THE INSTITUTION OF MECHANICAL ENGINEERS.

THE summer meeting of this Institution commenced on Tuesday morning at 10 o'clock in the Cardiff Public Hall. After an announcement respecting the ballot, Mr. I Lowthian Bell delivered an address as President; an address which contained much that is of great importance. In the first part, however, Mr. Bell dealt in praises of the work of the mechanical engineer, a profession to which he protested he did not claim to belong. He traced the inventions of the past half-century which have led to the modern methods of iron and steel manufacture. The important portion of his address dealt with England's position amongst the iron manufactures of the world and with the labour question. He said:—

In reading the addresses of your former Presidents, I observed upon some occasions that advice for future conduct has been added to an examination of the benefits conferred on mankind by the mechanical engineers of this and other countries. Nothing can be more appropriate, either to the individual or to the nation, than a periodical stock-taking, as it were, of the progress which has been made at home and abroad. With this view, no doubt, Mr. Cowper pointed out from the chair in 1880 how the British had been outstripped in the manufacture of certain objects; and reminded you that, forgetful of how much had been achieved by previous exertions, England was failing in the enterprise and energy necessary to keep her in advance of all other nations in arts and manufactures. That the British people for many years occupied the distinguished position Mr. Cowper is so naturally anxious for them to retain, will not, I dare say, be denied by any of our honourable rivals in the industrial race, in which some half-dozen nations are engaged with ourselves. In such comparisons as that drawn by my predecessor we must not overlook the vast differences in the circumstances of the two periods he contrasts with each other. Industrial science, as we now understand it, dates from the commencement of the present century; in point of fact, from Watt's grand invention of the steam engine properly so called. Recent years have greatly changed the aspect of affairs both at home and abroad. Want of space and of employment have perhaps promoted emigration from our shores to a greater extent than from those of other countries; and, in consequence, the increase of population on the Continent may relatively have exceeded our own. For seventy years, with few and short exceptions, peace has been maintained in Europe; railways have brought inland provinces nearer the coast, and large Continental coalfields have been discovered and developed. With our example before them, it would, under these circumstances, have been a matter of astonishment if other nations had not followed our lead; and with populations, many of them, to say the least of it, as well educated as our own, and gifted with an intelligence certainly not inferior to that of the inhabitants of Great Britain, can it be wondered at that some of the victories in industrial supremacy should have been achieved outside the boundaries of these islands? The services, however, which our own country has rendered to every branch of industry, scientific as well as practical, have been generously acknowledged by other nations. We, on our side, can well afford to recognise and feel grateful for the numerous and important contributions to the world's advancement and happiness made by foreign enterprise, in the United States as well as in Europe. Upon more occasions than one, not only in the addresses which have been delivered by some of your past-presidents, but in the public press, the iron trade of Great Britain has been reminded of the competition offered by other nations in neutral markets, as well as in certain articles required for consumption in the United Kingdom. Intimations have also not been wanting that this was a consequence of superior skill exercised, by Germany and Belgium in particular, in arts where hitherto our own country had rendered no mean service. After what I have just said in reference to foreign competition, I am not going to permit my patriotism to submit any statement of the relative importance of what has been done here and elsewhere towards raising the manufacture of iron and steel to its present high state of excellence. This would be best ascertained by individual research, or by an appeal to those foreign competitors by whom the very existence of the British iron manufacture, according to some authorities, is threatened. A few years ago an answer to such an inquiry, so far as Germany is concerned, was given by the iron manufacturers of that country; for at that time, in consequence of evidence tendered before a Government commission, a duty was levied of 10s. per ton on pig iron and 25s. on steel rails imported into the Zollverein, to rescue the German iron trade from the absolute ruin which British importations were alleged to be sure to effect. Notwithstanding these representations, these same ironmasters, then making much of their pig iron from the same Spanish ore as that used in Great Britain, with much higher transport charges to pay, were found underselling us in considerable orders for steel rails. The supposed answer to this apparent anomaly was that, protected by the cost for carriage from this country, added to the heavy import duty, a sufficiently profitable trade could be carried on in rails for home consumption, to support a considerable loss on any foreign transaction entered into after meeting the home demand—a loss which was preferred to that accruing from a partial stoppage of their works. Since the period in question, the introduction of the basic process has materially improved the relative position of the German steel rail makers. Pig iron suitable for the acid process, as it is now termed, cost in Westphalia about 30s. per ton more than the phosphoric metal obtained from the Liassic ironstone now so largely worked in Germany and in France. In Great Britain, the difference between the two kinds of iron was only about one-third of this amount. If, for the purpose of illustration, we assume 10s. to be the additional cost of conversion entailed by the basic process, a Middlesbrough steel rail manufacturer is left pretty much in the same position as he occupied under the acid system, while his German competitor has gained an advantage of about 20s. per ton by the change. Omitting the actual cost of working the minerals, as this may be greatly affected by the nature of the veins or beds in which they occur, there are two circumstances which operate, generally speaking, in favour of the foreign manufacturer, viz., the price of labour, and the dues paid to the owner of the soil for permission to work coal, ore, and limestone. With regard to the last-named item, the lowest amount chargeable as royalty against a ton of steel rails in Great Britain may be taken at 5s., whereas in Germany and France it is under 1s., and in Belgium it varies from 1s. 6d. to 6s. On the other hand, the cost of conveying the raw materials to the point where they are manufactured is, generally speaking, less heavy in Great Britain than it is in any of the three continental countries referred to. With the cost of labour and of royalty dues operating adversely to the manufacturer in our own country, and the cost of carriage on the minerals in his favour, the balance of the advantages is such that in many smelting works in Germany, France, and Luxemburg, a ton of pig iron, fit for making malleable iron or steel rails by the basic process, can be made somewhat cheaper, certainly quite as cheaply, as a similar quality of iron can be produced at Middlesbrough. The point at which we have now arrived in considering the question before us, is whether there is any difference of skill evinced in dealing with the minerals in the blast furnace, and in converting the pig iron thus obtained into rails or other objects, in which the continental manufacturers are competing with us, not only in neutral markets, but in certain articles of rolled steel and iron for consumption on British soil. Superiority of skill in the manufacture of iron means less waste of metal, a smaller consumption of fuel, and arrangements of such a character that the same amount of work is done with a lesser expenditure of labour. Measured by these standards, which are easily ascertained, I have arrived at the conclusion, after several years of careful examination in almost every country where iron is made, that if the manufacturers of this kingdom are not in advance of their foreign competitors, most assuredly they are not behind them. There is a fourth and not an unimportant question, viz., quality of the product. This, as all iron manufacturers well know, is dependent partly on the quality of the raw materials employed, and partly on the amount of labour usefully expended on their manufacture. To this inquiry my answer, *cæteris paribus*, would be in the precise terms given in the previous paragraph. Give a workman, be he English, Belgian, French, or German, pig iron and coal of the same description, and give all equally good machinery for dealing with the materials; ask then the consumer to pay for the manufactured article a price corresponding with the pains taken in producing it; and I believe that he will receive for his money the object he requires of equal quality, in whichever of the four countries it may have been made. I have spoken of the expenditure of labour in the sense of its amount; let us consider it shortly in the sense of its price. This term, of course, is by no means confined to the daily earnings of the individual. Were British miners and ironworkers to be measured by this standard, British iron would speedily be superseded by that of foreign manufacture; because in many departments the workmen with us are paid 20 to 40 per cent. higher wages than are given on the Continent of Europe. Dearer labour has, no doubt, led to the adoption of means for its economy in our own country; but it is, I believe, universally admitted abroad, that our more highly paid, and therefore better fed men, are capable of performing, and actually do perform, more work than is done by the workmen of almost any other nation. This, as regards ironworks, is certainly my own opinion, founded on the number of men required for the same amount of duty in each case. Notwithstanding this greater efficiency of our own labouring population, the wages they are paid exceed the comparative amount of work performed to such an extent, that in many instances its average cost cannot be taken at less than 25 per cent. higher than with continental nations. It would not be an easy matter to speak precisely with regard to the average intrinsic value of mining labour. It affects the cost of pig iron, owing to the great variety of the conditions under which it is applied to seams and veins essentially different in their nature. Suffice it to say, that there are certain of the best situated places in which, according to my calculations, pig iron, fit for forge purposes or for the basic process of making steel, can be made something like 2 or 3 per cent. cheaper than the same iron in the Middlesbrough district. Such a difference would, of course, be insufficient to cover transport from inland works abroad to sea-going vessels, and freight to this country. We may therefore safely assume that no nation can enter into competition with the Middlesbrough furnaces so far as our own domestic consumption is concerned. The same observation is applicable to steel rails of any ordinary sections, when sold, as they have been of late, at £4 12s. 6d. or £4 15s. per ton. When, however, we have to deal with tram rails, or iron and steel in any form worth £8 or more per ton, the extra cost being largely made up of labour, the Continental advantage of 25 per cent. begins to tell heavily against our own manufacturers. This view is being daily confirmed by actual experience; for steel tram-rails, iron girders, together with spring steel, and axles, and tires also of steel, are being imported by some of our large railway companies and house builders. The change of circumstances in connection with the basic process above referred to will also, I think, enable the German manufacturer, even in rails of ordinary sections, to compete with us on something like equal terms in markets to which the cost of sea freight is the same from both countries. In the North of England we hear of what are now generally known under the name of labour difficulties, more in connection with iron shipbuilding than in almost any other branch of manufactures. In the year 1880 I received from two large establishments a statement of the average earnings for that year. The chief men worked 313 days, during which they were paid rates varying from 8s. 9d. to 12s. 10½d. per day. So far as the information I have been able to collect enables me to form an opinion, the workmen in the English shipyards, all told, receive about double the wages paid abroad; but it would appear that for this extra pay they perform, as has been mentioned in connection with the men in the ironworks, more duty. As with the ironworkers, the extra work, however, is considerably less than the equivalent of the extra pay, according to foreign rates of wages. Favoured by the differences in the price of labour, there has been recently established in Norway a shipbuilding yard, where vessels, as well as the steam engines they require, are constructed out of iron supplied from the north-eastern ports of England. The establishment in question, begun only a year or two ago, now employs 800 hands. Mr. Raylton Dixon, whose practical knowledge of the trade is so well known, informs me that the actual cost of labour for a given amount of work in the locality in question is 25 per cent. less than he pays at Middlesbrough. This, after paying 10s. per ton freight on the plates from England to Norway, enables the Norwegian builder to construct the hull of the vessel for 15s. per ton of iron employed less than is paid in England—an amount equal on a ship of 1500 tons loading capacity to £525. It is self-evident that, if such a margin as that just named has to continue, we must prepare ourselves for seeing a great increase in the number of vessels built by means of foreign labour, even if they are afterwards navigated under the British flag. It is moreover not improbable that the plates used in their construction may be brought from German or Belgian ironworks; and this is inferred from the same reason which enables the ironmasters of these two countries to furnish our engineers and architects with railway material and iron girders, viz., cheaper labour. From various sources I have computed that the skilled workmen engaged in the manufacture of ship-plates in England earn, on an average, between three and four times as much as the same class of men do in Germany. According to the last return in my possession, the daily wages in a large plate mill in the county of Durham were as follows:—Head shinglers, 22s. 9d.; puddle rollers, 15s. 1d.; plate mill furnacemen, 16s. 1d.; head plate rollers, 41s. 1d.; head shearmen, 34s. 9d. Notwithstanding these high rates, it is a remarkable fact that at the present moment, owing to the large production, the wages per ton in the finishing mill alone are not higher in the English than in the German work with which it is compared. As soon, however, as the foreign houses commence to roll plates on the large scale which obtains in this country, there will be a considerable reduction in the cost of production with the former. It may therefore come to pass that the Norwegian shipbuilding may go on increasing, but that the consumption of English iron in connection therewith may proceed in an opposite direction. The coalowners and ironmasters of the North of England have agreed with their workmen on a scale of wages regulated by the ascertained selling price of their produce. This of itself cannot be accepted as a proof of the soundness of the plan itself. It is difficult to see how it could be otherwise. A sliding scale has for many years past been more or less in force in the northern counties, as well as elsewhere, because, when trade was active and prices high, labour was in demand, and it, like any other commodity, rose in price. Instead of the purchaser and seller of this commodity having to meet and make a fresh bargain at every fluctuation in price—which entailed delay and frequently interruption to work, under the form of strikes, not confined to this country—a self-adjusting scale has been adopted. Speaking from some lengthened experience with the system, it appears to me, and, I think, to many of my colleagues in these two industries, that its introduction has been satisfactory to both sides. It may and will happen that differences of opinion arise between the two parties on the nature of the scale to be adopted; but these differences are more likely to be reconciled when discussed from time to time with forbearance and good temper by those concerned, probably chosen for their presumed fitness for the office. It is, however, of the utmost importance that the whole industrial community should be able thoroughly to appreciate the circumstances by which they are surrounded. The employer is speedily warned of his position; for if he falls behind in the matters of price or of quality, his goods remain unsold if too dear, or if inferior in quality they decline in value; but this does not apply equally to the workman. In the markets of the world the capitalist has to meet competition from whatever quarter it may proceed; and legislation, introduced forty years ago, and in the introduction of which the employers of this country took a conspicuous part, opened the markets at their own doors to the manufacturers of every nation. This same legislation, however, let in cheap food, and has so equalised the price of all the necessaries of life, that the British workman is able to live as cheaply, and to hold his own against all comers in economy of production, as he hitherto has done in the quality of the product of his hands.

As showing the extent of the ground covered by the work of the mechanical engineer, Mr. Bell made a computation, from which it appears "that there is consumed for mechanical purposes, or for industries which are wholly dependent on machinery, about 63 per cent. of all the coal raised in Great Britain."

Mr. Bell's address was listened to with great attention, and his remarks on foreign iron manufactures and on the labour question were very favourably received.

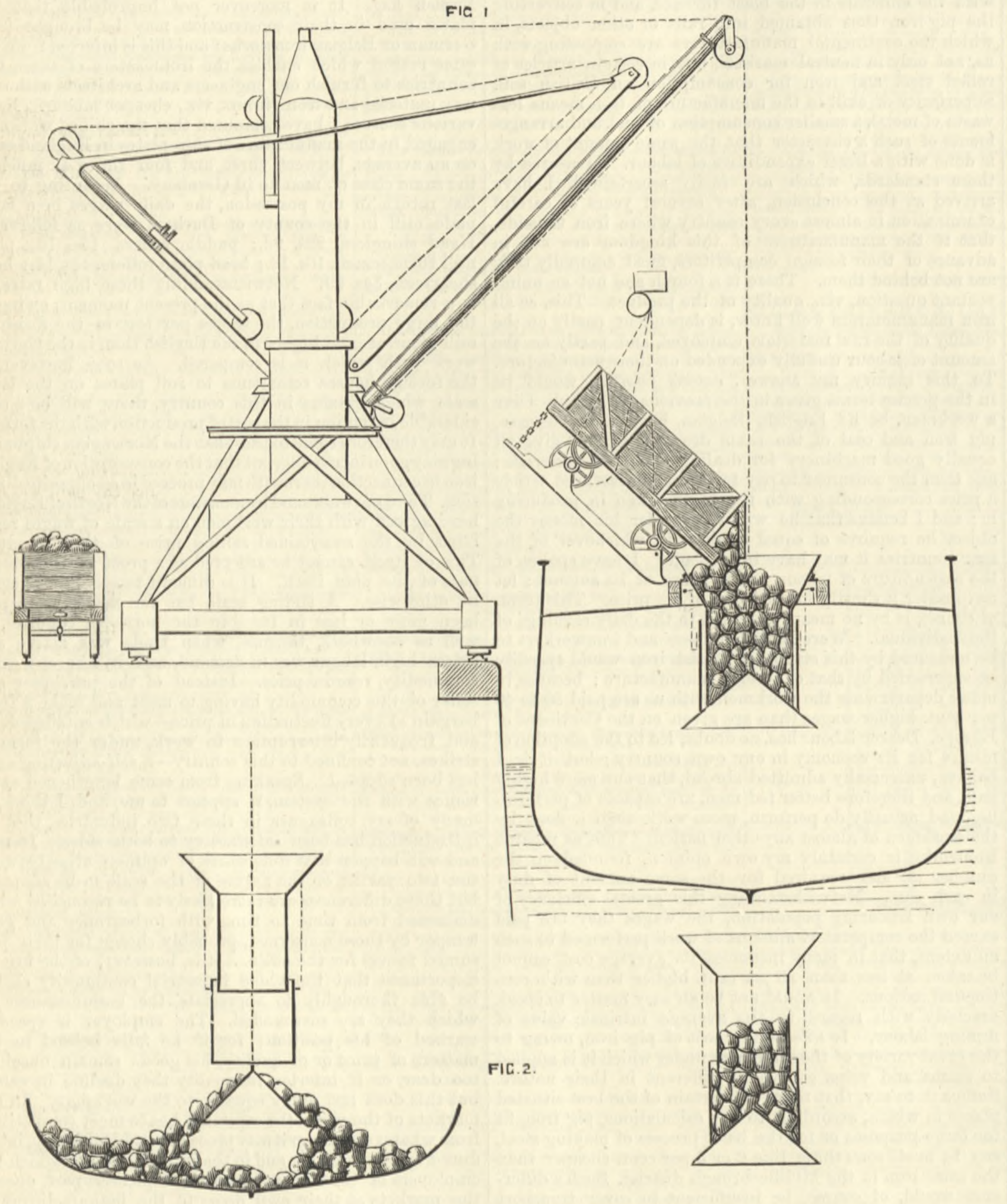
Mr. Robert Bird, the Mayor of Cardiff, proposed a vote of thanks to Mr. Bell in well-chosen words, and this was seconded by Mr. Head and Mr. Carbutt, both of whom spoke of him with very eulogistic, though well-deserved, praise, which, perhaps, may make Mr. Bell reconsider his expressions as to his fitness for the position of president of a mechanical engineering society. Mr. Bell's intentions as to the position may not be known, but when leading members of the society so strongly express the belief that the honour recently conferred upon the past president is well deserved by him, he may be tempted to think of the future only of the society.

Mr. Bell, in reply, said his remarks on the labour question were specially addressed to workmen and artisans.

A paper by Mr. John McConnochie was then read,

On the Recent Extensions of Dock Accommodation and Coal Shipping Machinery, Bute Docks, Cardiff.

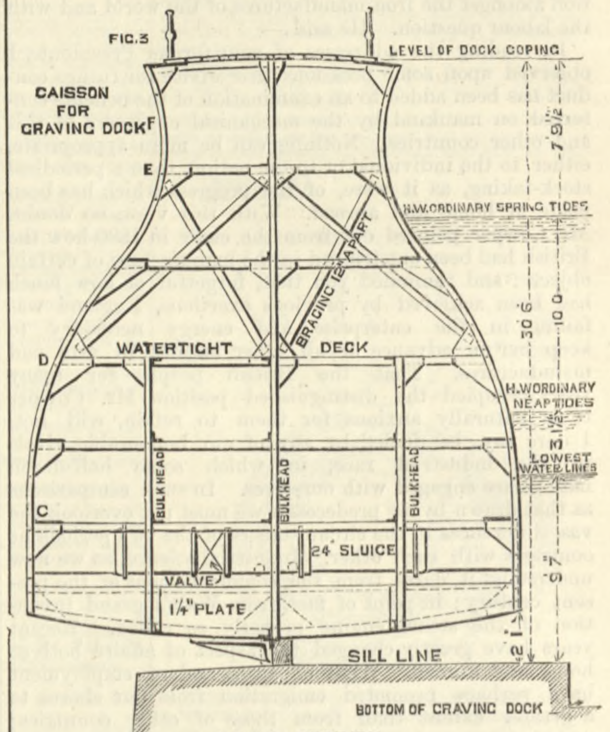
Roath Dock.—In 1882 an Act was obtained for the new Roath Dock, now in course of construction, which is to be entered from the Roath Basin through a lock 600ft. long by 80ft. wide, with three pairs of wrought iron gates, similar to the gates in the sea lock of the Roath Basin. The gates are being constructed by Sir Wm. G. Armstrong, Mitchell, and Co. The dock is to be 2400ft. long by 600ft. wide, having an area of 37 acres. The depth from coping to sill is 43ft. 6in., and the bottom of the dock is 3ft. below the sill level. The depth of water on the sill at high water is 35ft. 8in. at ordinary spring tides, and 10ft. less at ordinary neap tides. The construction of this dock was formally inaugurated by the Marquess of Bute on the 30th January, 1882, and the work is to be completed in October, 1885, the contractors being Messrs. Nelson and Co., of Carlisle. It is intended to devote the whole of the north side and east end of the dock to the shipment of coal, and the south side to the import and export trade of timber, iron, iron ore, and general merchandise. On the north side will be erected appliances of the most approved kind for the shipment of coal.



NEW MOVABLE CRANE, CARDIFF DOCKS.

Coal-shipping machinery.—The first hydraulic machines at Cardiff for tipping coal direct from trucks into the vessels were four put up for the Great Western Railway as far back as 1857 by Sir William G. Armstrong and Co. They were fixed hoists, differing but little from those now in use, except that in two of them the lift was only 15ft. and in the other two 22ft. The increasing size of vessels has necessitated a corresponding increase in the height of lift of the coal hoists; and the last two hoists erected at Cardiff in 1880 have a range of 27ft. These, curiously enough, were for the Great Western Railway, to replace the two with 15ft. lift erected in 1857, which were found to have too short a lift. They are on the east side of the Bute East Dock. Since 1874 the additional machinery for shipping coal is as follows:—(*a*) One hydraulic tip has been erected on the west side of the East Dock by Messrs. Brown Brothers and Co., of Edinburgh. (*b*) Tips Nos. 1 and 3 on the west side of the East Dock have been converted from balance to hydraulic tips, the machinery being supplied by Messrs. Parfitt and Jenkins, of Cardiff, and erected by the workmen of the Bute Trustees. (*c*) Two hydraulic tips have been erected on the east bank of the river Taff, which are connected with the Great Western Railway by a branch from the main line near Cardiff Station. (*d*) One movable hydraulic crane, capable of lifting 25 tons, has been erected on the east side of the Roath Basin, between Nos. 1 and 2 tips.

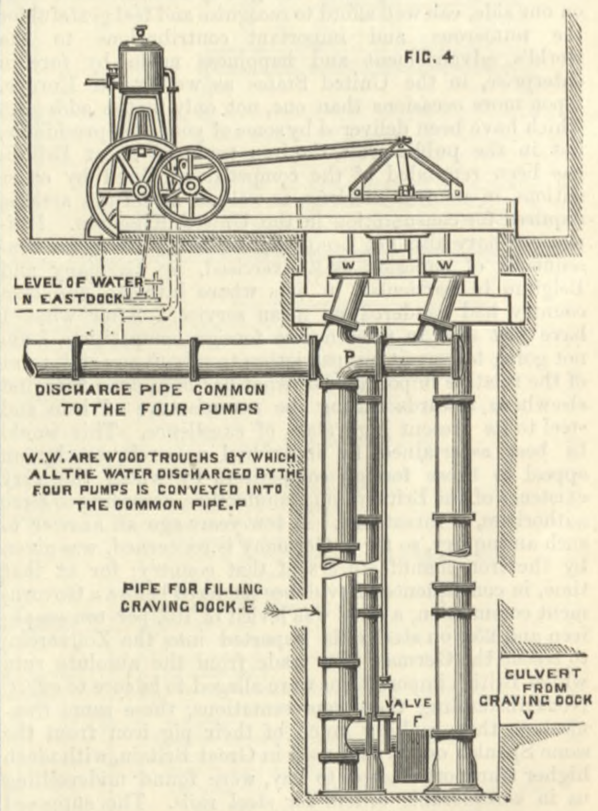
Movable hydraulic crane.—The employment of steamers instead of sailing vessels for carrying coal necessitates a much quicker despatch; and the increasing length and number of hatchways in the steamers has for some time made it most desirable to be able to load into two hatchways at least at the same time. With fixed machines this has been found impossible, except in rare cases, because the positions of the hatchways vary so much. It therefore became a question as to the possibility of using movable machines, and it was with a view of practically trying this that the movable crane tip at the Roath Basin has been put up. Fixed cranes have, of course, been in use for some years at other ports for shipping coal direct from the truck; but it has hitherto not been practicable to make such cranes movable, owing to the cradle or platform on which the truck is lifted requiring a pit or gap in the line of rails for its reception. This special seating for the cradle rendered it necessary that the crane should always pick up and deposit the wagons at one point. It is obvious that these arbitrary fixed points of picking up and depositing the wagons on the lines are not applicable to movable tips, inasmuch as it is absolutely necessary that the lines of rails should be parallel with the quay, and be continuous without break or gap, so as to be common to the tip in any position in which it may be placed along the dock wall. This problem has been solved in a very ingenious and efficient manner by Mr. Westmacott's coaling cradle, which must be looked upon as the key to the successful application of movable coal-shipping appliances. It may be described as a light platform suspended by chains, which takes its seat on an ordinary line of rails in any position. It is suspended on what may be called an anti-friction swivel, which enables a man to turn the cradle with a loaded wagon on it, thereby dispensing with turntables. There are no tipping chains to hook on and off every time a wagon is shipped, as is the case with coaling cradles of the usual construction; the tipping chains in this case pass through the centre of the swivel attachment, and are permanently connected with the cradle. The crane itself, as shown in Figs. 1 and 2, consists of a nearly square wrought iron pedestal or base, tapering upwards, which is carried on four wheels, one near each corner, running on rails of 24ft. gauge laid parallel to the quay wall. These wheels, however, are used only for travelling on; the whole of the weight when working is taken by four hydraulic jacks, one at each corner, which effectually prevent any movement of the crane. Rising out of the top of the pedestal, and revolving in bearings at the top and bottom of it, is the pillar, consisting of two flat plate-girders, between which is placed the hydraulic cylinder for lifting. The chain from this cylinder passes over the jib head, and both ends are attached to the cradle. The jib is attached at the lower end to the front of the pillar, just above the pedestal; and at the outer end by stays to the top of the pillar. At the back of the pillar is fixed a second hydraulic cylinder, which effects the tipping of the wagon by making a bight in the tipping chain that passes over the jib head to the cradle. The tipping chain is always kept taut by a third hydraulic cylinder placed on an inclined frame which is fixed to the pillar at the back in the same way as the jib is in front. Thus the tipping cylinder proper needs to have a short range only. The inclined cylinder and its frame act as a counterweight for balancing in some measure the load hanging from the jib head. The turning of the pillar and jib is effected by a pair of hydraulic cylinders, one on each



CROSS SECTION

CAISSON, BUTE DOCKS.

side of the pillar, fixed to the base of the pedestal, which itself remains stationary. The chain from these cylinders passes round a drum at the foot of the pillar. All the motions are controlled with the greatest ease by one man in a valve house on the side of the pedestal. There are two of these houses on opposite sides of the machine, so that he can use whichever is most convenient for enabling him to see into the vessel. The pressure water is conveyed to the crane by movable and jointed pipes, which can be attached to hydrants placed at convenient distances on the hydraulic mains along the quay wall. There is an auxiliary or anti-breakage crane on the side next the dock, the foot of the jib being carried from the pedestal, and the top by



PUMPING MACHINERY, BUTE DOCKS.

means of a chain from the top of the pillar, the invention of Mr. Chas. Hunter, engineer to the Bute Trustees. By an arrangement of a hopper resting on the deck, with telescopic throat, which is closed by a conical bottom or valve held up by the auxiliary crane, the first few wagonfuls of coal can be lowered quietly to the bottom of the hold, and a conical heap formed for the following coal to fall on, as is done at the hoists, so as to lessen the breakage of coal. When the anti-breakage crane is not in use it can be swung to one side, clear out of the way. It is found in actual work that a wagon can be shipped in from two and a-half to three minutes. The crane was designed and constructed by Sir Wm. G. Armstrong, Mitchell, and Co., and is similar to their well known and largely adopted movable hydraulic cranes for cargo and ballast work. These cranes were first introduced at the suggestion of the writer about fourteen years ago at the Atlantic

Wharf of the Bute East Dock, to supersede fixed cranes. The introduction of the movable crane resulted in such an increased amount of work and despatch to steamers that all the dock companies very soon recognised the importance of adopting cranes of this type. At the Royal Albert Dock, London, there are about ninety of these cranes. The number of tips for shipping coal at the Bute Docks is now as follows:—Thirteen balance tips at the West Dock; twelve balance tips at the East Dock; eight hydraulic tips at the East Dock and entrance basin, shown at H H; one hydraulic tip in the entrance channel for loading in the tideway; eight hydraulic tips at the Roath Basin; forty-two total number of tips. One movable hydraulic crane capable of lifting twenty-five tons. Each tip is capable of shipping 1000 tons of coal per working day; the total shipping capacity of the Bute Docks is therefore equal to nearly 12,000,000 tons of coal per annum. In some instances as much as 200 tons of coal have been shipped per hour at the hydraulic tips; and it is now not uncommon for a steam collier of 2000 tons burthen to enter the basin at high water of one day, discharge her ballast, receive her outward cargo, and leave at high water the following day, the entire operation having occupied less than twenty-four hours. The principal portion of the trade carried on in the Bute Docks is the export of coal and iron, which amounted to 2,750,000 tons in the year 1873, and to 6,916,000 tons in 1883. The import trade of iron ore, timber, and general merchandise, amounted to 630,000 tons in 1873, and in 1883 to 1,299,000 tons.

Railways.—The mineral traffic of the West Dock is supplied exclusively by the Taff Vale Railway from Merthyr, Dowlais, and the Aberdare and Rhondda Valleys. The traffic to the East Dock is supplied jointly by the Taff Vale, the Rhymney, and the Great Western Railways, the last of which is the means of communication with the great coalfield now being opened in the centre of Glamorganshire in the Ogmore distinct. The London and North-Western and Midland Railways have also access to the docks by their connection with the above railways. A general plan of these several railways communicating with the port is shown in the map contained in the detailed programme.

Sidings.—A very large extent of siding accommodation is required for working the coal-shipping trade; for, owing to the fluctuations of the trade, loaded wagons have to be stored in the sidings at times when the supply exceeds the demand. The extent of main lines and sidings provided and maintained by the Bute Trustees in connection with the docks amounts to 70 miles in length, namely, 25 miles of main line and 45 miles of sidings, the whole of which is fully occupied. In addition to this the Taff Vale Railway has constructed a large system of sidings 7 miles in length, above Crockherbtown Junction.

Graving docks.—The provisions for the examination and repair of vessels entering the port consist of eight graving docks.

(1) *Public graving dock.*—The commercial graving dock, constructed by the Bute Trustees, is available for use by the public on payment of dockage rates as at Liverpool. This graving dock is 600ft. long, 78ft. wide at the bottom, with an entrance 60ft. wide from the Roath Basin, the depth of water on the sill at high water of ordinary spring tides being 23ft. 9in. The bottom of the graving dock is 2ft. 6in. below the sill, and is laid with a line of cast iron blocks 4ft. apart throughout its entire length, the upper edge of these blocks being on the level of the sill. Access to the dock is gained by steps, in which also are slides for passing down materials required for the repair of vessels.

Caisson.—The entrance is fitted with a wrought iron boat-shaped caisson. It is 60ft. long, 26ft. in greatest width and 13ft. in least width at the centre, and 30ft. 6in. in depth, and is constructed of angle-iron frames, columns, and beams, and skin plates, with oak stems and keel, and fir deck-planking. It is divided by a water-tight deck and by bulkheads into sixteen compartments, communicating with one another by means of small slide valves, for water-ballast arrangements. To give the necessary displacement for any required flotation level, the water ballast is admitted to the four central compartments —from which it flows to the others—by two 9in. cast iron inlet pipes, or is discharged through the outlet pipe, each of which is fitted with a brass-faced valve worked from the deck. A small steam pump is fixed on the water-tight deck for the purpose of discharging the water ballast, in case of the depth of water on the sill being reduced whilst the caisson is afloat. The 24in. cast iron sluice pipes, fitted with valves worked from the deck, are fixed in the caisson for filling the graving dock. In addition to the water ballast, there are about 120 tons of iron ballast in the caisson, which, with the weight of the caisson itself, including the cast iron pipes, pump, &c., amounting to 152 tons, is equal to the displacement at the lowest water level at which it requires to be floated. The details of this caisson required careful consideration to provide by water ballast for a variation of 13ft. between the high water of high spring tides and the high water of low neap tides; and the author is indebted to the valuable assistance of Sir Edward J. Reed, K.C.B., M.P., in the arrangement of these details.

Pumps.—The pumping machinery for discharging the water from the graving dock consists of two centrifugal pumps, each working in a separate circular well, and driven by a high-pressure horizontal engine, and four lift pumps, all fixed in one square well, and driven by a direct-acting condensing engine. The water from the graving dock flows through a culvert into the square well, whence it passes by separate culverts into the circular wells, and there is also a culvert fitted with a sluice between the two circular wells. The water from the whole of the pumps flows through the culverts to the tank or well under the boiler-house floor, from which it is conveyed by a 5ft. culvert to the East Dock. When the pumps are started, the sluice between the two circular wells is closed, and each pump acts independently until the water level in the graving dock is so reduced that the lift of the pumps is equal to about 15ft.; the sluice is then opened, and the water discharged by the lower pump passes into the other well, below the level of the higher pump. When this takes place, the self-acting flap closes, and prevents the return of this water to the dock. The water discharged by the lower pump is thus passed through both pumps, and they divide the lift between them.

Lift pumps.—The lift pumps are each 29½in. diameter, and 48in. length of stroke. Their general speed is about fourteen strokes per minute, at which rate each pump discharges about 250 cubic feet, equal to 1000 cubic feet discharged per minute by the four pumps together. The engine which works the lift pumps works also two force pumps auxiliary to the force pumps for the service of the hydraulic machinery. Steam for these engines is supplied by three high-pressure boilers, working at 70 lb. to 75 lb. pressure; and by one low-pressure boiler, working at 10 lb. to 20 lb. pressure. A pipe with a valve in the square well in which the lift pumps are fixed is for the purpose of filling the graving dock from the East Dock when desired. The whole of the pumping machinery has been supplied by Messrs. R. Moreland and Son, of London. (2) The second graving dock is at the head of the Bute West Dock, constructed by Messrs. Charles Hill and Sons; it is 230ft. long, with an entrance 40ft. wide, and 12½ft. depth of water over the sill. Vessels can here be docked at all times, irrespective of tides. (3) and (4) Two graving docks have also been constructed by Hill's Dry Dock and Engineering Company at the north-west side of the Bute East Dock. One is 408ft. in length, with an entrance of 48ft. in width, and 18½ft. depth of water over the sill. The other is 400ft. in length, with an entrance of 40ft. in width, and 18½ft. depth of water over the sill. Vessels can be docked in both docks at all times, irrespective of tides. The docks are pumped out by a pair of centrifugal pumps, with suction and delivery pipes of 18in. bore and revolving disc of 4ft. diameter, made by Messrs. W. H. Allen and Co., of Lambeth. Each pump is intended to discharge 6000 gallons of water per minute; the two together have discharged on trial 18,000 gallons per minute, emptying the dock then in two hours. Each is driven by its own engine, having inverted cylinders of 15in. diameter and 12in. stroke, and working at an average speed of 180 revolutions per minute, with 60 lb. steam cut-off at three-eighths of the stroke. Either engine can work either pump, and can pump out either of the docks. The pumps have to discharge the water from the dry docks into the basin, the maximum height of lift being 22ft. They are charged by means of a steam ejector, which exhausts the pipes and pumps in about one minute, thereby dispensing with a foot valve; a self-acting flap valve on the delivery side is alone required. (5) One graving dock, with an entrance from the basin of Bute East Dock at one end, and another entrance from Bute West Dock at the other end, has been constructed by the Cardiff Junction Dry Dock and Engineering Company. It is 420ft. in length between the caissons, and 77ft. in width at top of coping, with 18ft. depth of water on the blocks; the entrances are 50ft. in width, and the depth of water over the sill 20ft. Vessels can be docked at all times, irrespective of tides; and this dock is available in case of need as an additional entrance to the West Dock through the East Basin. The water is let into the dock from both ends, through two sluices in each caisson; and the dock can be filled by these sluices in thirty minutes.

Caissons.—The caissons are fitted in grooves formed in the masonry, and are lowered and held down in their places by water-ballast run in through inlet-valves; the sinking occupies three minutes. For the purpose of raising the caisson, which has to lift about 5ft. in order to clear the sloping side-grooves, the water is pumped out by two pulsometers, which are fitted inside the caisson and are supplied with steam from the main boilers, the steam pipes being connected by flexible hose; the time occupied in lifting is six minutes.

Centrifugal pumps.—The whole of the water from the graving dock is pumped up to a level not less than 1ft. above the dock coping, and is returned to the Bute Docks. The pumping machinery was designed and constructed by Messrs. Parfitt and Jenkins, of Cardiff. There is one pump-well only, constructed of stone, and 9ft. diameter. In this well is fitted a vertical shaft, on which are two centrifugal pumps, each precisely the same in design and dimensions. The bottom one is fixed 2ft. below the dock bottom, and the upper one 14ft. above, leaving about 14ft. head on the top pump, when working. The pumps make 210 revolutions per minute, and are driven by a pair of horizontal compound condensing engines, geared to the pumps by mortice bevel-wheels. The engine cylinders are 22in. and 40in. diameter with 30in. stroke, making 70 revolutions per minute, or one-third the speed of the pumps; pressure of steam from 65 lb. to 70 lb. per square inch.

Bucket pumps.—Besides the main centrifugal pumps there are a pair of drain pumps, used for pumping out any leakage from the caissons into the dock. They are a pair of ordinary bucket pumps, 19in. diameter and 4ft. stroke, worked direct by a high-pressure beam engine having a 16in. cylinder, and the pump rods are hung off the extended ends of the beam. This engine makes about sixteen revolutions per minute, and when pumping out the dock works in conjunction with the main centrifugal pumps. The engines are supplied with steam by two boilers of the marine type, having brick flues at the back, instead of the ordinary combustion chambers. The boilers are 10ft. 3in. diameter and 11ft. 3in. long. The dock when full contains about 16,000 tons of water, and the time occupied in pumping it dry is 2¼ hours. When docking an ordinary sized steamer the time usually occupied is about two hours. (6 and 7) Two docks, each entered from the west side of the entrance channel to the Bute Docks, belong to the Mount-stuart Shipbuilding, Graving Docks, and Engineering Company. One dock is 324ft. in length, with an entrance of 45ft. in width, and depth of high-water over sill 19ft. 9in. at ordinary spring tides and 10ft. less at ordinary neap tides. The other dock is 420ft. in length, with an entrance of 52ft. in width; depth of high-water over sill 26ft. at ordinary spring tides and 10ft. less at ordinary neap tides. (8) A graving dock, with an entrance from the Roath Basin, is now being constructed by the Bute Shipbuilding, Engineering, and Dry Dock Company. It is 600ft. long, 87ft. wide at top, and 28½ft. deep, with an entrance 55ft. in width; depth of high-water over sill 25ft. at ordinary spring tides, and 10ft. less at ordinary neap tides. Most vessels can enter or leave at any time, as the ordinary working level of the Roath Basin gives about 18ft. of water over the sill. Provision has been made for dividing the dock into two by a caisson, which can be placed in any one of three recesses, either at the middle of the length or at 50ft. on either side of the middle; the inner division can be used for a vessel requiring to stay a longer time in dock, and the outer for vessels staying a shorter time. The dock may be filled either direct from the tide-way or from the Roath Basin. It will be emptied by two centrifugal pumps of 4ft. diameter, on vertical shafts, each in a separate well. Two horizontal non-condensing engines are provided, one for each pump, the cylinders being 16in. diameter, with 3ft. stroke, to work with 80 lb. steam. A small separate pump with engine is also provided for getting rid of any leakage water without running the large pumps. These pumps are designed to empty the dock in about four hours, the quantity of water to be discharged being about 929,000 cubic feet.

Gridiron.—On the east side of the entrance channel to the Bute Docks a gridiron has been constructed by the Bute Trustees, of which the length is 350ft. and the width 36ft.; the depth of water at high water is 23ft. at ordinary spring tides and 13ft. at ordinary neap tides.

A very short discussion took place on this paper.

Mr. Benjamin Walker remarked that the portable cranes referred to had enormously increased the facility with which coal could be loaded into ships. His firm had, he said, eighty-four of these cranes on order, fifty-six all alike, and for the Tilbury Docks. He thought the arrangement described for the prevention of the breaking of the coal, the chief part of the invention as described by Mr. McConnochie. This was the invention of Mr. Chas. Hunter, engineer to the Bute Trustees. He mentioned that the travelling crane was due to suggestions by Mr. McConnochie. He was of opinion that much yet remained to be done with respect to coal loading. This we may parenthetically remark was the opinion expressed by several members when they afterwards saw the cumbrous machinery used for raising trucks of coal to a height for unloading their coal into ships in the dock. It was thought quite clear that if the cost of the plant and of the wear and tear of cranes, to say nothing of the heavy wear on the coal wagons, were capitalised, the loading would be seen to cost more than by hand, and hence the gain was in time only. Mr. J. Tomlinson referred to the enormous strides made by Cardiff during the past twelve years, in which a growth of from 7 to 12 million tons of coal exported had been achieved.

Following this paper was one by Mr. C. Henry Riches on the new locomotive running shed on the Taff Vale Railway, Cardiff. This paper requires engravings for its illustration, which we have not yet been able to prepare, and must therefore postpone. The discussion on Mr. Riches' paper chiefly turned on the relative value or usefulness of turntables and traversers in running and repairing shops. The argument against the traverser was that if it broke down it would lock all the engines in the shed, while the breakdown of a turntable would only lock up as many engines as were on the line it controlled, it being assumed that there would be a number of turntables. The discussion was, however, only useful as showing that either turntable or traverser could be chosen with equally good reasons, according to the circumstances involved. Mr. Tomlinson said he had in forty years' experience only had one engine in a turntable pit. He also remarked that as the Taff Vale Railway Company only paid 16 per cent. dividend, Mr. Riches had probably been unable to persuade his directors to expend the money necessary to build him separate repairing and running sheds, and so he had got both by extending the one.

The next paper read was by Mr. E. P. Rathbone

On the Francke "Tina" or Vat Process for the Amalgamation of Silver Ores.

The process consists simply in the separation of the ore by hand at the mines into different qualities, by women and boys with small hammers, the process being that known as "cobbing" in Cornwall. The object of this separation is twofold: firstly, to separate the rich parts from the poor as they come together in the same lump of ore, otherwise rich pieces might go undetected; and secondly, to reduce the whole body of ore coming from the mine to such convenient size as permits of its being fed directly into the stamps battery. The reason for this separation not being effected by those mechanical appliances so common in most ore-dressing establishments, such as stone breakers or crushing rolls, is simply because the ores are so rich in silver, and frequently of such a brittle nature, that any undue pulverisation would certainly result in a great loss of silver, as a large amount would be carried away in the form of fine dust. So much attention is indeed required in this department, that it is found requisite to institute strict superintendence in the sorting of cobbing sheds, in order to prevent as far as practicable any improper diminution of the ores. According to the above method, the ores coming from the mine are classified into the four following divisions:—(1) Very rich ore, averaging about 6 per cent. of silver, or containing, say, 2000 ounces of silver to the ton (of 2000 lb). (2) Rich ore, averaging about 1 per cent. of silver, or, say, from 300 to 400 ounces of silver to the ton. (3) Ordinary ore, averaging about ½ per cent. of silver, or, say, from 150 to 200 ounces of silver to the ton. (4) Gangue or waste rock, thrown on the dump heaps. The first of these qualities—the very rich ore—is so valuable as to render advantageous its direct export in the raw state to the coast for shipment to Europe. The cost of fuel in Bolivia forms so considerable a charge in smelting operations that the cost of freight to Europe on very rich silver ores works out at a relatively insignificant figure when compared with the cost of smelting operations in that country. This rich ore is consequently selected very carefully and packed up in tough raw hide bags, so as to make small compact parcels some 18in. to 2ft. long and 8in. to 12in. thick, each containing about 1 cwt. Two of such bags form a mule load, slung across the animal's back. The second and third qualities of ore are taken direct to the smelting works; and where these are situated at some distance from the mines, as at Huanchaca and Guadalupe, the transport is effected by means of strong, but lightly built, iron carts, specially constructed to meet the heavy wear and tear consequent upon the rough mountain roads. These two classes of ores are either treated separately, or mixed together in such proportion as is found by experience to be most suitable for the smelting process. On its arrival at the reduction works the ore is taken direct to the stamp mill. At the Huanchaca works there are sixty-five heads of stamps, each head weighing about 500 lb., with five heads in each battery, and crushing about 50 cwt. per head per twenty-four hours. The ore is stamped dry, without water, requiring no coffers; this is a decided advantage as regards first cost, owing to the great weight of the coffers, from 2 to 3 tons—a very heavy item when the cost of transport from Europe at about £50 per ton is considered. As fast as the ore is stamped, it is shovelled out by hand, and thrown upon inclined sieves of forty holes per lineal inch; the stuff which will not pass through the mesh is returned to the stamps. Dry stamping may be said to be almost a necessity in dealing with these rich silver ores, as with the employment of water there is a great loss of silver, owing to the finer particles being carried away in suspension, and thus getting mixed with the slimes, from which it is exceedingly difficult to recover them, especially in those remote regions where the cost of maintaining large ore-dressing establishments is very heavy. Dry stamping, however, presents many serious drawbacks. To prevent the losses and inconveniences and injury to workmen arising from this, the writer proposed whilst at Huanchaca that a chamber should be constructed, into which all the fine dust might be exhausted or blown by a powerful fan or ventilator.

Roasting.—From the stamps the stamped ore is taken in small ore cars to the roasting furnaces, which are double-bedded in design, one hearth being built immediately above the other. At the Huanchaca mines these furnaces cost about £100 each, and are capable of roasting from 2 to 2½ tons of ore in twenty-four hours, the quantity and cost of the fuel consumed being as follows:—

	Bolivian Dollars at 3s. 1d.
Tola (a kind of shrub), 3 cwt. at 60 cents	1·80
Yareta (a resinous moss) 4 cwt. at 80 cents	3·20
Torba (turf), 10 cwt. at 40 cents	4·00
Bolivian dollars	9·00 say 28s.

One man can attend to two furnaces, and earns 3s. per shift of twelve hours. It is essential to the success of the Francke process that the ores should not be completely or "dead" roasted, inasmuch as certain salts prejudicial to the ultimate proper working of the process are liable to be formed if the roasting be too protracted. These salts are mainly due to the presence of antimony, zinc, lead, and arsenic, all of which are unfavourable to amalgamation. The ores are roasted with 8 per cent. of salt, or 400 lb. of salt for the charge of 2½ tons of ore; the salt costs 70 cents, or 2s. 2d. per 100 lb. So roasted, the ores are only partially chlorinised, and their complete chlorinisation is effected subsequently, during the process of amalgamation; the chlorides are thus formed progressively as required, and in fact it would almost appear that the success of the process virtually consists in obviating the formation of injurious salts. All the sulphide ores in Bolivia contain sufficient copper to form the quantity of cuprous chloride requisite for the first stages of roasting, in order to render the silver contained in the ore thoroughly amenable to subsequent amalgamation.

Amalgamating.—From the furnaces the roasted ore is taken in ore cars to large hoppers or bins, situated immediately behind the grinding and amalgamating vats, locally known as "tinas," into which the ore is run from the bin through a shoot fitted with a regulating slide. The tinas or amalgamating vats constitute the prominent feature of the Francke process; they are large wooden vats, from 6ft. to 10ft. diameter and 5ft. deep, capacious enough to treat about 2½ tons of ore at a time. Each vat is very strongly constructed, being bound with thick iron hoops. At the bottom it is fitted with copper plates 3in. thick, and at intervals round the sides of the vat are fixed copper plates with ribs on their inner faces, slightly inclined to the horizontal, for promoting a more thorough mixing. It is considered essential to the success of the process that the bottom plates should present a clear rubbing surface of at least 10 square feet. Within the vat, and working on the top of the copper plates, there is a heavy copper stirrer or muller caused to revolve by a vertical shaft at 45 revolutions per minute. At Huanchaca this stirrer has been made with four projecting radial arms; but at Guadalupe it is composed of one single bell-shaped piece without any arms, but with slabs like arms fixed on its underside; and this latter is claimed to be the most effective. The stirrer can be lifted or depressed in the vat at will by means of a worm and screw at the top of the driving shaft. Each vat requires from 2½ to 3-horse power, or, in other words, an expenditure of one horse-power per ton of ore treated. At the bottom of the vat and in front of it a large wooden stop-cock is fitted, through which the liquid amalgam is drawn off at the end of the process into another shallow-bottomed and smaller vat. Directly above this last vat there is a water hose, supplied with a flexible spout, through which a strong stream of water is directed upon the amalgam as is issues from the grinding vat, in order to wash off all impurities.

The following is the mode of working usually employed. The grinding vat or tina is first charged to about one-fifth of its depth with water and from 6 cwt. to 7 cwt. of common salt. The amount of salt required in the process depends naturally on the character of the ore to be treated, as ascertained by actual experiment, and averages from 150 lb. to 300 lb. per ton of ore. Into this brine a jet of steam is then directed, and the stirrer is set to work for about half an hour, until the liquid is in a thoroughly boiling condition, in which state it must be kept until the end of the process. As soon as the liquid reaches boiling point, the stamped and roasted ore is run into the vat, and at the end of another half hour about 1 cwt. of mercury is added, further quantities being added as required at different stages of the process. The stirring is kept up continuously for eight to twelve hours, according to the character and richness of the ores. At the end of this time the amalgam is run out through the stop-cock at bottom of the vat, is washed, and is put into hydraulic presses, by means of which the mercury is squeezed out, leaving behind a thick pulpy mass, composed mainly of silver, and locally termed a "piña," from its resembling in shape the cone of a pine tree. These "piñas" are then carefully weighed and put into a subliming furnace, in order to drive off the rest of the mercury, the silver being subsequently run into bars. About 4 oz. of mercury are lost for every pound of silver made. The actual quantities of mercury to be added in the grinding vat, and the times of its addition, are based entirely on practical experience of the process. With ore assaying 150 to 175 oz. of silver to the ton, 75 lb. of mercury are put in at the commencement, another 75 lb. at intervals during the middle of the process, and finally another lot of 75 lb. shortly before the termination. When treating "pacos," or earthy chlorides of silver, assaying only 20 to 30 oz. of silver to the ton, 36 lb. of mercury is added to 2½ tons of ore at three different stages of the process as just described. The *rationale* of the process therefore appears to be that the chlorinisation of the ores is only partially effected during the roasting, so as to prevent the formation of injurious salts, and is completed in the vats, in which the chloride of copper is formed progressively as required, by the gradual grinding away of the copper by friction between the bottom copper plates and the stirrer; and this chloride subsequently becoming incorporated with the boiling brine, is considered to quicken the action of the mercury upon the silver.

The subliming furnace is a plain cylindrical chamber, about 4ft. diameter inside, and 4½ft. high, lined with fire-brick, in the centre of which is fixed the upright cast iron cylinder or retort, of 1ft. diameter, closed at top and open at bottom. The furnace-top is closed by a cast iron lid, which is lifted off for charging the fuel. Round the top of the furnace is a tier of radial outlet holes for the fuel smoke to escape through, and round the bottom is a corresponding tier of inlet air holes, through which the fuel is continually rabbled with poles by hand. The fuel used is llama dung, costing 80 cents or 2s. 6d. per 250 lb.; it makes a very excellent fuel for smelting purposes, smouldering and maintaining steadily the low heat required for subliming the mercury from the amalgam. Beneath the furnace is a vault containing a wrought iron water tank, into which the open mouth of the retort projects downwards and is submerged below the water. For charging the retort, the water tank is placed on a trolley; and standing upright on a stool inside the tank is placed the pina, or conical mass of silver amalgam, which is held together by being built up on a core bar fitted with a series of horizontal discs. The trolly is then run into the vault, and the water tank containing the pina is lifted by screw jacks, so as to raise the pina into the retort, in which position the tank is then supported by a cross beam. The sublimed mercury is condensed and collected in the water; and on the completion of the process the tank is lowered, and the spongy or porous cone of silver is withdrawn from the retort. The subliming furnaces are ranged in a row, and communicate by lines of rails with the weigh-house.

The discussion upon Mr. Rathbone's paper was opened by reading a communication from Mr. Fricheville, H.M. Inspector of Metalliferous Mines, in which, amongst other things, it was suggested that by the use of copper at the bottom of the vats, and as the revolving parts, the tina might be better than the iron pan, because the copper would become amalgamated, and thus assist the process of separation, while the electric assistance, whatever that might be—and it really seemed to enter in an important manner into the process—would probably be greater with the copper than with the iron. But he said the process was but a slight modification of the Freiburg process, well known to metallurgists; and except in the points named, he did not see that there was any point of merit in what the paper described. This is probably the view that will be held by metallurgists generally.

Mr. Crampton seemed to be of opinion that the revolving and final grinding arrangement in the tina would be unnecessary if the ore were sufficiently well pulverised before putting it into the separator. In other words, much of the work in dealing with silver ores meant incomplete pulverisation. He said this work could be done with disintegrators at a very cheap rate, and the product of these machines could be well sifted by means of blast, as used for emery. He mentioned the use of Jordan's disintegrator for making coal-dust at about 1s. 6d. per ton with a blast separating arrangement, the coarse particles being returned to the disintegrator.

After these papers had been disposed of, the members lunched by the invitation of the local committee.

After lunch they visited the Bute Docks, and the new docks adjoining of about thirty-seven acres in extent, now in course of construction, and briefly described in connection with the machinery at the completed docks, by Mr. McConnochie. In the docks in course of construction, Messrs. Nelson and Co., of Carlisle and York, being the contractors, a very large quantity of modern contractors' plant and many locomotives were seen at work, and large quantities of heavy masonry walls in course of construction. It was noticed that the masonry employed a large number of men in mere surfacing, and it seems rather remarkable that simple machinery is not yet in use for this purpose.

In the evening the members dined in the Drill Hall, Cardiff, which was handsomely decorated, partly with portraits from Bute Castle, at the invitation of the Marquess of Bute.

On Wednesday morning the proceedings commenced with the reading of a paper by Mr. T. Urquhart on "The Use of Petroleum Refuse as Fuel in Locomotive Engines." In this paper he gave the results of his experience in the use of petroleum in locomotives on the Grazi and Tsaritsin Railway, South-East Russia. As bearing upon the use of this fuel in some foreign countries where it has some chance of competition with, or is much cheaper than coal, we shall give this paper and the discussion upon it in another impression. We may in the meanwhile say that the gist of the discussion showed that it is not in every country even where petroleum is cheap that it can be cheaply used in large quantities, for, though under present conditions its cost is little more than carriage, it has invariably risen very rapidly as soon as used in considerable quantity. It appears to have been considerably tried in this country, but always with the result that the price so increased that it cost very much more as fuel than coal.

This paper was followed by one on "The Causes and Remedies of Corrosion in Marine Boilers," by Mr. J. H. Hallett, to which and the discussion that followed we shall refer hereafter. The other papers on the list were postponed to another meeting, and after lunch, at the invitation of the local committee, the members visited the Great Western Colliery, the Lewis Merthyr Colliery at Hafod, the Cymmer Colliery at Porth, and the Llwynypia Colliery. After this some of them visited the Penarth Docks, and afterwards the Windsor Gardens, Penarth, by invitation of Lord Windsor. To-day—Thursday—the members visit several collieries and ironworks.

THE MIDLAND INSTITUTE OF MINING ENGINEERS.

This Institute has just held its annual dinner and meeting at Barnsley, when the following officers were appointed:—President, Mr. T. W. Jeffcock, C.E., F.G.S.; vice-presidents, Messrs. M. A. Chambers, C. E. Rhodes, and W. E. Garforth; council, Messrs. G. J. Kell, W. Hunter, A. B. Southall, J. Gerrard, J. Nevin, C. Hodgson, T. Dymond, and W. H. Chambers; secretary, Mr. Jas. Mitchell, Barnsley. The dinner was held at the King's Head Hotel, and was attended by most of the leading mining engineers of the county. Amongst those present were Mr. T. W. Jeffcock, president; Mr. T. Carrington, Kiverton Park, retiring president; Mr. T. W. Embleton, Leeds; Mr. Warrington Smythe, president of the Royal Commission on Accidents in Mines; Mr. A. Lupton, mining instructor, Yorkshire College, Leeds, &c. In responding to the toast of the "Mining Districts of the Country and the Coal Trade," Mr. M. A. Chambers—Thorncliffe Collieries—remarked that one of the most serious difficulties that had to be encountered in the daily working of mines was that of getting properly educated and intelligent men into the positions of managers and deputies and other officers about the mines. It now seemed to be thought that if boys had passed a sixth standard they were too clever to go into the pit, and they should try and get their workmen to understand that no boy was too clever and too intelligent to go into a coal mine and to qualify himself in taking part in the management of a mine. Those who had coal, he said, would, if they stuck to it and gave their managers a fair chance, find a good time before many years were passed, and find their capital was well laid out.

Mr. C. E. Rhodes (Aldwarke Main and Carr House Collieries) submitted the toast of "The Learned and Scientific Societies of this and other Countries," remarking that he believed that 80 per cent. of the accidents in mines could be prevented by ordinary care and foresight. Of the men themselves, speaking from experience, he said 90 per cent. of the accidents he had had to report in the last ten years as fatal and non-fatal accidents could have been prevented had the men carried out the rules which accompanied the Mines' Regulation Act. The great evil which managers had to contend with was the ignorance of the men. They might have rules and do their best to carry them out, but the men would use their efforts to thwart them if they could see the slightest opportunity of lessening the labour to themselves. They were indebted to the learned societies for bringing prominently before managers and the men the tremendous responsibility they incurred if they tampered with and ignored the precautions entered into by those above them.

In reply to the toast, Mr. Warrington Smythe, president of the Royal Commission on Accidents in Mines, who was well received, said he recognised the great good done by mining and other societies of the kingdom, and must recognise his duty to the Royal Society, which held its head highest amongst the societies of the world. It was in connection with that Society that he had had the honour to sit on the Royal Commission on Accidents in Mines. When he reflected on the admirable and philosophic method in which their discussions were carried on by the instrumentality in great part of such men as Sir Frederick Abel, Professor Clifton, of Oxford, and Professor Tyndall, they would appreciate the fact that nothing would be done, said, or written by the Commission without the greatest consideration and labour. In Professors Abel and Clifton he was allied to two of the hardest working men of the country, to men whose knowledge of physics was so great that he felt sure no mistakes would be made, and possibly some little insight would be obtained into matters that had remained more or less obscure. Their Institute had made suggestions to the Royal Commission, and the Commissioners coincided most strongly with most of their suggestions. The admirable experiments the Institute has been making for some time in safety lamps had confirmed certain facts; the Commissioners had themselves observed and had given them a hint to go further into the matter by rising to higher velocities than had yet been attempted, to show that there were points in the very best safety lamps which must be pondered, looked at, and combatted before they could say they had in their hands anything like a perfect safety lamp. He hoped their Institute would go on and flourish, for it was by the action of that and similar societies that the greatest progress was stimulated.

Mr. P. Rhodes gave the "Midland Institute."

The President, in responding, said they knew from what Professor Warrington Smythe had told them that opinions had great weight at head-quarters, and he hoped they would continue to work hard, and that the Institute would go on and prosper. Other toasts followed.

M. Louis Maiche, French electrician, has found that there is gold to be obtained from the quartz with which the roads around Paris are paved.

RAILWAY MATTERS.

THE earnings of the American railways in 1883 averaged 4½ per cent. upon the whole of the investments, the earnings per mile being, gross, 7400 dols.; and net, 3000 dols.

THE working of the Rajpootana Railway is about to be made over to the Bombay and Baroda Company, and the Government has reserved the power of fixing and varying from time to time both maximum and minimum rates.

THE sixth annual edition of the Great Eastern Railway Company's Tourist Guide to the Continent, edited by Mr. Percy Lindley, and illustrated by pen and ink and by sepia sketches by Francis Butler and Alfred Bryan, has just been published. It has again received valuable additions, can be obtained anywhere, and contains a great deal of very interesting information.

THE "Merryweather" engine successfully worked the tramway at the Wimbledon Camp for the whole of the fortnight during which the meeting was open, and conveyed large numbers of passengers. This system has now been in use at the camp since 1877, and the steam tramcars are in general favour with visitors, the Council deriving a good revenue from the working of their line.

IT is announced to the North London Railway Company that the accounts for the past half-year show, after debiting the revenue of the half-year with exceptional charges amounting to £4000, and carrying £3000 to reserve fund, sufficient to admit of a dividend at the rate of 7½ per cent. per annum, and to carry forward £2082, as against £1816 in the corresponding period of 1883.

IN concluding a report on a collision which occurred on the 4th June at Tyldesley, on the London and North-Western Railway, Major Marindin says:—"It is probable that the driver might have succeeded in averting the collision if the whole train had been fitted with a continuous brake under his control; and the guard, who seems to have been on the alert, might have done so if the brake had been an automatic one, capable of application from the guard's van."

AN alarming occurrence has taken place in Birkenhead, in connection with the Mersey Tunnel works. A considerable portion of the roadway in Hamilton-street, under which the tunnel is bored, collapsed without the slightest warning just after a tram-car and a cab had passed over the place. A gang of men were employed below, but, fortunately, none suffered any injury. In consequence of the accident, tramway and other vehicular traffic through the principal street in the town was suspended.

ACCORDING to *Poor's Railway Manual*, for 1884, just issued, the total length of the American railways is 121,592 miles. The share capital of the various companies amounts to 3,708,000,000 dols., the funded debt to 3,455,000,000 dols., and the floating debt to 332,000,000 dols., the aggregate liability on shares and debts being 7,495,000,000 dols. There were 6753 miles of new line constructed during 1883, and the total of the increased liability is 477,000,000 dols. In the course of the last three years railway indebtedness has increased by 1,094,000,000 dols., exceeding the probable cost of the newly constructed lines by about 200,000,000 dols. The effect of this inflation has been seen in the heavy liquidations recently enforced.

"W. S. D." writes to the *Times*:—"Good as is the arrangement for supplying travellers with water adopted by the London, Brighton, and South Coast Railway Company, the Norwegians have devised, I think, a more excellent way. In the place at the top of the partition between two compartments, usually occupied by a lamp, there is a glass tank with a small tap on either side. At the beginning of each journey the tank is filled with fresh water, in which a piece of ice is placed. Each compartment is furnished with a small drinking glass, so that travellers may refresh themselves with a draught of ice-cold water at any time in the course of their journey, and not 'at certain stations' only. The comfort of this is immense in hot weather, though the benefit, as far as I remember, is not extended to third-class passengers."

A BLUE-BOOK has been issued giving returns of accidents and casualties as reported to the Board of Trade by the several railway companies in the United Kingdom during the first three months of the present year, together with reports of the inspecting officers of the Railway Department to the Board of Trade upon certain accidents which were inquired into. Among the accidents reported were ten collisions between passenger trains or parts of passenger trains, by which 120 passengers and four servants were injured; fourteen collisions between passenger trains and goods or mineral trains, by which thirteen passengers and four servants were injured; nine collisions between goods trains or parts of goods trains, by which two servants were killed and seven injured; sixteen cases of passenger trains or parts of passenger trains leaving the rails, by which two servants were killed and four passengers and four servants injured; and thirty-two cases of trains running over cattle or other obstruction on the line, involving injury to four passengers. The total number of persons killed on railways in the United Kingdom in the course of public traffic during the three months was 254. The injured numbered 990. This is a decrease as compared with the corresponding period in 1883.

ACCORDING to the *Zeitschrift für Transportwesen und Strassenbau* there are now three railways in contemplation intended to augment the imperfect traffic facilities at present available between France and Spain, and regarding which Commissions appointed by the two countries will shortly make official reports. One line is intended to run from Pamplona in a north-easterly direction through the Roncal valley towards the French departments of Hautes Pyrenées and Haute Garonne. At the other end of the mountain chain there is intended to be a line built—without State help—from Lerida to the French departments of Ariège and Pyrenées Orientales, passing either through Arran or the more easterly valley of Noguera Pallares. The third project is favoured by the inhabitants of Arragon, and is a prolongation of the railway from Madrid to Saragossa and Huesca. At the Sompart Pass there will be a tunnel four miles in length, and the communication with the French railway system will be effected near Oleron on the Midi line. The French Government has shown itself opposed to this last-named scheme, and even the Spanish Government has manifested a preference for the Lerida-Arran line. Nevertheless, the works commenced in 1882 have been steadily proceeded with.

QUEENSLAND, next north of New South Wales, has, remarks the *Railroad Gazette*, but one-fourth of its population—248,255 in 1882, which is 54,000 more than Colorado had in 1880—but more than twice its area—690,000 square miles, which is 2½ times Texas—had 898 miles of railroad in operation at the close of 1882, which was at the rate of one mile to 296 inhabitants. The colony devotes large sums yearly to the importation of immigrants and the construction of railroads, and 30,000 immigrants arrived last year. The average cost of its roads has been but 33,840 dols. per mile, one of them having cost but 19,300 dols. per mile. In 1882 they earned £464,160 gross and £222,029 net=2516 dols. gross and 1202 net per mile. The latter small sum amounted to 3·55 per cent. on the cost of the roads. Queensland is all north of the 30th degree of south latitude, and mostly in the tropic zone; but the population is inconsiderable north of the 19th degree. Only the southern half of Florida is in as low a latitude as the part of Queensland most distant from the Equator, and some of the Queensland railroads are about in the latitude of Cuba. Grazing and mining are the leading industries, but there is some sugar growing near the coast. The Queensland Government in 1882 made a provisional contract for the construction of two long railroads—over a thousand miles in all—across the colony, for a land grant of 10,000 to 12,000 acres per mile; but the Parliament refused to indorse this agreement, and when the Ministry dissolved the Parliament and "went before the country" on this question, the new Parliament rejected the proposition by a still greater majority, and voted that the colony should borrow money to build the railroads required rather than make large grants of land to induce corporations to build them.

NOTES AND MEMORANDA.

DURING the week ending July 5th, 1884, in twenty-eight cities of the United States, with an aggregate population of 6,737,300, there were reported 3430 deaths, which is equivalent to an annual death-rate of 26·5 per 1000. This, says the *American Sanitary Engineer*, is the largest number of deaths chronicled in these columns since the week ending July 28th, 1883, when the number was 3431. This increase is due to the season, and the loss has been, as usual under such circumstances, heaviest among children, 54·4 per cent., or over one-half of all the deaths, being under five years of age.

THE French Ministry of Public Works publishes a formula for a hectograph or gelatine pad, which is said to produce very satisfactory results. The composition consists of 100 parts of good ordinary glue, 500 parts of glycerine, 25 parts of finely powdered baric sulphate, or the same amount of kaolin, and 375 parts of water. For the copying ink a concentrated solution of Paris violet aniline is recommended. To remove the old copy from the pad, a little muriatic acid is added to the water, washing it gently with this liquid by means of a soft rag, afterwards using blotting paper for removing superfluous moisture.

AT a recent meeting of the Royal Society of Dublin a paper was read by Prof. G. F. Fitzgerald, M.A., F.R.S., hon. sec., "On a Non-sparking Dynamo." By applying the principles of Maxwell's modification of Thomson's electrical doubler to a dynamo in which the current passes through two or more coils in parallel circuit, it is possible to arrange the magnetic field and the brushes so that when the terminals of any coil come into contact with their brushes, the terminals shall be at the same difference of potential as the brushes, and that when they break contact there shall be no current running in the coil, thus avoiding all sparking. The energy of self-induction usually wasted on local currents and sparks will in this case be spent in producing useful current.

IN June, 1882, the population of Germany amounted to 27,287,860, of which 11,712,485 may be regarded as the bread winners. The latter are divisible into the six classes following:—(1) Agriculture, the rearing of animals, gardening, forestry, hunting, and fishing, 3,462,268 men, 1,230,080 women; (2) mines, works, and construction, 3,065,218 men, 585,408 women; (3) trade and commerce, 766,127 men, 145,579 women; (4) work for salaries and daily wages, 160,640 men, 118,283 women; (5) the church, law, army, and liberal professions, 526,549 men, 60,661 women; (6) undeclared, 352,431 men, 353,064 women; total, 8,333,233 men, 2,493,075 women. Among the 11,712,485 bread-winners, 1,788,679 engage in 1,916,035 subsidiary occupations, in addition to which 399,244 of those returned as devoting themselves to household cares are also engaged in subsidiary occupations.

IN the preparation of aluminum, according to the *Chemiker Zeitung*, ferro-silicium is mixed with fluoride of aluminum in equal proportions, and the mixture is exposed to a fusing heat. The materials decompose each other, and volatile fluosilicium with iron and aluminum are produced, the latter two bodies being alloyed together. In order to extract the valuable aluminum, a copper alloy is formed by melting the iron alloy with metallic copper; by reason of the greater affinity of the copper for aluminum this is secured, leaving with the iron only a slight residue of aluminum. When the fused mass is cold, copper-bronze and iron have so settled that both bodies can be easily separated. In place of the pure fluoride of aluminum, chloride can be used, when chlorsilicium and iron aluminum alloy are formed. If in practice the chemical reactions above outlined are found to hold true, this patented process promises to be of considerable value.

M. CHOUBLEY has confirmed the observations made by Wasum on the influence of copper in steel upon its rolling qualities. Wasum found that 0·862 per cent. of copper did not, in the absence of sulphur, produce red-shortness, and Choubley, in the *Comptes Rendus de la Société de l'Industrie Minérale*, adds that even one per cent. of copper does not produce it. He melted 15 kilogrammes of steel scrap in a crucible with 150 grains of copper, the metal produced having the following composition:—Carbon, 0·495; manganese, 0·460; silicon, 0·150; phosphorus, 0·069; sulphur, 0·040; and copper, 0·960 per cent. This steel did not show the slightest trace of red-shortness. Noting that Wasum's tests were conducted with steel low in phosphorus, Choubley made some additional experiments to test the question what influence phosphorus and copper have. In order to see whether the steel was red-short, a small bar was nicked and then heated to dark cherry-red. The time of the fracture and its appearance would reveal any tendency to red-shortness; none was observed in any of the bars analysed. The steel rolled well. It is safe to conclude, therefore, that steel with 0·50 carbon, from 0·40 to 0·50 manganese, 0·20 phosphorus, and 0·50 copper does not exhibit red-shortness.

THE following table, quoted from page 203 of the Challenger expedition report on the composition of sea water, shows the most recent numbers assigned to the components of ocean water salts compared with those given by Forchhammer:—

	Per 100 parts of total salts.	Per 100 parts of halogen calculated as chlorine.	
	Dittmar.	Dittmar.	Forchhammer.
Chlorine	55·292	99·848	not determined
Bromine	0·1884	0·3402	,,
Sulphuric acid (SO_3)	6·410	11·576	11·88
Carbonic acid (CO_2)	0·152	0·2742	not determined
Lime (CaO)	1·676	3·026	2·93
Magnesia (MgO)	6·209	11·212	11·03
Potash (K_2O)	1·332	2·405	1·93
Soda (Na_2O)	41·234	74·462	not determined
(Basic oxygen equivalent to the halogens)	−12·493	—	—
Total salts	100·000	180·584	181·1

More than thirty elements are known to exist in solution in the ocean, but most of these are present in such minute quantity that it was hopeless to attempt to determine them in a number of small samples. Attention was accordingly confined to the chlorine, sulphuric acid, soda, potash, lime, and magnesia, which were estimated with very great accuracy and always by the same method, so that if more exact processes should be discovered at any future time the error of the method used may be calculated once for all, and applied as a correction to each analysis.

PROFESSOR C. R. C. TICHBORNE, Ph.D., read a paper at a recent meeting of the Royal Society of Dublin on "An Argentiferous Galenitic Blende found at Ovoca, Co. Wicklow." This mineral is very little known; it has been called "kilmacooite" locally in Ovoca, and it is generally termed "blue-stone" in the Island of Anglesey, the only two places in the United Kingdom where it is found. An analysis of the mineral made by the author gave the following results:—Silver, 0·024; zinc, 25·27; lead, 25·18; iron, 5·51; manganese, trace; antimony, 0·21; arsenic, 0·08; copper, 2·50; alumina, 0·60; magnesia, with traces of calcium, 0·02; sulphur, 23·71; silica, 16·896; total, 100,000. This mineral contains various amounts of pyrites according to the situation of the lode. The specific gravity was 4·73—intermediate between blende and galena—but it was harder than either of these minerals, and was therefore raised by blasting. The silver is equal to about 8 troy ounces per ton, or 8½ ounces avoirdupois. The mineral may be said therefore to consist of:—Sulphide of zinc, 37·68 per cent.; sulphide of lead, 29·07 per cent.; sulphide of silver, 0·0275 per cent. The author finds by experiments that this mineral is a mechanical mixture of microscopic crystals of blende and galena; it forms a fine-grained saccharoidal mass, very homogeneous in structure, except as regards the pyrites, and occurs in isolated crystals easily discernible by the eye. He stated that in 1865 Ireland yielded 14,000 ounces of silver per annum, or 2·4 per cent. of the whole of the silver raised in the world, and its value might be estimated at £3850 per annum, exclusive of the accompanying lead. If 1000 tons of this ore could be supplied, which represented of silver alone 8000 ounces, how lamentable it seemed that this valuable industrial resource should remain unworked.

MISCELLANEA.

AN electrical exhibition was opened on the 1st inst. at Steyer the Archduke Charles Louis.

IT is said that making gas from city refuse has been tried in New York. We believe Mr. Kidd, of Wrexham, did the same thing some time ago.

THE Wolverhampton Chamber of Commerce has authorised its president and secretary to write to Lord Northbrook, as Secretary of State for India, in favour of the farther development of the Empire by a largely increased system of railways.

A NEW catalogue of pumping machinery, engineers' brass fittings, fire fittings, well and water-closet machinery, and other manufactures, has been issued by Messrs. Hayward Tyler and Co. It is of the most convenient size—octavo—and is provided with an index.

THE Reddish Local Board having obtained an order from the Local Government Board suspending the Rivers Pollution Act, 1876, within their district, has directed Mr. R. Vawser, C.E., to prepare a complete scheme for the drainage and treatment of sewage of the district.

THE fire insurance companies of Sweden have offered a reward of 2000 crowns for the most practical device to arrest sparks and cinders from locomotive and steamboat smoke stacks. A trial of different devices that may be sent in will take place in Stockholm, Sweden, during the month of August, this year.

THE Mayor of Sydney has been setting an example which will probably not be much followed, but it might. The other day, the *Colonies and India* says, he, accompanied by the Inspector of Nuisances, the City Architect, and Dr. Dansey, visited several places in and around the city, and inspected their sanitary condition. A large number of the places seen were condemned.

THE cultivation of Cæara rubber seems to be the least successful of any of the new products of Ceylon. Mr. Gilliat, of Peradeniya, has for a long time past devoted great attention to this subject, but, the *Colonies and India* says, he has now become thoroughly convinced that rubber cultivation will not pay in Ceylon, and has therefore left the colony to settle in Australia. This seems to damp great hopes that were entertained as to extended services of india-rubber, a matter of much importance.

IN the division which took place in the Court of Common Council upon Mr. Peebles' amendment to publicly advertise for designs, offering premiums, and appoint as professional judges the presidents of the Royal Institute of British Architects and of the Institution of Civil Engineers, and another civil engineer to be selected by the committee, five of the six architects who are members of the court were present, and took part, viz., Deputy Hammach, Deputy Saunders, and Deputy Taylor, who voted with Mr. Peebles, and Mr. H. H. Bridgman against.

THE following circular letter has been addressed to all the Sanitary Authorities in the Lea watershed:—"12, Finsbury-circus, London, E.C., 30th July, 1884. Dear Sir,—In view of the possible introduction of cholera into this country, and the necessity of keeping the Lea and its tributaries as free as possible from pollution, I have to ask you that you will assist me by informing me of any sources of contamination which may come under your notice, and that you will see to the removal of nuisances—such as offensive manure heaps, overflows from cesspools, privies, &c.—which may contribute to the fouling of the river and the tributary streams thereof.—I am, dear Sir, yours faithfully, Lamnoch Flower, Sanitary Engineer, Lea Conservancy Board."

AN important piece of work has just been brought to a successful conclusion in Rome, in the complete renewal of the leaden envelope of the dome of St. Peter's Church, in Rome. It has occupied twelve years, and has cost over 200,000 lire (£8000). The original covering was applied to the dome in an imperfect fashion, which made continuous repairs a necessity; and at last it was determined to strip off the whole envelope and substitute a new one on a better system. New lead was imported from Spain and mixed with the old lead, in the proportion of one part old to two parts new. The total weight of the new cover is given at 354,305 kilogrammes, and if it were spread out flat it would occupy an area of 6152 square metres, or about an acre and a half. In stripping off the old plates three of them were found to be of gilded copper.

AS a commercial port the trade of Antwerp has increased to an astonishing extent within the last few years, as shown by the following figures:—In 1869 the tonnage of the port of Havre was 1,042,236; of Hamburg, 946,154; of Rotterdam, 673,830; of Antwerp, 546,554; of Bremen, 426,237; of Amsterdam, 413,780; of Dunkirk, 279,144. Of all the northern ports, therefore, Antwerp ranked fourth. But in 1882 it had so rapidly increased, owing to the improved harbour works and navigation of the Scheldt, as also to the greatly extended railway communication, that Antwerp has mounted to the top of the tree, and now stands first. The figures of 1882 show that the tonnage of the port was 3,401,534, while that of Hamburg was 3,030,909; of Havre, 2,266,927; of Rotterdam, 2,085,338; of Bremen, 1,129,217; of Dunkirk, 939,343; of Amsterdam, 784,379.

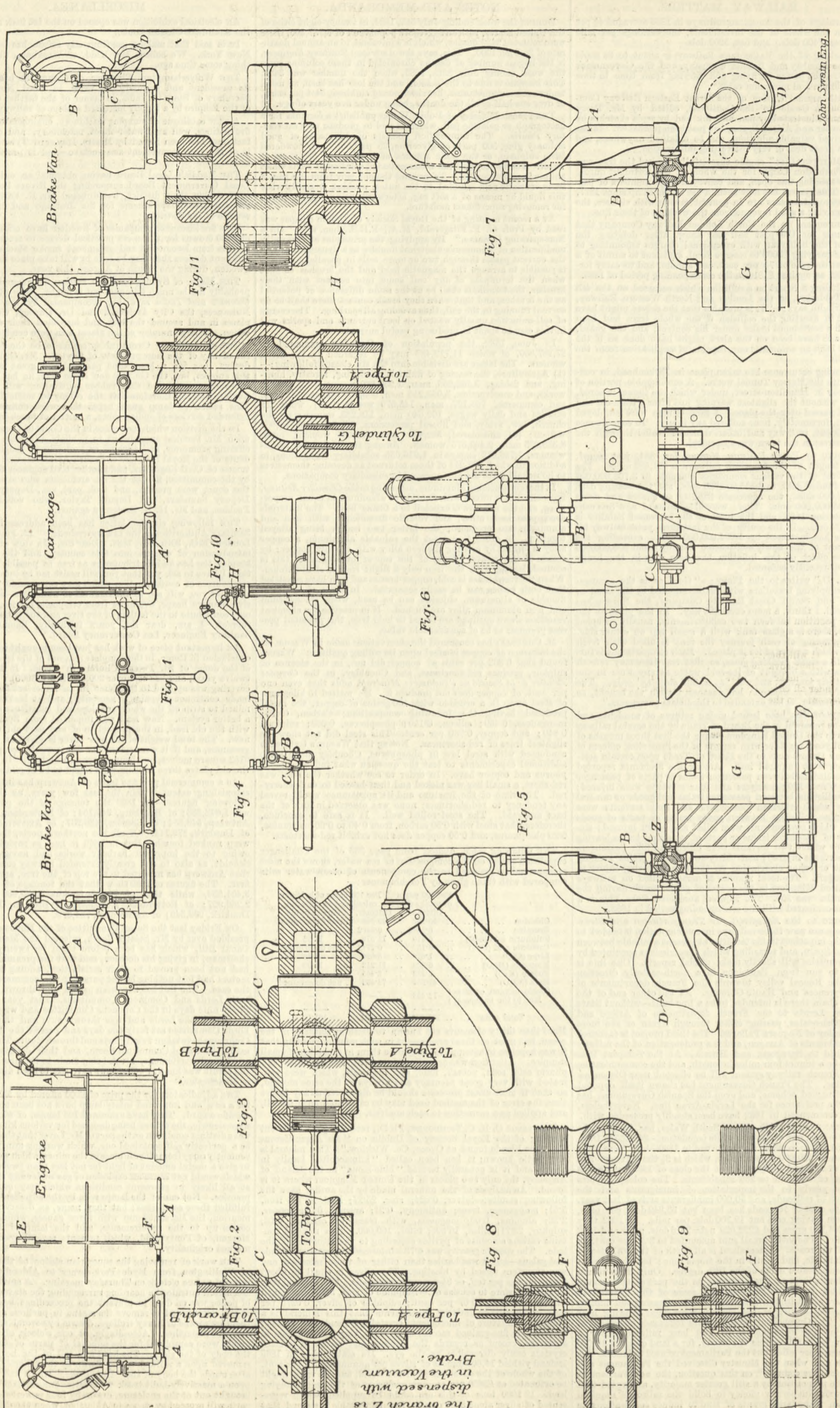
ON Friday last the Select Committee of the House of Commons, presided over by Mr. Sclater-Booth, rejected the Manchester Ship Canal Bill, which has been before them for twenty days. The chairman, in giving his decision, said that the preamble of the Bill had not been proved to their satisfaction, adding that the promoters had lost nothing by not pursuing the commercial aspect of the case. The Bill has now been passed and thrown out twice by both Lords and Commons Committees. Last year it occupied thirty-nine days in the Commons Committee and was passed, and ten days in the Lords and was thrown out; and this session the Lords Committee sat forty-one days and passed the Bill, and the Commons have taken twenty days and thrown it out. The Committee sat in the Grand Committee Room, and their decision was given amid much excitement, a rush being made to the doors as soon as the result was known. The news gave rise to keen disappointment in Manchester.

THE adjudicators for the prize of £500 offered by Mr. Ellis Lever for a new and improved safety-lamp have not been able to make a specific award. They have examined 108 lamps, of which only four were electric, the others being designed for various kinds of oils. It was a distinct condition on the part of Mr. Lever that the lamp should be a perfectly self-contained one, which working miners could conveniently carry from place to place in the mines, which would continue to give a useful amount of light for not less than twelve hours, and which would not cause an explosion of gas under any circumstances at all likely to represent conditions which may occur in actual practice. Not one of the lamps seen by the adjudicators perfectly fulfilled these conditions; but they name, as deserving of special mention, the Marsant lamp with three gauzes, which most nearly comes up to the requirements, and the lamp of Mr. William Morgan, of Pontypridd, which presents several good features of marked originality.

THE work of removing the equestrian statue of the great Duke of Wellington from Hyde Park-corner to Aldershot was commenced at one o'clock on Thursday morning. A small crowd had assembled outside the hoarding surrounding the statue, and a force of police was on duty to prevent the proceedings being impeded. It was determined to remove the statue in portions and to convey them by means of heavy trolleys, drawn by several strong horses, down to Aldershot. Accordingly, at one o'clock, all the arrangements were completed for the removal of parts of the horse and the body of the rider. The head and tail of the horse were first removed upon a railway trolley drawn by three horses, and shortly afterwards the body of the "Iron Duke," which had been placed upon a massively-built truck with large gun-carriage wheels, was brought out of the enclosure, drawn by four powerful horses. The parts will proceed by stages to Aldershot, when the different pieces will be put together again and the statue restored to its ordinary form.

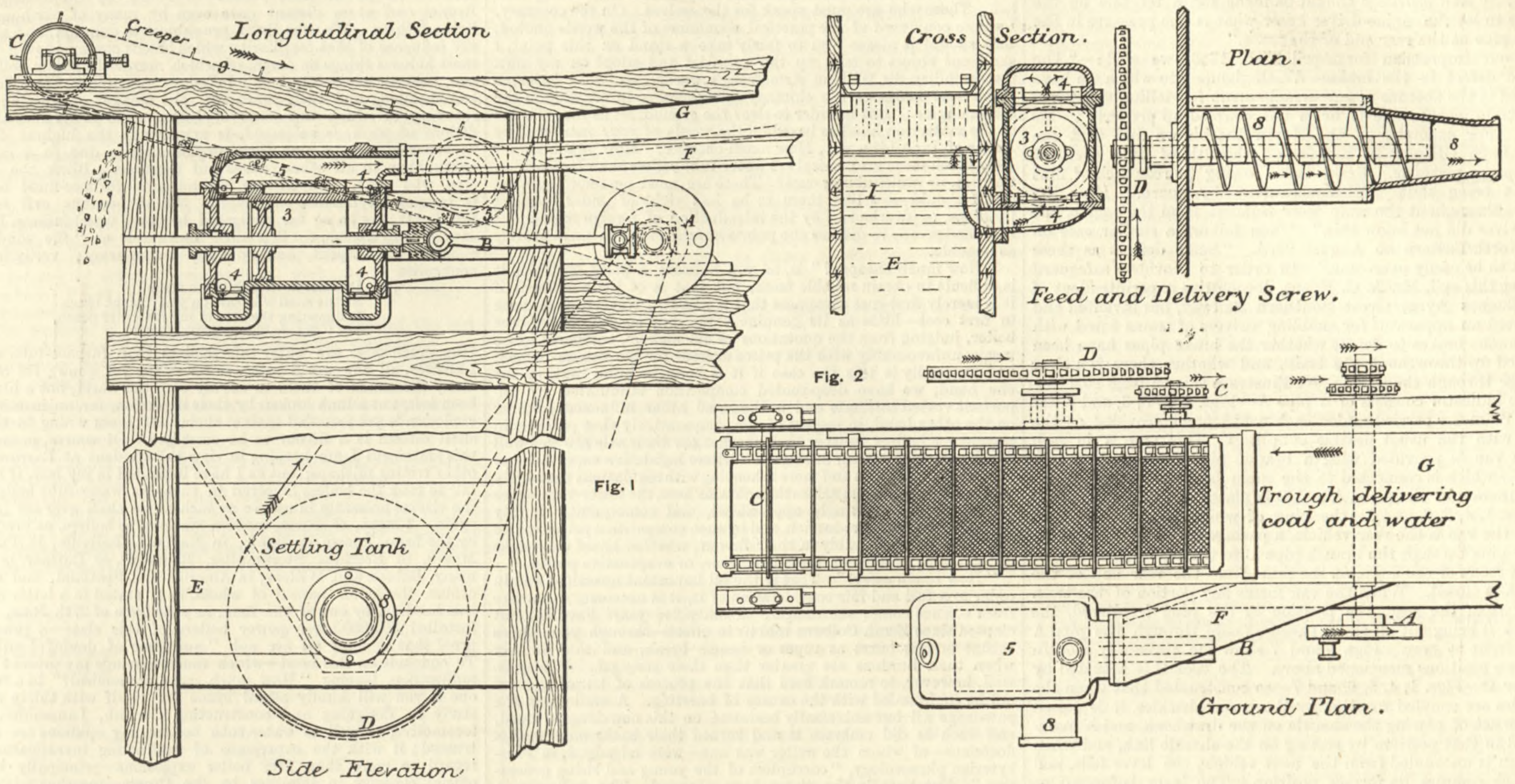
BRAKE TELL-TALE, LANCASHIRE AND YORKSHIRE RAILWAY.

(For description see page 103.)



COAL WASHING MACHINE.

MR. C. HALL, STANDARD IRONWORKS, SHEFFIELD, ENGINEER.



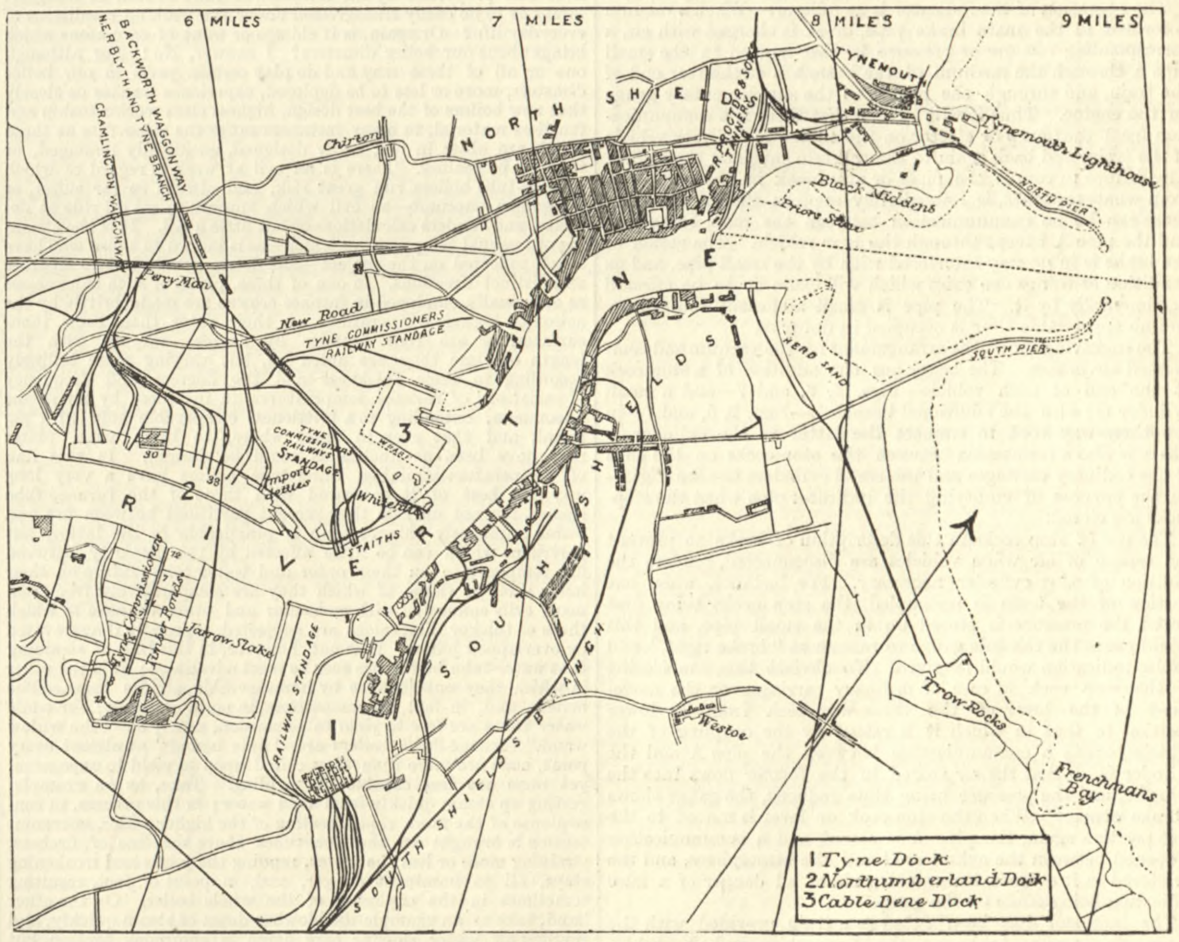
IN THE ENGINEER for April the 4th we illustrated a coal washing apparatus constructed and patented by Mr. C. Hall, then of Meersbrook-road, Sheffield, now of the Standard Ironworks, Washford-road, Sheffield. Trough washing has hitherto only been possible under some or all of the following conditions:—(1) Where there is an abundance of water; (2) where there is ample space and convenience for the erection and working of the same; (3) where large settling ponds could be used; (4) where the pollution of streams was of no moment, and where coal could be more conveniently carried by water to the vicinity of the coke ovens; (5) where the deposition of the dirt was of no moment. It will therefore be seen that mechanical washing possesses important advantages over the trough or spout system; but in order to make Mr. Hall's system a "universal" one, applicable under all circumstances and conditions, he has applied his improvements to the existing trough or gravitation process. By reference to the engravings above, which show an elevation and plan, Figs. 1 and 2, respectively of the open trough as it delivers the clean coal into a suitable tank, it will be seen that by the application of a reciprocating pump alongside, of sufficient capacity to force the necessary quantity of water to float down the coal in conjunction with the perforated delivery plate and creeper, he obtains the necessary partial vacuum underneath the plate to draw away all the water from the coal, and circulate the same through a pipe to a tank at the head of the washer spout where the raw material is first fed on. Fig. 1 is an elevation of this apparatus, and Fig. 2 is a plan; the same letters have reference to the same parts in both figures. G is the spout delivering the washed coal and water; E is a large tank with a converging bottom, along which moves the delivery screw 8 upon a square shaft; C is a perforated steel plate; 9 is the creeper, with its bearings attached to the side of the tank; 3 is the reciprocating pump, with its inlet and outlet valves and delivery pipe F conveying the water back to a tank at the head of the spout; A is the crank shaft for giving motion to the same driven by chain gearing. The plan shows the chain gearing for driving the various shafts; 8 the delivery tube for fine clean coal. When the machinery is put into motion, the coal and water fall from the spout on to the perforated plate, and the water is immediately drawn away by the pump and forced to the tank supplying the spout at its upper end. All fine coal drawn into the settling tank is immediately carried forward by the screw into the delivery tube and compressed into a solid column, whence it emerges into a suitable receptacle.

COBLE DENE DOCKS, NEWCASTLE-ON-TYNE.

THE visit of the Prince of Wales to Newcastle, and the opening of the docks that have been known during the long period o their construction as the Coble Dene Docks, draws attention to the shipping facilities of the Tyne. It is well known that the improvements that have been for two decades in progress on that river have changed its character, and of the great works that have been carried out, one of the chief is that of the dock that is intended to build up an import trade. The docks of the Tyne are the Tyne Dock, the Northumberland Dock, and the Coble Dene Dock. The Tyne Dock is the property of the North-Eastern Railway Company. Its water area is sixty acres; its facilities for grain storage are great, and it has coal jetties and spouts that have enabled it to ship over 20,000 tons of coal and coke daily. The Northumberland Dock is on the north bank of the Tyne, nearly opposite the Tyne Dock, and containing some fifty-five acres of water space. It is a coal dock, has spacious warehouses and quay space, and also large storage capacity and standage for goods. Finally, in going down the river from Newcastle, we come to the dock that is now in course of completion—the Coble Dene Dock, as Tynesiders have been accustomed to call it.

The Act of Parliament for the construction of this dock and the needful railways was passed in July, 1872, so that it will be seen that the time of construction has been somewhat prolonged. The dock is intended largely for import traffic; is to have a considerable area of standage ground, extensive wharves and warehouses, and has had expended on it an enormous sum of money. The official accounts show that up to the end of the past year the total expenditure on the dock, including interest, &c., was £768,000. The water area is twenty-four acres, and that of the tidal basin 2¾ acres. The tidal entrance is 80ft. wide, the lock 60ft. wide and 350ft. long. The depth of water on the sill at the entrance and inner cill is 30ft. high-water spring tides and 26ft. high-water neap tides; 15ft. at low-water spring tides and 19ft. at low-water neap tides. There is a new warehouse to hold 40,000 qrs. grain; there is standage ground and wharf to the extent of 168 acres, whilst the water area is surrounded by 3650ft. of deep-water quays. The entrance of the dock is at the eastern end. The engine and hydraulic machinery for filling the lock and moving the gates is by Sir W. G. Armstrong and Co., and hydraulic machinery will give the power in the warehouse. It is many months since the dock was flooded, the decision having been taken to open the dock and complete the excavation by dredging, and one of the largest of the fleet of the Tyne Commissioners' dredgers has been employed for over a year in this work. This recital of figures may be completed by the statement that over 5,000,000 tons of excavation have been made, a large portion of which has been carried out to sea in dredgers, each capable of holding 300 tons.

This is the outline, then, of the work of many years, a work that is, in point of magnitude, on an equality with those of river improvement that have changed the Tyne from a comparatively shallow stream to the great river we know. With the change the names of the past and present chairmen of the Commission, the late Sir Joseph Cowen and Mr. J. C. Steavenson, M.P., are identified, as are the names of Mr. Ure and Mr. P. J. Messent, and the late Mr. J. Guthrie and Mr. R. Urwin. A dredging plant that is remarkable has been brought into use; until since the year 1838 and down to the end of the past year 70,950,896 tons of material have been removed from river and dock. It would be easy to tell the effect of this on the trade of the Tyne—export, import, and manufacturing; but the story is old and the statistics have often been given. As we have shown by the figures above quoted, the new dock on the Tyne is as great in its way as the works that have preceded it, and its relation to the river and to the older sister docks may be gathered from the accompanying condensation of a chart which shows the course of the Tyne from Newcastle to the sea. The proximity of the new dock to the steam coal collieries is evident, and the map indicates the completeness of the arrangements that it gives to the Tyne for the import and export trades.



NEWCASTLE-ON-TYNE DOCKS.

TELL-TALE FOR CONTINUOUS RAILWAY BRAKES.

IN the existing forms of continuous brakes no provision is made for enabling the driver to detect whether or not the pipes have been coupled up between the various vehicles forming the train, nor whether any obstruction exists in the pipes themselves. This defect detracts from the efficiency of the brakes; in fact, however excellent a brake may be in itself, it ceases to have any value when the very first condition towards its continuity, the coupling of the pipes, is neglected, or when the continuity is broken by an obstruction. That this view is not in any way overdrawn is proved by the actual state of things shown in the Board of Trade returns of brake failures. Taking the returns for a period of two years ending June 30th, 1883, we have no less than seventy-seven cases reported in which the coupling of the pipes or turning of the cocks has been forgotten, or there has been obstruction in the pipes themselves. The result has been a number of cases of trains overrunning platforms, and in one instance a collision is reported to have occurred, the cause of which is attributed to the pipes between two vehicles not having been coupled. The case referred to happened on the Great Western on April 25th, 1882, at Portskewet.

The following extract from the report of Col. Yolland on the Blackburn accident may be quoted here, page 21, paragraph 10:— . . . "And provision should be made for a tell-tale on the engine to let the engine-driver know what is the pressure in the brake pipe at the rear end of the train."

In our impression for April 27th, 1883, we said:—"The second defect in the brake—Westinghouse—to which we have alluded is the absence of any arrangement for telling the driver of a train whether he is or is not coupled up properly to his train. For example, on the North British we find that the train from Glasgow to Kinross on the 8th of July overshot Bishopriggs platform. Brake failed owing to rear cock of first vehicle being shut. Mismanagement by guard. Here the brakes throughout the train were isolated from the engine, but the driver did not know this." Then follows a similar case on the North-Eastern on August 23rd. "Such defects as these ought to be easily overcome." In order to provide a safeguard against this evil, Mr. A. G. Evans, locomotive superintendent of the Buenos Ayres Great Southern Railway, has invented and patented an apparatus for enabling drivers of trains fitted with continuous brakes to detect whether the brake pipes have been coupled up throughout the train, and whether there is a clear passage through the pipes. We illustrate this on page 102.

The indicator consists of a pipe A—Figs. 1, 4, 5, 6, and 7—of small diameter carried under each vehicle, and provided at the ends with the usual flexible couplings. This pipe A in each brake van is provided with a branch pipe B—Figs. 1, 4, 5, 6, and 7—which is connected to the main brake service pipe. At the junction of the pipes A and B is placed a three-way cock C —Figs. 1, 4, 5, 6, and 7—the plug of which is so formed that when the van is the rear vehicle, a passage exists from the main brake pipe through the branch pipe B to the pipe A, and thence to the front of the train, at the same time the rear end of the pipe A is closed. When the van forms any portion of the train other than the rear, the position of the plug is altered, the branch B being cut off and a passage made through the pipe A from front to rear. Figs. 5 and 7 show the three-way cock in the two positions mentioned above. The cock C is actuated by a lever D—Figs. 1, 4, 5, 6, and 7—so constructed that when the vehicles are coupled together by the screw shackles, it is raised by the act of placing the shackle on the drawhook, and is maintained in that position by resting on the shackle link, and when the van is uncoupled from the next vehicle, the lever falls, and the cock resumes its former position. The lever is formed so that the coupling cannot be accomplished without its being automatically raised, and no handling of the lever is required either in coupling or uncoupling the vehicles. The small pipe A communicates with a Gresham tell-tale gauge, or with an ordinary vacuum or pressure gauge, in addition to the one usually carried. A valve F—Figs. 1, 8, and 9—is placed in the small pipe A on the engine in cases where the brake pipes are carried through to the front of the engine.

The operation of the indicator is as follows:—When a vacuum is formed in the main brake pipe, or it is charged with air, a corresponding vacuum or pressure is also created in the small pipe A through the medium of the branch B at the rear end of the train, and through the pipe A to the supplementary gauge on the engine. Thus it will be seen that there is a communication from the pump or ejector on the engine to the rear vehicle of the train, and back again to the tell-tale gauge on the engine. Any failure to couple the pipes or any break in the continuity from whatever cause, is immediately seen on the engine, since there can be no communication between the main brake pipe and the pipe A except through the rear vehicle. The action of the brake is in no way interfered with by the small pipe, and no condition of things can exist which will cause it to be affected detrimentally by it. The pipe is small and easily coupled up, and no appreciable time is occupied in doing so.

The engraving shows the arrangement for the vacuum and compressed air brakes. The latter has the addition of a stop-cock at the end of each vehicle—Figs. 5, 6, and 7—and a small cylinder G; also the additional branch Z—Figs. 2, 5, and 7—in the three-way cock to connect the latter to the cylinder G. There is also a connection between the stop-cocks on the ends of the ordinary carriages and the small cylinders G—see Figs.—for the purpose of emptying the indicator pipe when the stop-cocks are closed.

The use of stop cocks in this description of brake to prevent the escape of air when vehicles are disconnected, renders the addition of this cylinder necessary. For instance, when one portion of the train is uncoupled, the stop cocks being first closed, the pressure is stored up in the small pipe, and this would cause the tell-tale gauge to remain at "brake right," and a false indication would be given. To obviate this, the closing of the stop cock in case of ordinary carriages or the movement of the lever of the three-way cock from its lower position to that in which it is raised by the coupling of the vehicles, opens a communication between the pipe A and the cylinder G, so that the air stored in the former flows into the cylinder, and the pressure being thus reduced, the gauge shows "brake wrong." When the stop cock or lever is moved to the first position again, the pipe A is closed, and a communication is opened between the cylinders G and the atmosphere, and the air stored in it escapes, thus getting rid of all danger of a false indication being made on the gauge.

The indicator has been fitted to a train provided with the automatic vacuum brake on the Lancashire and Yorkshire Railway. It has, we understand, given perfect satisfaction.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents.*]

WATER-TUBE BOILERS.

SIR,—From numerous private communications received touching my rather rambling letter in your issue of 18th July, but more especially from a sense of the great honour conferred on me by the devotion to it of a leader in a scientific journal of such weight as yours, I feel it incumbent to return to the subject—which was so far promised at any rate.

With a disposition to avoid everything in the least degree savouring of captiousness in the criticism of so skilled a dissertation on steam boiler efficiency as is the leader in point, I am bound to dissent from the assertion with which the article opens, viz., that "I referred to the difference between the quantity of heat utilised and that actually developed in the combustion of fuel in the furnace of steam boilers," for from all that has yet appeared in your pages, my ideas on this point are as unrevealed as they are in regard to the portable engine boiler tested at Cardiff under the Royal Agricultural Society in 1872, to which you refer. No doubt such difference is dealt with in the quotation from Sir William Armstrong's address at Leeds, but surely all that I have to answer for in connection with that quotation is whether or not it is accurately or fairly given by me, as to whether or not leading men should guard against misconception when they speak of the steam engine wasting nine-tenths of the heat energy supplied to it. I took no thought, and would certainly deem it bad taste to presume to dictate in this or any other matter to a leading man bearing a name so justly honoured as that of Sir William Armstrong. Notwithstanding all that has been said, I am as yet in no way conscious of being misled. Those who are must speak for themselves. On the contrary, I am so convinced of the practical soundness of the words quoted, that should it please you to fairly take a stand on this point, I shall not object to take up the gauntlet and adopt on my own responsibility Sir William Armstrong's words, viz., that twice as much heat passes up the chimney as we succeed in utilising in the steam engine. But in order to clear the ground, let us first dispose of the matter on hand as based on the words of your introductory leader of June 14th, viz., How much cheaper? How much safer? How much more economical are water-tube boilers than Lancashire, Cornish, or multitubular ones? These are most pertinent queries, and I should not like them to be lost sight of under changed headings, or overlooked by the introduction of foreign matter. I shall endeavour to discuss the points *seriatim* with as much brevity as possible.

"How much cheaper?" is, as you indicate, a point on which it is difficult to obtain reliable facts; but that is of little moment if it is merely first-cost cheapness that is meant. Nevertheless, even in first cost—little as its genuine value may be—the water-tube boiler, judging from the quotations of its makers, compares by no means unfavourably with the prices current for the others named; and especially is this the case if it is borne in mind that, on the one hand, we have deep-rooted competition stimulated by important vested interests and a thousand other influences; whilst on the other hand, in respect of our comparatively slow progress in water-tube boilers, neither their market nor their sale are yet well developed. Of course, in countries where legislative supervision of steam boilers is strict and more in keeping with regulations that apply to other dangerous magazines than obtains here, the water-tube boiler is largely and increasingly appreciated, and consequently keenly competed for in its production, and by such competition prices can be shown to be considerably in their favour, whether based on weight of materials, grate area, heating surface, or evaporative power.

"How much safer?" That is the all-important question, and in order to a full and fair consideration of it, it is necessary to inquire from whence comes the danger. Twenty-five years have all but elapsed since Zerah Colburn told us in effect—through your pages —that boilers burst as ropes or beams break, and that is only when their burdens are greater than their strength. It may be well, however, to remark here that the process of bursting must not be confounded with the causes of bursting. A smile was the patronage all but universally bestowed on this new-fangled creed, and such as did embrace it and turned their backs on orthodox doctrines—of whom the writer was one—were adjudged, in Presbyterian phraseology, "corrupters of the young and rising generation." But happily the times have changed. The believers in mysterious explosions are now few and far between, and with all but one accord, obeisance is paid to Colburn's simple doctrine, which recognised nothing in the bursting of a boiler but the want of sufficient strength to hold itself together. The questions, therefore, are:—How does want of such sufficiency arise? Can it be that the data on which the strengths and structures of our boilers are based is erroneous? Is our workmanship bad, or our materials defective? Or is it that we are foolhardy enough to imperil our lives and properties by the adoption of lines so thin in marginal safety as to be easily transgressed under the working conditions of everyday life? Or again, is it old age or want of care alone which brings about our boiler disasters? I answer, No! For although one or all of these may and do play certain parts in our boiler disasters, more or less to be deplored, experience teaches us clearly that new boilers of the best design, highest class workmanship and faultless material, in many instances suffer the same fate as those which are older in use, badly designed, unskilfully managed, or thinned by scaling. There is an evil at work in regard to which furnace-tube boilers run great risk, and always so far suffer, or altogether succumb—an evil which appears to set all rule at defiance, and renders calculations of but little avail. It is the straining of unequal temperatures which—as is known to those who have at all reflected on the subject—acts detrimentally in two separate and distinct directions. In one of these, plates of such thicknesses as are usually employed in furnace crowns are made brittle by the action of higher temperatures on their outer than their inner surfaces, or are rent asunder by degrees, varying with the length of time they are acted on, but varying more tellingly according to their thickness and the degrees and frequency of variations of furnace temperatures, in instances by no means uncommon, extending to a brittleness comparable only with pig metal, and that even in cases where, to begin with, plates may have been as ductile as could be desired. In this line of temperature-straining, water-tube boilers have a very long way the best of it compared with those of the furnace-tube classes, for not only do they present partitions between fire and water immensely thinner than is practicable in the latter, but partitions which can be little affected by the disparity between fire temperature on their outer and water temperature on their inner side, in virtue of which they are comparatively free from many evils connected with molecular and other changes to which those of thicker dimensions are subjected, especially if aggravated by overlapped joints. It is not, however, in this line of straining that water-tube boilers are seen to most advantage; it is the other in which they out-distance by immeasurable strides furnace-flue boilers, and, in fact, all competitors, in point of safety; for while water tubes are free to yield to expansion, nearly as "the willow wand," furnace-flued boilers are "hide bound" at almost every point, none are more than they called upon to yield to expansion, yet none are less capable of yielding. Take, as an example, getting up steam quickly from cold water; in this process, in consequence of the more rapid heating of the higher water, enormous tension is brought on the flue tubes above the line of firebars, straining more or less the plates, rending the joints and weakening stays, all to imminent danger, and, in point of fact, resulting sometimes in the explosion of the whole boiler. On the other hand, take as an example the blowing down of steam quickly, and running off water slowly; here again is enormous tension, but quite in a different direction, for now the tubes are strained lengthways under the line of furnace bars, and compressed above it sometimes even to the extent of total destruction, though more frequently only to partial impairment of strength, leaving an appearance of soundness and safety, when in reality all that may be required to send the whole structure to the air in a shower of fragments is some little inadvertence, a subtle surge, or a trifling manœuvre which in other circumstances would be altogether harmless. Thrice in succession have I known three successive water-blow-downs rend to death flue tubes, thrice renewed to the same boiler, when at the respective moments of rupture there was no pressure in the case—pressure, in fact, plays only a very secondary part in explosions. I cannot, however, in a mere letter, multiply instances to prove this completely, or dwell on this kind of straining, but if I could, I can and would show its dangers from many points of view, as also the utter delusions of the loudly talked-of water circulation, which by some is supposed to neutralise its dire effects. Water circulation in furnace-flued boilers? No, forsooth! I would as soon believe in the snow falling upwards. Why there are instances of tropical fishes living in water of higher temperature than is sometimes—I had almost said often —found to exist at the undersides of such boilers, despite of cross pipes and all else, when above the furnace water is being rapidly generated into steam at 70 lb. or 100 lb. pressure. Water circulation in this connection is all well enough as a catchpenny caper, but "it's only noble to be good;" and no one should attempt to conceal the fact that before we can have water circulation in internal furnaced boilers we must reverse the laws of nature, a task more difficult than to sweep from nature's face all such boilers, an event which shall as surely be achieved by our children as we in our generation have swept to the uttermost verges of imagination the witches who blighted crops, induced storms, and strangled babes, in the estimation of John Knox, Judge Hale, and many thousands of the worthiest of our grandfathers; or just as surely as we now laugh to scorn the boiler explosion mysteries believed in—as we have reason to think—by Stephenson and Brunel, and at no distant date even by many of our honoured living fathers. We, like them, are subject to delusion, and also to the influence of that familiarity which breeds contempt even of the most hideous things on earth, of which murder by steam boilers is one, that we are soothed and lulled to rest under the extent of back-breaking and belly-rupturing, the amount of cramping and reaching to which this class of boiler, even in its normal conditions of work, is subjected, is grievous in the highest degree to contemplate; to this their explosions are due to a greater extent than to all other causes put together. Blink the question who may, temperature straining in furnace-flued boilers is beyond all manner of dispute the stupendous evil to be faced. It may be so far mitigated by great watchfulness, but it cannot be overcome, for it is alike inscrutable as "the wind and subtle as the serpent, and powerful as an army;" verily in this connection—

It is the devil as hard to reach
As the snail who safe on yon distant beach
Is digesting the core of my favourite peach,
It's "the shabbiest devil of all."

How much safer are water-tube boilers than furnace-tube ones? I answer, all the world safer, so far as we yet know; for of the many thousands of them in use all over the world, not a life has been lost, not a limb broken by their explosion, for no instance of explosion is yet recorded against them. If I am wrong in this, I shall esteem it a favour to be corrected. Of course, in making this statement I am keeping in view the accident at Barrow and other trifling mishaps; but as I have indicated in my last, it is not fair to rank the boilers involved in these as water-tube boilers of the classes presently in use, or as such as we shall ever see in use again. I mean, of course, modern water-tube boilers, as produced by the firms known as Roots, in England, Bellville, in France, Mayer, in Belgium, Sternmuller, Redbeauf, or Butiner, in Germany, Babcox and Willcox, in America and Scotland, and many others, the latter named of whom, as is stated in a letter under this heading, by one of the firm, in your issue of 27th June, have installed 300,000-horse power boilers of this class—a practical proof that at least all are not "nostrums of doubtful utility." To conclude on this head—which must conclude my present communication, leaving "How much more economical?" to a future one if you will kindly afford space for it—if with thirty years' study in designing and constructing Cornish, Lancashire, and locomotive, as well as water-tube boilers, my opinions are to be trusted; if with the experience of conducting investigations in regard to more than fifty boiler explosions—principally in an official capacity in inquiries by the Crown—together with the casual examination of perhaps as many more, I am to be listened to in regard to boiler explosions; or if with the insight obtained by cutting to pieces, in all the stages of age and use, numerous boilers of all the kinds named, and of occasionally dissecting, testing, and analysing their stays, furnace roofs, and other internal parts, my dictation is in any degree to be accepted, I risk my word that we never will be without boiler explosions so long as furnace flues or furnace tubes are used; and, on the other hand, that in all human probability we never will have explosions from water-tube boilers; and, further, that we will on all sides gain, and on no side lose by substituting the one for the other, which I will endeavour to show conclusively by my next.

I exclude from the above remarks the purely locomotive style of boiler, which differs essentially from all furnace-tube or furnace-flue ones, and which, next to the water-tube boiler, is probably the most reliable and safest we have.

GRAHAM STEVENSON.

Airdrie Engine Works, Airdrie, July 29th.

THE RAILWAYS OF NEW SOUTH WALES, AUSTRALIA.

SIR,—As one who not long since travelled through a portion of New South Wales, and resided for some weeks in Sydney, I am able to corroborate the remarks of your correspondent "N.S.W.," in your issue of August 1st, anent the jobbery practised on the Government railways there, in order to bolster-up so-called native industries, or rather those native industries in which certain prominent members and officers of Government are personally interested. Your correspondent refers to one precious little job perpetrated by the Honourable John Sutherland, late Secretary for Public Works. He also refers to the present Commissioner for Railways, Mr. Charles Goodchap, owing his appointment to the good graces of the Honourable John. Your readers, however, may be surprised to hear what promotion that appointment gave him. Up to 1878 he was but a clerk in the Government offices on £400 a year. He was then appointed straight off as Commissioner for Railways on £1000 a year. Subsequently this salary has been enhanced to £1200. Supposing him to be the most brilliant man imaginable, most people will agree that such rapid promotion would but merely result in turning his head. He is, however, nothing of the sort. From my own observations I concluded that he was a man of ordinary abilities, who would be the better for enlarged information and experience, especially in railway matters. The current report accounting for his good luck was that he made himself indispensable to honest John by preparing his written parliamentary speeches for him! Colonial statesmen and politicians are not always quite capable of trusting to their own powers for strict accuracy of grammar and speech.

C. E.

August 2nd.

VACUUM BRAKES AGAIN.

SIR,—On Saturday last, 2nd inst., another accident was caused by the two-minute leak-off vacuum brake. A heavy Midland passenger train, consisting of two engines and equal to fifteen vehicles, was running into the Wellington Station, Leeds. The so-called automatic vacuum brake was applied as usual, and worked well. It, however, "leaked off," and before another store of vacuum could be obtained the train ran with great force into the buffer-stops. The passengers were severely shaken, some being cut and injured. On the 4th July an accident similar in every way occurred at Leeds. On the 12th another case took place at Swansea. Three instances in a month of actual collision, to say nothing of running past signals, delays, &c. Yet this is the brake which never has "a failure to act" recorded against it in the Board of Trade returns.

CLEMENT E. STRETTON.

40, Saxe-Coburg-street, Leicester, August 4th.

THE MANCHESTER SHIP CANAL.

SIR,—I quite agree with your correspondent, Mr. Hurtzig, that this question offers points worthy of further discussion, but I do not think that the one he has raised can be reckoned amongst them. In fact, it was explicitly recognised by Mr. Leader Williams, and by the counsel for the promoters, that if silting did take place in the upper estuary, a deterioration of the bar would be the result. Is it probable they would have made this admission—which undoubtedly proved fatal to their case—if there had been any possibility of contesting it? The facts are, in reality, very simple, and no evidence adduced from the Humber or elsewhere will alter them. The upper estuary of the Mersey is practically filled twice a day, from one end to the other, by the flood tide. The water so filling it comes in over the bar—leaving the other channels out of account—and on the ebb it passes out over the bar. The amount so passing and re-passing is therefore measured by the tidal capacity of the estuary; and if this tidal capacity is largely reduced, the amount passing—in other words the volume of the current—will be reduced in about the same proportion. The only theoretical principle involved is that it is this volume of current which maintains the depth on the bar; but this the promoters were compelled to admit, because it is really a common-place of engineers, and especially of that school of engineers on whom they relied for the general support of their case.

Westminster, August 6th. WALTER R. BROWNE.

SIR,—The Bill for the above, in its present form, has been finally disposed of, and nobody, having read the evidence impartially, will dispute the wisdom and justice of the decision of the Committee.

As the present engineers for the scheme—having by some means usurped the position of the original engineer and promoter, Mr. Hamilton Fulton—have now produced a succession of abortive schemes, I would suggest that the promoters now let some other engineer have a chance. Let them throw the matter open to competition, when I have no doubt that some feasible and practical scheme will be offered, which will meet with the approval of the promoters and both Houses of Parliament. W.

Liverpool, August 6th.

SIR,—In my letter on this subject which you printed last week a rather important error has crept in, and I trust you will allow me space to correct it. At the commencement of the last paragraph but two are these words: "Now, I submit that if the entrance to the estuary be enlarged, any artificial works, &c." This should have been: "Now, I submit that if the entrance to the estuary be unchanged, any artificial works, &c."

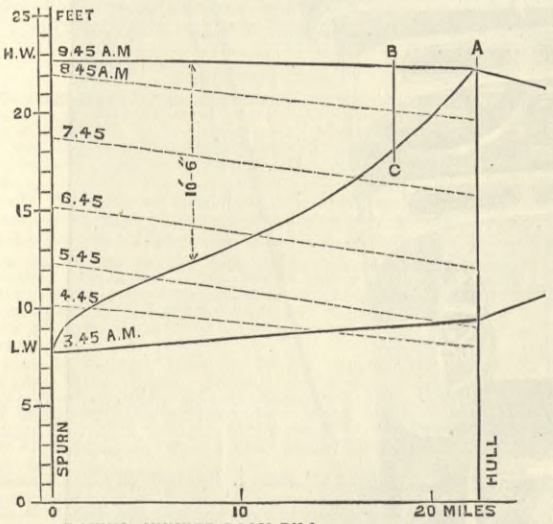
The omission of the diagrams has, I fear, rendered the letter somewhat unintelligible in the three concluding paragraphs.

Alexandra Dock Works, Hull, August 2nd. A. C. HURTZIG.

[We regret that Mr. Hurtzig's diagrams were inadvertently omitted. We give them here, with that portion of his letter referring to them.—ED. E.]

"Now, I submit that if the entrance to the estuary be unchanged, any artificial works within the estuary which cause accretion or reclamation will exclude tidal water only if such works are executed within the limits to which tidal water from the sea flows during the period of rising tide at the entrance to the estuary; and as a consequence, the farther from the entrance or bar that the works are removed the less will be the exclusion of tidal water.

FIG. I.



Refer now to Fig 1, which represents the tidal lines in the Humber for a certain tide. The water surface between Hull and Spurn for each hour of rising tide is shown. The velocity of flow at the entrance during the six hours of rising tide will not exceed 2, 4, 5, 5, 4, 2 miles respectively, and with these velocities the path of the first portion of water that enters is that of the curved line, supposing there be no mixture of water; and no water entering can, therefore, pass beyond the point A, about twenty-two miles from Spurn, during the period of rising tide at Spurn. Every estuary has, I say, a corresponding point determined by its capacity as a tidal receptacle; by the capacity of the entrance to pass the volume of water; and by the resultant of the forces of the tidal wave, and of the opposing upland waters. It is evident that if

you do not touch the water that comes in, and do not interfere with the conditions upon which its quantity depends, you cannot exclude any of it from the estuary, and the entrance or bar cannot consequently suffer. In Fig. 1 the portion shaded is an area proportional to the tidal inflow. If a reclamation take place at a point B, for example, the exclusion of tidal water proper would be nil in proportion to the depth of water where the reclamation is made, but to the depth B C as indicated on the diagram. Apply now these principles to the Mersey estuary and the Manchester Ship Canal. Fig. 2 is reduced from Mr. Shoolbred's paper on "The Mersey," in vol. 46 of the Minutes of "Proceedings" of the Institution of Civil Engineers, and it shows the tidal lines for successive hours for an equinoctial spring tide from the bar to Garston. Now, assuming the mean velocities of entry for such a tide at the bar to be 2, 4, 6, 6, 4, 2 miles per hour respectively during the successive hours of rising tide, the curved line shows the path of the first entering water and the limit beyond which any works in the estuary would not exclude tidal waters from the sea. The extremity of the training walls of the canal is about twenty-two miles from the bar, and if the above assumption of velocities be correct, observations are required to determine this accurately. The diagram shows how very small a proportion of tidal water would be excluded even if silting up were caused to the level of high-water mark; and if the accretion in course of years did not reach above, say, half-tide level, there would be no exclusion of tidal water at all. And the indirect effect of the training walls in diminishing the depth on the bar, and the tidal capacity of the entrance by accretion of the bar, need not be taken into consideration."

THE WILMSLOW ACCIDENT.

SIR,—The letter addressed to you in your issue of the 1st inst. by Mr. Clement E. Stretton on the above subject is full of inaccuracies, and should not be allowed to pass unnoticed. He states that the block system was improperly worked, and that Webb's steam brake failed to act. In the first place, the block system was worked in accordance with the company's rules, and in the second place it was not clearly proved that the steam brake had failed in its action. Whether this brake failed or not has no bearing whatever on the matter. The driver was in charge of a trial engine—not the foreman fitter, as one might infer from Mr. Stretton's letter; he had no business to run at a speed of sixty miles per hour under such circumstances; but notwithstanding this speed, he had a sufficient sight of the distant and home signals to enable him to have brought his engine to a stand had he been keeping a proper look out, as shown by the following table of distances:—

	Yds.
From point to where distant signal can be first sighted to the distant signal	1193
From distant signal to home signal	790
From home signal to crossing where collision occurred	65
Total	2048

The driver, therefore, had a distance of 2048 yards wherein to bring his engine to a stand after the first intimation he received that the line was not clear, and there was no necessity for him to have either reversed his engine or applied the steam brake in order to avoid the collision.

It seems strange that Mr. Stretton knows that the jury formed their verdict upon the evidence given by myself, as he was not present at the inquiries, whereas I was, and am therefore in a position to know that the verdict was not formed on my evidence only, but upon the whole of the evidence laid before them, together with the summing-up of the coroner, who presumably has had a proper experience in such matters. In future it will be well for Mr. Stretton to ascertain the true facts of any case upon which he may wish to rush into print, as he may find himself in serious trouble by his repeated misrepresentations on things pertaining to the railway service.

If I am correctly informed, Mr. Stretton has never been in the railway service, and knows little or nothing of railway working; and he will some day, if he is not careful, discover when too late that "a little learning is a dangerous thing." G. WHALE.

Crewe, August 4th.

SIR,—In your issue of last week I gave the details of the recent accident at Wilmslow, and mentioned that the unfortunate engine-driver had been committed for "manslaughter." When the case came before the magistrates at Macclesfield they did not even require an answer to the charge, but dismissed it with the remark, "There is no case at all, not the slightest." The driver having been dismissed by the magistrates, many persons forgot, or were not aware, that he must still be tried upon the coroner's inquisition. At Chester Assizes last week the Grand Jury could not even find any evidence upon which to return a "true bill," and in accordance with the directions of the learned judge, the jury at once returned a formal verdict of "not guilty," and the driver was set at liberty. CLEMENT E. STRETTON.

40, Saxe-Coburg-street, Leicester, August 2nd.

THE PENISTONE ACCIDENT.

SIR,—The crank shaft in question broke in a way in which the majority of ordinary web cranks do break, viz., right across the web, at a place where the grain of the metal runs across. I would suggest shrinking bands round the webs. These bands might be so forged as to be in one piece, and rolled or drawn out under the hammer round a mandril, so as to form a practically weldless hoop. I of course mean that the webs and bands should be machined before the latter were shrunk on.

I am of opinion that the action of this band would be twofold: In the first place, it would strengthen the crank in its weakest part to a far greater extent than an equal weight of extra metal left on the finished crank; and secondly, it would actually support a cracked crank, the flaw in which, as in the Penistone case, was so slight as to be invisible, probably, until corrosion enabled the examiner to detect it.

I am constantly hearing about the superiority of built-up cranks, and without wishing to enter into any controversy as to their merits, which I recognise in many cases, I still venture to think that a consideration of the way in which they are forged—for in the forging lies really the secret—will convince most people that they would be none the worse for bands, as suggested.

Warrington, July 31st. J. W. M. N. GALWEY.

[Some locomotive engineers have long adopted this crank web hoop.—ED. E.]

THE PROSPECTS OF YOUNG ENGINEERS.

SIR,—Having followed with much interest the articles on "The Prospects of Young Engineers" which were lately published in several issues of your valuable paper, you will, perhaps, allow me a short space in the same for a few reflections and ideas of mine on this interesting subject. That the prospects of young engineers are anything but bright just now is a fact which need not further be discussed; this may be partly attributed to the enormous contingent of young men that are now theoretically trained as engineers both in England and on the Continent, but chiefly to their deficient practical knowledge. I shall return to this point a little further on. It must be acknowledged that many young men going in for engineering studies never reach the satisfactory degree of cognitions that is at present expected from any engineer. Some of them undergo these difficult and complicated studies without having the required dispositions or intellectual aptitude indispensable to the same; it is certainly not very surprising if this class of young men prove little successful in future, or meet with badly-paid employments. In Italy, for instance, a good many go in for engineering studies, with little or no aptitude at all, for the mere sake of being called, more or less deservedly, an "engineer," to which title the greatest importance is attached in that country, as soon as a five years' theoretical training have been gone through with but scanty benefit. Such men are, of course, very indifferent factors to engineering in the very high position this science occupies at present.

That many parents should make engineers of their sons, with the sole object of securing them immediate means of existence, is a much to be regretted mistake. Theoretical studies are altogether insufficient to entitle a young man to call himself an engineer if not accompanied by a sound practical training, which can only be acquired to some extent by spending some years in workshops after theoretical studies have been duly gone through. Some three to four years should be given up to foundry, pattern, and fitting shops, unattended by the immediate necessity of earning money before this comparatively short time has fully elapsed. After this, due training should be made in the drawing-office, and I think that, if this plan is conscientiously carried out, accompanied by the sincere desire to learn and improve, it would lead most young engineers to earn something better than bread and cheese, with a little patience and short time. I am fully aware that many parents cannot afford keeping their sons for so many years, but it is obvious that with mere theoretical training they cannot expect them to grow anything better than inexperienced draughtsmen, or earn more money than they are really worth. Thus the pecuniary sacrifice that such parents have undergone for the theoretical training of their sons is in most cases fully lost, as a young man can be trained into a draughtsman with far less expense.

It will be seen in the course of these lines that I especially refer to the training of young mechanical engineers, and before concluding you will kindly allow me one more observation on the subject.

Young men coming from engineering schools, if they do undergo any practical training in workshops at all, generally neglect a very important part of it—this is the case, at least, on the Continent—viz., practical work for some time in the foundry and pattern shop. Although sound experience in the fitting shop is indispensable to a young engineer, some good knowledge of pattern and moulding work should certainly not be disregarded, as it will help him considerably in any constructions he may have to carry out in future. Your interesting article in THE ENGINEER of the 1st inst. is, no doubt, somewhat discouraging for young engineers. A great number of them are unemployed, or get so scanty a pay that in most cases it affords no compensation for the costly theoretical education they have gone through. They should give up more time to thorough practical training in workshops if they can afford it, and I am convinced many of them will prove more successful in the profession they have chosen.

Zürich, August 4th. H. A. WALKER, M.E.

SIR,—With reference to your remarks in last issue respecting the above-named subject, allow me to give you the following extracts from the autobiography of the late really eminent engineer, Sir John Rennie, Past-President Inst. C.E., viz.:—

"At present the system upon which public works are carried on is wholly wrong. There is no system. Any man without business, competent or not, dubs himself an engineer, starts a project, well or ill-founded, as the case may be—generally the latter—and issues a prospectus to the public to obtain the necessary funds to carry his proposal into effect. Next, he gets a contractor to back him by taking a certain number of shares, provided that he has the contract at his own price, in order to carry into effect his policy. The contractor generally stipulates for two or three of his own nominees to be placed upon the board to look after his interests, so that in point of fact the contractor pays himself pretty nearly what he likes. This is certainly a most discreditable state of things, and has been the cause of the most wasteful expenditure and the ruin of many valuable undertakings; and it will always continue to be the case so long as the present system prevails. The real object of the civil engineer is to promote the civilisation of the world by the proper application of all the great mechanical means at his command, and to take a high independent position as a scientific man, thoroughly versed in his profession, both theoretically and practically, and wholly independent of contractors and all sinister influences."—See ch. ii., page 432.

These are weighty words, well worthy of the attention of all true civil engineers, not only with the object of devising some way of reforming the present state of things, but also of discovering some means of excluding trespassers from the highest class of the profession. A. ORMSBY, M. Inst. C.E.

Institution of Civil Engineers, Westminster, August 6th.

AMERICAN STRAIGHT EDGES.

SIR,—Referring to a paragraph in your issue of July 25th, quoted from the *Scientific American*, respecting the straight edges manufactured by the Pratt and Witney Company, Hartford, Conn., it is there stated, as a proof of their wonderful accuracy, that two of the straight edges, 12ft. long, were placed face to face, one upon the other, with slips of tissue paper between their ends, and the superimposed weight of a heavy man sitting on the centre of the top straight edge; and that another piece of tissue paper could then be slid in between the two faces and any point between the end slips.

If the above quotation is correct, instead of proving the accuracy it rather points to inaccuracy in the straight edges, for to obtain the results mentioned they would have to be slightly hollow. As, if they were perfectly straight and planed, as described, the pressure on the slips of paper would be the weight of the man, and the top straight edge about 250 lb.; and supposing the two pieces of paper to be of equal size and the same distance from the ends, there would be about 125 lb. weight on each piece. If, however, a third piece of paper were introduced at any point between them, the weight would be divided between the three according to their relative positions; but the least weight that any one of them could have would be about 62½ lb., when it would be quite impossible to move it, much less to slide it up and down in the manner described.

Bow, August 4th. C. J. REYNOLDS.

FLAWS IN SHAFTS.

SIR,—It would help those engaged in devising means for preventing the frequent breaking of axle and crank shafts if Mr. Phillip Braham would kindly make public the result of his experiments, and make it known whether flaws running in a longitudinal way and round blow-holes in iron and steel are indicated by the method suggested in his letter in yesterday's ENGINEER. Blow-holes in steel or iron bars or rods would, by forging, spread and close in longitudinal flaws, and I believe that in new axles and crank shafts the flaws, if any, run mostly in a longitudinal way, which so far have not been detectable by any known test, but which develope in transverse flaws of every direction by the twisting, bending, and stresses to which axles and crank shafts are subjected in working, until ultimately they break. C. L. H. LAMMERS.

Gosforth, Newcastle-on-Tyne, August 2nd.

SIR,—The letter of Mr. Phillip Braham only describes Saxby's system of magnetic tests, devised many years ago. The results obtained are, however, untrustworthy, for reversed poles are found in bars of iron and steel, although there are no flaws of any kind; and perfectly sound bars or axles would be daily condemned if the tests were freely used. MAGNET.

London, August 4th.

THE PROPULSION OF METROPOLITAN TRAINS.

SIR,—May I call attention through your valuable publication that the method of propulsion of trains proposed by Mr. Rammel is not at all new? The same method was proposed and published in the Reports of the British Association, 1864, by Mr. Peter W. Barlow, C.E., F.R.S., F.G.S., page 184, "Transactions of Section G." The author estimates that a tractive force of eight tons—equal to that of three locomotives—applied for 300ft. at a station will propel a train of sixty tons for one mile at a greater velocity than if one locomotive worked the whole distance.

Bath, August 4th. PHILIP BRAHAM, F.C.S.

MODERN LOCOMOTIVE PRACTICE.

SIR,—The writer of the above paper, in referring to the Webb compound locomotive, says: "From the small size of the high-pressure cylinders, they are liable to slip when starting heavy trains, as the low-pressure cylinders are not then effective." Does the writer mean that by diminishing the size of the cylinders while the adhesion remains the same, the tendency to slip is increased? If so, I shall be deeply indebted to Mr. Whitley, or any of your correspondents, who will explain the cause of this, which seems to be opposed to the results of both theory and practice.

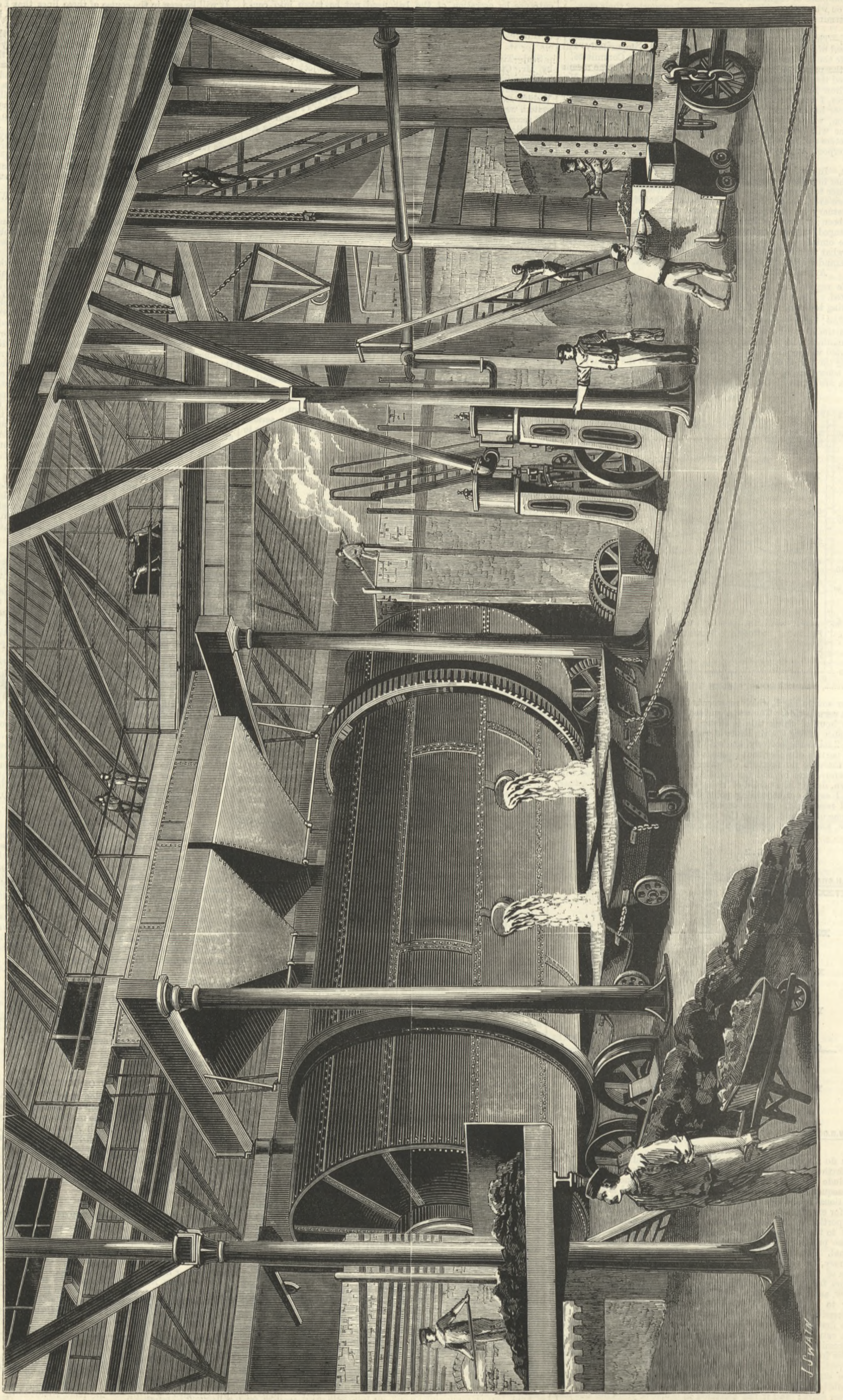
Crewe, August 5th. J. D. M.

FAST PASSAGE.—The Cunard steamer Oregon arrived at Queenstown on Wednesday. She left New York on July 30th; she arrived at Daunt's Rock Lightship at 7.12 a.m., making the passage in 6 days, 12 hours, and 54 minutes, the total distance run being 2853 miles.

REVOLVING BLACK ASH FURNACE, WIDNES ALKALI WORKS.

MESSRS. ROBINSON, COOKS, AND CO., ATLAS FOUNDRY, ST. HELENS, ENGINEERS.

(*For description see page 110.*)



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TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

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

F. P.—*There is no such paper.*

V. C.—*We fail to find anything new in your invention.*

B. A.—*Toothed wheels are regarded as inadmissible on board ship for driving propellers.*

Hydraulic.—*Will not Neville's "Hydraulic Tables and Formulæ" answer your purpose? If not, write again.*

W. C. D. (Sudbury).—*The Great Western Railway Company. The Flying Dutchman from London to Swindon attains the highest speed reached, considering the distance, on any railway.*

C. W.—*We are quite unable to say where such photographs as you want are to be had. In most of the principal dockyard towns views of the docks, ships, &c., can be had in the shops of the local photographers.*

FUNICULAR RAILWAY.

(*To the Editor of The Engineer.*)

Sir,—If any of your readers can give me the name of the maker or patentee of a system of narrow-gauge railway, called the funicular system, for passenger traffic, I should be very much obliged. Rail.

London, July 31st.

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DEATH.

On the 31st ult., at Woodleigh, West Croydon, Charles Woodley Whitaker, C.E., aged 47.

THE ENGINEER.

AUGUST 8, 1884.

THE MANCHESTER SHIP CANAL.

The decree of the Committee which has had charge of this Bill was delivered on Friday afternoon, and announced that the promoters had not proved the preamble of the scheme to their satisfaction. Both promoters and opposition were alike taken by surprise by this decision, for it appeared to be a foregone conclusion that the Bill would pass into law, notwithstanding the strenuous opposition offered to the project by the Liverpool Dock and Harbour Board, the railway companies, and the other interests affected. Mr. Pember, who conducted the promoters' case with conspicuous ability, was obliged, rather than risk the loss of the Bill through lapse of time, to suppress much of the commercial evidence that he had prepared in support of the Canal; but the Committee announced, when giving their decision, that the fate of the Bill had not been influenced by the curtailment of the commercial part of the case, thus leaving it to be inferred that, in the opinion of the Committee, the chief, if not the only, obstacle to the undertaking, lay in the possible injury that Liverpool would sustain from interference with the estuary.

The Mersey Dock Board brought very strong evidence to prove that the training of the canal through the upper estuary would be followed by accretion on such an extensive scale as to materially reduce the storage area of the estuary, and that as a necessary consequence the bar at the entrance of the river would be increased in height. The Committee, with expert evidence of the strongest kind affirming that no such result would follow, may not have accepted literally the evidence of the opposing engineers; but it is probable that the presence of a doubt as to the effect of the proposed works decided the Committee to withhold their sanction to the undertaking. This decision closes the second year's contest which the Provisional Committee of the Ship Canal Company have had to go through. It will be remembered that last session the Bill passed the scrutiny of an unusually strong Committee of the House of Commons, under the guidance of Sir Joseph R. Bailey, as chairman, but was thrown out by a Committee of the House of Lords, which was not remarkable for its patience or powers of apprehension. This year the order of things was reversed, the Bill passed the Committee of the House of Lords in the first instance without any restrictive conditions, but on Friday was thrown out absolutely, and almost without comment, by a Committee of the Commons.

It is reasonable to conclude that after two years of anxious preparation and advocacy, and an unprecedentedly large outlay, the Manchester public have been disappointed at the failure of their great project, especially as everything seemed to point to the successful conclusion of their labours; but whatever may have been the first impressions left by the defeat, they have been but transitory, for we learn that the Provisional Committee held a meeting on Tuesday last, at which the strongest determination was expressed to prosecute the scheme to a successful conclusion; and there is no doubt that in November next fresh plans and notices will be deposited for an amended Bill.

The chief strength of the opposition to the measure was, first, that interference with the estuary of the Mersey would produce serious effects on the approach to Liverpool; and secondly, that such interference was unnecessary, as the canal, instead of being excavated down the centre of the estuary from Runcorn, could be carried inland, and made to debouch at a point near Garston, where permanently deep water is found. This line, we believe, the promoters have already had under consideration, and it is probable that it will form the prominent feature of their new scheme. The change cannot affect the undertaking prejudicially; it will shorten the line of communication with Manchester by two and a-half miles, and will certainly relieve the proprietors of the canal from all those maintenance charges which they would undoubtedly have had to bear as a permanent burden had they carried the canal through the estuary. In the course of the enquiry before the Committee, the Mersey Dock and Harbour Board pledged themselves, through their counsel, that they would join with the Liverpool Corporation in the undertaking offered through their representative witness, Sir William Forwood, "That if the promoters would bring in a Bill next year carrying out their estuary works, as they can carry them out, without interference with the estuary, either along the northern or southern shores, the Corporation would not, upon principle, oppose that Bill." There is, therefore, good reason to suppose that if the Dock Board and the Liverpool Corporation—who have no interest in the scheme except so far as the Dock Board are affected—are true to their pledges, the undertaking may go through as an unopposed Bill.

AUTOMATIC BRAKES.

The Penistone accident has had the effect of inducing some railway shareholders to think a little about brakes. Such matters are generally left by the public to directors, and no questions are asked; but indications are not wanting that a new order of things may possibly prevail. It is well known that many companies are not doing what the Board of Trade says they ought to do; and it is by no means impossible that serious pecuniary consequences may ensue. Thus, for example, although it is granted that the flaw in the crank axle of the engine which broke down near Penistone was hidden, and could not possibly have been detected, it may be asked whether this fact effectually debars the relatives of those slain from sueing the Manchester, Sheffield, and Lincolnshire Railway Company for compensation. If it can be shown that all proper precautions were taken to secure safety, then the plaintiffs in actions for damages would have no case. But is this point quite clear? We venture to think that it is not. The Board of Trade has laid down certain rules with which all passenger train brakes should comply. It is not disputed that Smith's vacuum brake does not comply with these stipulations. Here is one point against the railway company. Again, evidence of various kinds, but all good, might be tendered, which would tend to prove that if the train which was wrecked had been fitted with a good automatic brake no lives would have been lost, or but very few. This is Major Marindin's opinion. Many instances might be adduced in which a train has been saved from utter destruction by good automatic brakes; and it would perhaps be difficult to persuade a jury that a railway company running a train with Smith's vacuum brake was properly equipped for passenger service. It is possible that because the full value of automatic brakes is not yet quite realised by men of the non-technical class from which juries are selected, the relatives of those killed in the Penistone accident might get an adverse verdict. But this condition of the public mind cannot last much longer; and the railway companies will do well to make up their minds to suffer pretty heavily in the near future if they run trains not fitted with automatic brakes. An admirable illustration of the value of such brakes in saving life is supplied by an event which has recently occurred in the United States. In Cleveland, Ohio, an excursion train was wrecked on the 20th July. There were no fewer than 1500 people in the train, of whom only two people were killed and eleven severely injured. The employés, to the number of 2500 persons, of Messrs. C. Aultman and Co., reaping machine makers, held their annual picnic at Cuyahoga Falls. Two special trains were provided to convey them, one of fifteen and the other of seventeen cars. The first train arrived at the town of Canton all right, but part of the second train left the track outside the town and fell into a pool of water in which the two persons killed on the spot were drowned. The circumstances of the accident in many respects closely resemble those of the Penistone catastrophe. We quote the following account of what occurred from the *New York Times*:—"The wreck was found to be near the Valley Coal Company's mines, about two miles north of the Canton passenger station. The track here runs for some distance between the Nimishiller Creek on one side and a pool or wide ditch of stagnant water on the other. Engineer Frank Kuhn told the *Times*' correspondent that the accident was probably caused by the spreading of a rail, by which the wheels of the tender struck and broke a frog, tearing up the track and throwing the cars over the embankment. The engine passed the frog without injury, but the tender jumped the track and carried with it nine cars freighted with human beings. The engineer put on the air brakes, sanded the track, and brought the train to a standstill within one-half of its own length. The tender remained with the engine, and was not damaged to any considerable extent. The first coach was hurled down the embankment into the ditch on the east side of the track, and in an instant the lower side of the car was in 4ft. of water, the passengers being thrown about promiscuously. The second coach did not overturn, but was whirled over into the ditch and filled with water to the seats. The third coach was found lying directly across the bank, while the fourth went down the embankment on the west side of the track, but not into the creek. Five other cars left the track, but were not thrown over the embankment. The air was filled with the heartrending shrieks of men, women, and children struggling to gain egress from the cars, which were rapidly filling with water. The train was brought to a standstill almost before the passengers in the rear coach were aware of the nature of the accident. In a moment, however, the latter rushed to the rescue of their unfortunate fellow-excursionists. The passengers in the wrecked cars were rapidly extricated from their perilous positions, and the injured were carried to the coaches remaining on the track." It will be seen that the train was broken into three portions. The engine and tender constituted the first, and remained on the road, just as the engine, tender, and van remained on the road at Penistone; the second portion of the train consisted of four cars, which ran down the embankment; the third portion consisted of five cars which left the rails, but did not run off the road, and seven cars which did not leave the rails. The train was fitted throughout with the Westinghouse brake, and we are told that it was pulled up in almost "half its own length." Can it be doubted that, but for the effectual action of this brake, at least the five cars which left the track would have followed the preceding four down the embankment, with fearful results? Indeed, so far as can be seen, the Westinghouse automatic brake in this case averted an appalling calamity, and converted the event into an accident of very minor importance.

It is highly desirable that the truth should be continuously enforced until railway companies accept the inevitable. Directors may fight against it as much as they please, in the end the result will be the same. We confess, however, that we are now and then discouraged when we hear men like Mr. Moon, of the London and North-Western Railway, or Sir Edward Watkin, of the South-Eastern, declaring against the automatic brake, and asserting that they have the best brakes in the world. It would be impossible to read what Sir Edward Watkin is reported to have said at a recent meeting of the South-Eastern shareholders without a smile were the subject less serious. Sir Edward, being asked by a shareholder if the brake in use on the South-Eastern was the same as that on the Manchester, Sheffield, and Lincolnshire Railway, replied "that the brake used on the South-Eastern was the vacuum brake, which was the very best brake out. The brake spoken of in competition with it—viz., the Westinghouse brake—was, in his opinion, one of the most complicated and dangerous brakes that could be put into operation. The Westinghouse was worked with an air pump at a pressure of 90 lb. to the inch. This was on the engine, so that if the air pump were to explode—and it was not an impossibility—it would lead to the most dreadful disaster. In the accident which had been alluded to the brake did its duty. The brake was on, and the carriages held together; and if, through Providence, the engine-driver could have gone another sixty yards, the train would have got into the cutting, and there might not have been a single injury." What Sir Edward has to say on such a subject would have no importance at all but for the fact that he is chairman of railway companies. The statements we have quoted lead irresistibly to one or other of two conclusions, namely:—First, Sir Edward Watkin wished to deceive his hearers; or, secondly, he knows nothing at all about brakes. As the first conclusion must, of course, be rejected, we are compelled to accept the second. The idea that a Westinghouse pump should "explode" is not more remarkable than the theory that by exploding it would cause a dreadful disaster. It is a great pity that Sir Edward was not pressed on this point, and asked to explain his meaning. The information that if the engine-driver could have gone sixty yards further he would have entered a cutting, and no lives would have been lost, is delicious. Sir Edward's faith in cuttings is so great that he would, perhaps, have all railways running in trenches. This state of mind comes of dealings with Channel tunnels and Metropolitan lines. The assertion that the vacuum brake is "the very best brake out" has a Rip Van Winkle flavour about it, which leads to the theory that Sir Edward Watkin has been asleep to all that has taken place in the recent history of the brake question. No one, engineer or layman, who knows anything about brakes, will agree with Sir Edward Watkin—not even those who are most interested in pushing the vacuum brake. Let us suppose that a meeting of mining shareholders was called, Sir Edward Watkin being the chairman, and that he was asked if the pumping machinery at their mine was efficient. If his reply ran, "We have an atmospheric engine by Newcomen and Cawley, which is the very best pumping engine out. The compound pumping engine is worked at a pressure of 90 lb. on the square inch; if it were to explode—and it is not an impossibility—it would lead to the most dreadful disaster"—what would be thought of him? Smith's vacuum brake bears at present just the same relation to good automatic brakes that the Newcomen engine does to the best modern compound pumping engine. The brake is a thing of the past, interesting from an historical point of view, but quite out of place on a main line fast passenger train.

THE METROPOLITAN DRAINAGE OUTFALLS.

A committee of the Metropolitan Board of Works devoted a portion of last Monday to an inspection of the river Thames at Woolwich. We may consider that very few of her Majesty's subjects, having the day at their disposal, would care to appropriate the happy hours of a Bank Holiday to the task of looking after the metropolitan sewage. The fact that the Metropolitan Board were able to muster a Committee for the purpose says something for the public spirit which animates the body. The visit was paid, and it is reported that the Committee found everything to their satisfaction. The measures of deodorisation recently adopted at the outfalls had proved successful. The water, it is said, "presented its normal appearance." According to the opinion of some people, this is not saying much, so far as concerns the river about Woolwich. But we are assured that "there were no offensive smells on the banks or on the stream." Had the day been any other than a *dies non*, the chances are that certain odours would have manifested themselves on the banks, even if the stream had been innoxious. There is, indeed, a difficulty in determining whence all the unsavoury odours proceed which haunt the banks of the Thames below and about the metropolitan boundary. There are factories on the banks of the river which need deodorising as much as the river itself, and occasionally more so. Possibly these disagreeable places were in a state of quiescence on the day in question. Had the river been foul, its condition would have been detected; and the Committee say they found nothing amiss. So may it ever be. Yet, if we are to believe some eminent authorities, the Thames was in a fearful plight in the early part of July. That such testimony was in some degree true is admitted by the Metropolitan Board. The satisfactory state of the river is attributed to "the measures of deodorisation;" and the explanation is one for which the Committee must be more or less responsible. Besides, it is scarcely to be supposed that the Metropolitan Board would involve themselves in a large expenditure to do something which had no need to be done. The deodorising process has been a costly one, and the Board have committed themselves to its continuance, having established chemical works of their own at Crossness, in order to provide the necessary ingredients.

The Metropolitan Board, it will be understood, have not attempted to purify the London sewage. All they dare to undertake is just to subdue the odious smell which is given forth in hot weather. To do so much as this has been no small undertaking. In a communication addressed to the Home Secretary, the Board state they encountered "great and unexpected difficulty in obtaining an immediate supply of the large quantity of chemicals required." The demand thus made was sufficient to raise the price in the market, and the experience gained has induced the Board to start the Crossness factory. Few people have an adequate conception of the magnitude of the London sewage. A single grain of suspended matter in a gallon of water seems a very small affair. But a grain per gallon in the London sewage represents a total of ten tons per day. Enthusiastic inventors, who propose to treat the sewage at the outfalls with just half an avoirdupois ounce of chemicals per gallon, are amazed to learn that they must provide more than 2000 tons of material per day, or more than 700,000 tons per annum. This likewise shows the enormous mass of suspended matter contained in the sewage of the metropolis. A careful and combined series of tests, devised and carried out by Mr. Dibdin, the head of the Chemical Department of the Metropolitan Board, prove that the average amount of suspended matter in the London sewage is 27 grains per gallon. This of itself represents 270 tons per day, irrespective of matters in solution, and amounts to more than 98,000 tons per annum. Our old friend, the Native Guano Company, which has survived the general smash of sewage adventures, wrote to the Metropolitan Board the other day, stating that it was prepared to enter into a contract to deal satisfactorily with "the whole of the sewage of London," relieving the Board from all further trouble, the contract to be backed up by a substantial monetary guarantee, the company undertaking to "produce a satisfactory effluent without nuisance." Such an offer as this would appear to present a perfect deliverance for the Metropolitan Board. One gentleman, who resides on the summit of Shooter's Hill, and also scents the sewage of London whenever the river is low and the wind is in the north-east, wonders how the Metropolitan Board can refuse such an "efficient and reasonable offer." As it happens, the Board have seen fit to mark the offer as "declined with thanks," and are going to rely upon their own resources. Twelve years ago the Native Guano Company was dealing with a portion of the London sewage at Crossness, with the result that it produced an excellent effluent, but without a sufficient proof as to the commercial success of the enterprise. In the process which the Board are adopting, there is no pretence of profit. Sundry thousands of pounds per annum will be cast into the Thames without the faintest attempt to get any of the money back again. Consequently, lack of profit is no argument against the A B C process, except that no trading company can be expected to work on permanently if all the work entails a pecuniary loss.

The Native Guano Company, it will be understood, proposes not merely to deodorise the London sewage, but to purify it. The precipitated ingredients will be collected in tanks, dried, and sold as manure. The Metropolitan Board intend to have no tanks and no drying process. They will simply dose the sewage with a chemical compound, which shall serve to prevent the escape of noxious effluvia. The sewage, plus the chemicals, will run into the river and take its chance. If precipitation follows, the Thames will be the tank, and sewage mud will be the result. But the Board do not want to precipitate the matters in suspension. Hence their use of chemicals will be moderate, and we may presume that the process will only be carried on when absolutely needed. The Board assert that the river only becomes offensive under the combined conditions of a reduced flow of water and a high temperature. This combination, it is stated, only lasts for a short time, and occurs at distant intervals. From these statements it is evident that the Board intend to do as little as possible. Supposing the Native Guano Company to step in once more, the undertaking would be directed to the production of a good effluent and a saleable manure, the process going on all the year round. On the former occasion the Native Guano Company added so much to the solid materials of the sewage that it more than doubled the weight. If the precipitated matter could be sold at a profit, the larger the quantity the better it would be all round. But if all the suspended matters in the London sewage were thrown down, and if the added weight of ingredients equalled the weight of the suspended matter, the manure would be produced at a rate exceeding 500 tons per day. A few weeks' storage of such an output would be a serious affair, and the preliminary process would demand an immense area for the precipitating tanks. In addition, there would be the drying apparatus, and other paraphernalia. The immense bulk of the London sewage, pouring down day after day, and every day, makes it next to impossible to treat the whole of the liquid with a view to collecting and selling the deposit. Apparently, the most that can be done in that direction is to watch the river and give it a dose of disinfectant when the case requires it. This may be thought a lame and impotent conclusion, and certainly it is, if we are to entertain the idea that there is an available process whereby a crystal effluent may be obtained, and nearly £2000 per day secured by the sale of manure. If the manure can be sold at anything like £3 10s. per ton, on a large scale, the Native Guano Company has a good case. Or, if it can fulfil a more modest *rôle*, and will just make the river as pure as the Metropolitan Board are going to make it, with the additional advantage of producing a profitable manure on a reduced scale, the company will do well. The scheme of the Board may be objected to on the ground that, despite the best of care, there is risk of increased precipitation in the bed of the river. Treatment in tanks, whether by the A B C process or any other, prevents the deposit of mud in the stream, and if this could be made a profitable operation there could be no doubt it would be the proper plan, always providing that no nuisance was created on the land as bad as that which has to be eliminated from the river.

The subject is one which demands consideration at the present time, seeing that the Royal Commissioners who are investigating the outfall question have recently spoken out concerning it in very unmistakeable terms in the shape of a letter addressed to the Home Secretary. Lord Bramwell not only speaks for himself, but commits his colleagues to a statement that the river in the vicinity of the outfalls on a certain day "was in such a state as to be a disgrace and a scandal to the metropolis and civilisation." If the Metropolitan Board could only have obtained their chemicals a little earlier, they might have anticipated the visit of the Sewage Commissioners, and so have made things pleasant. But the Board happened to be a day too late, their deodorising operations commencing on the day after the Commissioners had explored the locality. Lord Bramwell and five of his colleagues went up the river and down the river, and his lordship asserts that they found "ten miles of sewage." Another authority speaks on the subject in the person of Mr. J. B. Redman, member of the Institute of Civil Engineers, who, in a letter to the *Times*, describes the sewage from the outfalls as being driven back by the tide on certain days so as to manifest itself as high up the river as Blackfriars, or even Westminster. Some of the facts narrated by Mr. Redman are consistent with the idea that some portion of the outfall sewage was liberated on the flood tide. Such a circumstance is sure to occur occasionally, the sewage reservoirs being too small for the present volume of sewage. Had the Metropolitan Board been more prompt, and undertaken the enlargement of these reservoirs at an earlier period, they might have accomplished the work before the appointment of Lord Bramwell's Commission, with considerable benefit to the river. The state of affairs has now become critical. Without waiting for the final report of the Commissioners, Sir William Harcourt wrote some days ago to the Metropolitan Board, intimating that, unless they took the requisite measures to improve the state of the Thames in connection with the outfalls, it would become his duty to take action himself. The Metropolitan Main Drainage Act gives the Home Secretary authority for this purpose. But it is fair to notice that the Board commenced deodorising the sewage on the 10th ult., being four days prior to the date of Sir W. Harcourt's letter. As already explained, the deodorising process was also delayed by a practical difficulty. But there is the fact that the Thames becomes highly offensive in certain states of the weather, owing to the volume of sewage poured in at Barking and Crossness. Some remedy must be devised, and the engineer rather than the chemist seems to be required for the purpose. At one time there was room for hope that no very extensive measures would be necessary in order to settle the outfall question. But the trouble presents itself now in a worse form than ever, and the demand for the removal of the outfalls to some point lower down the river is daily gaining strength. The old project of taking the metropolitan sewage to the coast of Essex is again discussed, though the notion of reclaiming the Maplin Sands is scarcely entertained. On the whole, there seems a great probability that the London sewage will have to be carried further away, though deodorisation may be practised for a time. When the Main Drainage Act was passed there was an expectation that ultimately deodorisation would have to be employed, and at this point we have now arrived. But this is scarcely likely to be the goal, seeing how vast is the operation, and how it must be continually extended as the sewage increases in volume.

THE PROSPECTS OF YOUNG ENGINEERS.

In our last impression we indicated some of the causes which render it all but impossible for young men who have received an engineer's education—so called—to obtain work. We now proceed to consider the nature of the defects in teaching which conduce to so deplorable a result. It may be worth while before going further to summarise what we have said. It amounts to this—that young engineers do not get work because there is not work for them which they can do. There are far too many in the profession, and yet it is perfectly understood by employers that at no time was it more difficult than it is now to find really useful men. At first sight this appears to be remarkable, because very great pains have been taken to educate young men up to a high ideal standard. But a little enquiry among employers will suffice to prove that there is a radical defect in the whole system. The ideal standard of perfection is not the true standard. The education of mechanical engineers is not just what is wanted. At the risk of offending the prejudices of many excellent people we assert that in the present day, and for some time past, far too much importance has been attached to what is called a scientific training. We can only estimate the good or bad qualities of any system of education or training by its results. The mechanical engineers who are making money are not, as a rule, scientific men, save in a very limited sense of the term. But they are profoundly versed in the practical knowledge of their business. A young man attends science classes; or he goes to a science college, and spends two or three years in learning all that can be taught him. At the end of that time we shall suppose that he gets, by good luck or favour, a berth as manager, we shall say of a department, or even of works of moderate dimensions. Before a week has passed away he finds that all his scientific training is entirely useless to him. It is valuable, no doubt; so was the bag of doubloons, found by Robinson Crusoe on his island. His scientific attainments will not procure him a salary. We have no desire to disparage scientific training; for certain purposes it is invaluable. To the young mechanical engineer it is of no bread-and-cheese-earning value whatever. Out of his college he finds himself in another world. He sees things done and results arrived at apparently by intuition. He finds theoretical knowledge of all kinds at a discount. He learns that precedent is the great rule of life, modified and adapted to circumstances by the brain power of one or more individuals. He sees, if he is observant, things done, which for the life of him he could not do either with his head or hands; and he finds that if he is to be a mechanical engineer, earning a salary either as a head draughtsman and designer, or as a works manager, he must begin to learn all over again. It would take up much more space than we have at command to give many illustrations of what we mean. It may be useful, however, to give one or two. Let us suppose that the scientific young man is called on to design a crank axle for a locomotive. The dimensions of his cylinders and the pressure is given him, and he goes to work. He knows all about moments, and the calculation of strains, and the strength of materials. The chances are a hundred to one that he designs something which no locomotive engineer in his senses would think of using. He will find almost at the outset that his calculations give him dimensions which are too small—a margin has to be added for safety. How much margin? He examines drawings of engines already made, and he finds that the margin is such that the shaft may be said to be all margin. His calculations are practically of no value whatever. How, he may ask, is it that certain sizes are found to be right? We answer that these proportions have been arrived at by a long process of trial and error; and that the crank shaft of a modern locomotive is the result of the accumulated experience of half a century. Furthermore, all his information about the strength of steel or iron is useless to him in this connection, because the shaft that is strong enough to-day is too weak in a year, or it may be in ten years. Our young engineer will be better prepared to design a crank axle after one hour spent with rule, calipers, and note-book in a locomotive repair shop than he would be after six months' study in a college. Again, no subject has been more elaborately treated from a high scientific and mathematical point of view than the steam engine. To the steam engine maker such investigations have proved absolutely barren of result. They have simply done nothing to improve the steam engine. The whole principle of steam engine economy may be summed up in a sentence or two:—Keep your cylinder hot. Let the initial pressure be as high and the terminal pressure as low as it can be consistently with the conditions of size and power to be complied with, and with the first condition. Here is the whole secret. Pages of formulæ, the differential and integral calculus, and all the resources of science, cannot advance us one jot beyond this point. We might pursue this line of illustration, as we have said, but only at the risk of being wearisome. Many of our readers can supply for themselves what we omit.

Is it possible, we may be asked, that a high scientific training is of no value to the mechanical engineer? We assert nothing of the kind. We do assert that it alone will not enable a young man to earn his bread as an engineer; and we add that most of the time spent in acquiring it is thrown away, whenever it prevents the acquisition of practical information. Let us, however, look at the other side of the picture. Let us take the man of middle life, who, established in his own offices, discharges the duties of a consulting engineer. To such a man scientific training is simply invaluable. Not only can he find a use for it, but he cannot do without it. He is no longer a manufacturer. It is not for him to deal almost exclusively with pounds, shillings, and pence. He is consulted because difficulties have arisen which experience does not suffice to solve. Such men represent in one sense the brains of the profession. But even such men ought to possess sound practical knowledge as well. If they do not, they will be certain to make very serious mistakes. The truth is that in mechanical engineering there are many departments, and the man who attempts to fit himself to fill every position will be almost certain to fail to do anything well. There is this advantage about a scientific training—that a man who receives it can hardly help learning a good deal. On the other hand, it is quite possible, nay, it is very easy, for a youth to pass through the shops and the drawing office and learn nothing. We have been surprised by the absolute, dense, ignorance of men who have served an expensive apprenticeship. The fault does not lie with the masters. It is, no doubt, within the experience of many of our readers that the same shops will turn out ignoramuses and consummate engineers. The first go through life with their eyes shut; the others always keep them open. Nothing that goes on around them escapes them. If they are erecting an engine, let us say, every dimension of every part that they can get at, finds its way somehow into a note-book for future reference. If a thing is weighed, and they get a chance of finding out, they will ascertain what it weighed. They are careful to ascertain how many hours are required to do any given job on the lathe or the planing machine. Such men, too, cultivate with great care the art of freehand drawing. This is entirely neglected by most pupils and students. It is never properly taught. We do not refer to landscape drawing, but to skill in sketching on paper parts of engines and machines. The man who can draw nothing without the aid of a set-square and scale, will find when he is called upon to design that he is miserably deficient in detail. He cannot design a cylinder and valve chest that can be moulded; he does not know what a practical crosshead is like; a feed pump is something quite beyond him. The man who has never missed a chance of making an accurate freehand sketch will, on the contrary, not be at a loss for a moment, even if he does not directly use what he has in sketch-book. The practical training which he has given himself will stand him in good stead. He will find himself, so to speak, steeped in the art of putting things together.

Lastly, we would point out that the mechanical engineer is born, not made. No amount of training—scientific, theoretical, or practical—will supply brains, and tact, and the art of doing the right thing at the right time. Very many young men become engineers, not because they are fitted for the business, but because they think they are. They find this out in the first year of their apprenticeship, and would change if they could; but they cannot. Our advice to most young men who wish to become engineers is like that given by *Punch* to those about to marry: "Don't." The exceptions are those whose fathers are engineers, willing and able to supply that special training which can hardly be obtained for love or money by those whose first connection with the profession in any shape or way takes place when their indentures are signed.

NORTHERN MANUFACTURED IRON.

THE manufactured iron trade of the North is one in which we have the advantage of frequent official statistics. The last of these brings our knowledge of the state of the trade down to the end of the half-year. It shows that to that time the trade continued to decline both in volume and in value. In all there was a production of 68,829 tons of manufactured iron in the last two months of the half-year, and the average price of the whole was £5 5s. 5d. In the preceding two months the quantity was 75,044 tons, the average price being £5 8s. 11d. This decline in two months is very heavy in proportion, and it brings down the price to what is the lowest that has been known for many years with the exception of one quarter about five years ago. But the extent of the production cannot be well compared with that of the time named, because the number of the firms associated together is greater now than it was. Looking at this fact, and remembering that the value of the iron trade may have further fallen since the time to which the return brings us, we may not unfairly believe that the deepest depths of the depression have been about experienced now. At the same time, as about 80 per cent. of the total production is in the form of angles and plates, principally for shipbuilding, it can be scarcely expected that there will be any early recovery. A few orders given out for new vessels will only keep up the trade to its present extent, and it can scarcely be expected that there will be any very early revival in the shipping trade, though the dullest point may have been reached. At the same time the loss will go on, and replacement to some extent will be known, but not until there is a better state of the shipping industries will there be any large orders given out for new vessels to benefit the iron trade.

LITERATURE.

Pocket-book of Electrical Rules and Tables, for the use of Electricians and Engineers. 1884. Griffen and Co., London. By J. MUNRO and A. JAMIESON.

THIS book, which is printed and arranged in the same manner as Molesworth's "Pocket-book of Engineering Formulæ," is, to the best of our knowledge, the first of its kind published in England, the nearest approach to it being the appendix by Mr. Jamieson to the sixth edition of Rankine's "Rules and Tables;" also published by Messrs. Griffin and Co. It contains an exceedingly useful collection of electrical information, commencing with units of measurement, and giving the formulæ and a short description of the various tests employed in both telegraphic and electric light work; tables of conductivities of the different kinds of wire employed; methods of jointing and insulating joints; data on electro-metallurgy, batteries, dynamos, motors, and electric lighting generally, and concludes with a table of logarithms, natural sines, cosines, and tangents. Some of the information in it might, however, have been omitted, and advantageously replaced by more information on other subjects. For instance, there is only one page devoted to photometry, a subject that could well be expanded to several pages. Again, if we turn to the subject of dynamometer tests, we find the only dynamometer mentioned is the Prony, and there is no information about any power transmission dynamometer. Transmission of power is, indeed, disposed of in one page. As regards telephonic instruments, we would suggest that in the next edition skeleton diagrams of the connections of the various forms of transmitters should be given, with hints on their adjustment.

On the whole, we can say that this is an excellent little compilation, and will in a second edition prove very useful to all connected with the various branches of electrical engineering. We must, however, point out that in a book which is obviously a compilation, and one on a comparatively new branch of practical knowledge, it would not only be to the credit of the authors or compilers, but a matter of much convenience to those who use the book, if they would credit those from whom they have taken much of their information, and give the references to the sources, so that any user could when necessary refer to the original. This has been but sparsely done, though one of the compilers seems to have been much afraid he should not get all the credit due to him. This course would also have prevented a good many mistakes in the book, as the compilers would probably have seen that in some cases they have given the same thing under different terms and units, and have copied the errors of their authorities. Errors of much importance are also made in the values of practical electrical units, and these are inexcusable, as several books have been published giving all in a concise form, such as Swinburne's "Electrical Units." There are numerous little mistakes in the book, but it may be expected that the authors have taken this first edition as a set of revise proofs.

Mineral Resources of the United States. By ALBERT WILLIAMS, Jun. 8vo., pp. 813. Washington Government Printing Office. 1883.

IN the newly-organised United States geological survey, provision has been made for the publication of a series of statistical papers having special reference to the mineral resources of the United States, and a special division of the survey has been formed for mining statistics and technology, under the charge of the author, whose first report is contained in the volume under consideration. This contains an estimate of the output of the mines and furnaces of the United States for the year 1882, the chief items of which are summarised as follows:—

Metallic Products.	Weight.	Value. Dols.
Pig Iron	4,623,323 gross tons ...	106,336,429
Silver	—	46,800,000
Gold	—	32,500,000
Copper	45,823 net tons	16,038,091
Lead	132,890 ,, ...	12,624,550
Zinc	33,765 ,, ...	3,646,620
Mercury	2,017 ,, ...	1,487,537
Nickel	138 ,, ...	309,777
Antimony... ...	60 ,, ...	12,000
Platinum	—	1,000
Total of metallic products		219,756,004

Non-metallic Products.	Weight.	Value. Dols.
Coal, all kinds except Pennsylvania anthracite ...	57,963,038 tons ...	76,076,487
Coal, Pennsylvania anthracite...	29,120,096 ,, ...	70,556,094
Crude petroleum	30,123,500 barrels ...	23,704,698
Lime	3,100,000 tons ...	21,700,000
Building stone...	— ...	21,000,000
Salt	896,732 ,, ...	4,320,140
Cement	325,000 ,, ...	3,672,750
Limestone for iron flux ...	1,950,000 ,, ...	2,310,000
Phosphate rock	332,077 ,, ...	1,147,830
New Jersey marl (fertilisers)	1,080,000 ,, ...	550,000
Crude borax	2,118 ,, ...	338,903
Mica	37 ,, ...	250,000
Crude barytes	20,000 ,, ...	160,000
Chromic iron ore	2,500 ,, ...	100,000
Steatite	6,000 ,, ...	90,000
Manganese ore...	3,500 ,, ...	52,500
Asbestos	1,200 ,, ...	36,000
Graphite	212 ,, ...	34,000
Sulphur	— ,, ...	21,000
Cobalt ore and regulus ...	— ,, ...	15,000
Precious stones (rough)...	— ,, ...	12,500
Asphaltum	3,000 ,, ...	10,500
Corundum...	500 ,, ...	6,250
Pumice stone	70 ,, ...	1,750
		726,156,402
Other minerals estimated at not less than		8,000,000
Grand total		453,912,406

The total value of the minerals produced is, therefore, rather more than £90,000,000 sterling. In these figures are included everything of mineral origin, even to bricks and tiles, grindstones, lime, &c.; and, therefore, some deduction would have to be made in comparing them with the returns made for other countries.

The above figures are taken from the introductory summary, the data upon which they are formed being contained in the detailed chapters devoted to each mineral. These are all interesting, though of unequal merit, one of the best being that on coal by the editor and Professor Ashburner, of the Pennsylvania State Geological Survey, the latter dealing with the anthracite districts. A classified list of mineral localities in the United States, the work of several contributors is especially valuable as showing in a compact and concise form the principal occurrences of minerals of industrial importance, as well as indicating whether they are or are not being utilised. Such lists have long been wanted as forming the first step towards a proper mineral geography.

In addition to the proper subject of the volume, there are sundry articles printed under the head of miscellaneous contributions, which are certainly a little mixed. Thus we have a paper on electrolysis in metallurgy side by side with one on the divining rod. The particular purpose of the latter is not apparent.

Scattered through the volume will be found numerous technical papers on the metallurgy of the different metals, and a good market review of the trade is given for each of the principal metals in connection with the statistical part. A point worth notice is the extreme cheapness of the volume. It is a large octavo, the page measuring 9in. by 5½in., nearly 2in. thick, in a serviceable cloth binding, and is sold for 50 cents, or two shillings.

TEXTILE EXHIBITION.—An exhibition in connection with the great textile trades was opened in the Agricultural Hall, Islington, on the 4th instant, and closes on the 20th of September. It includes—machinery in motion, cotton spinning, cloth weaving, rhea fibre dressing, hosiery manufacture, silk weaving, dyeing and printing, English and foreign fabrics, costumes of all nations, raw materials, and mill fittings and appliances.

RICHARD GARRETT.

WE announce with sincere regret the death of Mr. Richard Garrett, of Saxmundham.

Richard Garrett was born at The Works House, Leiston, on the 22nd July, 1829, the twin and eldest son of Richard Garrett, the then proprietor, sometimes called the Founder of Leiston Works. As a matter of fact, however, there were at that time living four owners of the now famous name of Richard Garrett, of whom each had been, or was to be in turn, at once the senior partner of Leiston Works—which was founded in the year 1778—and head of the Garrett family. The Leiston Works then consisted of an ironfoundry, a smithy peopled by a strong band of those invaluable mechanics who still pass by the name of "country blacksmiths," men who, with the assistance of the third department, viz., the wheelwrights' shop, represented in embryo the engineers and machinists of agricultural engineering in the present day.

The Richard Garrett whose memoir we are now writing was educated at a good old-fashioned private school at Woodbridge, where he attained a popularity which still survives him. A boy of unusual personal attractions and influence, untiring energy and courage, his school life was in itself a little history upon which those who participated in its events still look back with pride and pleasure.

At the age of fourteen, however, Richard Garrett left school to embark, under formal indentures of apprenticeship, upon that best of all educations for an engineer, the post of apprentice-assistant to his enterprising father, who, in his own brave battle forwards in the development of Leiston Works, stood in urgent need of such assistance. It need scarcely be said that the influence of so promising a pupil-son soon took effect at Leiston Works, and at an age when most lads can be scarcely said to regard life seriously, Richard Garrett the younger, was to all intents and purposes works' manager; a position of which he took formal occupation on the completion of his majority in 1850. In 1853 he became a partner with his father and younger brother, John D. Garrett, who seceded from the business in 1860; and on the death of his father in 1866, Mr. Garrett succeeded to the position of head of the Garrett family and senior member of the Leiston firm, in partnership with his two brothers, Henry Newson Garrett—who also seceded from the business in 1878—and Frank Garrett, between whom and the subject of our memoir there existed bonds of close attachment.

Richard Garrett may be stated generally to have devoted his life to the construction and development of the thrashing machine—first as a horse-power implement, and later as the finishing machine, otherwise termed the combined thrashing, dressing, and straw-shaking machine, and the merits of his celebrated invention, patented in combination with the late James Kerridge, the then foreman of the thrashing machine department at Leiston Works, under date 18th January, 1859, No. 153, still finds high appreciation in all quarters of the globe. Under this arrangement the wind employed for the two or three blasts necessary at different intervals in the preparation of the grain for market by the combined machine is produced by one fan, which is keyed upon the same spindle as the thrashing drum, and the blast is conveyed to the needful points of contact with the grain through wooden channels. The advantage of such a system—which was probably suggested to the inventors by the arrangement adopted in all large smithies for the blowing of the fires by one large fan instead of by a multiplicity of bellows—is so apparent that it only needs to be added that the practical difficulties attending the application of the invention were completely mastered, in order to make its value understood.

Next to the thrashing machine the portable steam engine may be said to have been the object of Richard Garrett's engineering life; and perhaps no man living had a more thorough knowledge of the subject. Resolute in all his dealings and opinions, a most careful and trustworthy mechanic, and a perfect manager of workmen, firm and just and charitable, it is difficult to say whether he was most beloved or respected by his men; and the old hands are still working at their benches at Leiston who helped him to carry the Leiston portable engine forward through its multiplicity of stages to its present prominent position. We have spoken of the resolution of Mr. Garrett's opinions, and this resolution was applied with characteristic vigour to matters of mechanical construction, and nothing would induce him to adopt a form of construction in his designs because it was simply "fashionable." As an instance of this characteristic we may allude to one point in particular, in respect to which the Leiston engines differ from those of most other leading makers. Nothing would induce Mr. Garrett—at one time even at the risk of a most valuable connection—to construct the commercial portable engine, in which the steam is only used expansively to a very limited extent, with a steam jacket. Mr. Garrett had satisfied himself that a steam jacket was under such conditions misapplied, and consequently he refused to sacrifice his conviction upon the altar of fashion. He was also much opposed to automatic expansion as applied to portables, and to the undertype of semi-portable, and these forms of construction he never hesitated to condemn. Of the compound system of expansion in double cylinder portable engines he was as resolute an advocate; and although the credit of instituting this arrangement may be directly attributable to his brother and surviving partner, still the enterprise was undertaken under the highly interested approval and advice of Richard Garrett.

As already stated in our issue of the 1st inst., Mr. Garrett was a member of the Institution of Civil Engineers, to which position he was elected on the 30th October, 1877, at the instance of the late Mr. Amos, who acted for so many years as consulting engineer to the Royal Agricultural Society of England, supported by the following other members of the Institution:—Messrs. Edward Easton, James Easton, W. Menelaus, Ewing Matheson, W. Anderson, J. E. Gwynne, Peter Bruff, B. Samuelson, M.P., and Robert C. May. Upon this qualification Mr. Garrett set great store. He was also a member of the sister Institute of Mechanical Engineers. We have thus treated of Mr. Garrett in his capacity of an engineer and employer of labour, and on this head we have only to add that in such business capacity he was latterly strongly opposed to the fashionable tendency in his branch of engineering to a never ending system of over-production and over-speculation, and for this reason he would not consent to any material further extension of Leiston Works, although commercial openings for such enterprise were never wanting. In his private capacity, Mr. Garrett was very prominent as a sportsman and an agriculturist. As a young man he rode to hounds regularly twice a week throughout the season. He was also a great advocate of pugilism in the days when there was no discredit attached to the prize ring, and as an amateur he is said to have had no equal, even Tom Sayers being stated to have admitted the superior science and endurance of Mr. Garrett. In his later years Mr. Garrett devoted all his leisure to shooting. In the gratification of this taste he for many years rented the Dalmigavie grouse moors, near Inverness, of Mr. Aneas McIntosh, and more recently the entire Suffolk estate of Mr. William Angerstein, of Weeting Hall, near Brandon. It was here that the happiest days of his later life were spent. Holding some 2000 acres, he liked to call himself a Suffolk tenant farmer. He was a first-rate judge of horses, sheep, and cattle, and his collection of cups and prizes, of which a large proportion are attributable to the merits of his two unrivalled Suffolk cart horses, "Cupbearer the First, and Third," are, perhaps, almost unequalled in England. Mr. Garrett was at one time also known as a breeder and owner of racehorses, and although he won but little, still he was far from unsuccessful, and he was naturally very proud of the success of a horse of his own breeding. To the betting ring as an institution he was bitterly opposed, and it was his boast that he only backed his own opinions and his own horses at any time, and had never made a book.

Mr. Garrett was a warm supporter of the volunteer movement, and was often styled the "Father of the Leiston Rifle Corps," whose rank and file he was the first to join in its formation in 1860. Although his regard for the movement never waned, he retired from active service in 1870, after attaining the rank of major in the then 3rd Battalion of the Suffolk Rifle Volunteers.

Mr. Garrett's health had been failing for some years from heart disease, and since last March, when his mother passed away at the ripe age of 78, it had been yielding rapidly to the influence of the grief which took so strong a hold upon his already shaken system, and day by day his capacity for business and interest in the life around him faded, until on the 30th July he expired suddenly, in the morning, in the midst of a cheerful conversation with his attendant. Mr. Garrett was an exceptional man, combining the country gentleman and the engineer of the best types, and his loss will be regretted by a very large circle.

CHARLES MANBY.

THE name of Mr. Charles Manby, F.R.S., M. Inst. C.E., has for forty-five years been known wherever a member of the Institution of Civil Engineers has lived, and that is all over the world. He was born on the 4th February, 1804, and died on Thursday, 31st July, 1884, from disease of the liver, followed by dropsy. Thus has closed a career which, chiefly through its identity with that of the Institution of Civil Engineers, has been a power amongst engineers. Mr. Manby was for seventeen years the paid, and for twenty-eight years the honorary secretary, of the Institution. He was the eldest son of Aaron Manby, whose name was so well known as the founder of the Horseley Ironworks, and subsequently of the Paris Gasworks, of ironworks at Charenton, and he reorganised the great Creusot Ironworks.

In referring to the career of Charles Manby we might quote from an article in THE ENGINEER of the 16th January, 1857; but we may be content to refer to that, and to choose to quote from a notice of his death which has appeared in the *Times*, and which tells us that Manby was originally intended to follow a military career. With that object, as well as to acquire foreign languages, he was sent in 1814 to a semi-military college at St. Servan, in Brittany. But the ideas of peace which prevailed after the Battle of Waterloo caused this intention to be abandoned, and he returned to his father's workshops to go through a regular course of training as a practical mechanic. This led to his being occupied on some of his father's contracts, among other places at the East and West India Docks, where he was noticed by John Rennie, and became known also to Thomas Telford, and to other famous engineers of those days. For his father he was also engaged on the design and construction of the first pair of marine engines with oscillating cylinders; upon the building of the Aaron Manby, the first iron steamship that ever made a sea voyage; and upon the several works in France before enumerated. Subsequently he accepted a commission in the French service, and had charge of the Government tobacco manufactories. Towards the close of 1829 he returned to England, became connected successively with the Beaufort and the Ebbw Vale Ironworks in South Wales, and with the Bristol works of Messrs. Harfords, Davies, and Co. He removed to London in 1835, where for four years he practised the profession of a civil engineer in partnership with Mr. H. H. Price, the firm being mainly occupied in warming and ventilating public and private buildings.

In 1839 he was appointed secretary of the Institution of Civil Engineers, and soon afterwards threw himself, heart and soul, into a movement which revolutionised the society. The presidential chair had been held for ten years by Mr. James Walker, who seemed to regard it as a life-honour, as it had been in the case of Thomas Telford, the first president. It was felt, however, by many rising men, especially by those connected with the great railway works then in progress, that the chair should be open to all sections of the profession. After some debates—which, like all those that precede any material reform, however much it may be necessary, though not thought so by those who for various reasons believe in the things that be—were of a stormy character, Mr. Walker retired, and the chair has since been filled by men whose names have been great in the profession. During the time he acted as paid secretary for the Institution, his genial disposition acquired him a popularity which never faded. He had a remarkable way of making himself necessary to everyone, or at least to make all appeal to him when wanting friendly assistance, and he became a trusted friend and companion, ever ready to aid the senior members, to help the juniors, and to afford a cordial welcome to all foreign scientific men. As evidence of the appreciation in which he was held, it may be mentioned that when, in 1856, he relinquished the position—which has since been filled with unique ability by his pupil, Mr. James Forrest, Assoc. Inst. C.E.—he was presented with a service of plate and a sum of two thousand guineas, "as a token of personal esteem, and in recognition of the valuable services he had rendered to the members individually and collectively." In acknowledging this compliment, he asked to be allowed to devote a portion of the sum to the foundation of an annual premium which should bear his name, and the Manby Premium now forms one of the prizes at the disposal of the Council. At the same time he made suggestions which resulted in the establishment of the Benevolent Fund. Again, in 1876, Charles Manby received from the members of the Institution of Civil Engineers a silver salver and a purse of upwards of £4000, "in friendly remembrance of many years' valuable services." When he resigned the position of acting secretary, he accepted that of representative in London and abroad of the firm of R. Stephenson and Co., of Newcastle-on-Tyne, and this he occupied till his death. Charles Manby was affectionately known and spoken of by his intimates of forty years ago as "Charlie," and much of his power resulted from a disposition which acquires for its owner a certain kind of familiarity whenever he chose to permit it. He laid no claim to engineering skill, but he was a remarkable man, and his admirable physique and mental activity were illustrated by the zeal and energy he displayed in his work down to the end of a prolonged life. The great variety and number of men—scientific, artistic, and literary—whom he drew to himself were indicative of the peculiar attractiveness of his character; but it must be acknowledged that while none could be warmer or more constant in attachment, so, on the other hand, as a partisan or as an opponent he was, as the writer we have quoted tersely puts it, "very human." He was a fair musician, posssessed some literary ability, and had great presence of mind, ready wit, and humour, so that, without profound knowledge on any subject, his versatility and his colloquial powers enabled him to hold his own in any society. His grey eye shone with a woman's tenderness on a friend, but it lightened up with brightness that was not to be mistaken on an obstinate opponent. "The stuff that was in Charles Manby was typical of the spirit that has raised the pro fession to its present state—a determined will, guided by an intelligent brain, and ordered by the discipline of a thorough man of business and of the world.

With unfeigned sorrow, a sorrow that will be widely felt by all engineers, we regret to have to add that none of his old friends and colleagues were allowed to pay the last mark of respect by attending his funeral, which was conducted with the utmost privacy on Tuesday, at the Eastbourne cemetery.

REVOLVING BLACK ASH FURNACE.

THE revolving black ash furnace, or the "revolver," as it is generally termed in the chemical trade, furnishes another instance of how mechanical inventions are gradually being applied to every industry with the object of reducing the cost of production. This machine is used in the manufacture of soda, an industry that has developed within a comparatively short period into a trade of considerable magnitude. Some idea of its extent may be gathered from the fact that in 1883 no less a quantity than 708,070 tons of salt were converted into 602,250 tons of alkali, of which about 120,000 tons were caustic soda. Its enormous expansion in recent times is shown by comparing these figures with those of the year 1862, when only 254,600 tons of salt were used and caustic soda was only a scientific curiosity, or at most a laboratory reagent.

This rapid development has naturally called forth many improvements in the apparatus employed, and amongst the most important of these may be placed the revolving furnace. The process by which the great bulk of the alkali is produced is that known as the "Leblanc," so named after its illustrious originator, in which the chloride of sodium, or salt, is first converted into sulphate of sodium, and then, by fusion with carbonate of lime and slack, into black ash or crude carbonate of soda, out of which the soda is first dissolved in water, and then recovered by evaporation. The process of fusion was originally done exclusively in hand furnaces, a practice which involved a great amount of heavy manual labour, in order to insure sufficiently intimate and uniform mixture of the materials, and to expose every part to the action of the heat. About the year 1852, Messrs. Elliot and Russell, of Wallsend, then of the Patent Alkali Company, St. Helens, perceiving the advantages to be gained by the substitution of some mechanical means of mixing the materials in the furnace for the old laborious method of hand rabbling, conceived the idea of making the furnace bed in the form of a horizontal cylinder which, in its revolutions, should mix up the charge by continually rolling it over upon itself. Like most inventions of any importance, however, the revolver has had an eventful career, and its ultimate success stands as another tribute to the perseverance and ability of our manufacturers.

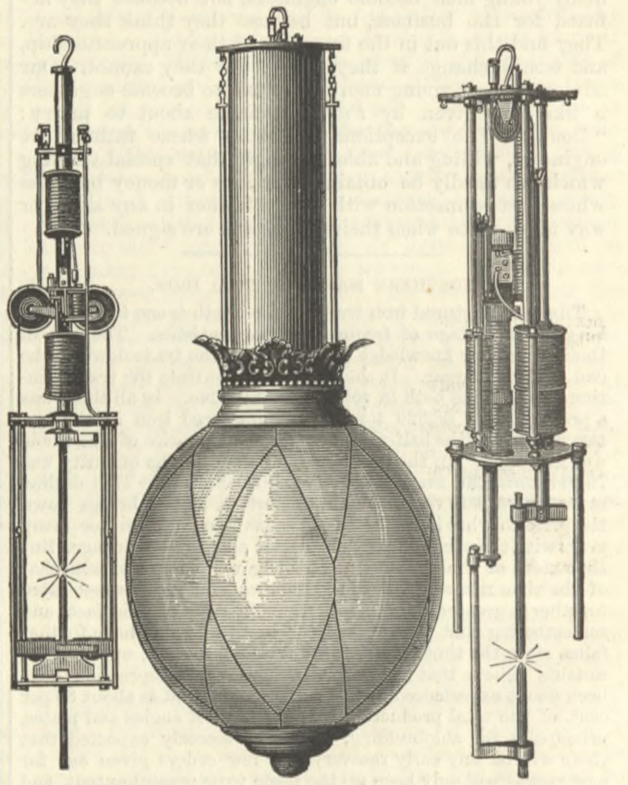
The following short *resumé* of its history may prove interesting to some of our readers. Several experimental furnaces were originally made by Messrs. Robinson, Cooks, and Co., of St. Helens, for Messrs. Elliot and Russell, but great difficulty was experienced in so mixing the charges as to make the soda in the product easily soluble. In 1854 a larger one was made, and sent to the Jarrow Chemical Company, South Shields, where it was worked for many years. It was here that the successful method of working the charges in the revolver was accomplished, and the credit of making the machine a practical success for the soda process belongs to Mr. J. C. Stevenson, M.P., the present representative of South Shields. Many years elapsed, however, before the invention was taken up by the alkali manufacturers generally. Messrs. Gaskell, Deacon, and Co., of Widnes, and Messrs. A. G. Kurtz and Co., of St. Helens, subsequently adopted it in the year 1868. Since that time the number in use has rapidly increased, and now no works of any importance in the manufacture of soda is without one or more. As might be expected, the size of the furnace has gradually increased, until in the case under notice we have a revolver capable of doing the work of eighteen hand furnaces, though occupying the space of only three. This furnace, which we illustrate on page 106, was made for and erected at the Widnes Alkali Company's works at Widnes, by Messrs. Robinson, Cooks, and Co., of the Atlas Foundry, St. Helens, whose Widnes foundry we took occasion to notice in THE ENGINEER of November 23rd last year. It is capable of producing from 80 to 90 tons of black ash per day, thus making a notable addition to the capacity of what is already the largest works of its kind in existence, its weekly produce reaching 600 tons of finished caustic soda, and 130 tons of bleaching powder.

This revolver, which is the largest that has ever been made, consists essentially of three parts—first, the heat generator seen on the left hand; secondly, the bed in the form of a large hollow revolving cylinder, which contains the materials to be operated upon, and through which the flames and heated gases pass; and thirdly, the gearing and engines seen at the right hand for driving the revolving cylinder round. The fireplace is rectangular, 17ft. by 10ft., with firing holes along one side; it burns 25 cwt. of coal per hour. The revolving cylinder is made of wrought iron plates, and is internally lined throughout with fire-brick and encircled by two bearing or carrying rings, which run on four carrying wheels supported at a convenient height above the floor by strong box bed-plates. In the side of the cylinder are two openings provided with strong movable doors, which are secured to the shell by necessary bolts and straps. When it is required to charge the cylinder the doors are taken off and the cylinder is turned round until these openings are directly under the charging hoppers seen overhead in the engraving, which have previously been filled with material from charging wagons running on an overhead railway, on to which they are lifted by a powerful steam hoist seen on the extreme right. As the revolver is represented in the engraving in the act of being discharged, no explanation is necessary except to mention that the bogies as they receive the finished charge are drawn along by a steam winch.

Movement is communicated to the revolver by means of strong spur gearing, and a pair of coupled steam engines, so arranged as to run at varying speeds to suit the operation in its different stages. Though this furnace is remarkable and important for its great size alone, it also possesses special interest from the fact that it is fitted with the patent solid cast steel combined bearing or carrying rings of Mr. Cook. These carrying or bearing rings have hitherto been made of cast iron, having wrought iron or steel tires shrunk upon them; but owing to the elongation of these tires from the continual rolling action when at work, as well as from the different ratios of expansion between the iron and steel, these tires frequently come loose and become troublesome. By this improvement in the construction by Mr. Cook, the tires are dispensed with altogether, and the carrying rings themselves are made of solid cast steel, so that the fruitful source of trouble and loss in the loosening of the tires is entirely obviated. These revolving furnaces of a smaller diameter have also been made by Messrs. Robinson, Cooks, and Co., for some of the large glass works in St. Helen's, for use in one of the many processes of that important branch of trade.

THE LIGHTING OF BETHNAL-GREEN MUSEUM.

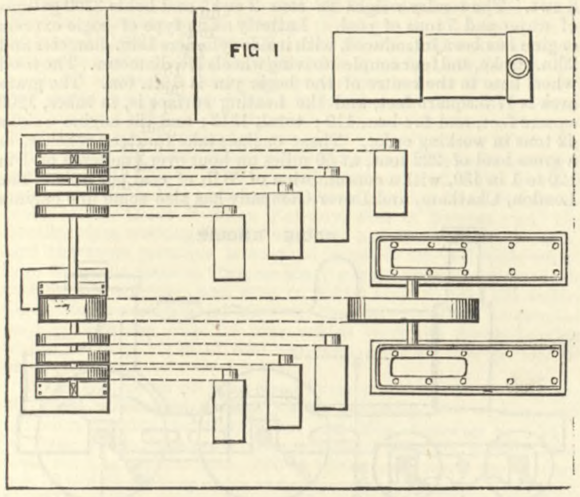
THE experience which has been gained in electric lighting has brought about a better state of things than existed two years, or even one year, ago. The mistakes and failures, consequent on ignorance, which brought discredit on the system at the outset, no longer occur to further shake the wavering faith of the public. Its confidence is being regained; slowly indeed, but surely. Fresh instances of the application of the light are few, and such as occur are on no very extensive scale. But each new installation yields satisfactory results, and every fresh success tends to place electric lighting on a more secure footing. For this reason, all who are not interested in the failure of the system must view these achievements with unmixed pleasure, as bringing rapidly nearer the complete realisation of hopes that seemed at one time doomed to be disappointed. To none are these successes likely to bring greater joy than to the shareholders of lighting companies, who have suffered most severely from the adverse circumstances into which electric lighting has fallen. These will see in every new installation successfully accomplished, even though it be that of a rival company, a long step taken towards the issue from their state of difficulty.



THE PILSEN ARC LAMP.

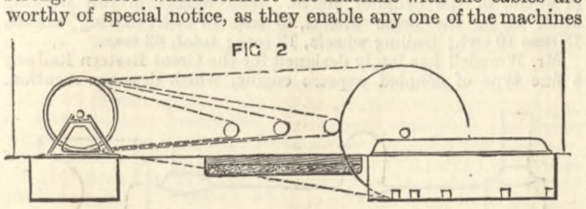
The lighting of the Bethnal-green Museum by the Pilsen and Joel Company affords many points of interest. To the public it is an instance of successful lighting under conditions of some difficulty. The form and division of the building, and the varied character of the exhibits, render it necessary to mingle incandescent with arc lamps, a combination that must be skilfully contrived to produce a pleasing effect. To those who regard the installation from technical points of view—the electrician and the engineer—it is an instructive example of symmetrical arrangement, in which all the parts have been made to bear a due proportion one to another, and in which every contingency has been provided against without marring the general simplicity and neatness of the design.

The building consists of a central bay and of lower and upper galleries extending all round the interior, Figs. 3 and 4. The exhibits are distributed over these galleries and bay, the pictures, of which there is a considerable number, being in the upper galleries. To properly illuminate these upper parts and the bay arc lamps were needed, as a powerful white light was required; but the space beneath the galleries, and the parts in the shade of the cases of exhibits, could be sufficiently lighted only by numerous incandescent lamps suitably distributed. These requirements have been met by hanging at various elevations in the bay thirty arc lamps, and distributing in groups of three a number of incandescent lamps over the galleries. The incandescent lamps are carried on ornamental brackets fixed to the pillars which support the upper galleries. The result is a very evenly diffused light, in which everything is distinctly seen in its true colours. The advantages of the electric light could hardly be anywhere better appreciated than in a building of this character, where shades of colour in the exhibits often constitute essential features. The absence of anything like unsteadiness in the arc lamps leaves the effect unmarred. The basement of the building is lighted by incandescent lamps only. These are also distributed in groups of three; but unlike those above, they are surmounted by flat deflectors to deflect the upward rays. No ornamental work is here used in the lamp supports. The arc lamps are hung on two circuits of fifteen lamps each, every alternate lamp being on a different circuit. An accident to one of the circuits would, therefore, only have the effect of diminishing the light without altering its distribution. The incandescent lamps are set on three circuits of 106 lamps each. These are connected to a switch-board in such a way that they may be made independent one of another, or joined up parallel as may be required. The arc circuit cables are carried into the building from the engine-house through the roof, and those for the incandescent circuits are led in beneath the floor. The former are neatly disposed against the ironwork of the roof, and everywhere rest upon insulators; and the clumsy arrangement of festoons, commonly adopted to allow the lamps to be lowered, has been obviated by putting the pulleys into the circuit and suspending the lamps from them by means of bare wires. The incandescent mains are carried through the floor in cement troughing covered with slabs of slate. They are well insulated, and are of sufficient section to give a square inch per 800 ampères of current. In every main,



subsidiary circuit, and branch, a fusible cut-out is inserted to afford security against fire. The wiring has been done with the greatest care, and every possible precaution observed to avert accidents from over heating. These arrangements have been carried out under the supervision and with the full sanction of Mr. Musgrave Heaphy, who has expressed entire satisfaction with all the details of this installation which came within the scope of his duties as the engineer of the fire insurance offices. The switches are of good design, and are made massive and strong. Those which connect the machine with the cables are worthy of special notice, as they enable any one of the machines

FIG 2



to be in a moment put in connection with any one of the circuits. The advantages of such a switch are obvious. The machines are of the Schuckert type, with some important modification in the details of the construction introduced by the Pilsen Company. They are conveniently arranged as in Figs. 1 and 2, in the centre of the engine-shed to be driven off an 18ft. length of 4in. shafting erected at one end. There is one machine to each of the arc circuits, and a reserve machine is provided for cases of accident. All three machines are connected to the switch board already mentioned, by means of which the reserve machine can in a moment be substituted for the one

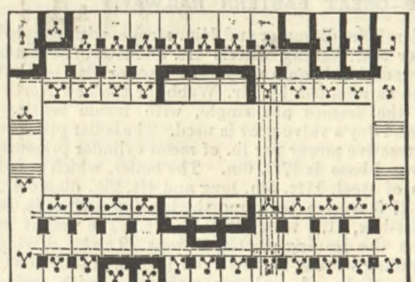


FIG. 3

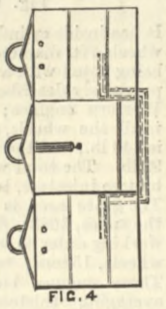
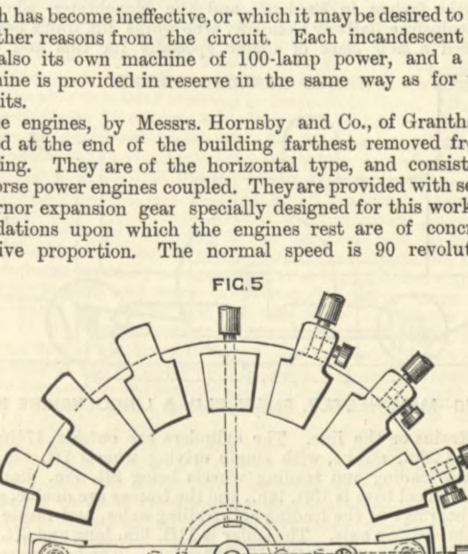


FIG. 4

which has become ineffective, or which it may be desired to remove for other reasons from the circuit. Each incandescent circuit has also its own machine of 100-lamp power, and a fourth machine is provided in reserve in the same way as for the arc circuits.

The engines, by Messrs. Hornsby and Co., of Grantham, are placed at the end of the building farthest removed from the shafting. They are of the horizontal type, and consist of two 16-horse power engines coupled. They are provided with sensitive governor expansion gear specially designed for this work. The foundations upon which the engines rest are of concrete, of massive proportion. The normal speed is 90 revolutions a

FIG. 5



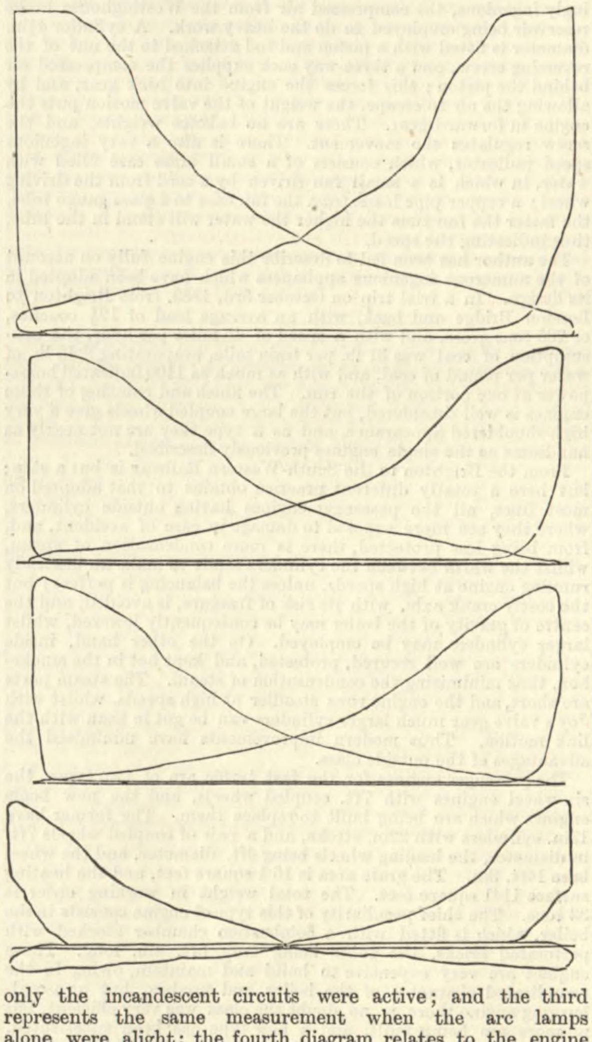
minute. The shaft, to which the power is transmitted by a 16in. treble leather belt, makes twice this number of revolutions. All the belts here used were made for this installation by Messrs. J. C. Nokes, of Queen Victoria-street.

The engine shed is a neat erection of galvanised iron, of sufficient dimensions to allow freedom of access to every part when the machines are running. The floor is laid with concrete and kept scrupulously clean. To preserve the machines and the engine from dust and dirt, the boiler has been placed in a smaller shed adjoining the principal building. This is a wise provision, that might be imitated with advantage in other installations of this character. The boiler is of the locomotive type, of nominally 35-horse power. The pressure at which it is required to work is 80 lb. to the square inch, but it has been tested up to 120 lb. It is provided with a feed-water heater, through which the exhaust steam from the engine is made to pass. In the design and the execution of this important installation, care, knowledge, and sound judgment are everywhere visible. It was carried out under the superintendence of the company's outdoor engineer, Mr. W. H. Trentham, M.I.M.E.

The Pilsen arc light as now constructed requires an electromotive force of 45 volts; with this force the current is 8 ampères. The light obtained from this expenditure of force is 2000 candles nominal—a degree of efficiency that must be regarded as highly satisfactory. The lamp we illustrate on the preceding page; it is so well known as hardly to need description. The position of the upper carbon is adjusted by a doubly tapered core, one end of which is in a solenoid in the main current, and the other in a solenoid in a high resistance shunt current. The incandescent lamp of this company requires a current of only 0·55 ampère, which is given by an electro-motive force of 96 volts. With this expenditure of force the light-power is 20 candles actual. This is a very remarkable result, inasmuch as it indicates the greatest efficiency yet reached in incandescent lamps.

On the 13th of May last careful measurements were taken of the external work done in each of the circuits—that is, in the lamps and in the leads. The following are the chief quantities obtained by these measurements:—In one of the arc circuits the current was found to be 8·39 ampères, and the electromotive force 829·9 volts. These values give 6954·5 watts, or 9·322-horse power. In the other arc circuit the current was 8·15 ampères, and the electro-motive force 6981·3 volts. In this case we have 6981·3 watts, or 9·368-horse power. The total value of the force expended upon the arc lamp circuits is thus 13,935·8 watts, or 18·69-horse power. In the first incandescent lamp circuit the current was 61·69 ampères; in the second, 61·16 ampères; and in the third, 59·32 ampères, the electro-motive force in all being 101·05 volts. Hence, in the first circuit, the work was 6233·77 watts; in the second, 6180·22 watts; and in the third, 5984·29 watts; a total of 18,408·278 watts, or 24·67-horse power.

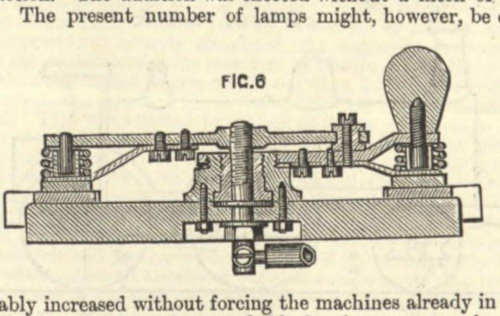
To complete the measurements, indicator diagrams were taken under various conditions of running. The first diagram was obtained when all the lamps, arc and incandescent, were burning; the second gives the work of the engine when



only the incandescent circuits were active; and the third represents the same measurement when the arc lamps alone were alight; the fourth diagram relates to the engine when running light.

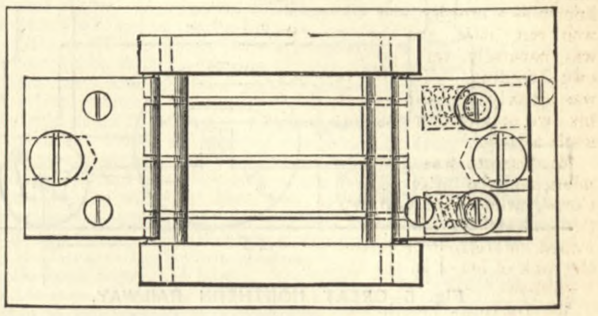
The installation was completed several months ago, and the lighting has continued in successful operation ever since. On the occasion of the recent visit of the Prince of Wales to the museum, a large number of extra incandescent lamps were run off the existing circuits by bringing one of the reserve machines into action. The addition was effected without a hitch of any kind. The present number of lamps might, however, be considerably increased without forcing the machines already in use.

FIG. 6



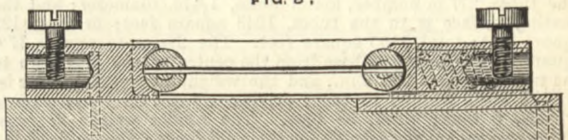
The Pilsen machine is remarkable for the new type of armature, designed by Messrs. G. Pfannkerche and R. E. Dunston, the electrical engineer of the company. The core of the armature consists of hoop iron. The central boss carries a number of arms terminating in a kind of fork, into which the iron is wound. Two strips are laid on side by side, and insulated layer from layer by calico wound on in a strip with the iron. Sufficient iron is laid on to form the broad flat ring characteristic of the Schuckert design. The sections of wire wound upon this ring are separated one from another by iron distance pieces of a forked shape, insulated from the rest of the iron in the core. It is claimed for the separate pieces that they increase the efficiency of the machine. Certainly the efficiency is high, and there is practically no heating of the armature. Moreover, the form of construction has been found to be cheap. The construction of the switches, by means of which any one of the machines may be connected to any of the circuits at will, is sufficiently shown

FIG. 7



in Fig. 5. It is strongly made, and the contacts are particularly good. The patent safety cut-out of Mr. Dunston are shown in Figs. 6, 7, and 8. It consists essentially of a group of lead rods, held in place by the pressure of a spring against the brass socket, into which their ends are set. This ingenious construction allows the fusible rods to be removed, or replaced by others when destroyed by the current, in a few seconds, and with the greatest ease.

FIG. 8.



Another important instrument used at the Bethnal Green Museum and at other installations of the Pilsen Company is a current meter, also due to the inventive genius of Mr. Dunston. This instrument is shown in Figs. 9 and 10. It is an electromagnet, having poles of the form indicated by the dotted lines.

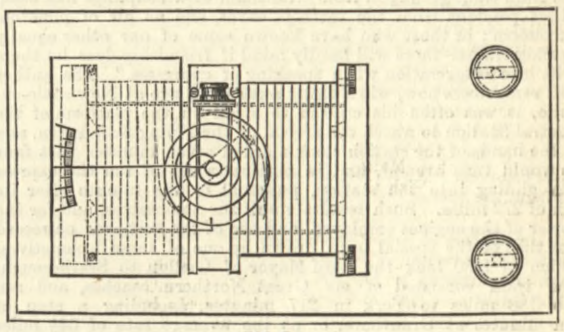
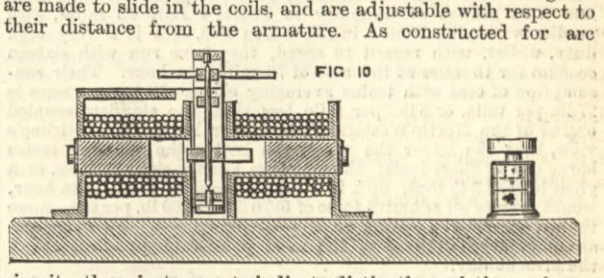


FIG. 9.

Between these poles rotates a soft iron armature, carrying an indicator needle against the tension of a flat spiral spring. The shape here given to the poles of the magnets produces equal deflections for equal increments of current. The readings are very accurate, and the armature is sensitive to extremely small variations of current. The iron cores of the electro-magnets are made to slide in the coils, and are adjustable with respect to their distance from the armature. As constructed for arc

FIG 10



circuits, these instruments indicate distinctly variations of one-tenth of an ampère. This is a matter of considerable importance in regulating the constancy of a lighting current. In all respects the Dunston current meter is superior to those which depend upon the action of permanent magnets, and as it is sold at a low price, it will doubtless speedily come into general use.

THE CONDITION OF THE THAMES.—In reply to a deputation which waited upon the Thames Conservancy Board on the 1st inst. The chairman—Sir Frederick Nicolson—remarked that as a matter of fact whatever they received from the water companies was entirely devoted to the improvement of the river above Staines. After some futher conversation the chairman said that the Conservators did not meet again until the 8th of September, and there were one or two points upon which his colleagues desired him to address them. With regard to the water companies, the average quantity of water passing over Teddington Lock was 400,000,000 gallons in 24 hours, and this, after the companies had taken their supply and so forth. Sir John Coode and Captain Calver, in their report, estimated that the consumption of water by the companies reduced the level of the river by about 2½in., but they would not admit that the reduction might be 4in., it certainly would not be more than that. With regard to the mud on the foreshores, a special examination had recently been made, with the result that no considerable quantity of mud was found in any part of the neighbourhood. Of course they could not be held responsible for any damage to the public health arising from the existence of sewage mud, for they were powerless on account of the suspension of the penalties of their Act which applied to the pollution of the river. The great question, however, before them was as to the proposed lock and weir, and he might as well refer the deputation to the letter which was addressed to the secretary of the Isleworth Lock Committee in January last, in which the Conservators stated that having weighed the statements presented to them, and looking at the whole of the circumstances of the case as affecting the various interests, they felt it their duty to oppose the project. That was the opinion at which they arrived after a very careful consideration of the whole of the arguments which had been adduced before them, and he had now to add that they did not at the present moment, after a short deliberation, feel disposed to say anything to the contrary, though it was quite possible that after the recess they might take this question—which was a very large one indeed—once more into their consideration.

MODERN LOCOMOTIVE PRACTICE.*

By H. Michell Whitley, Assoc. M.I.C.E., F.G.S.

(Concluded from page 92.)

Mr. Stirling, of the Great Northern, has adopted an entirely different type of engine to those last described. Holding strongly that single engines are more economical not only in running, but in repairs, and that cylinder power is generally inadequate to the adhesion, he has designed his magnificent well-known class of

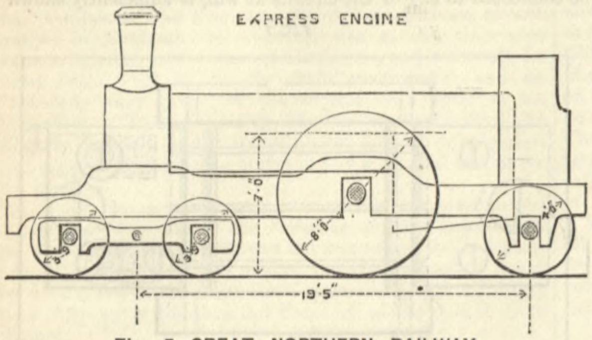


Fig. 5—GREAT NORTHERN RAILWAY.

express engines. They have single driving wheels 8ft. in diameter, with a four-wheel bogie in front and a pair of trailing wheels, 4ft. diameter, behind. The frames are single, and inside of one solid piece; the cylinders are outside, 18in. diameter and 28in. stroke; and the valve gear is of the usual shifting link description. The boiler is of Yorkshire plates, 11ft. 5in. long and 4ft. diameter, and the steam pressure is 140 lb.; whilst the tractive power per lb. of steam in the cylinders is 94 lb. The fire-box is of copper, and the roof is stayed to the outer shell by wrought iron radiating stays screwed into both; a sloping midfeather is placed in the fire-box. The tubes, 217 in number, are of brass, 1 3/16in. diameter; and the heating surface is, in the tubes, 1043 square feet; fire-box, 122 square feet; total, 1165 square feet. The fire-grate area is 17·6 square feet. The wheel base from the centre of the bogie pin to the trailing axle is 19ft. 5in., and the weight in working order is, on the bogie wheels, 15 tons; driving wheels, 15 tons; trailing wheels, 8 tons; total, 38 tons. The tender weighs 27 tons. These engines are remarkable for their efficiency; the traffic of the Great Northern Railway is exceedingly heavy, and the trains run at a high rate, the average speed of the Flying Scotchman being fifty miles an hour, and no train in the kingdom keeps better time. "Those who remember this express at York in the icy winter of 1879-80, when the few travellers who did not remain thawing themselves at the waiting-room fires, used to stamp up and down a sawdusted platform, under a darkened roof, while day after day the train came gliding in from Grantham with couplings like wool, icicles pendant from the carriage eaves, and an air of punctual unconcern; or those who have known some of our other equally sterling trains—these will hardly mind if friendship does let them drift into exaggeration when speaking of expresses." The author well remembers how, when living some years ago at Newcastle-on-Tyne, it was often his custom to stroll on the platform of the Central Station to watch the arrival of the Flying Scotchman, and as the hands of the station clock marked seven minutes past four he would turn around, and in nine cases out of ten the express was gliding into the station, punctual to the minute after its run of 272 miles. Such results speak for themselves, and for the power of the engines employed, and one of the best runs on record was that of the special train, drawn by one of these locomotives, which in 1880 took the Lord Mayor of London to Scarborough. The train consisted of six Great Northern coaches, and ran the 188 miles to York in 217 minutes, including a stop of ten minutes at Grantham, or at the average rate of 54½ miles an hour. The speed from Grantham to York, 82½ miles, with three slowing downs at Retford, Doncaster, and Selby, averaged 57 miles an hour, and the 59 miles from Claypole, near Newark, to Selby, were run in 60½ minutes, and for 22½ consecutive miles the speed was 64 miles an hour. In ordinary working these engines convey trains of sixteen to twenty-six coaches from King's-cross with ease, and often twenty-eight are taken and time kept. Considering that the great Northern main line rises almost continuously to Potter's Bar, 13 miles, with gradients varying from 1 in 105 to 1 in 200, this is a very high duty, whilst, with regard to speed, they have run with sixteen coaches for 15 miles at the rate of 75 miles an hour. Their consumption of coal with trains averaging sixteen 10-ton carriages is 27 lb. per mile, or 8 lb. per mile less than the standard coupled engine of the North-Western with similar loads. Mr. Stirling's view, that the larger the wheel the better the adhesion, seems borne out by these facts; thus, to take twenty-eight coaches, or a gross load of 345 tons, up 1 in 200 at a speed of 35 miles an hour, would require an adhesive force of 8970 lb., or 600 lb. per ton—more than a quarter the weight on the driving wheels. These engines are magnificent samples of the most powerful express engines of the present day.

The London, Brighton, and South Coast Railway Company has in the last few years had its locomotive stock almost entirely replaced, and instead of seventy-two different varieties of engines out of a total of 233, which was the state of the locomotive stock in 1871, a small number of well-considered types, suited to the different class of work required, are now in use. Mr. Stroudley considers—contrary to the opinion once almost universally held—that engines with a high centre of gravity are the safest to traverse curves at high speed, as the centrifugal force throws the greatest weight on the outer wheels and prevents their mounting; also that the greatest weight should be on the leading wheels, and that there is no objection to these wheels being of a much larger diameter than that usually adopted; in fact, by coupling the leading and driving wheels where the main weight is placed a lighter load is thrown on the trailing wheels, thus enabling them to traverse curves at a high speed with safety, whilst it permits of a larger fire-box being used; and these principles have been carried out in the newest class of engines specially designed for working the heavy fast passenger traffic of the line.

The modern express engines are of two types. The first is a single engine with 6ft. 6in. driving wheels, and leading and trailing wheels 4ft. 6in. in diameter and a wheel base of 15ft. 9in. The frames are single, with inside bearings to all the wheels; the cylinders are inside, 17in. diameter and 24in. stroke. The boiler is 10ft. 2in. long and 4ft. 3in. diameter; the fire-box is of copper with a fire-grate area of 17·8 square feet, and the heating surface is in the tubes 1080 square feet, fire-box 102 square feet; total, 1182 square feet. The weight in working order is about 35 tons. These engines have a tractive power of 89 lb. per pound of mean steam pressure in the cylinders, and their consumption of coal with trains averaging nine coaches is about 20 lb. per mile. The next type of engine designed had coupled wheels under the barrel of the boiler 6ft. 6in. diameter, with cylinders 17¼in. diameter and 26in. stroke, and were found so successful that Mr. Stroudley designed a more powerful engine of the same class, especially to take the heaviest fast trains in all weathers.

The 8.45 a.m. train from Brighton has grown to be one of the heaviest fast trains in the kingdom, although the distance it runs is but very short, whilst it is also exceptional in consisting entirely of first-class coaches, and the passengers mainly season ticket holders; it often weighs in the gross 350 tons, and to take this weight at a mean speed of forty-five to fifty miles an hour over gradients of 1 in 264 is no light work.

The engines known as the "Gladstone" type have inside cylinders 18¼in. diameter and 26in. stroke, with coupled wheels 6ft. 6in. diameter under the barrel of the boiler; the trailing wheels are 4ft. 6in. diameter, and the total wheel base is 15ft. 7in. The frames are inside, of steel 1in. thick, with inside bearings to all the axles. The cylinders are cast in one piece 2ft. 1in. apart, but in order to get them so close together the valves are placed below the cylinders, the leading axle coming between the piston and slide valve. The boiler is of iron, 10ft. 2in. long, and 4ft. 6in. diameter; and the heating surface is, in the tubes, 1,373 square feet; fire-box, 112 square feet; total, 1485 square feet. The grate area is 20·65 square feet, and the tractive power per pound of mean cylinder pressure is 111 lb. The weight in full working order is—leading wheels, 13 tons 16 cwt.; driving wheels, 14 tons 10 cwt.; trailing wheels, 10 tons 8 cwt.; total, 38 tons 14 cwt. The

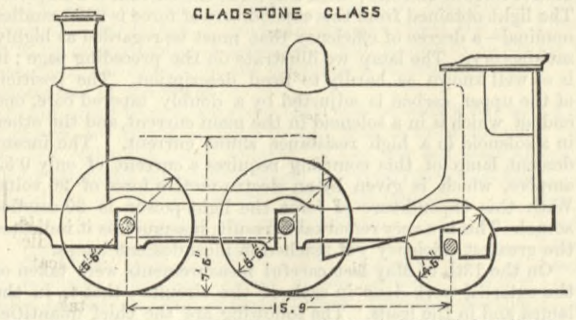


Fig. 6—LONDON, BRIGHTON, & SOUTH COAST RAILWAY.

tender weighs 27 ton. To enable these engines to traverse curves easily a special arrangement of draw-bar is used, consisting of a T-piece with a wheel at each end working in a curved path in the back of the frame under the foot-plate; on the back buffer beam a curved plate abuts against a rubbing piece on the tender, through which the draw-bar is passed and screwed up against an india-rubber washer, thus allowing the engine to move free of the tender as the curvature of the road requires; the flanges on the driving wheel are also cut away, so as not to touch the rail. In order to reduce the wear of the leading flanges, a jet of steam from the exhaust is directed against the outer side of each wheel. The centre line of the boiler is 7ft. 5in. above the rails, and the tubes, of which there are as many as 331, are bent upwards 1½in., which permits expansion and contraction to take place without starting the tubes, and they are stated never to leak or give trouble. The feed-water is heated by a portion of the exhaust steam and the exhaust from the Westinghouse brake, and the boiler is consequently fed by pumps, is kept cleaner, and makes steam better. The reversing gear is automatic and exceedingly ingenious, the compressed air from the Westinghouse brake reservoir being employed to do the heavy work. A cylinder 4½in. diameter is fitted with a piston and rod attached to the nut of the reversing screw, and a three-way cock supplies the compressed air behind the piston; this forces the engine into back gear, and by allowing the air to escape, the weight of the valve motion puts the engine in forward gear. There are no balance weights, and the screw regulates the movement. There is also a very ingenious speed indicator, which consists of a small brass case filled with water, in which is a small fan driven by a cord from the driving wheel; a copper pipe leads from the fan case to a glass gauge tube, the faster the fan runs the higher the water will stand in the tube, thus indicating the speed.

The author has been led to describe this engine fully on account of the numerous ingenious appliances which have been adopted in its design. In a trial trip on October 3rd, 1883, from Brighton to London Bridge and back, with an average load of 19½ coaches, or 285 tons gross, and with a speed of 45 miles per hour, the consumption of coal was 31 lb. per train mile, evaporating 8·45 lb. of water per pound of coal, and with as much as 1100 indicated horse-power at one portion of the run. The finish and painting of these engines is well considered, but the large coupled wheels give a very high-shouldered appearance, and as a type they are not nearly as handsome as the single engines previously described.

From the Brighton to the South-Western Railway is but a step; but here a totally different practice obtains to that adopted on most lines, all the passenger engines having outside cylinders, where they are more exposed to damage in case of accident, and, from being less protected, there is more condensation of steam, whilst the width between the cylinders tends to make an unsteady running engine at high speeds, unless the balancing is perfect; but the costly crank axle, with its risk of fracture, is avoided, and the centre of gravity of the boiler may be consequently lowered, whilst larger cylinders may be employed. On the other hand, inside cylinders are well secured, protected, and kept hot in the smoke-box, thus minimising the condensation of steam. The steam ports are short, and the engine runs steadier at high speeds, whilst with Joy's valve gear much larger cylinders can be got in than with the link motion. Thus modern improvements have minimised the advantages of the outside class.

The passenger engines for the fast traffic are of two types, the six-wheel engines with 7ft. coupled wheels, and the new bogie engines which are being built to replace them. The former have 17in. cylinders with 22in. stroke, and a pair of coupled wheels 7ft. in diameter, the leading wheels being 4ft. diameter, and the wheel base 14ft. 3in. The grate area is 16·1 square feet, and the heating surface 1141 square feet. The total weight in working order is 33 tons. The chief peculiarity of this type of engine consists in the boiler, which is fitted with a combustion chamber stocked with perforated bricks, the tubes being only 5ft. 4in. long. These engines are very expensive to build and maintain, owing to the complicated character of the boiler and fire-box, but as a coal-burning engine there is no doubt the class was very efficient, but no more are being built, and a new type has been substituted. This is an outside cylinder bogie engine, with cylinders 18½in. diameter and 26in. stroke; the driving and trailing coupled wheels are 6ft. 6in. diameter, and the bogie wheels 3ft. 3in. The wheel base to the centre of the bogie pin is 18ft. 6in.; the heating surface is, in the tubes, 1112; fire-box, 104; total, 1216 sq. ft. The weight of the engine in working order is 42 tons.

The Midland Railway route to the North is distinguished by the heavy nature of its gradients; between Settle and Carlisle, running

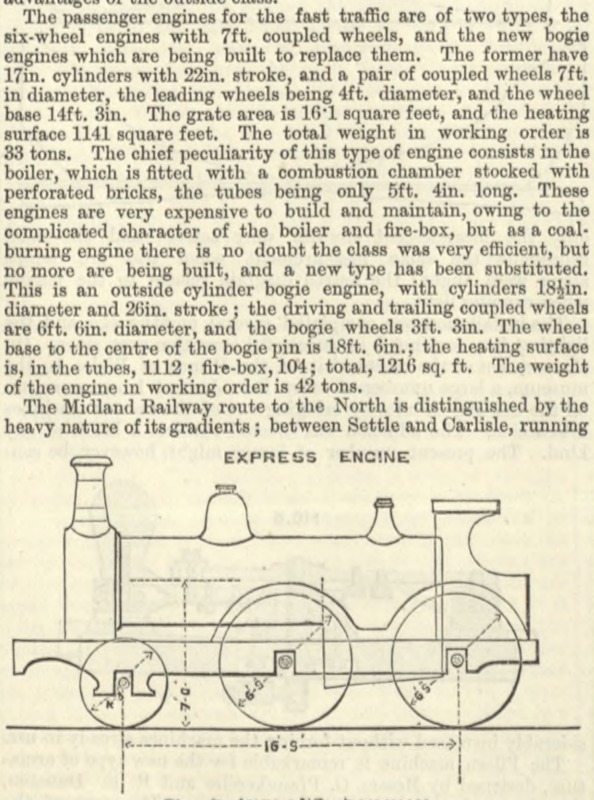


Fig. 7—MIDLAND RAILWAY.

through the Cumberland hills, attaining a height of 1170ft. above sea level, the highest point of any express route in the kingdom; and to work heavy fast traffic over such a line necessitates the employment of coupled engines. The standard express locomotive of this company has inside cylinders 18in. in diameter and 26in. stroke. The coupled wheels are 6ft. 9in. diameter, and the leading wheels 4ft. 3in., the total wheel base being 16ft. 6in., and the tractive force 104 lb. for each lb. of mean cylinder pressure. The boiler is of best Yorkshire iron, 10ft. 4in. long and 4ft. 1in. diameter. The grate area is 17·5 square feet, and the heating surface is, in the tubes, 1096; fire-box, 110; total, 1206. There are double frames to give outside bearings to the leading axle, as in the Great Western engine, and the engine is fitted with a steam brake. The weight in full working order is—leading wheels, 12 tons 2 cwt.; driving wheels, 15 tons; trailing wheels, 11 tons 6 cwt.; total, 38 tons 8 cwt. The tender weighs 26 tons 2 cwt., and holds 3300 gallons of water and 5 tons of coal. Latterly a fine type of bogie express engine has been introduced, with inside cylinders 18in. diameter and 26in. stroke, and four coupled driving wheels 7ft. diameter. The total wheel base to the centre of the bogie pin is 18ft. 6in. The grate area is 17·5 square feet, and the heating surface is, in tubes, 1203 square feet, and fire-box, 110; total, 1313; and the engine weighs 42 tons in working order. These engines take fourteen coaches, or a gross load of 222 tons, at 50 miles an hour over gradients of 1 in 120 to 1 in 130, with a consumption of 28 lb. of coal per mile. The London, Chatham, and Dover Company has also some fine engines

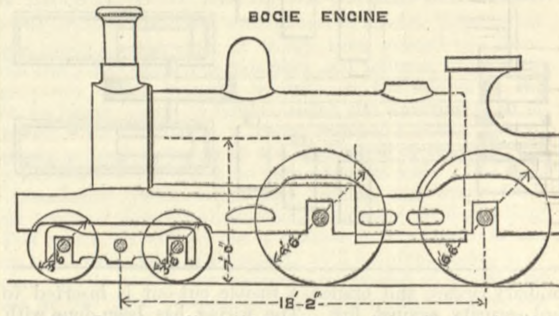


Fig. 8—LONDON, CHATHAM, & DOVER RAILWAY.

of a similar type. They have inside cylinders 17½in. diameter and 26in. stroke; the coupled wheels are 6ft. 6in. diameter, and the bogie wheels 3ft. 6in., the wheel base to the centre of the bogie pin being 18ft. 2in. The boiler is 10ft. 2in. long and 4ft. 2in. diameter, the grate area is 16·3 square feet, and the heating surface is, in the tubes, 962 square feet; fire-box, 107 square feet; total, 1069. The boiler pressure is 140 lb., and the tractive force per lb. of steam in the cylinder 102 lb. The weight in full working order is, on the bogie wheels, 15 tons 10 cwt.; driving wheels, 13 tons 10 cwt.; trailing wheels, 13 tons; total, 42 tons.

Mr. Worsdell has lately designed for the Great Eastern Railway a fine type of coupled express engine, which deserves mention.

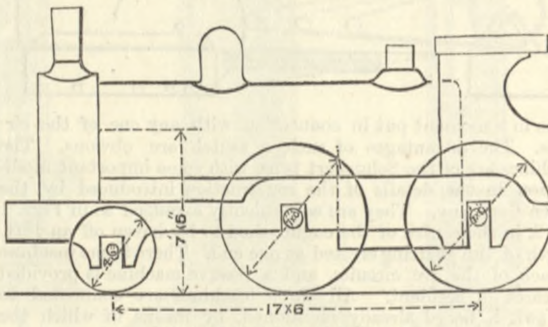


Fig. 9—GREAT EASTERN RAILWAY.

It has inside cylinders 18in. diameter and 24in. stroke, with coupled wheels 7ft. diameter and leading wheels 4ft. diameter, the latter being fitted with a radial axle on a somewhat similar plan to that previously described as adopted by Mr. Webb for the new North-Western engines; the frames are single, with inside bearings to all the wheels, and Joy's valve gear is used. The boiler pressure is 140 lb., and the tractive power per lb. of mean cylinder pressure 92 lb. The total wheel base is 17ft. 6in. The boiler, which is fed by two injectors, is of steel, 11ft. 5in. long and 4ft. 2in. diameter. The grate area is 17·3 square feet, and the heating surface is, in the tubes, 1083; fire-box, 117; total, 1200 sq. ft. The weight in working order is, on the leading wheels, 12 tons 19 cwt.; driving wheels, 15 tons; trailing wheels, 13 tons 4 cwt.; total, 41 tons 3 cwt. These engines burn 27 lb. of coal per train mile with trains averaging thirteen coaches. It has been seen that the Cheshire lines express between Liverpool and Manchester is one of the fastest in England, and the Manchester, Sheffield, and Lincolnshire Railway Company who works the trains has just introduced a new class of engine specially for this and other

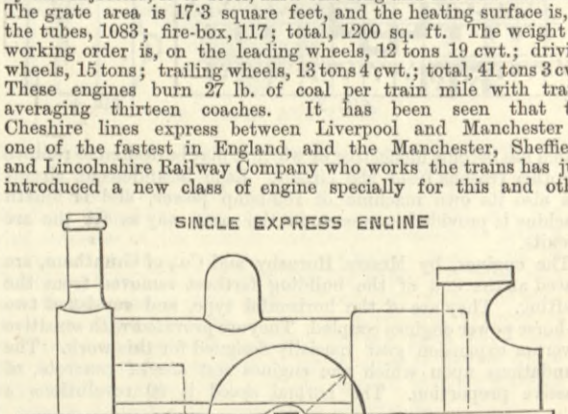


Fig. 10—MANCHESTER, SHEFFIELD, & LINCOLNSHIRE RY.

express trains on the line. The cylinders are outside, 17½in. diameter and 26in. stroke, with single driving wheels 7ft. 6in. diameter, the leading and trailing wheels being 3ft. 8in. diameter. The total wheel base is 15ft. 9in., and the frames are double, giving outside bearings to the leading and trailing axles, and inside bearings to the driving axle. The boiler is 11ft. 6in. long and 3ft. 11in. diameter, and the grate area is 17 square feet. The heating surface is in the tubes 1057 square feet; fire-box, 87 square feet; total, 1144 square feet. The tractive force per pound of mean cylinder pressure is 88·4 lb. The weight in full working order is, on the leading wheels, 11 tons 3 cwt.; driving wheels, 17 tons 11 cwt.; trailing wheels, 11 tons 18 cwt.; total, 40 tons 12 cwt. This engine is remarkable for the great weight thrown on the driving wheels, and its cylinder power is great in proportion to its adhesion, thus allowing the steam to be worked at a high rate of expansion, which is most favourable to the economical consumption of fuel. There are numerous fine engines running on other lines, such as the new bogie locomotives on the North-Eastern and Lancashire and Yorkshire Railways, and the coupled express engines on the Caledonian; but those already described represent fairly the leading features of modern practice, and the author will now notice briefly the two other classes of engines; tank passenger engines for suburban and local traffic and goods engines. The Brighton tank passenger engine is a good example of the former class, it has inside cylinders 17in. diameter and 24in. stroke. The two coupled wheels under the barrel of the boiler are 5ft. 6in. diameter and the trailing wheels 4ft. 6in., there are single frames with inside bearings to all the axles. The boiler pressure is 140 lb., and the tractive force per pound of mean cylinder pressure 106 lb., the total wheel base is 14ft. 6in. The boiler is 10ft. 2in. long and 4ft. 4in. dia

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* Paper read before the Civil and Mechanical Engineers' Society 23rd April, 1884

meter, and the heating surface is in the tubes, 858 square feet; fire-box, 90 square feet; total, 948 square feet. The engine is furnished with wing tanks holding 860 gallons of water, and carries 30 cwt. of coal. The weight in working order is 38 tons. These engines have taken a maximum load of twenty-five coaches between London and Brighton, but are mainly employed in working the suburban and branch line traffic; their average consumption of coal is 23·5 lb. per mile, with trains averaging about ten coaches.

Another example is Mr. Webb's tank engine on the North-Western Railway, which presents a contrast to the foregoing. It has inside cylinders 17in. diameter and 20in. stroke, coupled wheels 4ft. 6in. diameter, and a tractive power per lb. of mean cylinder pressure of 107 lb., the wheel base is 14ft. 6in. with a radial box to the leading axle; the heating surface is in the tubes, 887; fire-box, 84; total, 971 square feet; the weight in working order is 35 tons 15 cwt. The engine is fitted with Webb's hydraulic brake, and steel, manufactured at Crewe, is largely used in its construction. The consumption of coal working fast passenger trains has been 28½ lb. per mile. There are many other types, such as the ten-wheel bogie tank engines of the London, Tilbury, and Southend, and South-Western Railways; the saddle tank bogie engines, working the broad-gauge trains on the Great Western Railway, west of Newton; and the familiar class working the Metropolitan and North-London traffic. But the same principle is adopted in nearly all—a flexible wheel base to enable them to traverse sharp curves, small driving wheels coupled for adhesion, and wing or saddle tanks to take the water. One notable exception is, however, the little six-wheel all-coupled engines weighing only 24 tons, which work the South London traffic, burning 24½ lb. of coal per mile, with an average load of eleven coaches.

Goods engines on all lines do not vary much. As a rule they are six-wheel all-coupled engines, with generally 5ft. wheels, and cylinders varying between 17in. and 18in. diameter and 24in. to 26in. stroke; the grate area is about 17 square feet, and the total heating surface from 1000 to 1200 square feet; the average weight in full working order varies from 30 to 38 tons. One noteworthy exception occurs, however, on the Great Eastern Railway, where a type of goods engine with a pony truck in front has been introduced. The cylinders are outside, 19in. diameter and 26in. stroke, there are six coupled wheels 4ft. 10in. diameter, and the pony truck wheels are 2ft. 10in. diameter, the total wheel base is 23ft. 2in., but there are no flanges on the driving wheels. The boiler is 11ft. 5in. long and 4ft. 5in. diameter, the boiler pressure is 140 lb., and the tractive force per lb. of mean cylinder pressure, 162 lb.; the grate area is 18·3 square feet, and the heating surface is in the tubes, 1334 square feet; fire-box, 122 square feet; total, 1456 square feet. The weight in working order is on the pony truck, 3 tons 10 cwt.; leading coupled, 12 tons 8 cwt.; driving coupled, 13 tons 5 cwt.; trailing coupled, 12 tons 15 cwt.; total, 47 tons. The tender weighs 28 tons in full working order. These engines take forty loaded coal trucks or sixty empty ones, and burn 52 lb. of coal per train mile, the worst gradient being 1 in 176. A notice of goods engines would not be complete without alluding to a steep gradient locomotive, and a good example is the engine which works the Redheugh Bank on the North-Eastern Railway. This incline is 1040 yards long, and rises for 570 yards 1 in 33, then for 260 yards 1 in 21·7, for 200 yards 1 in 25, and finally for 110 yards 1 in 27. The engine, which is an all-coupled six-wheel tank engine, weighs 48½ tons in working order, it has cylinders 18in. diameter and 24in. stroke, and 4ft. wheels, the boiler pressure is 160 lb. and the tractive force per lb. of mean steam pressure in the cylinders is 162 lb. This engine will take up the incline twenty-six coal wagons, or a gross load of 218 tons, which is a very good duty indeed.

Having now passed in review the general types of engines adopted in modern English practice, the author would briefly draw attention to some points of design and some improvements effected in late years. And first, as to the question of single or coupled engines, there is a great diversity of opinion. Mr. Stirling conducts his traffic at a higher rate of speed, and certainly with equal punctuality, with his magnificent single 8ft. engines, as Mr. Webb on the North-Western with coupled engines, and the economy of fuel of the former class over the latter is very remarkable; this is, no doubt, owing, as has been previously pointed out, to their ample cylinder power, which permits of the steam being worked at a high rate of expansion. There is no doubt that if single engines can take the load they will do so more freely and at a less cost than coupled engines, burning on the average 2 lb. of coal per mile less with similar trains. With regard to loads, it is a question whether any express train should be made up with more than twenty-five coaches. The Great Northern engine will take twenty-six and keep time, and the Brighton single engine has taken the five p.m. express from London Bridge to Brighton, consisting of twenty-two coaches, at a speed of forty-five miles per hour. Of course where heavy gradients have to be surmounted, such as those on the Midland route to Scotland, coupled engines are a necessity. Single engines are said to slip more than coupled, thus an 8ft. single Great Northern engine running down the incline from Potters' Bar to Wood Green with twelve coaches at the rate of sixty miles an hour, was found to be making 242 revolutions per mile instead of 210; and in an experiment tried on the Midland Railway it was found that a coupled engine with ten coaches at fifty miles an hour made seventeen extra revolutions a mile, but when the side rods were removed it made forty-three. The Great Western, Great Northern, and Brighton mainly employ single engines for their fast traffic, and the Manchester, Sheffield, and Lincolnshire have now adopted the single type in preference to the coupled for their express trains; whilst the North-Western, Midland, South-Western, and Chatham adopt the coupled type. One noticeable feature in modern practice is the increased height of the centre line of boiler; formerly it was the great aim to keep this low, and numerous schemes to this effect were propounded, but now it has become generally recognised that a high pitched engine will travel as steadily and more safely round a curve—given a good road—than a low pitched one; and thus whilst in 1850 the average height of the centre line of boilers varied between 5ft. 3in. and 6ft. 3in., now in the latest designs it lies between 7ft. and 7ft. 6in. Single frames are very generally adopted, but double frames and outside bearings to the leading and trailing wheels, as in the Great Western engines, give great steadiness in running, and this class has also double bearings to the driving wheels, thus entailing greater security in case of the fracture of a crank axle. The general adoption of cabs on the foot-plate for the men is another improvement of late introduction, although at first not universally appreciated by those for whose comfort it was designed—"I felt as if I was in my coffin," said an old driver when asked how he liked the new shelter. Mild steel fire-boxes, which have been employed in America, are not in favour here, copper being universally used; they have been tried on the Caledonian, Great Southern and Western, North London, and North-Western, and were found not to succeed. Brake blocks of cast iron have now generally superseded wood; steel is being more and more used, especially on the North-Western. There is less use of brasswork for domes and fittings, although it is claimed for brass that it looks brighter and can easily be kept clean. There is greater simplicity of design generally, and the universal substitution of coal for coke for fuel, with its consequent economy; and last, but not least, the adoption of standard types of engines are amongst the changes which have taken place in locomotive practice during the past quarter of a century.

Having now reviewed, as far as the limits of this paper will allow, the locomotive practice of the present day, the author would in conclusion draw attention to what may possibly be one course of locomotive development in the future. Time is money, and it may be in the coming years that a demand will arise for faster means of transit than that which we possess at present. How can we meet it? With our railways laid out with the curves and gradients existing, and with our national gauge, and our present type of locomotive, no great advance in speed is very probable; the mean speed of express trains is about fifty miles an hour, and to take an average train of 200 tons weight at this speed over a level line requires between 650 and 700 effective horse-power, within the compass of the best engines of the present day. But if instead of fifty miles an hour seventy is required, an entirely different state of things obtains. Taking a train of 100 tons, with engine and tender weighing 75 tons, or 175 tons gross, the first question to determine will be the train resistance, and with reference to this we much want careful experiments on the subject, like those which Sir Daniel Gooch made in 1848, on the Bristol and Exeter Railway, which are even now the standard authority; the general use of oil axle-boxes and long bogie coaches, irrespective of other improvements, would render this course desirable. With regard to the former, they appear to run with less friction, but are heavier to start, oil boxes in some experiments made on the South-Western Railway giving a resistance of 2·5 lb. per ton, whilst grease boxes ranged from 6 lb. to 9 lb. per ton. Again, the long and heavy bogie Pullman and other coaches have the reputation amongst drivers, rightly or wrongly, of being hard to pull. The resistance of an express train on the Great Western Railway at seventy-five miles an hour was 42 lb. per ton, and taking 40 lb. per ton for seventy miles an hour would give a total resistance on the level of 7000 lb., corresponding to 1400-horse power—about double the average duty of an express engine of the present day. The weight on the driving wheels required would be 18¾ tons, allowing one-sixth for adhesion, about the same as that on the driving axle of the Bristol and Exeter old bogie engines. Allowing 2½ lb. of coal per horse-power per hour, would give a total combustion of 3500 lb. per hour, and to burn this even at the maximum economic rate of 85 lb. per square foot of grate per hour would require a grate area of 41 square feet and about 2800 square feet of heating surface. Unless a most exceptional construction combined with small wheels is adopted, it appears almost impossible to get this amount on the ordinary gauge. It is true the Wootten locomotives on the Philadelphia and Reading Railway have fire-boxes with a grate area of as much as 76 square feet, but these boxes extend clean over the wheels, and the heating surface in the tubes is only 982 square feet; but although these engines run at a speed of forty-two miles an hour, they are hardly the type to be adopted for such a service as is being considered. On the broad gauge, however, such an engine could easily be designed on the lines now recognised as being essential for express engines without introducing any exceptional construction, and there appears but little doubt that were Brunel's magnificent gauge the national one, competition would have introduced a higher rate of speed between London and our great towns than that which obtains at present.

The whole question of the future introduction of trunk lines, exclusively for fast passenger traffic, is fraught with the highest interest, but it would be foreign to the subject matter of this paper to enter more fully on it, the author merely desiring to state his opinion that if the future trade and wealth of our country requires their construction, and if a very high rate of speed much above our present is to be attained, their gauge will have to be seriously considered and settled, not by the reasons which caused the adoption of the present gauge, but by the power required to carry on the traffic—in fact, to adapt the rail to the engine, and not, as at present, the engine to the rail. High speed requires great power, and great power can only be obtained by ample fire-grate area, which for a steady running engine means a broad gauge. The Gauge Commissioners of 1846 in their report esteemed the importance of the highest speed on express trains for the accommodation of a comparatively small number of persons, however desirable that may be to them, as of far less moment than affording increased convenience to the general commercial traffic of the country. The commercial traffic of England has grown and prospered under our present system, and if its ever increasing importance demands high speed passenger lines, we may rest assured that the ingenuity of man, to which it is impossible to assign limits, will satisfactorily solve the problem.

BESSEMER STEEL FOR ENGINEERS' TOOLS.—How nearly Bessemer steel can be brought to crucible in its usefulness for tools is a matter than which there are few more important to the machinery engineer. The advance of the Bessemer metal in this respect means to him a considerable saving of money. It may not, perhaps, be generally known that the Barrow Hematite Steel Company is doing a good deal in the production of Bessemer steel for uses hitherto served by crucible steel. In addition to its usual out-turn of heavy steel, in the form of rails, blooms, tires, &c., the company is producing upwards of 1000 tons per week of special steel, which is being worked up in various parts of the kingdom into all the following forms:—Roll-turning and lathe-turning tools, chisels, files, shear blades, rail drills, rail punches, shear steel for welding to iron, miners' drills and tools, picks, shovels, hand hammers, roller bar and cotton spindles, locomotive engine, wagon, carriage, coach, and furniture springs, bolts, nuts, rivets, pit ropes, telegraph, crinoline, and corset wire, umbrella frames, wire for musical instruments, and the like. Nor has cutlery itself been found too hard a test; for this special steel has been made even into razors with decidedly good results. Touching the extent to which the articles answer, it may be mentioned that a 1in. pit chain, made from a soft sample of this special Bessemer make, withstood a breaking load of 35·63 tons; elongation, 6in. or 18in. The welding had been done by a smith not accustomed to chain work. This is very encouraging to machinery engineers, with whom Bessemer steels are gaining favour to the supplanting of cheap cast steels.

THE HULL AND BARNSLEY RAILWAY.—The important bridge on this line across the river Ouse, about forty miles above Hull, to which we referred in our issue of January 25th, 1884, was successfully "swung" on the 29th ult. For the benefit of those of our readers whose notice the article above referred to may have escaped, we may mention that the bridge is one of the largest of its kind in existence. The total length is about 410ft., divided into two fixed or shore spans of 81ft. each, and a swinging span of 248ft., the latter resting on twenty-four rollers. The diameter of the roller-path is 32ft. 6in., and the clear waterway on each side of the central pier is 100ft. The main girders are of the bowstring lattice type, and it may be of interest to notice that when the packings, on which the girders were erected, were removed, the maximum "droop" at the ends was about 1½in., which reflects great credit both on the designers of the bridge and also on the manufacturers of the ironwork, Messrs. A. Handyside and Co., of Derby. The operation of opening and closing the bridge will be effected by means of hydraulic machinery, the whole being controlled by the bridgeman who is stationed in the signal cabin on the top of the girder. Last Tuesday, however, as the hydraulic apparatus was not entirely completed, the engineers determined to test the equilibrium of the structure by turning the bridge round from the large timber staging which has been built in the middle of the river, and on which the swinging span has been of necessity erected. This was effected by means of ropes attached to the ends of the girders and worked by crabs fixed on the shore spans. The operation was entirely successful, and we are glad to be able to state that there was no hitch of any kind, the large mass of ironwork revolving with perfect ease and smoothness, and fitting in exactly when the ends met those of the fixed spans both as regards lines and levels. In the space of a couple of hours a gang of platelayers had laid a road across the bridge, and when the last metal was in place all assembled felt that a most important epoch in the history of the Hull and Barnsley Railway had been reached, inasmuch as now for the first time there was an unbroken stretch of metals throughout the line from one end to the other. An engine and saloon carriage which had brought Mr. W. Shelford, of 35A, Great Geeorge-street, Westminster, the chief engineer of the line, from the Barnsley end of the line, then passed over the bridge, and proceeded to Hull the next day. The total weight of the swinging span to be moved is about 660 tons, and it is reckoned that the bridge can be opened for the passage of a vessel in less than a minute. Mr. James P. Cooper is the resident engineer.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, July 25th.

THE American manufacturers are more concerned just now than they have been for several years over our political prospects, because of the increasing evidences of a political change which will unsettle their control over Congress. One evidence of this fact is that the chairman of the Republican Nation Executive Committee is one of the wealthiest iron manufacturers of the country, and has access to the ears and pockets of the iron manufacturers of the United States. The contest will be a very close one, and whoever is elected will not be counted out.

Failures are increasing, but the peculiarity of this year's failures in comparison with the failures of past years is that one trade is affected at a time. The dry goods interests are now getting it. The iron interests have about recovered. Restriction is still the rule in all industries. Much capacity is yet awaiting employment. Prices are moving downward in every department. The railway earnings show up well. Heavy wheat and corn crops are assured, and this prospect is stimulating speculation. Vanderbilt says the worst is over, and an improvement in railroad securities is assured, and a prediction of this kind is welcomed from this source. The Western Union securities will be threatened by the Bennett-Mackey combination.

The bank reserves at Boston, New York, and Philadelphia, show an increase. Loans have declined, because of the refusal of the banks to deal liberally with borrowers.

The Electrical Exhibition will open September 3rd, at Philadelphia. Every foot of space will be occupied.

The Pennsylvania Railroad Company shows a decrease in its gross earnings on its line east of Pittsburg and Erie for the month of June of 250,697 dols., and a net decrease of 96,116 dols. The decrease for the first six months of the year in gross earnings was 1,019,330, and the decrease for the same period in net earnings was 406,584 dols.

The New York bank reserves are 28,000,000 dols. over the 25 per cent. limit. Besides this an immense amount of capital is idle in private hands. Money is abundant at 3 per cent. on the Stock Exchange. The banks are asking 5 and 6 per cent.

The Reading Railroad is still in a slough of difficulty. The probable production of the coalfields for the remainder of the year will be 750,000 tons per week. About 300 miles of coal road are now being hastened to completion in six of the bituminous coal-producing States, and a rapid development of these regions will follow, provided the manufacturing demand will permit.

A new shipyard will be built at Alexandria by New York and Boston capital. The Delaware River shipyards are quite busy. On Thursday, July 24th, a new iron steamship was launched at Cramp's shipyard in Philadelphia. She is 350ft. long, 42½ft. breadth of beam, and 30ft. in depth of hold. Her engines are 1800-horse power. Our shipmasters are receiving much encouragement in the increased demand for shipping. The Disston Drainage Company, which has 4,000,000 acres of land to drain in Florida, has begun operations with a dredge which will cut a channel 60ft. wide and 10ft. deep at the rate of a mile and a-half a month. The Dingley Shipping Act is likely to make some trouble. The American Steamship Company unsuccessfully tried to ship a crew under its provisions, and were compelled to engage the crew after the old style of shipping, in order not to be delayed on their trip. The attempt was to engage them for the trip out, at 15 dols., instead of 25 dols. for the month, as formerly. Men could be secured for the return trip at much lower prices. But only inexperienced hands could be induced to accept the new terms, and the company decided it was better to pay old prices.

In some branches of the iron trade there is a decided and encouraging improvement, as, for instance, in plate iron, structural iron, and sheet iron, a considerable amount of business has been placed this week. Nearly all the mills are now well supplied for the next month; some of the mills have orders which will not be completed before the middle of September. The prices for small lots for prompt delivery are firmer. A bid was made yesterday on a 300-ton lot of plate at a slight advance from former rates, and the order will be placed. Plate iron ranges from 2 dols. to 2.25 dols.; shell, 2.50 dols. to 2.75 dols.; flange, 3.50 dols. to 3.75 dols. A good many inquiries are arriving every day, some of them for larger lots than have been asked for for several weeks, and hence a number of buyers who have been carrying very light stocks, and who have considerable work in hand unprovided for, are now coming into the market. This promises some encouraging activity for next week or the week after. A good deal of boiler plate has been bought, and the iron used in machine shops is now being looked for. The consumers of iron are, generally speaking, a little more anxious for ordinary supplies than they have been for some time past, and, in fact, since the opening of spring. A good deal of capacity has been restricted for two or three months past. Yesterday an 800-ton order for structural iron was placed in Philadelphia; the Phœnix Company also placed an order for 600 tons, and other makers also booked orders for smaller amounts, making the business for the week somewhat an exceptional one. The quotations for structural iron are still very low, and for the present no advance is probable; but if a few orders are placed for which specifications are now in hand, it will prepare the way for a slight advance at least on small lots, for which there will be a good demand as soon as the small fry of buyers discover that structural iron makers are pretty well filled up. In steel rails one or two exceptionally low sales were made, one as low as 38 dols. at mill, so it is stated; another at 28.50 dols. Small orders are readily snapped up at 30 dols. at mill, but for large lots it is probable there would be no difficulty in closing at 29 dols. The rail-making interest is in an unsettled condition. One concern has gone out for the summer. The St. Louis concern has not been making rails for six months, so that its failure will not affect the market. One or two other concerns are about shutting down, and in general it may be said that there is a feeling of dissatisfaction both as to to demand and prices. One or two rail-making concerns are responsible for this drop in prices. The scarcity of business has induced Pennsylvanian makers to invade the Western markets; sales of rails have been made there at 30.50 dols. If it were possible to keep this up, the Western people would find it necessary to shut down their mills, as it is impossible for Chicago or Joliet to turn out rails at that price. Our Pennsylvania rail-makers have been introducing economic features by which they can make rails a little lower than others. There are at present very few inquiries for large lots on the market. It is impossible to predict anything as to what the price of rails will be in the fall, but there are those in a position to know who say that prices must improve for two reasons—first, there will be a restriction, because such is the intention of the stronger companies; secondly, as soon as the buyers of large lots who are now holding back perceive that there is a restriction in progress, they will present their requirements, and this will make prices improve at least a dollar or two per ton. Old material of all kinds is exceedingly dull; prices are nominally 19 dols. to 19.50 dols. at Philadelphia for spot lots of foreign rails, while for American 19.50 dols. to 20 dols. is asked, with but very little business doing. Very little foreign iron is arriving, and scarcely any orders are going out. Bessemer pig is held at 19 dols.; 20 per cent. spiegeleisen is quoted at 28 dols.; ferro-manganese of 80 per cent. is worth 73 dols.; and steel blooms are quoted at from 38 dols. to 40 dols. Steel rail crop ends are offered at from 30 dols. to 21 dols.; Welsh crop ends, 19 dols. to 19.50 dols.; double heads and bridge rails are offered at 21 dols.; scrap iron, 20 dols. to 21 dols. The merchant mills have started up with a less volume of business than is usual at this season, and orders are taken for common iron at from 1.70 to 1.80; refined, 1.80 to 1.90, with occasional sales of special brands at a trifle more. Nails are offered at 2.25 dols., and are, in some cases, sold at a little less; puddled bars are plenty at 30 dols., though for some makes a dollar more is paid. The supply of pig iron seems to be equal to all current requirements; but very little is changing hands. No. 1 foundry ranges from 19 dols. to 20.50 dols.; No. 2, 18 dols. to 19 dols.; gray forge, according to quality, has been selling this week at from 15.50 dols. to 18.25 dols., but the average quotations are 17.50 dols. for standard brands. The western iron market has not improved as much as was predicted. The trade has assumed a retail character almost altogether. One mill there secured a 300-ton lot of structural iron. Between 2000 and 3000 tons of plate iron have been ordered within a week. Track supplies are quoted at 2.35 dols. for spikes; splice bars, 1.70 dol. Notwithstanding that the coke region has restricted production one-fourth, prices are still weakening. Wrought pipe is moving freely. Some business is being done in low grade steel.

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

(*From our own Correspondent.*)

THE occurrence of a national holiday, prolonged in many cases as far as possible consequent upon shortness of orders, added to the uncertainty which overhangs the ironworkers' and the colliers' wages questions, tended this week to keep both yesterday's and to-day's market very quiet. On account of some of the export markets, particularly Australia and the River Plate, orders for special makes of bars and sheets are coming to hand in encouraging numbers. Speaking generally, however, the export demand is decidedly flat.

Prices are no stronger this week. Although the list price of bars is nominally £7 10s., £7 is the utmost that is obtained, while many good bar makers are unable to obtain more than £6. William Millington and Co. quote cable iron, plating bars, and small rounds and squares ⅝in, £8; best chain iron, best plating bars, and rounds and squares ¼in., £9; rivet iron, £8 10s. £8 15s., and £10 5s., according to quality; angles, 1½in. to 3in., £8 10s., £9, and £10, according to quality; tang iron, ⅜in. and $\frac{5}{16}$in., £7 10s. for ordinary, £8 10s. for best, and £9 10s. for double best. Horseshoe and shutter bar iron, 1½in. to 2in., £7 10s.; rounds and squares, $\frac{5}{16}$in., £8 10s.; ditto No. 5, £9 10s.; ditto $\frac{3}{16}$in. and No. 6, £10; No. 7, £11; No. 8, £12; No. 9, £13 10s.; No. 10, £15 10s.; and No. 11, £17 10s. Treble best bars they quote £11 10s.

Plates Messrs. Millington quote at £9 for ordinary, £9 10s. for best boiler, £10 10s. for double best, £12 10s. for treble best for flanging outwardly, and £15 10s. for treble best for flanging inwardly. Sheets not larger than 10ft. by 3ft. by ¼in. they quote £9 10s., and best qualities 20s. per ton additional. The demand for sheets is generally quiet. Messrs. Lysaght's extensive works in Wolverhampton are exceptionally busy rolling sheets to be galvanised at their Bristol establishment. Mr. Lysaght, who has just returned from a lengthened visit to the Australian colonies and other parts of the world, speaks encouragingly of business prospects.

Certain of our local galvanised sheet makers report themselves with a very fair amount of work. It is significant that the aggregate exports of these manufactures from our shores keep up steadily, therefore some firms must be busy notwithstanding the general complaints. The leading Bristol makers, it is understood hereabouts, are quite active, and at that city some 2000 tons of galvanised sheets are being turned out every month. All, however, alike complain of the low prices at which business has to be accepted; £12 for 24 gauge, delivered Liverpool, is considered a good price as times go. In the black singles are £7; galvanising doubles, £7 10s.; and lattens, £8 5s. to £8 10s. easy.

Native pig iron is unimproved. Best pigs are especially a drug on the market. All-mines are 57s. 6d. to 55s. for hot-blast sorts, and 20s. per ton additional for cold-blast. Part-mines are 42s. 6d. and cinder pigs 37s. 6d. to 35s.

Consumers of Derbyshire, Northampton, Nottingham, and similar pigs held off the market more than usual this—Thursday—afternoon, consequent upon the announcement that the rates for the conveyance of such pigs into this district had as from and after the 1st inst. been reduced by the railway companies. Agents, however, explained that the reductions were so slight that there was no room for any easier prices. The London and North-Western and the Midland are the companies concerned, and they have reduced the rates on pigs from Derbyshire and Nottinghamshire in amounts varying from 1d. to 7d. per ton to stations in South Staffordshire; but for delivery to Birmingham the rates have been increased 3d. per ton, besides which an additional 2d. per ton will have to be paid by the consignors for unloading—a work which was previously performed by the companies for nothing.

The largest nominal reduction appears in respect of the freights from Northampton, which are reduced 1s. 2d. per ton; but vendors stated that in reality this is little or no relief, since the companies will now only deliver to stations instead of to consignees' works as before, will not unload the pigs, nor will they allow any excess weight, not even sand weight, over and above the imperial ton. Northampton pigs were to-day about 39s. per ton delivered to sidings, and Derbyshire pigs, 40s. 6d. to 41s.

The wages' question was considered by the Iron Trade Wages' Board in Wolverhampton on Tuesday. Mr. H. O. Firmstone, who presided in the absence of the chairman of the trade, set out the masters' case, stating that they had given notice for a reconsideration of the present wages, which would expire after August 23rd, in order that there might be some reasonable comparison between the rate of wages in this district and those prevailing in the North of England. It was notorious that the North of England were pushing themselves into this district. They could supply iron even at the door of the South Staffordshire makers at prices with which the latter could not compete. The Staffordshire puddlers were now getting 7s. 3d. per ton, against 6s. 3d. in the North of England. Mr. Capper, the operative secretary to the Board, said he was instructed to put forward a counter claim of 2½ per cent., or 6d. per ton, advance in puddlers' wages. Reckless underselling and serious over-production were assigned by the men as the cause of the present depression. The men advocated restricted production rather than reduced wages. They would be quite willing to work three days a week only. The masters combatted this view; and it was unanimously resolved to submit the question to Alderman Avery, of Birmingham, the arbitrator to the Board, and to ask him to make an early award.

The increased demand for coal which has been experienced by the Cannock Chase colliery owners since the majority of the South Staffordshire mines were shut down by the strike and lock-out, has just led them to advance prices. Coal has been advanced 1s. per ton, and slack 6d., and miners' wages will be increased in proportion. This step has infused more spirit into the disaffected South Staffordshire colliers, who are reiterating their intention of not submitting to the reduction. A resolution to this effect has this week been passed by the Central Committee, and at the different mass meetings the stereotyped decision to "play on" is still unanimously carried by those miners who attend.

The manufacture in cast malleable iron, of small light carpenters' tools, to compete with the cheap German goods abroad and in the English market, has been successfully inaugurated at Walsall by the Specialité English Tool Manufacturing Company.

At a meeting of the Mines Drainage Commission in Wolverhampton on Wednesday the mining engineer reported that the Moxley and Portobello pumping engines had been stopped. These, with Park Lane, made three engines stopped by the Commissioners during the last few months—a state of things rendered possible by their more complete arrangements—and meant a saving of about £3000 yearly. The chairman, Mr. W. Bassano, stated that the Fly engine at Old Hill had also been stopped. The water there was now raised by the Waterfall engine, at an annual saving of about £1200. It was decided to levy a general drainage rate of 1d. upon every ton of coal, slack, and other minerals raised during the past half-year. It was incidentally stated that the income of the Commission on surface work was £15,000 per annum. Only £5000 was spent in works, the remainder being expended on loan interest and sinking fund requirements.

Important alterations are about to be carried out upon certain of the Birmingham tramway lines. The existing lease to the Birmingham Tram and Omnibus Company of the lines between Hockley and Bournebrook expires in May next year. The metals are at present 4ft. 8½in. gauge, and it is proposed at the expiration of the lease to reconstruct them on the 3ft. 6½in. gauge. The estimated cost of this step is £20,000. The alteration of the gauge will afford an opportunity of adopting the section of rail with the narrow groove which will not admit the wheels of other vehicles, in place of the present wide groove section, which causes so much inconvenience to vehicular traffic. It is proposed to adopt a solid steel rail similar to that recently laid down on the Central Tramways route. Permission to use steam has been granted for three years. The tramways in Suffolk-street are to be taken up, and the line continued along John Bright and Navigation-streets. The 3ft. 6½in. gauge will be employed, and the cost is estimated at £28,000. Two new lengths to connect Congreve and Livery-streets will be put down at a cost of £1150. In order that this work may be done, the Town Council will have to obtain a Provisional Order, and it has been decided that it shall apply for it, the terms to be, as far as applicable, similar to an Order obtained last session. The Birmingham Tram and Omnibus Company will deposit with the Corporation, as a security fund, a sum of money equal to £1250 per mile, and will rent the line at 4 per cent. on the actual outlay for the first fourteen years, and 5 per cent. for the remainder of the term.

In North Staffordshire the ironworkers have this week been laid off for the holidays. The home markets are very quiet. Only little is doing in hoops and bars, and scarcely more in plates, except it be in some cases of girder descriptions. Puddled bars are being bought with slightly more freedom. As to foreign business, what is being done is small, and mainly on account of the Colonies, Russia, East India, and South America, the chief markets remaining flat. Prices keep very low, and this is the most unsatisfactory feature of business. Ordinary bars are plentiful at £6 2s. 6d. down to £6, and ordinary crown plates are abundant at £7 12s. 6d. down to £7 10s. per ton delivered Liverpool or equal.

The open market full quotations for finished iron of the make of Messrs. Robert Heath and Sons are:—R.H. and R.D. bars, both with brand of a crown, £7; ditto best bars, with similar brand, £7 10s.; angles and tees, £7 10s. Best angles, £8; best tees, £8; plates, £8 10s.; best plates, £9; best best plates, £10; best best best plates, £12. The Ravensdale hoops of the same firm are quoted £7 15s., and the Ravensdale sheets £8 5s. All these prices are delivered Liverpool and subject to the usual 2½ discount for cash.

Messrs. Kinnersly and Co., of the Clough Hall Ironworks, quote their list as:—Crown bars, delivered Liverpool, £6 7s. 6d.; crown angles, £6 17s. 6d.; crown tees, £7 7s. 6d.; crown plates, £7 17s. 6d.; with best qualities 10s. per ton more in each case. They quote their best boiler plates £8 5s. per ton for ordinary sizes.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business both in the iron and the coal trades of this district continues extremely dull, with a depressed feeling still generally pervading the market so far as the future is concerned. The restriction of the output of pig iron by the blowing out or damping down of furnaces in the district has so far had no very perceptible effect, buyers being still very apathetic about giving out orders. In the finished iron trade the weight of business coming forward is also still extremely small, and some of the local forges have great difficulty in securing work to keep them going even on short time.

The Cardiff meeting of the Institute of Mechanical Engineers drew away this week a number of the representatives of the engineering trades in this district, and there was only a small attendance on the Manchester Iron Exchange on Tuesday, with very little inquiry. Where business was done it was only at the lowest possible prices, and no transactions of any weight were reported. Lancashire makers of pig iron still quote 42s. to 42s. 6d. less 2½ for forge and foundry qualities delivered equal to Manchester, and do not seem inclined to give way upon these figures, as they are for the present kept going with deliveries against contracts. Buyers, however, are not disposed to pay these prices, and local makers are so much undersold by district brands, that except where they have a special advantage in low rates of carriage to works in the immediate neighbourhood of their furnaces they are practically out of the market, and very few new orders are being got. For Lincolnshire and Derbyshire brands delivered into this district 41s. to 42s. less 2½ is being taken; and although some of the makers are not disposed to entertain business at prices so low, these figures really represent about the full basis upon which any orders that are to be got are obtainable.

The demand for hematites continues extremely dull, but a few small orders are reported to have been booked at about 55s. to 55s. 6d. less 2½ for good foundry brands delivered here.

The manufactured iron trade remains much the same as last reported. New orders come forward very slowly, and £5 12s. 6d. is about the average price that makers are open to take for good qualities of local and North Staffordshire bars delivered here, with some common brands to be got at as low as £5 10s. per ton.

The condition of the engineering trades is pretty accurately summarised in the report issued this month by the general secretary of the Steam Engine Makers' Society. I may state that the number of unemployed members in receipt of donation benefit remains the same as last month, and the secretary states that there is no material change in the state of trade since his last report, unless it were a downward tendency in localities where marine engine work is the principal trade of the district. The decline in this branch of industry, the secretary points out, had now been going on for nearly twelve months, and it had been of so extensive a nature that it had caused the distress to be as heavy, if not heavier, than in any period within the past twenty years. This was especially the case in the north and north-eastern districts, as the reports from their branches in those parts would bear the amplest testimony. Whether the full extent of the depression had been reached it was hard to conjecture, but if the decline of wages was to be taken as a criterion they might assume that it had, for the wages were now almost as low as they were prior to the revival of 1880. At locomotive and tool works there seemed to be a fair amount of orders in hand, whilst the stationary engine and millwright shops seemed to be in general work. I may add that machinists in this district continue tolerably well employed, but in this branch, as in all others, orders are only got at such low figures that they leave little or no margin for profit.

The rejection by the House of Commons Committee of the Manchester Ship Canal Bill has been received not only with very great surprise, but with a considerable feeling of mortification, in this district. The promoters of the ship canal, however, do not seem to have lost heart, and they are still determined to persevere in their efforts to secure an adequate water transit for the large and important trade interests of this district. Although there is naturally deep disappointment that the large expenditure of time and money on the project should, up to the present, have ended so unsatisfactorily, still it is not felt that the work so far done has been without result. The promoters have now ascertained the limits of the opposition with which they have to contend, and although the original project—which they still consider the best that could be brought forward—may have to be abandoned, there are other alternative schemes which have been previously considered that they intend to propose, and with regard to which very sanguine hopes of success are entertained. Practically the opposition has been narrowed to the possible injury which might result to the estuary of the Mersey, and apparently the doubts entertained with regard to this portion of the proposed canal have largely, if not wholly, influenced the Committee in refusing their sanction to the Bill. The construction of the canal up to Warrington is really unopposed, except as it affects the lines of the railway companies crossing the river, and a further improvement in the gradients approaching the required bridges is to be carried out, which will, it is thought, effectually remove any opposition the railway companies have hitherto raised. In order to avoid the estuary of the Mersey, although the promoters still consider that this is the best and the proper outlet for the canal, there are several alternative schemes, the chief of which include the formation of a channel on the Cheshire side of the estuary, or the cutting of a canal through the land between Warrington and Garston. One of these schemes it is intended to bring forward for Parliamentary sanction during the next session rather than the project should be abandoned, and as the promoters have every ground for hoping that a scheme so amended would meet with little more than a nominal opposition, they have every hope that comparatively very little further expenditure of time and money will be necessary for bringing their efforts to a successful issue, so far as they concern the obtaining of the requisite powers for the construction of a ship canal to Manchester. I can only add that so wide and deep an interest has been manifested in the proposed scheme, and so much sympathy has been expressed for the promoters in the altogether unexpected adverse decision of the House of Commons Committee, that they feel themselves fully justified in continuing their efforts to secure for the district a cheaper means of outlet to the sea which could not fail to be of immense advantage to the engineering and other branches of industry throughout Lancashire.

In the coal trade there has been no material change in quoted rates with the commencement of the month, but the demand all through continues extremely dull, and there is a tendency towards weakness in the market. The complete collapse of the colliers' strike in West Lancashire has induced a rather easier tone in the prices which sellers are prepared to take for contracts; whilst for present requirements the supplies are so plentiful in the market that buyers who are in a position to take quantities are able to obtain concessions. The average prices at the pit mouth are about as under:—Best coal, 8s. 6d. to 9s.; seconds, 6s. 6d. to 7s.; common house coal, 5s. 6d. to 6s.; steam and forge coal, 5s. to 5s. 6d.; burgy, 4s. 9d. to 5s.; best slack, 4s. 3d. up to 4s. 6d.—in a few exceptional cases—with good ordinary qualities to be got at about 3s. 6d. to 4s. per ton.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Master-Cutler this year will be Mr. Bingham, head of the firm of Messrs. Walker and Hall, Electro Works, Howard-street. Mr. Bingham, who has lately been gazetted to the colonelcy of the 1st West York Engineer Volunteers, is at present in camp with them at Cleethorpes; but he returns this week to sail for the United States and Canada with Mrs. Bingham and his son. This will necessitate the postponement of the Cutlers' Feast, which is usually held on the first Thursday in September. Mr. Bingham cannot be back before the third week in September, and after that he would require time to make his arrangements, so that it is probable the banquet of the North may not be held till October. Mr. Bingham was Master-Cutler in 1881-82. The Cutlers' Company, though averse to the alteration of date, has a precedent in the year of Mr. George Wilson's Master-Cutlership.

The Royal assent having now been given to the Dore and Chinley Railway, the work of construction will be immediately proceeded with. Mr. Storey, C.E., of Derby, will take charge of the Chinley portion of the line, and Mr. Parry, C.E., will superintend the construction of other parts towards Dore.

The British Society of Mining Students, which has nearly 250 members, held its annual meeting on Bank Holiday at the Aldwarke Main Collieries, belonging to Messrs. John Brown and Co. Mr. C. E. Rhodes, the general manager, conducted the party over the works. Three seams of coal are worked at these collieries, viz., Barnsley Thick, 8ft.; Parkgate, 5ft. 2in.; and Swallow Wood, 5ft. 6in. The screening arrangements, the method of washing the coal for coking purposes, the winding and ventilating machinery, the tail and endless rope systems of haulage, and other leading features of Aldwarke Main, were explained. At these collieries the range of coke ovens includes several sets on the Jameson patent system, by which several bye-products usually wasted can be obtained and utilised. The system is not yet in general use. At the meeting, which followed the inspection, the President of the Society—Mr. W. Howard—vacated the chair, and Mr. Bulman was elected for the ensuing year. Vice-presidents were appointed for the North of England, Lancashire, Yorkshire, Derbyshire, Staffordshire, and Wales; and Messrs. Routledge, Howard, Durnford, and Cobbold—the secretary—to form with the vice-presidents a working committee. Several safety lamp tests were shown to visitors by Mr. Rhodes on an apparatus he had designed for the purpose.

By the breaking of a carriage axle in an excursion train from Sheffield to Cleethorpe on Bank Holiday, considerable damage was done to the station at Great Cotes and the signal wires, &c. The carriage on which the axle failed swayed and jolted about in an alarming manner, struck against a gate post, and ripped up the platform as the train dashed through the station. It is a marvel that the six passengers injured were so slightly hurt—they were able to proceed on their journey. It is said that on the axle being examined a distinct internal flaw was perceptible. The carriage axles were tapped at Letford in the usual way, but this kind of examination is insufficient to reveal a fault in the body of the metal.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUSINESS was almost at a standstill at the Cleveland iron market held at Middlesbrough on Tuesday last, the attendance being exceedingly small. Notwithstanding the announcement that stocks had increased 7620 tons in July, the principal makers steadily maintained their prices. Merchants still quote No. 3 g.m.b. at 36s. 9d. per ton, but, having only small lots to dispose of, the few sales they make have little, if any, effect upon the market. Makers' price for No. 3 remains at 37s. for prompt delivery, and for forge iron 35s. to 35s. 6d. per ton. Some of them have now become reconciled to the first-named figure in view of the continued slackness of demand.

Warrants are offered at 36s. 9d. per ton, but there is no demand for them.

The stock of Cleveland iron in Messrs. Connal's store at Middlesbrough continues to decrease, but only at a slow rate.

In the manufactured iron trade dulness prevails, with no immediate prospect of a change for the better. Orders are scarce, and the mills which are still in operation work very irregularly. Makers continue to quote ship plates at £5 to £5 2s. 6d. per ton; shipbuilding angles £4 15s. to £4 17s. 6d., and common bars at £5 2s. 6d. to £5 5s.—all on trucks at works; cash 10th, less 2½ per cent.

The export statistics for July show that 71,817 tons of pig iron and 38,923 tons of manufactured iron and steel were shipped from the Tees during the month. This is a great falling off so far as pig iron is concerned, being about 8000 tons less than in June, and about 21,000 tons less than in May. The principal items in the shipment of pig iron are as follows:—To Scotland, 19,126 tons; to Germany, 10,911 tons; to Russia, 7310 tons; to Wales, 6170 tons; to France, 5481 tons; and to Holland, 4272 tons.

The accountant's certificate, issued under the Durham miners' sliding scale, shows that the average net selling price of coal for the three months ending June 30th was 4s. 8·07d. per ton. The prevailing rate of wages of miners, colliery engine, and cokemen, will therefore be reduced 1¼ per cent.

Messrs. Bolckow, Vaughan, and Co. have decided to keep their blast furnaces at Witton Park at work for six weeks longer. This determination has been come to, in obedience to pressure brought to bear upon them by the inhabitants of the surrounding district. The latter think that the North-Eastern Railway Company may be induced to lower its rates on minerals rather than see the furnaces blown out. The hope that they will take this view is, however, generally regarded as but a forlorn one.

The Steel Works at Eston are entirely closed for want of orders. There is a prospect of restarting them after a time, but weeks will probably elapse first. The Eston blast furnaces continue, however, in blast, and the pig iron they make is sold whenever purchasers can be found.

The North-Eastern Steel Works continue very busy for the present. This arises from their having been permitted, by arrangement with the Rail-makers' Combination, to book a large contract for rails without competition. They are also getting considerable benefit from having cultivated a miscellaneous trade in ingots and slabs, for wire drawers, tin-plate makers, and plate and angle makers.

According to the ironmasters' return for July, just issued, there have been ninety-nine furnaces in blast during the month, and the output of pig iron of all kinds has been 201,721 tons, being 3727 tons less than in June. The stock of pig iron for the whole district is 277,519 tons, or an increase of 7620 tons for the month.

The loss of the Middlesbrough steamer, Dione, off Gravesend, on Sunday night last, has naturally caused a great sensation throughout Tees-side. The vessel coming and going as she has been wont to do every week for years, was familiar to every one. The idea of her going to the bottom with such suddenness as to give no chance whatever to more than half her crew and passengers was too awful to realise easily. The vessel will soon be replaced from the tiers upon tiers of those now laid up in North-eastern ports. But the gap in many a household will not be so easily filled. The accident is very similar to that which some months since took place in the Irish Sea, when a new vessel from the Clyde ran into an Irish mail steamer belonging to the London and North-Western Railway Company, striking her amidships and sinking her immediately. The Dione was built of iron, and the mail boat of steel. But whether ships be built of steel or iron seems to be of little consequence in cases of serious collision; they go down all the same, like tinpots.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow iron market was closed from Friday till Tuesday owing to the Bank Holiday. Since it re-opened there has only been a very moderate business in warrants, the prices of which do not show much alteration. Since last report an additional furnace has been put in blast at the Clyde Ironworks, and there is now a total of 95 in operation, as compared with 115 at the corresponding date last year. The amount of the shipments of Scotch pigs to foreign ports does not show any improvement. The Russian demand is now very poor, and that to America, though slightly better, is not at all satisfactory. Stocks in Messrs. Connal and Co.'s stores exhibit but a small decrease.

Business was done in the Glasgow warrant market on Friday forenoon at 41s. 6½d. to 41s. 7d. cash, and 41s. 8½d. to 41s. 9d. one month; the afternoon quotations being 41s. 7d. cash, and 41s. 9d. one month. The market was shut on Monday. Transactions occurred on Tuesday at 41s. 6½d. to 41s. 4½d. cash, and 41s. 8½d. to 41s. 6d. one month. On Wednesday transactions at 41s. 4d. cash. To-day—Thursday—in consequence of exaggerated statement with reference to the shipbuilding trade, the price of warrants advanced to 41s. 8d., but subsequently declined somewhat on these statements being discredited.

The values of makers' pig iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 6d.; No. 3, 50s.; Coltness, 57s. 6d. and 51s.; Langloan, 53s. 9d. and 51s. 6d.; Summerlee, 51s. and 46s. 6d.; Calder, 51s. 6d. and 46s. 6d.; Carnbroe, 50s. and 46s. 6d.; Clyde, 48s. and 45s.; Monkland, 42s. 6d. and 40s. 3d.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 42s. 6d. and 40s. 6d.; Shotts, at Leith, 51s. 6d. and 51s.; Carron, at Grangemouth, 48s. (specially selected, 54s.), and 47s. 6d.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 50s. and 43s.; Eglinton, 44s. and 41s.; Dalmellington, 47s. and 42s. 6d.

In the malleable iron department there is scarcely any favourable change. A few small orders are booked, but there are not sufficient to influence the trade as a whole. The past week's shipments of iron manufactures from Glasgow were comparatively small. They included £25,200 worth of locomotive engines, £4620 mill machinery, £5310 steel goods, and £21,700 general iron manufactures.

The coal trade has been active in the shipping department, and in the course of the week some very large cargoes were despatched from Glasgow, including 2300 tons to San Francisco, 2130 to Demerara, 2950 to Cronstadt, 2350 to Bordeaux, 1480 to Savona, 750 to Oporto, 500 to Quebec, &c. F.o.b. prices of coals at Glasgow are, on the whole, well maintained. The week's exports from Leith have also been good, exceeding 8000 tons, while 9236 tons were despatched from Ayr, and 12,424 tons from Grangemouth. There is a dull inquiry for furnace coals, but household sorts are in fair request. The shipments of coal from Scotch ports to date show a decrease of 90,000 tons compared with those for the corresponding period of 1883.

Efforts are now being made to raise the necessary capital for the construction of the railway, sanctioned by the present session of Parliament, for affording communication between the Lanarkshire coalfields and the Ayrshire ports. The capital amounts to £375,000, of which £100,000 has been applied for privately. The scheme is expected greatly to extend the shipping trade in coals in Ayrshire. The Glasgow and South-Western Railway will immediately greatly increase the facilities for the transit of minerals to Ayrshire ports.

Mr. John Connal, secretary to the coalmasters of Fife and Clackmannan, has written to the secretary of the miners—Mr. Weir—that the coalowners have resolved to accept the sliding scale of wages proposed by Mr. Weir, viz., that for every 3d. per ton advance received on the average price of ordinary steam coal shipped at Burntisland, wages to rise 2½ per cent., for every 3d. per ton reduction in price wages to fall 2½ per cent., the basis to be the present wages earned, and the shipping prices realised. Mr. Connal says that wages are higher at present than the prices warrant, but the masters are willing, as a matter of compromise, to give the scale a fair chance. At a meeting of the Miners' Committee, at which this letter was read, Mr. Weir pointed out that this was not the scale he proposed. What he asked was that the basis should be taken from the prices obtained from 1st November, 1883, to 31st January, 1884. Wages were then 1s. higher than how, and prices had only been reduced 1s. per ton, so that the basis referred to by Mr. Connal would be disadvantageous to the men. Mr. Weir was instructed to inform Mr. Connal that the basis offered was not satisfactory.

The shareholders of the Midlothian Oil Company have elected a new board of directors, who are pledged to do their utmost to retrieve the position of the company. The first general meeting of the Holmes Oil Company was held in Glasgow a few days ago, when Mr. John Millar, the chairman, explained that the directors had unanimously resolved to adopt the Young and Beilby Pentland retort as that which at present yielded the best results. They were erecting two benches of these retorts, which would distil 200 tons of shale per day, and thirty workmen's houses were also in course of erection.

There were 26 vessels with an aggregate tonnage of 21,690 launched from the Clyde shipyards in July, against 28 vessels and 30,144 tons in the same month last year. The seven months' work comprises 169 vessels and 171,613 tons, against 169 vessels and 226,130 tons in the corresponding period of 1883.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

I HAVE no good news to report of our iron industry. A few fresh orders are coming in from America, but none of any consequence, and the trade is principally of a hand-to-mouth character. Dowlais is short of orders, and I hear gloomy forebodings amongst the agents.

It is fortunate that we have a little business with America and Canada, or the mills must stop in several quarters. Last week the despatches of manufactured iron and steel amounted to 5000 tons. This was principally from Newport. I do not think that 100 tons left Cardiff. Coal exports are up to average, and the principal collieries are maintaining their output. Trade, in fact, may be regarded as firm in respect of best qualities, but there is no return, so far, of the rush, and work continues forward and orderly on rail and at docks. This may be taken as satisfactory for the time of year. House coal and seconds are dull. For small steam the inquiry is free at firm quotations, and stocks are being cleared away that have not become deteriorated. So, too, with patent fuel. From Cardiff the exceptionally good total of 4780 tons of fuel left this week. From Swansea, which commands the best trade in this commodity, the exports last week nearly reached 12,000 tons. There was a good deal of excitement last week in the Rhondda district when the news arrived that the Barry Bill had passed. Now there will be a general shaking hands all round, I hope, and every nerve strained to do the best for the mineral development of the district.

But there are one or two points which should be noted before this great fight is forgotten. It has cost the promoters £60,000, and now that they have gained the victory, they are scrutinising results somewhat dolefully. What they wanted was a new railway, and this the Lords would not give. This leaves them in this position—and I invite careful attention to an unprejudiced opinion:—They will be as much as ever in the hands of the Taff Vale Railway Co., whose interest, naturally, will be to favour its own instead of Barry traffic, and take it to its own ports of shipment, which will be four miles nearer the collieries. In fact, when Barry traffic leaves the Taff Vale system, whether it be at Hafod Junction or Treforest Junction, the Barry Company must, in order to place it upon the same footing as Taff traffic, carry four miles gratis. Four miles in a long lead of a hundred would not be worth speaking about, but four miles in twelve, which is the difference from Treforest to Cardiff, is simply 33 per cent.

I have just seen a copy of the Taff Vale half-yearly report, which shows that in the anxiety of the directors to increase facilities, they have, even with a larger revenue by some £3000 over the corresponding half of last year, only £148,797 to manipulate, instead of £155,979. Still, this is a large total, and accordingly a dividend of 10 per cent. and 6 per cent. bonus is declared.

I note some improvement in shipping industry, as shown by the starting of another steamship company. This is the "Gwenthian," mostly promoted by Cardiff men.

The Neath Harbour Smelting and Rolling Works Company has been started.

This week the president and members of the Mechanical Engineers' Society visited Cardiff. Mr. T. H. Riches has had all local arrangements, and the programme is a good one. Monday was chiefly preparatory, with a meeting at the Lecture Hall. Tuesday they inspected the Docks, and in the evening dined, at the Marquis of Bute's invitation, at the Drill Hall. Wednesday Treherbert was visited, and the route of the week includes Dowlais, Rhymney, Cyfarthfa, and Newport. So far the members appear very pleased with the scientific pabulum provided for them.

On Tuesday night a large engineering works at Cardiff was destroyed by fire.

Bad news reaches me from the Llanelly district concerning the steel trade. In fact, at no time has the trade appeared more sinister, and the opinion of Mr. Lowthian Bell and others on the crisis, at one of the meetings of the Mechanical Engineers, is looked forward to with interest.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office Officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

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

28th July, 1884.

10.685. CLUTCHES for CONNECTING PULLEYS to SHAFTS, A. M. Clark.—(*E. Barrath and J. R. Paddack, U.S.*)
10,686. CONVERTING ARTICHOKE JUICE into LEVULOSE, A. M. Clark.—(*E. L. J. Boniface, Paris.*)

29th July, 1884.

10,687. WATER-CLOSETS, &c., J. Shanks, Barrhead.
10,688. GEAR for COGGING MILLS, J. Riley, Glasgow.
10,689. STEAM BOILERS, G. Stevenson, Airdrie.
10,690. PULLEYS and BLOCKS, C. McG. Bate, Newcastle-on-Tyne.
10,691. PRESERVING GREEN CROPS, F. Silvester, Newcastle.
10,692. OPENING and SCUTCHING COTTON, S. Tweedale, Accrington.
10,693. ROTARY PUMPS, G. A. J. Schott, Bradford.
10,694. AUTOMATIC BRAKE for SEWING MACHINES, F. W. Cheetham, Hyde.
10,695. ATTACHING METALLIC TOPS to LAMPS, &c., J. P. Simms, Soho.
10,696. ALARMS, C. T. Powell, Handsworth.
10 697. GREASE-PROOFING COMPOSITION, W. Charleson, Leigh.
10,698. FOLDING LADDERS, F. Winter, Liverpool.
10,699. CONTROLLING ELECTRIC CURRENTS, J. Tavener, Basingstoke.
10,700. MANGLING and WRINGING MACHINES, J. Ormerod, Haslingden.
10,701. ROPE CLIP, E. Ormerod, Atherton.
10,702. CORSETS, M. A. Devenish, Caistor.
10,703. LATCHES, W. B. Shorland, Manchester.
10,704. LAYING TELEGRAPH, &c., WIRES, J. C. Sellars, Birkenhead.
10,705. GRILLES for PROTECTING SHOP FRONTS, A. Attwood, Ulverston.
10,706. DOG, &c., BISCUITS, B. C. and L. C. Tipper, Birkenhead.
10,707. PIPE TRENCH, J. Wolstenholme, Radcliffe.
10,708. SHIPS, J. Buchanan, Gourock.
10,709. ELEVATING HAY, &c., on to STACKS, H. Yorath, Cardiff.
10,710. BUFFER BOXES, J. Tordoff, Leeds.
10,711. VELOCIPEDE BELLS, A. C. Houston and R. E. Phillips, London.
10,712. RINGS for SUPPORTING CURTAINS, E. J. Day, London.
10,713. RAILWAY SIGNALS, W. H. Beck.—(*T. C. Miles, New York.*)
10,714. EXCENTRIC WHEELS, M. Heslop, London.
10,715. TOBACCO PIPES, &c., A. H. Storey, London.
10,716. NEEDLE-CASES, E. A. Jahncke and H. W. Herbst, London.
10,717. SYPHONING APPARATUS, W. J. Holmes, London.
10,718. TYPE MATRICE, &c., A. H. Reed.—(*M. H. Dement, Chicago.*)
10,719. TOOL for MAKING BOTTLE NECKS, A. J. T. Wild, London.
10,720. ROLLERS for PRINTING, &c., PAPER, &c., F. E. Elmore, London.
10,721. MARABEAU TRIMMING, C. E. Hencke.—(*C. Knapp, jun., Saxony.*)
10,722. MIGNONETTE CHENILLE, C. E. Hencke.—(*C. Knapp, jun., Saxony.*)
10,723. MACHINES for PLANING, &c., BOARDS, H. C. Tunis, Baltimore, U.S.
10,724. STEAM ENGINE, H. J. Haddan.—(*A. Zalm, Holland.*)
10,725. STOVES, &c., S. C. Davidson, Belfast.
10,726. HEATING COOKING OVENS, &c., G. Rydill, Highgate.
10,727. SPINNING SILK, H. E. Newton.—(*The Attwood Machine Company, Connecticut, U.S.*)
10,728. SHIRTS, G. J. Gissing, London.
10,729. GAUGING LIQUORS, P. Colligan, Leeds.
10,730. ENRICHING MILK, W. McDonnell, Dublin.
10,731. FLUSH TANKS, R. Weaver, London.
10,732. ADVERTISING, O. J. Smiles, London.
10,733. BATTERY CELLS, J. C. Howell, London.
10,734. STAND or HOLDER, A. M. Clark.—(*N. Robertson, Canada.*)
10,735. GUN and PROJECTILE, A. M. Clark.—(*J. Williams, Kentucky, U.S.*)
10,736. PROPELLING BICYCLES, &c., A. S. Bowley, London.
10,737. CAR COUPLINGS, W. H. Thurmond, Georgia, U.S.
10,738. SPRING-BENDING and FORMING MACHINES, G. Norwood, Connecticut, U.S.
10,739. RECOVERING, &c., the HEAT of EXHAUST VAPOURS or GASES, M. Gehre, Germany.
10,740. PURIFYING, &c., LIQUORS, W. R. Lake.—(*The Cushing Process Company, Massachusetts, U.S.*)
10,741. EXTRACTING OIL from SEEDS, T. Robinson, Leeds.
10,742. WATER-CLOSET APPARATUS, S. B. Goslin and J. J. Brown, London.
10,743. EXTRACTING SULPHUR from SULPHIDE of HYDROGEN, G. F. Redfern.—(*Dr. H. von Miller and C. Opl, Austrian-Silesia.*)
10,744. ELECTRIC FIRE-ALARMS, J. C. Chambers, Leeds.
10,745. CRANK AXLES, D. Joy, London.
10,746. STEAM ENGINES, D. Joy, London.
10,747. RAILS for TRAMWAYS, G. Lentz, Germany.
10,748. TOUGHENED GLASS, C. D. Abel.—(*La Compagnie Générale du Verre et du Cristal Trempes, Paris.*)

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10,749. TOOL for CUTTING METAL, C. Mather, Manchester.
10,750. ROLLERS for WRINGING, &c., MACHINES, R. Longdon, Manchester.
10,751. AUTOMATIC SPRING HINGE, R. Ann, Handsworth.
10,752. TONGUE and GROOVE HAND PLANES, T. Hopkins, Liverpool.
10,753. METAL CASES for MARINE TIMEPIECES, J. Allen, Birmingham.
10,754. LOCK SPINDLES, E. W. Buller, Birmingham.
10,755. TREATMENT of GUTTA-PERCHA ARTICLES, E. Dodd, London.
10,756. APPARATUS EMPLOYED during the HEATING and WELDING of BOILERS and CISTERNS, J. Collier and E. Binns, Halifax.
10,757. PARING HEELS of BOOTS and SHOES, F. Cutlan, Wellingborough.
10,758. STEAM JET VENTILATORS for MINES, M. Morgan, Mountain Ash.
10,759. VENTILATING, J. C. Baker, Liverpool.
10,760. SLIDES or FASTENINGS for the HAIR, A. Sedgwick, Liverpool.
10,761. FITTING, &c., BOATS, W. Welch, Portsmouth.
10,762. TWEEZERS for CUTLERY, J. Coombs, Sheffield.
10,763. APPARATUS USED in the MANUFACTURE of PAPER PULP, J. Plummer, jun., Edinburgh.
10,764. PROPELLERS, T. Leitch, Glasgow.
10,765. ARTIFICIAL IVORY, L. P. Merriam, London.
10,766. BOILER FURNACES, H. Thompson, London.
10,767. INDIA-RUBBER FROGS for HORSESHOE PADS, R. Lewty, Manchester.
10,768. WASHING CLOTHES, E. Taylor, Bury.
10,769. CURLING HAIR, J. Ainsworth, Over Darwen.
10,770. BICYCLES, W. A. Rudling and J. F. Coffin, London.
10,771. GAS GOVERNORS, D. B. Peebles, Bonnington.
10,772. GAS BURNERS, R. Flosky, Prussia.
10,773. DRIVING and STEERING VELOCIPEDES, &c., J. Whittingham, Nantwich.
10,774. VEHICLE BRAKES, J. Smith, Nottingham.
10,775. DRYING GRAIN, &c., G. M. Parkinson and J. G. Walker, Doncaster.
10,776. LAWN TENNIS POLES, R. P. Brown, Yorkshire.
10,777. CONNECTING CHISELS to their HANDLES, &c., G. Heaton, Oldbury.
10,778. ELECTRIC TELEPHONY, J. G. Lorrain, London.
10,779. VELOCIPEDES, W. E. Hurrell, London, and W. Spence, Surbiton.
10,780. DRIVING GEAR of TRACTION ENGINES, &c., A. Greig and R. H. Shaw, Leeds, and J. Whittingham, Nantwich.
10,781. ADDING MACHINE, G. F. Redfern.—(*A. J. R. d'A. Coutinho, Portugal.*)
10,782. LAWN TENNIS BOOTS and SHOES, R. B. J. T. Soanes, London.
10,783. AFFIXING POSTAGE STAMPS, R. W. Thomas and P. C. Smith, London.
10,784. CLEANING GROOVED RAILS, R. Brand, London.
10,785. PULVERISING and SIFTING COAL, A. Sottiaux, Belgium.
10,786. TOUGHENED OPAL GLASS, &c., C. D. Abel.—(*La Compagnie Générale du Verre et du Cristal Trempés, Paris.*)
10,787. LAMPS for RAILWAY CARRIAGES, T. J. Brewer.—(*T. W. Shaw, Natal.*)
10,788. BICYCLES, R. Laurence, London.
10,789. IMITATION HORN, F. O. Heinrich, Wimbledon.

31st July, 1884.

10,790. EXTRACTING TAR and AMMONIA from the GASES of BLAST FURNACES, J. Dempster.
10,791. SELF-ACTING BRAKES for TRAM-CARS, &c., R. Godfrey and J. A. B. Bennett, King's Heath.
10,792. BLEACHING, &c., WOVEN FABRICS, J. Farmer.—(*A. Lalance, Germany.*)
10,793. INDICATING the STATIONS at which RAILWAY TRAINS STOP, D. K. Simpson, Bootle.
10,794. DISPLAYING ARTICLES in SHOP WINDOWS, F. McIlvenna, London.
10,795. HUBS for BICYCLE, &c., WHEELS, A. Lilwall, C. Binks, and W. James, Birkenhead.
10,796. TAPE FRAMES for DRYING YARNS, T. Longworth and J. Mercer, Blackburn.
10,797. INDICATING the SPEED of STEAM ENGINES, H. Hall, Prescot.
10,798. MECHANICAL FIGURE or TOY, W. R. Seaton, Manchester.
10,799. RAISING and LOWERING ENGINE CHIMNEYS, T. W. Airey, Gainsborough.
10,800. TABLE FORKS, J. J. C. Valpy, East Dereham.
10,801. SECURING KNOBS to SPINDLES, H. T. Owens, Birmingham.
10,802. TOWEL RACKS, J. Hewitt.—(*J. T. Foster, New Jersey, U.S.*)
10,803. SEALING and OPENING ENVELOPES, E. F. Lever, Balham.
10,804. STRETCHERS for BOOTS and SHOES, E. Shayler, London.
10,805. DISPLAYING ADVERTISEMENTS, &c., J. Brown, Liverpool.
10,806. HANDLES of TABLE CUTLERY, C. Ibbotson, Sheffield.
10,807. MIRROR FRAMES, W. H. Bulpitt, Birmingham.
10,808. SECURING ELEVATORS to BANDS, J. Bentley, Birmingham.
10,809. WHEELS for PERAMBULATORS, G. Gibbs, Leeds.
10,810. ADVERTISING on WOODEN MATCHES, R. Besley, Herne Hill.
10,811. OBTAINING IRON OXIDES, J. MacTear, Glasgow.
10,812. FURNACES for CHEMICAL PROCESSES, &c., J. MacTear, Glasgow.
10,813. OBTAINING MANGANESE OXIDE from MANGANESE SULPHATE, J. MacTear, Glasgow.
10,814. FILTERS, D. Clerk, Glasgow.
10,815. PURIFYING WATER USED in STEAM BOILERS, D. Clerk, Glasgow.
10,816. DESSICATING MACHINES, W. A. Dyer, London.
10,817. WALL BRACKET CARDS, W. Harbutt, Bath.
10,818. AXLE BOXES, W. S. G. Baker, Maryland, U.S.
10,819. BOTTLE STOPPERS, T. McDonald, London.
10,820. CORK SCREWS, A. F. Petersen, Denmark.
10,821. WATER CLOSETS, J. Honeyman and W. P. Buchan, Glasgow.
10,822. WICKER BASKETS, B. Hawerkamp.—(*O. Schleicher, Prussia.*)
10,823. MATERIAL for ROADS, &c., C. F. Stollmeyer, London.
10,824. MACHINES for DRESSING MARBLE, &c., W. H. Burke.—(*MM. Puissant frères, Belgium.*)
10,825. VELOCIPEDES, C. Lee, London.
10,826. REGULATING the FLOW of LIQUIDS, W. A. M. Brown and J. M. Porter, Leeds.
10,827. SAFETY LAMPS, H. Armstrong, London.
10,828. BOILERS, J. Corbett, Carlisle.
10,829. ACTUATING DABBING BRUSHES for COMBING WOOL, J. J. Richardson, Horsforth.
10,830. BRASS HINGES, J. H. Starling and J. W. Barnes, Birmingham.
10,831. ADVERTISING BOX for CIGARETTES, &c., A. Lafargue, London.
10,832. APPARATUS for CONDENSING STEAM, H. H. Lake.—(*N. E. Jolly, France.*)

1st August, 1884.

10,833. LAMPS, T. C. J. Thomas, London.
10,834. GAS LAMPS, T. C. J. Thomas, London.
10,835. SCRAPING and CLEANSING DRAINS, G. Gowing, Ripon.
10,836. JARS for PRESERVING MEAT, &c., G. Gardner, Liverpool.
10,837. WOOD and INDIA-RUBBER CORK, S. Pritchard and H. Brookes, Birmingham.
10,838. BOX for SHUTTLES for HOLDING WEAVING BOBBINS, T. Webster, Morley.
10,839. LINING for CARRIAGES, &c., F. Bayling and T. Taylor, Coventry.
10,840. BICYCLES and TRICYCLES, C. A. E. T. Palmer, Aston-juxta-Birmingham.
10,841. HAND SHEARS, F. Harris and J. Woolhouse, Sheffield.
10,842. BEARING REINS for HORSES, &c., R. Hartley, Carshalton.
10,843. WEIGHING and MIXING GRAIN, J. D. Tomlinson, Rochdale.
10,844. GRAIN ELEVATORS, J. D. Tomlinson, Rochdale.
10,845. CHILDREN'S BEDS or COTS, W. Hatchman, London.
10,846. SHIPS' BLOCKS, J. Manifold, Liverpool.
10,847. ELECTRIC ARC LAMP, R. H. Gould, London.
10,848. PACKING CASES, G. H. Ellis, Exeter.
10,849. LARYNGOSCOPE, A. H. Vesey, London.
10,850. JOINTING of SANITARY PIPES, D. Cockshaw, Glass Houghton.
10,851. RAILWAY WHEELS and AXLES, H. Sainsbury, London.
10,852. ELECTRICAL BRAKES, G. Forbes and I. A. Timmis, London.
10,853. CUPBOARD FASTENERS, J. Brendon, jun., and G. D. Brendon, Callington.
10,854. CIRCULAR SAW BENCH, H. and T. T. Onslow, London.
10,855. PREVENTING the RADIATION of HEAT and TRANSMISSION of COLD, B. Rhodes, London.
10,856. HERMETICALLY SEALING FIRE-EXTINGUISHING GRENADES, E. P. Alexander.—(*J. H. Pierce, Chicago.*)
10,857. CORKSCREWS, G. Paffrath, Germany.
10,858. PRODUCING MOTIVE POWER, &c., J. J. Royle, Manchester.
10,859. AUTOMATIC and CONTINUOUS BRAKE, C. Helliwell, Hackenthorpe.
10,860. ANHYDROUS SULPHURIC ACID, H. E. Newton.—(*A. Nobel and G. Fehrenbach, Paris.*)
10,861. HEATING LIQUIDS, W. L. Wise.—(*T. A. de Koster, Amsterdam.*)
10,862. HARVESTING MACHINES, B. Samuelson.—(*C. W. Marsh, Illinois.*)

10,863. Supplying Water to Steam Boilers, &c., G. Addenbrooke, Leamington.
10,864. Treating Vulcanised Fibre, &c., F. Taylor, Wilmington, U.S.
10,865. Spool Holder, A. A. Murphy, Quebec.
10,866. Desks, M. T. Neale, London.
10,867. Chaff Engines, R. Maynard, London.
10,868. Forming a Selvage in Weaving, A. M. Clarke. —(*J. S. Lamond, New Jersey, U.S.*)
10,869. Distributing Liquids, C. D. Abel.—(*La Société Anonyme des Produits Chimiques de la Manufacture de Javel, Paris.*)
10,870. Purification of Alcohol, C. D. Abel.—(*I. A. F. Bang and M. C. A. Ruffin, Paris.*)
10,871. Method for Recovering Nitrous Products, C. D. Abel.—(*La Société Anonyme des Produits Chimiques de la Manufacture de Javel, Paris.*)
10,872. Shaft Couplings, A. M. Clark.—(*T. R. Almond, New York.*)

2nd August, 1884.

10,873. Tricycles, J. Sawbridge and J. Blower, Longford.
10,874. Corkscrew, M. Perkins, Birmingham.
10,875. Door Springs, F. L. Fear and P. Wilson, Birmingham.
10,876. Ball Casters, J. Wilkinson, Birmingham.
10,877. Rotary Engines and Pumps, W. B. Sayers, Birmingham.
10,878. Safety Apparatus for Driving, J. S. Stubbs, Manchester.
10,879. Combination Corkscrew, C. Woodroffe, Walton-on-the-Naze.
10,880. Velvet, R. S. Collinge, Oldham.
10,881. Carding Engines, G. Ashworth, Manchester, and J. A. Hart, Stockport.
10,882. Indicators for Textile Machinery, D. and F. H. Orme, Oldham.
10,883. Watches and Keys, G. Newton, Liverpool.
10,884. Lever Locks, J. B. and T. B. Fidler, Wolverhampton.
10,885. Gas Motor Engines, J. Shaw, Leeds.
10,886. Preparing Iron Sheets, &c., J. and J. Taylor, Wolverhampton.
10,887. Motor, J. E. Walsh. —(*A. D. Meunier, Tauxigny.*)
10,888. Petticoat, J. E. Walsh.—(*C. D. Cuper, Paris.*)
10,889. Garters, M. Wilson, Manchester.
10,890. Carousal, E. Unger, Prussia.
10,891. Tricycles, F. J. J. Gibbons, Wolverhampton.
10,892. Saddle Springs for Bicycles, W. Hillman, Coventry.
10,893. Temples for Looms, W., H. E., and J. C. Lupton, Accrington.
10,894. Check Feed Valve for Boilers, G. J. Dickinson.—(*J. H. Bedson, Colorado, U.S.*)
10,895. Cigarettes, J. Taylor, London.
10,896. Lamps, J. Hinks, Birmingham.
10,897. Supporting Shelves of Ovens, J. F. and G. E. Wright, Birmingham.
10,898. Coverings for Shafts of Carriages, C. Clarke, Birmingham.
10,899. Saddles for Bicycles, J. A. Lamplugh, Birmingham.
10,900. Obtaining Condensible Products from Coal, J. G. Willans, London.
10,901. Machine for Making Type, &c., E. G. Brewer. —(*A. J. Engelen, Brussels.*)
10,902. Pens, C. A. Connock, London.
10,903. Breech-loading Fire-arms, H. H. Lake.—(*H. Allender, Michigan, U.S.*)
10,904. Improved Waistcoat, E. Watson, London.
10,905. Hose Couplings, H. H. Lake.—(*C. E. Mark, Michigan, U.S.*)
10,906. Controlling Air in Atmospheric Brakes, H. H. Lake.—(*C. E. Mark, Michigan, U.S.*)
10,907. Electrical Haulage, F. Jenkin, Edinburgh.
10,908. Cradles, J. Hornsby, J. Innocent, and F. C. Southwell, Grantham.
10,909. Reaping and Mowing Machines, W. J. Burgess, Brentwood.
10,910. Water Meters, H. W. Pearson, Bristol.
10,911. Signalling, W. B. Woodbury, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for The Engineer *at the office of Her Majesty's Commissioners of Patents.*

5061. Apparatus for Getting Coal, &c., without the use of Explosives, *W. F. Hall and W. Low, Durham.—24th October*, 1883. 4*d*.

This relates to improvements on patent No. 3370, A.D. 1883, in which an apparatus is described for boring a series of holes in suitable positions in the coal, and then breaking a mass down by means of a wedge, screw, and levers. The present invention consists in the use of a compound bar to be inserted in the holes in the coal and fitted with two movable blocks, which upon being moved apart break down the mass. Wedges inserted between the blocks and actuated by screws force the blocks apart.

5470. Dynamo-electric Machines, *H. H. Lake, London.—20th November*, 1883.—(*A communication from T. J. McTighe and J. T. McConnell, Pittsburgh, Pennsylvania, U.S.*) 6*d*.

The cores of the field magnets are vertical and parallel, oblong in cross section, and form the frame of the generator. The connecting core pieces project inwardly, and are shaped to the contour of the armature. The commutator consists of two insulating rings having their adjacent faces convex and radially grooved, and a series of interposed metallic bars having their ends rabbeted to fit the faces of the rings.

5493. Chimney Cowls and Ventilators, *F. Leslie, London.—23rd November*, 1883. 6*d*.

A series of truncated conical sheets are mounted one over the other on the upper end of the flue pipe, and level with the top cone an annular plate is fixed with an opening larger than that in the cones. Over the top of the upper cone and parallel to the annular plate a horizontal plate or disc is fixed.

5636. Hot-air Engines, &c., *S. Wilcox, Brooklyn, U.S.—4th December*, 1883. 1*s*. 4*d*.

A cooling jacket is used in connection with a regenerator, both arranged round the cylinder, by which the zones of low temperature are lowered in the regenerator, and the water cools not only the air which moves to and from the cool end of the cylinder, but also the cylinder itself. The engine is regulated automatically by a governor which operates by shifting a link which moves changing pistons. A working piston reciprocates in a cylinder, and is located centrally within a larger changing cylinder enclosing an annular changing piston. A heater with a furnace below supplies heat to the air in the lower portion of the apparatus and expands it, inducing a momentary high pressure to force up the working piston. The operation of the changing piston then forces a larger portion of the air through a regenerator and cooler to the annular space, whereby the air is cooled and the working piston forced back.

5640. Warming Air for Heating Apartments, &c., *H. Darby, London.—4th December*, 1883. 6*d*.

Two vertical tubes supporting the stove are connected by two or more horizontal tubes, the lowest being divided by a partition, and into which the chimney of a lamp or gas-burner is introduced, and the heated gases from which cause air passing through the horizontal tubes to become heated.

5642. Apparatus for Mining Coal, *W. R. Lake, London.—4th December*, 1883.—(*A communication from B. F. Asper, Pittsburgh, U.S.*) 8*d*.

This relates to apparatus consisting of series of reciprocating picks, the strokes of which are produced by the contraction of powerful springs, distended by tappet arms on a motor shaft. Mechanism is provided to feed the picks forward, and consists of right and left-handed screws, one connected to the carriage and the other to the pick frame, and working telescopically within the former. Means are provided for adjusting the picks; imparting to the carriage a lateral feeding movement to and fro; cleaning out the channel as the work proceeds; and adjusting the machine to any desired angle.

5664. Governing Steam Engines, &c., *W. Knowles, Bolton.—7th December*, 1883. 6*d*.

This relates to means for varying the speed of the governor operating the cut-off, or the throttle valve of steam engines, according to the varying conditions of load and pressure; and it consists in an arrangement for automatically shifting a strap along conical pulleys, by which the ordinary governor is actuated, such shifting arrangement being controlled by a supplementary governor driven by the engine.

5697. Lighting and Extinguishing or Raising and Lowering Illuminating Flames, *G. P. Ganster, Reading, U.S.* 6*d*.

This relates to an arrangement of clockwork mechanism in combination with a cluster of lights in a lamp, whereby all the burners are ignited at a given hour, all but one burner extinguished at another hour, and the remaining one extinguished at a third fixed hour, such hours being capable of variation.

5707. Heeling and Finishing Boots and Shoes, *J. Keats, near Stoke-upon-Trent.—11th December*, 1883. 1*s*.

This relates to the general construction of machines for heeling and finishing boots and shoes, and includes the use of an expanding post for supporting and centreing the work to ensure the insertion of the nails in their proper places; an external nailing apparatus, and a rotary rasp having a detachable periphery for shaping the heels.

5726. Ironing Machine for Laundries, &c., *M. Heslop and J. Martin, London.—13th December*, 1883. 6*d*.

This relates to mechanism for giving and regulating motion in any desired direction to the iron, means for admitting and exhausting the heating medium to and from the iron, and also means for raising and depressing or exerting pressure on the same.

5736. Dynamo-electric Machines, *P. W. Williams, London.—13th December*, 1883.—(*Not proceeded with.*) 4*d*.

This relates to a machine for generating continuous currents, and having one or more circular magnet poles or poles of same polarity arranged in a circle.

5752. Stern Frame for Screw Steamers, *C. J. D. Christie, Tynemouth.—15th December*, 1883. 4*d*.

This consists in constructing stern frames of screw steamers so that the forward post curves backwards and merges into the rudder post at top and bottom of aperture for the screw, so as to give better support to the boss carrying the propeller shaft and cause the frames to rest upon the post, the shell plating being attached to the post by simple flanging.

5754. Manufacture of Cast Metal Pipes, &c., *W. R. Lake, London.—15th December*, 1883.—(*A communication from F. Shickle, St. Louis, U.S.*) 1*s*. 6*d*.

This relates, First, to apparatus for forming cores and moulds for castings, and consists in depositing the material employed endwise upon the core or mould; Secondly, to special apparatus for use with sand so as to facilitate its compression; Thirdly, to the pits in which the moulding and casting are conducted and the flasks and cores prepared. Other improvements are described, there being seven sheets of drawings and forty-nine claims.

5764. Tool for Opening Packing Cases, &c., *A. J. Boult, London.—17th December*, 1883.—(*A communication from E. Kricker, Germany.*) 6*d*.

The tool is similar to the ordinary pincers, consisting of two arms pivotted together and formed with jaws, the bottom one of which is forked so as to receive the top one between its arms. The jaws are pointed, and when closed can be inserted between the lid and body of a case, and by applying pressure to the handles the opening of the jaws will force up the lid. The upper jaw has a slit to pass over the stem or body of the nails securing the lid in position.

5778. Printing Types, *H. J. Allison, London.—18th December*, 1883.—(*A communication from L. B. Benton, Milwaukee, U.S.*) 6*d*.

This consists in making types and spaces of a width running-wise which shall be an exact multiple of a fixed unit of measure.

5782. Manufacturing Pottery and Earthenware, *F. A. Magowan, New Jersey, and R. M. Bassett, Connecticut.—18th December*, 1883. 6*d*.

This consists essentially in the use with heated dies and mechanism for applying pressure thereto of a movable metallic lining for the dies, and a thin sheet of elastic material for the purpose of better shaping pottery and earthenware, and to support the same on their removal from the dies.

5786. Metal Tips for Boots, Shoes, &c., *J. S. Crowley, Manchester.—18th December*, 1883. 6*d*.

This consists in forming metal tips with a thick segmental wearing surface and thin projections or flanges, by which they are secured in position on boots and shoes.

5789. Type-writing Machines, *W. R. Lake, London.—18th December*, 1883.—(*A communication from J. B. Hammond, New York.*) 1*s*. 4*d*.

This relates to the general construction of a type-writing machine, in which a set of key levers are employed for actuating a type wheel or segment. There are four sheets of drawings and fifty-three claims.

5801. Cleaning Seed and Grain, *J. Anderson, London.—18th December*, 1883.—(*A communication from Messrs. Lyall, Gray, and Co., Calcutta.*) 1*s*.

The grain is thrown into a hopper and falls on a coarse sieve, to which a jogging motion is imparted, and falling through the sieve, collects in a bin, from which it is raised by an elevator, which discharges it on to an inclined board provided with rubbers, to which a reciprocating movement is imparted, whereby the grain is cleaned. The grain is then delivered to another sieve to separate the dust, and then to a third sieve, which retains all rubbish, and the grain is then subjected to the action of a current of air.

5809. Regenerative Gas Lamps, *F. C. Glaser, Berlin.—19th December*, 1883.—(*A communication from J. A. Essberger, Berlin.*)—(*Not proceeded with.*) 4*d*.

The burner is arranged below the burner body and surrounded with a bell-shaped glass for causing the air previous to its promoting the combustion to pass through the regenerator chambers, and together with the products of combustion to escape through the central discharge tube.

5814. Apparatus for Advertising, *C. S. Nelson, London.—19th December*, 1883.—(*A communication from F. Fontaine, Atlanta, U.S.*) 6*d*.

This relates to a travelling endless band bearing any desired advertisements, and which is applied to vehicles, from the axles of which it is actuated.

5859. Augers, &c., *A. G. Brookes, London.—26th December*, 1883.—(*A communication from J. Swan, Seymour, U.S.*) 6*d*.

The object is the production of a machine capable at one operation of milling the floor lip and shaping the inner wall of the cutting spur of an auger or auger bit, the bit produced by the machine being novel as regards the shape of the cutting spur. The invention also consists in the combination with a rest to hold the auger bit of a rotating milling tool having its periphery toothed to mill the inner side of the cutting spur and leave it concaved and circular. Also in a rest to hold the bit combined with a rotating cylindrical tool provided with cutting teeth at its end and at its periphery near its end, the former teeth acting to mill the floor lip while the latter at the same time acts to mill and shape the cutting spur. It also consists in combining with the above a chuck or holder for the shank of the bit being acted upon by the rotating tool, the rest and chuck having their centre lines out of line with the centre of rotation of the tool, to thereby enable the floor lip to be cut at an inclination. It also consists in a cylindrical cutting tool.

5925. Spring Hinges for Doors, *J. S. Stevens and C. G. Major, London.—29th December*, 1883. 6*d*.

This relates to improvements on patent No. 5281, A.D. 1883. The heel of the door is fitted with a shoe and a pivot having two arms. A piston is fixed to its rod, and the cylinder placed with the closed end toward the pivot of the door, and the piston-rod pointing to the back of the enclosing box. The outer end of the piston-rod is pivotted to a pin in the back of the box. The cylinder is connected by rods to the arms of the pivot. The apparatus is double-acting, a spring between the piston and cylinder cover being compressed when the door is opened in either direction. The connecting rods are surrounded by springs, which come into operation if the door closes too quickly.

5975. Treatment and Utilisation of Leather Scraps or Waste, &c., *C. B. Warner, London.—31st December*, 1883.—(*A communication from L. Mestaniz, New York.*) 4*d*.

This relates principally to the treatment of cheese or caseine for the purpose of obtaining a material suitable for the agglutination of leather scraps or waste.

5984. Electrical Machines, *J. S. Williams, Riverton, N.J., U.S.—31st December*, 1883. 4*d*.

The cores of the electro-magnets and the wires forming the coils are insulated from each other by asbestos, which may be rendered impervious to moisture by any suitable means.

5991. Manufacture of Ornamental Fabrics, *J. Yuill, Glasgow.—31st December*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to the manufacture of a fabric by jacquard apparatus, with a raised design formed of chenille or "fur" material, whilst the ground or other parts are produced by ordinary yarns or threads.

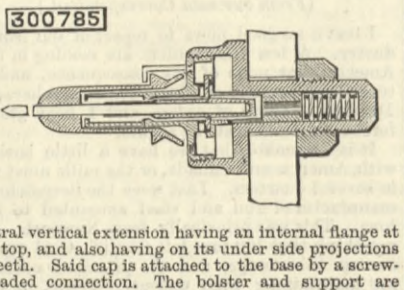
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

300,785. Spindle Bearing for Spinning Frames, *George B. McCracken and Samuel Hamer, Willimantic, Conn.—Filed July 7th*, 1883.

Brief.—The base or bolster case is provided in its top section with an oil reservoir, and in its lower section with a recess in which is placed a spiral spring upon which is placed a vertical support,, which is also provided with a recess, and at its top with a lateral flange. The lower end of the bolster loosely fits the recess in the vertical support, and is supported thereon by a lateral flange corresponding to the flange on said support, said flange on its upper side having projections or teeth. The cap is provided with a

300785



central vertical extension having an internal flange at the top, and also having on its under side projections or teeth. Said cap is attached to the base by a screw-threaded connection. The bolster and support are restrained from rotation by the engagement of the teeth upon the under side of the cap with the teeth on the flange of the bolster.

300,787. Double-force Pump, *M. Frank McNelly, Sterling, Ill.—Filed November 30th*, 1883.

Claim.—(1) In combination with the stem G and stock A, the tube B, channels E, F, H, and I, the cylinder C, provided with the partition *c*, the rod C^1, and buckets D D, substantially as shown, and for the purpose mentioned. (2) The tubes B, provided with alternately-acting valves a^1 b^1, the channels E, F, H, and I, rod C^1, cylinder C, and buckets D D, in combination, whereby a constant stream of water is drawn

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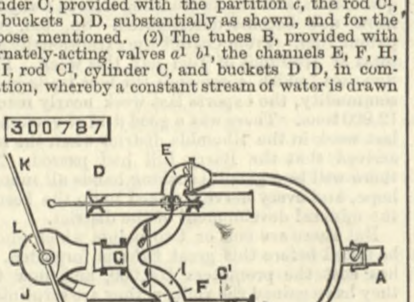

into the tube B and discharged from the cylinder C, substantially as shown and for the purpose named. (3) The combination of air chamber J, provided with trunnions L L integral therewith, lever K, rods c^1, buckets D D, and cylinders C, substantially as shown and for the purpose described.

300,827. Electric Motor, *Wellington Adams, St. Louis, Mo.—Filed March 27th*, 1883.

Claim.—(1) In an electro-dynamic machine, an annular field-magnet and inclosing casing therefor, adapted to constitute the tire-supporting portion of a car wheel, as set forth. (2) The combination, with a

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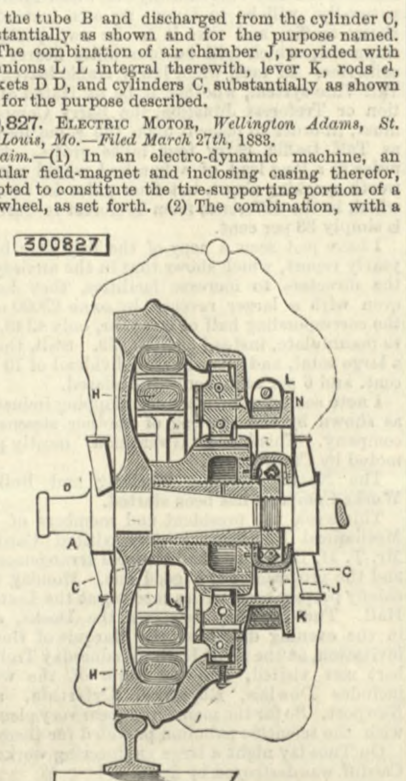

car wheel, of an electro-dynamic machine whose field-magnet and armature are incased by said wheel, substantially as and for the purposes hereinbefore set forth. (3) The combination, with a car wheel, of an annular field-magnet carried by said wheel, an armature adapted to be rotated within said field-magnet, and a shaft supporting the armature and constituting an axle for the wheel, substantially as and for the purposes hereinbefore set forth. (4) The combination, with the rotating armature and the wheel to be driven thereby, of intermediate motion transmitting and controlling mechanism arranged and operating, substantially as hereinbefore set forth, to automatically throw the armature into gear with the wheel to be driven when its speed of rotation has reached a predetermined point, as and for the purposes specified. (5) In an electro-dynamic machine an annular field-magnet rigidly attached to the supporting or main axle, and provided with a tire-supporting casing, in combination with an armature moving within the field-magnet, and having a hub mounted upon said axle, gearing connecting the periphery of said hub to the interior of the tire-supporting casing, automatic clutching devices supported by the connecting pinions, and means, substantially as described, for varying the tension of the clutch-operating mechanism and the speed at which the same becomes operative, as set forth. (6) In combination with an annular field-magnet and an armature contained and rotating therein, the hub C, pinions K, rings J, provided with sections N, springs O, and adjusting screws, the stationary adjustable band M, and shaft L, substantially as set forth. (7) In an electro-dynamic machine, the combination of armature H, and hub C, having oil chamber *c*, with adjustable bushing D, and suitable jam nut, and the main axle A, substantially as set forth. (8) The centrifugal adjustable clutch and its controlling shaft, in combination with the armature, the wheel, and the pinions carried by the clutch and engaging gearing carried by the armature and wheel, respectively, under the arrangement and for operation, substantially as hereinbefore set forth. (9) The combination, with the axle or shaft to be driven, of an electric motor whose armature is mounted to revolve on said shaft, and intermediate transmitting gearing for imparting movement from the armature to said shaft or axle, substantially as and for the purposes hereinbefore set forth.

301,076. Electric Arc Lamp, *Edward Weston, Newark, N.J.—Filed July 16th*, 1883.

Claim.—(1) In an electric lamp, the combination, with the movable carbon holder and a clamp or clutch, of means for raising and lowering the clamp, and thereby adjusting the carbons, a stop or detent, and means for imparting a vibratory movement to the same when in contact with the clamp, as set forth. (2) In an electric lamp, the combination, with the movable carbon holder, a clutch or clamp, and electro-magnets for controlling the position of the same, of a magnet in a normally open shunt or derived circuit from the main circuit, and an armature connected

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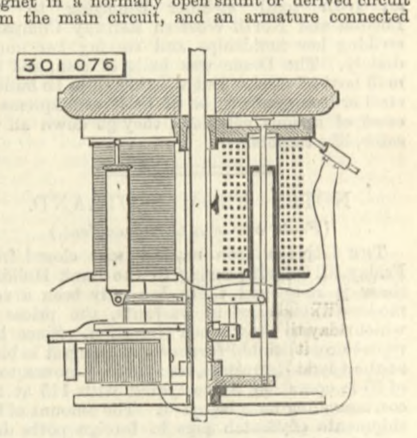

with the circuit of the said magnet, and arranged to be thrown into vibration on the contact therewith of the clamp, as and for the purpose specified. (3) In an electric lamp, the combination, with the feed controlling and adjusting magnets, the movable carbon holder, and a clamp or clutch, of an independent electro-magnet and armature for imparting a vibratory movement to the clutch, for the purpose specified.

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South Kensington Museum.—Visitors during the week ending Aug. 2nd, 1884:—On Monday, Tuesday and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,449; mercantile marine, Indian section, and other collections, 4326. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m to 6 p.m., Museum, 1695; mercantile marine, Indian section, and other collections, 235. Total, 16,705. Average of corresponding week in former years, 18,417. Total from the opening of the Museum, 21,235,795.