, 1904, he will find on page 429 a description by Mr. Rous-Marten of a record run made by this very "ocean special," hauled by an engine, No. 399, of a similar type to that of the ill-fated train of Saturday night. It is always run at a high speed, and on parts of the road 80 miles an hour is regularly attained. That such speeds in themselves have a steadying effect rather than otherwise is common experience, and it would not be too much to say that few passengers are aware how often they approach it. At slower speeds there is frequently more oscillation, and the inexperienced traveller whose attention is enforced by the movement concludes that the velocity is excessive. We mention this fact, well known to railwaymen, as a warning to those who too freely accept the statement of passengers that the speed through Salisbury was dangerously high. Whether it was above the speed at which the train is usually run over this part of the road—always very high—will be easily shown by the time books, and by the evidence of the guard himself. For ourselves we prefer to suspend judgment, in view of the fact that a broken rail, a broken axle, or an obstruction on the road, are causes at least as probable as excessive speed. For it must be remembered that speed alone is not a sufficient explanation of a derailment. It in itself is only an accessory, not a prime agent. This train has probably gone safely through Salisbury Station many scores of times at a speed as high as that of Sunday morning. But if speed alone were sufficient cause for a derailment, the train should have left the line the first time such a velocity was attempted. We have therefore to look for some other cause acting in conjunction with speed—rolling of the engine; unsteady and irresponsible action of the bogie; worn flanges; excessive side pressure due to the curve of the rails; some obstacle, slight in itself, which might have been passed safely at less speed, but which was sufficient at high speed to throw the wheels off the line; a broken rail; a broken axle; and so on. Something else must be found besides high speed, and whether it is discovered or not depends upon the facts that remain to tell their story, and upon the thoroughness with which the inquiry is pressed. And we trust that the inquiry will be pressed to the limits. There is no class of accidents more disturbing than unexplained derailments. Faulty signals, a defective bridge, fog accidents, a signalman's or a driver's error are all palpable causes which we can set about correcting. But when an engine or a train leaves the road, and no apparent cause is found, we are filled with a vague uneasiness. It would be far more satisfactory to know that this deplorable accident was due to a broken axle, or to any other definite cause, than to have vague statements about excessive speed, and it is not unlikely that some such cause will be found.

We cannot conclude without a few words to express our extreme regret that the accident should have happened to a train conveying so many Americans. In a sense, a sense which we like to expand when we offer our condolences to the friends of those who are deploring losses to day, every American who comes to England on pleasure is the guest of the country, and we feel that anything that mars the pleasure of their visit reflects upon our hospitality.

London Traffic.

THE eighth and final volume of the Report of the Royal Commission on London Traffic has just been published. It is a huge book, running to over a thousand pages. It is, as a fact, Vol. IV. of the series, and contains the appendices to the Report and the index. We have on several former occasions referred to this Commission and to its findings. There is not the smallest doubt that it worked exceedingly hard and amassed a prodigious quantity of information. The pity is that so few are likely ever to read and digest all that it has written. In an early article on this same subject we said:—"It is impossible to contemplate this colossal result of wasted energy without regret." We have seen no reason to alter our opinion in the meanwhile. The Commissioners have certainly carried out their work with a zeal and application which is highly commendable, and yet one cannot help feeling all the while that their labours have, to a large extent at all events, been in vain. Even supposing that all the recommendations are carried out, and the £30,000,000 or so which they would entail expended, is there really good reason to suppose that the betterment would be of lasting value to the metropolis? We are sadly afraid that there is not, but rather the reverse. It is becoming a somewhat trite saying, but it is true, nevertheless, that when greater facilities for traffic are given traffic will increase. As a general rule this increase outstrips the facilities afforded. This has been so in too many instances to be regarded as anything else but a natural result. It is but another instance of Charybdis and Scylla. One hesitates to say which is the less dangerous.

It may, perhaps, be well here to outline the general scheme proposed by the Advisory Board of Engineers, who went deeply into the matter, and reported at length to the Commission; the proposal was to construct a main avenue or wide street from Whitechapel direct to Bayswater, and another from Holloway to the Elephant and Castle, crossing the river by a new bridge constructed near the western boundary of the City proper. This formed the nucleus of the idea, but, in addition, numerous streets were to be widened, and provision made, not only as regards the breadth of any new streets made, but also as to the freeing of points of congestion where the tide of east and west traffic clashes with that from north to south. No doubt these recommendations would do good for a time. Perhaps the improvement would last long enough

for the Commissioners to point to their handiwork and say; "See what we have done for you! Who can say that your millions have not been well spent?" The result, however, would be the same in the end, and unless we are greatly mistaken, it would come much more quickly than is anticipated. Either one of two things would happen. Traffic is such an uncertain quantity, that it is impossible accurately to forecast exactly which of these two things it would be. Either the "improved" means of communication would not meet with the approval of the general public, and would produce no relief at all; or there would be an amelioration of affairs at first, to be followed later on by a condition similar to that which now exists. We are inclined to think that the latter would be the most likely eventuality. It must not, however, be understood that we are, therefore, opposed to any attempt to deal with the problem. Old thoroughfares, as it becomes possible, must be widened and straightened, and new roads must be built of as great a width as is possible. We must do all we can, even with the knowledge before us that in a few years' time all our work will be as though it had never been. On the other hand, we doubt if any sudden effort is desirable; rather it seems to us wise to follow the natural course with all cities, and let development progress with need.

Meanwhile there is one spark of comfort. Last November, in a reply sent by Sir Francis Hopwood in answer to a letter from Sir Henry Oakley, the chairman of the Central London Railway Company, it was stated that the Government had sanctioned the preparation of a Bill relating to London traffic. It is possible that the present Government may have different views on the subject, but in the absence of news to the contrary, it may be taken that the Board of Trade has the matter in hand, and intends to deal with it at an early date. The change of Government will, no doubt, have delayed the appearance of the Bill beyond the time originally intended. The proposal, according to Sir Francis, involved the establishment of a Traffic Board which was to have for its object the control and co-ordination of means of locomotion in the City. It may be said that this only reflected the views of nearly every witness heard by the Commissioners. The central idea was, as we explained at the time, that the Board was to seek to make all the various factors work smoothly together, and generally to superintend improvements. We think that such a Board might go far to ease matters. At the present time the police deal most efficiently with a traffic which is almost overwhelming. They are powerless, however, to carry out any improvements. The Board, on the other hand, would have full powers to do so. It is quite possible that a few alterations here and there would materially improve the situation. Nothing, however, will do away with the root of the evil, namely, centralisation. Wherever men congregate together, there congestion will be found, and we greatly doubt whether there is any real and lasting remedy. If cities built expressly to facilitate locomotion have failed to bring this condition of affairs about, how can one expect so to patch up London that there will be no blockage of traffic? The wonder in our minds is that things are not worse in our metropolis than they are.

London Electricity.

THE Committee appointed to hear arguments for and against the proposal of the London County Council to supply electricity on a huge scale in London are to be congratulated on the rapidity with which they came to a decision after hearing the voluminous and conflicting evidence laid before them. The last witness was heard on June 21st, and on Thursday afternoon, 28th ult., the decision of the Committee that the preamble of the Bill was not proved was announced by Mr. Luke White at Westminster. The bare fact of this statement we were able to include in the last issue of THE ENGINEER, but the report which was laid before the House of Commons on Thursday evening was in our hands too late for the press. The bulk of it will be found on page 21 of the present issue.

Last week, in announcing the rejection of the Bill, we rejoiced at the decision of the Committee, and if our satisfaction is somewhat damped by the encouragement which the Committee hold out to the London County Council to produce a new Bill, and bring it before the House as quickly as may be, we cannot but feel that much may happen before that is possible, and that the desire to municipalise everything may not be so strong, say, twelve months hence, as it is now. The principles underlying the Committee's advice to the London County Council to "try again" will be found in Clauses 10 and 11 of the report. Expressed briefly, they are—first, that the best means of supplying electrical energy in bulk for power and traction purposes is by one large and inclusive scheme, extending not only over the entire County of London, but also to adjoining boroughs and districts; and, secondly, that the proper central authority for the realisation of such a scheme in London is the County Council. If these opinions are infallible nothing remains to be said or done; sooner or later, with or without opposition, the whole supply of electricity in bulk must be undertaken by the municipality. But whilst we readily admit the advantages of unifying a variety of systems which already exist, it is a very different thing to create an entirely new system of huge dimensions for the sole reason that it is more economical than a divided system. If the County Council were under an obligation to supply electricity to the "County of London and adjoining boroughs and districts," then it could not do better than to bring all its branches under one head. But, save in its own opinion, the Council is under no obligation of the kind. Other people are quite prepared to supply the electricity in just such a way as the Council would supply it, and that they may or may not be able to secure the last per cent. of dividend in doing so by the method they propose is nothing to the Council. Each one of four or five separate schemes to supply different parts of London might not be so successful financially as a single gigantic scheme, but if the money invested were private money the shareholders who entered willingly upon the risk would be the only losers, and they only in the abstract sense that they might have made more under different circumstances. That the user would be any worse supplied by private enterprise than by the Council we find it hard to believe; and whereas, in the one case, the municipality has to meet the bill for a gigantic experiment, in the other it is put to no expense whatever. This financial aspect of the case has impressed the Committee, and we read with pleasure their warning that "the report of the Finance Committee of the County Council renders desirable a careful consideration of alternative schemes." This is a feature of its scheme to which the Council has resolutely closed its eyes. It has been so disturbed lest private enterprise should secure a Bill, that, reckless of the consequences, it has hastily drawn up its own without considering the cost. We need not recommend the many associations of ratepayers which are springing up wherever municipal extravagance is rife, to study the report of the Council's own Finance Committee on this very scheme.

Commenting some months ago on the formation of this hybrid Committee, and on the refusal of the "Additional" company to appear before it, we expressed the opinion that the Council would get its Bill whatever happened, and that it would profit by the facts brought out in the inquiry. That the latter plan will be adopted may be gathered from Clause 16 of the report, which reads: "Further consideration should be given in regard to many matters pointed out during the course of the inquiry, with a view to amending and improving the scheme." And in order that the Council may have every opportunity of putting this suggestion in force, the field is to be kept open for it till it brings in a regenerated Bill, improved by the knowledge gained during this inquiry, before the House next session. One of the facts that has been brought home to it is that due consideration must be given to the fact that both local authorities and companies have expended a great amount of capital in the building of generating stations, and the new Bill must contain clear and distinct provision "so that the existing financial position and obligations of local authorities and companies as authorised distributors should be taken into account in any revision of prices." This requirement will no doubt be met, and we still fear the Council will get its Bill, but its case has undoubtedly been weakened in many respects by the report before us. Much will now depend on popular feeling some nine or ten months hence.

Contractors' Liabilities.

DECISIONS of the Courts which relate to disputes between employers and contractors so often depend upon a peculiar set of facts that it is not always easy or even possible to deduce a general principle from any particular case. A recent judgment of the Privy Council, however, is worthy of note, inasmuch as it deals with a point which, so far as we are aware, is entirely new. It relates to the question whether a contractor may recover interest upon capital expended by him in carrying out works. The facts, so far as material, are shortly these:—The Thames Ironworks were employed by the Cape Government to construct certain railways. With regard to two of the railways, there was a clause in the contract providing that 10 per cent. should be retained by the Government from the payments falling due as the lines were constructed. This 10 per cent. was to form a guarantee fund which was first to be applied to making good any defects in the construction of these railways, and the balance was to be dealt with in terms of an agreement relating to the construction of a third railway. That agreement provided that the sums in question should be handed over to the company as follows, viz., one-third when the third line had been completed to a certain geographical point, one-third when to a certain further point, and one-third on final completion. The agreement for the construction of the third railway provided that the contractors should be paid a subsidy of £2000 per mile for the work done by them. It also provided for payment as the work went on, with a retention of 10 per cent., while the contractors had also to lodge £50,000 as security. We now come to the clause which is of importance for the present purpose. It was provided that if the contractors should fail in the construction of the third railway they should forfeit the security and the retention monies above mentioned "as and for liquidated damages, and thereupon the agreement between the Government and the concessionary shall cease, and the Government shall thereafter as soon as the amount of the actual cost of such incomplete line shall have been ascertained, pay to the said concessionary the amount so ascertained, less such amount as shall have been paid on account of subsidy, and less the amount of retention money hereinbefore referred to." The contractors failed to complete the third line within the time limited. The Government then obtained leave to enter upon and take possession of it. The contractors, whose interests had by this time come to be vested in Mr. Arnold F. Hills, then brought an action claiming, amongst other substantial items, the sum of £73,500 12s. 7d., at which figure the referees had valued that portion of railway No. 3 which had been constructed by the contractors. They also claimed interest on the capital which had been expended by them in part performance of the contract for the third railway. The Supreme Court at the Cape decided that there could be no claim for interest, and the Privy Council has affirmed this decision. In delivering judgment, Sir Arthur Wilson said: "To add interest would be to disregard the plain meaning of the word 'actual' as applied to cost. The referees have here, as practical men, estimated the cost of the works; in other words, they have said that so much money was expended to make them. To add something more in the name of interest would be to add something which never could be actual cost, for it would either be a sum calculated on an assumed general rate of interest, or it would be a sum which varied according to the financial position of a particular contractor." He also pointed out that, according to the schedule, the payments were made upon the engineers' certificates relating to actual cost. This is a decision which should be noted by the contractor. It would seem that when a contractor undertakes to carry out a piece of work for a certain sum of money, and for some reason or other he is unable to complete, but is in a position to make a claim for the value of what he has already done, he is not entitled to interest on the money which has been tied up in the works.

Iron Prices and Wages.

IT is remarkable how few serious disputes there have been of late in British industries connected with the iron and steel and engineering trades. So conspicuous is the change contrasted with only a few years ago, that we are disposed to believe that at last the unionist leaders are putting on wisdom. The alteration is one upon which the trade of the country is to be warmly congratulated. Not before it was high time that the workpeople showed greater confidence in capital, it is true, has the better conditions of things appeared; still, however tardy in arrival, it is none the less sincerely welcome. Perhaps foreign competition has at last told its tale upon trade union counsels. A conspicuous instance of the better relationships existing between masters and men has been afforded by the conditions in the manufactured iron trade of the Midlands and South Wales. For two years wages in the iron trade in the districts named and in South Yorkshire and Lancashire, have, as we lately pointed out in these columns, been conducted without the existence of a sliding scale. Owing to re-arrangement desired by the ironworkers the scale has been in abeyance, wages, meanwhile, being regulated mainly by the ascertainments from time to time in the North of England. Yet, though working conditions in the two districts are in some particulars largely dissimilar, there has been no disturbance of industry, the Midland and Welsh operatives having loyally abided by their

leaders' advice to remain quiet at the mills and forges. The first return of iron prices under the new scale, which has now been arranged, has just been issued. It is a historic document, since for the first time for a period of thirty years or so, the ascertained average is the result of an examination of the books, not of twelve iron-making firms, as always before, but of seventeen. Bars, axles and tees, plates and sheets, hoops and strip iron, are all included in the range from which the net wage is struck, and this average for the two months ending April—the latest date investigated by the accountants to the Wages Board—is declared to have been £6 18s. 3d. It was anticipated that the declaration, when ascertained, would give the men an advance—as it actually does—and this advance of 2½ per cent. was conceded to them in this belief a month ago. The actual increase which appears in the selling average price is 6s. 4d. per ton. It is interesting to observe that the average selling price of bars only is returned as £6 17s. 8d., while angles and tees figure for £7 2s. 3d., and hoops and strips £6 16s. 2d. As to plates and sheets, the combined average of these descriptions of mill produce was £7 10s. 5d. The Midland iron-works continue to hold the record as the largest producers of manufactured iron in the country. For the two months under review the output was 34,800 tons. The make of bars alone was 24,300 tons. Altogether the reissue of these returns after so long an absence is a very valuable event in the iron trade.

The Royal Agricultural Society.

WHEN the Royal Agricultural Society decided, contrary to the wishes of a large number of its members, and in spite of the warning of many of its friends, to abandon the migratory show system in favour of a fixed show yard near London, there were not wanting critics who saw in the change what was considered to be "the beginning of the end" of the Society's shows. That there was justification for the prophecy is only too true. The London shows were one and all unmitigated failures, from whatever point of view they are considered. The exhibitors fell off, and the London public ignored the existence of a show which lacked the excitement necessary to draw the pleasure seeker. We are delighted, therefore, to be able to record the success which has attended the return of the Society to the peripatetic system. Not only was the number of exhibits at Derby in excess of recent years, but the attendance on the four days of the show reached to over 119,000, or roughly five times that at Park Royal in 1905, and this in spite of unfavourable weather. The producer gas trials were equally successful, and attracted considerable attention, and although we are not in possession of the necessary data to formulate any opinion of the working of the various plants entered, we believe that the competition was very close, and will serve to show agriculturists and others what an inexpensive and simple plant the gas engine and producer constitutes, and how cheaply power can be obtained by its means. The Society has now sold its London show ground, its costly offices have been disposed of, and all the economies which can safely be made in the staff have been carried out. We venture to predict for this time-honoured institution a future worthy of its traditions.

LITERATURE.

Report of the Electric Railway Test Commission to the President of the Louisiana Purchase Exposition. New York: McGraw Publishing Company. 1906.

THIS large octavo volume of 621 pages, profusely, if indifferently, illustrated, contains the report of a Commission consisting of Messrs. J. G. White, chairman; H. H. Vreeland, treasurer; James H. McGraw, secretary; W. G. Wilgus, and George F. McCulloch. The volume is not one that lends itself to reviewing, if by reviewing is understood criticism of the work done by an author, and of the way in which he has done it. The report is a quite lucid and straightforward statement, and is very likely to be largely used as a book of reference. We cannot better define the origin of the volume than by the following quotation from the preface. "The organisation of the Electric Railway Test Commission was due to the recognition by the officers of the Louisiana Purchase Exposition of the fact hat the presence of a large amount of electric railway apparatus gathered together for exhibit purposes offered an exceptional opportunity for obtaining practical and scientific information of equal interest to the producer and to the user of electrical machinery; and of the further fact that such investigations could most advantageously be carried out under the auspices of the Exposition." Sub-committees were appointed, and series of tests were devised and made. The report is divided, as were the tests, into seven parts or sections, and sixteen chapters, to which are added two appendices. Part I. is introductory, Part II. deals with service tests of electric cars, Part III. with acceleration, Part IV. with the storage of air for braking and various systems of braking, Part V. with a storage battery locomotive. Part VI. with alternating current losses on track, and Part VII. with train resistance.

The work was carried out as far as possible under ordinary practical conditions, with the intention of supplying definite information as to what actually goes on day by day on an electric railway or tramway. There is in each case a description of the mechanism tested, of the method of test, and tabulated and graphic statements of the results. Anyone in this country or elsewhere with the book before him can tell what is likely to be the result obtained from any given combination of mechanism worked into a street car or a railway coach. The description is in all cases sufficiently full to enable anyone turning to the book for reference to see just how far his case and that given in the volume are alike. The competent reader will be able to recognise differences and make due allowance for them.

Not a few of the results obtained are directly or partially opposed to preconceived ideas, and some of the statements made are in a way surprising. Thus, the use of iron trusses under long coaches, to prevent them from sagging in the middle, seems to have been regarded as not more excellent than novel. The two most interesting chapters, at all events in a broad sense, are those devoted to acceleration and train resistance. The results of the trials of a "city car" are set forth in nine graphic diagrams, divided into two sets of curves for each test, one showing the electrical data, while the other shows the speed and distance data. The average acceleration was 1·33 miles per second; the average current, 146·7 ampères; the average power, 74·6 kilowatts. Twenty miles an hour was reached in 16·10 sec. In this, as in most other tests, the speed curves show a rapid increase at the start, which increase gradually falls off until the maximum velocity is reached.

When we turn to the air resistance tests we encounter much that appears to involve the whole puzzle of air resistance in a deeper mystery than ever. Railway experiments have gone to show that the head resistance is very small, and that it is the displacement resistance, due to the bulk of the train, which is the most important. The primary object of the tests was to secure data relating to the train resistance of an inter-urban car, without and with a trailer, at speeds of from 30 to 70 miles an hour. The second object was to obtain similar data for a dynamometer car specially constructed for measuring air resistance. This latter car was known as the Louisiana. A very detailed description of it is given in Chapter XV. In general terms, it consisted of a steel frame or chassis provided with rails. On these rails was supported by wheels with roller bearings the body of the car, which was retained in its place by springs and various safety devices. The resistance of the air always tended to move the car backwards on the chassis, and this movement was registered in distance and amount by sufficiently simple apparatus. The car body could be fitted with ends of various pattern, made up of light match-boarding on steel frames. One experimental end was dead flat, others were made with curves of different orders. It was found that the flat front was not only the worst, but out of all reason the worst, and that a parabolic "Vestibule," in plan much like the bow of a fast steamer, was the best. But the difference does not make itself greatly felt until high speeds are reached. The "suction" behind the car was by no means a negligible quantity; thus at 60 miles an hour, the car being fitted with parabolic wedges at both ends, the head pressure absorbed 32·2 horse power, and the suction 6·91 horse power. But the flat front required no less than 126 indicated horse power, while the suction represented 7·68 indicated horse power. The curves of pressure as worked out are very uniform. The actual speeds attained with the flat front did not exceed 50 miles an hour. There was not power enough to attain a higher velocity. But when the car was fitted with the parabolic wedge vestibule a speed of 75 miles an hour was easily reached. More cogent testimony to the value of the "cut air" bow could not be had.

The work of the Committees appears to have been very well done, as was indeed to be expected, considering the competence of those who served on them. We have failed to find any evidence of bias in dealing with the results. Indeed, there are only a few direct expressions of opinion. The story told is in all cases lucid and intelligible; but care has been taken to warn the reader that the whole ground has not been tilled, and that much remains to be done in improving the electric car. The book is, we may say in conclusion, a very valuable addition to the library of the electrical engineer, and the more so that it is surprisingly free from formulæ of all kinds.

SHORT NOTICES.

Practical Motor Car Repairing. A handbook for motor car owners and drivers. By Eric W. Walford. London: Percival Marshall and Co. Price 1s. net.—This little book deserves to be well-known amongst users of self-propelled vehicles. It differs from most of the publications of a somewhat similar kind which have hitherto appeared, in that it is essentially practical. There is a truly woeful absence of knowledge in road-side motor car repairing establishments, which this work ought to help to remove. Chapter I. deals with the petrol motor, the grinding in, and removal of valves, the repairing and setting of timing wheels, &c. Chapter II. is upon ignition, and contains useful hints upon how to discover causes of spark failure, and the charging of accumulators. There is an unfortunate misprint in this chapter, the starting handle being referred to as the "sparking" handle. Chapter III. treats upon the cooling system—a common cause of trouble in motor cars—and shows how adjustments, the repairs of pumps, and radiators may be effected. Chapter IV. includes useful information on carburetters, exhaust and lubrication systems. Chapter V. is headed "Transmission," and is rather brief, the bulk of the matter referring to clutches of the leather-lined pattern. The author shows how to proceed to re-leather a clutch, but omits the very necessary process of first soaking the leather thoroughly in water. In Chapters VI. and VII. the author describes methods of repairing frames, spring axles, and wheels, and tires while on the road. In Chapter VIII. some of the lesser troubles which bring a vehicle to a stop are described, and again typographical errors have crept in. Sparking plug is described as "sparkling" plug, while "rebrushing" of bearings is an obvious misprint. The sketches and illustrations are very legible.

Gold Dredging, annual supplement, illustrated. By Captain C. C. Longridge: London, 1906. *The Mining Journal*, pp. xi. and 67.—So much additional information has been forthcoming during the past year in connection with this progressive branch of mining, that it has been thought desirable to produce this volume supplementary to the author's book on the same subject published last year, and it is just as nicely produced and illustrated. The information includes notes on the relative merits of shafts and boreholes for prospecting, on various methods of gold mining, on centrifugal compared with bucket elevators, whilst the use of the submerged jet dredge and the application of the steam turbine, the suction gas producer, and petrol engines on dredgers are noted. There are 500 dredgers in operation now throughout the world, and the notes in this volume emanate from thirty-two localities in various parts of the globe; they are mostly rather scrappy, unedited cuttings, but it is handy for those interested to have them collected in one volume.

The Automobile Handbook, 1906. London: 119, Piccadilly. Price 3s. net.—This is the third edition of the handbook issued by the Automobile Club and the Motor Union of Great Britain and Ireland. In addition to giving particulars of the automobile organisations of the United Kingdom and other necessary information for users of self-propelled vehicles, the book forms a very complete guide to touring at home and on the Continent. There is a directory of hotels and repairers; itineraries of several important routes; plans of principal towns; regulations of foreign countries; steamship charges and arrangements; Acts of Parliament and regulations governing the use of motor vehicles; and a list of the standard motor cars of 1906. The book has been edited by Mr. W. Rees Jeffreys, and will form a welcome addition to the bookshelves of all users of motor cars.

Dictionary of Engineering Terms in English and Spanish. By Andrés J. R. V. Garcia, London: Hirschfeld Bros., Limited, Furnival-street, Holborn. Price 3s. 6d. net.—The author, in the preface to this little book, states that the object of the publication is to satisfy the demand for an up-to-date technical dictionary of the terms in general use by engineers, and he has succeeded in a large measure. The contents are arranged in a manner which renders the finding of any particular word fairly easy, but the book displays a rather incomplete knowledge of English engineering terms. The inaccuracies will, however, be obvious to most technical readers. "Back-action steam engine," for instance, probably is intended to mean "reversing engine," and "worm of screw" is no doubt intended for a "screw thread." Such slight defects may be remedied by careful revision.

The Business Blue-book. London: Curtis Gardner and Co., Limited, 65A, Cannon-street, E.C. Price 2s.—Although numerous articles have appeared from time to time in various papers, describing what the writers considered to be the correct method to buy, carry on, or sell a business, there have not been many books published on the subject. The "Business Blue-book" is written primarily with the above objects. It contains numerous short chapters on important matters relating to business enterprise, and gives much advice. We think that some of the chapters could be extended with advantage, and others made slightly more practical.

BOOKS RECEIVED.

Rhodesia Review: An Independent Quarterly for Settlers and Shareholders. By Percy Lindley. London: 30, Fleet-street, E.C.

The Concise Interest Calculator. By A. M. Campbell. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, Ludgate-hill. Price 2s. 6d. net.

Electric Machine Design: Being a Revised and Enlarged Edition of Electric Generators. By Horace Field Parshal and Henry Metcalf Hobart. London: Office of *Engineering*, 35 and 36, Bedford-street, Strand, W.C.

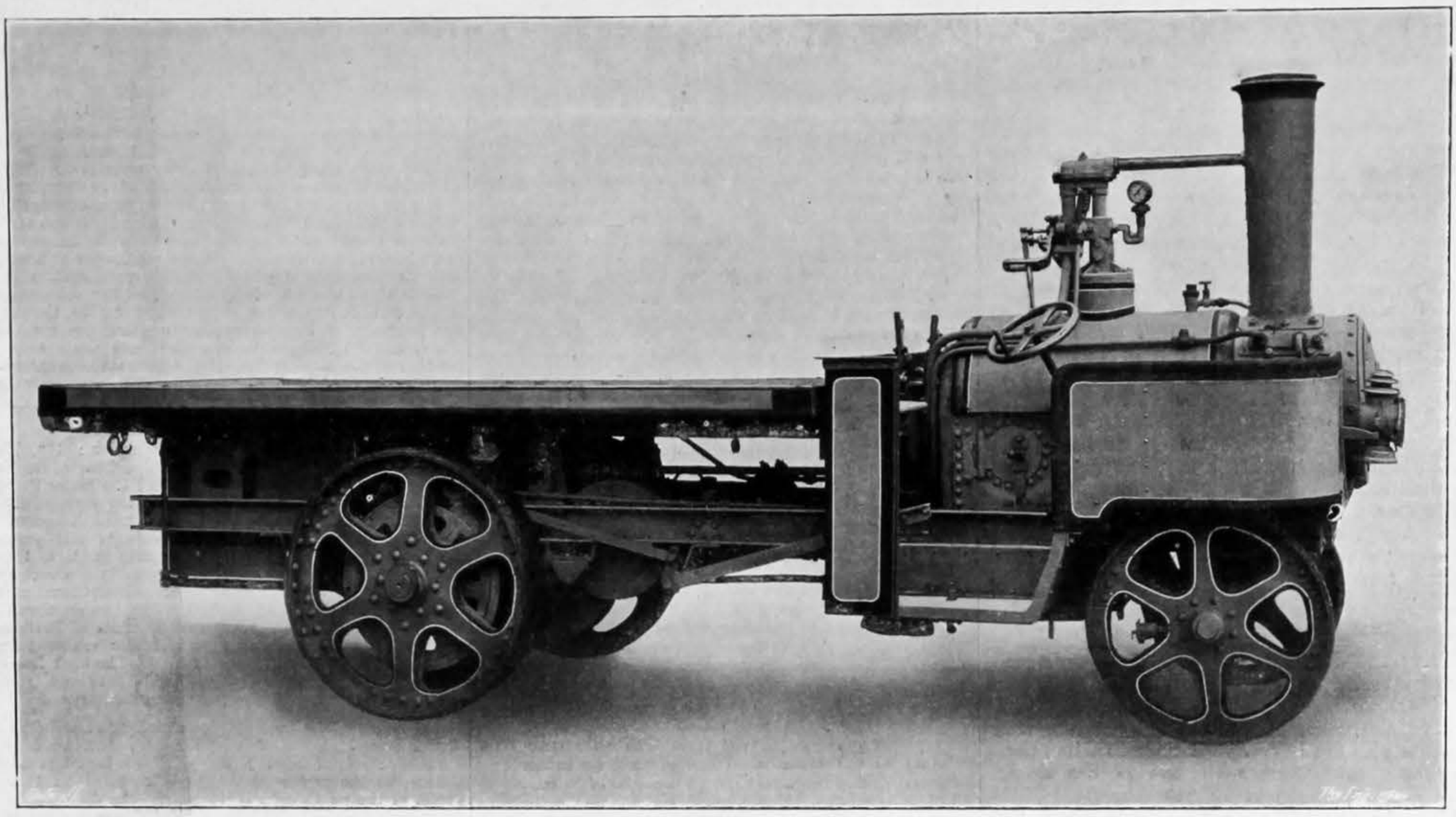
Heresies of Sea Power. By Fred J. Lane. London: Longmans, Green and Co., 39, Paternoster-row. Price 12s. 6d. net.

THE JAPANESE BATTLESHIP KASHIMA.

OUR two-page Supplement illustrates one of the Japanese Navy's latest additions, the first-class battleship Kashima. From time to time we have described the progress of the construction of the Kashima, and therefore most of our readers will doubtless be already acquainted with the particulars of her. However, the following description will remind others of the general dimensions of the ship. She was constructed on the Tyne by Sir Wm. G. Armstrong, Whitworth and Co., Limited. Her length on the water line is 455ft.; her breadth, 78ft. 2in.; her draught, 26ft. 7½in.; and her displacement in tons, 16,400. The armament consists of four 12in. guns twin-mounted in barbettes, four 10in. guns mounted singly in barbettes, twelve 6in. guns in the citadel, twelve 12-pounder guns, six Maxim guns, three 3-pounder guns, and five torpedo tubes. The 12in. guns are 26ft. and the 10in. 22ft. above the water line. The 6in. guns in the battery are from 13ft. to 14ft. above the water line. The general particulars of the main propelling machinery and boilers are as follows:—There are twenty Niclausse boilers arranged in three separate boiler-rooms. They have a working pressure of 230 lb., and a grate surface of 1300 square feet, and a heating surface of 43,000 square feet. There are twin engines, each having four cylinders of 36in., 51in., 63in., and 63in. diameter, with a stroke of 48in. The designed speed was 18½ knots. The displacement of the ship is over 17,000 tons. Further particulars of the Kashima will be found in THE ENGINEER of April 8th, 1904; March 24th, 1905; March 31st, 1905; and April 13th of this year.

TWO-TON STEAM WAGON

MANN'S PATENT STEAM CART AND WAGON COMPANY, LIMITED, LEEDS, ENGINEERS



ROYAL AGRICULTURAL SHOW.

No. II.*

LAST week we mentioned the firm of Robey and Co., Limited, Lincoln, as the latest addition to the ranks of motor wagon builders. The steam wagon exhibited for the first time at the Royal Agricultural Society's Show at Derby has many exclusive features. As will be observed from the general view, Fig. 6, the vehicle has a vertical boiler, horizontal engine, and steel channel frame. The motion is transmitted to the road wheels by gearing, no chains being used. The wheel base is short, and the load is placed well over the driving wheels. The wagon is designed to carry five tons and haul an additional load

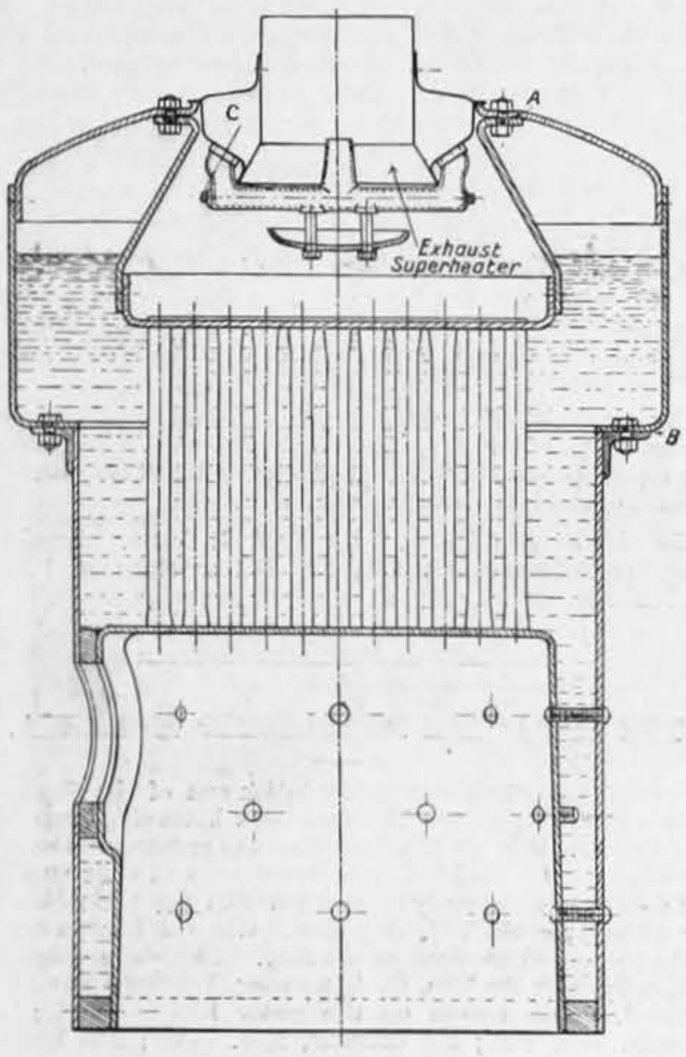


Fig. 4—ROBEY'S WAGON BOILER

of two tons. The boiler, shown in section in Fig. 4, has 108 vertical fire tubes, 1¼in. in diameter, all of which are submerged and easy of access for cleaning. The top of the boiler has an enlarged water and steam space, and the combustion chamber is arranged to provide superheating surface. The fire-door is in the barrel and facing the driver. Mudholes are provided for washing out and for internal inspection and scaling. Two bolted joints give access to the outside of the tubes and the top of the fire-box. The grate and heating surfaces seem sufficient for their purpose, and at the base of the chimney is a superheater, by means of which the exhaust steam may be dried prior to being emitted to the atmosphere. The engine is of the compound pattern, with two cranks, the high and low-pressure cylinders being brought out flush with the side frame of the wagon. This arrangement not only facilitates inspection, but also brings the driving stresses in line with the members of the frame. The crank shaft bearings are placed close to the

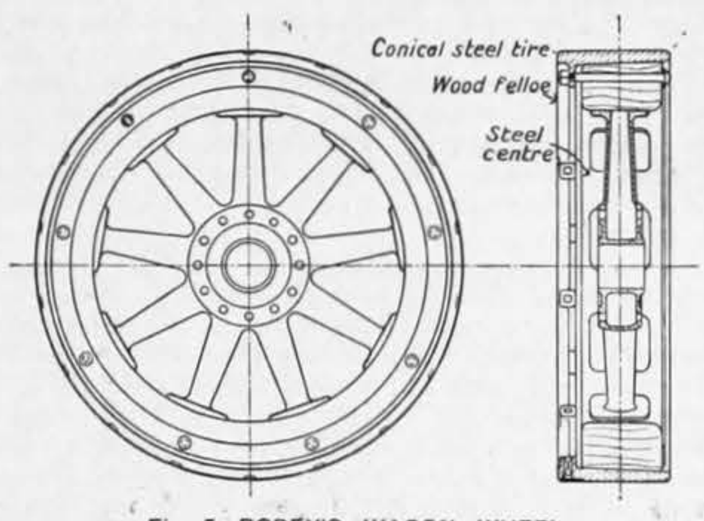


Fig. 5—ROBEY'S WAGON WHEEL

crank discs, giving great rigidity. The crank shaft and second motion shaft are fitted in the same cast steel brackets, perfect alignment being thereby always maintained. The legal speed of five miles per hour is obtained at a piston speed much below the safe working limit. A slow speed gear is fitted for hill climbing in bad weather or on bad roads. A very simple reversing excentric takes the place of link motion. An arrangement has been found to give satisfactory results, with minimum of wear and tear. The boiler feed pump has a slow speed, and can be run when the wagon is stationary.

A departure has been made in the construction of the road wheels; a reference to Fig. 5 will show how these are built up. They have cast steel centres and spokes, to which are bolted elm felloes. The centres and felloes are forced, under hydraulic pressure, into crucible cast steel tires, which have on their internal periphery a very slight taper. Should the tires in course of time stretch, they can be tightened by bolts provided for pulling the centres further into the taper rims. The renewal of tires is a very simple and inexpensive matter. Practically the whole of the bearings and engine parts are provided with forced lubrication, and are protected from dust by a casing. To facilitate starting, an auxiliary valve operated by the foot of the driver serves to admit high-pressure steam to the low-pressure cylinder. When a trailer is in use, the driver can apply the brakes from the footplate of the wagon, thus meeting the requirements of the law, and dispensing with an assistant on the trailer. This is effected by means of a simple design of flexible coupling between the two vehicles, the whole arrangement forming a continuous, powerful, and easily worked brake shaft extending from the footplate of the wagon to the road wheels of the trailer.

A light steam tractor designed to work under the Motor Car Act was exhibited for the first time by C. Burrell and Sons, Limited, Thetford. Its chief features are a double-crank compound engine, 5ft. driving wheels, springs under both axles, and worm and worm-

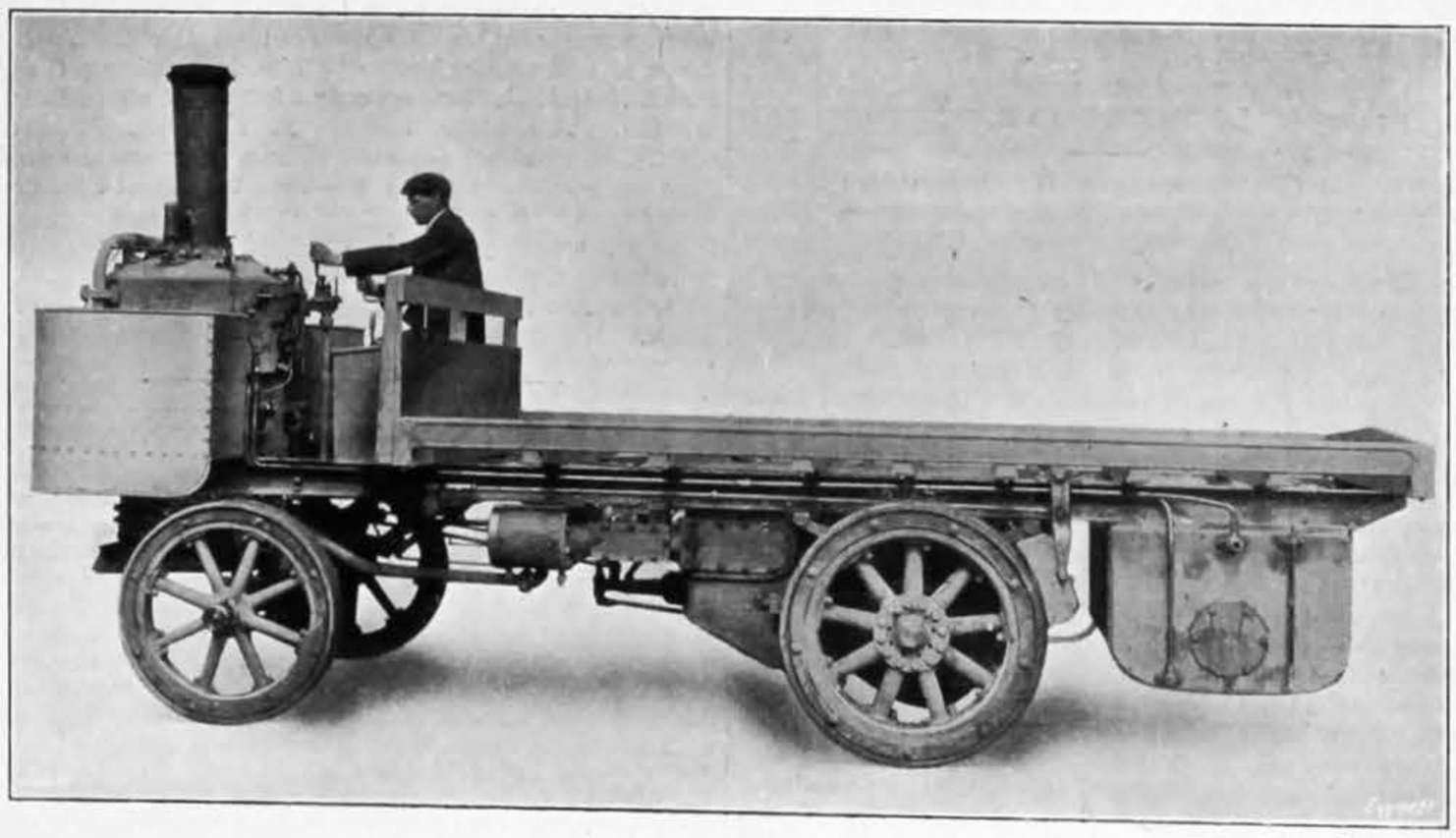


Fig. 6—ROBEY'S STEAM WAGON

wheel steering gear in place of the chain steering usually applied to this type of engine. The boiler is designed for a pressure of 200 lb., and an ample water tank is provided. Each of the driving wheels is separately

* No. I. appeared June 29th.

operated, and the compensating gear can be locked by the driver when necessary, and without dismounting. We have on previous occasions described the chief features of the steam wagons and tractors built by the Yorkshire Patent Steam Wagon Company; Jesse Ellis and Co., Limited; Aveling and Porters; Garretts, Wallis and Steevens; and Clayton and Shuttleworths. Mann's Patent Steam Cart and Wagon Co., Limited, Leeds, showed a five-ton wagon—already familiar to our readers—and a two-ton steam wagon, which is represented on page 16. This is a handy little vehicle, which enabling the driver and steersman to do their work with ease. The gear allows freedom of movement altogether independent of the load being hauled; shocks due to bad roads are cushioned, and damage to buildings, bridges, &c., is thus avoided.

Marshall, Sons and Co., Limited, Gainsborough, exhibited amongst other appliances on their prominent stand a long-stroke horizontal engine, class "L." This engine is made from new patterns, it is fitted with Marshall's trip gear, and has equilibrium double-beat drop valves both for the steam and the exhaust. The cylinder and screw for bevel cutting, and is firmly carried in a semicircular seating. It requires no locking in position when canted, as the screw and seating are sufficient to hold it. The maximum distance between the top of the table and side of the saw guide is 17in. Efficient saw guides are provided, the top one being frictionless, and does not affect the temper of the saw. This guide is carried at the end of an adjustable counterbalanced arm, which also supports the saw guard, the counterbalancing being effected by means of an enclosed coiled spring. The guide can be instantly raised and locked in any position.

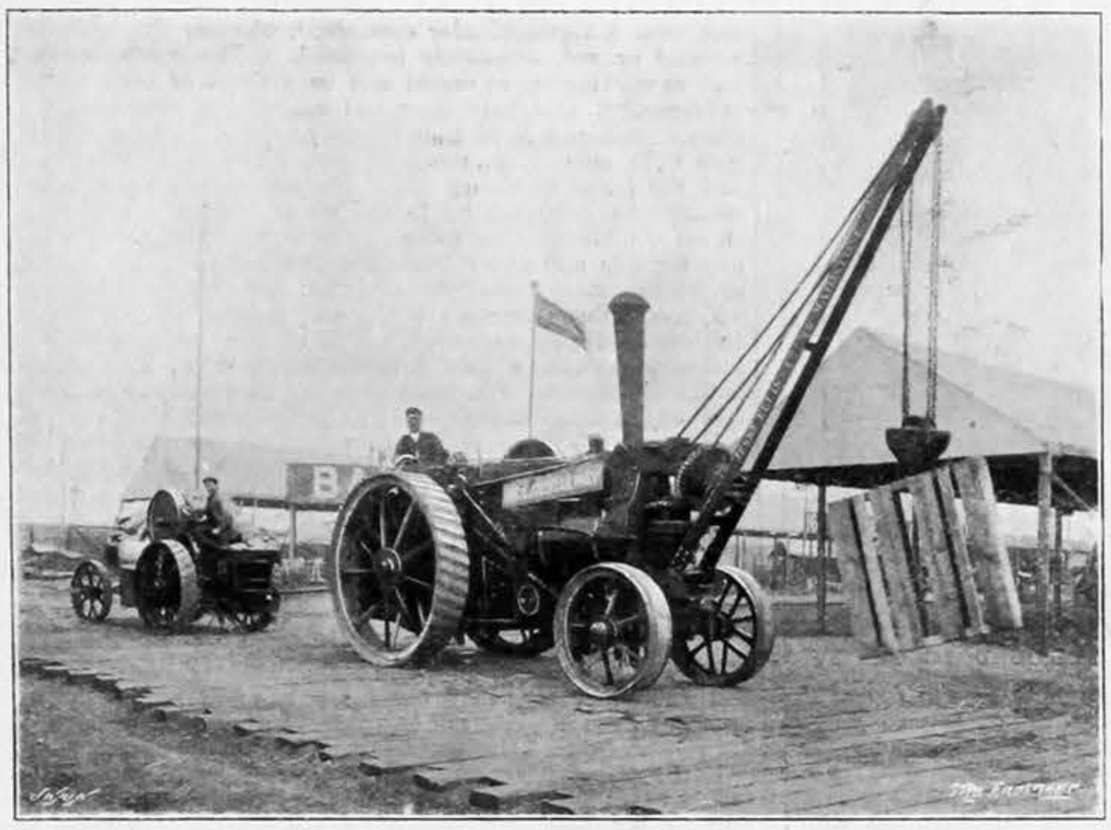


Fig. 7—ELLIS PORTABLE STEAM CRANE

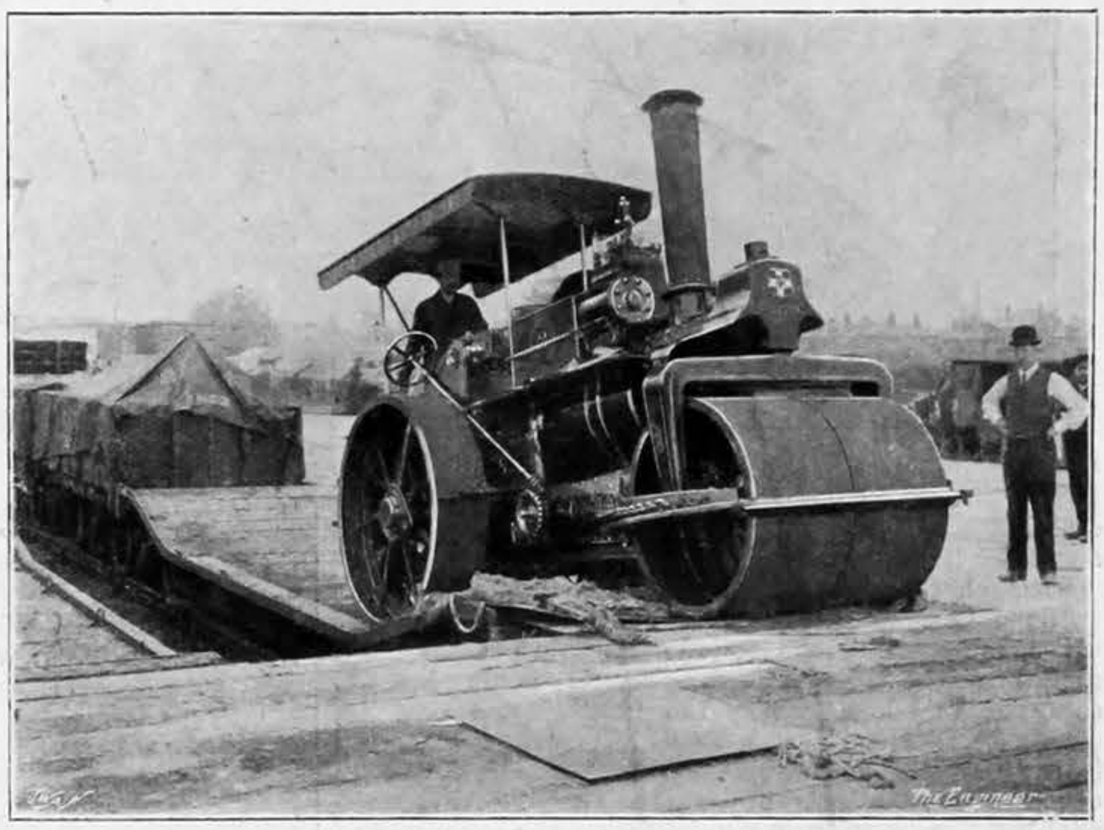


Fig. 8 RUSTON ROLLER LEAVING WAGON

this firm builds to operate under the eight-miles-an-hour speed limit. The loco. type boiler is similar but smaller than that of its larger sister, the frame is of steel channels, and the main axle bearings are held in position by radius rods. The engine is compound, with cylinders 3¾in. and 6⅜in. diameter, by 6in. stroke. The working pressure is 170 lb. The motion is transmitted from the crank axle by gearing running in an enclosed oil bath, and the wheels are secured on square shafts. A noteworthy feature of the Mann vehicles is the low situation of the engine, leaving ample head room between the frame and the platform. The steering gear consists of hand wheel, worm, and quadrant.

No important agricultural show would be complete without the imposing range of ploughing engines and gear, traction engines and road rollers, which John Fowler and Co. (Leeds), Limited, provides. Although the visitor no longer looks for radical departures in the design of this firm's exhibits, he will always find some admirable workmanship. The steam ploughing gear is

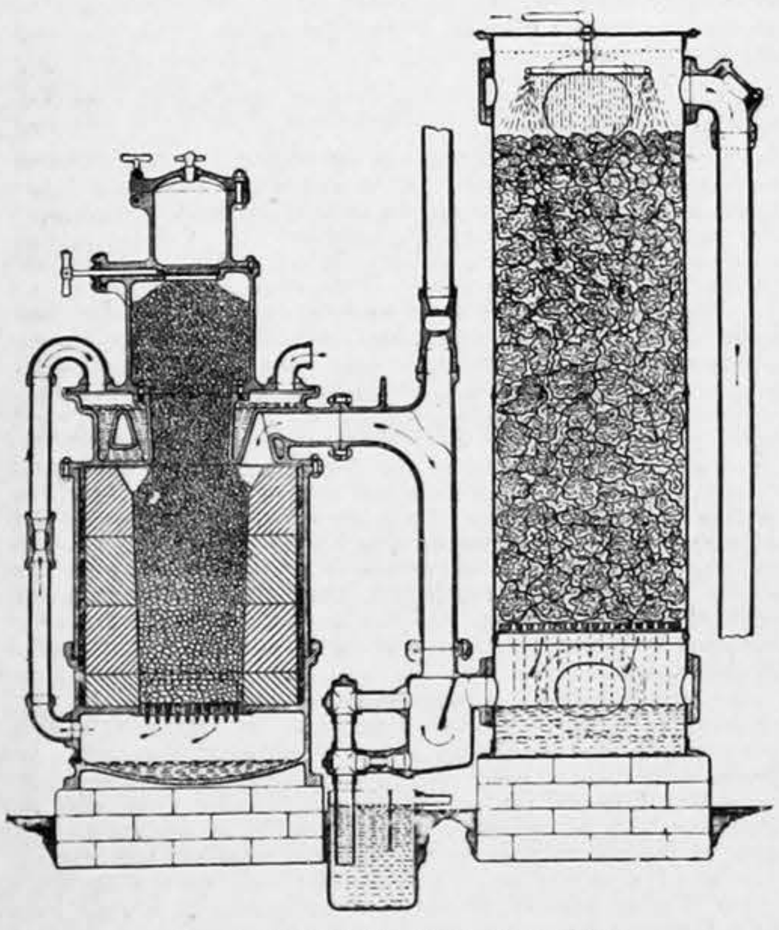


Fig. 6—TANGYE'S GAS PRODUCER

amongst the best this country can produce, but we are more particularly attracted by a compound spring mounted road locomotive, "Class B 6," the largest that can be lawfully used in England. The boiler is intended for a working pressure of 180 lb. per square inch. In emergencies high-pressure steam can be admitted into the low-pressure steam chest by means of a starting valve—which closes automatically—the engine then working double cylinder with high-pressure steam, thus giving off its maximum power. The driving cranks are set at right angles; thus a uniform speed of rotation is obtained. The engine can be readily started and reversed, and, when hauling, the load is steadily taken up.

The engine has an improved third speed road gear, with safety clutch, and is mounted on Fowler's spring gear. The unique features of this gear are—the central adjustable suspension bolt and equalising levers, which ensure the driving gear running constantly in true pitch; vibration is avoided, and jar is reduced to a minimum, is 11in. by 30in. Amongst the engines also is a self-contained engine of the vertical class "M.P." type, fitted with Pickering sensitive governor and equilibrium throttle valve. The engine has a cylinder 6½in. diameter by 10in. stroke, and is specially adapted for driving quick running machinery, &c., and for work where perfectly steady running is absolutely necessary. An important item in this year's exhibits is a 10-ton single cylinder road roller, so arranged that it can be converted into a traction engine for haulage purposes when not required for rolling. Ransomes, Sims, and Jeffries, Limited, Ipswich, had on view a varied collection of agricultural appliances, road locomotives, stationary and portable engines, thrashing machines, cultivators, &c.

Oil engines were shown by Fielding and Platt, Limited, Gloucester; Tangyes, Limited, Birmingham; Campbell Gas Engine Company, Limited, Halifax; William Glover and Sons, Limited, Warwick; Britannia Engineering Company, Limited, Colchester; Crossley Brothers, Limited; F. C. Southwell and Co., Limited, London; Fairbanks, Morse and Co, London; Blackstone and Co., Limited, Stamford; Richard Hornsby and Sons, Limited, Grantham; T. G. Slipper and Co., Norwich; National Gas Engine Company, Limited, Ashton-under-Lyne; and Teasdale Brothers, Limited, Darlington. Thomas Robinson and Son, Limited, had an extremely effective display of flour milling and wood working machinery. The latter included a new 36in. band saw, which is neatly designed. The table is arranged to cant by hand-wheel

We mentioned last week that, in addition to the suction gas plants entered for the trials, there were others which called for attention. Among these was that shown by Tangyes, Limited, of Cornwall Works, Birmingham. A sectional elevation of the gas producer and scrubber exhibited by this firm is given in Fig. 9. Its main feature is the simplicity of the design. The plant consists of a generator and scrubber. The base of the producer consists of a cast iron ash-box containing a fire-grate and bars, with doors for removing ashes and clinkers. Above this comes the generator casing. It is lined with firebrick, which is separated from the casing by a layer of sand. The vaporiser is arranged round the top of the casing, and is heated by the hot gases as they leave the generator. A fuel chamber and a charging hopper are placed above the vaporiser. For starting purposes, the usual small hand fan is supplied. The gases pass from the generator into a scrubber. This is made of steel

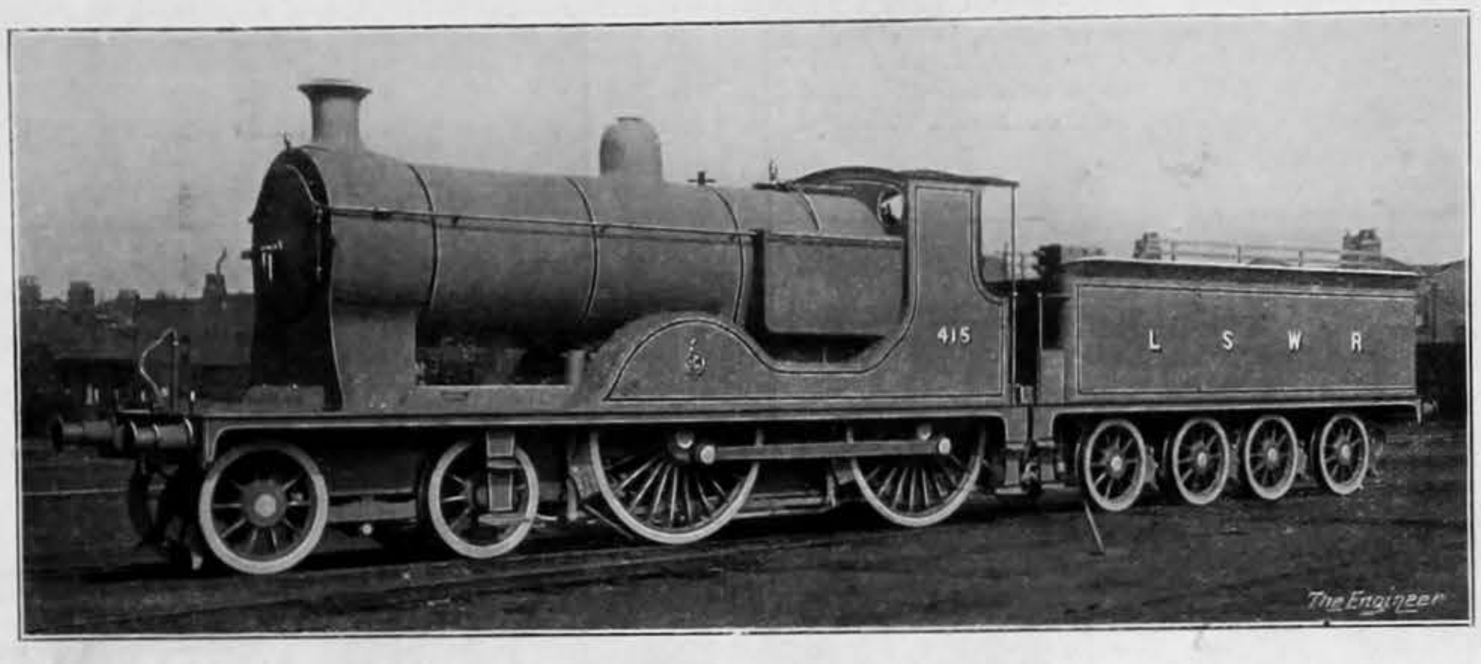


Fig. 10—MIDLAND RAILWAY COMPANY'S SPECIAL DOCK

plates, and is fitted with cleaning doors. It is similar to most other scrubbers, and contains coke cooled by a water spray. Before the gases enter the engine they pass through an expansion chamber, thereby reducing the "pull" on the gas plant when the engine is taking its charge. We are informed that, on a six hours' continuous test of a Tangye engine developing 21·11 brake horse-power, working in conjunction with one of these suction gas producers, the consumption of "anthracite" peas was only ·785 lb. per brake horse-power per hour. Although this class of fuel is recommended, and is

FOUR-COUPLED EXPRESS LOCOMOTIVE, L. & S. W. RAILWAY

D. DRUMMOND, NINE ELMS, ENGINEER



certainly the best for this work, the plant, we understand can be made to work on coke or lignite.

Through the courtesy of Mr. F. Buxton, the district goods manager of the Midland Railway at Derby, we are enabled to give the following information regarding the special arrangements made by the company for dealing with the implement traffic, live stock, &c.:—The site upon which the show was held is the property of the Midland Railway Company, and covers about 90 acres of ground. The Midland Company's sidings previously ran right up to the show ground, and, with a few additions, existing accommodation was converted into a convenient goods depôt, replete with every facility for dealing promptly with all descriptions of show traffic, including live stock. A large dock, 45ft. wide and 120 yards long—see Fig. 10—was provided, so that two trains of twenty wagons each can be dealt with at the same time. The end-on dock accommodation was equally good, covering as it does three roads, thus enabling three vehicles to be unloaded or loaded at one time. From these docks there is a graduated slope, about 80ft. wide, terminating within a few yards of the entrance to the show ground, admitting of traffic being transported to and from the docks with the greatest ease, and without clashing or confusion. The siding accommodation included a crane line, upon which a steam crane was used, and the cart roads adjoining were sleepered, so as to facilitate the passage of vehicular traffic. The Midland Company also provided a steam traction crane of five tons capacity—see Fig. 7—for lifting heavy articles from the wagons to the drays, and again from the drays on to the show ground. A steam road roller unloading itself from a traction wagon on to the end-on dock is shown in Fig. 8. The success of the company's efforts is evidenced by the fact that, apart from the show plant from Park Royal, the timber for the erection of the stands, and about 8000 sleepers to form the roads on the show ground, the whole of which were dealt with at this depôt, nearly 1300 wagons containing show exhibits, besides upwards of 700 trucks containing live stock, and a number of road vans containing horticultural exhibits, &c., were received and unloaded there without the slightest hitch. In a word, so perfect were the arrangements in this direction that on all hands the greatest satisfaction has been expressed.

Notwithstanding the facts that the Derby Show was open for only four days, and that the weather was unfavourable on three of these, the attendance of the public was highly satisfactory, the total for the four days being over 119,000, compared with 23,913 last year at Park Royal, and it would seem that the return to the migratory show system, coupled with more popular control and greater economy, will be the means of re-establishing the Society's prestige and giving the annual exhibitions the new lease of life which all who are interested in our great national industry will be pleased to see.

THE SALISBURY DERAILMENT.

IT will be of interest to our readers, having regard to the lamentable accident at Salisbury on the 1st inst., to see the illustration of the type of locomotive which was hauling the train, which we give above. It is from a photograph by Mr. F. Moore. It will be observed that the four driving wheels, which are 6ft. 7in. in diameter, are coupled, and that the engine is provided with a four-wheeled bogey. The series of engines to which this belongs has done consistently good work ever since it was introduced. The engine illustrated, No. 415, was the first of the type; the engine of the ill-fated train was No. 421.

THE SEA EROSION INQUIRY.

THE Royal Commission on Coast Erosion will be constituted as follows:—Chairman (Hon. Ivor C. Guest), Sir William H. Browneflolkes, Bart., Sir Leonard Lyell, Bart., Sir William Matthews, C.M.G., Mr. W. P. Beale, K.C., Commander G. C. Frederick, R.N., Mr. H. Rider Haggard, Professor J. T. Jehu (St. Andrews University), Mr. A. L. Lever, Mr. R. B. Nicholson (Town Clerk of Lowestoft), Mr. Patrick O'Brien, Mr. T. Summerbell, and Mr. A. Stanley Wilson.

THE Hamburg-American liner Deutschland reached Plymouth on Wednesday morning, having averaged 23·06 knots for the entire voyage from New York.

LETTERS TO THE EDITOR.

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

(*Continued from page* 6.)

THE LATE MR. F. W. WEBB AND COMPOUND LOCOMOTIVES.

SIR,—If I may, I should like to take note of the remarks of yourself and your correspondent "G. D. S." on this subject, as they appear in your columns this week. Before doing so, however, I have to take exception to what you say as to my having, in my previous letters, criticised Mr. Webb's character and behaviour. I cannot see that you have any grounds for this assertion, and I ask you to withdraw this statement. I am not concerned with Mr. Webb's character and behaviour, nor would it be fitting for me to discuss them. All that I have endeavoured to do, I may repeat, is to render justice to his professional standing and career as regards his connection with the London and North-Western Railway, and to his particular system of applying to locomotives the principle of what is known as "compounding," and generally to express my sincere, if humble, approval of his engineering ideas, and of London and North-Western Railway locomotive practice. I should like to correct here a slight error in my last letter as regards "banking" up Shap from Tebay of "trains stopping at Tebay—not Penrith, as it appears—as a regular thing." I was referring, of course, to the "down" journey.

As regards the complaint of your correspondent "G. D. S.," that on one occasion his train got stuck on the "up" Wolverhampton curve, after being stopped there, owing to one of the 6ft. compounds of the "Dreadnought" class being unable to move it until assistance was given by another engine at the rear, this does not amount to much; that is not the only train that has got stuck at that point. He does not say whether the train was an exceptionally heavy one or not, or what the state of the rails was; and he does not say, because he, perhaps, does not know, that this particular curve is one of the worst on the line, and easily capable of flange-locking any train that is unfortunate enough to get stopped on it, and of positively anchoring any engine, compound or otherwise, that tries to pull out of it. No engine is omnipotent, and no harder task can be set the most powerful locomotive than to start a train, no matter how favourable all the attendant conditions may be, on such a curve as the one in question, with every outer flange hard up against the rail and the compressed inside buffers aggravating the situation, and any one but an amateur would recognise this. Your correspondent does not state whether his train on that occasion "lost time steadily from Crewe," on account of signal checks, or bad weather. He simply lays the blame of all this experience upon the engine—because it was a Webb compound. This sort of criticism is valueless, particularly when it is apparently dictated by prejudice not of the most enlightened kind. In fact, if I may say so, criticism on locomotive and railway matters, from the merely amateur standpoint of an ordinary passenger, cannot carry much weight either generally or as regards the subject immediately under discussion.

And here, I think, I may claim an advantage over your correspondents and yourself, for I have had experience of the Webb compounds, both as a passenger with the locomotive and engineering interest very much alive, and as having ridden upon, driven, and fired, and been otherwise practically and intimately connected with them. I can claim, as you say, to have been behind the scenes, and to have had practical acquaintance with the working and maintenance of these engines sufficient to justify my appreciation of them and my belief in the principle of compounding and Mr. Webb's three-cylinder system of it. That others, either with or without special or practical knowledge of, and acquaintance with, this subject, disagree with my views does not affect me in the least. But I do not wish to emphasise at all the personal side of this discussion; only, as I am challenged to give reasons for the faith which is in me, and proofs of my assertions, I must necessarily do so from the facts of my direct personal experience. And as to your challenge for me to produce authoritative evidence on this question, I have two or three things to say.

It seems to me that the burden lies quite as much with yourself and your correspondents "Lynx" and "G. D. S." to prove by facts and figures the negative statements as to the Webb compounds being uneconomical, inefficient, expensive failures, bad timekeepers, and so on. Mere general and irresponsible criticism and condemnation cannot be accepted. You have before you the fact that for a quarter of a century the Webb compounds have been in existence, and before the public and the engineering world; that they have steadily, and in ever-increasing proportion, as their numbers increased—201 of them were built altogether, of all classes, goods and passenger, omitting the four-cylinder compounds, in which I never had much faith—dealt with the heaviest and fastest goods and passenger traffic on the London and North-Western Railway, with at least as much regularity and efficiency as any other class of engine on the line, and that had they been so useless and unsatisfactory as some would wish to make out, and fain believe, they could not possibly have remained in active existence as they did until recently. And here it may be remarked that their abolition under a new *régime* is not necessarily an utter condemnation of them; these things will happen, as we know. And for my part I should wish to be convinced of the error of my practical opinions on this subject by ostensible proofs of a solid and practical—not amateur and not theoretical—character.

For my own proofs, nothing would please me more than to set forth in your columns those statistics and official data of the working and general economy of the Webb three-cylinder compounds which are very fully recorded at Crewe, if I could obtain access to them and permission to publish them, which I am unable to do. Those particulars which I actually have are insufficient for my purpose and incomplete, and, therefore, I could not do sufficient justice to the subject to convince anyone holding contrary opinions. In this, therefore, I am at the same disadvantage as yourself and your two correspondents. I very much wish that all the available official information relating to the Webb compounds of all classes had originally been, and could now be, made public; and, above all, the extensive and valuable dynamometer records relating to these and other types of the London and North-Western Railway locomotives, because these are much the most trustworthy evidences of locomotive power and efficiency. And here I must allude to your inquiry for complete indicator diagrams sufficient to show the actual working of the three-cylinders and their mutual relationship. Personally, I have not much faith in locomotive indicator diagrams as evidences of power developed, efficiency, and so on. As anyone will understand, and as everyone knows very well who has had any experience, the taking of proper consecutive diagrams from a two-cylinder ordinary locomotive, with accurate accompanying records of speed, and piston speed especially, and of all other necessary details, is not only extremely difficult but practically impossible; and with a three-cylinder compound, whether the cylinders are coupled or not, absolutely impossible. The conditions of locomotive working are so varied and so difficult of observation and arrangement that indicating and calculating results is not the simple business it is with a stationary engine. The most that one gets is, in my opinion, not what power the cylinders themselves and the locomotive as a whole are respectively developing, but merely what is happening to the steam inside the cylinders, and this is of little practical value. The only indicator that does give any reliable and accurate record of what work the steam and engine are doing is the dynamometer; and this brake horse-power which it faithfully records is the only information worth having. Indicated horse-power, so-called, is at best, and particularly in locomotive work, a purely fictitious quantity; and unless the indicator diagrams of a locomotive are accurately correlated with the simultaneous records of the dynamometer they are, to my thinking, quite valueless, and cannot in any sense be considered to express the power which the steam transforms into gross and net work. This may sound heretical to some; those who have to deal with locomotive work will perhaps agree with me. I do not think, therefore, that there is any need to insist, as you do, on the importance of the relative working of the single low-pressure and the two high-pressure cylinders of the Webb compounds. In the first place, they were purposely arranged to work entirely independently and "on their own;" and as, naturally, the inertia of the separate sets of motion was adequately balanced, separately and independently, they could not possibly reflect upon one another as you suggest; nor in practice was there ever the slightest indication of their doing so.

That both sets of motion raced at times is a fact, and I cannot see that that was unavoidable or specially disadvantageous, because they neither raced simultaneously nor as a matter of course. What actually happened was that at slow speeds, with a late high-pressure cut-off and a full head of steam, as would be usual at starting, or in climbing a hill, the low-pressure cylinder received more steam power than it actually required, and so *had a tendency* to race; at high speeds, with the high-pressure cylinders working more expansively on an earlier cut-off, and possibly with a less open regulator, the low-pressure cylinder got a sufficiency, but not a superfluity of steam power and had therefore no inclination to race, while the high-pressure cylinders would not race at all, under any conditions of speed, unless for such normal reasons as cause any engine, with coupled or single driving wheels, to race at times. In practice also I could never detect any inharmonious working of the two sets of motion; each did its full amount of work, and the high-pressure cylinders did not suffer from any exhaust back-pressure, as you seem to suppose. Not only did the low-pressure steam chest and its two delivery pipes form an ample receiver for the two high-pressure exhausts, which came to it practically simultaneously and were immediately used up for one low-pressure stroke, but the long length of exhaust piping from each high-pressure cylinder to the smoke-box acted in the same way; and any congestion of high-pressure exhaust steam, and consequent high-pressure back pressure, were automatically relieved by a blow-off valve on one of the two low-pressure delivery steam pipes in the smoke-box, loaded to 45 lb. per square inch. This, therefore, represented the maximum possible amount of back pressure in the high-pressure cylinders; in practice this valve only acted when the engine was starting with the high-pressure valves in full travel and the regulator well open; and it was this factor which actually obviated the defect which you and your other correspondents insist upon, viz., the impulsive action of the low-pressure cylinder at starting. This effect was barely perceptible on the engine, and less so on the train, whenever it did occur. I admit that it was a defect in the early days of the compounds, but it absolutely disappeared when the men got quite used to handling them.

I am prepared to admit that the coupling of the three-cylinder powers on to one axle—but not in any other way—might have been an advantage in the passenger engines, as it turned out in the eight-wheel goods engines, provided that the low-pressure crank was placed opposite, and at 135 deg. with the high-pressure cranks, as in the goods engines. This arrangement would much simplify, if not altogether dispense with, the separate balancing of each of the three cranks and motions; it is certainly an ideal arrangement, and seems to show that a three-cylinder compound is capable of being an ideal locomotive. But I have personally no practical or theoretical objection to the uncoupled arrangement in the passenger engines. Now, the congestion of the low-pressure steam chest and high-pressure exhaust pipes was further capable of relief by the ample double-beat release valve of the Ramsbottom regulator type, placed on one of the low-pressure steam delivery pipes in the smoke-box, and worked from the footplate, and put on for the express purpose of preventing any possibility of the very difficulty which you state the Webb compounds suffered from at starting, viz., the locking of the high-pressure cylinders by back pressure, due to the non-release and congestion of their exhaust steam.

At starting this valve was always opened, so that the high-pressure cylinders exhausted direct into the chimney, and the low-pressure cylinder got no steam at all until the engine had moved sufficiently to bring the low-pressure valve into motion and the crank into its proper relative position for admitting and receiving steam respectively. And the maximum amount of movement of the low-pressure crank necessary to effect this was one-quarter of a revolution. If the crank and valve diagram be borne in mind this will be obvious; for, supposing the engine to be in forward gear, and the low-pressure crank either on the front or back centre, the valve having a lead of ¼in., as it had, the crank had only to be moved a few degrees past the dead centre to be immediately actuated by the steam. Take, however, another case, viz., when the low-pressure crank was standing just past the point of cut-off, *i.e.*, 75 per cent. of the stroke—which was a constant in those compounds which were fitted with the loose single direct-acting excentric driven by a pin on the low-pressure crank cheek, so placed as to give, both in forward and backward gear, the angular advance required for the lead referred to above—it is obvious that the crank only required to be moved through one quarter of its half revolution, or one-eighth of the revolution of the wheel itself, to get past the dead centre and to receive steam through at least the lead opening of the valve. Therefore, directly the first high-pressure exhaust took place, showing that at least one-quarter of a revolution of the driving wheels had occurred (assuming that the high-pressure wheels did not slip), the low-pressure cylinder could be supplied with steam, and come into immediate action; the release valve was then, accordingly, closed, and the high-pressure exhaust diverted into the low-pressure steam chest.

The high-pressure cranks were at right angles, and the valves being naturally in full gear at starting, the full power of at least one cylinder was always available to start the train, and I maintain, as was completely proved in practice, that this minimum available high-pressure cylinder power was sufficient to move the engine and train over the eighth part of a driving-wheel revolu-

tion which sufficed to bring the low-pressure cylinder into full action. These are simple mechanical facts, and, try as you will, you cannot controvert them ; and I am, therefore, justified both by theory and practice in claiming that the Webb compounds were at least as capable of promptly starting and getting away with a train as any ordinary type of locomotive, and that, in fact, more power was available for this purpose than any ordinary two-cylinder locomotive could afford. The release valve referred to solved every difficulty, and was, in effect, a starting valve, and, at worst, a regrettable though necessary addition and complication on the engines.

As regards the distribution of work between the high-pressure and low-pressure cylinders, why should it be equal? Naturally it was not, because there is only one possible point in the mutual relationship of the cylinder powers where they can be accurately balanced, the determination of which, depending on so many considerations, is too complex to discuss here, and too intricate to be solved, except by actual practice in particular cases. At low and moderate speeds the low-pressure cylinder developed more power, and so actually did more work than the two high-pressure cylinders ; at higher and maximum speeds the conditions became more nearly equal. There was no disadvantage in this that I can see ; on the contrary, I maintain that these conditions were favourable, both in theory and practice, just as two horses in a tramcar, though of unequal size and strength, balance the work between them, each reflecting its own power on to the other through the pivoted splinter bar ; and as two engines on a train, though of unequal weight and power perhaps, equalise between them the work exerted in pulling the train—the one helping the other ; the one relieving the other.

In practice there was really little difference between the working of the two cylinder powers, each helped the other, and so, as a natural consequence, they balanced each other as nearly as possible, and certainly neither was ever any drag upon the other. I can only insist upon all these points, if my theories are not agreed with, by the facts of my practical experience in the working of these engines. I am not sure that what you state as the theory of these engines and their cylinder powers is what Mr. Webb himself or anyone else ever particularly claimed for them. He rightly claimed an advantage in dispensing with coupling rods, and on this point I am in agreement with your remarks as to the rails acting as coupling rods. That is certainly the case, and to my mind it goes far to reduce the supposed advantage of coupled wheels, owing to the drag of the pair or pairs working with the driving pair, due to the necessary slackness in the coupling pins and elsewhere ; this is demonstrated by the fact that the wear on driving tires is heavier than on the tires coupled up to them. Where I think the advantage of coupled wheels comes in is simply the prevention of racing and consequent wastage of power. And this implies an advantage in single driving wheels, provided they are of large diameter, because they are not hampered by having to drag and push round another pair or pairs of wheels, which are always lagging behind and always resisting the coupling effect of the rails.

As regards four-cylinder compounds, I do not agree with you as to their being desirable either in theory or practice, whatever may be their arrangement of cylinders, because increased weight and general complication are involved all through, which is altogether disadvantageous ; and I doubt if the Webb four-cylinder compounds have ever been very successful, though they are said to have been improved since their arrangement of valve gear has been altered by doubling it.

As to the Webb compound fire-boxes and grates, they were not by any means excessively large, as you suggest ; and I do not think that increase of grate area or of fire-box surface necessarily involves increased coal consumption. Everything depends on how the box is fired, and a given amount of coal can be more economically fired on a large grate than on a smaller one. The Webb compounds had, it is true, larger fire-boxes and grates than any of the preceding types of London and North-Western Railway engines, though the first, or "Experiment" class, had the same boiler as the 6ft. 6in. four wheels coupled two-cylinder standard ordinary express passenger engines ; but these larger grates and boxes were really of quite moderate size, while the earlier boxes and grates of all the Crewe engines were abnormally small. With a large box and grate steam can be more easily made and maintained than with a smaller box and grate, as the fire does not want so much pushing, and there is, consequently, less wear and tear throughout and less fatigue for the fireman.

The gentle and intermittent low-pressure blast of the Webb three-cylinder compounds, combined with a 5¼in. blast pipe orifice, induced a very effective draught through the box, and made them very excellent steaming engines, while there was considerably less wear and tear of the tubes and box than with the ordinary four-beat high-pressure blast, the devastating effects of which are only too well known. It is to this excellent firing and steaming of the Webb three-cylinder compounds that their very moderate consumption of coal and its high evaporative duty are due. This coal-and-water-consumption economy, combined with the double use of the steam generated, were the prime factors of the successful working of these engines, and outweighed the extra consumption of oil and kindred materials to such an extent as to produce a considerable margin of net economy. Added to this the higher mileage between repairs which these engines invariably ran, and the extremely heavy work they were constantly performing, a further net saving over repair and maintenance costs was obtained. All these points have to be borne in mind and rightly understood in judging of the efficiency and economy of these engines, and to condemn them for those defects which, in common with all locomotives, they did possess, and to say that they were a failure generally, is not only unfair but foolish also, as being against the weight of practical evidence in their favour to prove that, as regards almost all the ideal qualities of a locomotive, they had a large net balance to their credit.

London, July 3rd. F. A. L.

SIR,—Like "F. A. L.," I, too, have railway statistics before me, not accessible to the general public. These in no way bear out the assumption that the working of fast passenger traffic on the London and North-Western was exceptionally economical, which it ought to have been if the compounds burned less coal and less oil and cost less for repairs than the other engines on the line. Even "F. A. L." admits that the London and North-Western average is worse than the average of twenty-four other lines.

The statement that a particular engine worked the heavy Scotch traffic for twelve months on 32 lb. a mile means nothing. We are all familiar with the fact (?) that every express locomotive in the kingdom burns about 30 lb. per mile. Seeing that all heavy London and North-Western trains were worked with pilots, 32 lb. a mile for the compound would be anything rather than economical. If "F. A. L.'s" statement is to possess any value, it must be supplemented by particulars of the weights of the trains and the pilot mileage. I have heard it stated that the "Lady of the Lake" class worked fast trains on 20 lb. a mile, but the trains never exceeded 100 tons behind the tender.

It can easily be shown that heavy fast traffic cannot be run on 32 lb. a mile. An average of 50 miles an hour cannot be maintained with a four-coupled engine and 250 tons behind the tender with less than an average of 750 indicated horse-power. Now, 32 lb. per mile at 50 miles and more means only 1600 lb. of coal, or 2·13 lb. per indicated horse-power per hour, an impossible consumption.

"F. A. L." apparently possesses a great store of information. He can become convincing if he pleases, and give the railway world for once a detailed statement of train weights, speed, and cost of working with compounds and with simple engines on the London and North-Western Railway. Let him take any section, say Euston to Carlisle and back. Not special figures for one engine, with special crews, special coal, and a special premium, but engines working the traffic in the ordinary way, and whether piloted or not.

So far all "F. A. L." says is that he has the necessary information. I am sure he has not published it. QUESTOR.

Oswestry, July 2nd.

SIR,—Commenting on the above and the previous correspondence. I had the privilege of a run from Carlisle to Crewe a few years ago on one of these engines, a four-cylinder compound, Magnificent, No. 1945, and give my observations as an independent witness. The back pressure on the low-pressure cylinder was so excessive that the engine had to be worked by the regulator alone, and so fine had the adjustment to be, that a small quadrant and set screw was attached to the end of the regulator quadrant, so that the driver could jar the regulator very slightly and then follow it up with this small set screw, in order not to run the risk of opening or jarring the regulator unevenly, and thereby letting too much steam into the cylinders and causing the low-pressure gauge to rise. Owing to this fine adjustment, the driver was able to keep the low-pressure cylinder gauge at from 20 lb. to 30 lb. pressure per square inch. I noticed that when the driver opened the regulator too far, the gauge registered a pressure of 45 lb. per square inch on the low-pressure cylinder. Also in my notes, I find mention made that the engine steamed badly, but the coal was inferior at the time. Under these conditions the engine certainly did its work, but on this particular run there was a pilot on the train the best part of the journey.

I also had the advantage of a ride from Crewe to London on a three-cylinder compound engine, following closely on the other run. My observations at the time on this run were "good," but it must not be forgotten that the engine was acting as a pilot, and I see in my notes a remark is made that the engine was erratic in starting. The working of this engine was, however, quite the reverse of the four-cylinder compound locomotive, inasmuch as the latter was worked with a full regulator the whole journey, the driver notching up to meet the varying conditions of the road.

I trust that these few observations may be of interest to some of your readers. S. M.

July 3rd.

"UNEXPLAINED" RAILWAY ACCIDENTS.

SIR,—The Baillieston railway smash, near Glasgow, on the Caledonian Railway, coming as it does so soon comparatively after the Witham accident, the late disaster on the Midland Railway, and other similar fatal and deplorable incidents, it surely behoves railway engineers, of all men, immediately to try and find an explanation for such apparently inexplicable blunders, if not worse.

As regards the Midland accident in the North, that was never, I think, properly cleared up, further than that it was stated that the original trouble was caused by a fish wagon, sandwiched betwixt two heavy coaches, leaving the track, and thus fouling the line, into which the other express dashed into death and disaster. To allow a lighter wagon, such as a fish one, to be placed between heavier passenger coaches in a high-speed train, and stand the chance of the lighter wagon being lifted, as it were, off the track by the pull of the heavier vehicles on each end of it, is surely almost criminal, and, to say the least, is practically to court disaster.

The later terrible disaster at Witham in the South, however, brought home to us what high speeds might mean under the existing condition of things, designed, as these were originally, for 50 per cent. less speeds than are run to-day. It would appear, however, from the Baillieston smash, that railway engineers and managers have as yet learned no proper lesson from the Midland and Witham catastrophes mentioned, as the danger to the travelling public of allowing fish vans or wagons to be run in express trains still exists, with the result of the fearful and fatal accident near Baillieston just reported.

These accidents—lamentable though they may be—if properly inquired into and dealt with, as they ought to be, should surely bring out some practical solution, and provide prevention of similar disasters in the near future.

Spreading of the rails—so prevalent in America and on the Continent—is, owing to our more solid and permanent railways, practically unknown in this country. This being so, and it being taken for granted, as in the said Midland, Witham, and Baillieston accidents, that the axles, the wheels as constructed, the track, the curves, the points, the uniform weight of the passenger coaches, and everything else were right and perfect—as they have been officially stated to have been—surely, mechanically speaking, it ought to be absolutely impossible for a railway train to leave the track at almost any speed, unless by collision or mechanical obstruction.

Is everything right, however, and to take the wheels as an example, are they properly designed and constructed for the excessive speeds of the expresses of to-day? What was designed for and good enough for an average speed of 30 or 40 miles an hour is, I fear, scarcely suitable for the excessive high speeds of the present through mail trains. The only reason why more "unexplainable" disasters do not happen may lie in the fact, that the locomotives and coaches of such main trains have been almost as proportionately increased in weight as they have been in speed running.

The construction of the wheels, however, and their somewhat unreliable guide or guard flanges, remain practically the same as they were fifty years ago. Lately, I asked one of the most prominent and successful locomotive superintendents of the present day why the guard flanges of the wheels were made so shallow, considering the high speeds now run, and he candidly replied that he really did not know, and that he often wondered himself why the said guard flanges were not made at least twice the depth, as they might well be.

Let it be remembered how often ordinary light horse-drawn tramway cars used to leave the line in the streets at very ordinary speeds, caused by the lightness of the said cars ; whereas, with practically the same guide or guard projection on the wheels, it is a rarity indeed for a modern electric tramway car—because alone of its infinitely greater weight—to leave the track, although it may run as fast as 20 miles an hour.

Then, in Berlin some time ago, at the excessive high speed trials of electric trains, running at the rate of some 200 miles, more or less, per hour, it was found absolutely essential to have a guard rail on each side all the way as high as 3in. above the track rails, to prevent the said heavy cars jumping the track when running at such high speeds. Does not this of itself point the moral, and speak volumes, and when will our railway magnates profit by such experience, at least, in principle?

After considering these points, and the fact that there is in general and present use the projection of practically only 1in. say on the inside of each wheel, to jump, on all our trains, and standing as it were between life and death, is it not about time to inquire why more effectual means are not taken to prevent any possibility of the derailing of fast trains, where the risk is so great, and where the security can at least be made so mechanically certain by the mere doubling of the depth of the present flange projections.

Why should not the Board of Trade carefully examine into this question, so vital to the travelling public, and if necessary decree that the guard flanges of all the wheels of at least the fastest trains should be considerably deeper and proportionately stronger than they are at present, when, this being carried out, and everything else being right, there should certainly never be any more such lamentable accidents produced by "cause unknown" as that at Witham, and by "cause a mystery," as that at Baillieston.

I note the public is once more assured in the Press by the railway officials—as it was assured in the case of the Witham "accident"—that "they are satisfied no blame attaches at Baillieston to anyone," and that "the cause of the accident is a puzzle to them." Surely, however, such misleading statements will not continue any longer to satisfy an intelligent and critical travelling public, seeing it is a question of life or death to those of us who, like the latest victim, the late Mr. Coote, put ourselves and our lives in the hands of the railway companies.

JAMES KEITH, Assoc. M. Inst. C.E., M. Inst. Mech. E.

London, N.W., June 29th.

THE COMMERCIAL ORGANISATION OF ENGINEERING FACTORIES.

SIR,—The system of allowing workmen to record their own time upon various jobs has long since proved itself to be utterly unreliable ; yet Mr. Henry Spencer, in your issue of June 29th, advocates a return to this antiquated method of obtaining labour costs. A little consideration will show how hopeless must be the attempt to secure accurate figures in this manner. Suppose, for instance, a turner to be engaged upon "day work" up to 10.30 a.m., followed by a "piece work" job occupying him until 12.15, after that a further spell of "day work." In such a case there is a strong temptation to alter the times of changing from one job to another in such a direction as to reduce the piecework time, thus increasing the bonus. It would be impossible for a busy foreman in charge of a large machine shop entirely to check this sort of thing ; he may be sent for by the manager, or his attention will be taken up by some special job for a considerable time ; during these intervals his men will be fully alive to their opportunities of booking their time on each job a few minutes wrong, one way or the other, to benefit their piecework earnings, and general inaccuracy of labour costs must result. No doubt an alert and energetic foreman will make the record of false times difficult, but such manœuvres ought to be, and are, impossible with the methods of time-keeping adopted by many up-to-date engineering works. Referring to Mr. Spencer's article, "Job Slip" 73 and "Time Slip" 71 should be combined in one card, with provision for stamping the times of starting and stopping work on each job by means of a recording clock, and no workman should be allowed to have more than one card in his possession. These cards could still be used by the foreman to indicate the work ahead of them, as explained for "Job Slip" 73, and their adoption for time recording would entirely prevent any "pilfering" of time for the benefit of piece-work bonuses. W. O. HORSNAILL.

Ipswich.

SIR,—In your issue dated the 29th June I notice Mr. Horsnaill's criticism of two points mentioned in connection with stores requisitions and factory orders respectively, to which I wish to reply.

Withdrawals from stores.—Your correspondent prefers that the clerical work involved shall be done in the shop manager's office, and if the manager's assistants have sufficient time at their disposal, there seems no reason why his suggestion should not work out satisfactorily. The question is one that depends for solution upon the constitution of the staff. Suffice it to say that, in the factory under notice, the machine shop foreman had the assistance of three charge hands ; and although, nominally, he was responsible the foreman rarely, if ever, had occasion to write out the requisition, but relied upon one or other of his deputies.

Manufacturing batches of parts.—Mr. Horsnaill has evidently overlooked page 619, column 2, paragraph 1, reference to which will discover that each batch of details, as per shop lists, is limited to twenty cars, so as to avoid overstocking. There is, however, a permissible exception to this rule in the case of automatic lathes making pins, bolts, studs, nuts, &c., which are customarily put through in special quantities against an "S" order, being subsequently delivered to finished stores room for re-issue to the fitters on a schedule requisition, Fig. 65. HENRY SPENCER.

Preston, June 30th.

THE RECENT EARTHQUAKE.

SIR,—I venture to ask the kindly assistance of your readers in collecting the materials necessary for a detailed study of the recent earthquake.

My principal objects are to trace as accurately as possible the boundaries of the areas over which the shock was felt, and the accompanying sound heard, and to draw lines on a map through all places at which the shock was of the same intensity. It would be of great service to know simply the names of as many places as possible at which the shock was felt or the sound heard. Still more useful would it be to have answers to any of the questions printed below. I should be most glad and thankful to receive accounts from any places whatever ; and I may add that no careful account, however scanty the information given, can fail to possess some value or to help in throwing light on the nature and origin of the shock.

1. Place of observation.
2. Situation of observer, indoors or outside, &c.
3. Time of occurrence—please state if accurate to the nearest minute.
4. (*a*) What were the nature and direction of the shock? (*b*) Did the shock consist of two distinct parts, separated by an interval of a few seconds? (*c*) If so, which part was the stronger, and how long was the interval between the two parts?
5. How many seconds did the shock last, not including the accompanying sound?
6. Was the shock strong enough : (*a*) To make doors, windows, fire-irons, &c., rattle? (*b*) To cause the observer's seat to be perceptibly raised or moved? (*c*) To make chandeliers, pictures, &c., swing? (*d*) To overthrow ornaments, vases, &c.? (*e*) To throw down chimneys or make cracks in the walls or buildings?
7. (*a*) Was any unusual sound heard at the time of the shock, and, if so, what did it resemble? (*b*) Did the beginning of the sound precede, coincide with, or follow the beginning of the shock? (*c*) Did the end of the soand precede, coincide with, or follow the end of the shock?
8. If any other shocks were felt, it would be most useful to have a list of them, together with answers for each to any of the above questions, especially Nos. 3, 4 (*a*), 6 (*a*), and 7 (*a*).

C. DAVISON, Sc.D., F.G.S.

16, Manor-road, Birmingham, June 27th.

THE SIMPLON TUNNEL.

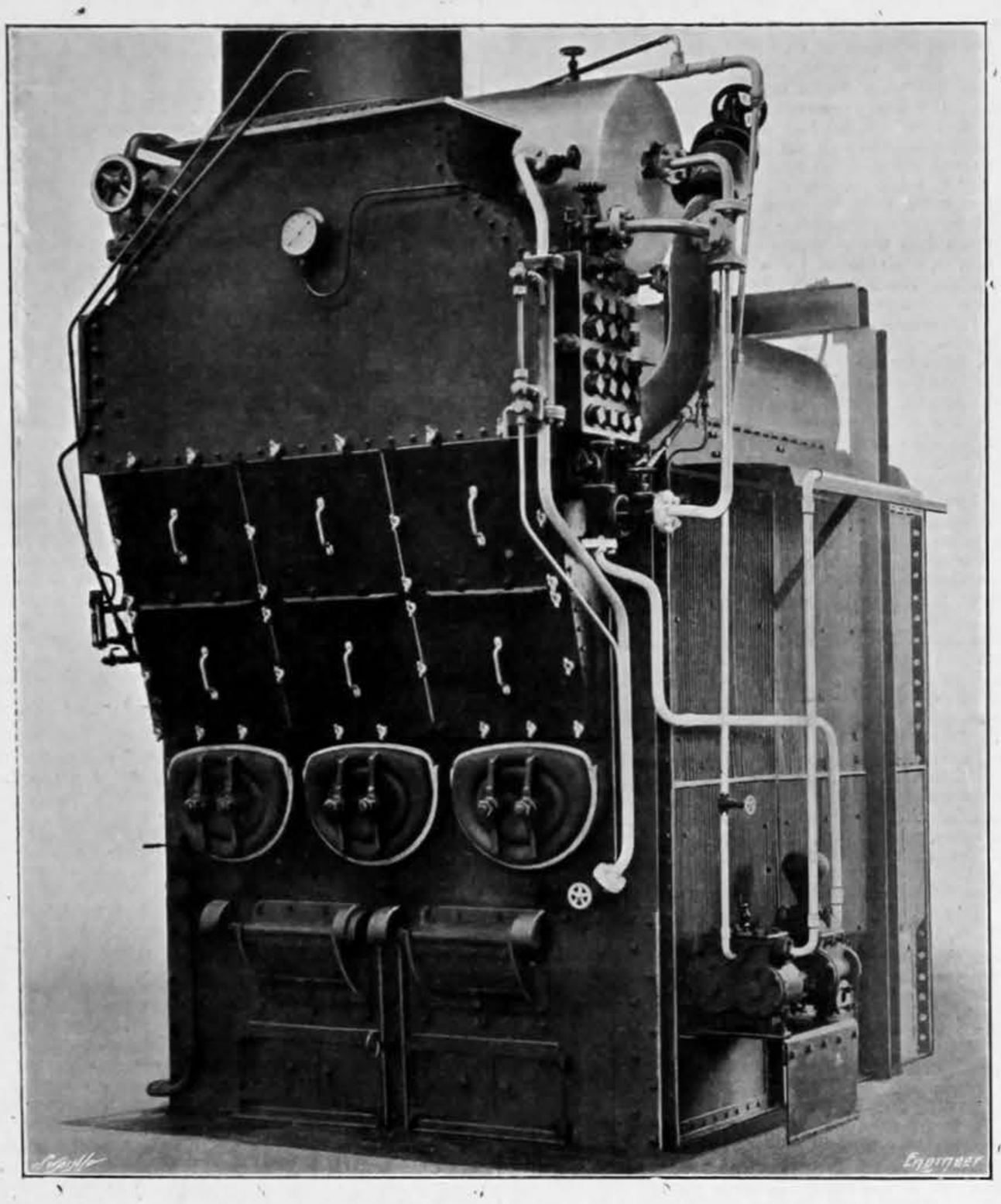
SIR,—Allow me to explain that the temperature of 80 deg. Fah. in the Simplon Tunnel, spoken of in your excellent article of June 22nd, is due to the absence of the icy high-pressure spray, which kept the thermometer at least 14 deg. lower for months. The maximum in the carriages was 66 deg. on February 25th, for instance, when the drains carrying off the water from the boiling springs had not yet been covered, and it was said to have been under 63 deg. on May 19th, the date of the inauguration by the King of Italy and the Swiss President. This spray, hitherto forced against the parts of the rock still insufficiently cooled, has lately been stopped in order to favour the experiments going on with electric traction, but its use is to be resumed as soon as measures have been devised to counteract its effects upon Messrs. Brown, Boveri and Co.'s plant. R. G. CORBET.

Temple, E.C., July 2nd.

THE Automoblile Club of America is arranging to conduct an alcohol fuel consumption test next autumn.

WATER-TUBE BOILER

DAVIES PATENT BOILER COMPANY, LIMITED, WESTMINSTER, ENGINEERS



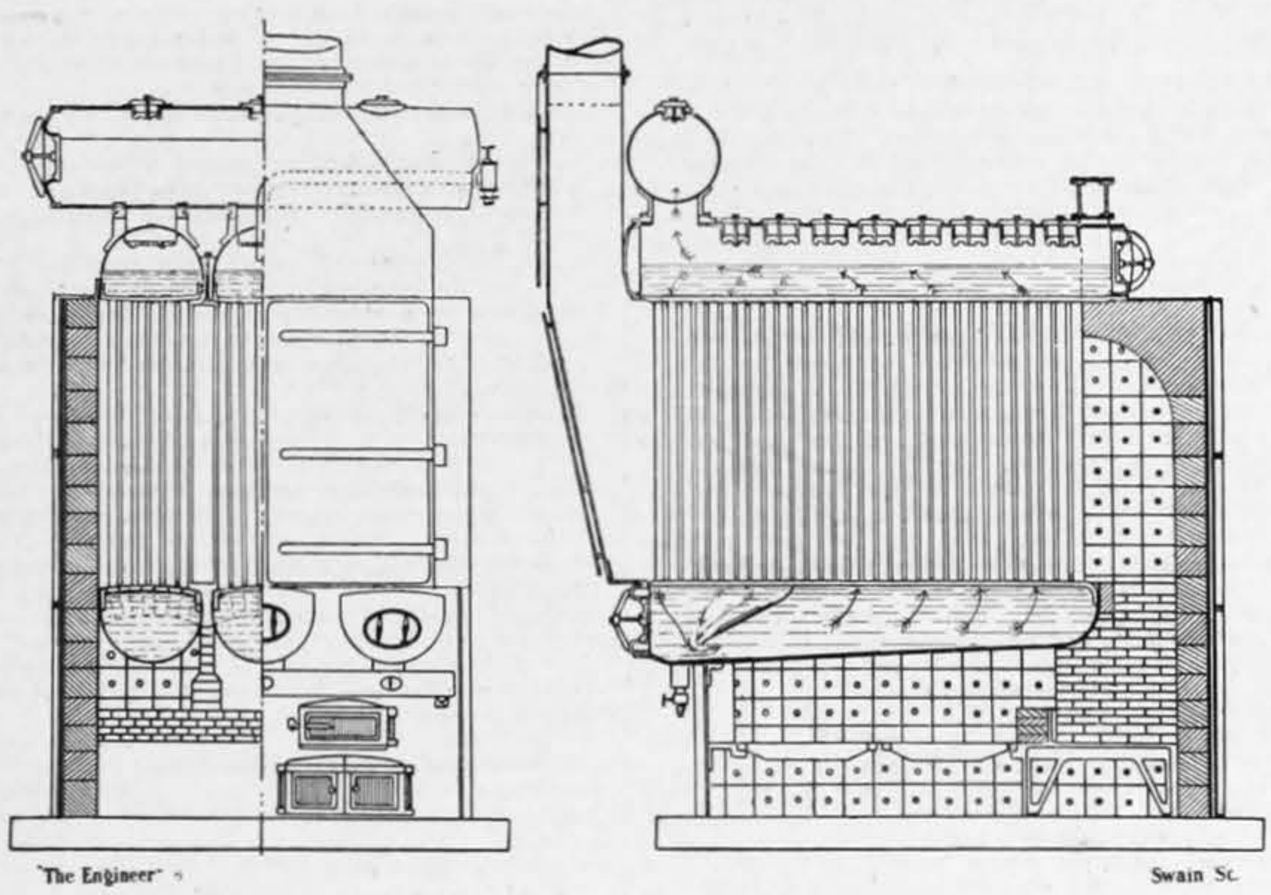
A NEW WATER-TUBE BOILER.

A WATER-TUBE boiler embodying some novel features has recently been brought to our notice. It is illustrated in the accompanying engravings. It is constructed with a combustion chamber at the back with the object of ensuring the complete combustion of the gases before they circulate among the tubes in the boiler. At the same time this chamber facilitates cleaning, inspection, and repairing operations. The boiler is being put upon the market by the Davies Patent Boiler Company, Limited, of 28, Victoria-street, Westminster, and it is claimed for it, among other things, that, in the event of a tube bursting, the steam arising therefrom would follow the course of the draught in the direction of the uptake, that the water would leave the tube chamber only in the direction of the smoke, and hence that the stokers would be able to draw the fires without danger.

As will be seen from the illustrations, the boiler consists of a series of several elements of vertical straight tubes. These are built up of pairs of semi-cylindrical top and bottom half drums, united by a number of tubes the diameter and length of which are varied in accordance with the heating surface and horse-power required, the nature of the fuel being used and the method of stoking employed. The bottom drums form the roof of the furnace, while the upper drums form the roof of the tube chamber, with a steam receiver above. It is consequently impossible for the furnace gases to circulate around the tubes until they have passed to the rear of the combustion chamber. The boiler is slightly raised at the back, and a brick lined combustion chamber is constructed at the rear. There are no external downcomer pipes. About two-thirds or half of the back end tubes act as the upcast, and the other third, or half, act as downcomers, according to the rate of working; the circulation of the water and steam is indicated by means of the arrows. A levelling pipe and mud collector are provided at the front, under the ends of the lower drums, and a blow-off is attached to the scale collector.

Hand holes are formed in the top drums for access to and withdrawal of the tubes, and manholes are made in the ends of all the drums large enough to allow a man to enter them for inspection, cleaning, or repairs. Hinged smoke-box doors are fitted to the front of the boiler as in marine type or dry-back boilers.

Between the elements of the boiler are inserted horizontally superheater tubes, which extend to about three-fourths of the length of the tube chamber. These tubes are expanded into steel boxes provided with handholes for renewal or repair of the tubes. The path of the gases through the boiler is similar to that in an ordinary marine type boiler. The gases from the furnace pass beneath the lower drum and into the combustion chamber, where they mingle with hot air passed in through hollow fire-bars. The mixture then circulates through the tubes and passes on to the superheater and thence to the funnel through an economiser which is placed in the smoke-box.



SECTIONS OF DAVIES WATER-TUBE BOILER

We give below a comparison, supplied by the makers, between an ordinary Scotch boiler and a boiler of the Davies type, with the differences in favour of or against the latter:—

Scotch Type Marine Boiler.	Davies Boiler.	Difference.
Height, 16ft.	17ft. 9in.	Loss, 1ft. 9in.
Width, 16ft.	10ft. 6in.	Gain, 5ft. 6in.
Length, 12ft.	12ft. 3in.	Loss, 3in.
Heating surface, 2655 sq. ft.	3200 sq. ft.	Gain, 545 sq. ft.
Grate area, 57·75 sq. ft.	57·75 sq. ft.	Same.
Weight, boiler, 57 tons	27 tons	Gain, 30 tons.
,, water, 37 ,,	7 ,,	,, 30 ,,
Total, 94 ,,	34 ,,	,, 60 ,,
Evaporation, 12,540 lb.	15,500 lb.	,, 3000 lb.
Evaporation to 15,000 lb.	to 20,000 ,,	,, 5000 lb.
Steam, 200 lb	225 ,,	,, 25 lb.
Floor space, 192 sq. ft.	128 sq. ft.	,, 64 sq. ft.

Mr. W. H. Booth, Mr. H. J. Donkin, and Mr. W. J. Harding have all made tests with and reported on the Davies boiler. From the reports of these gentlemen we obtain the following figures:—

—	Weight of coal used per square foot of grate area per hour.	Water evaporated per lb. of actual coal.	Water evaporated per lb. of combustible.	Equivalent evaporation from and at 212 deg. Fah. per lb. of combustible.	Overall efficiency of boiler economiser and superheater.
	lb.	lb.			
Mr. W. H. Booth..	14·0	11·616	12·296	13·33	86·342
Mr. H. J. Donkin..	19·44	10·53	—	13·35†	85·42
Mr. W. J. Harding	(1) 19·04	9·88	10·85	13·02	—
,, ,,	(2) 21·25	11·42	—	13·90*	—

The coal used by Mr. Booth was Nixon's navigation, and estimated calorific value of 14,962 B.T.U.; that used by Mr. Donkin — also Nixon's navigation — a calorific value of 15,025 B.T.U., and that used by Mr. Harding in (1) was Durham Tanfield Moor, and in (2) Nixon's navigation of good quality. In neither case is the calorific value given. The equivalent evaporation in Mr. Harding's test No. 2* is per lb. of coal and not per lb. of combustible, and the corresponding figure given by Mr. Donkin † is per lb. of dried coal.

One of the claims made for the Davies boiler is that it is smokeless, owing to the perfect action of the combustion chamber. On this point Mr. Donkin remarks in his report:—"There was an entire absence of smoke during the trial, and the boiler steamed easily and steadily throughout"; and Mr. Harding says: "Smoke—light brown during firings, absent between firings" for the Nixon navigation coal and for the Durham Tanfield Moor coal—which has the reputation of being an exceptionally smoky coal — "there was a small amount of smoke given off when firing, which gradually died off when the doors were closed, lasting from one to one and a-half minutes, and between there was an entire absence of smoke." The efficiency of the plant came out very high in these trials. In one instance an overall efficiency for boiler, economiser, and superheater, of over 86 per cent. was obtained, the apparent efficiency of the boiler alone being just over 81 per cent. In the other cases the overall efficiency was well over 85 per cent.

THE INSTITUTION OF MECHANICAL ENGINEERS.

IN accordance with previous announcements, the summer meeting of this Institution will be held in Cardiff, and will begin on Tuesday, 31st July. The following papers have been offered for reading and discussion, and will be read as time permits, but not necessarily in the order here given:—"The Development of Blast-furnace Blowing Engines," by Mr. David E. Roberts, of Cardiff, member; "Shipping of Coal at Cardiff," by Mr. Henry S. C. Ree, of Cardiff; "Shipping of Coal at Penarth," by Mr. T. Hurry Riches, Vice-president, and Mr. T. E. Heywood, of Penarth; "Shipping of Coal at Newport," by Mr. John Macaulay, of Newport, Mon.; a description of the apparatus at Barry will also be supplied; "Some Notes on the Equipment of Bargoed Colliery," by Mr. E. M. Hann, of Aberdare; "The Manufacture of Tin-plates," by Mr. R. Beaumont Thomas, of Dennel Hill, near Chepstow; "Railway Motor-car Traffic," by Mr. T. Hurry Riches, Vice-president, and Mr. Sidney B. Haslam, of Cardiff, Associate Member; and "Large Testing Machines in South Wales, 1829-1906," by Mr. J. Hartley Wicksteed, Past-president. Advance proofs of the papers can be obtained, as soon as ready, on application to the Secretary. The outline programme for the meeting is as follows:—

Monday, 30th July: The Secretaries' office will be open from 3 p.m. to 6 p.m. at the South Wales Institute of Engineers, Park-place, Cardiff, for the registration of addresses, &c.

Tuesday, 31st July: 10 a.m., the Right Hon. the Lord Mayor of Cardiff, Alderman Robert Hughes, and the members of the Reception Committee, will welcome the President, Council, and members of the Institution, and also a party of American engineers attending the meeting, in the hall of the South Wales Institute of Engineers; reading and discussion of papers; (A) 2.30 p.m., visit to Bute Docks and Messrs. Guest, Keen, and Nettlefolds' Cardiff Works, by special train, kindly provided by the Rhymney Railway Company; 8 p.m., Conversazione at Park Hall by the Right Hon. the Lord Mayor of Cardiff, Alderman Robert Hughes, and the Lady Mayoress.

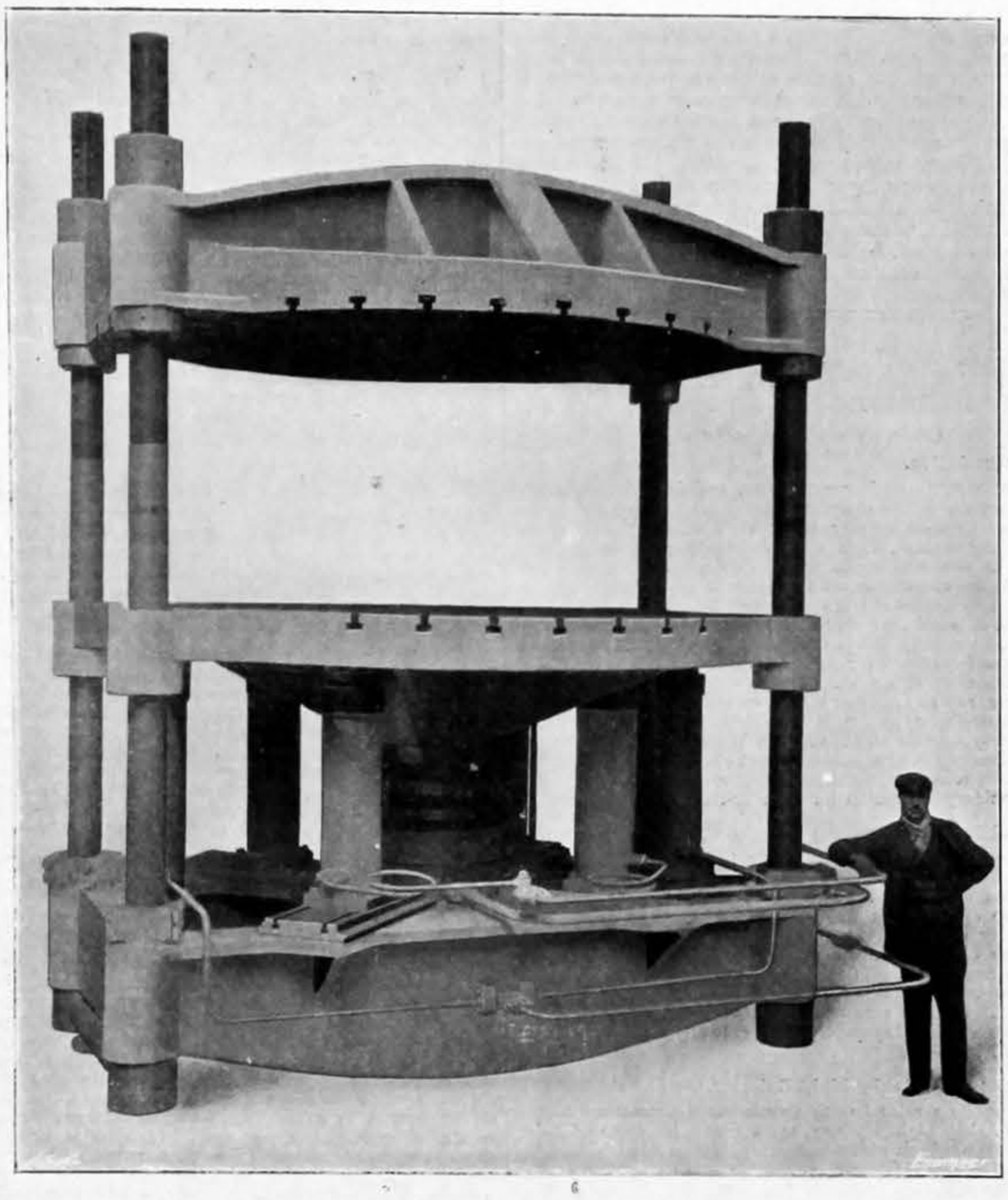
Wednesday, 1st August: 10 a.m., reading and discussion of papers; (B) 1.15 p.m.(?), visit to Penarth Dock, special train from Queen-street Station; 7 p.m. for 7.30 p.m., Institution dinner in Park Hall, Cardiff.

Thursday, 2nd August, alternative visits: (C) 10 a.m., Barry Docks, arrive in Cardiff about 3 p.m.; or (D) 10 a.m., Bargoed Colliery, train to Bargoed, visit colliery, arrive in Cardiff about 3.45 p.m.; or (E) 9.30 a.m., Newport Transporter Bridge and Alexandra Docks, Newport, train to Newport, electric tram to Transporter Bridge and Alexandra Docks, arrive in Cardiff 3.40 p.m.

Friday, 3rd August, alternative visits: (F) 10.18 a.m., Chepstow and Tintern; an excursion to Monmouth and Raglan may be arranged if excursion (F) is full; or (G) 10 a.m., Ilfracombe, special train to Barry Docks, steamer to Ilfracombe, 2½ hours), steamer returns to Cardiff, arriving late afternoon.

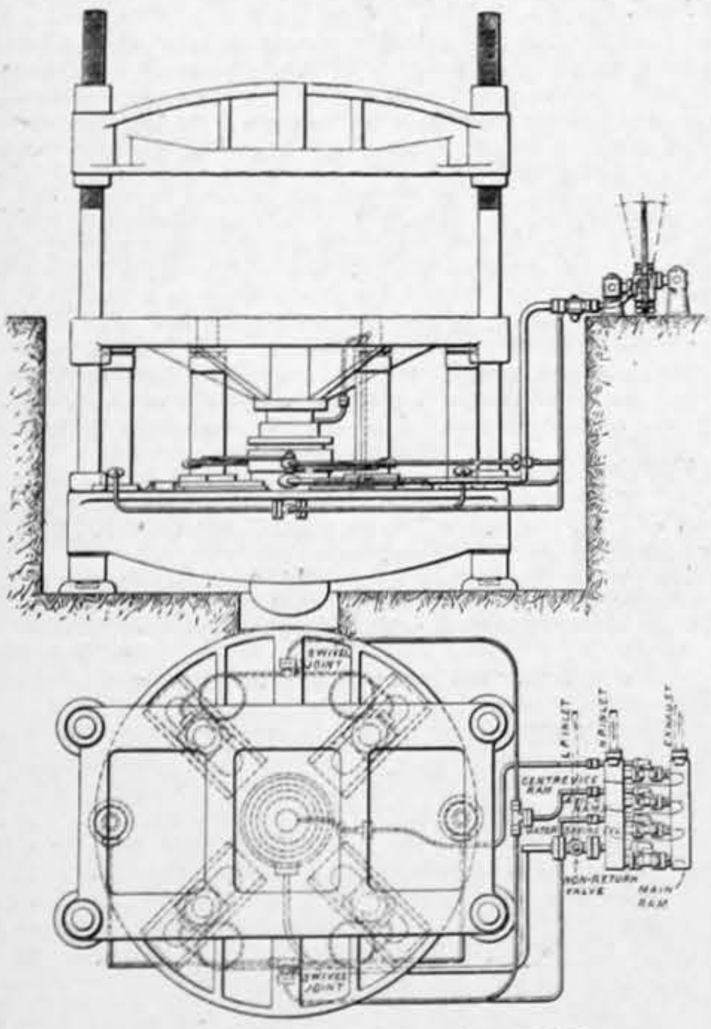
500-TON FLANGING PRESS

VAUXHALL AND WEST HYDRAULIC ENGINEERING COMPANY, LIMITED, LONDON, ENGINEERS



A LARGE FLANGING PRESS.

RECENTLY we were invited to see a new flanging machine, which has just been constructed by the Vauxhall and West Hydraulic Engineering Company, Limited, of 23, College-hill, E.C. The machine, which is of exceptionally large dimensions, has been built to the order of Mr. D. Earle Marsh, chief mechanical engineer of the London, Brighton, and South Coast Railway Company, for dealing with large boiler plates, &c., at one operation. The arrangement of the press, which is worked by hydraulic power, can be seen from the accompanying engraving. The main castings have been made of steel throughout, and we were informed that the exceptionally high factor of safety of 20 had been allowed.



PLAN AND ELEVATION OF PRESS

The table is 10ft. 6in. diameter, and is capable of taking the largest locomotive boiler plates that can be used. There are four guide columns, spaced 11ft. 3in. apart, from centre to centre. The top parts of these guides are threaded, and the head plate can be raised or lowered and locked in any position by means of the nuts shown in the illustration. The machine has a maximum daylight of 6ft., and an adjustment of 3ft. There is a main central ram working from below, and capable of exerting a pressure of 500 tons. A small vice ram, which can be worked quite independently, is contained in the main ram. There are also four powerful vice rams for dealing with large work. These can be readily adjusted to suit any diameter, by simply loosening the nuts of the four holding-down bolts, and moving them into the required position. Two other small vice rams similar to the four just referred to have been provided for lifting the press table until it comes into contact with the work. Whilst this is being done, the main cylinder is maintained full of water from a low-pressure service. Special attention has been paid to the design and arrangement of the valves, with the result that the system is simple and effective. Four levers control all the operations of the press. Common pressure and exhaust-boxes are fitted, to which all the valves are connected. Economiser valves and cylinders are also fitted, by which all the idle movements of the main table can be performed, a full supply of pressure water being required only after actual contact with the work has been made. The supply pipes to the four movable vice rams are provided with swivel joints, to allow for their movement without in any way straining the connections.

LONDON ELECTRICITY SUPPLY.

THE Select Committee to whom the London County Council (Electric Supply) Bill was referred, and who were instructed by the House on April 2nd to consider, with special reference to the terms of the Bill, the best means of providing for the Supply of Electrical Energy in bulk and for power and motive purposes, and to report thereon, have agreed, with regard to the said Instruction, to the following Special Report:—

1. The main general object of the Bill is to enable the London County Council to supply electricity in bulk to authorised distributors (that is, Local Authorities or Companies authorised by Act of Parliament or Provisional Order) within the Administrative County of London and certain adjoining Boroughs and Districts in the Counties of Essex, Kent, Surrey, and Middlesex.

2. The Bill proposes, in addition, to confer on the Council powers to supply electrical energy direct to railways, docks, tramways, and various other undertakings.

3. And the Bill also proposes to confer on the Council power to transform, distribute, and use electrical energy in various buildings, works, or undertakings belonging to, or maintained by them, or under their control; but this power is not to apply to schools and various other buildings, parks, open spaces, pleasure grounds, or workmen's dwellings without the consent in writing of the authorised distributor.

4. The Council do not, except as above, propose to supply electrical energy direct to any individual consumer wholly situate in the area of any authorised distributor without the consent of the authority concerned.

5. It is important to bear in mind that the supply of electrical energy in the Administrative County of London and adjoining districts is now in the hands of various Local Authorities and Companies. Powers for this purpose have been granted under the Electric Lighting Acts, and cover practically the whole of the County of London and the greater portion of the adjoining districts included in the Bill. At the present time these powers are held within the County of London by sixteen Local Authorities and thirteen companies, and with regard to most of the latter the Local Authorities are entitled to purchase the undertakings in the year 1931.

6. The Tables "A" and "B" appended to this Report show the Orders now held by Local Authorities and Companies respectively, the areas to which such Orders relate, and the extent to which competition within those areas has been authorised.*

In addition to these Orders, powers for the compulsory acquisition of land for power stations and other purposes have been obtained by special Acts of Parliament in respect of various parts of the County of London. The Table "C" appended to this Report gives a list of these special Acts.*

These Tables have been furnished to the Committee by the Board of Trade.

7. Up to the present time the capital expended by Local Authorities has been in round figures about £6,500,000, and by Companies about £12,000,000, making a total capital expenditure of about £18,500,000. Capital expenditure is stated to be proceeding at the rate of about £1,000,000 a year.

8. At the time the Electric Lighting Acts were passed the principal question was one of light, and it was provided that in the area of each Local Authority there should be a distinct and separate undertaking.

9. No doubt this system was adopted to maintain the power given to each Local Authority to purchase the undertaking in 1931. The effect has been to cause a large number of separate stations to be constructed.

10. The Committee are of opinion that the best means of providing for the supply of electrical energy in bulk, and for power and motive purposes, is by one large and inclusive scheme, extending not only over the entire County of London, but also to adjoining boroughs and districts.

11. For the purpose of carrying out such a scheme some Central Authority is required with ample Statutory powers and corresponding duties. In addition to the proposal of the London County Council various other proposals have been placed before the Committee. After giving full consideration to this question the Committee are of opinion that the London County Council should be the Authority.

12. The Bill before the Committee is solely permissive. No obligation is imposed on the Council to give a supply to any of the Local Authorities or Companies; in fact, no obligation is imposed on the Council to carry into effect any of the powers sought by the Bill, and there is no prescribed time either for beginning or for carrying out the work. The Committee consider that the Council should be under such obligations, and that under fair and reasonable terms and conditions any authorised distributor (whether a Local Authority or a Company) should have the right to require a bulk supply.

13. The adoption of these proposals would alter the whole scope and intention of the Bill; but it would, at the same time, make the measure more practical and effective for all purposes.

14. Authorised distributors made a most strenuous opposition to Clause 35 of the Bill. This is a most important Clause, empowering the Council to make representation to the Board of Trade that the prices charged by any authorised distributor were excessive, and ought to be reduced, or that the methods of charge ought to be altered, and after an inquiry such Order was to be made as in the opinion of the Board of Trade would be fair and reasonable, having regard to all the circumstances of the case, including, amongst other things, the terms upon which and the time within which the Council would be willing and in a position to furnish a supply.

15. The Committee doubt whether due consideration has been given to the fact that both Local Authorities and Companies as authorised distributors have expended a great amount of capital in the erection and equipment of generating stations, and that this has been done, and the money borrowed under Parliamentary sanction. Any alteration of existing conditions ought to uphold in a fair and reasonable manner the interests of the authorised distributors.

It was contended that the words in the Clause "having regard to all the circumstances of the case" were sufficient to safeguard these interests; but the Committee consider that in such a Bill there should be contained a clear and distinct provision, so that the existing financial position and obligations of Local Authorities and Companies as authorised distributors should be taken into account in any revision of prices, and it may be desirable that such prices when so revised should be made maximum and not actual prices.

16. With regard to the Scheme generally the Committee are of opinion that further consideration should be given in regard to many matters pointed out during the course of the Inquiry with a view to amending and improving the Scheme.

17. The distribution system proposed by the Council is one which requires further consideration. The suggestion of duplicated routes is well worthy of attention. This was proposed in the Scheme of the Administrative County of London and District Electric Power Company. The Trunk transmission system should be on the highest voltage consistent with safety underground and the cost of insulation.

18. In recommending that the County Council should be the Authority, the Committee desire to refer to the statement made by Mr. Llewellyn Smith, on behalf of the Board of Trade, which they regard as of great value. The Committee have in view the fact that the County Council, as the Authority, may exercise its powers in more than one way.

(*a*) The County Council may undertake the whole work, providing every authorised distributor and every private consumer with electricity in bulk at a maximum scale of prices.

(*b*) The County Council may retain for itself one part of the undertaking, while permitting a private enterprise to undertake another part.

(*c*) The County Council may lease for a substantial consideration the whole enterprise to a private enterprise, to resume possession of it when its initial stages are over.

The Committee are of opinion that the Report of the Finance Committee of the County Council renders desirable a careful consideration of alternative schemes.

The Committee desire to say that the scheme put forward by the Administrative County Company appeared to be conceived on scientific lines, and calculated to afford a cheap supply of electrical energy at private risk, though it was not clear to what extent the necessary paramount authority of the County Council, and the ultimate possession of the enterprise by the Council, could be secured under this scheme.

19. Evidence was given at length regarding the generation of electrical energy at the coalfields and the transmission of it to London at a very high voltage by overhead cables along the public roads. The Committee were not able to regard this as a suitable scheme.

20. The Committee visited the County Council's generating station at Greenwich. The installation—apart from the question of the method of generation—appeared to them to be in all respects admirable and to reflect credit upon the Council's Engineer, Mr. J. H. Rider.

21. The Committee consider that the provision of cheap electric power for London is so important and pressing that they do not view with favour the possibility of the question being indefinitely hung up; they therefore urge that the Council should be prepared to make a decision as to their action early enough to allow other Bills to be presented for next Session.

22. Having given full and careful consideration to all questions in respect to the Bill the Committee have determined to Report to the House that the Preamble is not proved.

23. A Memorandum relating to Electric Power and Supply Bills of the present Session, which was presented to the House by the Commissioners of Works, was referred to the Committee, who considered it and took evidence upon the points raised in the Commissioners' observations. With regard, however, to all Bills introduced into Parliament during the present Session in respect

* These tables we do not reproduce.—ED. THE E.

to electric supply in London and the adjoining districts, the Committee are of opinion that, pending the introduction of a satisfactory Bill next Session by the London County Council—or, in default of the London County Council, then by some competent body of Promoters—it is not advisable that any further progress should be made with such Bills.

NOTES FROM SOUTH AFRICA.

(From our own Correspondent.)

Johannesburg, 4th June, 1906.

The new tariff agreed upon between the Governments of the Cape, Natal, Orange River Colony, the Transvaal, and Southern Rhodesia, was published on the 25th May, and has been the subject of considerable comment, not wholly favourable, in business circles in Johannesburg. The present time was, of course, most inopportune to introduce any alterations in Customs rates, but owing to the notice of the Natal Government that this Colony would retire from the old Convention at the end of June, and as it is very generally considered most desirable that there should exist a General Customs Union between all the Colonies and territories of South Africa, a conference was held at Maritzburg in March last to decide on the full terms of a new Convention, superseding that entered into in the year 1903. The Transvaal has not been able to secure very favourable terms, the Coast Governments being determined without exception to secure increased revenue from Customs duties, and being quite prepared to sacrifice the union to gain their desires. The new tariff means a further measure of protection for the coast manufacturers, and at the same time a set back for the minor industries of the Transvaal. Additional duties will raise the cost of living throughout South Africa, with this exception, however, that the promised reduction in the Central South African Railway traffic rates is expected to minimise or annul this effect in the case of up-country districts. A reduction of these railway rates will, however, mean diminished receipts to the Transvaal and Orange River Colony Governments, and postponement of necessary railway expansion, unless the revenue is provided by some other form of taxation.

Manufacturers and importers are aware that under the old Convention nearly all engineering supplies were placed under Class III., and liable to 2½ per cent.—now 3 per cent.—*ad valorem* duty, which, however, was rebated in the case of produce or manufactures of the United Kingdom and imported therefrom, or from reciprocating Colonies. This class is now increased by the inclusion of the following articles previously rated in other less favoured classes:—Power lorries and trailers for power vehicles—traction engines were previously in this class—lifts and gates, carbonic acid gas, cement liquid for tube mills, disinfectants, slates for roofing, emery, felt and ruberoid, screw and hydraulic jacks, ammonium, barytes and pumice, calcium, gypsum, magnesium sulphate. Cement will now pay 1s. 3d. a cask, with a British rebate of 3d. Blasting compounds will pay 2½d. per pound, instead of 1½d. as before, and the duty on the British article will be 2d. instead of 1½d. Collodion cotton, used in the manufacture of explosives, is now placed in Class III., its duty previously being ½d. per pound. Mining buckets, skips, &c., which were formerly in the 2½ per cent. *ad valorem* class, are now in the free list.

The meeting of the Inter-Colonial Railway Conference was held simultaneously with that of the Customs Conference at Maritzburg, and resolutions were passed which supplement those just alluded to. The special preference rate for South African produce is to be done away with, and raw materials carried over the railways are no longer to be charged rates in advance of those levied on the manufactured article. South African railway statistics are to be collected, classified, and published in a reliable form, and at the earliest possible moment a railway clearing house is to be established. A revised list of through rates is also to be prepared, and the promise has been made that these, as well as local traffic rates, are to be substantially reduced.

Recently published trade statistics show that during the month of April Transvaal trade, as judged by the value of imports, has fallen off somewhat. In February the total value of merchandise imported was £1,387,549, in March £1,409,004, while in April the amount is shown at £1,356,542. Owing to a decline in the amount of goods imported from the British Empire other than Great Britain, the proportion of foreign goods imported has gone beyond any mark reached of recent years; but it has to be pointed out that this diminution in the imports from oversea Colonies was probably the result of the rumour, since justified, that in the new tariff a preference was to be shown towards the goods imported from other British Colonies.

Official returns also show that British shipping to South Africa is giving way somewhat to foreign competition. This is shown in the figures which have reference to the tonnages of direct steam transport received during the past five years:—

	British tonnage.	Foreign tonnage.
1901	4,280,085	283,874
1902	5,321,111	387,009
1903	4,885,693	381,661
1904	4,511,983	481,992
1905	3,677,824	503,660

During the past year therefore the foreign tonnage to South African ports increased by 4·5 per cent., whilst the British tonnage actually decreased 18·8 per cent. This is a matter that deserves the attention of the Shipping Ring.

On the 2nd inst. was held the sixth annual dinner of the Transvaal Institute of Mechanical Engineers. As usual, it was largely attended, but it was a matter of general regret that Lord Selborne, owing to absence at Bloemfontein, was unable to be present. The chief speakers were the Mayor of Johannesburg, Mr. Lionel Phillips, and Sir Percy Fitzpatrick. The latter delivered one of the finest speeches ever listened to in Johannesburg, and one with which his audience were apparently entirely in sympathy. The speech dealt mainly with the future political situation in the Transvaal, and was an eloquent appeal to the Briton to assert his rights and rule the country. The President of the Institute, Mr. E. Farrar, spoke mainly in support of the mechanical engineer as an integral part of scientific mining, and in justification of the large capital expended in securing the best mechanical plant. He alluded to the statements that had been made in England to the effect that the mines did not make the fullest use of mechanical appliances to save human labour, *i.e.*, the unskilled variety. With all due respect for these critics, he said they were talking absolutely without knowledge, not only of the extent to which mechanical appliances were already being used, but also of the factor which limit the use of these devices. There was a point—and some of them had already found it—where the interest on capital outlay, the cost of power for operating, and the cost of the maintenance and skilled supervision necessary for their successful running, amounted to more than the cost of the unskilled labour which these mechanical devices were designed to take the place of. The mechanical engineer was sometimes an enthusiast, but still he would not knowingly propose to spend a pound on machinery to do the work which coloured labour could do for half that amount. Some of them knew of cases where mechanical means of moving material had seemed to promise success, but which had proved too costly in operation, and had been reluctantly abandoned. Still, there was some little truth in the criticisms referred to, and all engineers were doing their utmost on the plants with which they were connected still further to utilise machinery in the mines. Oversea inventors were likely to be of but little service in this matter, for the conditions on different mines varied so much. If the mining houses, however, encouraged the men in their own employ, who, as a rule, took a keen and whole-hearted interest in their work, and would give them some suitable recognition of their work when successful, he believed that much might yet be accomplished in the matter of reducing working cost on the mines.

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

(From our own Correspondent.)

Engineers Active.

Mechanical engineers are busy, and have experienced a good demand for lathes and for automatic machines for screw-cutting, an excellent inquiry being forthcoming for the last description of machines, since the screw-making trades are very busy. Motor vans and steam tractors are selling well. Railway carriage and wagon builders are pressed with work, and are much interested in the report of large contemplated railway extensions in the South of Russia, for which the locomotives and wagons are, it is said, to be mainly divided between English and American firms. A good contract for railway carriages for a metropolitan company is under execution. Motor wagons are coming into increased use, and so are other motor vehicles of various descriptions. The city firemen are, it is said, to have a motor vehicle, which is a very sensible idea; and the West Bromwich Corporation have already placed an order for a 24 horse-power motor fire-engine tender, to carry fire-extinguishing apparatus and ten men. Special machinery is on order for the War-office and Admiralty.

Iron and Steel.

There is not much that is new to report with regard to iron and steel. Crude iron is firmer than recently, Lincoln forge being quoted 50s., or 1s. 6d. advance upon a fortnight ago. Staffordshire cinder is 48s. to 50s., and other sorts as last quoted. The quarterly meeting next Thursday is looked forward to with interest, new business for the most part being postponed until then. The foreign demand for manufactured iron keeps good, and galvanised corrugated sheets are quoted £12 10s. to £12 12s. 6d. Marked bars are still £9. Steel is active in all departments, angles being quoted £6 15s. to £7, and girder plates £7 10s. to £7 15s.

The Burton and Ashby Light Railway.

A public service has this week been commenced on the Burton and Ashby Light Railway, upon which, inclusive of land, some £150,000 has been wisely laid out. It is an electric line, on the overhead system, 11½ miles in length, the power station being situated at Swadlincote. The line has been built by the Midland Railway Company to connect Ashby and the intervening township with Burton-on-Trent, with the exception of 1¼ miles, situated within the borough of Burton, and built by Burton Corporation for the Midland Railway Company's use.

Tramways.

The Birmingham Corporation are pursuing steadily their policy of acquiring all the tramways in the city. This week another line has been taken over from the Birmingham and Midland Company, and thirty new cars have been put on, the town being now in possession of three routes. In the centre of the city lines are being laid to form central junctions with all the radiations, several streets being in the hands of the workmen for this purpose. Other outlying routes are nearing completion, and are expected to be opened on the 1st of January next.

Extension of Railway Buildings.

An important piece of railway engineering work, namely, the reconstruction of Snow-hill Station, Birmingham, by the Great Western Railway Company, is about to be undertaken, wherefore the Public Works Committee of the City Council has been busy lowering an adjacent carriageway preparatory to the building by the railway company of a new railway bridge, which is one of the items in their scheme. The lowering of the roadway will be completed in about a fortnight's time, when the Corporation will also alter another roadway, by raising it, in order to enable the Great Western Company to deal with another bridge, which requires rebuilding. A third railway bridge—belonging to the London and North-Western Railway Company—is also to be reconstructed, so that altogether some of the busiest parts of Birmingham will be very much in the hands of the railway engineers shortly.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester, July 4th.

Retrospective.

The past month in pig iron has been remarkable for its great steadiness. Warrants, indeed, seem to have been avoided by the general public, both bulls and bears being more or less afraid to operate, while consumers have only purchased from hand to mouth, as indicated in former reports. On the Manchester Iron 'Change on Tuesday there was considerable speculation as to the future course of the market. At present some English makers are going on the basic products so as to accommodate the foreign demand, which appears to be good, and will probably last over a lengthened period under present conditions. On Tuesday there was very little inquiry here, and, if we were to believe all we heard, there is considerable competition for the few orders being given out. In fact, it was stated that 6d. to 1s. less than makers' rates was being quoted by holders in second hands. Scotch makes have been on the easy side for a fortnight past, but an exception can safely be made to this in the case of Glengarnock. Makers' representatives state they have practically no iron to sell. Lincolnshire is well held owing to continental demand, but both Lancashire and Derbyshire is on the easy side, while Staffordshire is being rather freely offered. It is scarcely likely, however, in face of heavy shipments and diminishing stocks, that we shall see much decline on present rates.

Finished Iron.

Merchants continue to report a fair demand and rates remain unchanged.

Steel.

The principal feature is the continued strong demand for constructional steel. It is said that the English and Scotch producers have almost arrived at an agreement for partitioning off the market, but there seems to be some difficulty as to Ireland. We are assured, however, that it will ultimately be got over, as the present opportunity, coupled with an absence of foreign competition, is very favourable. In billets English makers continue to hold out for full rates, and plates are steady.

Manufactured Copper.

There is a great quietude in this department. Matters remain as before.

Quotations.

Pig iron: Lancashire No. 3 foundry, 61s.; Lincolnshire, 56s. to 56s. 6d.; Staffordshire, 55s.; Derbyshire, 57s. 6d.; Middlesbrough open brands, 59s. 1d. to 59s. 4d. Scotch: Gartsherrie, 63s 6d.; Glengarnock, 61s. 3d.; Eglinton, 60s. 9d.; Dalmellington, 60s. 6d., delivered Manchester. West Coast hematite, 65s. 3d., f.o.t.; East Coast hematite, 65s. 6d., f.o.t. Scotch, delivered Heysham: Gartsherrie, 61s. 6d.; Glengarnock, 59s. 3d.; Eglinton, 59s. 9d.; Dalmellington, 59s. 6d. Delivered Preston: Gartsherrie, 62s. 6d.; Glengarnock, 60s. 3d.; Eglinton, 59s. 9d.; Dalmellington, 59s. 6d. Finished iron: Bars, £7 5s.; hoops, £7 17s. 6d.; sheets, £8 7s. 6d. to £8 12s. 6d. Steel: Bars, £7 5s.; hoops, £7 15s.; boiler plates, official, £8 12s. 6d.; plates for tank, girder, and bridge work, £7 7s. 6d. to £7 12s. 6d. English billets, £5 7s. 6d. to £5 15s.; sheets, £8 17s. 6d. Copper: Sheets, £96 per ton; seamless copper tubes, 11¼d. to 11½d.; brazed ditto, 11d. to 11½d.; brazed brass tubes, 10¾d. to 10½d.; seamless ditto, 9¾d. to 9½d.; rolled brass, 8½d. to 8¾d.; brass wire, 8½d. to 8¾d. Sheet lead, £19 10s. per ton.

Lancashire Coal Trade.

There is an increase in the short time now being worked in the Manchester and East Lancashire districts which has interfered with output to a considerable extent. This does not seem, however, to have had any effect on prices so far. The demand for house coal is at a minimum, but slack continues steady. Shipping demand is dull. Late quotations are repeated.

Manchester Engineers' Association.

On Thursday in last week a party of ladies and gentlemen journeyed from Manchester to inspect the Royal Show at Derby. So far as the railway and general arrangements were concerned they were in every respect admirable, and everything had been done to ensure the comfort of all present. Unfortunately, owing to an accident at the Irlam Lock, on the Ship Canal, Mr. W. Henry Hunter, the president, was absent, and the regret felt by all present was voiced in a few appropriate remarks by Mr. R. Matthews, the ex-president. The weather was shocking throughout the day, but notwithstanding this there appeared to be a Mark Tapleyan flavour amongst the party which rendered the outing to rank as fairly successful throughout.

Barrow-in-Furness, July 5th.

Hematites.

There is a weaker tone in the hematite iron market this week, and this is shown not only in a lessened demand, but in lower prices. Makers still quote 67s. for mixed Bessemer numbers net f.o.b., but sales are not made at this price except for special sorts. Warrant iron is neglected at 64s. 3d. net cash sellers, buyers 6d. less. There is every indication of a further reduction in prices, and it looks as though there was going to be a slump. The chances are that makers will find it necessary to reduce the make of the district by putting some of the furnaces most in need of repair out of blast. There are 38 furnaces in blast, and 33 of these are on hematite. It is just possible, however, that a reduction in prices may help the demand, as it is generally thought that the iron trade is in the most healthy condition when mixed Bessemer numbers are at about 60s. per ton, and the price of raw material accordingly low. Makers are not so well off for orders as they were some time ago, but they are in a strong position in having but small stocks on hand, as for some months past they have had all they could do to keep faith with delivery engagements. On the other hand, warrant stocks have lately been falling. This is a sign that holders have been expecting a lower range of prices, and have been clearing their holdings in view of the depression which has been expected for a few weeks past. During the week stocks have been reduced by 1306 tons, and there is now on hand 72,839 tons. There is not much life, however, on the warrant market, and it is not expected stocks will materially increase unless prospects of a better demand than are afforded at present present themselves. Iron ore is in good demand, and prices are steady at about 15s. for good average sorts net at mines. Spanish ores are very largely used in the district, and they are quoted at 19s. 6d. net at West Coast ports.

Steel.

There is not much that is new to report about the steel trade. The rail mills are on full time, but it is not probable they will remain so for long, as the demand is very quiet, but it is generally understood that orders are being withheld because of the prospect of lower quotations. Heavy sections are down 2s. 6d. on the week, and are now quoted at £6 5s. net at mines. Shipbuilding descriptions of steel are in small demand, and the mills are only on half time. Indeed, it is questionable whether they will be kept on half time for long unless new orders come in. Plates are 2s. 6d. per ton lower on the week, at £7 5s. Merchant steel quiet.

Shipbuilding and Engineering.

There is nothing new to report in these branches of trade. No new orders are reported. Shipbuilders are in need of new work.

Shipping and Coal.

There is a fair business doing in the exportation of iron and steel. Last week the shipments amounted to 18,333 tons, an increase of 8155 tons on the corresponding week of last year. The total shipments this year have reached 395,371 tons, a decrease of 23,636 tons on the corresponding period of last year. Coal and coke are steady, and good prices are ruling.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

House Coal.

Having regard to the season of the year, and the sultry weather, business in household fuel is fairly satisfactory. Taken as a whole, the house-coal pits are working from two to about three days a week, which is the normal condition of affairs in the beginning of July. The diminished output, of course, causes less small fuel to be available for manufacturing purposes, and the shortage makes the market firm in the latter class of coal. Stocks are reported to be less than in former years, and quoted rates are thus maintained, except in the case of large purchases, which are effected at somewhat easier rates. Silkstone coal, in the best qualities, fetches about 11s. per ton; secondary sorts making from 9s. 9d. to 10s. per ton. Barnsley thick seam house coal realises about 9s. to 9s. 6d. per ton; secondary kinds are obtainable at about 7s. to 8s. per ton in owners' wagons at the pits.

Steam Coal.

The call for steam coal continues to be very active, more especially on shipping account. There is no difficulty experienced in finding a market for the entire output, a large proportion of

which is consumed in the various contracts. Locomotive coal contracts rule at 8s. 6d. per ton, which is the figure applicable to a good many of the shipping contracts. Supplies of secondary steam coal have been delivered in certain instances at about 8s. 3d. per ton. The Baltic ports are receiving a heavy tonnage of South Yorkshire hards, the bulk of which goes from Hull, the trade from Grimsby being competed for by Derbyshire coal, while Goole is chiefly supplied by the West Riding coalowners. In addition to activity in shipments, the requirements of the steam fishing fleets are exceptionally heavy. The exports from Hull for the week ending June 26th reached a total of 64,888 tons, compared with 25,651 tons for the corresponding week of last year; from Grimsby, including coastwise destination, for the week ending June 29th, 32,641 tons, compared with 29,308 tons for the corresponding week of 1905.

Coking Slack and Smudge, &c.

A good demand is reported for coking slack and smudge, in consequence of the increasing requirements of the by-product ovens, which continue to be erected in various districts. Good samples realise about 4s. 6d. per ton. For ordinary slack and smudge there is a fair market. Lancashire cotton mills and Yorkshire textile trades take freely, prices ruling at 4s. to 4s. 3d. per ton. Engine nuts sell well at 6s. to 6s. 6d. per ton. Coke is in improved request, chiefly for North Lincolnshire, Derbyshire, and Leicester, for the use of the blast furnaces. Good ordinary samples of smelting coke fetch from 11s. to 11s. 6d. at the ovens, in owners' wagons; good washed samples make from 9d. to 1s. per ton more.

The Heavy Trades.

The works at the East End employed in the heavy manufactures continue busy in most departments, although a good deal more could be done in the matter of military material and heavy forgings. Nothing new in respect of armour-plates is reported from the Government, and foreign inquiries so far have not resulted in the placing of definite orders in shipbuilding. It is stated that except in several lines the production of material for shipbuilding, such as heavy forgings, is not equal to what it was a short time ago. For railway material, however, some good work is coming forward on South American and Indian account. There is a satisfactory business doing in railway tires, and one of the Argentine railway companies has recently placed further work of this description. This is expected to be followed by orders for railway wagons from the same quarter, which, wherever placed, will, no doubt, result in a considerable portion of the material, such as springs, axles, and wheels, being done in the Sheffield district. A considerable quantity of work on Indian account is being inquired about at present in tires, tool steel, brass boiler tubes, twist drills, circular saws, steel pins and cottars, bolts and nuts, &c.

Iron and Steel.

The iron and steel trades are generally satisfactory, although the holiday season usually brings a little quietude. Ordinary trade requirements are equal to the output, as a general rule, and very little iron is going into stock. Indeed, one of the most gratifying features in the iron market has been the recent steady diminution of stocks. The situation is regarded as sound, both in iron and steel, with every prospect of improvement in the autumn. Some of the best makers are complaining that fresh orders are not coming out very freely, especially in the home trade, but expectations of betterment later on are confidently entertained. Quotations for raw material delivered in Sheffield are given this week as follows:—West Coast hematites, 74s. 6d. to 75s. 6d. per ton; East Coast hematites, 71s. 6d. to 72s. 6d. per ton, both less 2½ per cent., at Sheffield and Rotherham. Lincolnshire No. 3 foundry, 54s. per ton; Lincolnshire No. 4 forge, 51s. per ton; Lincolnshire No. 5, mottled, white, and basic, 55s. per ton; Derbyshire No. 3 foundry, 54s. per ton; Derbyshire No. 4 forge, 49s. 6d. per ton. From Frodingham the report is that there is a good demand for pig iron, especially for shipping orders, and that orders are coming in briskly in the steel works, which are busy on full time.

John Brown and Co., Limited.

The annual meeting of the shareholders was held at Sheffield on the 29th ult. In the absence, through illness, of Mr. J. D. Ellis, the chairman, Sir Charles B. McLaren, presided. In proposing the adoption of the report, he stated that last year the directors indicated that they considered trade was improving, and the results had borne out their prognostications. Prices in the manufacturing departments at Atlas Works had certainly been better, although the prices of finished material had not advanced in proportion to the price of raw material. Still, there had been regular work, and as the prices had not been unduly pushed up, trade had remained fairly steady. He was glad to think that there was no prospect of things going back. At the same time, there was no "boom," and he was glad to say they did not anticipate anything like a speculative "boom" in steel or iron. Owing to the rise in the price of pig iron, they had had a second blast furnace put in, which had not been the case for some years past. Their order-book was in a very fair condition. They had a good number of orders for marine and other forgings. The chairman went on to refer to the coal trade, about which he could not report so favourably. As in the two previous years, prices sank during the last financial year. But for the largely-increased facilities for output, prices ought to have gone up, but they had to face the fact that new collieries had been developing, while, owing to the coal tax, their foreign coal trade had been restricted. This had, no doubt, reacted to a large extent upon the South Yorkshire and North Derbyshire coalfields. During the last few months, however, prices had risen all over the country, and most colliery proprietors felt that there was a better chance of making money to-day than they had had during the last few years. He was glad that the coal tax had been taken off, and that they would probably get back some of the foreign markets that the tax had lost them. The chairman afterwards referred to the shipbuilding department of the company, and the extensions at Coventry and Clydebank. The report was unanimously adopted. Mr. C. E. Ellis, Colonel Davis, and Mr. Bernard A. Firth were re-elected directors. A vote of condolence with Mr. J. D. Ellis in his illness was unanimously carried.

The Master Cutler.

The Forfeit Feast, frequently called the "Little Cutler's Feast," was given on the 29th inst. by the Master Cutler and Mistress Cutler—Mr. and Mrs. Sydney Jessop Robinson. The Forfeit Feast is the last public function of the Master Cutler's year of office. Amongst the guests were Sir William White and Lady White, the Master and Mistress Cutler of the London Company of Cutlers; the Prime Warden of the Dyers' Company; and Mrs. Flux; the Bishop of Sheffield; Mr. W. F. Osborne, Senior Warden; W. H. H. Bedford, Junior Warden, and others. Sir William White, in proposing "The Lord Mayor and Corporation," said that well acquainted as he was with technical education, not merely in this but in other countries, he had never seen anything that seemed more admirably adapted to its purpose than the technical school which now formed a part of the University of Sheffield.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Pig Iron.

DELIVERIES are unprecedentedly good, but the distribution of fresh orders is decidedly slow, but the latter feature is to be expected at this period of the year, July being generally a quiet time. Makers believe that shipments will, however, be exceedingly good throughout the month, and next month the demand for autumn delivery will set in. There is not much likelihood of any material reduction in prices, but on the chance of getting cheaper iron consumers hold back. A report has been in circulation in the London iron market and elsewhere this week that there was likely to be trouble with the blast furnacemen of this district, a rumour for which there is no foundation. The wages of the blast furnacemen in this district have been for many years regulated automatically by sliding scale. The Cleveland ironstone miners, however, have decided to go in for a substantial advance of wages, but that is not likely to give rise to any trouble, and will be settled amicably. There has been no regular strike in the ironstone mining of this district for over thirty years, and this application, which will be considered next week, will not induce one. The price of No. 3 Cleveland G.M.B. pig iron has been steady this week at about 50s. 3d. per ton for early f.o.b. delivery, though some of the leading firms are asking more. No. 4 foundry is at 49s. 6d., and No. 4 forge at 48s. 9d. per ton.

Hematite Pig Iron.

Makers report that the orders at present for East Coast hematite pig iron are few, but all that is produced is going direct into consumption, and there is no stock in their hands, nor is there any in Connal's. But makers are still well off for contracts, and thus there is not much competition, and prices are steady, mixed numbers being at 65s. 9d. per ton for early delivery, and No. 4 at 63s. 6d. Ironmasters have good contracts running for Rubio ore, and as they are not prepared to pay the prices now asked by the Spanish mine owners, they are giving out scarcely any orders. The present quotation for 50 per cent. Rubio is 19s. 6d. per ton c.i.f. Tees.

Cleveland Pig Iron Stock.

Owing to the scarcity of Cleveland pig iron in makers' hands, and to the cheaper figures quoted for warrants, there were during June considerable withdrawals from the stock in Connal's public stores, where a decrease of 28,526 tons had to be reported, as compared with 30,000 tons in May, and since the early part of March the stock with Connal's has been depleted to the extent of 108,734 tons. The total held at the end of June was 641,371 tons, which consisted of 612,184 tons of No. 3—decrease, 26,067 tons for month—28,687 tons of other iron deliverable as standard—decrease 2459 tons—and 500 tons of other iron not deliverable as standard. It is expected that the decrease in stock will go on for the rest of the year, for the good demand is likely to be kept up, while the production cannot well be increased, owing to the difficulty of getting increased quantities of ironstone from the Cleveland mines. The 500 tons referred to above under the head of "other iron not deliverable as standard" was taken out on Tuesday, and Connal's have no iron under that head now.

June Pig Iron Exports.

These were most satisfactory; they were exceeded by those of only one month—May, 1906—when 143,571 tons were exported, the June figure being 143,063 tons. But, as a matter of fact, the June deliveries by sea were actually brisker than those of May, and were thus the most active on record. It must be borne in mind that June was a shorter month than May—it included only twenty-five working days, whereas there were twenty-seven in May. That being so, the average shipment per day in June was 5722 tons, while in May it was 5317 tons, or 7½ per cent. less. If June had been as long a month as May an export of 154,000 tons would have been recorded. The June average over the last ten years has been 101,377 tons, so that last month's return was 41,686 tons, or 41 per cent. better than the average, while it was 50 per cent. better than the export for June last year, and 85 per cent. better than in June, 1904. The extraordinary shipments were due to the enormous tonnage required on oversea account, particularly to Germany, France, Belgium, and Italy. The total oversea, 100,966 tons, was the largest on record, and of this Germany alone took over 54,000 tons—more than half the shipments foreign, and more than a third of the total exports. In June last year only 14,789 tons were taken by Germany. Belgium received 6834 tons, against 2615 tons in June, 1905, and Italy 14,162 tons, against 4711 tons. That there is a dearth of native pig iron on the Continent is shown unmistakeably by these figures, and the Cleveland ironmasters are profiting by it. The quantity of Cleveland pig iron sent to Scotland has fallen off, and was smaller in June than in any month since February, amounting only to 33,228 tons, thus leaving Germany once more the best customer for Cleveland iron.

Half-year's Statistics of Exports.

The figures showing the shipments of pig iron from the Cleveland district for the last half-year are particularly worth notice, as they are, by a good deal, the largest on record for any previous six months. They reached 696,285 tons, whereas the previous best was in 1899, with 677,764 tons, which was 18,621 tons, or nearly 3 per cent., less. As compared with the first half of last year, there is an increase of 236,318 tons, or 51 per cent., last year's total being only 459,967 tons, or nearly a quarter of a million tons less. Germany has had 200,043 tons in the last six months from Cleveland, against 75,000 tons in 1905, and Italy 52,927 tons, against 25,799 tons. To Scotland the quantity sent has been 208,451 tons.

Dispute at Ormesby Foundry.

The strike which has been in progress for more than a month at Messrs. Cochrane and Co.'s Ormesby Foundry, Middlesbrough, and which involved the stoppage of over 1200 men, has been settled this week, and a Conciliation Board is to be formed, which will in future adjust all wages difficulties between the firm and its men. The men originally ceased work because the firm, having introduced labour-saving machinery at its casting pits, desired to lessen the number of hands employed at them. The terms of the arrangement come to by the firm and the men have not yet transpired; indeed, they are not yet fully agreed upon. Work, however, has been re-started.

New Zinc Works on Teesside.

The Tees Conservancy Commissioners have sold to the Central Zinc Company, Limited, of London, 52 acres of reclaimed land at Seaton Snook, near the mouth of the Tees, on which to erect zinc and spelter works, the first of the kind in this district, which, however, is a large consumer of spelter for galvanising purposes. The price reported as being agreed upon for the land is £100 per acre for that required for the works, and £300 for that required as sites for workmen's cottages. It is the intention of the company to import its ore into Hartlepool, so that Middlesbrough will not benefit so much as was generally expected. The company will begin forthwith with the construction of its works, and will erect a large wharf on its river frontage.

New Graving Dock on the Tees.

Smith's Dock Company, of South Shields, is commencing the construction of a new graving dock on the Tees near Southbanks, which will be extensive enough to accommodate the largest vessels that trade with the district.

Manufactured Iron and Steel.

There is no improvement in the demand for finished iron and steel, but that does not weaken the prices, for producers are still well supplied with contracts, and are not under the necessity of keenly competing among themselves or with producers in other districts. It is a long time since any alteration was made in the quotations for manufactured iron and steel, and producers believe that before they get short of orders a revival of demand will have to be reported. The rail manufacturers are fairly well situated, and quote £6 5s. to £6 7s. 6d. net, f.o.b., for heavy steel rails. The steel platemakers are still well off, but buyers are backward. Nevertheless, sellers do not take less than £7, less 2½ per cent., for steel ship plates, and £8, less 2½ per cent., for steel boiler plates. Steel ship angles are at £6 12s. 6d., less 2½ per cent., and steel joists at £6 7s. 6d., less 2½ per cent. A good business is done in galvanised sheets at £12 15s., less 2½ per cent.

Angle Makers' Combination.

When last year the platemakers of the North of England and Scotland formed a combination which had for its object the prevention of competition between the manufacturers in their own districts, an endeavour was made to establish a similar combination between the angle makers, but without success, as one of the leading North of England firms, which has hitherto always set its face against such combinations, refused to have anything to do with the matter. This year the success which has attended the establishment of the platemakers' combination has led to negotiations being resumed among the angle makers, with the result that within the last few days an angle makers' combination has also been formed, with the firm who last year objected among its members. The Scotch plate and angle makers will not compete for North of England orders, and the North of England firms undertake not to seek orders in Scotland. A question was asked in the House of Commons on Wednesday with a view of getting the Government to interfere with the establishment of such organisations, but, of course, the intervention of Parliament could not be promised.

Shipbuilding.

Very little new business is reported, but there is enough on the books of builders to keep the yards fully going over the current half-year. An inquiry has been received on Teesside, which it is believed will result in an order from an Italian house for several steamers, and it is reported that a portion of the large Brazilian order already referred to in these pages will be placed on Tyneside, probably with Messrs. Swan, Hunter and Wigham Richardson, Limited. This firm estimate that its output for the current year will reach 110,000 tons, which will include the large Cunarder Mauritania. The Northumberland Shipbuilding Company has secured an order for a steamer of 4169 tons for Bremen owners. Palmer's Shipbuilding and Iron Company is building a launch of a new type, which is intended to demonstrate the practical value of the new type of hull which it has patented, and also the applicability of the oil engine for marine propulsion. The Griffin oil engine is to be used. On the Wear during the year so far forty-four vessels have been launched, of 137,009 tons, the largest output on record, and forty-one steamers are on the stocks.

New Bridge.

The Cleveland Bridge and Engineering Company, Darlington, which is completing the new High Level Bridge over the Tyne, which is to be opened by the King next week, has secured an order for a rolling lift bridge to carry the Soudanese Government Railway over the harbour at Port Soudan. It will, with one exception, be the longest rolling lift bridge ever built, and will need 1300 tons of steel and ironwork. On the bridge there will be two sets of railway track, and foot and wheel traffic will also be accommodated. The machinery will be worked by two electric motors of 50 horse-power each, and it is intended that the bridge shall be opened and closed in fifty seconds.

The Coal and Coke Trades.

The coal trade, especially that in Durham, is very satisfactory, and large forward sales have lately been made. Business is considerably better than we usually find it at this season of the year, and prices are stiff, as coals are realising 9s. 9d. f.o.b. for next year's delivery, and sellers are holding out generally for this. The abolition of the coal tax on November 1st next facilitates the transaction of business for next year, and consumers abroad who, for this year, had bought more cheaply abroad, are coming back for supplies of Durham coal. Best gas coals for early delivery are realising up to 10s. 6d. per ton f.o.b. Bunker coals are in more request, unscreened Durham sorts being sold at 9s. 3d. f.o.b. Tyne Dock. Best coking coal is steady at 10s. 3d. per ton; and coke, likewise, is stronger in price, 18s. 6d. f.o.b. being quoted for best foundry; and 17s. for medium coke delivered at the furnaces on Teesside.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The General Condition of Trade.

THERE is little or no change in the trade situation since last report. The markets have been steady, with a moderate amount of business. It is noticeable that speculative transactions in pig iron are reduced in amount, but this usually occurs about the present season. Whether values are likely to decrease or advance is held to be doubtful, but certainly the experience of the last few days has been that the tendency is becoming easier. Reports from abroad are colourless, and little or no reliance is placed for the moment on these. In most of our manufacturing branches at home a fair measure of employment is assured.

The Pig Iron Warrant Market.

The Glasgow warrant market has been quiet during the last few days, but the tone is steady on the whole. While sales of warrants tended to depress prices, a smart recovery took place, and recent transactions have been about the best figures. It is alleged that some merchants have been gradually acquiring possession of warrants, and such a thing is not unlikely considering the recent extensive demand for Cleveland iron for shipment abroad. Business has been done in Cleveland warrants at 50s. 1d. cash, and 50s. 2d. for delivery in ten days. Scotch warrants are quoted 56s. 3d., and standard foundry pig iron 50s. per ton.

The Hematite Trade.

The output of Scotch hematite has not merely been maintained, but there has been an increase in it to the extent of about 300 tons per week. Cumberland hematite has not been in much request in our market, and the current quotations is 64s. 1d. per ton at Cumberland ports. Scotch hematite is 1s. per ton lower, merchants quoting 68s. 6d. for delivery at the West of Scotland steel works. It is reported that makers have been rather pressed for delivery to the steel works, where it is desirable that there should be ample supplies in view of the approaching holiday time.

Output and Stocks of Pig Iron.

An additional furnace has been lighted at Wishaw Ironworks to produce hematite pig iron, and there are now 46 making hematite, 37 ordinary and 6 basic iron, the total of 89 furnaces thus blowing in Scotland comparing with 85 at this time last year. Messrs. Connal and Co. issued a statement at the end of June, which showed that the stock in the Glasgow stores amounted to 18,566 tons, being 468 tons less than at the beginning of the month. There are warrants in circulation for 11,300 tons Scotch iron and 6000 tons foundry pig iron—616 tons of ordinary Scotch and 650 tons foundry iron being unrepresented by warrants. A small quantity of iron has been withdrawn from store since the beginning of the month.

Prices of Scotch Makers' Iron.

The makers' prices have been in a number of cases reduced, the reduction varying from 6d. to 2s. per ton, being largest in the case of the special brands. G.M.B., No. 1, is quoted at

Glasgow 57s. 6d.; No. 3, 55s. 6d.; Monkland, No. 1, 58s.; No. 3, 56s.; Carnbroe, No. 1, 61s.; No. 3, 58s.; Clyde, No. 1, 64s. 6d.; No. 3, 59s. 6d.; Calder, No. 1, 65s. 6d.; No. 3, 60s. 6d.; Gartsherrie, No. 1, 65s.; No. 3, 60s.; Summerlee, No. 1, 66s.; No. 3, 61s.; Langloan, No. 1, 69s.; No. 3, 63s.; Coltness, No. 1, 72s.; No. 3, 61s.; Glengarnock at Ardrossan, No. 1, 65s.; No. 3, 60s.; Eglinton at Ardrossan or Troon, No. 1, 60s.; No. 3, 57s. 6d.; Dalmellington at Ayr, No. 1, 61s 6d.; No. 3, 56s. 6d.; Shotts at Leith, No. 1, 66s.; No. 3, 61s.; Carron at Grangemouth, No. 1, 67s.; No. 3, 62s. per ton.

Pig Iron Exports and Imports.

The shipments of pig iron at Scottish ports in the past week were 1542 tons foreign, and 2887 coastwise, total 4429 tons, being 591 tons more than in the same week of last year. During the past six months the shipments have aggregated 146,377 tons, being 3033 tons more than in the same half of 1905. The week's arrivals of Cleveland iron at Grangemouth reached 9336 tons, being 3066 tons less than in the corresponding week. The aggregate imports of this class of iron for the past half-year have been 253,601 tons, showing an increase of 13,184 tons, compared with the arrivals in the first half of 1905.

Finished Iron and Steel.

Some of the steel makers are reported to be much pressed for deliveries by the shipbuilders, but the fresh orders coming to hand at the moment are admittedly limited. Representatives of the English and Scotch steel makers met at Carlisle at the end of last week, and arrived at a definite arrangement for the regulation of prices and other conditions of sale of angles and other kinds of material. It is now expected that cutting of prices, from which the trade recently suffered so much, will be obviated. Makers of malleable iron have fair employment, but the current inquiry is not so active as could be desired.

The Shipbuilding Trade.

The launches of new vessels in Scotland during June reached the unprecedented total of 128,074 tons, compared with 48,225 tons in the same month last year, and 32,308 tons in June, 1904. The Clyde total was 124,544 tons, and of this no less than 75,544 tons accrued from the launches during the month of the warship Agamemnon and the new Cunarder Lusitania. During the six months the aggregate launches in Scotland amount to 360,489 tons, against 259,860 in the first half of last year, and 201,633 tons in the corresponding period of 1904.

The Coal Trade.

The shipping department of the Scottish coal trade has shown a great deal of activity, due in some measure, it is believed, to the holidays on the Tyne. The aggregate shipments of coal at the Scottish ports were 322,712 tons, being 55,372 tons more than in the preceding week, and 85,808 tons greater than in the corresponding week of 1905. In the inland departments of the trade there has also been a good business, and prices of all kinds of coal are given without material alteration.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Railway Amalgamation.

EVERY season of late years brings forward a rumoured amalgamation, and for a long time the changes have been rung, including the Rhymney, Brecon, Taff Vale, and Cardiff lines. This time the lines suggested as being under discussion are the Swansea and Rhondda Bay and the Great Western, and though no official statement has yet been given, the probability is regarded in good quarters as likely. The Swansea Bay, after a long uphill, struggle, has attained a safe position, the quotation, mid-week Cardiff, being 9¼ to 9½ per cent. ordinary. Authorities state that the advantages of acquirement to the Great Western are obvious, an access to the Rhondda Valley being the prominent one. For some time the Great Western has used the Rhondda and Swansea Bay bridge across the Neath River for its coal traffic from the Ely, Garw, Ogmore, and Llynvi Valley, to Swansea, and there is the expansion of the Port Talbot traffic to be reckoned with. Of course, parliamentary sanction has to be obtained, and strong opposition to be considered. Still it is not at all unlikely but that one of the contests of the early future will be their amalgamation.

The Cardiff Railway Bill.

This has been the interesting feature of the week, and the evidence of Sir Douglas Fox and Mr. Hurman has been given, and the inquiry adjourned at an advanced stage.

The Steam Coal Trade.

Steam coal is now the predominant and almost the sole quality, for house coal has declined into its summer slackness. On Saturday last the week ended with a good deal of animation; thirty-seven steamers left Cardiff, many of them of large tonnage, and excluding ballast and coke, there was a total of coal conveyed verging upon 78,000 tons. All the Welsh ports shared the briskness of trade last week. Newport total was 95,457 tons, and Swansea 75,600 tons. This week there has been a falling off. On Tuesday only thirteen vessels were cleared from Cardiff with coal, totalling only about 36,000 tons; Newport despatched three with 11,000 tons; and Swansea eight with about 8000 tons. The latest Exchange report records a continuance of quietness, and though best steam coals remain firm inferior and dry coals are weaker.

Closing Cardiff Prices of Coal.

Best steam commands 15s. 9d. to 16s.; best seconds, 14s. 9d. to 15s. 3d.; seconds, 14s. 3d. to 14s. 6d.; drys, 12s. 9d. to 13s.; best washed nuts, 12s. to 12s. 6d.; seconds, 11s. 6d. to 12s.; best washed peas, 11s. to 11s. 3d.; seconds, 10s. 3d. to 10s. 9d. Very best smalls, 9s. 9d.; best ordinaries, 9s. 3d. to 9s. 6d.; seconds, 8s. 6d. to 9s.; inferiors from 8s. to 8s. 3d. Monmouthshire semi-bituminous coal:—Best large, 14s. 9d. to 15s.; best ordinaries, 13s. 6d. to 14s.; seconds, 11s. 9d. to 12s. 3d. House coal:—Best households, 15s. 3d. to 15s. 6d; best ordinaries, 14s. to 14s. 6d.; seconds and other sorts, 11s. to 13s.; No. 3 Rhondda, 15s.; brush, 13s.; smalls, 11s. to 11s. 3d.; No. 2 Rhondda, 10s. 9d. to 11s.; through, 9s. 6d. to 9s. 9d.; smalls, 8s. 3d. to 8s. 9d. Patent fuel, 16s. to 16s. 6d. Coke, 17s. to 25s. Pitwood, 21s. 3d to 21s. 6d. Easier tone characterises Eastern Valley coals.

Anthracite Coal.

On 'Change, Swansea, this week best qualities were firmly quoted, but there was no improvement in the red vein. At Llanelly much more animation has been shown of late in the anthracite trade, and prospects are distinctly good. At the Cwmcapel Colliery a long and costly labour in connection with the new airway is completed, and promising results are certain. Swansea prices this week are as follows:—Best hand-picked malting, 19s. to 20s.; seconds, 17s. 6d. to 18s.; red vein, 9s. 3d. to 9s. 6d.; Swansea Valley big vein, 12s. 6d. to 13s.; cobbles, 17s. to 18s. 6d.; nuts, 18s. to 19s.; peas, 9s. 6d. to 11s. 6d.; rubbly culm, 6s.; duff, 4s. to 4s. 6d. Steam coal, 15s. 6d. to 15s. 9d.; No. 3 Rhondda, 14s. 9d. to 15s. 3d. Patent fuel, 13s. 6d. to 14s. Patent fuel: Trade is better; over 15,000 tons despatched last week.

Port Talbot Trade.

Another record week is reported. Last week shipments were 43,081 tons, or 5,00 tons in excess of any previous record. On Friday last there was a shipment of 10,000 tons, and on Monday 10,220. A busy week is assured. Two valuable seams of coal have been struck at Glyncorwg of the No. 2 Rhondda, one nearly 7ft., the other 3ft. 9in.

Advance in the Iron and Steel Trade.

It is a good proof of the improvement which has set in of late in this trade that the advance of 7½ per cent. to iron and steel workers was sanctioned by the Board, the same to take place on and from the 1st July. The outlook of the trade is considered to be promising, notwithstanding the slackness in tin-plate. Heavy rails are being worked off for the Indian State Railways, and the Buenos Ayres and Pacific Railways, and this week two large cargoes of railway material were despatched. There is no abatement in the demand for light rails, and fish-plates and miscellaneous goods continue in evidence. Constant despatches of steel billets are being made to Lydney, and of sheets to Bristol. This week 1500 tons of old steel rails came to Newport from Madras consigned to Guest, Keen, Nettlefolds and Co. A small shipment of steel billets from Antwerp came to hand last week. In the Swansea Valley the steel trade is buoyant. It was stated on 'Change at the beginning of the week that the activity in the trade was very marked, that the output of furnaces was large, and furnaces were producing to their fullest capacity. Chief rolling mills are very busy, and authorities state that business is more brisk than it has been for the past twelve months. Nickel, copper, and spelter fairly busy; foundries active.

The Tin-plate Trade.

Regrets are heard on every hand that from Swansea to Llanelly depression continues, and, compared with the steel trade, the contrast is discouraging. Last week the shipments did not touch 50,000 boxes, while close upon 65,000 boxes came from works. Stocks are now 222,051 boxes, and no important loadings are taking place. Seven mills are now idle.

State of Trade at Llanelly.

Complaints are many, heard on all sides, that tin-plate orders are most difficult to obtain at anything like remunerative prices. Every week of late the opinion has been expressed by competent critics of the situation that, unless a speedy change takes place, some makers will close their works.

Latest Prices in Iron and Steel and Tin-plate.

Swansea Metal Exchange report this week gives Bessemer pig iron, mixed numbers, 64s.; Middlesbrough, 49s. 10d.; Scotch, 56s.; Welsh hematite, 70s. Steel bars, Siemens and Bessemer, continue at £5. In tin-plate makers' prices remain: Ordinary sizes, C. 20 by 14, Bessemer cokes, 12s. 10½d. to 13s.; Siemens, 13s. 1½d.; C. A. roofing sheets, £9; big sheets for galvanising, £9 7s. 6d.; finished black plates, £9 10s. Block tin is at £179 5s. Lead, £17. Copper, 30 3-16d. per oz. Spelter, £27. Iron ore at Cardiff or Newport, 18s. 9d. to 19s.

Non-Unionist Troubles at Collieries.

Several large and important collieries have been idle this week in the Plymouth, Merthyr, and Dowlais districts. Midweek it was decided at Dowlais to return to work, and probably in all a resumption of work will take place Thursday or Friday. The sole disagreement is, that a certain number of non-unionists are in the pits. From a statement made by a collier, much of the difficulty consists in the colliers being unable to pay up the deficiency. The merits or demerits of the question are, I believe, secondary in many cases. If a collier falls into arrear with his payments, the difficulty of paying up becomes great.

The Gilfach Coch Inundation.

The inquest has taken place, and, after a few formalities, was adjourned. In the meantime, the full extent of the accident will be known. Two men have been found alive after six days' captivity. Four men, it is now ascertained, were killed. Full inquiry is promised, and one of the points to be cleared up is how near were the unfortunate men working to the old workings, whence came the inrush of water into the drift.

Statue to a Colliery Owner.

With befitting ceremony, a statue to the late Mr. Archibald Hood, of Llwynypia, has been unveiled in the Rhondda, and a justly-deserved tribute to his memory paid by Morien, Mr. W. Jenkins, J.P., and others before a great gathering. As a pioneer of the Rhondda, Mr. Hood has a lasting place in its history.

NOTES FROM GERMANY.

(From our own Correspondent.)

Favourable Condition of the Rhenish-Westphalian Iron Market.

AN increasing demand is reported to come in for raw material and for the heavier sorts of finished iron, and the blast furnace works, as well as the steel works, have hardly ever before been so vigorously engaged as they are at present, for, besides an extensive consumption on home account, there has also been an exceptionally good demand coming in from abroad. All the iron and steel-producing establishments of the district are, accordingly, engaged to their fullest capacity, and complain of an increasing want of trained workmen. Prices are, generally, remunerative, although wages have been advanced. The raised output of the blast furnace works meets with ready consumption. Present quotations are likely to continue till the first quarter of next year. Forge pig is quoted M. 68 p.t; iron for steel making, M. 70 p.t.; spiegeleisen, M. 93 p.t, free Siegen; basic, M. 70 p.t. to M. 70·50 p.t.; hematite, M. 82 p.t.; and foundry pig, M. 70 p.t., free at works. The fifth blast furnace that is in course of erection at the Hoesch Works is to commence operations in autumn; although the production of the four existing blast furnaces at the said works has been raised considerably of late, supplies in pig iron proved to be insufficient for the establishment, and so a large quantity of pig iron had to be purchased in England. From the semi-finished steel market most satisfactory accounts come in. The following figures show the good trade that has been done in semi-finished steel recently:—In May of present year 158,947 t. have been delivered, against 153,891 t. in April of present year, and against 169,539 t. in May last year; railway material 179,190 t., against 147,000 t. in April, and 152,159 t. in May, 1905; sectional iron, 184,434 t., against 163,668 t. in April, and 171,955 t. in May, 1905. From January to May of present year shipments of the Steel Convention were as follows:—

Semi-finished Steel.

	1905.	1906.
January	127,081 t.	175,962 t.
February	121,905 t.	156,512 t.
March	175,396 t.	178,052 t.
April	157,758 t.	153 891 t.
May	169,539 t.	158,947 t.

Sectional Iron.

	1905.	1906.
January	137,079 t.	129,012 t.
February	89,284 t.	125,376 t.
March	147,684 t.	177,107 t.
April	150,622 t.	163,668 t.
May	171,952 t.	184,434 t.

Railway Material.

	1905.	1906.
January	112,804 t.	154,859 t.
February	118,701 t.	155,671 t.
March	147,844 t.	172,698 t.
April	120,803 t.	147,000 t.
May	152,159 t.	179,190 t.

Though capable of turning out very heavy lots, the steel works are hardly in a position to satisfy the present increasing demand. Raw bars are quoted M. 87·50 p.t.; billets, M. 100 p.t.; and plates, M. 102·50 p.t. In the finished iron department inquiry and demand continue brisk and extensive as before; good merchant bars realise M. 130 p.t. and more; for the third quarter of present year M. 147 p.t. will be quoted for merchant bars, and M. 150 p.t. for horseshoe bars. Hoops are in very good call, and the mills vigorously engaged, prices remaining at M. 140 to M. 142·50 p.t. Firmness characterises the plate market; an exceptionally strong demand is reported for heavy plates, but lately sheets have likewise been in lively request. Heavy plates stand at M. 137·51 to M. 140 p.t., boiler plates M. 150 p.t., and sheets M. 142·50 to M. 150 p.t. The position of the locomotive and wagon-building department is in every way most satisfactory.

The Siegerland Iron Trade.

The various branches of the iron and steel industry in the Siegerland are reported in good employment. The works are doing their very best, and try to execute the contracts previously booked as quickly as possible, so as to be able to take in plenty of fresh work at the present more favourable prices.

Extensions at the Iron and Steel Works in Lorraine.

Activity in the pig iron trade continues most satisfactory, and production is to be raised at nearly all the blast furnace works. At the branch establishment of the Rombacher Hütte, at Maizières, near Metz, two additional blast furnaces are to be blown in soon; the same is the case at Kneutingen, and on the Karlshütte, near Diedenhofen, and the firm de Wendel intends building two new blast furnaces.] In Luxemburg, the Differdingen Works have, some weeks ago, blown in the sixth blast furnace, the seventh is in course of erection, and there is talk of another being added later on. At Rodingen the building of a new steel works is contemplated.

Production of Pig Iron.

In May of present year the output of pig iron in Germany, and Luxemburg, is stated by the Union of German Iron and Steel Masters to have been 1,048,150 t., against 1,010,789 t. in April, and 951,431 t. in May last year.

The Coal Trade.

The scarcity in coal on the Rhenish-Westphalian market has led to advances in quotations. In Silesia the coal trade is being influenced by the want of wagons, which prevents deliveries in coal from advancing in proportion to the increasing demand for industrial purposes. Austria buys freely in Silesia, and if the number of coal wagons could be raised, the business in fuel would be exceptionally good.

Foreign Rail Orders Coming to Austria.

A slightly rising tendency can be reported from the Austro-Hungarian iron market, quotations for girders and for sheets having met with an advance of 1 crown p.t. Demand for nearly all articles of raw and finished iron remains brisk. Even the rail works, that had been rather less actively engaged than other branches of the finished iron industry, have fair prospects for a lively occupation during the next few weeks, an order for 24,000 q. rails for Bulgaria, and another for 2000 t. rails for Roumania having been placed recently. The strike in the Wittkowitz district has considerably impeded the export trade, which might otherwise have been very active; contracts of weight have been placed in Austria lately. The position of the Austro-Hungarian coal market is favourable, both as regards prices and demand.

Dying Out of the Paris Strike.

Though still to some extent impeding business transactions on the French iron market, the Paris strike has been decreasing, and the condition of the iron industry is satisfactory on the whole, employment at the mills and foundries remaining regular, and prices tending in an upward direction. Coal is unaltered and in fair request.

The Belgian Iron Trade.

A steadily rising movement can be reported from the Belgian iron market, the different departments being extremely well occupied, both on home and on foreign account. Steel bars vary between 150f. and 155f. p.t., while iron bars are still sold at 142f. to 145f. p.t. The condition of the Belgian coal market continues exceedingly firm; stocks are low and steadily decreasing, and quotations naturally very firm. There is talk of a rise in prices for best sorts of dry coal later on.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, June 27th, 1906.

LARGE purchases of basic Bessemer iron continue to be made; the largest order placed during the past week amounted to 10,000 tons of basic for an Eastern Pennsylvania mill at 17·75 dols. delivered. Quite a number of orders have been placed for foundry, forge, and pipe irons in both eastern and western markets, the bulk of the material ordered by machine shops, engineering plants and agricultural implement plants. Some rumours prevail of a break in pig iron, but the market conditions do not warrant any decline, and the heavier producing interests refuse to recognise the drop of 50 cents an ounce at certain southern points. There is some talk of another steel combination, but the development has not developed far enough to give an opinion concerning it. All of the larger railroad companies and systems are still in the market for steel rails. For the past week only a small amount of business has been done. Railroad building that is to be done during the first half of next year has been only partially provided for. There is a great deal of construction which has been resolved upon, and the managers of these new railroad enterprises have not yet entered upon negotiations.

In the structural steel department great activity prevails because of the numerous and very urgent requirements for material for bridges and for engineering requirements in the way of buildings for commercial purposes. The structural capacity is being steadily sold ahead. Considerable new capacity is now being hurried along, and within a few months there will be sufficient capacity to take care of almost any demand that may be made for years to come. The Carnegie Steel Company will instal during autumn at South Sharon, Pa., the largest blooming plant ever built. Plate mill capacity is also being increased, and the requirements of the country for next year will be amply provided for. The makers of cast iron pipe are having all the business they can take care of, and the makers of merchant pipe as well as of boiler tubes are similarly busy. The copper and tin markets present some interesting features. The drop in refined copper in Europe was followed by a corresponding drop here. The outside price to-day is 18½ cents. Export of copper for week ending June 21st is 5740 tons, and for the month of June to date 15,097 tons. There is a large amount of metal available on this side for export. Electrolitic is quoted at 18½, casting 18¼.

Tin has once more risen in price, and a further upward movement is predicted. Sales of spot tin are being made at 39½ cents at the dock; 25 tons arrived at Philadelphia on Friday, making 2627 tons since June 1st. The amount afloat is 2886 tons.

THE new pumping station for supplying the city of Schenectady is operated by electric motors, and is capable of pumping 24,000,000 gallons of water per day against a head of 110lb.

LAUNCHES AND TRIAL TRIPS.

CYCLOPS, twin-screw steamer; built by David and W. Henderson and Co., Limited; to the order of Ocean Steamship Company; dimensions, 500ft., 58ft. by 42ft. 6in.; engines, triple-expansion, 23in., 38½in., 65in. by 48in., pressure 190 lb.; constructed by builders; everything worked smoothly.

IRWELL, steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of Lancashire and Yorkshire Railway Company; dimensions, 255ft. by 36ft.; to carry passengers, cargo, and cattle; a mean speed of over 15¾ knots was attained; trial trip, June 12th.

LYDERHORN, steel screw cargo steamer; built by Laxevaages Engineering and Shipbuilding Company; dimensions, 224ft., 32ft. by 15ft.; to carry 1350 tons dead-weight; engines, triple-expansion, 16in., 25½in., 43in. by 30in., pressure 175 lb.; constructed by builders; a mean speed of 10¾ knots was attained; trial trip, June 12th.

BALACLAVA, steel screw steamer; built by Northumberland Shipbuilding Company; to the order of Messrs. Lloyd and Co., London; dimensions, 372ft., 48ft., 30ft. 10in.; engines, triple-expansion, 25in., 41in., 69in. by 48in., pressure 180 lb.; constructed by Richardsons, Westgarth and Co.; a speed of 11½ knots was attained; trial trip, June 13th.

STRATHSPEY, steamship; built by the Grangemouth and Greenock Dockyard Company; to the order of Messrs. Burrell and Son, of Glasgow; dimensions, 370ft. by 52ft. by 28ft. 6in.; to carry dead-weight capacity of 7100 tons; engines, triple-expansion; constructed by John G. Kincaid and Co., Greenock; launch, 19th inst.

SCHELDE, steam tug; built by Wilton's Engine Works and Slipway; to the order of International Tug Company; dimensions, 144ft., 25ft. by 14ft. 6in.; launch, June 21st.

BIRTLEY, steel screw steamer; built by Messrs. Wood, Skinner and Co., Limited; to the order of Burnett Steamship Company, Limited; engines, triple-expansion, 19in., 31in., 51in. by 36in., pressure 180 lb.; constructed by North-Eastern Marine Engineering Company; a mean speed of 11 knots was easily maintained; trial trip, June 21st.

FRITZOE, cargo steamer; built by Sir Raylton Dixon and Co., Limited; to the order of Messrs. Fearnley and Eger, of Christiania; dimensions, 360ft., 51ft. 2½in. by 28ft. 10in.; to carry 7000 tons deadweight; engines, triple-expansion, 26in., 42in., 70in. by 48in., pressure 180 lb.; constructed by North-Eastern Marine Engineering Company; launch, June 21st.

AMELIA, steel screw steamer; built by Swan, Hunter and Wigham Richardson, Limited; to the order of Donald Steamship Company, Limited; dimensions, 237ft., 31ft. 8in. by 16ft.; engines, triple-expansion, 21in., 34in., 56in. by 36in., pressure 180 lb.; constructed by North-Eastern Marine Engineering Company; launch, June 22nd.

SNOWDON RANGE, steel screw steamer; built by Irvine's Shipbuilding and Dry Docks Company, Limited; to the order of Neptune Steam Navigation Company, Limited; dimensions, 336ft., 47ft. by 24ft. 10in.; engines, triple-expansion, 24in., 38in, 64in. by 42in., pressure 160 lb.; constructed by Richardsons, Westgarth and Co., Limited; launch, June 22nd.

SHEAF FIELD, steel screw steamer; built by Blyth Shipbuilding Company, Limited; to the the order of Sheaf Steam Shipping Company, Limited; dimensions, 269ft. 6in., 37ft.; engines, triple-expansion, constructed by J. Dickinson and Sons, Limited, Sunderland; launch, June 23rd.

RIBSTON, steel screw steamer; built by Irvine's Shipbuilding and Dry Docks, Company; to the order of Messrs. R. Sargeant and Sons; dimensions, 336ft., 47ft., 24ft. 10in.; engines, triple-expansion, 24in., 38in., 64in. by 42in., pressure 160 lb.; a mean speed of 11 knots was attained; trial trip, June 23rd.

ANTAR, steel screw steamer; built by Tyne Iron Shipbuilding Company, Limited; to the order of Egypt and Levant Steamship Company; dimensions, 360ft., 50ft. by 25ft. 8in.; engines, triple-expansion, 24in., 39in., 66in. by 45in., pressure 180 lb.; constructed by North-Eastern Marine Engineering Company; launch, June 23rd.

BELLE OF IRELAND, steel screw steamer; built by Northumberland Shipbuilding Company, Limited; to the order of Messrs. Crow Rudoff and Co.; dimensions, 372ft., 48ft. by 30ft. 10in.; to carry 7300 tons deadweight; engines, triple-expansion, 24½in., 40in., 68in. by 48in., pressure 180 lb.; constructed by North-Eastern Marine Engineering Company; a speed of 12 knots was attained; trial trip, June 23rd.

IRISMERE, turret vessel; built by Wm. Doxford and Sons, Limited; to the order of Irismere Steamship Company, Limited, Newcastle; dimensions, 340ft., 50ft. by 25ft. 3in.; engines, triple-expansion, 26in., 42in., and 68in. by 42in.; constructed by Doxford's; launch, June 26th.

THISTLEMOR, steel screw steamer; built by Craig, Taylor and Co., Limited; to the order of the Albyn Line, Limited; dimensions, 360ft., 51ft. by 28ft.; engines, triple-expansion, 24½in., 41in., 67in. by 45in., pressure 180 lb.; constructed by John Dickinson and Sons, Limited; a speed of 12 knots over a course of 17½ knots was maintained; trial trip, June 28th.

PRINCESS ROYAL, passenger steamer; built by John I. Thornycroft and Co., Limited, Southampton; to the order of South of England Royal Mail Steam Packet Company; dimensions, 204ft., 25ft. by 9ft.; engines, compound-surface condensing, 36ft. and 57ft. by 60in., pressure 120 lb.; a speed of over 14¾ knots was attained on an average of six runs; trial trip, May 28th.

BATTERSEA POLYTECHNIC.—The governing body of the Battersea Polytechnic have appointed to the position of head of the department of electrical engineering Mr. A. W. Ashton, M.Sc., of the University of Leeds. Mr. Ashton is a Whitworth Exhibitioner, an 1851 Exhibition Scholar, and he obtained his B.Sc. in Electrical Engineering with Honours at the Durham College of Science in 1898, afterwards graduating M.Sc. During the college vacations he worked in different departments of Messrs. Siemens and Co., of Charlton, and prior to his appointment at Leeds was for five years assistant to the manager of the Helsby Cable Company at Runcorn, where he also conducted evening classes in electrical and other engineering subjects.

THE LATE MR. F. W. WEBB.—Mr. Webb left estate of the gross value of £211,543, of which the net personalty has been sworn at £196,158. He bequeathed £110,000 to charitable purposes, some of the bequests being as follows:—£10,000 to found a nursing institution for the benefit of the poorer classes in the borough of Crewe; £5000 to the benevolent fund of the Institute of Civil Engineers; £2000 to endow a bed in University College Hospital, to be called "The Francis Webb Bed," and to be preferably for the relief of London and North-Western Railway employés; £2000 to Owens College, Manchester, to establish a Webb Scholarship for the benefit of London and North-Western Railway employés and their sons; £2000 to the University College of Liverpool, for a similar purpose; £1000 to the Institute of Civil Engineers, for providing annually a Webb medal, and a premium of books to be awarded for the best paper on railway machinery. Subject to the payment of these legacies, and estate duty, &c., which will amount to over £30,000 for the Exchequer, the testator left the residue of his estate, about £75,000, to erect and endow an orphanage for orphan children of deceased employés of the London and North-Western Railway, to be known as "The Webb Orphanage."

CATALOGUES.

R. H. LONGBOTHAM AND CO., Limited, Wakefield.—Pamphlet of particulars of exhibits at the Colliery Exhibition.

S. F. EDGE, New Burlington-street, London.—Photograph of the spring joints of a Napier six-cylinder car, showing methods of lubrication.

EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY, Limited, Queen-street, London, E.C.—Catalogue, Section VIII., Part I., "Electric Fans."

CROMPTON AND CO., Limited, Chelmsford.—Two new pamphlets just issued are devoted to switch gear and alternating-current generators and motors.

E. P. ALLAM AND CO., 11, Red Lion-street, Clerkenwell-road, E.C.—Catalogue of electric motor starters, controllers, switches, cut-outs, and circuit breakers.

MATHER AND PLATT, Limited, Manchester.—"Polyphase Induction Motor" pamphlet, third edition.—The particulars given provide all necessary data of machines ranging from 5 to 500 horse-power.

SIEBE, GORMAN, AND CO., Limited, 187, Westminster Bridge-road, London, S.E.—Illustrated catalogue of breathing appliances for enabling persons to work safely in noxious and poisonous atmospheres.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. JAMES HALCROW gives us notice that he has removed to No. 18, Coleman-street, E.C.

MR. E. ARNOLD POCHIN, machine-cut gearing specialist, has removed to Trafford Park, Manchester.

MR. GEORGE I. ROCKWOOD has been appointed to the Professorship of Steam Engineering in the Worcester, Mass., Polytechnic Institute.

MESSRS. HUNTER AND SWAN, of 1, James-street, Bute Docks, Cardiff, have been appointed representatives of the Brush Electrical Engineering Company, in South Wales.

MR. H. ELLISON WALKER, South Wales agent of Crossley Brothers, Limited, Manchester, has removed to new offices and stores at 259, Bute-street, Cardiff. Mr. Walker is also agent for Messrs. B. and S. Massey, of Manchester.

THE Leeds Engineering and Hydraulic Company, Limited, late of Providence Works, Stamford-street, Leeds, notifies us that it has moved to Oaklands-road, Rodley, near Leeds, where it will have increased facilities for dealing with its business.

WE are asked to say that the Abner Doble Company has resumed business at its new offices, which are situated on the site of those which were burnt down in the recent great fire. The address is Fremont and Howard-streets, San Francisco.

THE Chloride Electrical Storage Company, Limited, of Clifton Junction, near Manchester, informs us that in future its Northern district office will be situated at Standard-buildings, City-square, Leeds, which office will be in charge of Mr. L. Broekman, as branch manager.

DR. SCHUMACHER, Osnabrück, Germany, the patentee of a new process for making iron ore and other briquettes, has appointed C. E. Muller and Co., Limited, Middlesbrough, as sole British agents for this process for the manufacture of iron ore briquettes.

W. B. BROWN AND CO. (BANKHALL), Limited, wish us to say that greatly exaggerated reports have appeared as to the extent of a recent fire at the Globe Works, Bankhall, Liverpool, the damage was confined to a very small area, and that the company is prepared to accept and carry out all orders, of whatever magnitude.

MESSRS. A. AND W. DUDGEON, of Leadenhall-street, E.C., announce that arrangements have been made by which the business of Mr. Harry Gray, M.I.N.A., consulting engineer and marine surveyor, of 110, Fenchurch-street, has been amalgamated therewith, and will be carried on jointly at the above address under the title of Dudgeon and Gray.

WE are informed that Kramos, Limited, of Looksbrook Engineering Works, Bath, have just opened a head sales office and showrooms in London at 169 and 170, Shoreditch High-street, E.C., as well as branches in all the principal industrial centres in this country, and, in future, all inquiries, orders, and sales correspondence will be dealt with from London.

WE are asked to state that Mr. Alfred Ingram, who was for some time carriage and wagon superintendent for the Metropolitan Railway Company, has now severed his connection with the company, and opened offices for the supply of all materials for railway and electric traction purposes, under the style of Alfred Ingram and Co., Queen Anne's-chambers, Westminster, S.W.

MR. H. W. TURNER has associated himself with Mr. H. M. Hobart, consulting engineer, of Oswaldestre House, Norfolk-street, Strand, and will be engaged in advising with regard to manufacturing methods, machinery and shop organisation, not only as regards winding and insulation, but also as regards other departments of works manufacturing dynamo electric machinery. This arrangement will, we understand, not interfere with Mr. Hobart's regular consulting practice.

CONTRACTS.—J. S. Hall and Co., Limited, of Newark-on-Trent, have just delivered to some large collieries in the North of England four of their 5ft. double-ended disintegrators, and also a 6ft. disintegrator.—C. and A. Musker, Limited, of Liverpool, have secured the order for the electric overhead travelling crane for the Eccleston-place sub-station of the Westminster Electric Supply Corporation; also for hydraulic capstans for the South-Eastern and Chatham Railway, hydraulic cranes for Nicholson's Wharves, Limited, and electric wharf crane for Owen's European Bottle Machine Company, Limited.—Salford Corporation have decided to instal a 1000-kilowatt Willans-Parsons turbine coupled to direct-current dynamo of Brown-Boveri manufacture. The complete order for the turbine, dynamo, and condensing plant has been placed in the hands of Willans and Robinson, Limited, Rugby.—We are informed that Henrich, Winby and Co. have received an order to construct a shaft and carry out boiler-setting work for Messrs. Umney and Peckett, London, E.C.—The Continuous Rail Joint Company of Great Britain, Limited, of 20, King William-street, E.C., has just received orders from the India-office for 350 tons of patent continuous rail joints for the Indian State Railways. The company has also in hand the manufacture of continuous rail joints for the London County Council, Birmingham Corporation, Gosport, and orders from the contractors, Messrs. J. G. White and Co., Limited, for use on the railway and tramway work at Para, Bombay, Lacroze, and Monte Video.—The New Arrol-Johnston Car Company, Limited, of Underwood, Paisley, inform us that among recent orders received are several from Rangoon, Ceylon, and New Zealand. The chief demand is for 12-15 horse-power cars and chars-à-banc, although the other types of pleasure and industrial vehicles are also selling well.—The South Metropolitan Gas Company has placed a contract for a complete ammonium sulphate handling plant with the Chain Belt Engineering Company, of Derby. This firm is also erecting a coal-handling plant for Grays Gas Company, and two refuse conveyors for the Southwark Borough Council.—The Brush Company has sent us a list of orders recently received by it. Among these we notice an order for two 1000-kilowatt turbo-alternators, and one 500-kilowatt steam alternator for the Buenos Ayres and Great Southern Railway, and an order for a 500-kilowatt turbo-generator for the County of Durham Electrical Power Distribution Company.

BRITISH PATENT SPECIFICATIONS.

Selected and Abridged by **JAMES D. ROOTS,** *M.I. Mech. E.*

When an invention is communicated from abroad the name and address of the Communicator is printed in italics.

When the abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent-Office Sale Branch, 25, Southampton-buildings, Chancery-lane, London, W.C., at 8d. each.

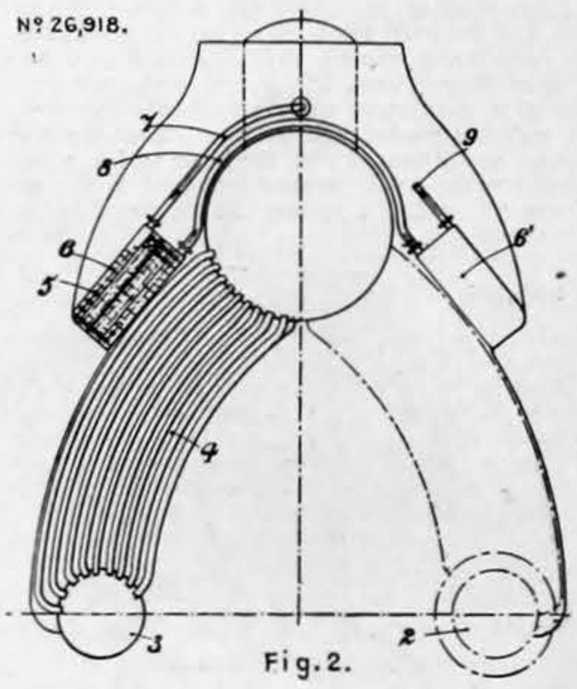
The first date given is the date of application; the second date at the end of the abridgment is the date of the advertisement of the acceptance of the complete specification.

Any person may on any of the grounds mentioned in the Acts, within two months of the date given at the end of the abridgment, give notice at the Patent-Office of opposition to the grant of a Patent.

STEAM ENGINES AND BOILERS.

26,918. December 23rd, 1905.—IMPROVEMENTS RELATING TO SUPERHEATERS, *La Société Anonyme de Perfectionnements Mécaniques*, 43, *Rue Taitbout, Paris, France.*

THIS invention has for its object a cascade or compound arrangement of superheaters, applicable to water-tube boilers, which permits of the simple conversion of boilers producing saturated steam into boilers producing superheated steam, without introducing any alteration in the constitution or grouping of the heating surfaces. For the first stage of the superheating of the steam an additional tubular surface is added, which, if necessary, may act as a feed-water heater, and which is arranged so as systematically to utilise the products of combustion which escape from the boiler furnace. The second stage of the superheating is obtained

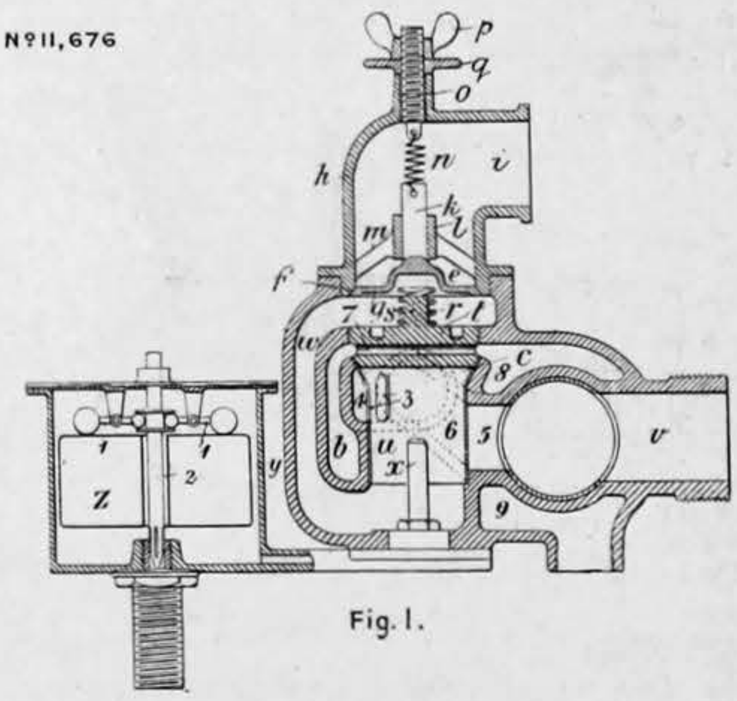


in one or more tubular elements arranged in proximity to the furnace in order that they may be partially submitted to the radiation from the grate and partially to the impact of the hot gases, which are at a high temperature. There are eight figures. Fig. 2 is a diagrammatic elevation, showing the application of the invention to a boiler of what is termed the small-tube type; 2 and 3 are collectors, and 4 the water tubes; the first portion of the superheater is formed by two groups of U-tubes 5, inserted in partitional collectors 6 6¹, placed on each side of the barrel of the boiler in the uptake conducting the gases to the chimney. The steam from the boiler is conducted through the tube 7 into one of the superheaters 6; after having traversed this superheater, it proceeds through the connection 8 to the superheater 6¹ situated on the opposite side of the steam barrel, and thence through the pipe 9 to the second portion of the superheater, which is formed by a third row of superheater tubes arranged in the wall of the furnace.—*June 6th*, 1906.

INTERNAL COMBUSTION ENGINES.

11,676. June 3rd, 1905.—A NEW OR IMPROVED CARBURETTER FOR INTERNAL COMBUSTION ENGINES, Messrs. Wade and Jones, Limited, and Francis R. Wade, both of 95, Colmore-row, Birmingham.

This invention relates to an improved carburetter for vaporising heavy hydro-carbons, such as ordinary paraffin and of the known type in which the heat from the exhaust gases or products of combustion passes through a jacket surrounding the carburetting chamber, in which the air inlet valve opens against the action of a spring and



in which the oil jet or nozzle is situated in an opening or carburetting chamber. There are three figures. Fig. 1 is a sectional elevation. The casing is provided with inlets *c* for the exhaust gases, either of which may be used while the other is closed by a plug; the object of having two is to render it possible to use whichever may be most convenient for the inlet from the exhaust pipe. The casing is provided with a valve port *e*, seating *f*, and a valve *g* mounted in a dome or hood *h*, having an opening *i* to the outer air. The dome is screwed or bolted to the carburetter body *a*. The valve *g* is provided with a stem *k* guided in a guide *l* mounted on two bridge parts *m m* extending across the inside of the dome, and a spring *n* capable of adjustment—by means of a screw *o*, a fly nut *p*, and a lock nut *q*—is attached to the stem of the valve *g*. On the other side of the valve there may be a cushion spring *r*. The cushion spring is loosely mounted on a stem *s* forming part of a plug *t*, which closes the upper part of the carburetting chamber *u*, so as to prevent the air entering the carburetting

chamber directly. The air—being drawn through the carburetter by suction from the motor piston or a pump in connection with the suction pipe *c* of the carburetter—passes through a jacket *w* surrounding the exhaust jacket *b*, is thereby heated, and passes into the carburetting chamber *u*. In this chamber *u* is mounted the nozzle or jet *x*, through which the oil is admitted from a tank *y* provided with the float *z*, weighted pivoted levers 1 1, and a needle valve 2 for maintaining a constant level. Surrounding the oil jet *x* are several apertures 3 in the wall of a jacket 4 inside the exhaust jacket, so as to heat the gaseous mixture which is drawn out by the suction of the motor piston or pump through the passage 5 passing out of the side of the casing, the latter passage 5 communicating with the jacket 4 by the passage 6. The jacket *b* for the exhaust gases is connected by a hole or holes 7 passing through the plug *t* to another part of the jacket marked 8, and the latter connects by a port or passage with the jacket part 9.—*June 6th*, 1906.

RAILWAYS AND TRAMWAYS.

11,193. May 29th, 1905.—IMPROVEMENTS IN RAILROAD TRACKS AND RAILS, *William Goldie*, 106, *Trenton-avenue*, *Wilkinsburg*, *Allegheny County*, *Pennsylvania*, *U.S.A.*

The object of this invention is to provide a track of sufficient stiffness to carry the loads to which such tracks are at present subjected through the increased weight of locomotives, and the cars and loads carried therein. It also has for its object a system of railroad track in which the bearing of the track upon the ties is extended out for a considerably greater width than with the usual rail, thereby giving a greater distribution of the load, and in which a greater angle of lateral resistance is obtained. The rail proper, comprising head, base, and intervening web, is made of a relatively high carbon steel having high wearing qualities, while the continuously-running, rail-supporting base bar is of tough low carbon steel, and has in its upper face a seat corresponding to and adapted to receive and envelop the lower face and the sides or edge portions of the rail base. There are two figures. Fig. 1 is a cross section of a continuous under-running, rail-supporting base bar and of a double-headed railroad rail. The base bar can be rolled to shape, and is formed with the hollow raised ribs 4, which provide several vertical web portions 5 to add to the stiffness of the track structure, and also reduce the weight of the ribs 4 and

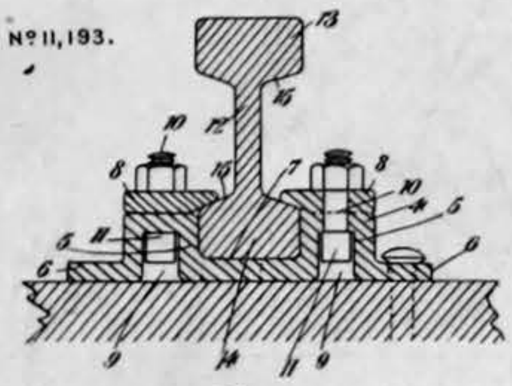


Fig. 1.

provide for bolting of the fastening devices, while beyond the same are the outwardly-extending tread flanges 6, through which it is spiked or secured to the ties. The base bar has in the central portion thereof the hollow seat 7 between the ribs 4, corresponding in shape to the rail tread, the upwardly-extending ribs 4 making it possible to provide a seat for the tread sufficiently deep to take the entire tread, and also providing means for securing to such ribs the clips 8 or other fastening device projecting over the upper faces of the rail tread, and holding it within the seat 7. As shown in the drawing, the bolt heads 11 of the bolts 10 fit in the hollow portions 9 of the ribs 4, the bolts passing through the ribs and holding the clips 8 in place. The rail has the web portion 12 and the heads 13 and 14, the seat 7 in the continuously under-running base bar conforming in shape to the lower head 14 of the rail and the clips 8 extending over the upper faces 15 of the rail tread 14. The rails themselves may be connected by any suitable form of joint, such as the joint plates secured together by bolts, as illustrated. The clips 8 can be secured in place in the spaces between the ties, though, as they fit within the hollow seats 9 in the ribs 4 of the base bars, they can, if necessary, be placed above the cross ties. It may be desirable or requisite to employ in connection with the base bar and rail a slight cushioning means within the seat 7, in which case a sheet or layer of felt, wood, or like cushioning means may be found advantageous.—*June 6th*, 1906.

15,345. July 26th, 1905.—IMPROVEMENTS IN RAILWAY CHAIRS TO PREVENT THE KEYS SLIPPING, Herbert Besley, 186, Finchley-road, Hampstead, London, N.W.

This invention relates to railway chairs, in which the face of one of the chair jaws is formed with a series of grooves, or with a recess into which the wooden key swells on being driven home; it has for its object to provide a chair that shall take a firmer hold of the key than those hitherto proposed, and consists in forming in the jaw a single vertical groove that extends to the top of the

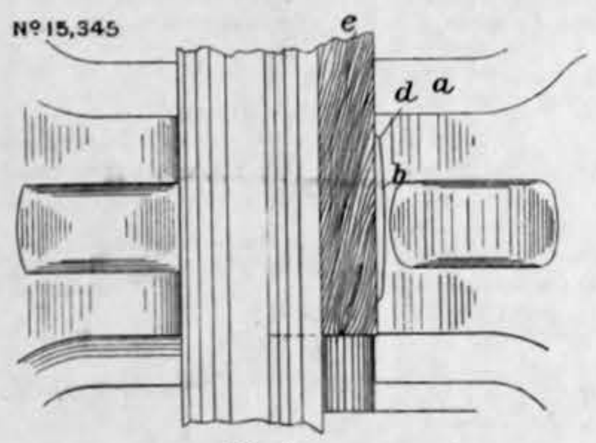


Fig. 2.

jaw, and transversely across the whole depth of the side face of the key, so that the key can swell into the recess and fill the groove. Thus the gripping action caused by the indentation of the wooden key by the metal of the chair is limited to two lines extending right across the key. There are two figures. Fig. 2 is a plan of the railway chair. The inner face of the jaw *a* is formed with a vertical groove *b* open at the upper end *d*, so that the whole depth of the key *e* can expand into the groove, the open top *d* of the groove facilitating the expansion and locking of the key in the groove.—*June 6th*, 1906.

CENTRIFUGAL PUMPS.

442. January 6th, 1906.—IMPROVEMENTS IN CENTRIFUGAL AND TURBINE PUMPS AND THE LIKE, *Carl H. Jaeger*, 20, *Klingenstrasse*, *Leipzig-Plagwitz*, *Germany*.—*Date under International Convention*, *6th January*, 1905.

In the manufacture of centrifugal or turbine pumps it is very difficult to secure in manufacture uniform conditions on the opposite sides of enclosed impellers, so as to balance the impellers without special balancing devices, and it is found in practice that, although the lateral pressures are equal or properly compensated for by balancing devices when the pump is new, the irregular wear of the moving parts and other causes will vary the lateral pressures in the pump after use, so that end thrust will be caused. There are four figures. Fig. 1 is a central longitudinal section of a centrifugal or turbine pump of a well-known type having two impellers. A is the pump casing, B the suction, C the delivery, and D D^1 the impellers carried by the shaft E. The impellers are of a well-known type of enclosed impeller having the side walls 10 and vanes 11 extending between the side walls, and chambers outside of the impeller which are closed to the suction by the running joints 1 on opposite sides, which will be provided with the usual packing rings. Outside of the impellers are shown the diffusing rings 13, and the impeller D delivers to the impeller D^1 through its diffusing ring 13 and delivery passage 15 to the delivery C. The impellers are shown as provided with the usual balancing chambers 16 on the rear side of the impellers connected with the suction by openings 2, so as to balance the suction pressure on the front side of the

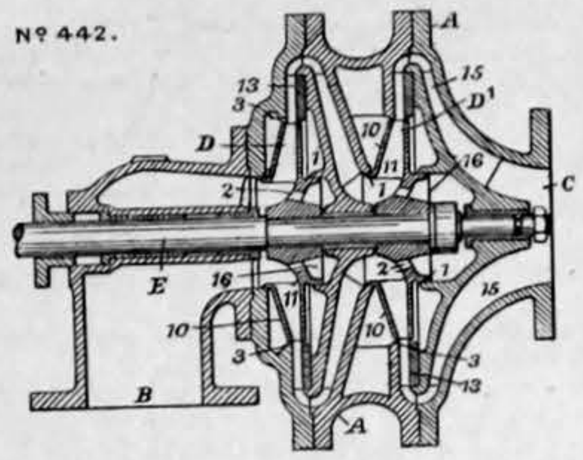


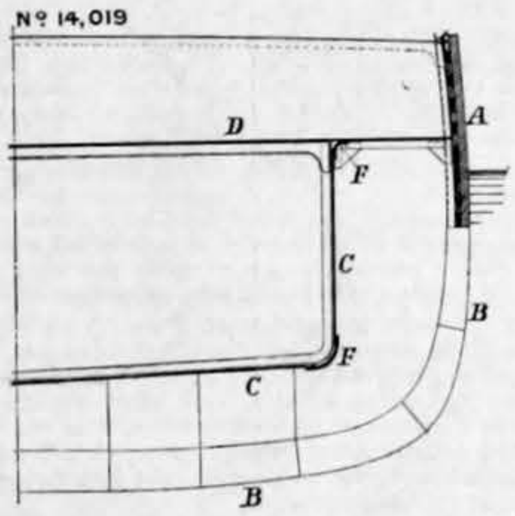
Fig. 1.

impeller. The shaft E is mounted to permit some lateral movement, and the running joints 1 are made of such length as required for such lateral movement. The side edges of the impeller walls of the periphery of the impeller or the walls on opposite sides of the passage through which the impeller delivers are made narrow, so that a small lateral movement of the shaft will shift the impeller to open it to one or the other of the side spaces 12 on opposite sides of the impeller, and thus increase the pressure therein until such pressure becomes sufficient to force the shaft back to its normal position. Or if the excess of pressure on the right is constant and sufficient the impeller will remain open to the chamber at the left, and thus compensate for the excess of pressure on the right. The edges 3 of the rings surrounding the impellers and enclosing the passage through which the impellers deliver are tapered or made conical, so as to provide a narrow edge on each side of the passage.—*June 6th*, 1906.

WARSHIPS.

14,019. July 7th, 1905.—IMPROVEMENTS IN THE CONSTRUCTION OF SHIPS OF WAR, Sir Edward J. Reed, K.C.B., M.P., Broadway-chambers, Westminster.

This invention consists of further improvements in the system of constructing ships of war, based upon the well-known law that expansive or explosive forces are diminished in magnitude in inverse proportion of their distance from the centre of expansion or explosion, but in a much greater ratio than the distance. The object of the first part of this invention is to so arrange the internal armour that every part of it shall lie at a distance of several feet from every point of the outer bottom plating at which it is possible for the torpedo to strike it, in order to reduce the force of a torpedo proportionally to the distance of the inner from the outer bottom. This may be accomplished in various ways, one of which is illustrated in the drawing, in which A is the side or belt armour, B the thinner outer bottom plating, C the inner armour for torpedo defence, and D a strong deck up to which the inner armour is



carried. Any other equivalent arrangement may be substituted, provided that the inner armour is so far removed from the outer bottom plating as to prevent either the direct effect of the explosion, or the fragments of the torpedo, or of the outer bottom plating and frame angles, &c., which may be driven in by the force of the explosion, from breaking through the internal armour. For example, the upper portion of the internal armour may be sloped or curved in lieu of being vertical, as in the drawing. The object in all cases is to provide, with a given thickness of internal armour, that the space between that armour and the outer bottom plating shall be sufficient to allow the explosive gases of the torpedo charge to be so expanded that they cannot penetrate the armour of themselves, nor force the fragments of the hull bottom to penetrate it. Care is taken to avoid as much as possible all such forms and combinations of parts as would give a lead to the forces of explosion, or allow them to have a "ripping" effect upon riveted work, employing for this purpose curved corner plates with suitable overlaps as far as practicable, as shown at F F, and introducing special strengthenings where such corner plates cannot conveniently be worked.—*June 6th*, 1906.

SHIPS' PROPELLERS.

11,639. June 3rd, 1905.—IMPROVEMENTS IN SHIPS' PROPELLERS, James A. Fleming, 28, Stanley-street, Glasgow.

This invention relates to improvements in ships' propellers. The propeller is divided into various series of blades, and each series of blades may be fixed at a different angle, the object being to cause the blades of each series to have the most effective purchase in the water, and the greatest propelling power. The employment of the blades in series, besides enabling the blades of each series to be placed at the most convenient angle, enables as many blades to be put into each series as will give the best propelling results in that series. There are nine figures. Fig. 1 is a sectional elevation. Fig. 2 is an elevation. On the propeller shaft A is mounted a portion of the hub or boss B, from which radiate the arms *b*, these arms being preferably formed with a twist or angle. The arms may be provided with recesses. The hub B may be reduced in diameter at b^2 and formed with a threaded portion b^3. On the portion b^2 of the hub may be fixed the other portion of the hub B^1, with radiating arms b^1 to correspond with the arms *b* of the other portion of the hub B. The arms b^1 may be also provided with recesses. The portions B B^1 of the hub may be held firmly together by means of the lock nuts C, which are screwed on over the screwed portion b^3 of the hub B. The lock nuts may be provided with the pin *c*. Carried by the arms *b* b^1 of the hub B B^1 are rings D E F G, all of which are shown concentric with the propeller shaft A. Radiating from

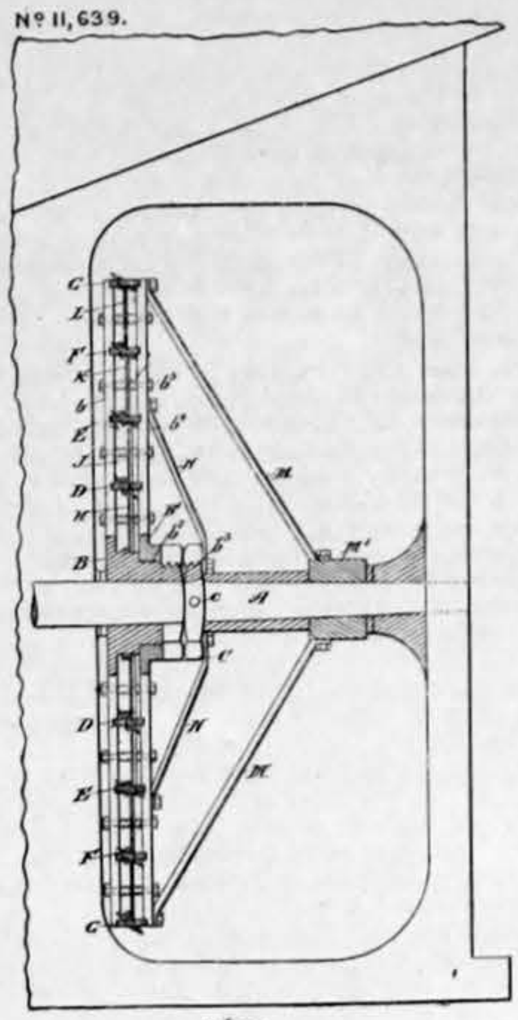


Fig. 1.

each of the concentric rings D E F G are the propeller blades H J K L. These blades may be given the required angle, and are preferably attached to the angled portion of these concentric rings. Fig. 1 shows the attachment of the blades to the rings. The arms *b* b^1 of the hub B B^1 are preferably held rigidly together

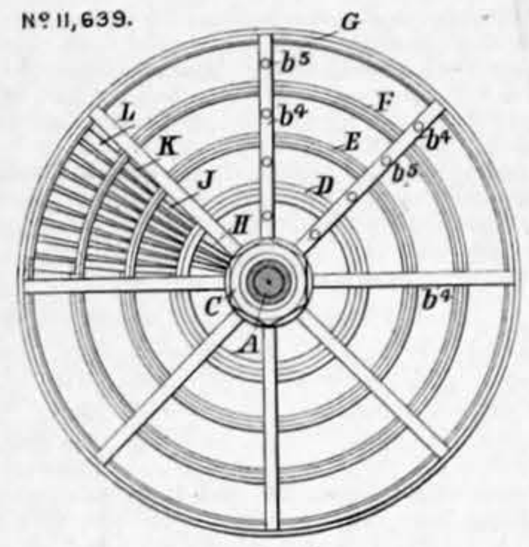


Fig. 2.

by means of bolts such as b^5, small pieces of tube being inserted between the arms *b* b^1 so as to prevent their buckling when tightened up. The stays M for taking the thrust may be secured to the thrust block M^1 and to the radiating arms of the propeller. The second set of stays N may be secured to the sleeve portion b^2 of the hub B^1.—*June 6th*, 1906.

MISCELLANEOUS.

13,126. June 26th, 1905.—IMPROVEMENTS IN AND CONNECTED WITH ROAD-MAKING AND REPAIRING MACHINES, John M. Sanderson, 106, Derwent-view, Benwell, Newcastle-on-Tyne, and Thomas Common, 2, Sanderson-road, Jesmond, Newcastle-on-Tyne.

This invention is illustrated by four figures, of which Fig. 1 is a diagrammatic elevation. It consists of a hopper A, wherein the stones, sand, and other road-making material are carried which are distributed on the road by means of a working table B, connected and geared either to the back axle C, or driven direct from the crank shaft of the engine by bevel wheels, chains, cams, or any other gearing which by its arrangement allows the working table B to be worked to and fro, so as to eject and distribute the stones,

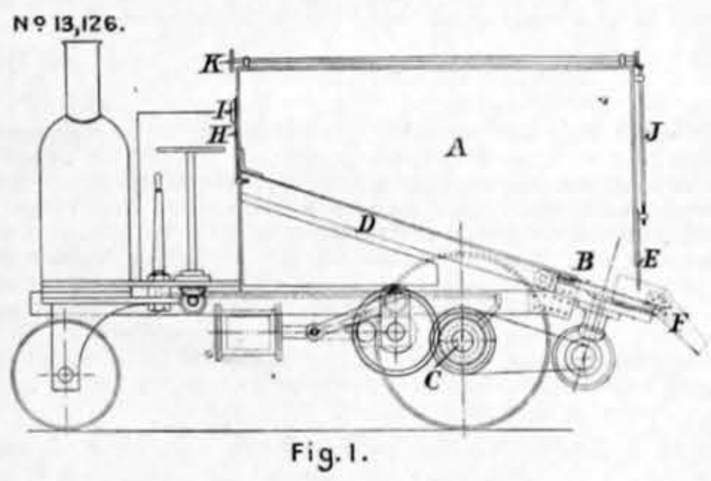


Fig. 1.

sand, and other road-making material over the surface of the road. The bottom D of the hopper is built at an angle, so that the road-making materials slide on to the working table B and are ejected automatically and evenly. The hopper A can be raised and lowered by means of screws or rack H, so as to give the bottom D more angle, and is operated by means of a hand wheel I connected to the screws or rack by bevel gearing. The thickness of the layer of road-making material is regulated by means of a vertical sliding door E, placed at the rear of the hopper A, which is raised or lowered by a screw J connected by bevel gearing to a hand wheel K, which is marked so that the driver can ascertain the thickness of the layer of road-making material without getting from his seat. The width of the layer of road-making material is regulated by means of a shoot F with movable slides, which are worked out and in by means of right-hand and left-hand screws and swivel nuts engaging slots operated by means of a hand wheel. The shoot F is placed at the rear of the hopper A, so that the working table B ejects and distributes the stones, sand, and other road-making material.—*June 6th*, 1906.