THE IRON AND STEEL INSTITUTE.

THE proceedings of the autumn meeting of the Institute commenced on Wednesday morning in more commodious, suitable, and handsome apartments, in the St. George's Hall, than often falls to the lot of the Institute. There are few places where a large meeting of gentlemen could be so easily accommodated and entertained as in Liverpool, where the presence of so many fine public buildings offers so many facilities. On Tuesday detail programmes for the guidance of members were circulated, with maps of Liverpool and the district, together with several of the papers which have been since read. The programme, though not at all bulky, is certainly the most complete of its kind ever offered for the guidance of those attending such a meeting. It is not that a small book is made of it, filled like diaries with a lot of information that one does not want, but it contains just that which everyone requires. The names of the members of the Council and all other officers are followed by the business to be done each day, including the alternative excursions to places, works, or vessels of interest, accompanied by a few particulars relating to each. The names of a considerable number of other works, factories, &c., open for inspection at the convenience of members, is then given, with a few notes on each. A list of places of interest in Liverpool is followed by a clear guide to the postal arrangements, which are useful to everyone. This programme is printed well by the Liverpool Stationery Company, and it reflects great credit on Mr. Jeans, the secretary of the Institute.

On Wednesday morning the proceedings commenced by an opening speech from the Mayor, the meeting being held in the Concert-room of the Hall. His words of welcome were warm and to the point, and suitably few in number. The President, Mr. Williams, replied to the Mayor, and in speaking of the substitution of steel for iron in shipbuilding, upon which the Mayor had touched, said that steel would be much more readily adopted were it not that the rules officially regulating its use demanded that the plates if of steel should be of a quality equal to boiler plate.

It was afterwards announced that the ballot had resulted in the election of fifty-eight new members, and that the Council had passed the proposition papers for thirty-eight more. The President made a few remarks upon the invitation to the Institute to hold its next meeting in Dusseldorf; said that the Council had accepted the invitation, and on putting the question to the meeting the acceptation was confirmed. M. Thierry, on the part of the members of the Institute in the Rhenish-Prussian and Westphalian metallurgical districts, recounted to the meeting the many inducements for visiting that district. He said that though they could not show their English brethren much that was new in steel works, they could show them much in the use of steel and iron in construction, and particularly as permanent way of railways.

After the business described had been completed and the above announcements made, a discussion was taken on a paper by Mr. John Pattinson, on volumetric determination of manganese, which was read at the last meeting. Of the paper we now give an abstract :—

THE VOLUMETRIC DETERMINATION OF MANGANESE IN METALS.

After referring to the ordinary gravimetric method as applied to spiegeleisen, ferro-manganese, and steel, the author describes a new volumetric method by which the whole of the manganese in a solution may with certainty be precipitated as hydrated dioxide, if a certain amount of ferric chloride be also present in the solution, when a sufficient excess of solution of calcium hypochlorite—bleaching powder—or bromine water is added, and after heating the solution to from 140 deg. to 160 deg. Fah. excess of calcium carbonate is then added, and the mixture well stirred.

When the ferric salt is absent, and the other conditions are observed, the precipitate invariably contains a certain proportion of lower manganese oxides, the amount of manganese precipitated as dioxide varying from 98·20 to 99·27 per cent. of the amount of manganese present in the solution. Heat is essential in order to obtain all the manganese as dioxide, for if the precipitation is made by calcium hypochlorite and calcium carbonate in the presence of much ferric chloride in the cold, the precipitate then contains only from 98 to 99 per cent. of its manganese as dioxide. The following solutions and reagents are required in the process :—First, solution of calcium hypochlorite—bleaching powder—made by diffusing in 10,000 grains of water 150 grains of powder or chloride of lime containing about 35 per cent. of available chlorine. The clear solution is separated from the insoluble portion. Second, calcium carbonate of a light granular pulverulent character. Third, solution of ferrous sulphate in excess of sulphuric acid, containing about 10 grains of iron in 1000 grains of solution, made by dissolving crystals of ferrous sulphate in a mixture of one part of monohydrated sulphuric acid and three parts of water, 530 grains of crystals in 10,000 grains of the dilute acid giving a solution containing about 10 grains of iron in each 1000 grains. Fourth, standard solution of potassium dichromate, made so that 1000 grains of it are equal to 10 grains of iron, and carefully brought to standard.

Manganiferous Iron Ores. — These generally contain from 15 to 25 per cent. of manganese, and at least 20 per cent. of iron, and therefore usually sufficient iron for the dioxide precipitation. Ten grains of the ore, dried at 212 deg. Fah., are placed in a beaker of about 20 oz. capacity, and dissolved by the aid of heat in about 100 fluid grains of hydrochloric acid of about 1180 specific gravity. When completely dissolved, the cover and sides of the beaker are rinsed by a jet of cold water, and then calcium carbonate is added until the solution becomes of a slightly reddish colour, showing that the free acid is neutralised. Six or seven drops of hydrochloric acid are now added in order to slightly acidify the solution, as it is found that the precipitate falls in the best condition for being filtered and washed when this is done. About 1000 grains of the solution of bleaching powder are now added, and then boiling water is run in until the solution is heated to about 140 deg. to 160 deg. Fah. About 25 grains of calcium carbonate are now added, and the solution well stirred until the evolution of carbonic acid ceases. The dark brown precipitate of oxides of manganese and iron settles readily, generally leaving a colourless supernatant liquid; but if the bleaching powder has been much in excess, the supernatant liquid has sometimes a pink colour, owing to the formation of permanganic acid. Should this be the case, a few drops of alcohol are added until the pink colour is destroyed. If sufficient bleaching powder has been added, the solution smells of chlorine, or it may be tested for excess by a strip of iodised starch paper. Instead of the solution of bleaching powder, about 500 grains of saturated bromine water may be used. The precipitate is collected on a double filter, and washed with water until the washings show no trace of chlorine or bromine when tested by iodised starch paper. A thousand grains of the acidified ferrous sulphate solution are now measured into the beaker in which the precipitation has been made, and the filter with its contents is placed in the iron solution. The precipitate readily dissolves, the manganese dioxide converting its equivalent of ferrous sulphate into ferric sulphate. Cold water is now added, and the amount of ferrous sulphate remaining in the solution ascertained by adding from a burette the standard solution of potassium dichromate, as in testing an iron ore. The quantity of ferrous sulphate existing in the 1000 grains of ferrous sulphate solution at first is determined by measuring another 1000 grains from the pipette, and, after adding a filter to it of the size used in collecting and washing the precipitate, triturating it with the potassium dichromate solution. Supposing the 1000 grains of ferrous sulphate solution used in standardising has required 101·1 deg. of dichromate solution, and the 1000 grains to which the manganese precipitate obtained in testing an ore has been added has required 57·0 deg. of the dichromate solution, the percentage of manganese in the ore is calculated as follows:—101·1—57·0=44·1 deg. of dichromate solution, which are equal to 4·41 grains of iron, the amount of iron converted from ferrous to ferric sulphate by the manganese dioxide yielded by 10 grains of the ore. On multiplying the amount of iron thus peroxidised by 0·491 the total amount of manganese contained in the ore is ascertained. In this case, $4{\cdot}41 \times 0{\cdot}491 = 2{\cdot}165$ grains of manganese in the 10 grains of ore, equal to 21·65 per cent.

The slight modifications required for dealing with spiegeleisen, ferro-manganese, steel, manganese slags, &c., are set forth in the paper, but as these will be divined with little difficulty by metallurgical chemists, we need not describe them. Previous to the commencement of the discussion Mr. Pattinson made a few remarks to the effect that experience since his paper was read has confirmed the accuracy and trustworthiness of the method described. In opening the discussion Mr. Riley said the occasional error in the ordinary method arose from the fact that in the final estimation every atom of oxygen represented three atoms of manganese. In Mr. Pattinson's method this source of error is removed, inasmuch as oxygen and manganese are in the ratio of equality. The only source of error in Mr. Pattinson's method he thought was the possibility that the whole of the manganese might not be precipitated as peroxide, otherwise he had found that the process works well and is quicker by three-fourths to five-sixths in time. He had not yet used it for actual working analysis, preferring at present to retain the old method, though it was troublesome. Mr. Stead spoke of his experience with Pattinson's method, and in a series of six tests obtained the same results within 0·05 per cent., and found that all tests were correct within 0·005 of 1 per cent. He therefore looked upon the process as thoroughly reliable. The next paper read was by M. A. Pourcel, of Terrenoire, on the dephosphorisation of iron and steel, followed by one on the neutralisation of phosphorus in steel and steel-like metals by Mr. R. Brown, of Ayr. This was followed by a short communication by Mr. H. C. Bull, London, on dephosphorising iron. The discussion was then taken on all three.

THE DEPHOSPHORISATION OF IRON AND STEEL.

To a great extent this paper is a development of that read by the author in June last before the Société de l'Industrie Minerale, Paris, a translation of which was given in THE ENGINEER of the 8th of August. The paper is, however, of much importance. In the dephosphorisation of iron and steel three essential elements must be taken into consideration—(1) the chemical composition of the cinder; (2) the temperature of the place in which the operations are performed; (3) the atmosphere in which the reaction takes place. Each of these elements may enter into the problem with a conventional sign, positive or negative, the positive being assigned to a basic cinder, a high temperature, and a reducing atmosphere, while the sign minus (—) will be that of an acid cinder, a less high temperature, and an oxidising atmosphere.

Now, according to the circumstances of the case, the apparatus employed, and the physical condition of the final product that it may be desired to obtain, one of these elements will enter as a constant, while the others will be variable. Stated in this manner, the question of dephosphorisation, in each of its special cases, may be, as it were, put in the form of an equation, and its solution sought in a methodical manner.

The author takes as his first example the blast furnace. It is true that dephosphorisation does not take place in the blast furnace, but with the same ore, according to the conditions of temperature, may be obtained grey mottled, white, or cold and spongy pig, with a content of phosphorus often varying in the ratio of 3 to 1.

It is not the basic nature of the slag that exercises a predominating influence on these results; it is the temperature. A high temperature, necessary to the production of very grey pig, with a calcareous slag, has the special effect, in the reducing atmosphere of the blast furnace, of reducing the phosphoric acid combined with the lime or with the oxide of iron, it matters little which, and of causing all the phosphorus to pass into the pig, without any trace of it remaining in the slag. When the temperature diminishes, and when the weight of ore in proportion to the coke increases without the blast being colder, the pig passes from grey to mottled, from mottled to white, and from white to spongy, the mottled pig containing less phosphorus than the grey, the white less than the mottled, and the cold spongy pig still less than the white.

In the blast furnace, where the third element of the problem enters as a constant with the positive sign, of the two elements which are present as variables, that which exerts the preponderating action is the temperature. To sum up, in this particular case of the problem, in which the operation was conducted in a reducing atmosphere, and where consequently the third element is clearly determined with the positive sign +, the dephosphorisation is in inverse ratio to the temperature—the second element—whilst the degree of acidity of the slag exerts only a subordinate influence on the result, the metal being equally pure whether the slag contains 18 per cent. or 36 per cent. of silica, thus playing the part of independent variable. The problem is subject to conditions similar to those of the Catalan forge, in which the product is wrought iron instead of pig. The direct method, which Dr. Siemens has endeavoured to revive, possesses the great advantage of obtaining a pure product from an impure raw material.

By means of ingenious appliances, the quantity of coal used as well as the labour has been reduced, but the loss was considerable, and variable. The author has had analyses of cinder which showed from 19 to 30 per cent. of silica, and from 35 to 43 per cent. of metallic iron, with a large amount of phosphorus. Thus, with 28 per cent. of silica, 2·24 per cent. of phosphorus was found in the cinder. There is no doubt that the ball, freed from its cinder by the squeezer, ought to yield a very pure iron; but in that case the sole advantage of the process applied to phosphoriferous ores disappears, for the dephosphorisation is in this case inverse ratio to the temperature.

The characteristic of dephosphorisation applied to direct methods is the positive sign with which the third element enters as a known quantity into the problem. The operation is carried on in an atmosphere essentially reducing, the action of which varies with the intensity of the temperature; a moderate temperature is required to obtain a metal free from phosphorus; and the chemical composition of the cinder, which was desired to play the principal part, only exerts a very secondary influence, and frequently none at all. The second example of the problem of dephosphorisation applied to methods in which the third element enters as a constant with the sign minus (—), that is to say, in which the reactions occur in an oxidising atmosphere, presents as many special cases as the former; the types are, however, easy to distinguish. Pig iron is the starting-point in every case; but the result may be a soft metal, solid or liquid, or a carburised metal freed from the other metalloids which entered into the composition of the pig. It is not so easy to maintain the constancy and permanence of an oxidising intermolecular atmosphere, which is, in this case, the constant of the problem, as it is to vary in a greater or less degree the action of the reducing atmosphere. It is, therefore, a little hazardous to affirm that the dephosphorisation is in this case in direct ratio to the temperature. With a given pig, the resulting iron is better in proportion, as it has been obtained at a higher temperature; and the lessons learned from numerous chemical investigations which have been made on iron at different stages of the operation of puddling may thus be summed up :—(1) Take care to reject the first cinder which forms during the melting of the pig; this cinder takes off about half the phosphorus; (2) add a pure refining cinder, and effect its intimate contact with the pig by some mechanical means or other; (3) when the iron comes to nature, again renew the cinder, and keep the temperature as high as possible, in order to form the balls in a very fluid cinder which runs off easily. The chemical composition of the cinder exerts a direct influence on the dephosphorisation; it must be basic, with a little manganese, if needs be, to increase its fluidity, but especially basic, owing to the iron. The temperature acts in direct proportion with its intensity. Lastly, by turns of the hands, by mechanical means, and especially by the skill and care of the puddler, the constancy of the third element with the negative sign must be ensured, that is to say, the refining intermolecular action must be maintained. In the Danks and Howson furnaces this last result has been obtained, and, when the temperature is sufficiently high, the problem of dephosphorisation has been completely solved.

The introduction of manganese facilitates the passing off of phosphorus in puddling, but its action is less of a chemical than a physical nature. At the temperature of the puddling furnace, a pig iron containing from 3 to 4 per cent. of manganese, and from 3·5 to 4 per cent. of carbon, melts but slowly. Falling drop by drop on the bottom in the form of oxidised lumps, its contact with the refining substance is established; so that, during its passage from the solid to the liquid state, it often loses three-fourths of its phosphorus, and, at the same time, the greater portion of its manganese and silicium. In my opinion, silicium plays the principal part in processes for the purification of pig iron. The operation lasts so much longer without the carbon being attacked in direct proportion to the quantity of silicium present; and from the prolonged oxidising action on the phosphide of iron should result a more purified metal, without much increasing the loss, because silicium is a reducing agent of oxide of iron. If the

cinder be manganiferous, it will be more fluid, and will preserve the pig from the oxidising action of the flame, though not in itself refining. M. Pourcel desired to introduce this action of the silicium into the converter during the first stage of the Thomas-Gilchrist operation of dephosphorisation, and his hypothesis has been found either inadmissible, or so full of truth that some persons have appropriated and patented it. If the author's hypothesis, represented by the probable curve of phosphorus—see The Engineer, p. 101 *ante*—be not realised under the conditions now adopted for the Thomas-Gilchrist method, it may perhaps be realised by exaggerating in the pig the content of silicium in proportion to that of phosphorus, and by adding a sufficient quantity of blue billy, 20 per cent. of the charge, for instance, of a mixture of three of blue billy with one of lime. By running out the cinder on the appearance of the spectrum, the greater portion of the phosphorus could be eliminated; and the after blow might be of very slight duration, because at the end there would only be a small quantity of phosphate of iron to scorify. Is this an error? In endeavouring to prove it by experiment, one might perhaps alight upon a truth that was not suspected. As to the possibility of obtaining in the converter a metal having less than 0·2 per cent. of phosphorus, the author thinks that this is certain. "It must be acknowledged that imaginations have been given up to the most extraordinary conceptions during the last few months; but what will be the upshot? In my opinion nothing better than what we have seen at Eston." In a note appended to the paper the author gives quotations from the writings of Berthier and Lencauchez, which show how far they anticipated recent discoveries on the subject of his paper.

The Neutralisation of Phosphorus in Steel.

Instead of endeavouring to get rid of phophorus, Mr. Brown has given his attention to the practicability of turning the "enemy into a friend," and he has, his paper informs us, succeeded to the utmost of his expectations. The proportion of phosphorus that can be allowed to remain in steel is generally exceedingly small, something like ·03 to ·05 per cent., whereas, by his process, he is able to neutralise nearly as much as 1·5 per cent., still leaving the metal malleable. The agent employed is bichromate of potash, which is a convenient, expeditious, certain, and effective means of introducing the chromium into the metal, be it iron or steel. To neutralise three-quarters per cent. of phosphorus, about one-half per cent. of bichromate is employed. Scotch pig iron contains about 0·75 per cent., and Cleveland about 1·5 per cent. If it is thought to be desirable, an equal mixture of the two metals would give a metal containing about 1·1 per cent. of phosphorus. This could be further reduced by the assistance of purer pig iron or malleable iron scrap, which would lessen the quantity of bichromate to be used with Cleveland iron.

Castings made by this process are said to be very solid and free from blowholes. There is, moreover, little or no loss of metal in the slag, as when the material is used the slag is generally of a fine grey colour, showing no black oxide of iron. The bichromate of potash should be mixed with the melted metal. It may be blown in as powder by the blast, or may be introduced from the mouth of the converter, the blast being stopped during the introduction and afterwards renewed for a short time in order to effect a thorough mixture. When adding the material in a reverberatory furnace or other vessel, it may be in powder or in the usual crystals, in small paper packages, or other wrappers which will afford a slight protection whilst it is being introduced. When the iron contains much carbon, the excess of carbon should be eliminated. For cast iron containing ·75 per cent. of phosphorus and a variable quantity of carbon, the carbon should be reduced to about ·2 per cent., and about ·5 per cent. of bichromate should be mixed with the metal: this will yield a ductile steel. More bichromate will give a harder steel; only a portion of the phosphorus is removed; but when the proportion of carbon is small, the phosphorus has no injurious action. With more phosphorus the steel will be harder, and with less a larger proportion of carbon may be retained. With care any of the steel so made will weld, even when it contains large percentages of carbon and phosphorus.

The following analyses were given in the paper with some of the tensile strengths in tons per square inch:—

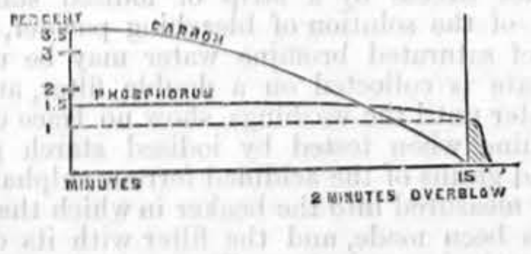
	No. 1*b*.	No. 2*b*.	No. 3*b*.	No. 4*b*.
Carbon, combined per cent.	·30	·30	·52	·41
Chromium per cent.	·14	·16	·20	·26
Phosphorus per cent.	·90	·95	1·16	1·39
Tensile strength	43·6	44·4	6·0	4·5
Ultimate extension per cent.	19·35	8·19	...	...

The carbon in 3*b* and 4*b* is in excess of what it ought to be for a large percentage of phosphorus, and to this was ascribed the low tensile strength. Mr. Brown explained that his inefficient experimental plant did not enable him to decarbonise the metal, and added that with the carbon, therefore, decreased, there would be no difficulty of increasing the percentage of phosphorus to 1½ per cent. with good results. The author exhibited a considerable number of specimens of the steel made as described, showing the ordinary tests of twisting, nicking, and breaking, and also some specimens of the welding, which, as far as could be judged by outward appearances, was very satisfactory.

De-Phosphorising Iron.

The process described by Mr. Bull in this communication consists in the elimination of phosphorus by converting it into phosphuretted hydrogen. In carrying out the process in the Bessemer converter, steam is forced through the molten iron after all the silicon, manganese, and carbon are removed. The steam is decomposed, some of the iron is oxidised, and the free hydrogen in a nascent state combines with phosphorus, forming phosphuretted hydrogen. It is preferred to carry out the process in a Siemens or other similar furnace, and then the melted iron, mixed with as large a percentage of roll or hammer scales as is produced in the works, is subjected to strong oxidising flames impinging on the surface, while a jet of steam is forced through it, the silicon, carbon, and manganese are oxidised by the joint action of the steam, free oxygen of the flame, and the oxygen of the roll or hammer scales. When the iron is free from silicon, carbon, and manganese, and not till then, the steam is decomposed by the iron and phosphuretted hydrogen formed.

In the discussion which followed these three papers, taken collectively, Mr. Windsor Richards, of Messrs. Bolckow, Vaughan, and Co., explained, by means of a diagram, roughly, thus—that M. Pourcel's views respect-



ing the effect of silicon and carbonic oxide on the elimination of the phosphorus were not correct, as found by experiment on the large scale at Middlesbrough. The upper line in the diagram indicates the quantity of carbon in the molten pig, which drops from 3½ to 0 per cent., and the lower line shows the phosphorus from 1·5 per cent. of phosphorus to 0. Then from the curve it will be seen that the phosphorus has dropped to about 1·0 per cent. when the carbon is 0. Following the curve it is seen that phosphorus drops below one-tenth per cent. after the two minutes of overblow represented by the shaded portion of diagram. If M. Pourcel's views were wholly correct, then the phosphorus curve would have dropped at the beginning of the blow and re-ascended, but long working now shows this not to be the case. The phosphorus line is absolutely horizontal for the first seven minutes. The further remarks of the same speaker were to the effect that the process is daily becoming more thoroughly satisfactory, and that only slight mechanical improvements remain to be made. Mr. Snelus also objected to M. Pourcel's views respecting the governing effect of temperature. He considers that the author had not sufficiently recognised the difference between oxidising and deoxidising flames, and that his reference to a blast furnace is not satisfactory, as phosphorus would not be found in the slag unless the furnace was working badly. If a furnace has sufficient power to reduce the oxide of iron, then the phosphorus will be reduced, the more powerful the reducing action the more the phosphorus will be reduced, and the elimination is more a question of reduction than of temperature. M. Pourcel says that the pig and ore open hearth process did not promise well in making mild steel, but the Steel Company of Scotland have for some time successfully made mild steel in this way. Dr. Siemens agreed with Mr. Snelus in his objections to the temperature element, and thought the presence of oxygen of some advantage. He also confirmed the remarks on the pig and ore method of making steel in the open hearth furnaces, and said that scrap was now seldom used; it quickened the out-turn, but it is not now necessary. M. Pourcel makes certain suggestions respecting tapping off the slag at certain stages, but Dr. Siemens stated, that ten years since he had practised this, and added silica and manganese as necessary, but the work was irregular, though he still thought something might be done with the process. Mr. Riley referred to the Towcester process as that of the future for removing phosphorus. Probably the most important information was communicated by Mr. Lowthian Bell. It seems that the Cleveland process is sufficiently in practical work to permit of several hundred tons of rails being made, a good many of which are down on the North-Eastern Railway. Mr. Bell gave the average analysis of the rails down on that line as 0·10 per cent. of phosphorus, and said that some analyses had given only 0·04 per cent., which was equal to hematite iron. The rails had been subjected to very heavy tests. The usual test on the North-Eastern line is two blows from a ton weight, falling 5ft. This had no effect, and the height of fall was increased to 10ft., and subsequently to 27ft., when the rail was not broken, but bent, and a piece broken out of the head. Sufficient has not yet been done to determine the question of cost, but enough has to ascertain the great merit of the invention, and the credit due to the inventors. With respect to Mr. Brown's paper, Mr. Snelus said that the process was very like Sherman's, and referred to the analyses and tests as sufficient indication of the uncertainty of the process. The process was generally considered expensive, but Mr. Brown put it at 4s. per ton of steel. Of Mr. Bull's process, the general idea was that steam always would, as it has yet done in the hands of other experimenters, cool the metal too much before elimination was effected.

At one o'clock, the reading of papers and discussions being concluded for the day, the members went in different parties to see the three new and largest vessels of the Cunard, Inman, and White Star lines respectively, viz., the Gallia, the City of Berlin, and the Germanic. This last is the latest addition to the White Star Line, and, like her sister vessels, is well known for the remarkable regularity of her speed. She has made the passage from Queenstown to New York, Sandy Hook, in 7 days 11h. 37m.; and from New York, Sandy Hook, to Queenstown in 7 days 15h. 17m. Average speed per hour, winter and summer, across the Atlantic, 15½ knots; greatest day's run, 410 knots, or 19½ statute miles per hour for twenty-four hours consecutively. Her dimensions are—Length, 476ft. 6in.; breadth, 45ft. 2in.; depth, 33ft. 7in. The engines are by Messrs. Maudslay, Sons, and Field, and the horse-power indicated 5431; length of stroke, 5ft. Diameter of two high-pressure cylinders, each 48in.; two low-pressure cylinders, each 83in.

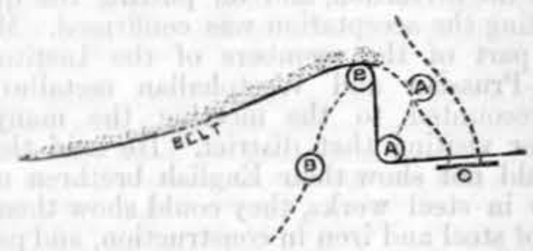
The s.s. City of Berlin, was built by Messrs. Caird and Co., of Greenock, in 1875. She is 5491 gross tons, and 3139 tons net register. Her length is 489ft. keel and fore rake; depth, 36ft.; breadth, 45ft. She has accommodation for 220 saloon and 1200 third-class passengers. Her engines are 1000 nominal horse-power, and 5200 indicated. They are inverted direct-acting compounds, with two cylinders, low pressure, having a diameter of 120in.; high pressure, 72in.; stroke, 5ft. 6in.; steam, 75 lb.; vacuum, 26in.; revolutions, 56; expansion, 20in.; speed, 16 knots. Has made the run from New York to Queenstown, 2830 knots, in 7 days 14h. 2m., being equal to nearly 15¾ knots per hour. Has made in one day's running 405 knots, equal to 490 statute miles, or an average of 19 statute miles per hour.

The s.s. Gallia is the latest addition to the Cunard fleet, which now consists of forty-six vessels, having an aggregate of 84,354 tons of gross tonnage, and 12,988 nominal horse-power. She was built in 1878, by Messrs. G. and J. Thomson, of Glasgow. Her gross tonnage is 4808 tons; and she is 5300-horse power indicated, and 700 nominal. She accommodates 300 cabin and 1200 steerage passengers.

From these vessels the parties went to the Mersey Steel and Ironworks, to the grain warehouses and North Docks, and to Messrs. Laird Brothers' works. Three tenders were placed at the disposal of the Institute by the Mersey Dock Board, and by these the members were taken to and from these vessels and places.

The Liverpool Granaries.

In these granaries the principal features observed were the grain carrying and distributing belts, and the hydraulic machinery provided with water by double-cylinder condensing engine of 360 indicated horse-power. The grain belts are three ply canvas india-rubber, about 16in. to 17in. in width. The belts now running have been at work eleven years, and are only now showing unimportant wear. They run at from eight to ten miles per hour, and sometimes have together distributed about eighty tons of grain per hour. The method of transferring the grain from one belt to another running at right angles thereto is simple, and consists simply in making the belt run up on a raised pulley B and under A—thus—when the grain is shot forward off



B and into a hopper, indicated by dotted lines, which directs the grain on to the belt C, running normal to the other belt. The rollers A and B are upon a frame, by which they may be placed as shown in full lines, or as indicated by dotted lines, when the belt runs on straight, and delivers elsewhere. Means of dressing or sifting the different sorts of grain at a very cheap rate are required in these granaries, and probably something might be made in connection with these belts. Good portable elevators for lifting the grain from ships' hulls on to the quay are also needed. They should be floating elevators, so as not to encumber the quay in any way, and, if floating, could be placed beside a ship wherever it became most convenient to place the latter.

Messrs. Laird Brothers' Shipbuilding Works.

These shipbuilding and engineering works are situated on the Birkenhead side of the river, a little above the Woodside Ferry landing. They were established in 1824 by the grandfather of the present proprietors. They occupy an area of more than twenty acres, and include extensive ranges of workshops and five dry docks, one of which is roofed over. When fully employed as many as 3000 workmen are engaged, but at present the number is much less. Many celebrated vessels both for warlike and peaceful purposes have been constructed here. Among the former may be mentioned the Agincourt, 6621 tons burden, built in 1865; the Scorpion and Wivern turret ships, of 1827 tons burden, built in 1863; the unfortunate ship Captain, which went to the bottom in the Bay of Biscay with almost all her crew, built in 1869; the Alabama, which was but too notorious during the American war, and for whose depredations we had eventually to pay so much; and the Huascar, Peruvian warship, of whose exploits against the Chilian navy we are now hearing from week to week. Among the vessels built here for the merchant service are several of the finest American and other liners; but space will not now admit of further reference to them. Altogether nearly 500 vessels have been built by Messrs. Laird. At present they have in hand the following important orders, viz.:—Two paddle-wheel steamboats for the London and North-Western Railway Company, to run between Dublin and Holyhead. They are each 310ft. long by 33ft. broad, 1623 tons burden, and are driven by oscillating cylinder engines of 3200-horse power. They are being constructed entirely of Bessemer steel supplied from the Crewe Works. They will attain a greater speed than their predecessors, the Rose and the Shamrock, built three years since. In the moving parts of the engines, Whitworth's and Siemens's steel are freely employed. A twin-screw towing and relief boat for the British Admiralty, constructed of Landore steel. Two gunboats for the Portuguese Government, built of iron sheathed with wood, and again cased with zinc sheets. The armament is to consist of one 64 and two 32-pounder Armstrong guns in each case. The screw propellers are made so that they can be feathered and placed upright by mechanism operated from the inside of the vessel, when it is desired to proceed under canvas alone. A large store-ship for the

Argentine Government, to be built of iron. H.M.S. Hotspur, in dock and undergoing alterations. She was built about nine years since to the designs of Mr. E. J. Reed. A turret is now being fitted, and her armour is being remodelled. When completed it will be 10in. thick in two layers; the outer face 4in. thick, being of steel, and the inner one 6in. thick of iron. She will carry two 25-ton guns in her turret, and a pair of stern chasers also. The pivot upon which the turret turns is entirely composed of plate iron made into cylinders, contracted one over the other, and formed into a pedestal by uniting them with a broad and strong circular base plate stiffened with gussets. This arrangement is found better able to resist sudden blows than the solid upright forging formerly used.

The marine engineering shops contain a large number of first-class tools suitable for heavy work, and including hydraulic presses of enormous power, for bending armour plates. The most important work at present there is the machinery for H.M.S. Algerine, itself under construction at Messrs. Harland and Woolf's yard at Belfast.

Wednesday's proceedings were brought to a close by a largely attended reception by the Mayor, held in the Walker Art Gallery.

Thursday's proceedings commenced with some announcements by the President respecting the excursions, some particulars of which were given in our last impression.

A paper was then read by Mr. J. A. Picton, of Liverpool, a gentleman well known by his historical writings, and who has for many years taken a most active part in the educational affairs of Liverpool. He was a leader in obtaining the Liverpool Free Library Act and library, and has been chairman on the Library Committee since its formation, about a quarter of a century since, and it is his name which has been given to the Picton reading-room, just completed, forming a handsome structure, connecting the old Free Library and the Walker Fine Art Gallery. Of this structure we give some drawings elsewhere, and a description will appear in our next impression. His paper was entitled

THE PROGRESS OF IRON AND STEEL AS CONSTRUCTIVE MATERIALS.

This paper is purely of a historical character. It points out that with the free use of iron commenced the arts of modern life, and that every invention which contributes to our comfort is connected with the employment of iron. The progress of iron and steel, as constructive materials, is illustrated by a rapid glance at the history of things made with them. Though in considerable use 1300 years before our era, it was, notwithstanding its abundance, one of the metals last brought into use. The employment of iron by the Britons before Cæsar's time, and the ironworks of the Romans in Gloucestershire and in Sussex, are referred to, as are also their primitive methods, which were replaced in the sixteenth century by the introduction of the blast furnace. The early use of iron for military purposes, and the wide reputation of the Sheffield *thwittle* in the time of Chaucer, precede some remarks on the beauty of mediæval ironwork both in England and on the Continent, which are followed by others on the general introduction of the use of cast iron in the seventeenth century, illustrated by reference to its employment in pieces of large size by Smeaton in 1755, and subsequently in the celebrated bridges of Pritchard over the Severn, at Broseley, 1779; Telford's, over the same river, in 1795, at Buildevas; and the Sunderland—Monkwearmouth—bridge, of 236ft. span, designed by the celebrated Thomas Paine, and opened in 1796. The subsequent substitution of wrought iron for bridge and similar work is illustrated by reference to Telford's beautiful bridge—1825—over the Menai Straits; Stephenson's ugly bridge over the same straits; Baker's fine bridge at Runcorn; the St. Lawrence, Tay, and other bridges. The use of iron in the steam engine as a locomotive or marine engine, and the inestimable effects of their employment the whole world over, and the impulse which they have given to iron production and construction, are followed by remarks on the use of iron in ships, illustrated by reference to Fairbairn's canal boats of 1830, the Richard Cobden—1844—Great Eastern 1858, the fine vessels of the several great companies, including the just completed and most perfect of all passenger ships, the Orient. The credit of having invented ironclads is taken from the late Louis Napoleon III., and given to England. This the French will not allow, although they will allow the other claims made by Mr. Picton, unless they refer to such things as Mons Meg, made before the English iron industry was born. The use of iron for building purposes in the Crystal Palace is referred to approvingly as an iron building designed to look like what it is, instead of like something that it is not, and its employment for fireproof buildings, dome roofs, and floor girders, as in the Picton reading-room, receive passing remarks, concluded by reference to engineers' general neglect to the third element in the ancient motto respecting building, namely, "Strength, commodity, beauty," and, to architects' inefficient, insufficient use of iron—"When employed, they have striven to hide it from sight, and seem to apologise to themselves and the world for being obliged to use it instead of brick or stone."

Though this paper was not scientific and hardly technical, it soon proved to be a text upon which much that is important to steel makers and steel users, including all interested in constructive work, was based. Mr. Head, who was on the staff of engineers under Robert Stephenson when Thomas Paine's Bridge was strengthened, made some remarks of historic interest upon the way in which this was effected by intermediate girders, the Monkwearmouth folk objecting to the removal of the bridge then, and still considered to possess features of much beauty. Robert Stephenson once remarked that the bridge was an unequalled display of ignorance of engineering principles, but in reply to this question, Mr. Picton quoted a well-known adage respecting stones and glass houses. This was very warmly received, and Paine's originality and boldness in building the bridge very strongly supported by Mr. Adamson and others. In the further course of the discussion, Mr. Adamson maintained that the tests for ship plates are altogether disproportionate to requirements, and, referring to the bending tests, he complained of their entire want of similarity with the tests applied in practice. It is of little use demanding that a plate shall double sharp upon itself, if, to gain that quality, some other quality of more importance must be sacrificed, and Mr. Adamson, therefore, urges that bending to small radii should not be demanded if the plate will not have to be so bent, because a greater tensile strength can be obtained with plates that will not be so treated. He mentioned certain experiments which had been made with reference to the plates for the chains for the Firth of Forth Bridge, and said that this was a case in which great tensile strength is necessary, while ductility is not so necessary, for the two spans of the bridge being each 1600ft. the strength and lightness of the supporting chains is a matter of much importance, and therefore it is desirable to employ a steel which will stand 50 tons on the square inch, will have an extension of 15 per cent., but which will not under these conditions stand the doubling. On this point Dr. Siemens agreed, but he would not agree with Mr. Adamson in his proposal to give up the bending test for boiler and other work. Mr. Adamson is really in favour of decreasing the official tests, and making all tests according to the duty to be performed by the steel. He stated that it is proposed to use thin steel plates for the chains for the Forth Bridge, and that experiments have shown that they may now be coupled by rivetting so as to secure a joint equal to from 90 per cent. to 95 per cent. of the strength of the full section. The greater strength of such plates as compared with the very mild steel necessary to withstand the tests, Mr. Adamson looked upon as giving greater stiffness to ships made of them, but Dr. Siemens pointed out that the decrease of ductility does not secure greater stiffness of the structure—as both mild and hard steels are equally stiff within their limits of elastic extension—therefore, under the loads commonly applied in structures such as ships, the mild steel has the advantage that it would bend instead of break under impact strain, as a collision. The bending test he therefore considers necessary, as showing the facility with which the iron will coldflow—if the expression may be used—under such circumstances. Tin-plate manufacturers are now using mild steel instead of charcoal iron, and they test the plate by bending. If the plate will stand bending backwards and forwards, each time hammered close, they consider it a pretty good plate. Such severe tests are also, it was considered, necessary to prevent the work rivetted up over night from falling to pieces in the morning; but as Mr. Adamson remarked, this will ever take place, unless steel is judiciously selected for the work, and the President went so far as to say that cases of flanged and rivetted work falling to pieces by reason of internal conflicting strains are now more numerous than they have ever been with steel since attempts have been made to use it for such purposes. For bridge work, the principal authorities seemed to be agreed that steel of a much higher tensile strength than is consistent with the present tests for ductility might with great advantage be employed. Such a material could be produced at a cheaper rate than the mild steels, or he might say, the fine irons; and Mr. Snelus stated that he had now made many thousands of tons for boiler and such work which will stand a tensile strain of about 35 tons to the square inch, and give an ultimate extension of 15 to 20 per cent. Mr. West, of Lloyd's, explained the difficulty in which those he represented stood, owing to the conflicting demands of shipowners, ship-makers, steel-makers, and underwriters. He said that Lloyd's are as desirous as any one of reducing the tests, or of suiting them to requirements; but at present their real knowledge as gained from steel-makers' and steel users' evidence, given them under no constraint, showed them that at present the tests could not be reduced with safety. Mr. Crampton recalled attention to the fact that steel work does, to all appearance, spontaneously go to pieces sometimes, and that while such is known to be a contingency, it will be necessary to be on the safe side. He also referred to the question of the greater corrosion of steel than of iron, especially of the commoner kinds, but this question was not taken up. On this subject experiments are being made by two institutions, but it is questionable whether much in the way of new facts will be gathered together. It transpired in the course of the discussion that the first Bessemer steel plant was made and worked by Mr. Menelaus at the Dowlais Works, and that Mr. Menelaus was thus one of the pioneers at whose cost the early experiments were made before the spiegeleisen idea was adopted. Mr. Picton's paper was followed by one "On Some Physical Changes Occurring in Iron at High Temperatures," by Mr. Thos. Wrightson, of Stockton-on-Tees. We shall, however, postpone this paper for another impression. A considerable party visited the Picton Reading-room after the preceding discussion was concluded.

The proceedings of the day terminated with excursions in accordance with the programme to the Pemberton and Garswood Hall Collieries, the works of the Wigan Coal and Iron Company, and those of the Messrs. Corquodale and Co., the White Cross Wire Company, and the Warrington Works of Messrs. Rylands; and in the evening the annual dinner took place in the St. George's Hall.

THE AMERICAN IRON TRADE.—According to the *Iron Age*, considerable apprehension is felt at Pittsburg that the upward movement which has lately taken place in the iron trade will be overdone, that it will stimulate importations, largely increase the production, and create labour troubles.

THE FLOW OF RIVERS ROUND BENDS.

ON the second day of the last meeting of the Institution of Mechanical Engineers, at Glasgow, Professor James Thomson, LL.D., F.R.S., of the University of Glasgow, exhibited a very interesting apparatus for the purpose of illustrating the theory of the changes of the courses of rivers flowing through alluvial plains. This difficult subject was, we believe, first treated by Professor Thomson in a paper which he read before the Royal Society, and printed in their "Proceedings" for May 4th, 1876.

It is very well known by everyone who has observed the little streams which flow down the sands of the sea-shore when the tide has receded, that their courses are constantly changing, and that the bends tend to become larger and larger, until the convolutions meet and an island is formed, the ends of the original stream silt up, and the original course is converted into a deep pool.

The experimental winding stream exhibited was constructed of wood, and was of the section and plan shown in Figs. 1 and 2; the large arrows in Fig. 2 indicating the direction of the water in the river. The direction of the flow of the water upon the bottom of the river at the various points in its course was shown experimentally by three distinct methods. The first was by sticking down pins at the various points where its direction was wished to be determined, and attaching fine cotton threads to the pins, which acted like flags in a breeze, the direction of the current at any point in the depth and at any place in the river could be determined. Another method was by planting small particles of aniline dye upon the bottom of the river, and as it dissolved a blue streak was made upon the bottom of the river

FIG. 1

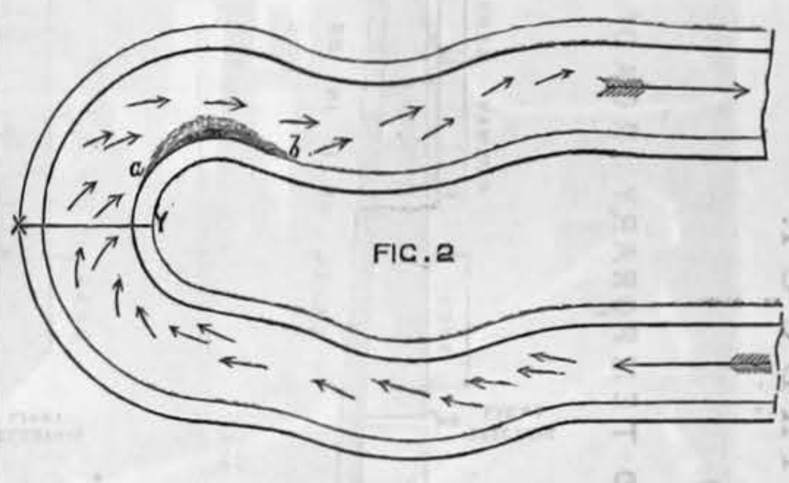


FIG. 2

which indicated the direction of the stream. The third, and the one which resembled the action of nature the most, was by means of poppy seeds, which possess the property of being only slightly heavier than water. The seed as it was dropped at the upper part of the course was carried along and deposited.

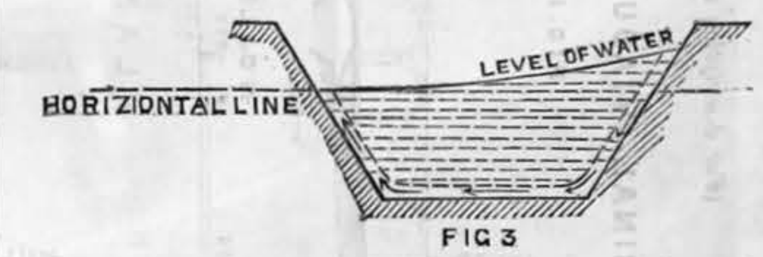


FIG 3

The directions upon the bottom of the river at the various points are approximately indicated by the small arrows in Fig. 2, and it becomes at once evident how the banks at the outer side of a bend in a river are washed away, and the inner are filled up at their expense. It will now be interesting to consider Professor Thomson's explanation of the causes which produce the currents indicated by the small arrows.

When water flows round a bend the course of every element is curved, and somewhat resembles the shape of the bend, and as a matter of course there arises a centrifugal action which is exerted upon every particle, and tends to make it rise higher on the outer bank than the inner, and take the form shown in the vertical section Fig. 3, across the centre of the bend at x y, Fig. 2.

Now, in consequence of the sides and bottom of the river by their surface friction retarding the velocity of the film of water next to them, the centrifugal action is not exerted upon this film that is exerted upon the rest of the water, and a current is consequently set up from the outer circumference of the bend to the inner, which is indicated by the arrows in Fig. 3, and the sand and gravel is swept from the outer sides of the channel, and transferred to the inner at the point marked.

The foregoing description of the principles involved will give a general idea of the action of rivers; but as the question is very important and interesting, we must refer our readers to Professor Thomson's paper, already alluded to, for a more minute investigation of the subject.

NAVAL INTELLIGENCE.

THE Herreschoff torpedo boat, which did not answer satisfactorily at Portsmouth a few months back, owing to defects which arose in the machinery, has just been overhauled by the dockyard engineers, and been fitted throughout with copper pipes and a double-action pump for the supply of feed-water to the coils, the result being that a couple of successful runs have been made. The action of her reversible steering gear, which enables her to steam at the same rate in any direction, was also exhibited. She is now to be fitted with torpedo frames and the usual apparatus for loading and discharging the Whitehead torpedo. The striking peculiarity of this little craft, which is 59ft. 6in. long and 7ft. 7in. broad, with a draught of 1ft. 3in., and a displacement of eight tons, is that its boiler, which consists of a coil of iron piping, weighs about one-third less than ordinary boilers of the same power, while its screw is immediately under the bottom a little abaft the centre of the boat, and its balance-rudder below the keel. The engines are of the compound type, and are placed in the bows, and steam can be raised in five minutes. There is also a novel arrangement for the condensation of the steam, the condenser running along the bottom of the boat and forming a deep keel. A speed has been realised on the Thames of 15·323, knots and the boat proved very handy, stopping almost dead when the engines were reversed from full speed to astern. The highest pressure was 150 lb. to the square inch, and the maximum number of revolutions 400 per minute. The new turret ship Colossus, building at Portsmouth, which has been already described in our columns, is expected to be equipped with breech-loaders of 38 tons or more.

THE LLANDULAS VIADUCT.

(*For description see page 235.*)

ELEVATION SHEWING ORIGINAL VIADUCT AND TEMPORARY ROAD

FIG. 1.

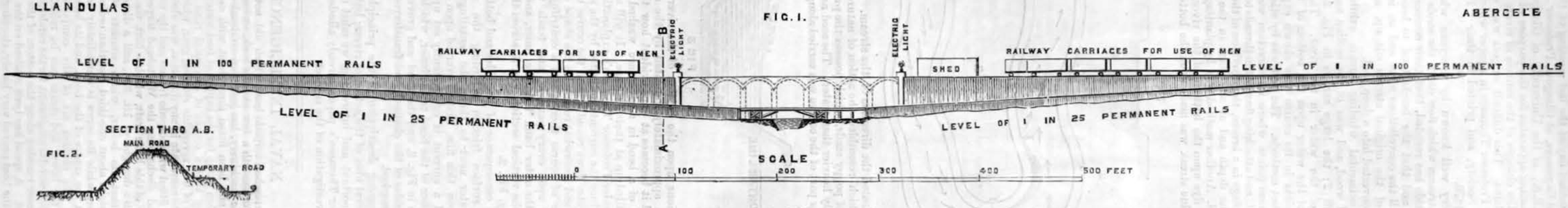
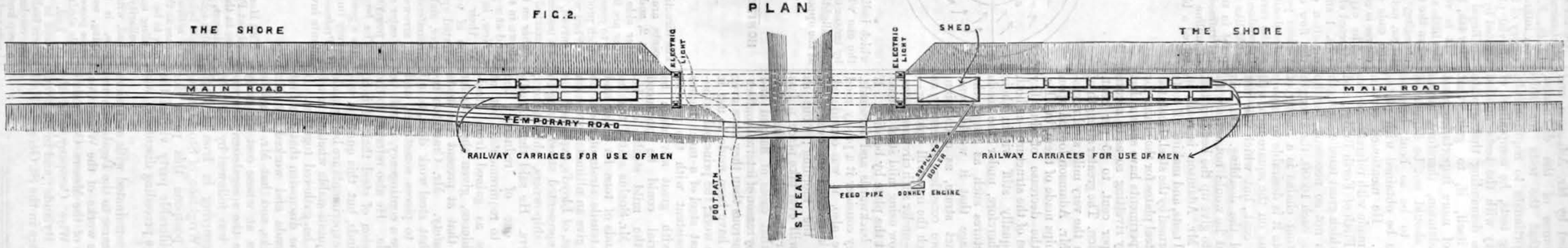


FIG. 2.

SECTION THRO A.B.

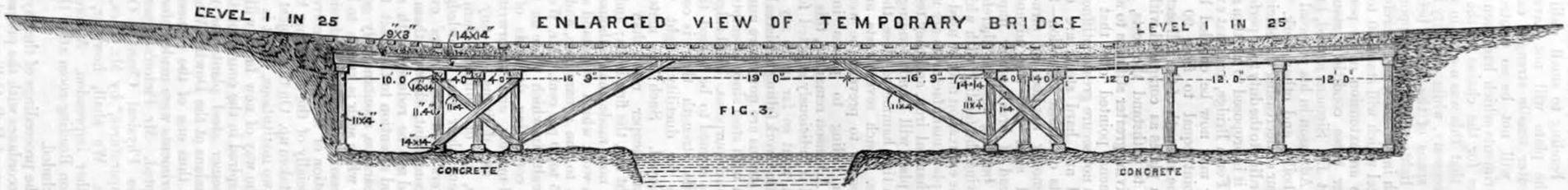
PLAN

FIG. 2.



ENLARGED VIEW OF TEMPORARY BRIDGE

FIG. 3.



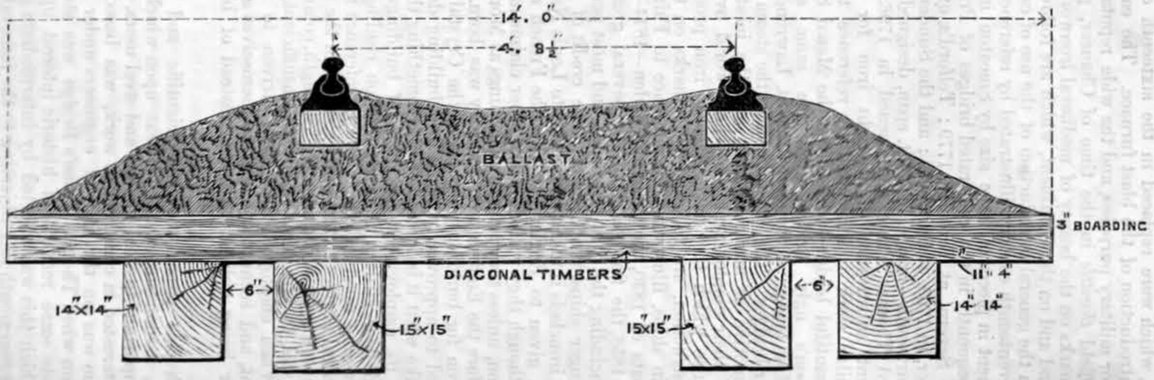
SECTION THRO' B.C.

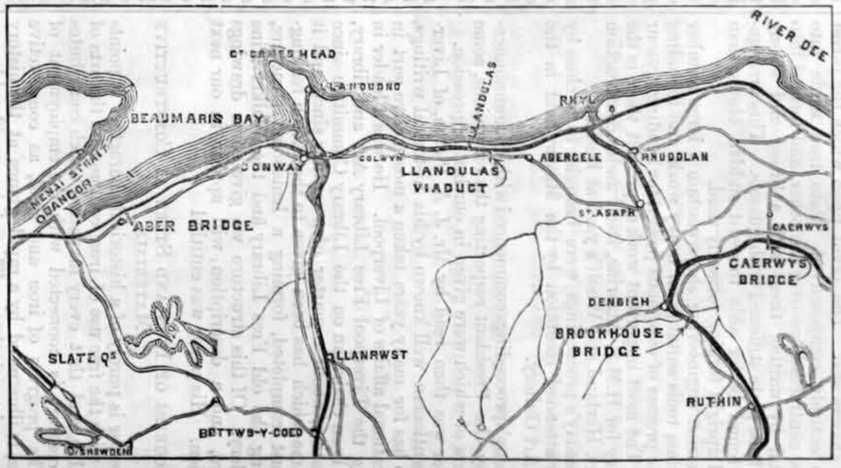
SCALE ½ INCH = 1 FOOT

SCALE

FEET

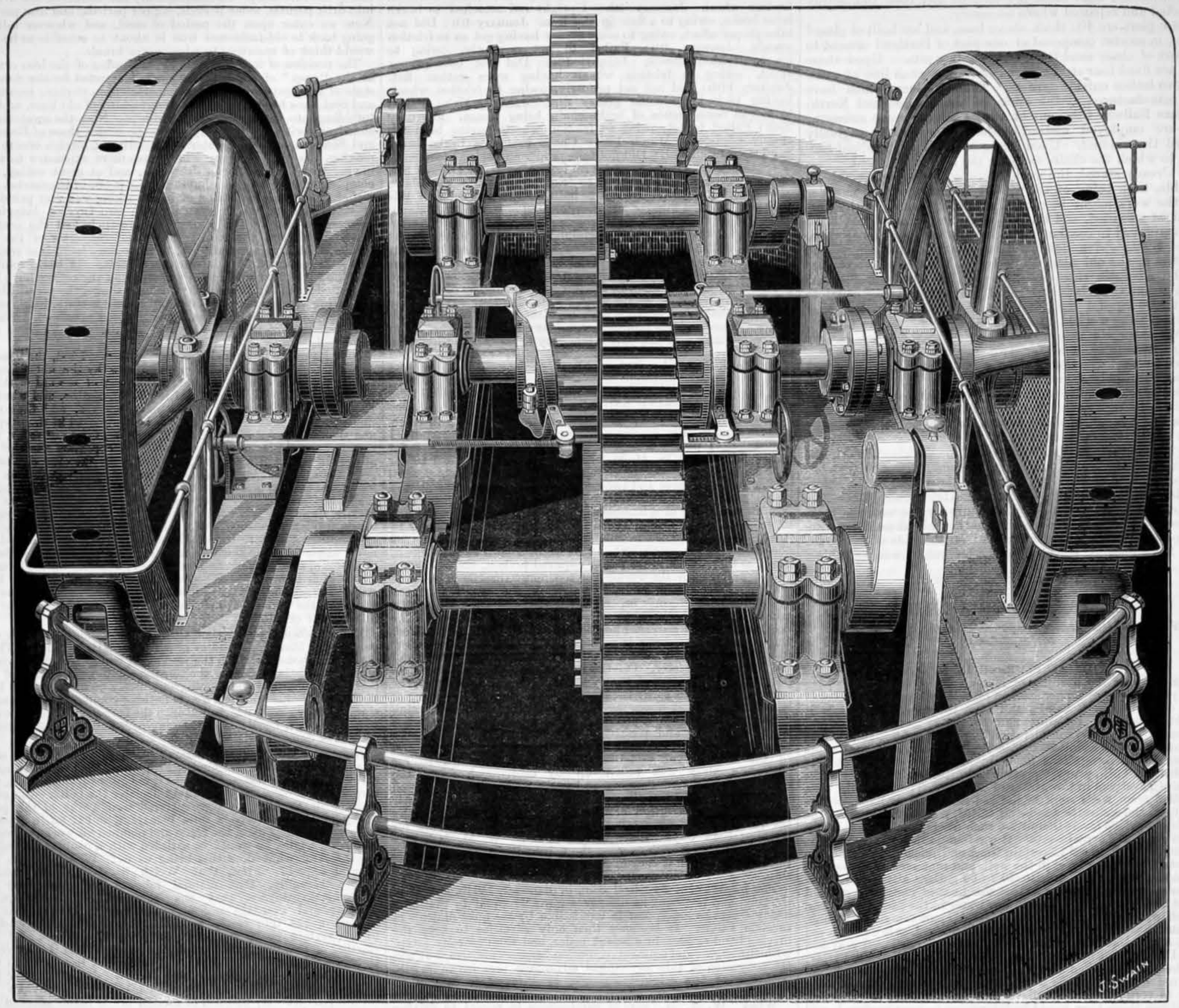
FIG. 4.





PUMP GEARING—LEAMINGTON WATERWORKS.

MR. G. B. JERRAM, C.E., ENGINEER.



IN our last impression we illustrated and described the well work of the new Leamington Waterworks. We now illustrate above the pumping gear at the top of the well. The engraving requires no description beyond that which we gave last week. It is proper to state, that the large well works were carried on by Mr. Davidson, now borough engineer of Sheffield, before Mr. Jerram's appointment to Leamington.

THE RENEWAL OF THE LLANDULAS VIADUCT.

A DETAILED account of the reparation works recently carried out by the London and North-Western Railway Company in North Wales will prove interesting to many of our readers.

The floods of Sunday, August 17th, which especially visited the North Wales district, are considered by the oldest residents in the neighbourhood never to have been equalled. The rain, commencing on the previous Friday evening, continued with but slight intermission until Sunday evening, and the downpour on the Saturday was very great, the force of the water as it rushed down the sides of the mountains being something terrific; consequently the various streams and rivers rose to an alarming extent, and as the culverts and bridges were not able to convey the large volume of water away, the roads and fields were flooded over a very large area.

Of course our readers will have already obtained, through the medium of the daily papers, an idea to some extent of the damage done by these floods throughout the country, and especially to the lines of railway in North Wales.

The viaduct at Llandulas is situated on the Chester and Holyhead line between Llandulas and Pensarn—or Abergele—stations, about one mile from the former and two miles from the latter, and about half a mile from the scene of the terrible accident that occurred near this place about eleven years ago. This viaduct spans a small stream which, in ordinary weather, is not more than 4ft. or 5ft. wide, and very shallow. It rises in the mountains that overlook the valley.

The viaduct under which the stream passed—Fig. 1, page 234—was a substantial structure of seven arches, each arch having a span of 28ft., with limestone piers and abutments, each pier being 4ft. thick, with double plinth foundation 4ft. 6in. and 5ft. thick, the height from the bottom plinth to the springing of the arches being 21ft., and from the top plinth to the springing 17ft. The arches were of brick in cement, and 1ft. 6in. thick. The gradient of the line was 1 in 100 down towards Chester.

On the day of the demolition of the viaduct, the waters of the stream being very high, and augmented by the incoming tide, swept with great force round the base of the piers, and very soon loosened some of the stones of the third pier from the Llandulas end of the viaduct. These stones being quickly washed away by the current, the total destruction of this pier occupied but little time, and the loss of it immediately caused the collapse of the whole of the seven arches, and the entire demolition of the structure.

Very fortunately, the accident occurred during the day, for had it happened in the middle of the night undoubtedly a dreadful catastrophe would have been the result. As it was, the dangerous state of the viaduct was noticed immediately after the passing of a train, and only a few moments before its destruction, and, of course, prompt steps were at once taken to stop the further traffic of the line.

A short distance away from the line, and situated on the banks of the stream, were two small stone houses, and these have met with the same fate as the viaduct, nothing now remaining but the *débris* to indicate the position where they once stood.

The damage caused by the floods was not confined to the district of Llandulas and Abergele alone, for the railway communication was stopped by the partial destruction of a small bridge near Aber Station, situated between Penmaenmawr and Bangor, and, as before, on the Chester and Holyhead line. The railway lines between Denbigh and Mold and Denbigh and Ruthin were also rendered almost useless by the destruction of the bridge at Caerwys on the former line, and of the Brookhouse bridge on the latter.

As soon as the railway company became aware of the damage done to their lines, prompt action was taken to remedy as far as possible these mishaps, and a large number of omnibuses, phætons, brakes, and other conveyances for passengers, as well as carts for goods, were sent from Liverpool, Chester, Rhyl, Bangor, and other towns to the nearest stations to the damaged bridges. The bridge at Aber was soon made ready for work again by repairs of a temporary nature, and the trains from Holyhead, Carnarvon, &c., were enabled to proceed as far as Llandulas, whilst the trains from Chester could run as far as Abergele. At both these stations passengers and luggage had to be transferred to other means of conveyance from one station to the other, a distance of about 4½ miles. This method of travelling on one of the most, if not the most, important of the railway main lines in the kingdom, of course caused great delay, not only to passengers and their luggage, but also to the mails and goods, the last-named having to proceed by the Cambrian Railway *viâ* Afon Wen and Carnarvon, but this line was soon blocked with the extra quantity of traffic.

The railway authorities being fully alive to this great delay and inconvenience, at once commenced to make such better arrangements for the temporary management of the traffic as lay in their power. The Aber bridge being so far repaired as to allow of the passage of trains, the attention of the company was directed to the destroyed viaduct at Llandulas. It was at first intended to make a temporary footpath down the side of the slopes of the embankment, with a wooden bridge across the stream, in order that passengers might be brought up by the trains to each side of the viaduct, and then walk from one side to the other over the temporary footpath, and then proceed on their journey again. As it was considered that the inconvenience would still be very great, even with this footpath, it was eventually determined to try the experiment of constructing a temporary road for railway purposes over the site, and in lieu of the proposed footpath, and immediately from 600 to 700 men were brought upon the works, and at once commenced to make this temporary road, and also to rebuild the permanent viaduct.

The men were divided into three gangs, each gang working sixteen hours, and by this means the works were continued both day and night. There was some dissent amongst the men at the early stage of the works because of not being able to procure any accommodation, and particularly food, for the little village of Llandulas could not provide sufficiently for this large influx of visitors. This, however, was soon obviated by the railway company supplying food for all, and it also provided a number of railway carriages for the men to sleep in, and by this means the works were enabled to proceed with great rapidity.

On August 26th, or eight days after the accident, the workmen finished the temporary road, which was in the centre of and about fifteen yards south of the old viaduct, and over which a single line of rails was placed. The wooden bridge over the stream was fixed at a level of about 20ft. below the old line of rails, and this bridge was approached on either side by an inclined road cut out of the side of the embankment—see Fig. 2*a*—and swerving from the main line, and at a gradient of 1 in 25, with a lead from the permanent level of the Abergele side of about 220 yards, and from the other side 250 yards, to the centre of the bridge—see Figs. 1 and 2.

The bridge was constructed with wooden frames and diagonal stays, with longitudinal timbers and 3in. planking on the top; this was covered with ballast about 2ft. thick, composed of cinders, the sleepers carrying the chairs being laid in this ballast. The frames at the bottom were bedded in cement concrete. A detailed elevation of this bridge is given in Fig. 3.

Great caution had to be exercised in working the traffic over this temporary road; the trains as they approached being stopped at the top of the incline, and a powerful locomotive was attached behind, in order to act as a brake in going down the incline, and to assist in getting the train up the other side; with very heavy trains two engines were necessary at the rear instead of one.

As only one line of rails was laid, crossover roads were employed at each end on the permanent road in order to work the up and down lines. This bridge was thoroughly tested before being used, and was duly inspected and

approved of by the Board of Trade inspector. By the construction of this road the trains were enabled to run right through from Chester to Holyhead.

The new viaduct, over which the traffic was turned on the 17th inst., and which has been constructed in such a very short space of time, has six piers, which were built upon the old foundations after these foundations had been thoroughly inspected and repaired where necessary.

These piers are 4ft. thick above base, and are built of glazed bricks, in mortar composed of one part of Portland cement to one part of clean sand from Colwyn Bay pits. Upon these piers are fixed four steel girders, one under each line of rails, and two lattice outside girders. These girders, which have been manufactured at the works of the London and North-Western Railway Company at Crewe, are of great strength, and are employed instead of the arches which originally formed the viaduct. Upon these are laid longitudinal timbers, to which the chairs carrying the rails are secured.

As already stated, the works were continued as quickly as possible, time being of the utmost importance, and in order that the work might be carried on during the night the electric light was used, and this was quite sufficient to enable the men employed to continue their labours without loss of time. These lights—with Serrin's lamps—were placed upon the pilasters of the old abutments, two of the Gramme machines on the Abergele side—see plan Fig. 2—and one Siemens machine on the Llandulas side; the former being equal to about 4000 candles each, and the latter to 5000 candles, each machine being worked at about 800 revolutions per minute. On the Abergele side a wooden shed was erected for the electric machines, and for two engines which were employed to work the same. One engine of 8-H.P. for the two Gramme's machines, and one of 6-H.P. for the Siemens; and one boiler was employed to feed the two engines, the water required to supply this being pumped up from the stream below by a small donkey engine, which was fixed on the bank of the stream, as in Fig. 2.

In the engravings, Fig. 1 is an elevation showing the original viaduct and the bank connecting the same, with a view of the temporary road and bridge. Fig. 2 is a plan of the above, showing the position of the temporary road and bridge, shed for electric lights, carriages for men, donkey pump for the water supply, and so on. Fig. 2*a* is a cross section of the embankment, showing the position of the temporary road on the side of the bank. Fig. 3 is a detailed elevation of the temporary wooden bridge.

LETTERS TO THE EDITOR.

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

TIDAL INFLUENCE IN MINES.

Sir,—Under the heading of Notes and Memoranda, on page 207, you refer to the phenomenon of tides having been observed in a coal mine in Bohemia, and from the concluding words it would appear to be quite new to the *savans* of Berlin and Vienna. Under this consideration I have thought that it might be interesting to mention that a similar observation was made during the investigations made by direction of Mr. Robert Stephenson, C.E., into the present and future water supply to the town of Liverpool in the winter of 1849-50. The town was then supplied from wells sunk in the red sandstone and the permeability of the measures was being tested, when on comparing the yields at various levels there were such discrepancies as led to a repetition of the experiments. It was found subsequently that the engine had to be eased at certain times and quickened at others to maintain the water level in the well, and that such variation was about two strokes per minute, 50 to 60 gallons above and below the usual working speed, and that the greatest variation occurred about two hours after high and low water in the Mersey. When a well was standing the water level did not remain the same, but the rise and fall were not accurately noticed, as it was believed to be due to the influence of pumping at other wells. I may add that I had charge of the pumping experiments directed by Mr. Stephenson and called his attention to what I had observed, and received his instructions to continue the experiments with the view to verify them. I believe that my notes are in existence, and if you think they would be interesting to your readers I will make an extract from such as bear upon this question, and let you have some particulars of observations made every three hours with counter numbers, &c. Wm. Waller.

128, High-street, Redcar, Yorkshire, September 19th.

[We have no doubt that all available information on this subject should be made public.—Ed. E.]

THE CLARK AND WEBB CHAIN BRAKE.

Sir,—No one who reads over the returns of continuous brakes for the six months ending in June last can fail to notice that a large amount of the progress made by the railway companies in the application of continuous brakes has been in a wrong direction. Out of a total of 1381 vehicles fitted with continuous brakes during the last six months, no less than 293 or 21·22 per cent. have been fitted with the Clark and Webb chain brake, a brake which has been repeatedly condemned by the Board of Trade and by all impartial observers. The London and North-Western Railway Company alone are responsible for 279 of these 293, and have now—including West Coast Joint Stock—2228 vehicles fitted with brakes, which, in the words of the Board of Trade, "cannot in any reasonable sense of the word be called continuous brakes." The position taken up by this company in defiance of public opinion and of the repeated censures of the Board of Trade is indeed remarkable, though an explanation may perhaps be found in a sentence from your contemporary *Iron*, for June 21st, 1879, which says that "The London and North-Western have been tinkering year after year at the Clark and Webb chain brake until a species of affection has grown up for it, like that of a mother for a lame child." That the directors themselves have not confidence in it is, I think, made clear by paragraph six of the company's brake regulations, which says, "For ordinary stoppages at roadside or terminal stations the van [hand] brake alone is to be used." Mr. Webb's own opinion of it was expressed to the Railway Accidents Commission on the 9th of February, 1875, when he said "If we have this powerful brake introduced for ordinary stoppages without a separate brake for the ordinary working too, as sure as fate we shall come to grief some day." That the company's trains have repeatedly come to grief since then, sometimes in spite of the brake, at other times because of it, cannot be denied. The latest example of the latter class of accident occurred on the 28th ult., at Hammersmith Junction, to a train proceeding from Broad-street to Mansion House, when two persons were injured. The carriages of the train were separated from the engine by the chain brake being suddenly applied from the rear, and afterwards ran forward and came into collision with the engine, which had been brought to a stand at a signal. Col. Yolland in his report, says:—"This slight accident and collision affords a fair illustration of the system of brakes now in operation on the London and North-Western Railway. The fracture of a coupling was due to the sudden application of continuous brakes by the two guards in the vans when the driver whistled for the brakes. If the power of applying them had been placed in the driver's hands, they need not have been suddenly, but only gradually applied, to enable the engine to have stopped short of the main signal." This is a direct instance of an accident—which might have had serious consequences—being caused by this brake. The list of failures in the last return is also instructive, as it shows that this brake is not by any means to be depended upon, even on those rare occasions when it is allowed to be used. Here are some of the causes of failure as specified in the last return:—"January 2nd: Did not act efficiently—flat place worn on friction wheel. January 4th: Upright rod attached to brake lever broke, owing to a flaw in the iron. January 4th: Did not take proper effect, owing to some grease having got on to friction wheels. January 4th: Failed to act promptly, owing to ice on friction wheels. January 10th: Did not take proper effect, owing to friction wheels having worn rather flat. January 14th: Did not act properly, owing to friction wheels having picked up some greasy dirt. January 17th: Failed to act, in consequence of brake chain being frozen. February 25th: Failed to act, owing to friction wheels having been too closely adjusted. March 18th: Chain broke on brake being applied. March 24th: Did not take proper effect, in consequence of friction wheels being coated with ice. May 17th: Did not act, owing to grease having got on to friction wheels." The above causes of failure are sufficient to indicate the character of this brake, and, to the mind of any disinterested observer must stamp it as being thoroughly unreliable. The London and North-Western Company appear determined to persevere in the wrong direction until they are sharply brought to their senses by power being given to the Board of Trade to "enforce the precautions which it has declared to be necessary for the safety of the lives of passengers." Until then, in the words of the *Times* of the 25th ult., "travellers must derive what satisfaction they can from the reflection that a bad brake is probably better than none, and the directors may perhaps profitably consider whether good brakes on competing lines may not have a tendency to assist in the diversion of traffic." J. N. A.

Bradford, September 20th.

MARINE ENGINE GOVERNORS.

Sir,—It appears that in my letter of the 12th inst., in reference to a pneumatic marine engine governor, I have committed a mistake. I placed a diaphragm in the wrong position. I am much obliged to "W. M. M." for a correction, but I fail to see that it discloses any difference in the principles involved. Either of five units, or three and two added together make five all the same, and the throttle valves of many marine engines that require something of a hammering process to move them are still dependent—in the case of the use of the pneumatic governor in question—upon a tube or column of confined air, or vacuum, as the case may be, some 50ft. to 100ft. in length to move them. Now, as there is not much power required to do it, the writer has been familiar with the working of too many throttle valves that worked quite stiff enough to retain the water in "the vessel at the stern," or, on the other hand, prevent its admission; and this calls to mind a defect in the design of the original fly-wheel governor now in general use, and which defect this pneumatic governor is possessed of even to a greater extent in each of two ways. I say greater extent because the length of the spring is greater. On the original fly-wheel governor, as patented, the impetus of the fly-wheel effected only through the winding up of two cords the closing of the valve, the opening of it being dependent upon the force or strength of the reacting spring of the governor. Though the winding up of the cords would promptly and positively close the valve as nearly as required, the spring supplied the only power to push it open; and in the working of difficult throttle valves, except so far that the slack was taken up by centrifugal force, the cords might be seen hanging as loosely as the traces between a tram-car and the horses when the latter slack their speed. The substitution of the winding drum and cords by the quadrants and connecting rods completed the governor for working both ways with equal force, and "W. M. M." very properly credits it with opening the valve with promptness equal to that with which it closes it, and this maintains the speed of a ship.

The impact of a fly-wheel 30in. in diameter, 150 lb. weight in the ring, and revolving at 100 per minute, is equal to that of a heavy sledge hammer, and is irresistible by the most difficult of throttle valves. It becomes then only requisite to keep the driving band or gear in efficient order, and simultaneous action with the engine and truthful regulation becomes positive. It was the possession of this mechanical advantage that led to its substitution of the original balance, or "four-ball centrifugal governor.

What "W. M. M." says of carelessness in regard to driving bands or gearing, &c., does not occur on steamers that are under general efficient management. Such managers of the different "liners," as Mr. Wallace, of the Canada line; Mr. Lamb, of the Peninsular and Oriental Company; Mr. Horn, formerly of the St. Petersburg Company; or the late Mr. Thompson, of the Cunard Company; and others that could be mentioned, would not allow an engineer to remain in their employ for a moment who was not up to his work in this particular. The attention of the Board of Trade should be called to such steamers as are under loose control.

"W. M. M." says "there are engine makers who do not approve of governors on marine engines at all." This is easily explained. Amongst the many cases in the early days of the governor exploitation, where it was acknowledged to be "all very well, but it won't pay us," it may for this purpose suffice at present to refer to a single instance in the experience of the late Mr. John Hamilton, without the assistance of whose untiring perseverence it is still possible, irrespective of the value of the thing, that the governor even at this late day would have made but little show, as Mr. Hamilton related it on soliciting the patronage of ——, one of the principal steamship builders of the kingdom, he received the reply—"Yes, Mr. Hamilton, it is a good thing—a first-rate thing—but we make more out of repairing broken engines than by building new ones." Whilst we could not expect such candid confessions as this from many, we may be sure that but few will work against what they consider their own interest.

In my letter to The Engineer of the 12th inst. I intimated that there was no liability in the way of patent fees on the fly-wheel governor. There is an exception, and I must beg leave here to apologise to the owners of patent No. 1, 1868, for a similar governor, which has, amongst other advantages, the use of a larger driving pulley to a given speed of the fly-wheel, increased power over the throttle valve, and great compactness in form. T. Silver.

Royal Exchange, Glasgow, Sept. 22nd.

THE FUTURE OF THE WELSH IRON TRADE.

Sir,—Having had a wide and varied experience as manager of a Welsh ironworks, and been accustomed from youth to every detail, I have been asked to give my opinion of the future of the iron trade of South Wales, and do so, feeling that I enter upon a theme of great interest, that in many respects it is a delicate one, and that, with the exercise of every care, I must tread upon somebody's corns, and to a few, interested in the retention of old conditions, give offence. Such will be unavoidable, but I must not be blamed. We stand on the margin of a new era; the old lamps must be given away for new ones, and it will be as idle and as foolish to blame me for my statements and my advocacy, as it will be to condemn the supporters of co-operation, or the introducers of American produce.

It is our fate, I will not say fortune, to live in a time of great and wonderful changes, and just as our fathers were able to point to the steam engine and other great inventions, so have we to reflect that we live in an age when the manual is giving way to the mechanical, and brain instead of muscle effects the great reforms, many of them Augean-like in their character.

If our age ever becomes mythologised our gods will be men of spare frames and ample foreheads, or the painters will sin. But, you will say this has nothing to do with my subject. I submit it has, and will show it by entering upon the matter of which this is the threshold. Archæologically the centuries are divided into drift periods, stone periods, copper periods, and iron periods. Now we enter upon the period of steel, and whoever talks of going back to old-fashioned iron is about as sensible as he who would think of resorting to wigwams or kraals.

The position of iron works at the beginning of the iron era was at the "crop" of the coal, in places suggested by the denuded state of the strata; and the early operations in working iron mines and coal have been likened to the scratching of old hens, and the tumbling into the furnace of the results. Now the scratching is ended, and with the discovery of new processes, those of Bessemer and Siemens, and the greater adaptability of foreign ores to steel making, the old Welsh ore has become more expensive to work, having to be sought for in deep pits, and at great outlay, thus completing its fate, and almost driving it out of the market altogether. The early condition of iron working was very primitive. It was the open hearth system, with two tuyeres, bringing a pressure to bear of 1¼ lb. to the square inch, and the contrast between this and the closed vessel and converter of the new system, with a pressure of 25 lb. to the square inch, is as remarkable a one as any field of labour can exhibit. It has revolutionised the whole iron world; the puddler and the refiner have been dispensed with, and the country has been shown the practicability of making steel or homogenous iron of any texture, hardness, or of malleability by the Bessemer and Siemens processes, with the retention only of the roller man of all the varied classes once employed.

Now let us see how much has been proven. First, the lessened requirements of Welsh iron ore, and now by the old processes the depreciation of the old plant. Take any of the old works on the hills, Plymouth, Nantyglo, Llwydcoed, Blaina, and what are they? Perfectly useless for the new iron era, and the sooner melted up the better. Cyfarthfa is better placed in this respect, and the mills and furnaces having been kept in good order, may turn out the old-fashioned iron in the least expensive mode of any of the old works, if a demand, coupled with the offer of a better price than now exists, be made; but while I place Cyfarthfa in a somewhat exceptional light, I must add that if it should re-start, that start will be only temporary and spasmodic, unless the Messrs. Crawshay avail themselves of the new modes, and resort to the appliances of mechanical labour, instead of falling back to the traditions of Mr. Robert Crawshay's youthful manhood. I never knew whether the late iron king ever saw the wonderful processes of steel making, and contrasted them with the old formlua with which he was so well acquainted. If so he must have been startled to see the mixture of ores put into furnace, and the pig run into the converter, and, without rest, turned out into the finished bar or rail.

I have often thought that this age of wonderful fact is surpassing the Munchausen tales of our grandfathers' times. There is the telephone, to which the wonderful trumpet of the baron is a penny whistle, and now the romance of the American, of the cow put into a mill, and coming out nicely jointed and its hide tanned and horns polished, &c., is nothing compared to the earth, simply heavy earth, which, put into the furnace, comes out eventually rail, bar, needle, sword, frying-pan, kettle, and a thousand articles of domestic use.

No matter how great the distance between portions of the steel works, means have been found to keep the steel sufficiently hot to carry on other processes. Still, as it is better for mills, rolls, and furnaces to be close together—and the closer the better—this gives another death blow to the scattered iron works of the past. Many of these covered a mile in extent, and if an ironmaster were now to enter upon the trade and planned his works properly, instead of a mile, he would be satisfied with a couple of hundred yards. And what does this bring us to? What I ask is the natural sequel? First, that Welsh iron ore is of lessened value; secondly, that manual labour has given way to mechanical; thirdly, that the old plant of ironworks is useless; and now the necessity of bringing the sections of a steel works into closer proximity with each other, points to the certain issue, the abandonment of old sites and the starting of new ones. A part of my creed is that I believe in the resuscitation of the Welsh iron trade, but it will be in the form of steel or homogenous iron, and the site of the new life will be—where? Why on the seaboard! This is obvious for several reasons. (1) Spanish or foreign ore is better adapted for making steel than Welsh ore, and the coals formerly used, and considered best from the northern crop, are now held not to be so indispensable, because it has been found that coals situated nearer to a seaboard are to be had of a quality better adapted for ironmaking than that formerly used at most of the old iron works on the hills. This coal, ranging from Caerphilly to the Mumbles Head on the southern crop, is excellently adapted, and from its proximity to the shore, would lessen another important item of expense if the situation of ironworks be changed.

And this brings us to my last factor. In the resuscitation of the iron trade is Cardiff or Newport to take the foremost position? Cardiff capitalists have already embarked considerably in shipping, with a view to the full development of the Spanish ore trade, and it has paid them. Will other capitalists also take the next step?

To my thinking the Marquis of Bute might take the subject into his thoughtful consideration, having a deeper interest than anyone, and in the probable formation of new docks arrange for the new iron era. For I maintain that as foreign ore yields three times the quantity of Welsh, as coal is cheaper at seaboard, and expenses lessened to a trifle in make, the new furnaces will be so arranged that from the ship and not from the train will the ores be poured into furnaces, and the ship that brings in the ore from Bilbao will be the one to take out bars and rails over sea!

This may be taken as startling, as revolutionising, but who that has followed my course of reasoning will deny it, and for the purpose there is ample scope along the marshes. Already the subject is under careful discussion at Newport, and it has been suggested that from the new works formed on the marshes sufficient slag would in time be obtained, that would make the marshlands as substantial as any other. But Cardiff is properly the scene of the new location. It has all the requirements to meet the demand, and as people will be enabled to live more cheaply there by having good stores of foreign produce, labour in consequence will be reduced to the required point.

I do not claim the gift of foretelling the future, but who can deny the almost certain possibility of these things coming to pass, and while the mountain land will continue to be large colliery districts for hundreds of years, the great producing quarter, Cardiff, will be the scene where the raw material will be worked up and sent away by rail and sea.

These are my views, and to many who have invested largely in works, like ironmasters, or humbly like cottage proprietors, they may not be acceptable, and may lead to discussion. But I submit that the wiser course will be to prepare for the inevitable, not like the sailor furling his canvas against the storm, but making ready for the tide of good that is coming again into Wales. D.

Cardiff, Sept. 18th.

London Association of Foremen Engineers.—At the sitting of this institution to take place, at 8 p.m., on Saturday, the 4th prox. at the Cannon Street Hotel, Mr. Michael Reynolds will read a paper entitled "Practical Notes on Engine Driving."

RAILWAY MATTERS.

THE United States *Railway Gazette* contains reports of the laying of track on new railroads thus far this year. The total is 1346 miles, against 1005 miles reported for the same period in 1878, 943 in 1877, 1231 in 1876, 607 in 1875, 916 in 1874, 2028 in 1873 and 34,585 in 1872.

MESSRS. WITTY AND WYATT, of Fenchurch-street, are now importing mules from Spain for working tram cars, the London Tramway Company being the first to substitute mules for horses. It is claimed that a mule can be kept for £11 per year less than a horse. This is an important question for more or less impecunious tramway companies.

GREAT progress continues to be made with the St. Gothard tunnel. Three thousand workmen are engaged between Fluchen and Goeschenen, and sixty boarding and lodging-houses have been constructed for their accommodation. Next year 5000 men will be gathered together in the same district, and a hospital has been specially erected at Wasen, supported to a large extent, like that at Altorf, by contributions from the *employés* themselves. Ten thousand kilogs. of dynamite are used every month at the works, and double that quantity of lime and cement every day.

LAST Saturday, two years from the date of laying the first stone, the new stone viaduct over the valley at Denby Dale was finished by the fixing of the keystone of the last arch. This is one of the most substantial works in the railway world. Its length is 1100ft., and greatest height 126ft., and it consists of twenty-one arches of 40ft. span, supported by sixteen piers and six abutments. The contractors are Messrs. Naylor Brothers, who with eight steam engines and fifteen horses, have moved 100,000 tons of material, or about 200 tons for every working day. The estimated quantity of timber and plant is 1000 tons.

WITH regard to the project of the German Government for the purchase of railways, the *Independance Belge* says the treaty relates to the most important Prussian lines, notably those of Berlin-Stettin, Magdebourg-Halberstadt, Cologne-Minden, Berlin-Potsdam, Berlin-Anhalt, and the Rhenish Railway, forming altogether a network of 4700 kilometres in length, and representing a capital of about 1,600,000,000 marks. Up to the present moment the conventions relating to the first two railway lines are alone signed; the others have still to be approved of in the general meeting of shareholders. The chances are not all the same; for instance, the purchase of the Rhenish Railway is beset with many difficulties. The acquisition of this line and that of Cologne-Minden would give the Government a great influence over the traffic with Belgium and the Low Countries.

PROPOSALS having been made to the Bradford Corporation in connection with the laying down of tramways within the borough, it has been decided that the corporation shall take up the matter. At the next meeting of the Town Council—in October—it will be determined as to whether an application shall be made to Parliament for a Provisional Order, authorising the corporation to lay down tramways, commencing at the top of Darley-street, and extending along Manningham-lane to the borough boundary. Another line will start from Peel Park, and up Leeds-road to the boundary at Bradford Moor. The third tramway would commence near to the Mechanics' Institute, and would traverse the new Sun Bridge-road and Thornton-road, to Four Lane-ends, in the direction of Allerton, Daisy Hill, &c. There is a steepish rise up Manchester-road, but not so steep as the ascent of Sun Bridge-road, but, rather singularly, the scheme does not provide for Manchester-road, one of the most populous districts in the borough, and where a tramway would prove very useful, and would be almost sure to pay well. Other tramway schemes have been mooted, but they have never got much farther, and one was wound up with considerable loss to the promoters.

WE have to record the completion of a most important work in connection with the doubling of the London and South-Western Railway Company's narrow gauge line of railway to the West of England, viz., the doubling of the Meldon Viaduct, two miles west of Okehampton station. The viaduct is constructed of iron, in six spans, of 90ft. each, the height in the middle being about 160ft. The viaduct has been doubled at a cost of about £15,000, from the designs of the company's chief engineer, Mr. W. Jacomb, Memb. Inst. C.E., by Messrs. Head, Wrightson, and Co., of Stockton-on-Tees, under the supervision of the company's district engineer, Mr. B. J. Fisher, Memb. Inst. C.E., and although a work of great magnitude, and attended with many risks, has been carried out with such care that no mishap of any kind in connection with it has occurred. The new widened portion of the viaduct was last week inspected on behalf of the Board of Trade, by Major-General Hutchinson, R.E., and subjected by him to very severe tests, which entirely satisfied him of the strength and stability of the structure. The work has been carried out for the contractors in a most able manner by their representative, Mr. Clark. The doubling the line of railway from Meldon Viaduct to Lidford is in a very forward state, and will be ready for opening in a few weeks, when the London and South-Western Company will have a complete double line from London as far as Lidford towards Plymouth, it having during the last few years doubled its line from Exeter to Meldon—twenty-eight miles; the remaining section, now nearly completed, from Meldon to Lidford, being a further length of eight miles.

A CURIOUS contrast of the proportionate receipts and expenses on railways is afforded by some official statistics in regard to the Great Northern Railway—one of our typical passenger railways. These facts may correct some misapprehensions as to the sources of receipts and expenditure on railways, and the contrast afforded by little more than three years' working is instructive. Four years ago the receipts from passengers, parcels, mails, &c., were equal to 4·89s. per train mile; in the last half of last year—corresponding half-year—they were 4·28s. per train mile; and in the first half of this year they had sunk to 3·73s., it being always borne in mind that the latter half of the year is the more remunerative one. In 1875 the receipts from merchandise and mineral traffic were reported as equal to 5·48s. per train mile; in the corresponding half of last year the receipts from these sources were 5·52s. per train mile; and in the first half of the current year they were 5·39s. per train mile. Adding other slight items of expenditure, the receipts over the whole train mileage—passenger and goods—of the company were, in the earlier year, at the rate of 5·29s. per train mile; in the corresponding period of last year, 4·99s.; and in the first half of the present year, 4·69s. Thus though the gross receipts of the company are increasing, they are not increasing so rapidly as is the train mileage, the running of which earns them. As to the expenditure, the figures are instructive also. Four years ago the maintenance of way, works, and stations cost 6·20d. per train mile; in the corresponding half of last year it cost 5·91d.; and in the first half of the present year the cost was 5·63d. For locomotive power the charge was, in the earliest half-year named, 8·69d.; in the contrasting half of last year, 7·63d.; and in this year, 7·81d.—the change being chiefly due to the reduced price of coal. The traffic expenses are the costliest item; they were, four years ago, 11·18d. per mile; at the end of last year, 11·0d. per mile; and at the present time, 10·60d. per mile. Compensation has fallen from ·78d. per mile to ·67d. and ·55d.; law charges are practically unchanged, and general charges have fallen ·20d. per mile. The only noticeable increases are in the cost of repairs to carriages and wagons, and in rates and taxes. The total cost was, four years ago, 2·77s. per train mile; and, in the corresponding period of last year, 2·66s., whilst for the present year the amount has been 2·63s. The reductions, therefore, in the expenditure have not been so large as those in the receipts. In the cost of many materials there have been large reductions, but there has not been an application of the pruning knife so fully in other directions, and it is probable that on our chief railways the example set by the North British in the reduction of salaries and wages may have to be followed.

NOTES AND MEMORANDA.

M. RAOULT has shown that porous nickel absorbs hydrogen when it is employed as the magnetic electrode in the decomposition of acidulated water.

IT is said in the United States that M. Hippolyte Fontaine's opinions have been supported so universally in condemnation of Mr. Edison, that it is now suggested that the patented and published discoveries of the latter are only a blind to conceal his movements, and that he is really working in some other direction.

OVER fifty patents have been obtained for cow milkers, thirteen in England and forty in America. These machines have been divided into three classes. First, tube milkers; second, sucking machines; third, mechanical handmilkers. The first are tappers, the second suckers, and the third squeezers and strippers. Some devices are formed of combinations of these classes. As yet no one machine can be considered a success.

M. LEON TESSERENC DE BORT has ingeniously modified the common aneroid barometer by substituting for the train of clock work terminating in a pointer a mirror mounted on a jewelled axis, which is rotated by the rise and fall of the exhausted receiver, and its indications read off by a small telescope by reflection from a graduated scale. The sensibility of the instrument is said to be much increased, and all errors due to a long train of wheelwork are eliminated.

M. A. GORGEN has succeeded in making an artificial deutoxide of manganese, having all the properties and characteristics of polianite. It was obtained by heating nitrate of manganese, very slowly and for a considerable time, at a temperature of from 155 deg. to 162 deg.—311 deg. to 323·6. deg. Fah.—in a glass phial placed in a bath of oil or paraffine. His experiments confirm the hypothesis which was published in 1860 by MM. Sainte-Claire Deville and Debray.

GUYARD discovered uralium about the year 1869 in some commercial platinum obtained from Russian ores. He has lately published an account of it. Next to silver it is the whitest metal known. It is as malleable as the purest platinum, but much more ductile; and it is nearly as soft as lead. Its melting-point is about the same as that of platinum, and it is not volatile. Its specific gravity is 20·25, and its molecular volume, like that of osmium, platinum, and palladium, is 6·25. Its atomic weight is 187·25. This metal has very nearly the same chemical properties as platinum.

OF mixtures of metals which become liquid at temperatures at or below the boiling point of water, there are several known, some of which are placed in convenient order as follows:—(1) D'Arcet's—Bismuth, 8; lead, 5; tin, 3 parts. This melts below 212 deg. Fah. (2) Walker's—Bismuth, 8; tin, 4; lead, 5 parts; antimony, 1 part. The metals should be repeatedly melted and poured into drops, until they can be well mixed previous to fusing them together. (3) Onion's—Lead, 3; tin, 2; bismuth, 5 parts. Melts at 197 deg. Fah. (4) If to the latter, after removing it from the fire, one part of warm quicksilver be added, it will remain liquid at 170 deg. Fah., and become a firm solid only at 140 deg. Fah. (5) Another—Bismuth, 2; lead, 5; tin, 3 parts. Melts in boiling water. Nos. 1, 2, 3, and 5 are used to make toy spoons to surprise children by their melting in hot liquors. A little mercury (as in 4) may be added to lower their melting points. Nos. 1 and 2 are specially adapted for making electrotype moulds. French cliché moulds are made with the alloy No. 2. These alloys are also used to form pencils for writing, also as metal baths in the laboratory, or for soft soldering joints.

MESSRS VAUBRIEL AND BECK, of Hanau, have invented a lamp which is made entirely of glass, the use of which they claim to be attended with very considerable advantages. It is chiefly intended for petroleum and spirit lamps. A serious of experiments have been made with it at the instance of the Technisches Organ für Gewerbe und Haushaultung, and the report given in its columns is decidedly favourable. The flame clings closely to the wick, so that lighted lamps may be carried about without fear of their being extinguished by sudden draughts; moreover, no sparks are liberated from it. With an equal amount of this wick turned up, a much brighter and clearer light is obtained than where cotton ones are used. The smoking is greatly reduced, and at least 10 per cent. of oil is saved. There is scarcely any waste of the wick itself, and the troublesome trimming and cutting to which lamp burners are accustomed is altogether needless, for no portion of it is carbonised. Used in spirit lamps it greatly increases the heat of the flame, and finally it can be produced and sold at a very cheap rate. We have not yet heard where the new wicks can be obtained, nor has any description of the wick yet been published, probably because the patents are not yet complete.

IN 1876 G. Van der Mensbrugghe demonstrated the two following propositions:—(1) If the upper free layer of a liquid mass undergoes an expansion, it becomes cooler; if, on the contrary, it contracts, it becomes warmer. (2) In each case there are developed in the mass thermo-electric currents, with intensities inversely proportioned to the mass, and directly proportioned to the surface variations. He applied these propositions to the explanation of the movements on the surfaces of soap bubbles, the alternating movements of liquid layers on other liquids, the occasional extraordinary production of heat in a solid when moistened by a liquid, the thermo-electric currents developed by variations of extent in the surface of separation between two liquids, the enormous electric discharges in storms, the maintenance in a liquid state of the little drops which form clouds and mists in a freezing atmosphere, the exceptional phenomena presented by some alloys near their limits of greatest density, the intense heat which is required to detach a volatile liquid from a porous surface, the phenomena of ebullition observed in Donny's classical experiments, Hansten's relation between meteorological perturbations and magnetic variations, the movements of bubbles of air in levels and vapour bubbles in the cavities of minerals, and Savart's phenomena in liquid sheets. In a recent paper he has extended the application of his formulas to the loss of heat in a jet of vapour, the increasing energy of waves, the formation of bars at the mouths of rivers, and the motion of the Gulf Stream. His explanations are, says the *Journal of the Franklin Institute*, all very ingenious, and many of them are confirmed by satisfactory experiments.

THAT portion of the west coast of Africa which lies south of the river Volta furnishes us with our principal supplies of palm oil. Nearly a million hundredweights of this oil are annually imported into Great Britain, of the value of over a million and a half sterling, its principal use being in the manufacture of soaps, perfumery, candles, and similar articles. Among the natives it is highly valued, both for food—taking the place of butter—for lighting and cooking purposes, and for anointing the head and body. The so-called oil, which is, rather, a fatty substance resembling butter in appearance, is obtained from the fruit of several varieties of palms, but chiefly from that of the species known as *Elais guineensis*, which grows in abundance on that part of the western coast of Africa after which it is named. So thickly do these trees grow, and so regular and rapid are their supplies of fruit, that in some localities where the regular collection of the produce is not practised the ground becomes covered with a thick deposit of the oily, fatty matter produced by the ripe berries. According to a Melbourne paper, deposits of palm "oil," which may almost be called "mines" of vegetable fat, exist in some parts of the Gold Coast which, if not in themselves worth working, at least practically illustrate the natural wealth of the country in such productions and indicate its undeveloped resources. These "mines" would probably not repay the cost of exploration, as the palm oil is apt to become rancid, and valueless for its general uses after long exposure, though for such purposes as candle making these deposits might still be valuable.

MISCELLANEA.

ON the 1st October the new telegraphic treaty between Belgium and the Netherlands comes into force. The cost of a simple telegram between the two countries will henceforth be half a franc. For each additional word the charge will be 5 cents.

THE relative cost of rival great guns is an important factor in the gunnery problem, and is as follows:—The Krupp steel gun of 70 tons, £22,000; the Armstrong 100 ton coiled wrought iron gun £16,000; the Woolwich—Fraser—wrought iron coil gun, 80 tons, £10,000. Therefore two 80-ton guns of the Woolwich type can be constructed for the cost of one of their German rivals, and leave £2000 to the good.

IT is reported that the Russian Government is making a contract with American shipbuilders for the construction of a number of ocean corvette cruisers to cost nineteen and a-half millions of dollars. The contract, if completed, will probably be awarded either to Cramp and Sons, Philadelphia, or to John Roach and Sons, Chester, Pa.; in either case giving employment to several thousand mechanics.

LARGE ironworks are being put down at Savona, Italy, for the manufacture of railway materials. The company undertaking the work is in connection with the firms of Golpin-Sue, Jacob, and Co., and the Société des Forges, Fonderies, et Chantiers de la Buire, at Lyons. The society, as at present constituted, is to last for fifteen years, and it will in time be able to supply the bulk of the materials required by the Italian railways.

A COMMISSION lately appointed by the Prussian Government to investigate the best class of inks to be employed for official purposes have just presented their report. They state that aniline inks are not suited for this purpose, because they can be easily washed away, especially by preparations of chlorine. Inks in the composition of which alzari (Adrianople red) is employed can be obliterated less easily. But they are of opinion that the best of all is made from gall nuts, and recommend that it shall be used for official purposes and for all documents the preservation of which is of importance.

A NEW grape sugar manufactory at Peorai, Illinois, rapidly approaches completion. The dimensions of the structure are 200ft. long, 104ft. wide, and 93ft. high, to which is added a boiler-room 90ft. long, making the entire length of the building 200ft. The establishment will have a capacity for the conversion of 6000 bushels of corn into sugar and syrup daily, and, when completed and in operation, will give employment to 250 men. To accommodate this increase in the population, and give them a home near their work, a small village is being built in the vicinity. It will contain about thirty small dwelling houses, and a commodious boarding-house.

THERE has recently been introduced at the mill of Phillips, Nimick, and Co., Pittsburgh, a large apron made of hollow sheet iron, which is hung in front of puddling furnaces to protect the workmen from the great heat. The apron is hung by pulleys on a bar, so that it can be easily slid to one side when charging or drawing the iron, and it is filled with water constantly running from a hose. This apron, thus filled with running water, is a perfect non-conductor, having only the small opening for the puddler's tools uncovered. All the workmen bear testimony to the perfect success of the invention, and say that with it two men can easily do the work formerly done by three.

ON Friday morning a party of engineers and machinists left Bradford for Liverpool *en route* to America. A strike in these trades has been in existence for some time in Bradford, and a committee has been formed for the purpose of assisting the men out of work to emigrate. On the previous day thirty men belonging to the same place left Liverpool for Philadelphia, an agent for a firm in that city having received instructions by cable to engage and send out immediately by the American line 100 rivetters, the firm paying half the passage money, and guaranteeing three months' constant work at good wages. Some hundreds of working men assembled at the Bradford Railway Station to witness the departure.

A COMPANY in Westfield, Mass., have, it is said, after much experimenting, perfected a wheel of remarkable cutting qualities, being composed of corundum, the next hardest substance in nature to the diamond. In a scale of twelve, rating the diamond at twelve, corundum stands at eleven; while emery averages at eight and a-half in hardness. The difficult problem, attempted by so many, of finding a base strong enough to hold corundum without interfering with its cutting qualities, has, it is thought, at last been solved by a happy combination of materials and an ingenious use of the process of vitrification. The cost of the corundum wheel is only about 25 per cent. more than that of the ordinary emery wheel.

AN apparatus, says the *Scientific American*, has been put into practical use in Chicago by the inventor, Colonel A. C. Ellithorpe, and subjected to serious tests in the Chamber of Commerce, where the elevator car, which itself weighed 2 tons, was loaded with 5000 lb. of iron, and, to test the real merits of the invention, a basket of eggs and some glass globes; the car was then dropped from a height of 40ft., and was checked so gradually by the air at the bottom of the shaft that neither an egg nor a globe was broken. This encouraged two men to drop with the car, and they reached the bottom not only in safety, but almost unshaken. This seems very like the recent account of a similar trial in Europe, in which the "apparatus" consisted simply of an empty pit below the lowest stopping place of the car, forming a pneumatic cushion.

A RECENT investigation by United States consuls in various European countries, at the request of the State Department, goes to prove the following facts:—First, that wages in the United States are double those of Belgium, Denmark, France, and England; three times those of Germany, Italy, and Spain; and four times those of the Netherlands. Secondly, that the prices of the necessaries of life are lower in the United States than in Europe, and that the labourer in the United States, were he satisfied with the scanty and miserable fare upon which the European labourer must live, can purchase like food for less money than it can be purchased for in Europe. Thirdly, that the French working people, with far less wages, are happier than the working people of Great Britain, who receive the highest wages in Europe, on account of the steadiness and the economical habits of the former, and the strikes, drinking habits, and consequent recklessness of the latter. Fourthly, that more misery results from strikes, drinking, Socialism, and Communism in England and Germany than from all other causes combined, hard times included.

MR. J. TAYLOR KAY, the librarian of the Owens College, has prepared for the forthcoming conference a note on the present state of the College library. The nucleus of the library, it is stated, was formed by a donation, immediately on the establishment of the College, from Mr. James Heywood, F.R.S., of 700 volumes, shortly afterwards increased to 1200 volumes. This was seconded by grants from the then trustees for the purchase of books, and by valuable donations from members of the governing body and the professors, until in 1869 the number of volumes reached some 5700. In 1870 the first large accession was received, being a legacy of nearly 7000 volumes by Dr. James Prince Lee, late Bishop of Manchester. In 1877 3600 volumes were purchased from the executors of the late Mr. David Forbes, F.R.S., and large donations have since been received from Mrs. G. V. Vernon and Mrs. F. Crace-Calvert. In 1874 a benefaction by Mr. Charles James Darbishire, of Rivington, deceased, was received of £1000 for extending the College library by the addition of selected standard books (subject to certain regulations), the administration of the fund being in the hands of trustees. The library now contains 29,920 volumes, having increased by 24,000 volumes in the last ten years.

THE STEAMSHIP ORIENT.

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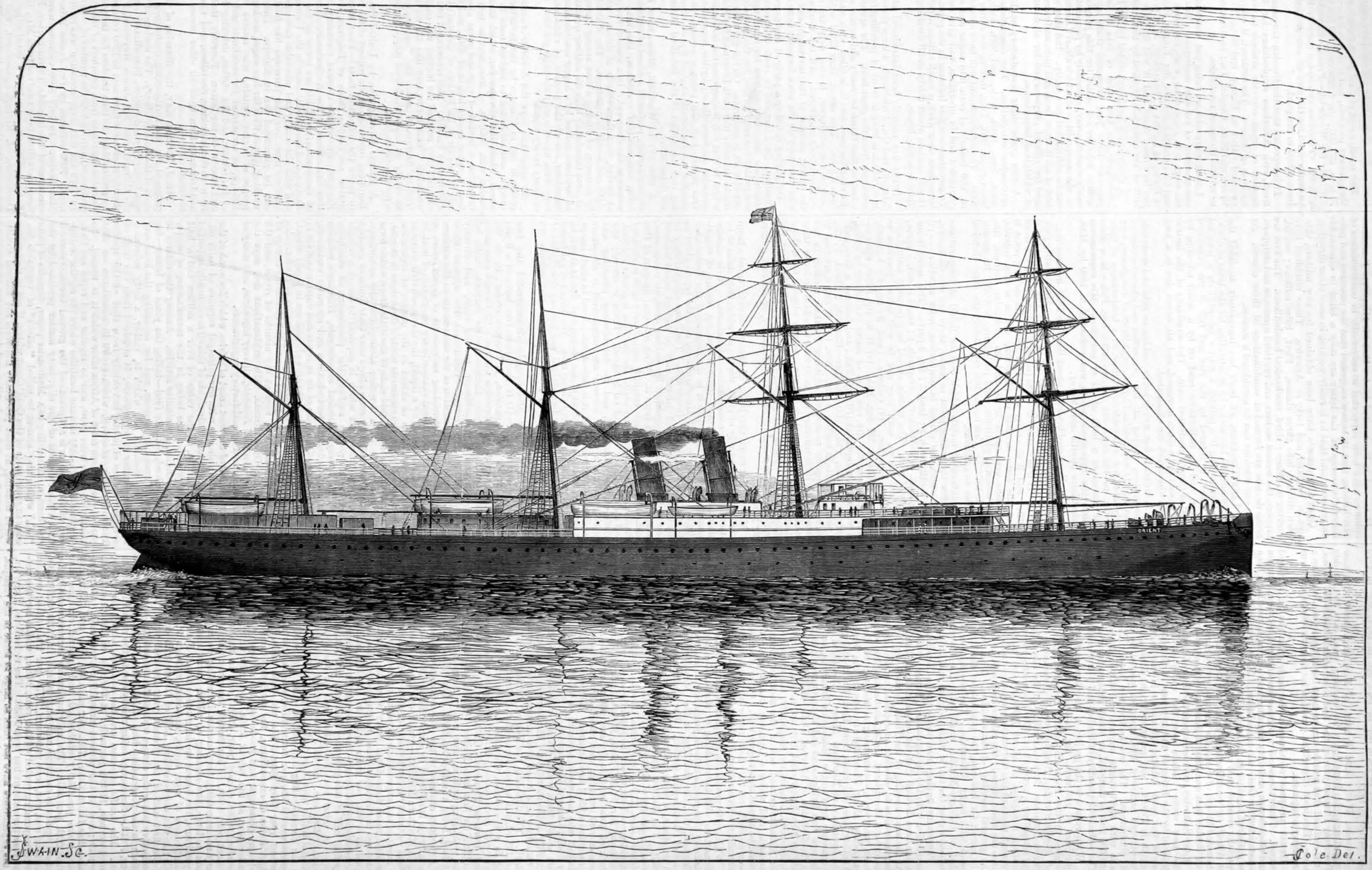
(*For description see page* 241.)



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TO CORRESPONDENTS.

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E. M. H.—*Bessemer scrap is easily melted down in a Siemens furnace, or it can be forged into cutlery. Large quantities are used for the latter purpose.*

R. L. (Rotterdam)—*Messrs. Easton and Anderson, Erith Ironworks, London, or Messrs. Bryan, Donkin, and Co., Bermondsey, London, can supply the machinery you want.*

AN AMATEUR.—*Screws enclosed in hoops and working in cylinders have been repeatedly tried, but they have given no better results than screws used in the ordinary way. Screws working in tubes have generally performed worst of all.*

A WRETCHED SAILOR.—*The idea of the Channel Tunnel has not been abandoned. Some preliminary boring work is, we understand, still in progress, but there is no prospect whatever that the construction of the tunnel will commence at an early date*

C. S.—*A 1in. pump with a 9in. stroke could not be safely driven against three tons per square inch pressure at 200 strokes per minute, but you could obtain the required result by using, say, four pumps running at 50 strokes per minute without expending any more power.*

GIRDER.—*Omitting the strength of the web and assuming that the area of the angle irons is no more than sufficient to compensate for loss of sectional area in flanges by punching: then, taking the length as 29ft. 4in., and the depth as 1ft. 4in., the strain on the flanges will be 55·13 tons. If, however, the effective depth of the girder be taken as 1ft. 3in., then the strain will be 58·65 tons. Allowing a tensile strain on the material of the bottom flange of 5 tons per square inch, then the necessary area will be 11·73 square inches. If the upper flange be pretty well stiffened with gusset pieces between web and flange, the same strain may be allowed for it, and therefore the same area, but the necessity for greater area in this flange must be decided by reference to the conditions under which the girder must work. Adopting the generally employed formula for breaking weight of such girders, viz.,* $\frac{80\ A\ D}{S}$, *it will be found that the above area gives a factor of safety of four when the practical conditions taken into account by the constant 80 are considered.*

CONDENSED MILK PLANT.

(To the Editor of The Engineer.)

SIR,—We shall feel obliged if any of your readers can give us the names of firms making condensed milk plant and machinery their speciality?

P. W. AND Co.

London, Sept. 18th.

PATENTS.

(To the Editor of The Engineer.)

SIR,—Will any of your correspondents kindly give me the full address of the makers of the Hurd patent gas engine, and also of speciality working firms for the making of patent improved Venetian blind actions or apparatus?

N.

Hyde, Sept. 2nd.

THE ACCIDENT AT A CIRCULAR SAW.

(To the Editor of The Engineer.)

SIR,—Your description of the above in your paper of the 19th is very accurate, with the exception of the address, which should be as below. We are pleased to state, notwithstanding the serious nature of the accident, the poor fellow will be enabled to leave the hospital on Wednesday next.

BODLEY BROTHERS AND Co.

Old Key Foundry and Engine Works, Commercial-road, Exeter, Sept. 22nd.

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THE ENGINEER.

SEPTEMBER 26, 1879.

PATENTS IN 1878.

THE Report of the Commissioners of Patents for Inventions for the year 1878 has just been published. It is a brief document, and will be found rather dry reading. Yet it will repay perusal, because it contains not a few statements of facts which are extremely suggestive, and well worth the attention of inventors. An exposition of the theory of patent law and patent right we have no intention of placing before our readers. Beyond question it is but indifferently understood by the public at large. The great mass of inventors hold ideas concerning patents and the value of them, which are exceedingly erroneous; but the beliefs of inventors are in no way permitted to affect the operation of patent law; nor, indeed, are their views much concerned with it. The crude popular idea is that a patent represents something which possesses a tangible pecuniary value, the fact being that a patent possesses no intrinsic worth whatever. The thing patented may or may not be valuable; but its value depends, first, on the powers possessed by the inventor of bringing the thing patented before the world in saleable condition; and, secondly, on the disposition of the public to purchase the wares which the patentee sets before them. This is not the popular view of the matter. The principle on which most inventors act is embodied in rushing to the Patent-office and obtaining a patent the moment an invention has been produced. This done, the inventor casts about to get the invention taken up and worked, and, as a rule, he fails in this and loses his money. If he acted wisely he would first ascertain whether the world wanted what he was going to patent. This is, perhaps, too much to expect from sanguine men; but it is not too much to expect that a would-be patentee should, before he spent money in patent fees, satisfy himself that he was in a position to make for himself what he proposed to patent, or else that some firm or individual who had the means to do what he could not himself do would do it for him. For example, a sailor or a surgeon invents an improvement in reaping machines, patents it, and never succeeds in selling as much as one machine. He himself cannot make the thing, and he finds no one who will. The proper course which he ought to have pursued is simply to enter into arrangements with some large manufacturer of reaping machines, and induce him to put the invention before the world. If he cannot succeed in doing this, then he should certainly not take out a patent unless he is rich enough to afford himself expensive luxuries.

The report before us supplies a comment on the experiences of patentees, which we would gladly see taken to heart. In 1878 no fewer than 5343 applications for patents were made, and of these 3438 remained in force at the end of the year; thus 1905 applications resulted in nothing. The fees paid for these applications could not amount to less on the average than £6 each, thus a sum of £11,430 was wasted in a single year by the patent-taking community in this way alone. The applications lapsed in 1834 cases, because the applicants never sealed their patents, and in seventy-one cases because they did not file final specifications. It would seem therefore that in 1878 nearly 2000 persons went to the Patent-office, and applied for patents without knowing whether they were or were not even in a position to complete them; whether they had or had not money enough to pay all the fees; whether the inventions for which patents were sought were or were not novel enough or good enough to deserve patents, or, in other words, over one-third of the whole number of applicants wasted their money. Concerning the wisdom shown by the remainder in taking out patents we cannot speak. But unless more prudence was shown in this respect in 1878 than in other years, we fear it must be said that many unwise folks got patents, and thereby wasted more money than those who drew back after they had made the first step. A terribly suggestive table will be found in the Report, from which we learn that of all the patents obtained from 1852 to 1871, only about 30 per cent. paid the third year's stamp duty of £50, while but 11 per cent. paid the seventh year's stamp duty of £100. It has often been said that 14 years is too short a term for a patent to last, yet it appears that not more than about one patent in ten lasts 14 years, and it can hardly be said that in this respect the amount of the stamp duty is deterrent. If a patent is worth anything at all, the owner of it must be able to pay £100 after the patent has lived seven years. The truth is, that not one patent in ten is worth £100 at the end of seven years. Either it never was worth much, or the invention for which it was granted has been superceded or become obsolete, and so the value of the invention has departed from it. The public taste affects the value of patents in this way very much; for example, a few years since numerous patents were taken out for improvements in the process of manufacturing crinoline steel; these patents are now worthless if they are yet in force. Again, at least one fortune has been made by roller skates; no one thinks of patenting roller skates at present. Some scores of patents are still in force for modifications and improvements in their construction, none of these are now of more value than is the little tin box containing the seal attached to the parchment. Even the patents which run more than three years are comparatively few and far between. Thus, of 3045 patents in force at the end of the third year in 1875, the owners paid the £50 stamp duty, prolonging them four years, on only 895. It would seem indeed that a life of but three years suffices for the great bulk of the patents taken out, and we are disposed to think that even less would be found to suffice in very many cases—all which goes to prove that more caution in taking out patents is desirable on the part of inventors. It is a noteworthy fact that the depression of trade and commerce seems to have in no way diminished the popularity of patents or the means of obtaining them possessed by the community. Dividing the period since 1852 inclusive into five periods of five years each, and one period of two years, we have the following results:—In 1852 only 914 patents were sealed, in 1856 the number was 2094, in 1861 there was a slight falling off, 2047 patents being taken out; in 1866 there were 2124, in 1871 the number augmented to 2376. In 1876 it reached 3435, in 1877 it was 3317, and in 1878 the greatest recorded number of patents was taken out, namely, 3509. It is not easy to account for this; the reason probably lies in the fact that while manufacturers are very busy they have no stimulus to make new inventions, and no time to take them out, whereas in bad years time hangs on their hands, they invent and they patent. Furthermore, it is well known at this moment that only the mechanical engineers who have specialities are making any money, and the desire to possess a speciality has no doubt driven many persons to the Patent-office. Be this as it may, the circumstance that the badness of trade and the assumed augmentation of poverty has not reduced the number of applicants of patents, may be used as a powerful argument against those who advocate reductions in the amount of the Patent-office fees.

Turning to the end of the report, we have a balance-sheet showing the expenditure and receipts of the Patent-office for 1878. From this it appears that the total income, including a comparatively small sum paid for registration, &c., of designs and trade marks, amounted to £186,245, while the total expenditure was but £42,069, leaving a balance of £144,176 to the credit of the office; the total surplus now amounts to the enormous sum of £1,751,538. Of course this can be utilised as so much revenue. But it is not too much to expect that something might be done for the inventor and patentee who contributes so largely. When we pay taxes we expect to get as much as possible for them; and it is quite certain that the patentee does not get nearly as much as he might expect in return for his money. The fine library of books possessed by the Patent-office is rendered inaccessible, first by being placed at the very top of a lofty building, and secondly by the stowing away of thousands of volumes in rooms which are practically not in the library at all, although it is true that they can be disinterred with some trouble. Were it not that the officials in the Patent-office library are the most courteous in the world, the worry and vexation attending the use of the library would long since have been voted intolerable. The Patent Museum at South Kensington is little more than a lumber room, disgraceful to the nation. The expenditure of the surplus income of even a single year would suffice to provide proper accommodation for the some 30,000 volumes pertaining to the Patent-office, and much less than the surplus income of a second year would suffice to render the Patent Museum just what it ought to be. The patentee after all does not ask much from the Government. The Government might rest content to do without its surplus for a year or two.

THE MANAGEMENT OF BOILERS.

EVERY owner of a boiler has had cause to be anxious at one time or another as to its safety. The obtaining of a sound boiler of ordinary type in the first instance is a comparatively easy matter, provided the purchaser is prepared to spend a fair amount of money, and to deal with any one of the hundreds of respectable engineers in the country who know what good workmanship and material are, and who have sufficient regard for their own reputation to let their customers have the benefit of their knowledge. The real difficulties of the purchaser do not begin until steam has been got up, and the boiler has been consigned to the charge of its future attendant. Among boilers subject to careful inspection, the number of actual explosions is small. Probably at the present time not more than one boiler in 7000 explodes each year among those subject to the inspection of the principal boiler insurance associations; but of the explosions which do occur a very large proportion may be traced to defective management. It is, however, really the minor accidents which the owner of a well-made boiler subject to regular inspection has chiefly to guard against; these being almost without exception due to faults of some kind on the part of persons in charge of the boilers. From the published reports of the Boiler Insurance and Steam Power Company, it appears that about five boilers per thousand of those under inspection suffer damage annually from overheating, caused by accumulation of deposit, or by deficiency of water. About one-fifth of these accidents is due to deposit, and here the owner is no doubt sometimes quite as much to blame as the attendant; the quality of the water and the supply of proper fittings for efficient blowing out being matters which require the careful attention of the owner in the first instance. It may fairly be taken, however, that from four to five boilers per thousand suffer serious damage annually from simple neglect of ordinary precautions on the part of the attendants. The immediate causes of shortness of water are as follows, and the accidents occur in the proportion here indicated:—The inattention to water gauges causes, say, 1000; then neglecting to close the blow-off cocks causes 212; feed apparatus out of order, 200; escape of water through fractured plates or pipes, 75; attendant drunk or utterly incompetent, 50; blowing off before drawing fires, 12.

The importance of placing in the hands of men immediately in charge of boilers carefully prepared directions for their general guidance is of course evident; and accordingly we find that a code of "instructions" intended to be placarded in the boiler-room in full view of the attendant is issued by each of the boiler insurance associations. Unfortunately, however, but scant respect is in many cases paid to these placards by those for whose benefit they have been prepared, and we are afraid that the character of the "instructions" themselves has had not a little to do with the want of respect with which they have been treated. For example, in the well-known placards provided by the Boiler Insurance and Steam Power Company, some 12,000 or 14,000 of which are probably distributed throughout the boiler-rooms of the United Kingdom, the fireman is instructed as follows:—"In case the water should fall below the bottom of the gauge glass or beyond the range of the float, draw the fires at once; but if the plates of the furnace become

red-hot before this has been noticed, and the fires cannot be drawn with safety, close the dampers and open the fire-doors, but on no account attempt to let water into the boiler." There can be no doubt that the injunction "on no account to let water into the boiler" is conducive to accident, for wherever this sentence is impressed on the mind of the fireman his first instinct on the discovery of the state of affairs depicted above is to shut off his feed at a time when a few minutes' quick working of the pumps or injector might materially help to place his boiler in safety.

Again, he is told, "After throwing on fresh fuel leave the fire-door a little open if no better means of admitting air be provided. Atmospheric air is as essential for the combustion of the gases as it is for the support of human and animal life. Do not, therefore, heed the common prejudice against its admission." With smoke prevention in view, which is, however, never mentioned, there can be no doubt of the soundness of the advice given here. But there are many people besides the stoker who would be unable to appreciate the subtle distinction between "human" and "animal" life suggested, and if illustration be desirable at all instead of clear and concise injunction, this is hardly the kind of thing to convince an intelligent but not much read man of the urgent necessity of administering doses of "atmospheric air" by the fire-doors when his daily experience tells him that he can support the life of his fire extremely well by letting all the air go through the grate bars, and that the less he opens his fire-doors the better he can keep his steam. Finally, the fireman is cautioned, in red ink, thus :—"Don't believe the opinion, entertained by many, that explosion cannot result from defects on the underside of a boiler so long as there is a sufficient supply of water. Such opinion is entirely erroneous and most dangerous." We are much afraid that no amount of red ink would convince the boiler attendant who was muddle-headed enough to entertain such an idea, of the erroneous and dangerous nature of his opinion; and the insertion of the paragraph has, no doubt, frequently wounded the *amour propre* of the more intelligent fireman, for whose special benefit the remarks on "atmospheric air" must have been concocted. Considering the great extent to which these "instructions" have been circulated throughout the boiler rooms of the country, it is satisfactory to know that they are at length being superseded by a more business-like production, in which more of the plain practical engineer, and less of the pedagogue can be distinguished. We print below the new "instructions" being issued by Mr. McDougall, whose secession from the Admiralty to take the management of the Boiler Insurance and Steam Power Company we recently reported, and one of whose first acts has been to suppress the placard we have commented upon.

"Water gauges should be blown out frequently during the day, and the glasses and passages to the gauges kept clean. More accidents are due to inattention to water gauges than to all other causes put together. Safety valves should be tried at least once a day, to make sure that they will act freely. Overloading or neglect of these valves tends to the most disastrous results, and cannot be too carefully guarded against. Pressure gauges, where fitted with cocks, should be tried occasionally, by shutting off the steam and letting the pointer run back to zero. For this purpose the cock to the gauge should be arranged to open to the atmosphere when shut off from the boiler. Blow-off cocks should be taken apart, examined, and greased when the boiler is cleaned. Make certain that no water is escaping from the blow-off when the cock is supposed to be closed. Check valves, or self-acting feed valves, should be taken out and examined when the boiler is cleaned. Satisfy yourself frequently that the valve is acting when the feed pump is at work. Fusible plugs should be examined when the boiler is cleaned, and carefully scraped clean on both the water and fire sides. If this is not done the plug will not act. To save coal keep the boiler clean inside and outside. If there is a plentiful supply of steam keep a thick fire, but if short of steam work with a thin fire, keeping the bars evenly covered. Firing a furnace on each side alternately tends to prevent smoke. To preserve the boiler raise steam slowly. Never light fires till the water shows in the gauge glass. Never empty under pressure, but allow the boiler and brickwork to cool before running the water off. Clean the boiler inside regularly once a month, oftener if the water be bad. Clean all flues once a month, stop any leakages, and get rid of any damp in the seatings or covering. Examine especially plates subject to the direct action of fire, the underside of the boiler, and any parts in contact with the brickwork, or with copper or brass, where water is present. If not required for some time, and it is impracticable to empty and thoroughly dry it, fill the boiler quite full with water, and put in a quantity of common washing soda. Should the water get too low draw fires at once, as a rule, but if the fire is very heavy, or if the furnace crown appears to be red-hot, it is best to smother the fire with wet ashes, wet slack, or any earth that may be at hand. The dampers may then be closed. If the engine is running, or the feed pumps delivering into the boiler, do not stop them, but if not working do not start them, and do not attempt to blow off the steam until the fire is out, and the overheated plates have cooled."

Simple, concise, and straightforward directions, systematically arranged as these are, and touching upon nothing that is not of great practical importance to the boiler attendant, can hardly fail to command attention.

MR. EDISON'S LAST DISCOVERY.

Whenever the prognostications of sanguine newspapers concerning Mr. Edison's electric light were falsified, it was said that Mr. Edison was not responsible for that which he had not himself said; at last he has spoken himself, and that of very wonderful discoveries indeed in a paper "On the Phenomena of Heating Metal in Vacuo by the Electric Current," read before the American Association at Saratoga Springs. The substance of his discovery is that by exhausting air or something else from platinum while at a high heat its durability is enormously augmented, as well as its power of giving out light. If a short length of platinum wire, one-thousandth of an inch in diameter, be held on the flame of a Bunsen burner, at some part it will fuse, and a piece of the wire will be bent at an angle by the action of the globule of melted platinum; in some cases there are several globules formed simultaneously, and the wire assumes a zigzag shape. With a wire four-thousandths of an inch in diameter this effect does not take place, as the temperature cannot be raised to equal that of the smaller wire, owing to the increased radiating surface and mass. "After heating, if the wire be examined under a microscope, that part of the surface which has been incandescent will be found covered with innumerable cracks. If the wire be placed between clamping posts, and heated to incandescence for twenty minutes, by the passage of an electric current, the cracks will be so enlarged as to be seen with the naked eye; the wire under the microscope presents a shrunken appearance, and is full of deep cracks." If the current is continued for several hours these effects will so increase that the wire will fall to pieces. Mr. Edison states that the cause of the shrinking and cracking of the wire is due entirely to the expansion of the air in the mechanical and physical pores of the platinum and the contraction upon the escape of the air, and that by eliminating the air with the aid of syringe pumps he has succeeded in producing "a metal in a state hitherto unknown and which is absolutely staple at a temperature where nearly all substances melt or are consumed—a metal which, although originally soft and pliable, becomes as homogeneous as glass and as rigid as steel. When wound in the form of a spiral is as springy and elastic when at the most dazzling incandescence as when cold, and which cannot be annealed by any process now commonly known." This is not all, Mr. Edison goes on to state that by the increased capacity of platinum to withstand high temperature, he is able to employ small radiating surfaces, and thus reduce the energy required per candle light. "I can now obtain eight separate jets, each giving out an absolutely steady light, and equal to sixteen standard candles, or a total of 128 candles, by the expenditure of 30,000 foot-pounds of energy, or less than one-horse power. The most astounding statement of all is, however, contained in the following passage :—"As a matter of curiosity, I have made spirals of other metals, and excluded the air from them in the manner stated. Common iron wire may be made to give a light greater than platinum not treated; the iron becomes as hard as steel, and just as elastic. Nickel is far more refractory than iron. Steel wire used in pianos becomes decarbonised, but remains hard and assumes the colour of silver. Aluminium melts only at a white heat." This means that the fusing points of the metals named is enormously increased by heating them slowly to very high temperatures in vacuo. Thus, for example, aluminium in its ordinary condition melts at a full red heat. Assertions so remarkable and so publicly made will not be suffered to pass unquestioned. It is extremely desirable that the inquiry should be taken up in this country, and pushed to its limits.

TORPEDO WORK IN THE UNITED STATES.

There is a class of officers continually undergoing instruction in torpedo work in the United States. The class undergoes a very practical examination once a year. The examination took place this year at Newport, beginning on the 2nd inst. With the details of the examination we need not concern ourselves. The occasion was utilised by exhibiting two *quasi* novelties in torpedo practice. The first of these is the steam launch Success, fitted with electrical apparatus, by the aid of which she is made to go through a wonderful performance. Lieutenant Newell, one of the instructors, sat at a keyboard on the shore. He made the boat start, back, go to starboard or port, drop two countermines, fire two countermines, drop the spar torpedo, and fire the torpedo. He made her do all these things at will, and showed to the satisfaction of the board of examiners how the same appliances could be adapted to a common launch and used for the purpose of clearing channels from torpedoes which might be planted by the enemy, by putting down countermines, and exploding them. The contrivance is, we are told, the original invention of Lieutenant McLean, a former student and instructor at the station, but it has been improved from time to time by the officers of the station. The second novelty (?) was the now somewhat well-known, or, at least, well talked about, Lay torpedo. Its peculiar build attracted no little attention as it lay alongside the wharf, with a red flag at one end, and a white flag at the other. It was manipulated, like the Success, by Lieutenant Newell, who was seated before the keyboard on the wharf. It started off at the rate of about six miles an hour, and in turning, after going about 300 yards, it began to slow down, and before it was brought about it came to a standstill, to the surprise of everybody on shore. Captain Ramsay somewhat superfluously said that there was some trouble with it, and his opinion was naturally shared by Lieutenant Newell. A boat's crew was sent off to it, but just as they reached the spot it gradually sank, and ingloriously went to the bottom. All further experiment with the Lay torpedo was ended, and it was with no little difficulty that the wreck could be raised. A diver and derrick were brought into use. This is the fourth torpedo built by Mr. Lay. The second one is also at the station, and as this was on *terra firma* it was exhibited, together with its internal arrangements, and explained by Lieutenant Meade. The officer was asked several questions by the members of the board, who, we are not surprised to hear, appeared to be somewhat sceptical after the accident to the one lying on the bottom of the harbour.

THE COMMERCIAL OUTLOOK.

At Sheffield the Rev. W. Moore Ede, M.A., one of the lecturers on political economy in connection with the Cambridge University scheme, has been giving his opinions on the depression of trade, and his anticipations as to the future. Mr. Ede thinks there are signs that the disastrous effects of the rash speculations of 1870-1-2-3 have almost spent their force. Unsound trading concerns have been swept away; those that had weathered the storm inspired confidence, and with a revived confidence a brisker exchange of commodities would ensue. Already we were hearing of an increasing activity in America, Canada, and in various departments of our own industries. Not much as yet, it was true, but it was the sign of coming prosperity. With revived confidence a rise of prices would take place which would stimulate industry, and an era of brisker trade would set in. That we should return to the high and extravagant prices of 1870-3 did not seem likely, nor was it desirable that we should. The reckless speculation which that period of inflation caused was one of the chief reasons of our present distress, from which we should only emerge after the loss of much capital, which had been recklessly, wildly thrown away. Mr. Moore Ede contends that the transition from high to moderate wages has not inflicted severe distress on the wage receivers, as evidenced by a decrease in the number of paupers from 1,081,926 in 1871 to 742,703 in 1878, and an increase in the saving's bank deposits from £56,000,000 in 1871 to £73,000,000 in 1878. The consumption of bacon, wheat, sugar and tea, as well as of wine, beer, and spirits, has also increased per head. This would argue that the depresion had not been so severe, especially on the working classes, as some of the panic-mongers would have us suppose. In spite of bad times they had, as a body, enjoyed more of the good things of this life than in even the rioting days of prosperity in 1871-3. Mr. Ede's conclusion sums up the situation as follows:—"When we reflected that our trade, though less than during the speculative period of 1870-3, when it was so unduly, so madly, extended, was yet greater than at any preceding period of our history, greater than it was in 1868—when we reflected on these and other like facts—we should, he thought, come to the conclusion that as a nation we had weathered far worse storms than the present, bad though it was, and that there was life in the old dog yet."

LITERATURE.

Friction and Lubrication: Determination of the Laws and Coefficients of Friction by New Methods and with New Apparatus. By R. H. Thurston. London: Trübner and Co. 1879.

Professor Thurston has for all practical purposes exhausted his subject. What is not contained in this little book is not worth knowing, by the practical engineer at all events; and this we say while fully understanding that our author leaves much that is interesting to the philosopher, the chemist, and the theoretical mechanician entirely untouched. The book may be defined as containing in a very small space a synopsis of the received opinions concerning friction, and, what is perhaps more to the purpose, the most complete treatise on lubricants that has yet been written. The volume is so moderate in price and so accessible that it is quite unnecessary to explain at any great length what it contains; but it may serve a useful purpose if we indicate the nature of some of the statements set forth by Professor Thurston, and point out one or two features in the book which render it specially worth attention.

Our author begins by defining friction as "a resistance which is always met when two bodies or particles, whether solid, liquid, or gaseous, are compelled to move one upon another. There are three kinds of friction so-called, rolling and sliding with solids, and fluid friction with liquids and gases. These are all governed by different laws, and with each the statements of these laws, as usually given in the text-books, probably require some modification." He then goes on to give terse general rules and formulæ. As for example :—"A railroad train in good order, and on a good road, will not be safe against starting under the action of gravity alone, unless the gradient is less than 18ft. or 20ft. to the mile; once started, it will continue in motion on gradients as low as 13ft. to the mile. . . . The coefficient of rolling friction for trains in good order is therefore $\frac{13}{5280}$, or nearly equivalent to one quarter of 1 per cent., or less than 6 lb. per ton." And again, "The resistance on railroads under the average conditions, and including all forms of resistance is given by Clarke as for train only $R = 6 + \frac{v^2}{240}$, and for engine and train $R = 8 + \frac{v^2}{171}$." Here Professor Thurston, or his printers for him, has misspelt Mr. Clark's name, but one instance out of many. In alluding to the resistance of the air to trains, our author entirely omits all reference to the curious experiments on train resistance carried out by Dr. Lardner and a committee of the British Association in 1838. Dr. Lardner, assisted by Mr. Edward Woods and Mr. Hardman Erle, succeeded in showing that the atmospheric resistance depended mainly on the volume of the train; a fact which has oddly enough been completely ignored by almost everyone who has since written on the subject.

The most valuable portion of the work is that devoted to lubricants. "The value of a lubricant as a lubricant is entirely independent of the market price, except so far as the demand of consumers of unguents affects the market price. Many of those materials which would be most useful in reducing friction could they be so applied, are entirely unknown to consumers of lubricating substances because of their monopoly for other purposes, for which they are in such demand as to entirely remove them from a market in which other unguents can be obtained at such a comparatively low price as to throw the former quite out of competition in the oil market." The efficiency of a lubricant varies, our author points out, with the conditions under which it is applied, and this leads directly for obvious reasons to a consideration of the amount of load that may safely be put on a bearing. Our author states that he has found that steel will carry without heating much more than iron, a very important proposition which will be new to most of our readers. From a comparison of the behaviour of the engines of naval steamers as far back as 1862, Professor Thurston deduced the following formula for the size of engine journals : $l = \frac{P V}{6000 d}$, in which l is the length of the journal in inches, P the load in pounds, and V the velocity of the rubbing surface in feet per minute; d is the diameter in inches. Steel may sometimes work well if of one half the length given by the formula.

Our author insists that much of the value of a lubricant depends on the way in which it is used, and we quite agree with him that much oil and grease is wasted every year. "A perfectly uniform supply of the minimum safe quantity enables an economy to be attained, which is surprising to one who has not measured the quantity of oil used. Some years ago a distinguished firm of tool builders told me that the hangers of their line shafting were working perfectly with but 34 drops of oil each per

week." It is to be regretted that our author has not explained how so unusual a result was obtained.

Instructions for ascertaining not only the quality, but even the kind of any sample of oil are given with admirable minuteness and precision. A set of tables of reactions is supplied, and the names of certain reagents are given, which are easily obtained and used. As an example of the instructions furnished by our author we take the following:—

Having given a fixed oil to find its name, try bi-sulphide of calcium. This reagent may give for example a golden yellow emulsion which retains its colour. The oil can be neither olive of low quality, pea-nut, nor beech. It is useless to try chlorine here. Pass on to chloride of zinc, we may obtain, for example, a greenish bluish green; the oil cannot be a poor quality of olive oil, or sesame, or rape-seed, or cotton. Test with sulphuric acid, this reagent gives say a reddish yellow colour; this eliminates colza and illuminating olive oils, leaving camline, sweet almond, and superfine olive. Apply the fuming bi-chloride of tin, perhaps a light brownish red may appear instantaneously and with it a thick mass of faint or straw yellow colour. The first reaction eliminates sweet almond and best olive, the second confirms the first, the oil must then be camline.

A large portion of the volume is devoted to a description of machines for testing lubricants, among which those discovered by Professor Thurston are perhaps the most complete. The work concludes with an account of investigations of the law of friction and the performance of lubricants, which covers far more ground than we could possibly traverse here. Before taking leave of the book, however, we would call attention to the following passage, which is worth notice:—

The true value of an oil to the consumer is not proportional simply to its friction-reducing power and endurance under the conditions of his work, but its value to him is measured by the different value of power expended, using different lubricants, less the difference in total cost of oil or grease used. . . . The consumer will usually find it oconomical to use that lubricant which is shown to be the best for his special case without regard to price, and will often find real economy in using a better material, sufficient to repay excess in the total cost many times over. He cannot afford to accept low grade unguents, even without charge.

We regret to say that the book has been very badly printed, or very badly corrected. It abounds, as we have already said, in misprints, and there are not a few uncouth sentences, the meaning of which is not easily made out. There are many figures and tables, the accuracy of which should be above reproach, and which, under the circumstances, we must perforce regard with suspicion. If misprints abound in the text, what security have we that they are not to be found in the tables? The author would do well to restore the confidence of his readers by stating positively and of his own knowledge that the figures and tables are perfectly accurate. If not, then a table of errata ought to be pasted into each volume.

THE STEAMSHIP ORIENT.

No. I.

THE steamship Orient, launched on the 5th of June last by Messrs. John Elder and Co., and now lying in the south-west India dock, is one of the most remarkable vessels ever constructed. She is the property of the Orient Steam Navigation Company, now in existence about two years. Until a comparatively recent period no attempt was made to send steamships direct to Australia. They could not carry coal enough from England for the purpose, and to stop and coal at the Cape involved a very large outlay. Communication with Australia was therefore carried on almost exclusively by sailing ships. The Great Eastern was specially designed to overcome the difficulty; and it was intended by Brunel that she should carry coal enough for the voyage out and home. Steam communication was maintained with Australia, either by way of the Red Sea, or by Pacific steamers running to San Francisco. When the Suez Canal was opened it became possible to steam direct to Melbourne or Sydney without trans-shipment of passengers and goods. As time went on it became apparent that with the introduction of economical engines it was possible to steam direct to Australia without coaling anywhere, provided vessels of sufficient size were used; and it was also seen that these large ships would be just those best adapted for the Australian trade, being the most comfortable and satisfactory in every way. Messrs. Anderson, Anderson, and Co., of Fenchurch-avenue, tried the experiment. Chartering from the Pacific Steam Navigation Company the Cuzco, Chimborazo, and some others, the result was eminently satisfactory; and the Orient Steam Navigation Company was formed, Messrs. Anderson and Co., and Messrs. F. Green and Co. being appointed joint managers. Then the company resolved to have ships of its own. Specifications were prepared for a great passenger vessel; tenders were obtained from several firms, and that of Messrs. John Elder and Co., of Glasgow, was accepted, the contract price being £130,000, while extras raise the sum to about £150,000.

More or less full descriptions of the ship have been published in the daily press, but they all leave much to be desired by the technical reader. We propose to as far as possible supply the deficiency. Those who have the opportunity, however, should visit the ship herself; she will be open for inspection during the next three days. We illustrate the ship as she may appear on a calm tropical sea, at page 238. The drawing has been prepared, not from a picture or photograph, but from the vessel herself, and even sailors will, we think, admit that she is an exceedingly handsome craft. She has been said to take a place next to the Great Eastern in dimensions, but a great gap fortunately intervenes. The displacement of the Great Eastern is about 22,000 tons; that of the Orient is 9500 tons. She is 445ft. 6in. long between perpendiculars, and 460ft. over all; her beam is 46·35ft.; her depth to the main-deck is 27·1ft.; and to the after-deck, 35·1ft. She can carry 3000 tons of coal, and 3600 measurement tons of 40ft. of cargo. The ship nearest to her in size is probably the Inman Atlantic steamer City of Berlin, built by Messrs. Caird and Co., of Greenock, in 1875. She is 5491 gross tons, and 3139 tons net register. Her length is 489ft. keel and fore rake; depth, 36ft.; breadth, 45ft. She has accommodation for 220 saloon and 1200 third-class passengers. Her engines are 1000 nominal horse-power, and 5200 indicated. They are inverted direct-acting compound, with two cylinders, the low pressure having a diameter of 120in.; high pressure, 72in.; the stroke being 5ft. 6in.

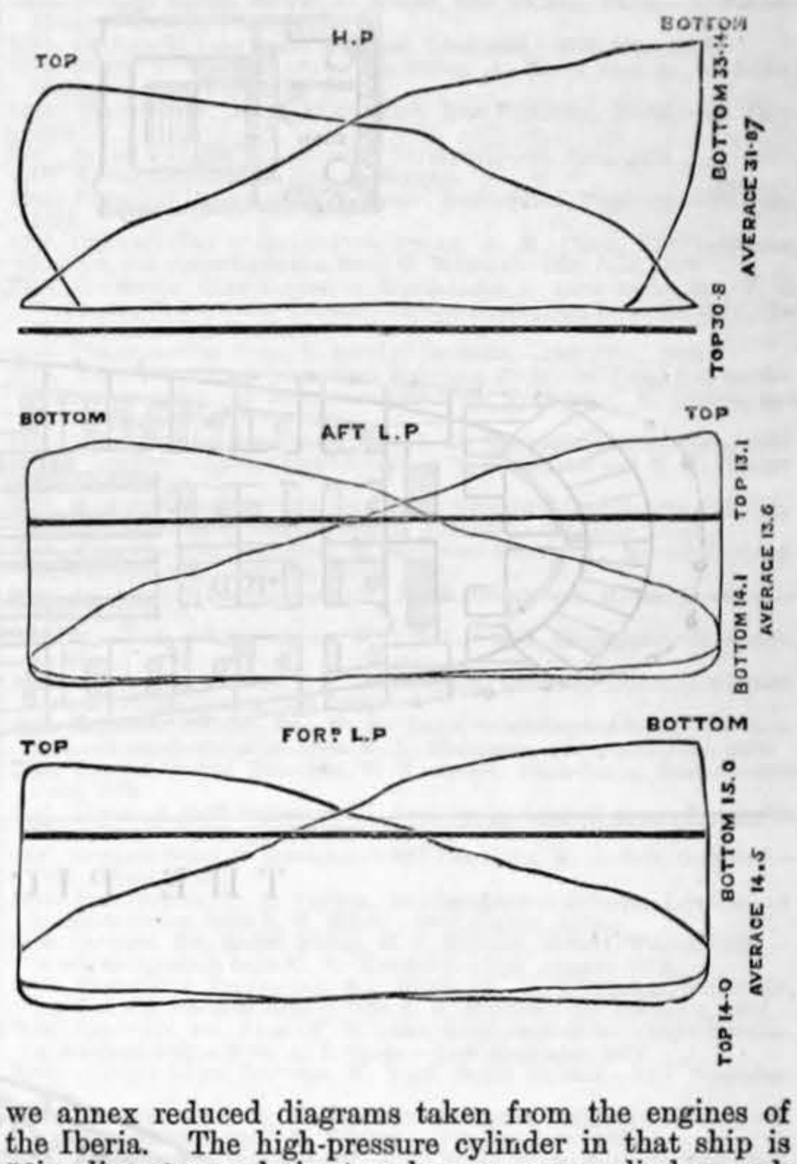
The Orient differs from nearly all other steamers in the beauty of her fittings, and the unusual care that has been taken to render the passengers comfortable. For example, the accommodation provided for second-class passengers is quite equal in all respects, and superior in many to that afforded to first-class passengers in the greater number of steamers. We give at page 242 a plan, which explains better than pages of descriptive letter-press, the general arrangement of the ship. The accommodation for first-class passengers is admidships and forward on the main-deck. That for second-class passengers is on the same deck aft; while the third-class passengers are well lodged aft and on the lower deck. Their cabin is divided into two by a longitudinal bulk head. On the port side are the open berths for single men, while on the starboard side are closed berths for married couples and women. Of third-class or steerage passengers she can carry 300, and it is not too much to say that in no steamship afloat will they find more roomy or comfortable quarters. Ventilation is provided by perforated pipes running under the deck beams above the bunks, and these pipes are continually being exhausted by one of Moss and Mitchell's ventilators.

The second-class passengers, 130 in number, have a saloon devoted to their use 60ft. long by 25ft. wide, the berths being arranged at each side. This saloon is very handsomely and substantially furnished, the berths are of unusual dimensions, the whole of the fittings are pitch pine varnished, and throughout there is a total absence of that tawdry decoration but too common on board ship.

The main saloon for 120 first-class passengers is made the whole width of the ship; it is 44ft. square. Instead of the usual companion, a noble triple staircase in polished oak is provided, leading to an entrance hall, from which access is obtained to the saloon. Over the centre tables is an open oval space surrounded by a balustrade. The aperture opens into a deck-house, which constitutes a music-room. It is surrounded by a divan, and will no doubt play an important part as a drawing-room. The saloon is wainscoated throughout with polished oak; the ceilings are white, the edges of the beams being lined with gold; the furniture is all of solid black walnut; the punkas are worked by machinery, all the rods being nickel-plated and resembling silver; the side lights are very large and very numerous; the berths are really supplied with every luxury that it is possible to provide on board ship, while the sanitary arrangements, lavatories, and bath rooms have all been constructed on a scale and with a finish and elegance of detail unparalleled in a West-end club or a first-class hotel. A hurricane deck, 160ft. long by 43ft. wide, is devoted to the service of the saloon passengers. On it is carried the chart room and captain's room, and from it she is steered by steam gear, of which we shall have more to say. In one word, the ship is, as regards passenger accommodation, a floating palace; and so much attention has been paid to artistic effect that nothing will be found to offend the most fastidious stickler for high art, unless, indeed, the Australian and other tropical plants with which the saloon is decorated may be deemed too gaudy. The arrangements for promoting the safety of the vessel against fire and water are as perfect as possible. She has three iron decks, and is divided into thirteen water-tight compartments, four of which must be filled at once to sink her. From the lower to the main deck she is divided into six compartments by iron bulkheads and doors, which last can be closed and made fast in a moment, so that should a fire break out it can almost be isolated, and might be left to burn itself out. Were space available, we might say much more concerning the Orient regarded as a ship. As it is, we must now consider the means by which she is propelled.

The engines of the Orient are of the three-cylinder type, and were designed by Mr. A. C. Kirk, late manager to Messrs. Elder and Co., and now with Messrs. Napier. The high-pressure cylinder stands between the two low-pressure cylinders. It is 60in. diameter; the low-pressure cylinders are each 85in. diameter, and the stroke is 5ft.; the revolutions are about 58 per minute, though as many as 62 have been attained. It is hardly necessary to say that the engines are of the highest possible finish, and that no pains have been spared to make them a good job; yet we think it is to be regretted that the three-cylinder type was selected. A glance at the history of the type will not be out of place here.

One of the great objections to the compound system is that when great powers are required the low-pressure cylinder attains colossal proportions, because it must be of such dimensions that the entire power required to propel the ship could be developed in it, provided steam of full pressure were admitted to it direct. For example, had a compound engine of the usual type been employed to indicate 5400-horse power—that required to drive the Orient at full speed—the large cylinder would have been 120in. in diameter. Cylinders of this size are not unknown at sea—for instance, the City of Berlin has one—but they are very liable to crack, and, we need hardly say, are very heavy and expensive. To get over the difficulty two systems are available. On wo one, t distinct compound engines are employed, the small being placed over the large cylinder, as in the Britannic, engined by Messrs. Maudslay and Sons,* and the City of New York, engined by the North-Eastern Marine Engineering Company.† The other consists in using two low-pressure cylinders instead of one; and thus, in the case of the Orient, two 85in. cylinders have been substituted for one of 120in. diameter. The three-cylinder system was first brought prominently before the world at the Paris Exhibition in 1867, when the engines of the man-of-war Friedland were exhibited.* Mr. Kirk, however, was the first to apply it to ocean steamers in the way in which it is now used. It must not be confounded with the multiple cylinder system of the late Mr. John Elder, who proposed to expand high steam through as many as three cylinders, one after the other, and so to combine their action on the shaft that the strains on the main bearings would be reduced to a minimum. It is true that Mr. Kirk disposes his three cranks at equal angles round the shaft centre; but this is simply to balance the engines, and the steam, as it expands from the high-pressure cylinder, is at once taken by whichever low-pressure cylinder may be ready for it. The sole object had in view has been to reduce the size of the low-pressure cylinder. Engines of the three-cylinder inverted type were first fitted in the Liguria, we believe, in 1873, and subsequently in the Zealandia and Australia. These were mail steamers of large size running between New Zealand and San Francisco. To illustrate the action of the steam in engines of this type



we annex reduced diagrams taken from the engines of the Iberia. The high-pressure cylinder in that ship is 56in. diameter, and the two low-pressure cylinders each 78in.; the stroke is 5ft. These dimensions are pretty nearly those of the engines of the Orient. The indicated power from the cards we publish is H.P.C., 1527; forward L.P.C., 1344; and aft L.P.C., 1260; or together, 4131 I.H.P.; the pressure was 66 lb.; the vacuum, 28·5in.; the revolutions per minute, 69, corresponding to no less than 690ft. of piston speed per minute. The engines of H.M.S. Inflexible are nearly identical with those of the Orient, only the Inflexible will have two sets of them, one driving each screw, and the whole engine has been crushed down, so to speak, to get it low enough to satisfy the conditions laid down by Mr. Barnaby.

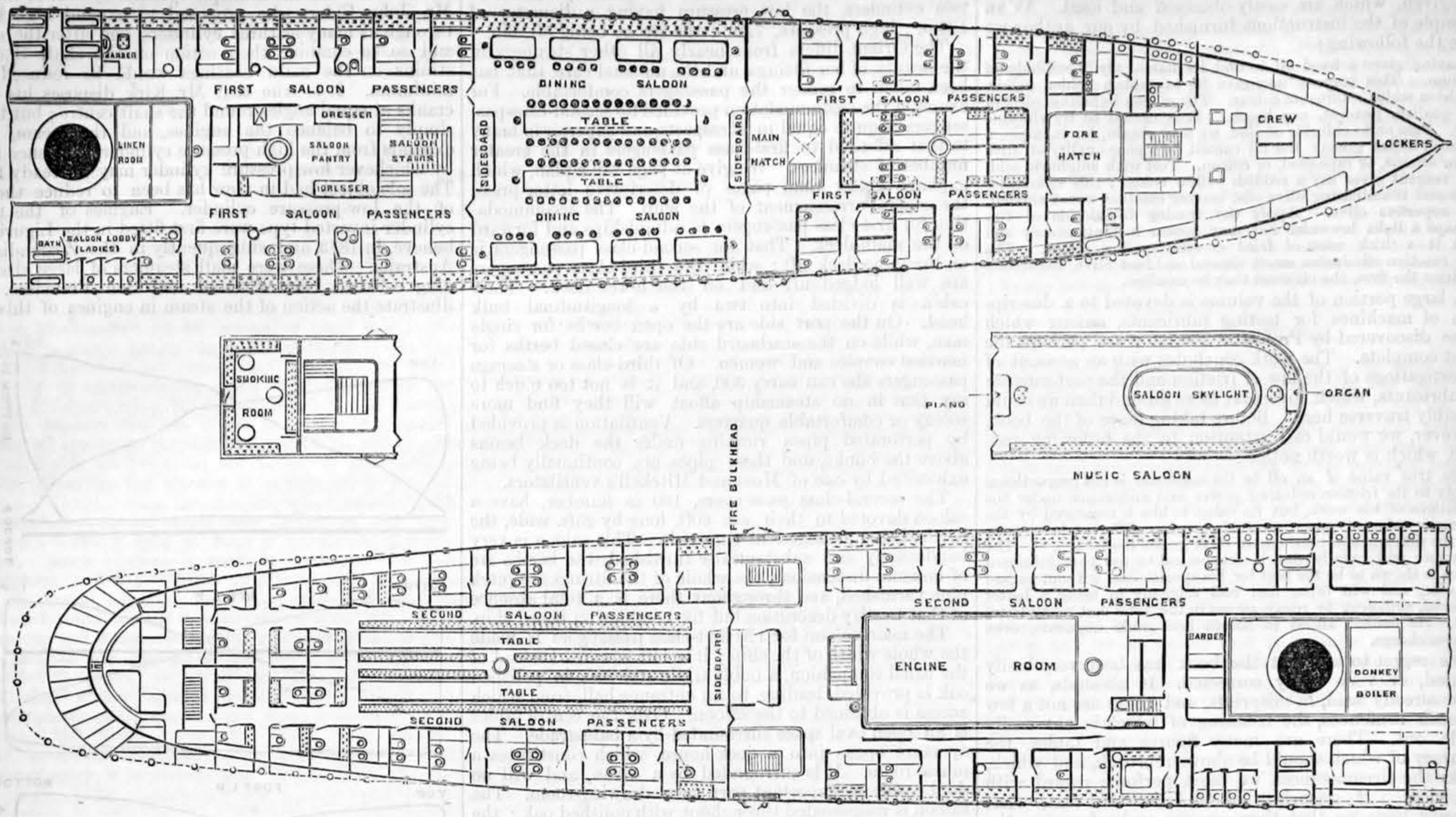
The great objection to the type is that the space occupied by the engines in the length of the ship is much more than that needed for the ordinary compound engine. For example, assuming that the lengths of different types of engines will be as the respective diameter of their cylinders, then the engines of the Orient of the two-cylinder type would be 120 + 60 = 180in. long. Of the three-cylinder type they must be 85 + 60 + 85 = 230in. long. Had they been made with two 42in. cylinders above two 85in. cylinders, the length occupied would have been but 85 + 85 = 170in. The relative lengths of the three types stand, therefore, at 170, 180, and 230. The difference represents in such a vessel as the Orient 130 to 150 measurement tons—probably a good deal more. We deal here with minimum proportions, and many two-cylinder engines are as long as those of the Orient. It may be argued that space is wanted neither for cargo nor for anything else in such a ship; but it will be conceded that an engine-room cannot have too much space in it, and the extra room between bulkheads which would be afforded by shortening the engines 5ft. or 6ft. would be of great value. In the case of the Orient there would have been no difficulty in adopting the double-cylinder type, because there is more than enough height over the tops of the cylinders between them and the skylight above. In our next impression we shall have more to say concerning the machinery of the Orient, with which no fault can be found if it is once conceded that the three-cylinder system is right, but this is just what we dispute on the grounds we have stated. We have dwelt on the subject at some length because the tendency to put bigger and bigger engines into passenger steamers daily gathers strength, and controversy begins to run high as to how these big engines are to be made. No one supposes that any one of the types we have named is more efficient than another; albeit, not a few maintain the three-cylinder system is the least economical of the whole. It is probable that the results obtained with the Orient will go far to settle the question, for her fuel performances can be readily compared with those of the White Star ships with compound independent engines.

* Illustrated in THE ENGINEER for Oct. 27th, 1876.
† Illustrated in THE ENGINEER for Dec. 28th, 1877.

* Illustrated in THE ENGINEER for July 19th, 1867.

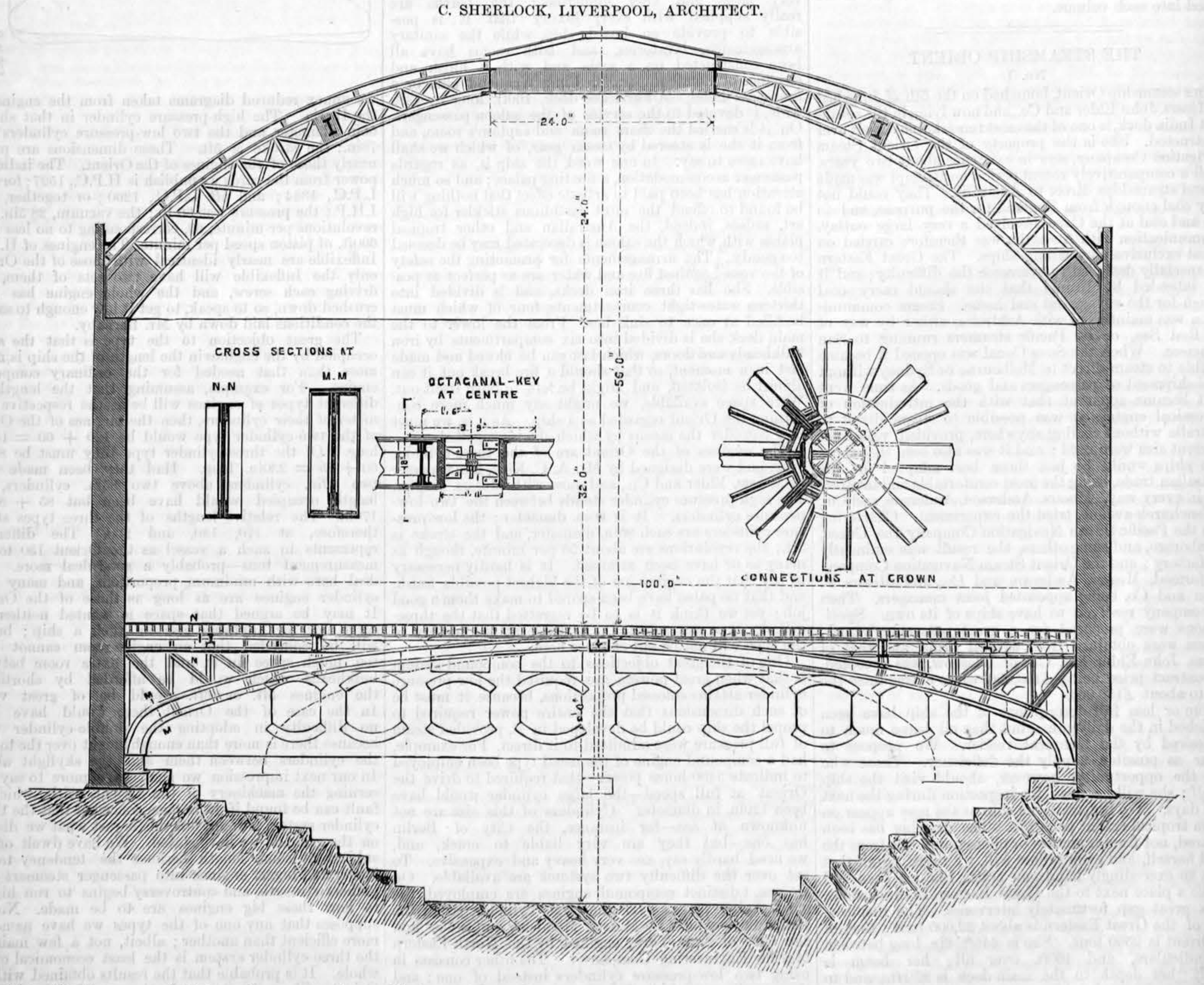
THE STEAMSHIP ORIENT—PLAN OF CABINS.

(see page 231.)



THE PICTON READING-ROOM, LIVERPOOL.

C. SHERLOCK, LIVERPOOL, ARCHITECT.



THE Picton Reading-room, of which we give a section above, is one of the finest rooms of the kind in England, and has been built to accommodate the growing requirement for space in the Liverpool Free Library. It has been designed by Mr. Cornelius Sherlock, while the floor, carried on girders as shown in our illustration, was designed by Mr. J. N. Shoolbred, of Westminster. The building is 100ft. in diameter inside, and rests upon the parent sandstone rock on which Liverpool is built, the rock being cut out to make a theatre below the reading-room. We shall give further particulars in our next impression, with drawings illustrating the construction of the floor, which is peculiar,

BURNTISLAND DOCK.

IN THE ENGINEER for the 11th October, 1878, we gave a general plan, bed sections, wall sections, and a general description of the Burntisland Dock. Since that we have, in the impressions for 27th June and 25th July, given two supplemental working drawings, showing details of the dock and gates. We now give a working drawing of the entrance masonry, which completes the set.

Sheet No. 1, published with our impression for 27th June last, shows the general plan of the entrance, together with details of bollards and parts of dock gates. With regard to the plan, it will be noticed that there are only two machines for working the gates, instead of four, as is usually the case. The arrangement was suggested by the makers of the machinery, Sir W. G. Armstrong and Co., and will be readily understood from the drawing. The machines are ordinary hydraulic engines working a cup drum which pays off the chain as it is overhauled, into a well below the machinery. The chains are led along the top of the gate to sheaves near the mitre post, thence they pass down to lower sheaves which are at the centre of gravity of the gate so far as regards height, and from thence they pass to the side walls of the entrance where they are made fast to bolts in the walls. This system has the advantage of doing without the ordinary chainways, and, as already remarked, only one machine is required to each gate, which, although perhaps it may not save much in first cost, is undoubtedly handier in working. On the other hand, the working and fixed parts under water are difficult to get at to repair or replace. A deeper gate recess also is required in order to properly house the sheaves which otherwise would be apt to be carried away by passing vessels. The details given on this sheet show the sheaves on the gate and the mode of attachment, the lower sheaves of course require to be on a swivel joint. The gate rollers, roller path, pivot, and shoe are of chilled iron.

Sheet No. 2 shows the gates of greenheart timber, heel posts, 20in. square, the two bottom ribs 20in. by 18in., and the others 18in. square. The ribs are morticed into heel and mitre posts, being drawn home with 1in. bolts, countersunk and plugged up. The inside planking is 2½in. by 7in. greenheart, fixed vertically with galvanised coach screws, and caulked with oakum and pitch.

Sheet No. 3 shows the entrance masonry; the cills and aprons are not heavy, the bottom being rock. The whole of the masonry of the entrance is freestone except the hollow quoins, which are granite set in cement. After being set, the bearing surface of these quoins was fine axed and polished, so as to make a water-tight joint with the heel post. The concrete used on the works was in the proportion of seven of ballast and broken stone to one of cement; the facework of the entrance, cills, &c., is of freestone ashlar; the backing of the walls, rubble in blue lias mortar.

We have to acknowledge our indebtedness to Messrs. Bouch and Meik, through whose courtesy we have been enabled to place these drawings before our readers.

TRIAL TRIP OF STEAMSHIP BAVINGTON.—On Saturday afternoon the steamship Bavington, belonging to Messrs. Hine Brothers of Maryport, proceeded into the river for a trial trip after undergoing repairs and being fitted by Messrs. Cochran and Company, of Birkenhead, with one of their patent multitubular vertical boilers. This trial was of interest, as this steamer is the first of the small coasting class that has been fitted with one of these boilers. The boiler which it replaced was an ordinary return tube double furnace boiler, and was quite unable to keep up steam. The new boiler kept steam to the working pressure of 50 lb. per square inch easily, and afforded an abundant supply. Captain Wilkinson overlooked, and Messrs. W. R. Mc.Kaig and J. Carlton, the superintendent engineer on behalf of the owners, were present at the trial and expressed themselves highly satisfied with the result. Immediately after the trial the steamer sailed for Duddon.

PROJECTED ENGINEMEN'S CERTIFICATE ASSOCIATION.—Sir Henry Tylor presided on Friday, the 4th inst., at a meeting held at 23, Finsbury-place, E.C., the object of which was, the establishment, on a broad basis, of an institution for granting certificates of efficiency to engine drivers, locomotive and stationary, throughout the United Kingdom. Resolutions in favour of this arrangement were unanimously carried, and Messrs. D. K. Clark, C.E., Mr. Joseph Newton, C.E., Mr. Michael Reynolds, and others demonstrated the necessity for the creation of such a society. It was confidently predicted that the Board of Trade would lend their countenance to the project. At the next meeting, shortly to be held, officers will be appointed, and details be more fully considered than was possible at the preliminary meeting in question. It was stated that there are at this moment not less than 200,000 engine drivers in Great Britain and that they have been—as a rule—appointed to their posts on a kind of haphazard rather than a systematic plan.

PONTYPOOL AND TALYWAIN RAILWAY.—An important link of communication in the Monmouthshire Railway system, which has been four years in construction, has recently been completed under the engineer, Mr. T. D. Roberts, M.I.C.E., and approved by the Board of Trade. The railway commences by a junction with the Eastern Valleys main line at Trevethin Junction, a short distance to the north of the station at Pontypool, and in order to gain an elevation of about 320ft. to form a junction with the Talywain and Abersychan Extension of the London and North-Western Railway at Talywain, follows a contour line past Tranch Colliery, Cwmffrwdoer and Cwmnantddu Valleys, Pentrepiod Snatchwood, and Pentwyn, where a junction is made with the Ebbw Vale Company's private railway, and thence by a high embankment over the Sychan Brook to Talywain. The gradients, though heavy—the steepest being 1 in 48—are no exceptions to the ordinary run of railway gradients in South Wales valleys; they are so far favourable that they are with the load and not against it. A somewhat extraordinary curve is described by the line in crossing the Cwmffrwdoer and Cwmnantddu valleys. It traverses three-fourths of the entire circle, so that when standing at the upper end the commencement of the circle is seen a considerable depth below, but at a very short distance off. The Cwmffrwdoer branch railway and stream are crossed by a massive stone bridge 40ft. in height, and the Cwmnantddu branch railway and stream by a viaduct of four spans, between 40ft. and 50ft. high, also built of masonry, with brick arches. At Snatchwood a great landslip took place, and the railway embankment having moved bodily down the hill, a deviation of the line became necessary in order to avoid the treacherous ground on which it had been formed. A massive concrete wall supports the embankment between Pentwyn and Abersychan works for about 350 yards, soon after passing which a tunnel spans the private railways of the Ebbw Vale Company. This bridge is built upon an old slag tip, about 60ft. above the natural level of the Sychan Valley, and a high embankment is carried over the bridge, so that the height from the natural surface to the level of rails is more than 100ft. Ample siding room has been provided at the terminus to accommodate the traffic which in minerals especially will probably be very heavy. It is in contemplation to open the line for passenger traffic at an early date, and that trains will be run from Newport to Brynmawr without change of carriage.

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 pages, in place of turning to those pages and finding the numbers of the Specification.*]

Grants and Dates of Provisional Protection for Six Months.

3377. BOXES for BRUSHES, &c., G. Baker and J. C. W. Stanley, Featherstone-street, St. Luke's, London.—21*st August*, 1879.
3379. CLEANING KNIVES and FORKS, W. H. Robinson, Brighton.
3381. TRACTION ENGINES, R. P. Parsons, Elsworth, Cambridge.
3383. RAILWAY, &c., SLEEPER and CHAIR, T. Smith, Blaydon-on-Tyne, Durham.
3385. CARPET STRETCHERS, R. Freakes, Sackville-street, Southsea, Southampton.
3387. BLEACHING OZOKERITE, &c., W. P. Thompson, High Holborn, London.—A communication from V. Ofenheim, Vienna.
3389. GRAIN-ELEVATING MACHINERY, W. R. Lake, Southampton-buildings, London.—A communication from J. B. Stoner, Toledo, Ohio, U.S.—22*nd August*, 1879.
3393. TELEPHONES, P. S. Justice, Southampton-buildings, London.—A communication from S. H. Short, Franklin, Ohio, U.S.
3395. CLAY TOBACCO PIPES, J. R. Bird and C. G. Roberton, Glasgow.
3397. HAND SAWS, A. Vayriot, Lunéville, France.
3399. SHIPS' LAMPS, I. Blake, Birmingham.
3401. FIRE-ENGINES, B. Massey, Stafford.
3405. INDICATOR BOLT, E. Cushing, St. John's Wood, Middlesex.—23*rd August*, 1879.
3407. SPINNING, &c., COTTON, E. Hird, Bolton.
3413. CONSTRUCTING ROADS and WAYS, C. W. Bradshaw, Birmingham.
3415. OIL LAMPS, L. B. Bertram, Park-road, New Wandsworth.
3417. PICKERS used in LOOMS, G. Burslem, Stockport.
3419. OIL CANS, J. C. Mewburn, Fleet-street, London.—A communication from E. Dawson, Lille, France.
3421. BLOTTING PADS, J. H. Kearns, Southwark-street, London.
3423. AUTOMATIC BRAKE for CRANES, &c., C. T. Powell, Lodge-road, Birmingham.
3425. PARALLEL and DIVERGENT PENCILS of LIGHT for SIGNALLING, G. Pitt, Sutton.—A communication from Messrs. Mangin and L. S. Lemonnier and Co., Paris.—25*th August*, 1879.
3427. HORSESHOES, B. J. B. Mills, Southampton-buildings, London.—A communication from J. R. Williams, Johnstown, and E. V. McCandsslo, Pittsburg, Pennsylvania.—26*th August*, 1879.
2718. ROPES, &c, H. C. Petersen, Copenhagen, Denmark.—A communication from C. Söeborg and L. Petersen, Köskilde, Denmark.—4*th July*, 1879.
3058. HASSOCKS and KNEELERS, E. C. B. Lawford, King-street, Cheapside, London.—28*th July*, 1879.
3086. TRICYCLES and BICYCLES, F. W. Jones, Dix's-fields, Exeter.—30*th July*, 1879.
3312. TREATING STRAW MANURE, T. H. Cobley, Dunstable, Bedford.
3314. PEGGING MACHINERY, W. R. Lake, Southampton-buildings, London.—A communication from G. W. Copeland, Malden, and W. S. Eaton, Boston.
3316. MANUFACTURE of SHOT, E. Field, Chandos-chambers, Adelphi, London, and W. B. Lord, Clare House, Hampstead, London—16*th August*, 1879.
3318. MANIPULATING, SCREENING, and SORTING COAL, W. Haydock, Wigan, Lancaster.
3320. STEAM STEERING GEAR, A. Higginson, Liverpool.
3322. CLAMPING, &c., DOOR and other FRAMES, T. Lees, Park Foundry, Hollingwood, near Manchester.
3324. INCREASING HEAT of BLAST in FURNACES, W. R. Lake, Southampton-buildings, London.—A communication from Gutehoffnungshutte Actien-Verein für Bergbau und Hüttenbetrieb, Oberhausen, and R. M. Daelen, Dusseldorf.—18*th August*, 1879.

Inventions Protected for Six Months on the Deposit of Complete Specifications.

3640. FOUNTAIN, &c., PENS, W. R. Lake, Southampton-buildings, London.—A communication from A. T. Cross, Providence, Rhode Island, U.S.—11*th September*, 1879.
3650. COATING SHIPS' BOTTOMS, W. Ward, South Shields.—12*th September*, 1879.
3651. TURNING WOOD, H. H. Lake, Southampton-buildings, London.—A communication from J. Davies and F. B. Chidester, New Jersey, U.S.—12*th September*, 1879.
3677. WRAPPERS, &c., for PACKING, H. H. Lake, Southampton-buildings, London.—A communication from J. H. Weaver, Chicago, Illinois, U.S.—13*th September*, 1879.
3685. ORNAMENTING GLASS-WARE, A. J. Boult, High Holborn, London.—A communication from H. Feurhake and W. Beck, Pittsburgh.—15*th September*, 1879.
3709. SCREW PROPELLERS, H. J. Haddan, Strand, Westminster.—A communication from E. A. Heath, New York, U.S.—16*th September*, 1879.
3717. TYPOGRAPHICAL, &c., PRINTING MACHINES, H. A. Bonneville, Piccadilly, London.—A communication from H. Voirin, Rue Mayet, Paris, France.—16*th September*, 1879.

Patents on which the Stamp Duty of £50 has been Paid.

3594. REFRIGERATING, F. P. E. Carré, Paris, and E. Jullien, Marseilles, France.—13*th September*, 1876.
3628. KILNS, J. Garlick, Birmingham.—16*th September*, 1876.
3647. METALLIC DRUMS or CASKS, J. Simpson, Liverpool.—18*th September*, 1876.
3655. GAS GOVERNOR, W. Foulis, Glasgow, Lanark, N.B.—19*th September*, 1876.
3723. STRING MUSICAL INSTRUMENTS, D. Semple, Airdrie.—23*rd September*, 1876.
2772. MANUFACTURE of TIE-BUCKLES, J. T. King, Liverpool.—28*th September*, 1876.
3645. PRODUCING DRAUGHT, &c., J. Y. Smith, Pittsburgh, Pennsylvania, U.S.—18*th September*, 1876.
3646. STEAM BOILERS, C. D. Abel, Southampton-buildings, Chancery-lane, London.—18*th September*, 1876.
3652. AXLES, &c., W. R. Lake, Southampton-buildings, London.—18*th September*, 1876.
3667. SKELPS and TUBES, C. F. Grimmett, Edgbaston.—19*th September*, 1876.
3665. TRANSMITTING PRESSURE to HYDRAULIC MACHINE TOOLS, R. H Tweedell, J. Platt, and J. Fielding, Atlas Works, Gloucester.—19*th September*, 1876.
3670. THERMO-ELECTRIC GENERATORS, C. A. Faure, Faversham.—19*th September*, 1876.
3684. CONNECTING, &c., ROLLING STOCK, F. Barnes, Sulham, near Reading.—20*th September*, 1876.
3703. PILLS, J. M. Richards, Great Russell-street-buildings, Great Russell-street, Bloomsbury, London.—21*st September*, 1876.
3791. APPLYING COUNTER PRESSURE to the LEVERS of ENGINES, J. H. Johnson, Lincoln's-inn-fields, London.—29*th September*, 1876.
3712. CARDING COTTON, &c, W. Dobson, Plymouth, T. H. Rushton and B. A. Dobson, Bolton.—22*nd September*, 1876.
3713. REFRIGERATING, &c., LIQUIDS, W. Lawrence, St. Mary Axe, London. 22*nd September*, 1876.
3773. LUBRICANTS, &c., for STEAM ENGINES, &c., H. P. Scott and B. H. Zerbe, Westoe Villa, Burdett-road, Bow, London.—28*th September*, 1876.

Patents on which the Stamp Duty of £100 has been Paid.

2782. TREATING BRICK, &c., G. H. Smith, Southampton-buildings, London.—19*th September*, 1872.
2795. PLAITED PAPER CUPS, &c., E. S. Bigg and W. F. Hunt, Hill's-place, Oxford-street, London.—28*th September*, 1872.
2838. SHUT-OFF APPARATUS for LIQUIDS, P. J. Davies, Campsbourne-terrace, High-street, Hornsey, London.—25*th September*, 1872.

Notices of Intention to Proceed with Patents.

1296. VESSELS for CONTAINING LIQUIDS, F. Preston, Huddersfield.—1*st April*, 1879.
1894. MAKING HELICAL PIPES of CLAY, &c., L. Rohrmann, Krauschwitz, Germany.
1914. MACHINE-DRIVING CHAINS, W. R. Lake, Southampton-buildings, London.—A communication from W. D. Ewart.—13*th May*, 1879.
1917. HOLDERS for DENTAL, &c., INSTRUMENTS, W. P. Thompson, High Holborn, London.—A communication from H. D. Justi.
1935. SPINNING and DOUBLING FIBRES, G. Lumb, Marsh, near Huddersfield.
1936. GRINDING, BARK, &c., J. W. Harrison and T. Hammond, Wakefield, —14*th May*, 1879.
1948. SLIDE VALVE APPARATUS, L. Schwartzkopff, Berlin.—A communication from E. Kaselowsky and C. Prött.—15*th May*, 1879.
1969. ELECTRIC LIGHT APPARATUS, A. Longsdon, Queen Victoria-street London.—A communication from A. Krupp.—16*th May*, 1879.
1974. FASTENING DEVICE for STUDS, &c., W. Morgan-Brown, Southampton-buildings, London.—A communication from T. Hedges, E. Möller, and C. Graf.
1978. BUCKLE or CLASP for BRACES, &c., P. Jolin, Holloway, London.
1979. CUTTING SCREWS, A. M. Clark, Chancery-lane, London.—A communication from E. Dejonc.—17*th May*, 1879.
1983. HOSE-COUPLINGS, E. Schultz, Französische-strasse, Prussia.—A communication from J. L. Schmidt.
1985. TRANSMITTING, &c., MOTION of WINCHES, &c., T. A. Weston, Fleet-street, London.
1988. EXHIBITING ADVERTISEMENTS, &c., H. A. Reinhold, Woolwich, Kent.—19*th May*, 1879.
1992. SELF-ACTING FIRE ALARM, R. P. Gill, Duke-street, Liverpool.
2000. ELECTRIC LAMPS, J. Cougnet, Brussels.
2005. PURIFICATION of STEEL and IRON, P. Jensen, Chancery-lane, London.—A communication from A. Krupp.—20*th May*, 1879.
2015. POWER TRAVELLING CARRIAGES, &c., L. Higginbotton and T. Mannock, West Gorton.
2023. COLOUR PRINTING PRESSES, B. Hunt, Serle-street, Lincoln's-inn, London.—A communication from G. W. Woodside, S. E. Gumpert, and J. D. Wolf.—21*st May*, 1879.
2040. TRACTION and WAYS, J. L. Haddan, Great George-street, London.—22*nd May*, 1879.
2063. SLIDING VALVES, P. Everitt, Great Ryburg, Norfolk.
2067. SETTING SAW TEETH, J. Trickett, Newark-upon-Trent.—23*rd May*, 1879.
2102. DYEING MIXED TISSUES, C. Autier, Rue du Bac, Paris.—A communication from A. Mauger.
2114. COCKS and VALVES, E. Marsden, Liverpool.—27*th May*, 1879.
2172. SURFACE WOOD PLANING MACHINES, A. Knox and A. E. Knox, Glasgow.—31*st May*, 1879.
2211. TELEPHONES, H. C. Dumoutier, Rue Pommier, Paris.—4*th June*, 1879.
2247. STEAM-BOILERS, T. Lancaster, Liverpool.—6*th June*, 1879.
2251. WINDOW-SASHES, G. Hartig, Brixton.
2261. FOUNTAIN PENHOLDERS, R. Spear, South-place, Finsbury.—7*th June*, 1879.
2287. CHANNELLING or QUARRYING STONE, A. M. Clark, Chancery-lane, London.—A communication from G. Wincqz.—10*th June*, 1879.
2383. EFFECTING ELIMINATION of METALLOIDS in IRON ORES, &c., J. C. Mewburn, Fleet-street, London.—A communication from Le C. C. De Montblanc and L. Gaulard.
2387. TREATMENT of SODA, E. Solvay, Brussels.—16*th June*, 1879.
2515. PRODUCING NEW COLOURING MATTERS, F. Wirth, Frankfort-on-the-Maine, Germany.—A communication from W. Meister, E. Lucius, and A. Brüning.—23*rd June*, 1879.
2592. COUPLINGS for HOSE and PIPES, J. G. Tongue, Southampton-buildings, London.—A communication from W. J. Stevens and W. F. Proctor 27*th June*, 1789.
2718. MAKING ROPES of STRAW, &c., H. C. Petersen, Copenhagen —A communication from C. Söeborg and L. Petersen.—4*th July*, 1879.
2742. SELF-FEEDING DRILLING or RATCHET BRACE, T. Moore, Gerrard-street, Islington.—5*th July*, 1879.
3008. BEDS and SLEEPING COTS, W. Exall, Holybrook House, Reading.—24*th July*, 1879.
3058. HASSOCKS and KNEELERS, E. C. B. Lawford, King-street, Cheapside, London.
3066. CHEQUES or DRAFTS, T. A. Brockelbank, Gresham House, Old Broad-street, London.—28*th July*, 1879.
3080. TREATING SPONGE, &c., W. R. Lake, Southampton-buildings, London.—A communication from W. N. Blakeman, jun.—29*th July*, 1879.
3086. TRICYCLES and BICYCLES, F. W. Jones, Dix's-fields, Exeter.—30*th July*, 1879.
3163. TABLES, J. Cuthbertson and J. Armstrong, Ancrum-street, Newcastle-upon-Tyne.—6*th August*, 1879.
3307. CONSTRUCTION of UMBRELLAS and PARASOLS, H. Currey, Crayford.—16*th August*, 1879.
3393. TELEPHONES, P. S. Justice, Southampton-buildings, London.—A communication from S. H. Short. - 23*rd August*, 1879.
3409. CUTTING, &c., SHEET METAL, H. J. Haddan, Strand, Westminster.—A communication from C. E. Kennedy.—25*th August*, 1879.
3577. SIGNALS for TELEPHONE, &c., WIRES, W. T. Whiteman, Staple-inn, London.—A communication from S. W. Francis.—5*th September*, 1879.
3640. FOUNTAIN, &c., PENS, W. R. Lake, Southampton-buildings, London. A communication from A. T. Cross.—11*th September*, 1879.
3650. COATING SHIPS' BOTTOMS, W. Ward, South Shields.—12*th September*, 1879.
3677. WRAPPERS, &c., H. H. Lake, Southampton-buildings, London.—A communication from J. H. Weaver —13*th September*, 1879.
3685. ORNAMENTING GLASS-WARE, A. J. Boult, High Holborn, London.—A communication from H. Feurhake and W. Beck.—15*th September*, 1879.
3709. SCREW PROPELLERS, H. J. Haddan, Strand, Westminster.—A communication from E. A. Heath.—16*th September*, 1879.

All persons having an interest in opposing any one of such applications should leave particulars in writing of their objections to such application at the office of the Commissioners of Patents within twenty-one days after date.

List of Specifications published during the week ending September 20th, 1879.

4136*, 4d.; 4914, 4d.; 44, 6d.; 95, 6d.; 205, 6d.; 309, 6d.; 421, 4d.; 551, 8d. 552, 6d.; 554, 6d.; 570, 6d.; 572, 6d.; 574, 6d.; 577, 6d.; 578, 6d.; 579, 6d.; 580, 4d.; 582, 1s.; 584, 6d.; 589, 6d.; 590, 6d.; 593, 6d.; 594, 6d.; 595, 2d.; 596, 4d.; 601, 6d.; 606, 2d.; 608, 6d.; 612, 6d.; 616, 1s.; 617, 6d.; 618, 6d.; 621, 6d.; 626, 6d.; 632, 8d.; 636, 4d.; 641, 2d.; 644, 6d.; 645, 4d.; 646, 2d.; 647, 2d.; 648, 2d.; 649, 2d.; 651, 6d.; 652, 6d.; 653, 2d.; 656, 2d.; 660, 2d.; 661, 2d.; 662, 3d.; 663, 2d.; 664, 2d.; 666, 6d.; 667, 6d.; 669, 2d.; 670, 2d.; 672, 2d.; 673, 6d.; 674, 2d.; 675, 2d.; 677, 6d.; 682, 6d.; 683, 2d.; 685, 2d.; 686, 2d.; 687, 6d.; 688, 2d.; 690, 2d.; 694, 2d.; 695, 2d.; 696, 6d.; 697, 2d.; 698, 6d.; 699, 2d.; 701, 2d.; 702, 2d.; 703, 2d.; 704, 6d.; 706, 6d.; 709, 2d.; 711, 2d.; 712, 2d.; 713, 4d.; 714, 6d.; 715, 2d.; 716, 2d.; 717, 4d.; 718, 4d.; 722, 4d.; 724, 4d.; 728, 4d.; 729, 2d.; 731, 4d.; 732, 2d.; 736, 6d.; 738, 4d.; 739, 2d.; 741, 2d.; 742, 4d.; 744, 2d.; 747, 2d.; 748, 2d.; 755, 4d.; 777, 6d.; 812, 6d.; 814, 6d.; 821, 6d.; 842, 6d.; 1103, 6d.; 1916, 6d.; 2268, 2d. 2416, 4d.; 2437, 4d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

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

5258. CUTTING AND SCREWING TUBES AND RODS, &c., *W. Crow.—Dated 24th December*, 1878. 6*d.*

As a cutting tool the apparatus consists of a headstock to receive the rod or tube and provided with a handle. At the top is a boss tapped with a female screw and grooved on one side to receive a flat sliding cutter, the upper end of which is bent over at right angles and received by a collar formed on a male screw passing through the head of the cutter, and through the female screw on the boss of the headstock, so that by turning the screw the pressure of the cutter is brought upon the rod, and turning the tool round effects the cut, the sliding cutter being advanced by the action of the screw through the boss. For cutting and screwing rods or tubes a doubled jawed head is employed, and is capable of opening and closing on a pin joint. One jaw is fitted with a handle and the other extends a short distance below the pin joint and is formed with a boss to receive an adjusting set screw to open and close the jaws. Inside the jaws are fixed cutters.

96. FORGES, *H. Eyre.—Dated 9th January*, 1879. 6*d.*

In order to utilise the waste heat of a forge to produce steam to drive the fan, an L shaped boiler is arranged so that its inner vertical wall constitutes the back or tuyere plate of the forge, and the horizontal plate forms the hearth, thus there will be a water space below and at the back of the forge, or at the parts in contact with the ignited fuel. The tuyere pipe passes transversely through the vertical portion of the boiler and communicates with the fan, which is actuated by a small steam engine attached to one side of the forge and coupled by a clutch to the fan spindle.

164. STEREOSCOPES, *H. Grubb.—Dated 15th January*, 1879. 6*d.*

The two pictures are placed side by side but horizontally with their faces downwards when they are transparent, illuminated from above, or opaque illuminated from below, or with their faces upwards when they are opaque and illuminated from above. The object lenses are made in a composite from, one face of each being convex to operate as a lens and the other faces of prism form, so that the rays passing through the lens face are reflected at right angles, and both being so set as to converge the reflected rays on a concave mirror. From these the rays are reflected to the eyes of the observer, the right eye receiving the image of the left picture, and the left eye the image of the right picture.

347. COMPOSITION FOR PRESERVING FOOD, *S. Fulda.—Dated 28th January*, 1879. 4*d.*

The composition consists of ½ lb. alum, ½ lb. crystal silicate of potash, ½ lb. borax, ½ lb. cream of tartar, 6 oz. glassgall, 2 lb. caustic lime, and 1 lb. sulphate of soda, the whole dissolved in 8 lb. of cold water previously boiled.

349. SHOES, &c., *B. G. Brewer.—Dated 28th January*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

The sole and quarter are made in a single piece by cutting out a form of the required shape, then after damping and by means of patterns imparting to it the exact form which it is required to give the shoe.

353. SLIDE VALVES, *J. Hill.—Dated 28th January*, 1879. 6*d.*

In order to dispense with the cover of the valve, the ends of valve are prolonged so as to cover the steam ports of the valve face, and are formed with recesses constituting ports corresponding with the steam ports of the cylinder valve face, and in accordance with the stroke and requirements of the valve. These recesses have an additional breadth given them on the side corresponding to the side on which is formed the steam supply port of the cylinder valve face, and the recesses in the valve are connected together by a longitudinal passage covering the steam supply port on the cylinder valve face, the exhaust port being formed as in ordinary D valves. The steam is thus supplied under and through the valve, instead of over and round it.

378. FURNACES, *T. Vicars, sen., J. Vicars, sen., T. Vicars, jun., J. Vicars, jun., and J. Smith.—Dated 30th January*, 1879. 6*d.*

A revolving shaft beneath the fire-bars gives motion to the self-stoking machinery, and also to feeding plungers actuated by excentrics on the shaft. Cams on the shaft give a forward and backward motion to two bars placed across the furnace, and on which the front end of the fire-bars rest.

403. BOOTS AND SHOES, *C. Edwards.—Dated 31st January*, 1879.—(*Not proceeded with.*) 2*d.*

A boot is provided with a rim entirely around the inner sole, so as to form a strong flange, and the outer sole is made adjustable thereon by means of a plate on its upper side, which is so attached that its edges will slide within the flange on the inner sole, thus securing the two soles together. It is still further secured by a spring at the waist.

405 APPARATUS FOR SUPPLYING WATER TO WATER-CLOSETS, BATHS, &c., *H. Owen.—Dated 31st January*, 1879. 6*d.*

A cistern of a capacity equal to the water required for each flushing has a hole in the centre of the bottom fitted with a tapered socket, to which is connected an union for the water-closet supply pipe. To the lower end of the socket is attached a metal cylinder with openings at the bottom for the outlet of water. In the cylinder works a drum, at the lower end of which is a plug whose seat is on the socket. Through the drum and valve, and connected to the valve, passes a pipe, whose upper end passes above the water line, such pipe working within a second pipe screwed to the cylinder. A ball cock with a double reversible action is employed, one for the supply of water to the cistern and operated by a ball, and the other to shut off the supply while the cistern is being emptied, and which is operated by a lever connected to the pull.

406. GULLEYS AND FAT TRAPS, *H. Owen.—Dated 31st January*, 1879. 6*d.*

A square box forming a receiver or fat trap, and made of stoneware, is provided at one side with a syphon, to which an outlet pipe is adapted for the discharge of noxious gases. Above the water line are a suitable number of inlet openings in the receiver, and its upper edge has a rim to receive a curved flange on an iron tray which fits into the receiver, the bottom of the tray extending below the water-line, traps the inlet for gulley water; the centre of the bottom of the tray is open and forms a receptacle for water. The tray has a rim round its upper edge, and between it and the curved flange are a number of openings for waste pipes. A second tray with a recessed bottom is employed, the bottom edges of the recess dipping into the receptacle of the first tray, thus forming a second trap. A grating fits over the second tray.

407. BURNERS FOR PETROLEUM LAMPS, *W. Brierly.—Dated 31st January*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

The wick is pressed by springs against the toothed wheels, so as to obtain a sure and equal gear of the wick within the wick holder.

408. MACHINERY FOR COMBING COTTON, &c., *T. H. Rushton and J. Macqueen.—Dated 31st January*, 1879.—(*Not proceeded with.*) 2*d.*

For feeding the sheet from the lap forward to the combing nippers a pair of nippers is employed, the bottom jaw of which is supported on a centre by the bottom jaw of the combing nippers, and the top jaw is supported on a shaft carried by the bottom jaw, such shaft forming the joint for both jaws. On this shaft is a lever brought into contact with a fixed point by another lever fixed to the same shaft, and actuated by a comb.

409. APPARATUS FOR PROPELLING SHIPS, &c., THROUGH WATER, &c., *C. D. Abel.—Dated 31st January*, 1879.—(*A communication.*) 8*d.*

A number of discs with one or more spiral or volute shaped arms are fitted upon each other, so that while the axes of the bosses are in line with each other the arms are slightly in advance, the second of the first, and so on. A body is thus formed in which one or more helical and spiral stepped blades extend along and around the central axis, and the steps are then removed so as to form a continuous smooth surface. One end of the body is closed by a conical disc, and the propeller being rotated, the action of the blades will be to grasp the water at their outer ends, and force it to move inwards towards the centre, and longitudinally outwards towards the open end.

410. GALLERY OR GLOBE HOLDER, *J. Fielding.—Dated 1st February*, 1879.—(*Not proceeded with.*) 2*d.*

Three or more hook clips are employed to hold the globe in position, one of them being made so that when turned aside it admits the diameter of the rim to pass, and when turned back again it fixes or holds the same.

411. HELMETS, &c., *E. Cooper.—Dated 1st February*, 1879.—(*Not proceeded with.*) 2*d.*

The body of the helmet is made up of two or more thicknesses of cork with a layer of muslin or leno between them, the layers being connected together by an india-rubber solution.

412. COMPOUND MICROPHONES, *L. J. Crossley.—Dated 1st February*, 1879. 6*d.*

A microphone is mounted on a parchment diaphragm and connected with a battery and induction coil, so that any variations in the microphone caused by sound waves effects a corresponding reaction in the strength of the current of electricity flowing through the microphone and induction coil. The variation also causes a variation in the current induced in the induction coil, which being connected to a telegraph line causes corresponding currents to flow through the telegraph or electrical wires, and by attaching a telephone to the distant end of these wires causes by the increase of the intensity of the sound produced, the message conveyed to be faithfully, plainly, and distinctly heard and recorded.

413. STOVES OR HEATING APPARATUS, *W. E. Gedge.—Dated 1st February*, 1879.—(*A communication.*)—(*Not proceeded with.*) 6*d.*

This relates to a hygienic prismatic stove or heating apparatus heated by a mixture of air and gas, without escape pipe, with boiler return of concentrated heat, movable fireplace and safety-cock indicating consumption of gas.

414. STAMPING AND GRINDING MINERAL AND OTHER SUBSTANCES, *R. J. Edwards.—Dated 1st February*, 1879. 6*d.*

This consists, First, in a reciprocating anvil block in combination with stamps actuated by cams or by steam or compressed air. Secondly, the combination with the reciprocating anvil block of crushing rollers or cylinders and transverse adjustable plates or forks. Thirdly, supporting the reciprocating anvil block upon friction rollers. Fourthly, a shield or cover having its lower edge dipping in water for the purpose of preventing dust from injuriously affecting the friction rollers and bearings.

415. PERFORATING MACHINE, *H. J. Haddan.—Dated 1st February*, 1879.—(*A communication.*) 6*d.*

This consists, First, in the combination with one of the cutter shafts of a universal joint for the purpose of enabling the cutters attached thereto to be lifted out of and returned into operative connection, and to be driven by gear wheels continuously in one direction without alteration of their relative positions. Secondly, in the general construction and arrangement of various parts of the machine, embracing the feeding in, cutting and conveying appliances, together with devices operating as stops, and an intermittent lifting mechanism common to certain of the parts, whereby the machine is adapted for the production of many varieties of work.

416. ELECTRIC LAMPS, *J. D. F. Andrews.—Dated 1st February*, 1879.—(*Not proceeded with.*) 2*d.*

Two plates of carbon are placed face to face at a little distance apart, and are connected to the electrical circuit, the voltaic arc presenting itself at some point of their peripheries, and as the carbons are consumed the arc travels round the periphery, and inwards towards the centre of the plates.

417. TRICYCLES AND BICYCLES, *J. T. Townsend.—Dated 1st February*, 1879.—(*Not proceeded with.*) 2*d.*

The backbone of the tricycle is made of a steel tube, and is carried from the steering wheel back under the driving axle, where it is turned up and over the driving axle towards the front wheel to a suitable position to receive the seat. To the back part are attached two arms. The pedal levers can be adjusted by making the part to which the connecting rod is fastened to slide to and fro along the pedal lever by means of a rack and pinion. The footsteps of bicycles are made adjustable by forming the bracket attached to the backbone with a socket, in which the stem of the foot-rest slides, and can be secured by a set pin.

418. STEAM ENGINES, *D. Greig, W. Hartnell, and W. Daniel.—Dated 1st February*, 1879. 8*d.*

A pair of engines are placed side by side, on a frame which carries a locomotive multitubular boiler secured to it, and in part resting on the engines. The cylinder of one engine is larger than that of the other, so the steam is expanded from the smaller through the larger cylinder. To facilitate starting and reversing an intermediate valve is provided, whereby steam may be admitted direct into the valve chamber of the larger cylinder if required; this valve may be so arranged that it is brought into action by putting the reversing lever a little beyond the position for running the engine with the slide valves in full gear, so that no second handle is required to open the intermediate valve.

419. TOBACCO PIPES, *L. B. Bertram.—Dated 1st February*, 1879. 4*d.*

A disc divides the stem into two parts, and through its centre passes a short tube opening one end into the channel leading to the bowl, and at the other into the chamber leading to the mouthpiece. The nicotine is retained in the first chamber, the smoke passing through the short tube to the mouthpiece.

420. BURNER FOR VOLATILE OIL LAMPS, *F. H. F. Engel.—Dated 1st February*, 1879.—(*A communication.*) 6*d.*

A cylindrical tube of length sufficient to reach nearly down to the bottom of the vessel containing the volatile liquid is employed. This tube contains a wick of cotton with an inner cylindrical core of wire gauze. Over the upper part of this wick tube, and outside the vessel, is placed a second tube, which exactly fits the inner tube. The outer tube is on the top furnished with a cover containing a number of small borings or perforations for the volatile evaporations or gases from the oil to pass through from the oil vessel of the lamp to the open air, *i.e.*, to the point of consumption. The gases when ignited give a number of flames more or less near to each other, and of volume corresponding to the number and size of the borings. Within the outer tube, and near to the mouth of the inner tube, a plug is fastened, furnished with four or more borings to allow the gases to pass through.

422. SET PANS, *J. Yeodon.—Dated 1st February*, 1879.—(*Not proceeded with.*) 2*d.*

These pans are made portable, and consist of a frame mounted on wheels and carrying a fire-grate, and at the top of the frame is a brick casing, the inside bottom portion of which is contracted and arranged to receive the fire. At the top of the contracted portion is placed the set pan, and the heat from the fire passes through an opening in the contracted part, and is prevented passing direct to the chimney by a midfeather placed in a vertical direction between the pan and the casing, so as to cause the heat to pass round the set pan before getting to the chimney.

423. SELF-ADJUSTING GANGTRYS, *W. Bockwood.—Dated 1st February*, 1879. 4*d.*

This consists in the construction of self-adjusting gangtrys of steel in which certain portions of the framework act as the elevating springs for the purpose of tilting up the barrel which it supports, thereby doing away with separate and distinctive springs.

424. APPARATUS EMPLOYED IN BLAST FURNACES, *T. Hollis.—Dated 3rd February*, 1879. 6*d.*

A tymp is employed to each open forepart furnace; such tymp, with the filling plates and wedges which secure it in position, is of the width of the open forepart. The central part of the outer side of the tymp projects, and forms a trough over which the cinder passes as it escapes through an orifice in the centre of the tymp.

425. CHRONOMETERS, CLOCKS, AND WATCHES, &c., *A. C. Henderson.—Dated 3rd February*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

On the prolonged shaft of the pinion of the time wheel of a clock is placed a small barrel, which gears with the central pinion inside the small plate. The spring of this barrel may be tightened at will, which communicates to the escapement the perfectly exact force required. The rest of the escape wheel occurs at the end of the detent, its small spring is placed below the detent on a ferule in the same way that a spiral is placed on the seat of a cylinder; the small spring may be placed on a plate, the escape wheel may be at a tangent, and the back spring is placed on a plate. A steel frame with arms is placed on the axis of the balance, and a copper frame on the steel one close to the axis. Bent levers are articulated to this frame, and compensating and regulating weights are fixed to the levers.

426. LOCKING OR SECURING NUTS, *A. Martyn.—Dated 3rd February*, 1879. (*Not proceeded with.*) 2*d.*

A slot is formed through the threaded portion of the nut, which is turned on the bolt, until such groove corresponds with a similar groove formed on the bolt, when a pin is introduced and prevents the nut turning.

427. ELECTRIC LAMPS, *C. Dubos.—Dated 3rd February*, 1879. 4*d.*

The carbon rods are of semicircular form, and two of them are mounted in a lamp, so that one point of each is towards each other, the other point being held in a socket at the end of a radius, so that the two carbons nearly complete a circle round a centre about which the socket radii are free to move. On the axis of each radius are fixed pulleys, round which cords pass, one cord in each case being connected to a lever acted on by an adjustable weight, which tends to force the points together. The other cord is connected to a soft iron core, free to move within a coil of wire that forms part of the electrical circuit. The core being attracted into the coils acts on the radii, so as to separate the points.

428. MANUFACTURE OF AGGLOMERATED FUEL FROM COAL DUST OR SLACK, *W. L. Wise.—Dated 3rd February*, 1879.—(*A communication.*) 4*d.*

The binding material employed is paper pulp, from 1 lb. to 10 lb. of which is mixed with 100 lb. of coals.

430. PACKING FOR STUFFING BOXES, *W. McGlashan.—Dated 3rd February*, 1879.—(*Not proceeded with.*) 2*d.*

The packing employed is made of wood pulp, which is strongly pressed in moulds to the form required, and has the property of slightly expanding when heated by steam.

531. REELING OFF OR UNWINDING YARN OR THREAD, *E. H. Dutton.—Dated 3rd February*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

The bobbins are sustained by carriers hinged to a fixed rail, and having mounted thereon a spindle to receive the bobbin. Above each spindle is a curl or guide through which yarn is led, and which is fixed to a part hinged to a second rail. The upper point of each spindle enters the corresponding curl and is held in a vertical position until the bobbin carrier is raised, when the spindle end is released and the carrier yields, whereby the spindle is inclined outwardly and the empty bobbin can be readily replaced with a full one.

432. UTILISING OSTRICH FEATHERS FOR THE MANUFACTURE OF COLLARS, MUFFS, &c., *M. Joseph.—Dated 3rd February*, 1879.—(*Not proceeded with.*) 2*d.*

Chamois leather is shaped to the required form, and the waste portions of ostrich feathers are split, prepared, cleaned and curled, and then secured by stitching or otherwise to the leather.

433. COMPOSITION FOR THE MANUFACTURE OF ELASTIC ROLLERS, *J. Burbridge, R. C. Thorpe, and T. Oakley.—Dated 3rd February*, 1879. 4*d.*

The composition consists of sulphurised linseed or other oil with fibrous material and gum, resin, or pitch, the softness and elasticity of the rollers being regulated by the quantity of fibrous material and gum, resin, or pitch in proportion to the sulphurised oil used.

434. RAILWAY BRAKES, *H. E. Newton.—Dated 3rd February*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

A continuous line of shafting, with suitable couplings between the carriages, extends from end to end of the train, and is connected with brake blocks applied to each wheel, so that by revolving this shaft from the engine, the whole of the blocks are simultaneously applied.

435. HYDRANTS AND STAND PIPES, *A. B. Houghton.—Dated 3rd February*, 1879.—(*Not proceeded with.*) 2*d.*

The hydrant or stand pipe is surrounded by an outer casing, the space between them being filled in with sawdust or other suitable substance, so as to prevent refrigeration.

436. TRAMWAYS AND RAILWAYS, *H. Vignoles.—Dated 3rd February*, 1879. 6*d.*

This consists, First, in the combination in tramways or railways of rails having a vertical web, with chairs having an upright formed to fit against one side of the web and under the head of the rails, the uprights of the chairs being secured by bolts to the webs of the rails. Secondly, in connecting together the abutting ends of the rails by chairs in close proximity to one another, and by a fish-plate extending from one chair to another, such fish-plate being applied to the opposite side of the rails to that which is bolted to the uprights of the chairs, and the fish-plates also being formed to fit at their top to the underside of the head of the rails, and at their bottom to rest on a ledge or projection on the chairs or on a flange at the bottom of the web of the rail.

437. SEWAGE WORKS, &c., *W. H. Denham.—Dated 3rd February*, 1879. 6*d.*

This consists, First, in an arrangement of tanks so that the upper part may be formed into a furnace. Secondly, in the erection of a tall chimney from the furnace or furnaces, vertically divided or not, but so constructed that each furnace may communicate with it. Thirdly, the forming of the bottom of each furnace of bars of iron or such other material as may be desired, so closely placed that nothing but finely calcined material may fall through them to the tank or tanks below. Fourthly, placing a short distance below the under surface of the furnace a revolving or otherwise movable sieve to ensure that nothing but finely calcined or pulverised materials pass from the furnace to the sewage below. Fifthly, the burning of house refuse, scavenger matters, earth, and other articles to be used as an agent to precipitate sewage either in the furnace or furnaces, or by other means.

438. WATERPROOFING WOVEN FABRICS, LEATHER, &c., *W. R. Lake.—Dated 3rd February*, 1879.—(*A communication.*) 4*d.*

The composition consists of:—Yellow or white wax of best quality, 1 kilog.; English varnish, ·060 kilog.; Burgundy pitch, ·040 kilog.; earth nut oil, ·080 kilog.; sulphate of iron, ·050 kilog.; essence of thyme (or other suitable essence), ·020 kilog.

441. BOILERS FOR RANGES, STOVES, &c., *H. Schooling.—Dated 4th February*, 1879.—(*Not proceeded with.*) 2*d.*

This consists in making those parts of the boiler which come in immediate contact with the fire, either of cast iron, or of thick wrought iron or copper, or any other suitable material, and such parts as do not come into such contact of light sheet iron or of any other suitable sheet metal which is capable of being easily shaped into any required form and size.

442. BUTTON-HOLE ATTACHMENTS FOR SEWING MACHINES, *S. Pitt.—Dated 4th February*, 1879.—(*A communication.*)—(*Complete.*) 10*d.*

This consists in the combination of a chambered turret single pivotted reciprocated driver and a ratchet wheel actuated by the driver on its upward movement only, and serving to impart motion by way of the crown wheel to cloth clamp acting mechanism.

443. APPARATUS EMPLOYED IN COMBING WOOL, &c., *J. Holden.—Dated 4th February*, 1879. 8*d.*

This relates to improvements on patent No. 3457, dated 31st August, 1878, and consists in preventing the heat of the steam used to heat the comb from operating to heat the central stud of the circle of comb teeth. For this purpose, in place of the central stud being simply bored to receive the exhaust pipe, the upper end of this pipe, within the stud, is applied into and so as to revolve with the central tube receiving the radial inlet and outlet conducting arms, and the lower part of the central tube with its exhaust tube is guided by a bearing carried by the top of the central stud, wood or other non-conducting material being inserted between the underside of the bearing and the top of the hollow stud, the size and bore of which are further increased so as to afford increased space between the exhaust pipe and the central stud. When employing a clearing comb to clear the teeth of square motion gill combs used as working combs in wool combing machinery, motion is given to the clearing combs by cam or tappet on the driving shaft of the square motion, thus enabling the adjustment of the time of action of such clearing comb as required.

444. GLOVE AND OTHER FASTENINGS, *E. Atkins.—Dated 4th February*, 1879. 6*d.*

This relates to improvements in and additions to solitaires, for the purpose of connecting the solitaires to the edges of the glove, and for facilitating and ensuring the proper fastening of the glove.

445. FOLDING HEADS OF CARRIAGES, *J. G. Harrison.—Dated 4th February*, 1879.—(*Not proceeded with.*) 2*d.*

This relates to mechanism combined with spring rods used for supporting or balancing the folding head.

446. SEWING MACHINES, *J. H. Johnson.—Dated 4th February*, 1879.—(*A communication.*)—(*Complete.*) 6*d.*

The feed surface is given the usual movement required in feeding, one excentric producing the vertical as well as the backward and forward movement. A vibrator intermittently relieves the pressure of the foot in order to facilitate the turning of the work. A friction pad holds the thread taut, and releases it automatically at the proper time. A guide and separator plate provided with a projection is adapted to form, when in position on the foot, a continuation thereof to prevent the work curling up, and to ensure the stitches being made at the proper distance from the edges. A plait guide embraces both edges of the plait or other material, the guide for the outer edge remaining stationary, while the guide for the inner edge is adjusted upon it as required for the width of the plait, the stationary part of the guide serving also to hold the plait to the throat plate.

447. COLOURING MATTERS, *C. Casthelaz.—Dated 4th February*, 1879.—(*A communication.*) 4*d.*

This consists in the employment of chlorophtalic or nitro-chlorophtalic acids in the preparation of colouring matters.

448. PACKINGS FOR PISTONS AND STUFFING BOXES, &c., *A. M. Clark.—Dated 4th February*, 1879.—(*A communication.*) 6*d.*

This consists of an elastic packing having three portions arranged as follows:—First, a straight or cylindrical spiral made to close by its own elasticity upon the piston rod (or between the heads of the piston), following and fitting its surface. Secondly, a straight spiral made to expand by its own elasticity and fill the stuffing-box or cylinder. Thirdly, an intermediate tapered or conical spiral portion which connects the first and second parts, permitting by its elasticity and the flexibility of its coils in sliding upon each other, the friction of motion required by the first and second parts independently of each other, and without causing such a separation of the parts as shall permit leakage in any place.

449. FLESHING MACHINES, *R. Middleton.—Dated 4th February*, 1879. 6*d.*

A cylinder is provided with spirally placed cutters on its periphery and it is mounted between framework in bearings or slide blocks fitted within suitable slide bars on the framework. To the cylinder is imparted a reciprocating motion and simultaneously therewith a rotary motion. A flat table is provided below the cutter, which is supported on castors arranged so that it may be moved in any required direction, and on it is fixed the hide to be fleshed by a clamp or other means.

450. ENVELOPES AND WRAPPERS. *J. Stubbs.—Dated 4th February*, 1879—(*Void.*) 2*d.*

This consists of a note sheet or letter and envelope all in one piece.

451. KNITTING MACHINERY, *M. Grieve.—Dated 4th February*, 1879. 6*d.*

This consists in the combination with a head of a main thread carrier of bolts acting in conjunction with inclines to operate additional or splicing thread carriers.

452. APPARATUS FOR HEATING AND COOLING LIQUIDS OR GASES, &c., *J. Price, jun.—Dated 4th February*, 1879. 6*d.*

A series of tubes, placed preferably one within the other, are fixed between end plates forming chambers, which are divided into sections fitted with inlet and exit pipes, and perforated so that alternate annular chambers are in communication with each other and with one set of these sections, and the remaining alternate chambers are in connection with the other set. The steam or gas to be condensed, or the water or gas to be heated, flows through one set of chambers, and the cooling or heating medium through the other set.

457. SHEARS, *C. G. Hallas, F. W. Flower, and E. Pearson.—Dated 5th February*, 1879. 6*d.*

The steel is rolled to the required dimensions and passed through two cast iron chilled rolls of equal diameter, and caused to rotate at equal speeds. These rolls are provided on their periphery with depressions forming counterparts of the shears, one half being on one roller, and the other half on the other, the depressions being so arranged relatively to each other that the pressure is exerted where required, and the metal forced into the cavities as the rolls revolve.

453. MOULDS AND CORES FOR USE IN CASHING STEEL, *A. M. Clark.—Dated 4th February*, 1879.—(*A communication.*)—(*Complete.*) 2*d.*

The mould is made of silica obtained from rocks, crystals, white pebbles, or white sand, and mixed with suitable binding materials, such as molasses, sour beer, flour, or other glutinous substance, silicate of alumina, or the like, care being taken to employ no substance containing any metallic oxide or anything that might flux.

455. APPARATUS FOR COMPRESSING, DRYING, &c., WASHING BLUE, *R. Ripley.—Dated 5th February*, 1879. 6*d.*

This consists, First, in the manufacture of blocks of blue and other substances from caking material, of the employment of a cam or its mechanical equivalent arranged so as to always bring the die gradually down to one special position and—preferably by a continuance of the same movement—raise it again to its highest point, when it is stopped and securely held from descending by a notch or its mechanical equivalent. Secondly, in the combination of a lever, movable block, chamber, tray, and upper block, pressed down by a cam or its mechanical equivalent.

456. COMBINED SYRINGE, WHISTLE, AND POP GUN, *C. F. Stahlecker.—Dated 5th February*, 1879.—(*Not proceeded with.*) 2*d.*

This relates to a combination of syringes, a whistle having a musical scale and a pop gun, whereby one of these articles may be used as required.

458. PAPER-MAKING APPARATUS, *D. Smith.—Dated 5th February*, 1879.—(*Not proceeded with.*) 2*d.*

This consists in combining with the usual apparatus and in place of what is known as the hog vat, a piece of apparatus through which the stuff is passed immediately before being delivered upon the wire.

459. APPARATUS FOR CUTTING, RULING, OR PERFORATING PAPER, &c., *The Hon. H. N. Waldegrave.—Dated 5th February*, 1879.—(*Not proceeded with.*) 2*d.*

A bed-plate is provided of wood, and having an even top face of glass, metal, or other suitable substance. At one side is fixed a guiding projection or bar, and on the same side is arranged the fulcrum for a hinge bar, which extends across the width of the bed-plate, and in or on which is arranged a sliding block having a pin which can slide in a slot of a bar fitted thereon; this latter bar is at its lower end provided with one or more cutting, perforating, or marking wheels, or other cutting, perforating, or marking appliances which may be interchangeable or not.

460. HEATING AIR FOR DESSICATING YARNS, &c., *S. Hallam.—Dated 5th February*, 1879. 6*d.*

This consists in the combination and arrangement of plates, baffiers, and enclosing jackets, or envelopes to absorb radiant heat in conjunction with steam or otherwise heated pipes.

461. MANUFACTURE OF CITRATE OF MAGNESIA. &c., *G. Wheeler.—Dated 5th February*, 1879. 6*d.*

A double tank is employed, between which a circulation of cold water is maintained, in order to keep the inner tank cool. In this tank the various chemical ingredients are mixed, and owing to the coldness of the tank begin to slack, soften, or deliquesce. The ingredients so softened

are fed into moulds and placed in a screw press, when plungers enter the oulds and compress the ingredients into solid blocks.

462. STEAM ENGINES, *G. Saxon.—Dated 5th February*, 1878. 6*d.*
This consists in attaching a block between the main slide and the cut-off valves, which has ports on each side to suit the motions of the main slide and cut-off valves respectively.

463. STEAM CHESTS, &c., USED IN PRINTING, DYEING, AND BLEACHING, *H. Turner and J. Ruscoe.—Dated 5th February*, 1879. 2*d.*
This consists in enamelling the surfaces of cast and wrought iron steam chests, drying cylinders, colour boxes, dye vats, bleaching kiers, pipes, and other articles or utensils used in printing, dyeing, and bleaching.

464. BAKERS' OVENS, *J. and R. A. Tomlinson.—Dated 5th February*, 1879. 6*d.*
This consists in heating two bakers' ovens by one fire-grate or furnace; this grate is placed between the two ovens, and each oven is connected to the grate by two flues, one of which is for heating the back of the oven, and the other the front end. Each flue is provided with a damper, which can be opened or closed when required. Above the fire-grate is a steam boiler, the steam from which is conveyed by pipes to the furnace; the water from this boiler can also be utilised for mixing the dough or other purposes; and the boiler is provided with a gauge to indicate the level of the water. The furnace doors slide in side grooves, and are opened sideways, and at the joint is a rabbet to make an air-tight joint.

465. LUMINOUS ELECTRIC BUOYS, &c., *S. W. M. de Sussex.—Dated 5th February*, 1879. 2*d.*
This relates to improvements on patent No. 2194, dated 5th June, 1877. The buoy is provided with the battery constructed as described in that specification, but having the panels by which the elements are separated made much thinner; this allows a larger number of elements to be included in the same space.

466. PIPE WRENCH, *J. Wells.—Dated 5th February*, 1879. 6*d*
This consists of a pipe wrench in which one of the inclined jaws is made movable, and capable of being adjusted at the proper distance from the other fixed jaw by means of a rack and rotating worm.

467. LAMPS, *H. E. N. Mason and J. Price.—Dated 5th February*, 1879. 6*d.*
This consists in combining the holder and gallery for carrying the chimney and globe and the dome of the burner together, so as to constitute one piece or one article, and separate from the body of the burner, so that by removing the said separable part the chimney and shade and dome are removed together, and the wick or wicks exposed for trimming.

468. MACHINES FOR POLYCHROMATIC PRINTING, *W. L. Wise.—Dated 5th February*, 1879.—(*A communication.*) 6*d.*
The plate cylinder is somewhat smaller in diameter than the impression cylinder, so that supposing the machine to be a five-coloured machine the periphery of the impression cylinder is one-sixth larger than that of the plate cylinder, the former revolving five times whilst the latter revolves six. Each sheet fed into the machine is printed with six copies of a picture with five different colours. Each plate of the cylinder is adapted to print a certain definite colour, and each comes into use during one rotation of the plate cylinder. A separate ink reservoir and distributing rollers and inking rollers are provided for each plate, and rise or fall into or out of contact with their respective plates, as the latter are brought under their proper rollers.

469. TREATMENT OF PAPER AND PARCHMENT TO DETECT ERASURES, *N. J. Heckman.—Dated 6th February*, 1879. 2*d.*
This consists in placing in the size (used in the finishing process of paper making) equal parts of prussiate of potash and sulphuret of ammonia in the proportion of 6 oz. of each to every gallon of size. The paper or parchment is to be passed through this solution, and finished as in making ordinary paper; any colour or tint can be added as at present.

470. PROCESS AND APPARATUS FOR MANUFACTURING ICE, &c., *A. Crespin.—Dated 6th February*, 1879.—(*A communication.*) 2*d.*
This consists in the employment of chlorure of methyle as a means of refrigeration and the production of ice. The apparatus is composed of a pump to produce a vacuum above the chlorure of methyle, so as to quicken the evaporation of methyle, and afterwards to compress the vapours so as to liquefy them again. The pump is a two-cylinder pump; the piston of the first cylinder forces the gas into the second cylinder of three or four times less capacity, and which in its turn forces it into a tubular receiver, through which passes a current of fresh water. The chlorure of methyle liquefies, accumulates, and returns to its starting point. The liquid to be cooled should be uncongealable. Moulds may be employed containing water, which would be converted into ice.

472. BLOW PEDALS FOR ORGANS, *E. T. Hughes.—Dated 6th February*, 1879.—(*A communication.*) 6*d.*
The bellows are arranged so that young children can blow for themselves, and it consists in combining with the principal pedal (usually near the floor) a second pedal above, made to engage with the bellows strap when desired, and so that the bellows may be operated either by one pedal or the other.

473. PERCUSSION CAPS AND DETONATORS, *F. Wirth.—Dated 6th February*, 1879.- (*A communication.*) 4*d.*
The bottom of the cap is weakened by a ring or cross, and the sides are strengthened as much as possible. The cap is closed firmly at the top by placing a conical copper cap within it, provided with a hole in its bottom.

474. IRON AND STEEL FENCING, &c., *M. Bayliss.—Dated 6th February*, 1879.—(*Not proceeded with.*) 2*d.*
This relates to those uprights for fencing and hurdles which have a stronger section of metal at the lower end thereof. The stronger section is formed solid upon the uprights by rolling instead of welding it thereto, as in the ordinary manner.

475. COAL MINING AND ROCK DRILLING MACHINES, *B. J. B. Mills.—Dated 6th February*, 1879.—(*A communication.*) 6*d.*
The machine is constructed with a drill or pick having a cancave face or end and thin concave edges. A longitudinal reciprocating motion is imparted to this drill by a piston working in a horizontal cylinder and driven by compressed air or steam, which is admitted to the ends of the cylinder alternately by means of either a rotary or reciprocating valve, driven by a double rotary engine, consisting of a pair of excentrics coupled together so as to stop and start at any point, and governed by two slide valves held down by air or steam pressure. The motion of the machine is regulated by a throttle operated by a lever on the end of the valve chest.

476. LADDERS FOR BUILDING, &c., *B. J. B. Mills.—Dated 6th February*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*
The apparatus consists of a platform supported at the top of a double series of articulated rhombs, connected together at their axes or angles by rods, and employed to effect the raising and lowering of the platform in a similar manner to the extension and contraction of a pair of "lazy tongs."

477. GALVANIC BATTERIES, *T. Slater.—Dated 6th February*, 1879. 6*d.*
This consists in using metal nickel in combination with flat or cylindrical plates of carbon, platinum, or other suitable metal in single or double fluids as excitants, which may be any of the well known solvents of nickel.

478. INSTRUMENT FOR SIMULTANEOUS IGNITION OF A NUMBER OF FUSES, *W. Bickford-Smith and G. J. Smith.—Dated 6th February*, 1879. 6*d.*
This consists of a cylinder of tin-plate, zinc, wood, or other suitable material, the diameter of which is in proportion to the number of fuses it is desired to ignite simultaneously. Into one end of the cylinder is fitted a socket or block formed of wood or other suitable material, through the centre of which a hole is bored, the diameter of which is proportioned to the size of the single fuse by which the number of fuses are to be ignited. At the base of the block or socket within the cylinder, and placed close against the end of the hole through the block or socket, is inserted a disc, wad, or cap, of a size proportioned to that of the cylinder, and made of, containing, or saturated with some inflammable material. The ends of the several fuses to be simultaneously ignited are brought together and inserted within the cylinder, so that they abut against the inflammable disc, wad, or cap.

479. PIPE VICES, *J. N. Sperryn.—Dated 6th February*, 1879.—(*Not proceeded with.*) 2*d.*
The gripping face of the jaw has transverse slots extending from side to side of the jaw to receive steel pins. These slots may be dovetailed or undercut, or they may be larger at one end than the other, the steel pins in either case being of corresponding form, so as to be driven tightly into the slots and retained securely therein with one of their edges or angles projecting from the jaw to ensure a firm grip of the pipe or other object.

480. MEANS OF FACILITATING PICKING UP CHANGE AND TICKETS AT BOOKING OFFICE WINDOWS, &c., *M. C. Greenhill.—Dated 6th February*, 1879.—(*Not proceeded with.*) 2*d.*
The counter of the window is provided with a lip or flange rising about 2in. above the general level of the counter, and sloping upwards in a direction towards the front of the window, so that the payee, by drawing or sweeping with the ends of the fingers the coins or tickets up the inclined lip, may readily seize them between the fingers and thumb on their arrival at the edge of the said lip.

481. TENTER AND OTHER HOOKS, *E. Walker.—Dated 6th February*, 1879. 2*d.*
This consists in the manufacture of hooks of a mixture of tin and zinc, of about the proportions of three parts tin to one of zinc; this is cast, rolled, or stamped to the form of the hook required; or a like composition of metals may be run or cast upon and around a core, hook of iron or other metal.

482. TRIMMINGS FOR ARTICLES OF DRESS, *J. Steiger.—Dated 6th February*, 1879.—(*Not proceeded with.*) 2*d.*
This consists in combining lace and embroidery in such a way as to produce an elegant trimming.

483. LACE CURTAINS, *J. Steiger.—Dated 6th February*, 1879.—(*Not proceeded with.*) 2*d.*
This consists in applying Jacconet muslin or other suitable material, and tambour or chain stitch on the muslin round the design upon a lace curtain as produced in Nottingham, after which the muslin outside the pattern or design is cut away, thus producing a combination of a Swiss tambour applique, and a Nottingham lace curtain.

484. MANUFACTURE OF GLASS, *J. H. Johnson.—Dated 6th February*, 1879.—(*A communication.*) 6*d.*
This consists, First, in melting the glass in one furnace at a high temperature, and then tapping the contents into a separate and independent working furnace or trough maintained at a lower temperature. Secondly, causing the heated lining of the furnace above the body of glass to take at intervals a position below the same, while the surface is acted upon by a flame. Thirdly, the combination of a movable melting furnace with a working trough or troughs, into which the contents of the furnace can be discharged. Fourthly, the working trough or furnace, consisting of a longitudinal chamber having an arched roof, in which are working holes.

485. SOUNDERS FOR TELEGRAPHIC PURPOSES, *J. R. Edwards.—Dated 7th February*, 1879.—(*Not proceeded with.*) 2*d.*
The single form of the instruments consists of a stand carrying a permanent magnet, preferably of horseshoe form, one pole being made longer than the other, and placed uppermost. Below this long pole is fixed an electro-magnet having a soft iron core passing through the long pole of the permanent magnet, and magnetised by it, and made in two parts capable of being adjusted at any required distance from each other by a screw or its equivalent carried on a bracket on the long pole of the magnet or otherwise. Below the shorter poles of the permanent magnet is placed another electro-magnet with an iron core capable of being adjusted in regard to its height above the coil. A soft iron armature carrying at its outer end the brass hammer for striking the sounding plate, bell, or drum, is hinged or pivotted to the short pole of the permanent magnet, and magnetised by it.

486. BICYCLES, &c., *F. Cafferata.—Dated 7th February*, 1879. 4*d.*
The fork is formed of three or more tubes on each side, made of weldless drawn steel, and brazed to the lower crosshead, the upper crosshead, and at bottom to the joint or hinge to which the bearing is attached. The main hole in the crank and the end of the main crank axle are made oval and split at the base, and beyond the hole the split end is clasped to the crank body by a bolt or nut. By slackening the nut the crank can be adjusted.

487. RAILS, WHEELS, AND FISH-PLATES FOR TRAMWAYS AND RAILWAYS, *T. Floyd and W. H. Penning.—Dated 7th February*, 1879. 6*d.*
The rail is triangular in section, each face being grooved to serve in turn as the wearing surface thereof. Two or more grooves may be made in each face, in which case the wheel of the vehicle to run thereon is provided with a corresponding number of flanges. The fish-plates consist of a plate pierced for bolts at each end, and having near the centre two or more studs on one side to fit into holes in the rails.

488. CARDING MACHINES, *R. and J. H. Smith, and H. Mills.—Dated 7th February*, 1879. 6*d.*
In order to produce flaked, clouded, or spotted yarn, roving or slubbing threads from condensers are conveyed from one or more condenser bobbins through feed rollers to a taker-in roller on the cylinder, doffer, or doffers of the condensing carder. The taker-in roller has on it strips of card of equal or unequal widths, and placed at suitable distances apart. This roller lays the roving or slubbing threads upon the cylinder doffer or doffers of the condensing carder, where it blends with the wool or other fibre on the carding engine.

489. MARKING OR PRINTING ON SPOOLS, *S. Bash and H. Levy.—Dated 7th February*, 1879.—(*Not proceeded with.*) 2*d.*
This relates mainly to the application of markings or printings to the barrels of the spools or bobbins, and consists in effecting such application by a process of direct printing on the wood or other material of the spool or bobbin, instead of gumming or otherwise attaching thereto separately printed labels.

490. BATCHING JUTE, &c., *F. S. Sandeman and J. McLean.—Dated 7th February*, 1879. 4*d.*
This consists in employing as the batching liquid a decoction formed by boiling in water, seaweed, or freshwater plants, or soapwort, or a mixture of two or more of these vegetable matters.

492. PRODUCTION AND APPLICATION OF MOTIVE POWER, *L. A. Aspinall.—Dated 7th February*, 1879.—(*Not proceeded with.*) 2*d.*
To the interior of the steam space of a steam boiler is connected a battery or other source of electricity by wire, and the electric spark or flash is caused to act upon the steam. The steam pressure is thus increased according to the strength of the current or number of wires, and "electro steam" is produced, which is utilised for the production of power in a piston motor engine constructed with insulated parts where required.

493. BOTTOM DOORS OF RAILWAY WAGONS, *R. Morton.—Dated 7th February*, 1879. 6*d.*
A shaft is mounted transversely across the bottom of the wagon and at either extremity of this shaft is keyed an actuating lever, so as to enable the same to be worked from either side of the line of rails. An arm branching from this shaft is connected by a link to a weighted double lever suspended underneath the framework of the wagon, the shorter arms of which lever are designed to hold the doors in the closed position after releasing the ordinary bolt. This arrangement of lever is capable of being locked in the closed position, and by its means the doors may be opened simultaneously from either side of the wagon.

494. LAMPS, *J. P. Lawrence.—Dated 7th February*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*
This consists in the provision and employment of a metallic disc, having a central opening or aperture of about the diameter of a lamp chimney, the said disc being applied to a common glass globe, so as to form a top thereto, the said globe being fastened on a lamp burner in the same manner as lamp chimneys are usually fastened.

495. CALORIC ENGINES, *M. P. W. Boulton.—Dated 7th February*, 1879. 6*d.*
A heating vessel is provided, within which air is heated at a high pressure. A cylinder is fitted with a piston, which drives the engine. A vessel is provided, fitted with a piston or movable diaphragm for causing displacement of air. Charges of cold air are received in this vessel and transferred to the heating vessel, and it also receives hot air, which performs work in the cylinder engine. Two passages are formed between the charging vessel and the heating vessel, and a regenerator is provided communicating with one of these, being placed between the heating and charging vessels. A pump compresses the air, which passes to an air vessel, the pressure in which is higher than that of the atmosphere, but lower than that in the heating vessel.

496. SHIP AND OTHER LAMPS OR LANTERNS, *A. M. Silber.—Dated 7th February*, 1879. 6*d.*
This consists in the combination of a uniformly thin well annealed inner glass secured to the body of the lamp or lantern with an outer glass (which may be lenticular) secured in a separate light frame loosely held to and supported on the body of the lamp or lantern, so as to give free air passage above and below, and at the sides thereof and between it and the inner glass.

499. PLATES AND DISHES, *H. Benson.—Dated 8th February*, 1879. 4*d.*
This consists in forming recesses upon or in the upper outer rim for the reception of salt, mustard, or other seasoning.

FIRE PROTECTION OF THE SUBURBS.—The North Metropolitan Fire Brigade, of which Mr. Lutwyche is the captain, have acquired a powerful Merryweather steam fire-engine, provided with all the most recent improvements, and placed it at their chief station, Lower Clapton; and within the past few days, the South London Volunteer Fire Brigade have been supplied with a steam fire engine of Captain Shaw's pattern, by the same makers, which has been stationed at the head-quarters, Weardale-road, Lee, thereby increasing considerably the means of prompt fire extinction in this part of the metropolis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION, SOUTHAMPTON BUILDINGS, CHANCERY LANE.—The fifty-seventh session of this Institution will commence on Wednesday next, on which occasion the inaugural address will be delivered by Canon Farrar. The evening classes, which are open to ladies and gentlemen, include English, French, German, Italian, Spanish, Portuguese, Latin, Greek, mathematics, arithmetic, book-keeping, natural and mechanical science, logic, political economy, law, literature, history, geography, hygiene, short-hand, drawing, painting, music, &c. &c. Special classes will also be held for the London University Examinations. Some indication of the work carried on by this Institution will be gathered from the fact that one hundred classes meet weekly in the various subjects. The committee hope that the appeal for funds to erect a new building, which is so urgently required, will meet with a generous response. Amongst the contributors are Prince Leopold (the patron of the Institution), and the Corporation of London.

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

(*From our own Correspondent.*)

UPON every hand there is a disposition this week to as much as possible postpone all fresh buying till the quarterly meetings have removed all lingering doubts as to the prices which, for rolled as well as raw iron, are likely thereafter for a time to prevail. Consequently only few new orders are this week being distributed at any of the mills.

The rates at which the bulk of the sheets are now being sold are not quotable. They are stronger for the moment by the strength of the quotations of the galvanised sheet firms. Makers are asking £1 10s. advance on all current sales. It is inferred that the stocks on hand in Australia have likewise been realised on the same terms, and that the advance has been established at the Antipodes.

Common bars hold to their rise of the 5s. per ton which was necessitated by the scarcity of old rails, which were raw materials extensively employed. Bar firms who had been relying on that material are now entering the pig market upon unfavourable terms compared with the firms who had been making bars from puddled iron; and in the new business the latter firms, who have stocks of pigs, are getting the pull.

Upon hoops for petroleum barrels, upon strips for cotton and wool baling, and upon strips also for tube-makers, the strip mills are fairly employed, but they are complaining that new orders are not now arriving. The prices at which most of the new orders have been taken are very irregular, and mostly leave but a very fine margin of profit.

The marked bar houses are not busy, yet they hold their iron for the full list rates of £7 10s. A similar report has to be made of the best plate firms. Orders for common plates and angles are not easy to secure from the engineers; and there is less doing at the mills and forges whence the smaller engineering and the hardware firms obtain their supplies. The railway bolt firms are not buying so freely as lately, and there is at length a falling off in the demand, on account of the agricultural fencing firms who have long had a splendid run of business.

It is noteworthy that the nut and bolt firm in Wolverhampton is executing the order for the bolts for 40,000 tons, of the 65,000 tons of steel rails distributed recently for the Canadian Pacific Railway Company. Yesterday, however, the order was reduced by 5000 tons, for the Canadian Government have to that extent reduced their total order for rails, which now therefore stands at 60,000 tons.

So well sold are the majority of the pig firms, that few would either to-day in Birmingham or yesterday in Wolverhampton book forward orders.

The attitude of the millmen in the Cleveland district in resisting the arbitration award was much discussed on 'Change in Birmingham to-day, and it was strongly condemned.

Amongst the enquiries in the market for heavy ironfounding work, is one by the sanitary authorities of Tamworth, for about 900 tons of cast iron pipes from 9in. to 2in. in diameter, together with some other castings. They will be required for conveying the water from the reservoir which I last week reported had been sunk.

The wire-drawers are busier, and an advance of 2s. 6d. per ton is being asked on fencing sorts. This week a telegram has been received from South America by a leading firm of merchants, ordering a considerable quantity of fencing wire. It is believed that the reason for ordering with this despatch is to be found in advices sent out from this side intimating that prices were strengthening.

Foreign competition is still troublesome. French and Belgian hardwares and machinery are being imported into Birmingham, and offered for sale at quotations which leave native manufacturers at no advantage, but rather a disadvantage, in the competition. French pocket-knives are coming here in large numbers, but it is believed they are for re-shipment.

An important advance has been made in the enamelling business by a Wolverhampton firm, who have produced and patented a lustrous enamel, which imparts to the goods a bright, silvery appearance. The new process is being applied to lamp reflectors and to gas cones for sunlights, and a street lamp having one of the new reflectors for its upper part is about to be practically tested by the Birmingham Corporation. General hollow-wares can be equally treated in the new style.

The rise in copper and brass is causing an advance in certain manufactures into the composition of which these metals largely enter. Copper wire, sheets, and tubes are quoted up ½d. per lb., and brass wire, sheets, and tubes ½d. per lb.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

THERE has been a very firm tone in the iron trade of this district during the past week, but this has been influenced more by the rapid upward movement in prices which has taken place in the Scotch and Middlesbrough markets than by any real increase in the amount of iron going into actual consumption locally. For shipment there is still a considerable inquiry, and I have heard of several good orders having been given out during the past week on American account, but the requirements of consumers here do not show any material increase, and although the advance in prices has caused some excitement amongst dealers and speculators who have not yet covered themselves, founders, engineers, and merchants, as a rule, seem disposed to hold back in the expectation that the present spurt in the market will be only of a temporary character.

In Lancashire pig iron there is not very much doing at the prices now quoted, viz., 47s. per ton for No. 3 foundry, and 46s. 6d. for No. 4 forge, less 2½ per cent., delivered into the Manchester district; but local smelters are not pressing for new orders at present, as they do not care to interfere with their stocks, and their output is already sold for the remainder of the year. In a recent report I stated that local smelters were making preparations to increase their production, and the Wigan Coal and Iron Company, one of the largest concerns in Lancashire, have just blown in two of their large furnaces. The company own ten furnaces, five 80ft. high and five 65ft. high, worked by three engines of 350 nominal horse-power, but during the recent period of depression not more than four of the furnaces have been in operation. Three years ago it was decided to adapt the Whitwell hot blast stoves to a couple of the large furnaces, but owing to the depression in trade the work was suspended. The recent improvement has, however, induced the company to complete the work, and the Whitwell stoves are now in operation in the two furnaces which have just been blown in. By these stoves, it is stated, the blast can be raised to a temperature of 1800 deg. to 2000 deg. Fah., and with this increased temperature there is a corresponding decrease in the amount of fuel consumed per ton of iron produced, the saving effected being estimated to average from 1 cwt. to 2 cwt. of coke per ton of iron. Should the stoves prove a success I understand that in all probability they will be applied to the whole of the ten furnaces.

In outside brands of pig iron a moderate amount of business has been doing, but this has been chiefly in Lincolnshire and Derbyshire; the advanced prices asked for Scotch and Middlesbrough have operated as a check upon buyers. It is difficult to say what prices have really been ruling in the market, as quotations have varied so much, some sellers indeed declining to quote at all for the present. For No. 3 foundry Middlesbrough the prices asked have ranged from about 45s. to 46s. 6d. per ton net cash delivered equal to Manchester; in Lincolnshire iron there have been sellers at 44s. 10d. for No. 3 foundry and 43s. 6d. for

No. 4 forge, less 2½ per cent., whilst others have quoted fully 1s. 6d. per ton above these figures; for Derbyshire iron 47s. per ton has been quoted for No. 3 foundry, and 45s. for No. 4 forge, less 2½ per cent.

In the finished iron trade generally there are reports of improvement. Many of the forges are now pretty well supplied with orders up to the end of the year, and manufacturers are asking higher prices, whilst there is less disposition to book contracts for anything like extended deliveries, owing to the uncertainty as to the course which the pig iron market may take. For Lancashire bars delivered into the Manchester district the average quotations range from £5 10s. to £5 15s. per ton.

Founders are reported to be better supplied with orders, and in engineering work there is rather more doing; but machinists generally continue very slack. One of the large ironworks in Cheshire, which has been closed for twelve months, has, I understand, been again started, owing to considerable orders having been received from America.

In the coal trade there is a rather better demand for house fire classes of fuel, and some advance in prices will be made in the Manchester districts at the close of the month. Other classes of fuel are without change, there being no material improvement in the demand for either forge or engine coal, and prices are quite as low as ever, with contracts being competed for at extremely low figures. Best Lancashire house coal at the pit mouth can be bought at from 8s. to 8s. 6d. per ton; second qualities at from 6s. to 7s.; common coal at from 4s. 6d. to 5s. 3d.; burgy at from 3s. 9d. to 4s. 3d.; and slack at from 2s. to 3s. per ton, according to quality.

For some weeks past there has been a gradually improving tendency in the North Lancashire and Cumberland iron trade, and makers of metal have by degrees assumed a firmer position. It was thought a short time ago that the large number of orders offering were the result of the low prices which have of late been ruling, and it was thought any advance on these prices would destroy the demand, but sales for early delivery have been made to such an extent, and makers have so well sold forward, that prices have as a consequence improved from 52s. 6d. for No. 1 Bessemer to 55s. per ton at makers' works, with No. 2 at 54s., and No. 3 at 53s. per ton, and 54s. as a figure for an all round purchase. Forge iron is selling well, and Bessemer qualities are in large consumption not only by steel makers in the locality, but by users at a distance. A very large amount of metal is still being shipped to America and the Continent, and before the close of the ensuing month a very large delivery will be made. The demand from America shows every disposition to increase, and it is not improbable local makers will have a large work to do during the winter for delivery next spring across the Atlantic. I am told there are better prospects for iron shipbuilders, and that although the price at which iron ships are now built is very low and scarcely such as will leave a profit, several considerable orders are expected. The Barrow Shipbuilding Company have accepted an order from the Great Eastern Railway Company for the construction of a large passenger paddle steamer, which is intended for the Rotterdam and Harwich station. The new steamer will be built of steel, her dimensions being—length between perpendiculars, 254ft.; breadth, 32ft. Her engines will be of the oscillating class, and capable of indicating 1600-horse power.

The iron ore trade shows a marked improvement, the demand having improved and prices having advanced 6d. or 1s. per ton. The coal and coke trades are better employed.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

PRICES of coal and iron are unquestionably "stiffening"—the former, so far as household sorts are concerned, in view of the winter, and the latter in expectation of a still more marked improvement in the heavy trades. I am afraid that this revival of business, of which everybody is speaking, is not so general as have been represented. During the last fortnight I have been trying to discover specific instances of orders—I mean orders of consequence—received by local establishments. Such an inquiry, of course, is met by the not unnatural reticence of one firm to let another know what they are doing, and the information afforded is usually given on such conditions as to publicity as reduce it to a general statement of very little weight indeed.

Pig iron is undoubtedly in greater demand. At three local works furnaces have been re-lighted; but then I am told that this is owing quite as much to the exhaustion of old stocks as to any fresh impetus given to trade. Part of it may also be attributed to the briskness in steel rails, which are certainly being turned out in enormous weight. A better feeling is prevailing in this branch, and there is a decided tendency to insist on higher quotations. Railway companies are ordering heavy quantities, in the expectations that rates are bound to rise. The Midland Railway Company has recently re-laid a considerable length of its line in this district with a very heavy section of rail. The contracts have been executed by Messrs. Steel, Tozer, and Hampton, the Phœnix Works, Ickles, Rotherham; and Messrs. Wilson, Cammell, and Co., Dronfield Steel Works.

Mr. Charles Markham, managing director of the Staveley Coal and Iron Company, Limited, has hit upon an improved chair for the rails to rest on. I saw one in the hall of the company's offices last Monday. It looked more substantial than the ordinary chair, and its arrangement appeared to be well adapted for firmly securing the rail. On the Midland line I noticed the other day that the distance between the sleepers was being reduced—three sleepers being put down where only two were formerly placed. This must tend to secure a smooth run, especially with the heavy rail now being laid down.

Mr. W. Harrison, Mr. W. Hudson, and Mr. G. Fisher, three Sheffield manufacturers, who have sailed for the United States, have been commissioned by the Chamber of Commerce to wait upon Sir E. Thornton, the English minister at Washington, in reference to commercial matters in which Sheffield is keenly interested. The chamber have also resolved to furnish certain information with regard to our commercial intercourse with Servia. In reference to France, further communications have been received from the Government, from which it appears that our commercial treaty is to continue for six months after the prolongation of a new general tariff in that country.

During the week there have been fresh speeches on free trade and modified protection. The Duke of Rutland, speaking at Bakewell Cattle Show, read to the farmers the speech of Alderman Ward—Mayor of Sheffield—recommending 5s. per quarter duty on corn, which he warmly advocated. The Mayor is in daily receipt of letters from all parts of the country thanking him for the stand he has made against one-sided free trade.

Further difficulties have occurred in the coal trade. Restriction of output is threatened by the miners unless the masters will concede 10 per cent. advance, which they are not likely to do.

The directors of Messrs. Charles Cammell and Co., Limited, Sheffield, at their meeting on Wednesday last, decided upon the payment of an interim dividend after the rate of 5 per cent. per annum, payable on the 1st of October next.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

A VERY considerable rise has taken place in the Cleveland iron market, which has had the effect of turning the heads of some pig iron makers. Pig iron which last week could be bought for 35s. 9d. net cash No. 3, jumped on Tuesday to 38s., and 40s. was offered for delivery over the next three months. Unfortunately, however, beyond the demand from America, which does not do very much more than compensate for the falling off in the continental demand, there is nothing to warrant this sudden rise other than the fact that the Scotch market has rapidly risen. The causes which have tended to bring about improvement in the Scotch pig iron trade are not operative in Cleveland. Blast furnaces are being blown in instead of out, and the make is quite equal to the demand. This sudden rise will have a very ugly effect upon those merchants who have contracted to supply iron ahead at the rates prevalent a week ago. Scarcely less disastrous will it be to iron manufacturers who are unable to obtain enhanced prices, while compelled to pay much more for their raw material. Messrs. Connal and Co.'s stock of Cleveland iron has increased to 83,000 tons.

The manufactured iron trade is very quiet. Mr. Dale's award on the question of a general reduction of 6d. per ton in puddling, and 5 per cent. in other forge and mill wages, being in the negative, has given great satisfaction to the general body of ironworkers, whose wages are really very low. On the question, however, of a reduction of 15 per cent. in the wages of higher paid operatives in plate and sheet mills, his award of a 12½ per cent. reduction has been met with the greatest hostility throughout the district of the Board of Arbitration. At Jarrow, Hartlepool, and Stockton the mill men have come out on strike, and consequently have brought the ironworks to a standstill.

Some manufacturers, in view of the rise of pig iron, have advanced their quotations 5s. per ton, but they are not obtaining the increased rates.

A little move is apparent in the iron shipbuilding trade, and consequently shipbuilders are inquiring for plates.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE iron market has been exceptionally strong and active during the past week, with a large increase in prices. From America the demand continues, and is more extensive than the most sanguine anticipated. The shipments of pigs in the course of the last week amounted to 15,650 tons, as compared with 7956 in the corresponding week of last year. We must ascribe the present animated condition of the market almost solely to the revival of business in the United States, for the continental trade seems, if anything, quieter than it was some weeks ago, and the improvement in the home demand as yet has been inconsiderable. The excitement and speculation which prevail in the market at present are not conducive to the formation of a sound opinion as to the probable duration of the activity now being experienced, but there is a general impression that prices will yet go higher. The improvement noticed last week in the Cleveland import trade is more marked this week, there being a substantial increase in the arrivals of pig iron. The stock in the hands of Messrs. Connal and Co. again shows an increase to the extent of 3877 tons for the week, and now amounts in the aggregate to 308,170. But if the present extensive demand continues, either additional furnaces will have to be put into blast or the stocks will suffer diminution. There are sixty-five furnaces in blast, as compared with ninety-two at the same date last year.

The warrant market has been exceedingly lively, with a large speculative business doing. On Friday forenoon business was done at from 49s. 1½d. to 49s. 6d. cash, and from 49s. 4½d. to 49s. 9d. one month; while in the afternoon transactions began at 50s. 1½d. cash, and ended at 49s. 6d. The market was again very strong on Monday. Quotations improved from 50s. to 51s. 7½d. in the course of the forenoon, and in the afternoon 51s. 9d. up to 52s. were paid, the rates for one month being 52s. 3d. to 52s. The feeling was stronger still on Tuesday, when transactions were effected from 53s. up to 55s. cash. The market was very irregular on Wednesday, but a large business was done. The ironmasters resolved to give the miners 6d. advance. To-day—Thursday—the market was strong, with business at 55s., 55s. 6d., and 54s. 10½d. cash.

Owing to the heavy demand for makers' iron, the prices have advanced rapidly since last week, and the following quotations must be accepted as in some degree nominal, because the figures are changing while I write:—G.m.b., f.o.b. at Glasgow, per imperial ton, No. 1, 55s.; No. 3, 50s.; Gartsherrie, No. 1, 59s.; No. 3, 55s.; Coltness, No. 1, 62s. 6d.; No. 3, 51s.; Summerlee, No. 1, 60s.; No. 3, 52s. 6d.; Langloan, No. 1, 58s.; No. 3, 50s.; Carnbroe, No. 1, 59s.; No. 3, 50s. 6d.; Monkland, No. 1, 55s.; No. 3, 50s.; Clyde, No. 1, 55s.; No. 3, 50s.; Govan, at Broomielaw, No. 1, 55s.; No. 3, 50s.; Calder, at Port Dundas, No. 1, 60s.; No. 3, 52s.; Glengarnock, at Ardrossan, No. 1, 59s.; No. 3, 51s.; Eglinton, No. 1, 56s.; No. 3, 53s.; Dalmellington, No. 1, 56s.; No. 3, 50s.; Shotts, at Leith, No. 1, 57s.; No. 3, 50s.

There are at length signs of the beginning of a movement in the manufactured iron department, the inquiry being better, and as nearly all the old iron to be had is being rapidly secured for the United States, it is considered probable that a call will now be made for manufactured iron.

Last week's shipments of iron manufactures from the Clyde included five locomotives and tenders, valued at £6100, for Bombay; the hulls of three steam barges, £19,000, for Rangoon; £7600 worth of machinery, of which Rangoon took £4552, Melbourne £2200, and £800 went to Trinidad; £19,500 castings, of which £10,818 were pipes for Rio de Janeiro, £3372 for Calcutta, £1994 for Buenos Ayres, £1743 for Melbourne, and £570 for Vienna; £13,500 miscellaneous goods, of which Rangoon took £5000, Montreal £4000, Calcutta £1400, Melbourne £950, and £900 for Buenos Ayres; £1841 worth of steel rails for Montreal, £3572 old iron for New York and Philadelphia, and £1280 worth of sewing machines.

The coal trade does not show any improvement, and the dispute between the sale coalmasters and the ironmasters as to the propriety of increasing the colliers' wages operates as a barrier to the transaction of business.

The *employés* of the Steel Company of Scotland at Newton, near Glasgow, have received a notice of a reduction of wages, to come into force from Saturday last.

The fifteenth half-yearly meeting of the West of Scotland Association of Gas Managers has been held at Bridge of Allan, under the presidency of Mr. R. Mitchell, of Coatbridge.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THERE was an unusual degree of animation at Cardiff last week, and many of the transactions in coal carried a hopeful character with them. Coalowners exhibited an unwillingness to enter into long contracts, and though in no case that came under notice was business transacted at an advance, still it was evident that a little greater pressure for supply, and an advance would certainly be secured.

Demands from the West Indies are increasing, and the French trade continues good, over 30,000 tons leaving Wales last week for that destination. The total shipment of coal from Swansea, Newport, Mon., and Cardiff last week was 118,230 tons, but I am sorry to record a great falling off in the exports from one place, namely Newport, the total of which was only 12,594 tons. Still this may have been done, as is the case sometimes, through an absence of steamers and coaling vessels generally, in which case the falling off of one week will be made up by the briskness of the next. In proof of this I see no lack of orders moving about, and of being placed; and to my knowledge many of the principal coalowners are secured for several months to come.

With regard to the prominent subject of discussion at the present moment in trade circles, "Is an advance of price possible?" I must simply point to an old assertion of mine, that it will be possible, and certain, when the iron trade is in a little better condition. It is rapidly improving, and confidence is increasing. When a little further business is done, and more coal is consumed in the manufacture of iron, we may look for an advance.

One of the best signs of the times has been afforded at Abersychan, where fifty coke ovens, which have been disused for over four years, were re-lit this week.

The tin plate-trade is continuing to look up, and large contracts are secured that will last some time.

Some little interest has been shown of late in the probability that the year's totals of coal from Wales will surpass that of former years. The third quarter is now nearly at a close, and I note that so far the exports of coal from Cardiff from January to August were close upon 3,000,000 tons, and of iron and steel 56,000 tons. In the same period Swansea sent 445,353 tons, and from Newport, Mon. 614,077 tons. Since the announcement in THE ENGINEER that a private sale of Pentyrch Works would be entertained, many of the leading managers of the district and also several influential capitalists have gone over the works, but nothing has yet been decided.

The Tin-Plate Masters' Association is to be continued.

The South Wales colliers are agitating for reforming their Unions.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Sept. 20th, 1879:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 13,008; mercantile marine, building materials, and other collections, 2524. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 5 p.m., Museum, 1629; mercantile marine, building materials, and other collections, 170. Total, 17,331. Average of corresponding week in former years, 19,480. Total from the opening of the Museum 18,408,792.

NEW TRAMWAYS.—The Board of Trade have issued a report giving an account of what has been done this year in regard to new tramways. In 1878 the board made 21 provisional orders authorising the construction of new tramways, and four of these orders—Liverpool, Newcastle, Dewsbury, and Stoke—gave authority to use steam or other mechanical power. In all the orders it was declared that the tramways should be subject to the provisions of all general Acts, and to any tax and any regulations as to the use of the tramways, or as to the motive power, which might be imposed by any such general Act. The usual Bill to confirm the orders was kept back this session until after the House of Lords' Select Committee on Tramways reported; and that committee having recommended that the use of steam or any other mechanical power should be authorised, under restrictions, clauses were inserted in all the orders accordingly, giving the Board of Trade certain powers of inspection, supervision, and revision of fares, and imposing a further penalty in case of neglect to maintain the rails and substructure in good repair. Additional conditions were inserted in the four orders above mentioned, requiring, among other things, that every engine should be free from noise produced by blast or clatter of machinery, all fire concealed from view, and the machinery concealed from view at all points above four inches from the level of the rails; the speed not to exceed eight miles an hour, or four at movable facing points; power being also given to the Board of Trade to make bye-laws regulating the emission of smoke or steam, the use of a bell or whistle as a warning, bringing engines to a stand at cross streets, and in such cases as horses being frightened, or of impending danger, as the Board of Trade may think proper. The Select Committee having further recommended that the Board of Trade should be permitted to grant special temporary licences for the experimental use of steam or other mechanical power on tramways not otherwise authorised to use such power, a clause to this effect was inserted in the bill for confirming the tramway orders; and in committee an amendment was made requiring that there be obtained in such cases the consent of the local and road authorities having jurisdiction over at least two-thirds of the length of the tramway. In the case of the Derby tramways, a provision was inserted in the order requiring the promoters, before opening for traffic any of the tramways authorised by the order, to purchase the omnibus undertakings and plant. With these and one or two other amendments the Tramways Orders Confirmation Bill received the royal assent on the 11th of August. It will not be out of place to notice here that the Superintendent of the P—or Camberwell—Division of the Metropolitan Police says, in his report on the year 1878—"Fifty-six accidents occured to vehicles passing over tram-car lines in this division. I have personally experienced and noticed in other cases the difficulty drivers of vehicles of all kinds experience in getting out of tramrails, owing to the defective state of the paving and laying of the rails. During wet weather the lines in many places are submerged in mud for yards, to the great discomfort of pedestrians requiring to cross the road. Tram-cars are a boon to thousands as a cheap conveyance, but I think that the best means should be adopted in the construction of the wheels and laying of the rails, so as to make the roads available for all traffic to pass over at any place without the risk of twisting axles and tearing off wheels."

CONTENTS.

THE ENGINEER, September 26th, 1879.