THE IRON AND STEEL INSTITUTE.

THE May meeting of the Iron and Steel Institute began on Wednesday, in the hall of the Institution of Civil Engineers, Great George-street, Westminster. The attendance of members and visitors was not large. After the usual routine business had been transacted, Mr. Smith left the president's chair, which was taken by Mr. Bernard Samuelson, M.P., who proceeded to deliver by far the best and most interesting presidential address that we have heard for a very long time. After a few apologetic words, he briefly reviewed the position of the Institute, which has grown from 250 original members to 1250; and he glanced at the history of the iron and steel trades since 1869, the year in which the Institute was born. In that year the world's production of pig iron was 10,500,000 tons; in 1882 it was 20,500,000 tons. The blast furnaces of 1869 produced on the average a little over 180 tons per week, with a temperature of blast scarcely exceeding 800 deg. Fah. The consumption of coke per ton of iron varied from 25 to 30 cwt. To-day our blast furnaces produce on the average upwards of 300 tons per week. The Consett Company has reached a production of 3400 tons in four weeks, or 850 tons per week, and of 134 tons in one day from a single furnace. From the United States we have authentic accounts of an average production of 1120 tons per furnace per week having been attained; and he gave his readers to understand that this vast production was found to be economical, and did not entail the speedy destruction of the furnaces. Mr. Samuelson dwelt at some length on the improvements which are being effected in the manufacture of coke, and which have already been dealt with in our pages. He called attention to specimens of coke on the table, made by the Carvès-Simon ovens in operation at the Crook Works of Messrs. Pease, where twenty-five of these ovens have been put up; the average yield of ammoniacal liquor per ton of coal has been 30 gallons of a strength of 7 deg. Twaddell, valued at 1d. per gallon at the ovens; the quantity of tar per ton has been 7 gallons, valued at 3d. per gallon. These products would therefore realise 4s. 3d. per ton of coal. Of course the profit on the ton of coke is considerably more, and to this has to be added the value of the additional weight of coke, which in the ordinary beehive ovens from coal of the same quality is only 60 per cent., or in beehive ovens having bottom flues about 66 per cent., whilst in the Carvès ovens it is upwards of 75 per cent.. Mr. Samuelson held that it was, on the whole, a good thing that England was not called on to supply all the iron of the world. Speaking of the vast progress made by the steel makers, he quoted a letter from Mr. Windsor Richards, of Messrs. Bolckow, Vaughan, and Co.'s, to the following effect:—"Our cogging rolls are 48in. diameter, and the roughing and finishing rolls are 30in. diameter. We roll rails 150ft. long as easily as they used to roll 21ft. Our ingots are 15½in. square, and weigh from 25 cwt. to 30 cwt., according to the weight of rail we have to roll. These heavy ingots are all handled by machinery. We convey them by small locomotives from the Bessemer shop to the heating furnaces, and by the same means from the heating furnaces to the cogging rolls. So quickly are these ingots now handled, that we have given up second heating altogether, so that after one heat the ingot is cogged from 15½in. square down to 8in. square, then at once passed on to the roughing and finishing rolls, and finished in lengths, as I have said before, of 150ft., then cut at the hot saws to the lengths given in the specifications, and varying from 38ft. to about 21ft. The 38ft. lengths are used by the Italian 'Meridionali' Railway Company, and found to give very satisfactory results." Mr. Samuelson holds that in the extension of railways lies the great future hope of the iron and steel trade, pointing out that America has fifty times as great a mileage in proportion to its inhabitants as India has; and he concluded by alluding to the spread of technical education among the working classes, which he regarded as a most hopeful sign of the times. On the close of his address a vote of thanks was proposed by Sir H. Bessemer and seconded by Mr. I. L. Bell. Mr. Snelus was then presented with one Bessemer gold medal, another being reserved for Mr. Thomas, who has had to proceed to Australia for the benefit of his health. Mr. Snelus said that he had got his first lesson in science from Professor Pepper, at the now extinct Polytechnic.

A discussion was then commenced on a paper by Mr. Snelus, read at the last meeting, on the strength of rails. Mr. Snelus first called attention to what he believed to be a new method of very quickly testing rails for hardness. It consisted in driving in a punch with a point ground to an angle of 45 deg., with a pressure of thirty tons to the square inch. He had obtained the following results. Three rails were tested; one good ordinary; the two others purposely made hard and brittle. They were submitted to the fall of a monkey in the usual way:—

Fall	10ft. ...	15ft. ...	20ft.	Depth of punch mark.
Deflection ...	$1\frac{3}{16}$in. ...	$2\frac{3}{4}$in. ...	$4\frac{1}{8}$in. ...	·468in.
,, ...	$\frac{7}{8}$in. ...	2in. ...	broke ...	·343in.
,, ...	$\frac{3}{8}$in. ...	broke ...	broke ...	·250in.

The discussion which followed was unimportant. A French engineer, however, stated his conviction that what was done to rails during the process of straightening them had a great influence on their durability. An adjournment for luncheon took place at 1 p.m., and on resuming at 2 p.m., Mr. Parker, of Lloyd's, and Mr. Allen, of Sheffield, read papers on steel castings, which, as was expected, excited a very warm discussion. It will be remembered that in our annual article for 1883 we wrote at some length concerning steel castings in "the strict sense of the words," and we unwittingly gave offence to not a few of our readers who pointed out that they had been steel casting makers for many years. It is to be regretted that none of them were present to fight their battles on Wednesday, only two or three of the larger steel-making establishments being represented, and it was definitely stated, and not contradicted, that only a very small number of firms indeed could make a steel casting fit for shipbuilding purposes, although a great many firms thought that they could. Mr. Parker's paper put into a complete form much that we only hinted at, and he gave some valuable facts and figures to show the great progress that was being made in the production of steel castings of all kinds. He called attention to the remarkable difference of opinion which exists as to the relative value of crucible, open-hearth, and Bessemer castings, and the propriety of annealing, and appeared to regard Messrs. Jessop and Sons, of Sheffield; Messrs. Spencer and Sons, of Newburn-on-Tyne; and the Steel Company of Scotland as the only firms competent to supply such castings as shipbuilders wanted. He referred at some length to the value of tempering, and cited as curious facts the following results of an experiment he had had made:—"Tempering, or, in other words, cooling the castings in oil is, however, very beneficial. The first application entirely transforms the large crystalline grain of the metal into a finer and more homogeneous grain, while each successive repetition still further adds to its homogeneity, tenacity, and ductility. As an illustration of this, I had four specimens cut from a casting made at Terre-Noire, and tested under my own supervision. The first specimen, in the same condition as when cut from the casting, broke with a tensile stress of 32·07 tons per square inch, and an elongation of 16 per cent. in a length of 5in.; the next specimen, which was annealed, broke at a stress of 33·7 tons per square inch, with an elongation of 17 per cent.; the third specimen was annealed and tempered in oil, and broke at a stress of 38·6 tons per square inch, having an elongation of 17 per cent.; and the fourth specimen, which was twice tempered in oil, broke with a stress of 41·1 tons per square inch, with an elongation of 15 per cent." Mr. Allen's paper was very short. It was simply an advocacy of the use of "stirred" steel. Curiously enough, no one seems to have adopted a process which according to Sir Henry Bessemer secures the most admirable results.

We have said that it was expected that a somewhat lively discussion would ensue, but Mr. Martell took the meeting by surprise when he stood up and went right in the teeth of his colleague's opinions by warning his hearers not to run away with the idea that steel castings were admirable. He did not, he said, doubt that they might yet become admirable, but at present they were most uncertain in quality, and Lloyd's had to use the greatest care to exclude the work of firms who know nothing about the making of anything but small castings. The surveyor had to be instructed to test them to destruction, which was not difficult. Mr. Riley, of the Steel Company of Scotland, Mr. Hall, of Messrs. Jessop and Sons, Sir Henry Bessemer, Mr. Spencer, and others took part in the discussion, and some of the differences of opinion which appeared to exist as to the open-hearth and the crucible systems were shown to have existence more in theory than in practice. Mr. Putnam, of the Darlington Forge, spoke in favour of iron, and exhibited two broken porter bars of cast steel. He generally used iron porter bars, which were exposed to severe jarring strains, and these iron bars lasted from fifteen months to five years. The steel bars broke, however, the very first day they were used. In defence it was attempted to be shown that the makers thought that steel was wanted to replace cast iron, and that a good material had not been used; to which Mr. Putnam asked how that could be, seeing the makers charged him five times cast iron price for them. Mr. Parker defended steel against Mr. Martell in replying in the discussion, and Mr. Allen explained, in reply to a question, that pouring Bessemer from one ladle to another would not do as much good as stirring the metal properly. The meeting adjourned at about half-past four p.m.

On Thursday morning the proceedings commenced with the reading of a paper by Mr. W. Hawdon, of Middlesbrough, giving the comparative results of the working of a blast furnace, with blast varying in temperature from 990 deg. to 1400 deg. Fah., at the Newport Ironworks, Middlesbrough, of Messrs. B. Samuelson and Co. Some Cowper brick stoves were erected for new furnaces, but for a time used with furnaces which had been at work with the cast iron U-pipe stoves. This furnace was 85ft. in height, 27ft. diameter at bosh, and had been in use ten years, though still in good condition. During seven weeks with the cast pipe stoves, the temperature of the blast being 990 deg., the yield was 400 tons of 3·23 quality pig, with 23·8 cwt. coke per ton and a blast of 4½ lb. per square inch at the tuyeres. During the next four weeks the brick stove was connected, a temperature of 1168 deg. employed, and then the yield was 409 tons, quality 3·36, and coke 23·21 per ton of iron. During the next two weeks the temperature was raised to 1295 deg., the result being that the yield was increased to 449 tons, quality nearly the same or 3·35, and the coke reduced to 23·02 cwt. per ton. The temperature was raised to 1328 deg. during another seven weeks, when the yield was 461 tons, quality 3·14, coke 22·8. During the next two weeks, this iron being dry and rich, the burden was increased, when the yield was 458 tons, quality 3·02, coke 22·3 cwt. The practical result being that by increasing the temperature of the blast from 990 deg. to 1414 deg., a decrease of 1·5 cwt. coke per ton of iron, and increased yield of 60 tons per week were effected, and by the figures given by the author, it was shown that over £1000 per annum was saved by the use of the brick stoves. Another paper on this subject was read by Mr. I. Lowthian Bell, but dealing more especially with the value of successive additions to the temperature of the air used in smelting iron. The early part of Mr. Bell's paper is occupied by an estimate of the quantity of coke theoretically required per ton of iron, which he gives as 12 cwt., though about 10 cwt. more than this is used even when the blast is heated to 1000 deg. The reason for this Mr. Bell says, is the existence of a limit, beyond which the action of carbonic oxide, the reducing agent, is annihilated by the admixture of the resulting carbonic acid, which latter has an opposite tendency to that of carbonic oxide, being an oxidising instead of being a reducing agent. Whatever the limit in question may be, it constitutes the first and most important impediment to lowering, beyond a certain point, the quantity of fuel employed for smelting iron. But further on in the paper the author refers to past experience in the use of hot blast, and to more recent experience, which, guided by theoretical consideration, leads him to question whether any advantage was being derived from heating the blast above 1000 deg. when applied to furnaces of sufficient capacity, and to conclude that any saving from a higher temperature than this must be theoretically very small. He gave figures from different furnaces to show that there is no simple arithmetic ratio in the economy of fuel by successive increments in the temperature of the blast, and further that the high temperature of the blast does not promote the copious formation of carbonic acid, but that the largest quantity of carbon in the highest stage of oxidisation is found in furnaces using low temperature blast. Generally his paper was to the effect that the very large furnaces with very high temperature blast, as used by Messrs. Cochrane's Ormsby Works, had not given better results than he supposed possible even in furnaces of moderate capacity, blown with air at more moderate temperatures, though he admitted that he had not known any other furnace, except that of Mr. Cochrane, with a blast at 1000 deg. Fah., produce a ton of iron for so small a quantity of coke. After a few remarks from Mr. Massicks, Mr. Chas. Cochrane was called upon by the President, and it seemed to be generally understood by the meeting that some sparring was about to commence. Mr. Cochrane was well prepared with notes and energy, and after referring to his own statements as to possibilities of the blast furnace in 1869, and giving a lot of figures to show in what way the heat from the coke was used in performing the different operations in the furnace upon the ores, fluxes, moisture, and the coke itself, he went on to attack Mr. Bell because he had not, as he said, taken into account the loss due to the conversion in a certain zone in the furnace of carbonic oxide back into carbonic acid, and after that the relation between the heat work done in converting 1 cwt. of carbon into CO_2 and into CO was 3·27, he said that it was through overlooking this that Mr. Bell had been unable to recognise the value of the brick stove as a means of heating blast to a very high temperature. Mr. Cochrane pointed out that once carbon was converted into carbonic acid, it never goes back to carbonic oxide, and that the carbonic acid does a great deal of harm in the upper part of the furnace, which can best be reduced by the use of high temperature blast. He objected to Mr. Bell's taking figures from different furnaces, not using the same coke, and then averaging results to get at a mean. He also spoke of the advantage which he had found attend drawing the tuyeres away and increasing the distance from 6ft. to 7ft. Mr. W. Whitwell was not slow to make capital out of Mr. Bell's acknowledgments that brick hot blast stoves had accomplished something, and he gave some figures relating to size and cost of the Whitwell stove. Mr. Snelus spoke of the necessity of taking into consideration every fact and element when dealing with blast furnace economy, and not to attempt to generalise from isolated facts and observations taken at different furnaces under dissimilar circumstances. Mr. W. Richards spoke highly of the very high temperature blast. Mr. Bell replied to the discussion, and chiefly to Mr. Cochrane, whom he said had misapprehended him, as his contention was not that high temperature blast was not good, but that the same amount of heat could be more advantageously obtained by fuel in the blast furnace itself.

HIGH PRESSURE AUTOMATIC BRAKES.

FROM the moment that the compressed air system of continuous brakes had demonstrated its powers during the Trent brake competition, we accepted it as the best system, and we have persistently advocated its adoption to the exclusion of other systems ever since. We have been told that we were mistaken, and that the vacuum brake, owing to its greater simplicity, must in the end beat its rival. We also held that the automatic principle must be adopted, and we were assured that on this point also we were wrong. The action of the Board of Trade so fully supports all that we have urged on this latter subject, that we need not further refer to it here. The time has, however, arrived when facts are available which demonstrate in the fullest possible way the soundness of the conclusions at which we had arrived concerning the value of compressed air automatic brakes. These facts are supplied by the Board of Trade returns, to which we have already drawn attention in two articles; and we shall show from these returns that not only have the various anticipations of disaster formed by the opponents of the high-pressure system not been borne out by facts, but that the performance of one type of brake has been so excellent that it could not be easy to find any machine of any kind performing its duties with so few failures. The conditions laid down by the Board of Trade, with which, in their opinion, a continuous brake should comply, have by some been considered almost impossible of accomplishment under all circumstances, and for every kind of traffic, and it has been said that, however great might be the advantages of automatic brakes under certain contingencies, these were purchased at too high a price, owing to the delays and difficulties which would ensue in daily working from the more complex parts required in such a brake continually getting out of order. We propose to test this supposition. The Westinghouse brake is far more widely used than any other, and while it is generally allowed to comply with the Board of Trade conditions better than any other system—if it is not indeed the only brake which really does so—it may for that very reason at the same time be considered the most complex in construction. Yet, notwithstanding this fact, the reports against it resolve themselves simply into a record of defective material and mismanagement on the part of servants, the complex organs peculiar to the Westinghouse brake being only mentioned often enough to show that they are in use. This result by no means agrees with the prophetic forebodings of those who, it may be in all good faith, have made a practice of opposing the introduction of this system. The essential parts peculiar to the Westinghouse brake are—(1) the air-pump on each locomotive; (2) the triple

valve on each vehicle fitted with the complete brake; (3) the couplings between each carriage; (4) the driver's brake valve. Except, perhaps, the coupling, these parts have one and all been called complicated, and liable to injury and derangement. When the first form of Westinghouse brake was being introduced—we mean the non-automatic air brake—the great bugbear was the air-pump; and we were told that such a novel system of working an engine would prove quite impracticable. But when the triple valve was added and the brake made automatic, it was said, even by those who acknowledged its ingenuity, that it was hopeless to think of getting such a device to work regularly. With this opinion we have never agreed. Practical experience was the only test; and how much truth there was in the charges brought against the various parts, and indirectly against the soundness of our judgment, may now be ascertained from the Board of Trade Returns. Taking the return recently issued for the six months ending December, 1882, it is interesting to note how completely the accusations are disproved, as will be seen at once from the table which we print below. In the first place, seven out of the fourteen railway companies using the brake have no delays or mishaps of any kind to record arising from the use of the particular parts mentioned; nine of the fourteen companies, including the Midland, make no mention of triple valves; and twelve of the fourteen attribute nothing to the driver's valve. In compiling our statement, only those cases are reckoned in which the delay is positively attributed to a part of the brake mechanism, and which did not arise from the neglect of a servant. For instance, there are sixteen cases against the air pump; but as six of them are due to want of lubrication or other neglect, only ten are counted, and these are due to the failure of material. There are in all thirty-three cases in which a triple valve is mentioned in connection with delays; but since there are a number in which the incident is reported as being only "probably" due to this part, only twenty-three cases are dealt with, and these are mainly caused by leaks. Couplings are reported twenty-one times; but as ten of these refer to couplings with valves—which were in course of being changed—being mixed with those without valves, or to their having been improperly coupled up, there are really only eleven cases to deal with, and even these are merely matters of india-rubber washers wearing out.

Analysis of Reports against Parts of Westinghouse Brake from Return for December, 1882.

	Total number in use in Great Britain at December, 1882.	Number causing delay once in six months.	Total miles run.	Miles per case.
Air pumps	1173	10 or 0·85 per cent.	12,759,837	1,275,988
Triple valves	9457	23 ,, 0·24 ,,		554,777
Couplings	21,463	11 ,, 0·05 ,,		1,159,989
Drivers' valves	1173	5 ,, 0·42 ,,		2,551,977

In other words, deducting these reported cases, we find that fourteen railway companies in this country, using 1163 pumps, 9434 triple valves, 21,455 couplings, and 1168 drivers' valves, ran 12,759,887 miles in six months, without being the cause of delay or incident upon their own account. It is doubtful, indeed, if there is a single case in the returns of any of these parts really acting improperly, that is owing to the principle or the design being faulty. But even allowing for the uncertainty or imperfection of material and the frailty of men, such a result as that we have given is very striking. To show, however, what may be accomplished on one large railway, having practically all its stock fitted, and where the men have become accustomed to the brake, we give another statement of the results on the North-Eastern Railway. Air pumps are mentioned four times, but all of them being simply cases of neglect, such as want of lubrication, are therefore not counted. Couplings are mentioned twice, and both cases refer to those with valves, which were being done away with, and are also omitted.

Same as above for North-Eastern Railway only.

	Total in use at December, 1882.	Number causing delay once in six months.	Total miles run.	Miles per case.
Air pumps	334	0	4,417,472	At least. 4,417,472
Triple valve	2955	1		4,417,472
Couplings	5671	0		At least. 4,417,472
Drivers' valves	384	1		4,417,472

It may further be shown that out of the fourteen companies using the Westinghouse brake ten of them ran 5,598,420 miles with but one incident to one triple valve in the six months. As a matter of fact, and as is clearly proved by the performances recorded above, the triple valve is not at all an easy thing to render inoperative in ordinary working. This is the experience of every line using the brake, and is not at all surprising when we remember that its motions, consisting of a simple upward and downward movement, are governed by absolute pressures, amounting to a weight of several hundred pounds. The Board of Trade returns prove that, considering the objects it effects and the work it performs, it would be very difficult, if not impossible, to find a mechanical device more simple in construction, more certain in action, and less difficult to maintain and keep in order than the Westinghouse triple valve.

It would perhaps lead to a better appreciation of the merits of the various brakes if the work performed could be got at. The only information to be procured from the returns is the amount of stock fitted and the number of miles run; but this, as is often pointed out, may be no criterion at all. The Clark-Webb brake, for instance, on the London and North-Western Railway, is not used except in emergencies, at which times it is generally found to be of no service; but nevertheless it gets credited with more than 8,000,000 miles for the half-year. If the average number of stops made per day was also returned by the railway companies, some interesting comparisons might be made. The London and Brighton Company has, however, procured the information for its own line. Every train upon this railway is now equipped with the Westinghouse brake, and it has been ascertained that upon a certain day in April, for which careful arrangements for procuring the most accurate data were made, the applications of the brake, including stopping at stations, signals, &c., amounted to the enormous number of 16,460, and this notwithstanding the day was an exceptionally favourable one as regards traffic. At the height of the summer traffic, or during the fogs of winter, no doubt the number would be largely increased, owing to the greater obstructions to traffic. The Brighton Company in December, 1882, had 2361 triple valves in use, and taking the number of trains run, the result is that above 1,000,000 movements of the triple valves are made per week, and this is probably under the average. Taking the trains all round, it is found that the Brighton Company averaged one stop for every mile run, and it results that during the half-year with which we have been dealing, about 30,000,000 movements of the triple valve were made. In running, as they did, nearly 3,000,000 miles during the half-year with trains fitted with the Westinghouse brake, six triple valves are reported as causing trifling delays once in the six months. On the basis which has been arrived at then during the six months, out of 30,000,000 applications of triple valves, only six gave any trouble, or a proportion of one in 5,000,000!

We have frequently protested against the idea that complex construction must necessarily imply difficulty in operation, any more than simplicity of parts guarantees certainty in working. For instance, nothing is said to be more simple in construction and arrangement than the Smith vacuum brake, but as has often been shown, nothing is more untrustworthy. Upon the Great Western Railway an automatic vacuum brake is used having a plain hole in the piston, instead of any valve arrangement—see page 315. Can anything be more simple? Yet an examination of the returns reveals the fact that in comparison with the triple valve, as a mechanical device, it is simply nowhere. Upon the Great Western line the delays on account of stopped holes amount to one hour and forty-two minutes. Compare this with the work of the triple valve on the North-Eastern Railway, where there is only one suggestion of a triple valve having caused a trifling delay; and this notwithstanding the fact that the North-Eastern Company ran 50 per cent. more miles during the half-year, and had 50 per cent. more triple valves in use, than the Great Western had holes!

The records we have given constitute a complete vindication of the triple valve, and form the best possible testimony as to its appropriateness for the work it has to do. Were the case otherwise, however, it would be worth while to put up with some inconvenience when the importance of such an appliance is remembered, and the impossibility of doing without it, or a device of a similar character, which is found in several automatic vacuum brakes. Although not necessary for securing automatic action—a condition which may clearly be fulfilled without a triple valve—it is essential for procuring the best work, for the following reasons:—(1) It ensures the instantaneous and simultaneous application of the brakes, as well as complete power of graduation. This results from the fact that only a very small quantity of air at high pressure has to be moved in order to bring the triple valves into action. In brakes without such an arrangement, the whole of the air stored on one side of the piston in a large cylinder upon every carriage must be exhausted before the brakes can be fully applied; whereas with a triple valve only a part of that in the brake pipe alone need be discharged, or, say, at the most one-tenth the quantity. By this means continuous brakes are able to be worked upon trains of any length, and this upon any other system would be quite impracticable. For the same reason brakes with a triple valve must necessarily be able to stop trains in a shorter distance than without such an arrangement. (2) Great economy of air results, since, as just said, only a small quantity of that contained in the train pipe is used in addition to the air which enters the brake cylinders. (3) The use of piston-rod packing is avoided. This alone constitutes a most important advantage in a system of brakes. Were it not for the triple valve, it would be necessary to maintain air pressure upon both sides of the brake pistons; therefore, the piston rods would require to be packed. In other systems of brakes, consequently, packing the rods is indispensable.

That railway engineers generally are coming over by degrees to the views long advocated by Mr. Harrison, Mr. Drummond, and many other competent authorities is demonstrated by the fact that the use of the brake is extending rapidly. We learn that the orders for this system alone amount to over 9500 engines and over 41,300 carriages in all parts of the world. If the triple valve is impracticable, those who have ordered over 50,000 of them are guilty of something worse than folly.

THE HAY-SAVING COMPETITION AT READING.

It may be taken for granted that few people are aware how much it is possible to spend in adjudicating upon a £100 prize offered but never awarded. Some figures just published by the Royal Agricultural Society concerning the show at Reading last year enable us to throw a gleam of light upon this subject. It will be fresh in the recollection of most readers that in connection with that exhibition a local gentleman offered a premium of £100 for an efficient system of drying hay and corn artificially, the "Royal" undertaking to defray the cost of the trials. This delightful arrangement worked excellently for the Reading gentleman, for the judges declared that none of the competing systems deserved the prize, and thus his money was saved. But not so lightly fared the Royal Agricultural Society, who actually succeeded in losing £1848 17s. 5d. before making up their minds to withhold the prize. A management which can accomplish a feat of this kind must be possessed of no ordinary merit. Curiosity may inquire how the thing was done. We will anticipate the question by giving the answer furnished by the manipulators themselves. Here are the interesting figures:—

Expenditure.	£	s.	d.
Grass	428	4	0
Barley	444	9	3
Judges (exclusive of lodgings)	275	10	3
Engineers	42	0	0
Assistant steward	75	12	0
Foreman	28	0	9
Labour	242	3	8
Police	19	13	9
Surveyor	13	2	6
Lodgings	36	5	6
Refreshments	86	0	0
Carriage hire	60	9	6
Horse hire	249	17	6
Hire of engines and drivers	85	3	6
Carriages of reapers	7	0	0
Carriage of hay-makers and damage	21	14	7
Sledges and sweeps	12	0	0
Rakes and forks	6	7	3
Sacks	9	12	0
Coals	15	14	9
Straw	21	15	6
Thatching and fencing	33	12	11
Thermometers and sundry small implements	7	17	6
Canvas, &c.	8	7	1
Carriage	7	5	10
Sundries	3	2	1
Total	£2241	2	0

Receipts.	£	s.	d.
Sales of barley	298	1	7
Hay	88	3	0
Sledges and sweeps	6	0	0
Total	£392	4	7

Deducting these receipts from the expenditure, we arrive at the £1848 17s. 5d. loss named above. Is the knowledge gained by the trials worth that large sum? We fear not. Truly these "Royal" trials are "fearfully and wonderfully made."

"EXPLOSIVES ACT 1875."—ORDERS IN COUNCIL OF APRIL 20TH, 1883.

The following letter has been forwarded to the Home Secretary.

Nobel's Explosives Co., Limited,
149, West George-street,
Glasgow, 4th May, 1883.

To H.M. Secretary of State for the Home Department,
Home Office, Whitehall, S.W.

Sir,—With reference to the Orders in Council under the "Explosives Act," 1875, which appeared in the *Gazette* of 20th ultimo, my directors having carefully considered the injurious effects which these Orders are calculated to produce, I am instructed to protest against them for the following, amongst other reasons:—

1. That they will have the effect to a large extent of reviving some of the most objectionable provisions of the Nitro-glycerine Act which Parliament, after careful inquiry, saw fit to repeal in 1875.

2. That they are so drawn as to be almost unintelligible to the great body of persons whom they are intended to affect.

3. That they will injuriously affect the mining industries of the country, and many collateral branches of trade which are intimately associated with the manufacture of explosives; that they will impose unreasonable restrictions upon mining enterprise in this country from which foreign mining is exempt; and that they will seriously interfere with the progress of railway construction, river and harbour improvement, and many other works of great public utility.

4. That they are altogether unwarranted from anything which has occurred in connection either with the sale to doubtful characters, or with the careless custody of the explosives manufactured by the company.

5. That they will fail to reach the class of miscreants who may wish to use nitro-glycerine and nitro-glycerine compounds for seditious or malicious purposes.

6. That they will prove a source of great inconvenience and loss to hundreds of thousands of industrious and inoffensive workmen, many of whom will be thrown out of employment, and amongst whom much dissatisfaction is likely to arise, when the nature and scope of the Orders become better known.

7. That they virtually leave it to the discretion of the police to decide what explosives, other than gunpowder, are to be used in any particular district.

8. That they do not affect gunpowder, with which numerous murders and outrages, such as that at Clerkenwell Prison, have been committed.

9. That they will have the effect of materially assisting in the attainment of some of the objects which the authors of the recent outrages doubtless have in view, such as the disorganisation of various departments of industry and the spread of discontent amongst large and important classes of the citizens who are at present industrious and law abiding.

As one of the objects of the "Explosives Act," 1875, was to relieve dynamite and other admittedly safe explosives from the injurious restrictions to which they had previously been subjected by the "Nitro-glycerine Act" of 1869, I do not at present enter upon the question of the competency of H.M. Privy Council to pass these Orders without the sanction of Parliament or in virtue of any powers supposed to have been conferred upon them by section 43 of the "Explosives Act," 1875.

I have the honour to be, Sir,
Your most obedient servant,
(Signed) Alexr. A. Cuthbert, Manager.

A Competition of Pumping Machinery.—The "Royal Office of Agriculture, Industry, and Commerce," Italy, has determined, with the view of extending the diffusion of water-extracting machinery and engines best fitted to irrigate the fields or to water the cattle, on a proposal of the General Director of Agriculture, and on the advice of the Agricultural Committee, to hold an international prize meeting between all sort of water-raising engines and gearing apparatus, to take place at Cagliari, Sardinia. The meeting will be declared open on the 1st of June, 1883, and will close not later than the 10th day of June of the same year. Applications for space may be made up to the 15th inst. Inventors, constructors, and others of every nation may take part in the competition. Agents shall be considered as representative of constructors; the latter being consequently esteemed to be the real exhibitors, they are entitled—if it is the case—to win the prize. Machinery is divided into the following classes:—First class: Tubular well perforating engines with their suction pumps. Second class: Augers and boring machines for subterraneous sources; artesian wells. Third class: Swings, rope and chain pulleys, screw boxes, scoop wheels, hydraulic rams, and all kinds of pumps. Fourth class: Sketches and drawings of irrigation works, whose application in Sardinia and economical advantages ought to be both ascertained. The prizes from the Agricultural Royal Office are:—First class, one gold medal—two models of the machinery, amongst those which shall win this first prize, will be acquired at the Royal Office's charge—two silver medals, two bronze medals. Second class, one gold medal, two silver medals, two bronze medals. Third class, two gold medals, four silver medals, four bronze medals. Between the best and rewarded samples of this class, the Royal Office will purchase some up to the amount of 4000f. The Royal Office reserves the choice and employment of the said machines. Fourth class, one gold medal and 500f. recompense. Further information may be obtained at the Science and Art Department, South Kensington.

RAILWAY MATTERS.

THE first section of the Intercolonial Railway to the Victorian border from Adelaide to Aldgate, a distance of twenty-two miles, was opened by the Governor on March 14th.

AMONGST the deaths caused by railways of the United Kingdom, in 1882, one was that of a woman in a house at the side of the line, who was struck and severely injured by fragments of a broken connecting rod of a passing engine.

OF the 414 rails which broke on our railways last year, 253 were double-headed, 149 were single-headed, and 12 were of the bridge pattern; of the double-headed rails, 190 had been turned; 161 rails were made of iron, and 253 of steel.

THE following accidents occurred on our railways last year, but they involved no personal injury:—1149 failures of tires, and 414 of rails; 51 of the flooding of portions of the permanent way; 14 slips in cuttings or embankments; and 1 fire at a station.

THE operatives at the locomotive engine works in Wolverhampton, of the Great Western Railway Company, have not been successful in their application that the notices for short time might be withdrawn, and the works are now inoperative on a Saturday.

THE North-Eastern Railway Company is about to erect a new lift for shipping coal at the Middlesbrough Docks. The lift will be worked by hydraulic power, and will raise the coal trucks 34ft. above high water mark, so that vessels will be able to take in their cargoes and bunker coal at the same time.

CAPTAIN EADS maintains that his ship canal project has not been abandoned, but is certain of success. His papers say the road will be built from ocean to ocean long before De Lesseps' Panama Canal is opened; but, as the *Railway Review* says, we do not look for either event in the "near future."

THE Commissioner of Public South Australia Works has stated that the Government intends next session to introduce Bills providing for the construction of railways from Port Darwin to Pine Creek, 144 miles; from Terowie towards the Barrier Ranges, 120 miles; from Hergott Springs to the north-east of Lake Hunot, 140 miles; and from near Hergott Springs to Strangways Springs, about 140 miles.

OF the 451 axles which failed on our railways last year, 264 were engine-axles, viz., 242 crank or driving, and 22 leading or trailing; 32 were tender-axles, 2 were carriage-axles, 140 were wagon-axles, and 13 were axles of salt vans. 63 wagons, including the salt vans, belonged to owners other than the railway companies. Of the 242 crank or driving-axles, 156 were made of iron and 86 of steel. The average mileage of 150 iron axles was 206,857 miles, and of 83 steel axles 192,453 miles.

THE preamble of a bill for the construction of a short line from a point between Auchlebarran and Lochgilly Town Wake to Linktown, where it is proposed to construct new docks inside the rocks known as the East and West Bows, which form a natural breakwater, has been proved. It has been promoted by the Fifeshire coalowners in order to obtain an independent rail and harbour for the shipment of their coal. This dock will cover an area of 7½ acres, and the estimate for its construction is £175,000, and that for the railway £66,135.

LAST week the North British Railway Company opened the Arbroath and Montrose coast line, which has been completed for some time, with the exception of the viaduct at Montrose, now coming into use for passenger traffic. This viaduct has been entirely reconstructed, to replace one condemned soon after the fall of the Tay Bridge. By this route the journey from Edinburgh to Aberdeen will be shortened by one hour and a-half or more. The North British Railway Company will resume a service of trains similar to that in operation during the time the Tay Bridge was standing.

OF the 1149 tires which failed on our railways last year, 36 were engine-tires, 22 were tender-tires, 12 were carriage-tires, 25 were van-tires, and 1054 were wagon-tires; of the wagons, 842 belonged to owners other than the railway companies; 998 tires were made of iron and 151 of steel; 35 of the tires were fastened to their wheels by Gibson's patent method, 10 by Beattie's patent, 10 by Mansell's patent, 13 by Drummond's patent, none of which left their wheels when they failed; 1067 by bolts or rivets, 2 of which left their wheels when they failed, and 14 by various other methods, one leaving its wheel when it failed; 51 tires broke at rivet-holes, 164 in the solid, 5 at the weld, and 929 split longitudinally, or bulged.

AT the end of 1881 there were 5523 miles of railroad in operation n Italy, of which 110 miles had been opened within that year. Of this mileage 2452 miles belonged to the State. It did not work 827 miles of this, which was leased to companies, but on the other hand, it leased and worked 591 miles which belonged to companies. The *Railroad Gazette* makes the following interesting comparison between Italian and American statistics:—"The population of Italy by the census of 1881 was 28,951,349, so that there were 5243 inhabitants per mile of railroad, more than ten times as many as in the United States. The equipment per mile of road was at the rate of 0·277 locomotive, 0·852 passenger car and 4·814 freight car per mile of road. A still more significant measure is that there were seats for 31¼ passengers, and room in freight cars for 46⅜ tons of freight per mile of road. The average service of the equipment was 21,202 miles run per locomotive—very large for Europe—22,480 miles per passenger car and 9740 per freight car. The average cost of the roads had been 94,617 dols. per mile of road, of which 8321 dols. was for equipment. This is more than 50 per cent. more than the average cost of the roads of this country. The earnings in 1881 were at the rate of 6723 dols. per mile, while the average shown for this country was 6688 dols. by the census of 1880. No less than 46 per cent. of the Italian receipts were from passenger, however, and only 25 per cent. here. The working expenses in Italy were 4726 dols. per mile, or 70·3 per cent. of the receipts, and the net earnings were 1997 dols. per mile. Here the expenses were 4065 dols. and the net earnings 2623 dols. per mile. Per train mile the gross earnings were 1·56½ dols., the expenses 1·10 dols., and the net earnings 46½c."

DURING the year there were 532 servants of our railway companies or contractors reported as having been killed and 2423 injured, in addition to those concerned in accidents to passenger trains. Of these 34 were killed and 429 injured whilst coupling or uncoupling vehicles; 3 were killed and 34 injured by coming in contact, whilst riding on vehicles during shunting, with other vehicles, &c., standing on adjacent lines; 43 were injured whilst passing over or standing upon buffers during shunting; 33 were killed and 285 injured in getting on or off, or by falling off, engines, wagons, &c., during shunting; 6 were killed and 199 injured whilst breaking, spragging, or chocking wheels; 21 were killed and 51 injured whilst attending to ground points, marshalling trains, &c.; 4 were killed and 151 injured whilst moving vehicles by capstans, turntables, props, &c., during shunting, and 20 were killed and 364 injured by various other accidents during shunting operations; 12 were killed and 28 injured by falling off engines, &c., during the travelling of trains; 12 were killed and 28 injured by coming in contact with over-bridges or erections on the sides of the line during the travelling of trains; 7 were killed and 48 injured whilst getting on or off engines, vans, &c., during the travelling of trains; 85 were injured whilst attending to, or by the failure of, machinery, &c., of engines in steam; 133 were killed and 140 injured whilst working on the permanent way, sidings, &c.; 7 were killed and 6 injured whilst attending to gates at level crossings; 121 were killed and 185 injured whilst walking, crossing, or standing on the line on duty; 40 were killed and 157 injured by being caught between vehicles; 33 were killed and 111 injured by falling or being caught between trains and platforms; 45 were killed and 24 injured whilst walking, &c., on the line on the way home or to work; and 1 was killed and 55 were injured from various other causes.

NOTES AND MEMORANDA.

THERE are 12,000 miles of underground telegraph wire in the United Kingdom. To lay the whole of the Post-office system underground would cost about £20,000,000. Hence there is no thought of putting wires underground except in towns.

ACCORDING to the statistics published by the American *Sanitary Engineer*, the average annual death rate in twenty-six principal American cities in February was 20·32 per thousand, the total number of deaths being 3993, of which 136 were due to accidents, and by far the larger proportion due to lung diseases and consumption.

A PAPER "On the Specific Gravity of Paraffine Wax, Solid, Liquid, and in Solution," was recently read before the Chemical Society by Mr. Beilby. The specimen melted at 38 deg. C. Its specific gravity, solid at 21 deg. C., was 0·874 when dissolved at 21 deg. in heavy paraffine oil 0·7956. By taking the specific gravity of samples fused at various temperatures and continuing the curve thus obtained, the specific gravity of fused paraffine at 21 deg. would be ·076.

IF a forger has used a different ink to that used by the original writer of the document, his error can be made manifest, says the American *Chemical Review*, in the following manner:—Get nine ½ oz. or 1 oz. vials and fill separately with (1) dilute sulphuric acid; (2) concentrated muriatic acid; (3) dilute nitric acid; (4) solution of sulphurous acid; (5) solution of caustic soda; (6) concentrated solution of oxalic acid; (7) solution of chloride of lime; (8) solution of tin crystals; (9) solution of photo-chloride of tin. Take nine quill pens, each one for its particular reagent. Now, with a rule, draw lines crossing original and suspected portions; the difference will show itself at a glance.

IN speaking at the Society of Arts of dynamo-electric machines for transmitting power, Professor Forbes said the efficiency varies with the quantity of power which is transmitted. If we transmit very little energy, we get a high efficiency, nearly = 1; if we transmit the maximum amount of energy possible, the efficiency is ½. In fact, the work done by the motor is proportional to the efficiency minus the square of the efficiency where $w = 4M(e - e^2)$. M = the maximum work possible; e = the efficiency; w = the actual work returned, and consequently, when the efficiency is nearly equal to unity, the work done is zero. It is found in practice to be preferable to get nearly the maximum work out of a machine, rather than to increase the size and cost of the machines, in order to get a certain amount of work from the apparatus.

M. J. MENDELEJEFF reports that an examination of various samples of Baku naphtha from different strata and districts and of different seasons, established the identity of the lighter products yielded thereby. The samples examined were:—(1) White naphtha from a spring at Surachan, 1880; (2) green naphtha from a spring at Balachan, distilled 1863; (3) naphtha from the Kokoreff boring, 1880; (4) Benkendorff naphtha, 1881; (5) naphtha from Nobel's establishment, 1880; and (6) naphtha from Beibat, Tagieff, Sarkisoff and Co. After four or five fractionations, in all the samples the specific gravity of the fraction between 100 deg. and 105 deg. proved to be 0·751 to 0·756, while in American naphtha it amounted to 0·703 to 0·710.

BY acting upon a large excess of mesitylene with benzylchloride in the presence of anhydrous aluminium chloride at 100 deg., M. E. Loüise obtained a thick, blackish mass, from which, when added gradually to water, a transparent yellow liquid separated out and rose to the surface. Upon subjecting this liquid to distillation, the excess of mesitylene passed over first, and was followed at between 295 deg. and 305 deg. by a new hydrocarbon. This hydrocarbon melts at 31 deg., but exhibits the phenomenon of superfusion to a remarkable extent, as it will remain liquid for some time at a much lower temperature if undisturbed. It is soluble in benzene, alcohol, ether, acetic acid, &c., and may, the *Journal of the Society of Chemical Industry* says, be obtained from these solutions in needle-shaped crystals, the composition of which leads to the formula $C_6H_2(C_7H_7)(CH_3)_3$, *i.e.*, benzylmesitelene, or trimethylbenzylbenzene, being mesitylene in which one atom of hydrogen is replaced by benzyl, $C_6H_5.CH_2$.

PERHAPS the oldest tunnel in the Alps in existence is the heading driven by the orders of Margrave Louis II., of Saluzzo though Mont Viso, and constructed in the years 1472 to 1480. The passes over Mont Genévre and Mont Cenis, which before that time were the only means of communication between Northern Italy and Dauphinè, are very difficult. Morever, they entailed a very heavy expense upon the inhabitants of Saluzzo, and were, besides, frequently entirely closed to them, owing to constantly recurring border feuds. This state of things, says the *Times*, suggested to the Margrave the scheme of piercing a direct road though Mont Viso, connecting the valley of the Po with that of Queyras, opening on to the Durance. The negotiations entered into with the Estates of Dauphiné and King Louis XI. of France led in 1477 to a satisfactory arrangement, and the tunnel was completed a few years later by Martoni d'Albano and Baltasar d'Alpiasco, at a total cost, including the paths leading to the respective openings, of 12,000 florins. The tunnel has a height of 6½ft. and an average width of 8ft., and at the present time a length of only about 250ft. It is stated, however, that, in consequence of frequent landslips, the openings of the tunnel have gradually receded, and that it may have had when first opened doubled its present length. The geological structure of Mont Viso, is similar to that of Mont Cenis, and frequent irruptions rendered repeated repairs necessary. During times of war the tunnel has been frequently blocked, and even walled up; but Napoleon I. gave orders for its complete restoration.

AT a recent meeting of the Chemical Society a paper was read on "The Condition in which Carbon Exists in Steel," by Sir F. A. Abel, C.B., and W. H. Deering. Two series of experiments were made. In the first series discs of steel 2·5in. in diameter and 0·01in. thick were employed; they were all cut from the same strip of metal, but some were "cold rolled," some "annealed," and some "hardened." The total carbon was found to be, "cold rolled," 1·108 per cent.; hardened, 1·128 per cent.; and annealed, 0·924 and 0·860 per cent. Some of the discs were submitted to the action of an oxidising solution, consisting of a cold saturated solution of potassium bichromate, with 5 per cent. by volume of pure concentrated sulphuric acid. In all cases a blackish magnetic residue was left undissolved. These residues, calculated upon 100 parts of the discs employed, had the following compositions:—"Cold rolled" carbon, 1·039 per cent.; iron, 5·87 per cent.; annealed, C. 0·83 per cent., Fe, 4·74 per cent.; hardened, C 0·178 per cent.; Fe, 0·70 per cent. So that by treatment with chromic acid in the cold, nearly the whole of the carbon remains undissolved with the cold rolled and annealed discs, but only about one-sixth of the total carbon is left undissolved in the case of the hardened disc. The authors then give a *résumé* of previous work on the subject; in the second part they have investigated the action of bichromate solutions of various strengths on thin sheet steel, about 0·008in. thick, which was cold rolled and contained, carbon, 1·144 per cent.; silica, 0·166 per cent.; manganese, 0·104 per cent. Four solutions were used, the first contained about 10 per cent. of bichromate and 9 per cent. of H_2SO_4 by weight; the second was $\frac{8}{10}$ths as strong; the third about half as strong; the fourth about one and a-half times as strong. In all cases the amount of solution employed was considerably in excess of the amount required to dissolve the steel used. A residue was obtained as before; with solution 1 the residue contained C 1·021; solution 2, C 0·969; solution 3, C 1·049. The atomic ratio of iron to carbon was Fe 2·694 C_1, Fe 2·65 C_1, Fe 2·867 C_1; solution 4, 0·266 per 100 of steel. The authors conclude that the carbon in cold rolled steel exists not simply diffused mechanically through the mass of steel, but in the form of an iron carbide, Fe_3C, a definite product capable of resisting the action of an oxidising solution—if the latter is not too strong—which exerts a rapid solvent action upon the iron through which the carbide is distributed.

MISCELLANEA.

THE Municipality of Singapore have asked Major-General Sir Andrew Clarke, K.C.M.G., to select and send them out a chief engineer. Salary £1000 a year. Candidates should send their applications, with testimonials, addressed to Whitehall.

THE precise financial results of the "Royal" Show at Reading last summer are—Total receipts amounted to £15,822 12s. 1d., and the expenditure to £15,803 1s. 10d., thus leaving a sum of £19 10s. 3d. standing to the credit of the Society.

THE Strand Union has decided to give the lighting of their parishes, including St. Ann, Soho; St. Paul's, Covent-garden; St. Clement Danes, St. Mary-le-Strand, Liberty of the Rolls, &c., and the precincts of the Savoy, to the Jablochkoff Electric Light and Power Company, Limited, under a seven years' licence."

EXPERIMENTS are now being made at the Terrenoire Ironworks for utilising the residue of iron pyrites. Briquettes are made with the pyrites conglomerated with hydraulic lime; and, by simple exposure to the atmosphere, an ore is obtained which is said to yield pig excellent for steel-making purposes. The sulphur is believed to be completely counteracted by the lime, and there is no phosphorus.

ON Wednesday last the steamship Eeta left the Tyne for London upon her first trip at sea. She is 235ft. long, 32ft. beam, and 14ft. 9in. depth of hold, and has been built to the order of the Demerara and Berbice Steamship Company, by Messrs. Wigham, Richardson, and Co. She had 600 tons dead-weight on board, and made an average of about 9½ knots per hour throughout the run, the engines indicating 620-horse power. During her construction she has been inspected by Mr. J. F. Flannery, consulting engineer, London.

AT the annual general meeting of the Sanitary Institute of Great Britain, held at 9, Conduit-street, on the 7th inst., a report was presented by the Council on the progress of the Institute, and on the work achieved at the Congress and Exhibition held by the Institute at Newcastle in the autumn of 1882. The chairman gave an address, and the officers for the coming year were elected, the president being the Duke of Northumberland, P.C., and the trustees Sir John Lubbock, Bart., D.C.L., F.R.S.; Mr. Thomas Salt, M.P.; and Dr. B. W. Richardson, F.R.S.

IN the course of a discussion on the repairs of the Leeds Town Hall organ by the Leeds Corporation last week the Mayor said that "many of the wires in the organ were thickly coated with sulphuric acid. This was a direct result of the gas exhibition foolishly held in the Victoria Hall a few years ago. If the organ had been the best in the world that would have been the most effective means of ruining it." We should not like to say that the Mayor of Leeds has found a new way of getting sulphuric acid, but it is quite clear that gas exhibitions are not the things for town halls or organs.

THE *Manchester Examiner and Times* states that further litigation in the matter of the Thirlmere Lake arbitration award has been avoided by a compromise between the Manchester Corporation and the Countess of Ossalinsky, owner of a portion of the Thirlmere Lake estate, required for the new water supply scheme for Manchester. The Corporation on the 2nd inst. resolved to carry the case to the Court of Appeal, but a meeting of representatives of the Countess and the Corporation has since been held, and an agreement as to the sum to be paid to the Countess has been arrived at.

ON Monday last all the workmen employed by Messrs. Bolckow, Vaughan, and Co., Limited, at their Middlesbrough works—with the exception of the blast furnacemen—were paid off. The men were asked to agree to a reduction of 5 per cent., but refused to do so. It is said that the works will, in any case, be closed for a fortnight. The company build their own locomotives and make their own machinery and tools at their Middlesbrough works. The men employed at the Eston Steelworks have also received notice, and will doubtless have to submit to a reduction, as the steel rail trade is in a very depressed condition at present.

THE Colonial Secretary of New Zealand has been instructed to offer the following bonuses for the encouragement of new local industries:—Fifty per cent. on the value realised for the first £1000 worth of cocoons or silkworm's eggs produced in the colony, to be paid on quantities of not less than £50 worth, or more than £100 worth, reared by any one person; £500 for the first £2500 worth of native manganese and bronze; £300 for the first £1500 worth of native marble sold in a foreign market for not less than 9s. per cubic foot; £500 for the first 250 tons of native antimony regulus sold in a foreign country at a fair market value; and £1000 for the production, from native ores by a direct process within the colony, of 200 tons of "iron blooms" of marketable quality.

THE colliers of the West of Fife, to the number of about a thousand, held an open-air meeting last Saturday in the neighbourhood of Dunfermline. They were addressed at great length by Mr. Weir, their secretary, who stated that he had made a tour round the collieries, and discovered that the late failure of the men to give written notices on the question of reducing hours and increasing wages had arisen from a misunderstanding. He intimated that he had made application to the employers for an advance of 6d. per day, and said that if it was not complied with, he would advise the men to give fourteen days' notice of their intention to quit the masters' employment. When trade was busy at present, he considered the time most opportune both to obtain an increase of wages and an amendment of the working regulations at the collieries.

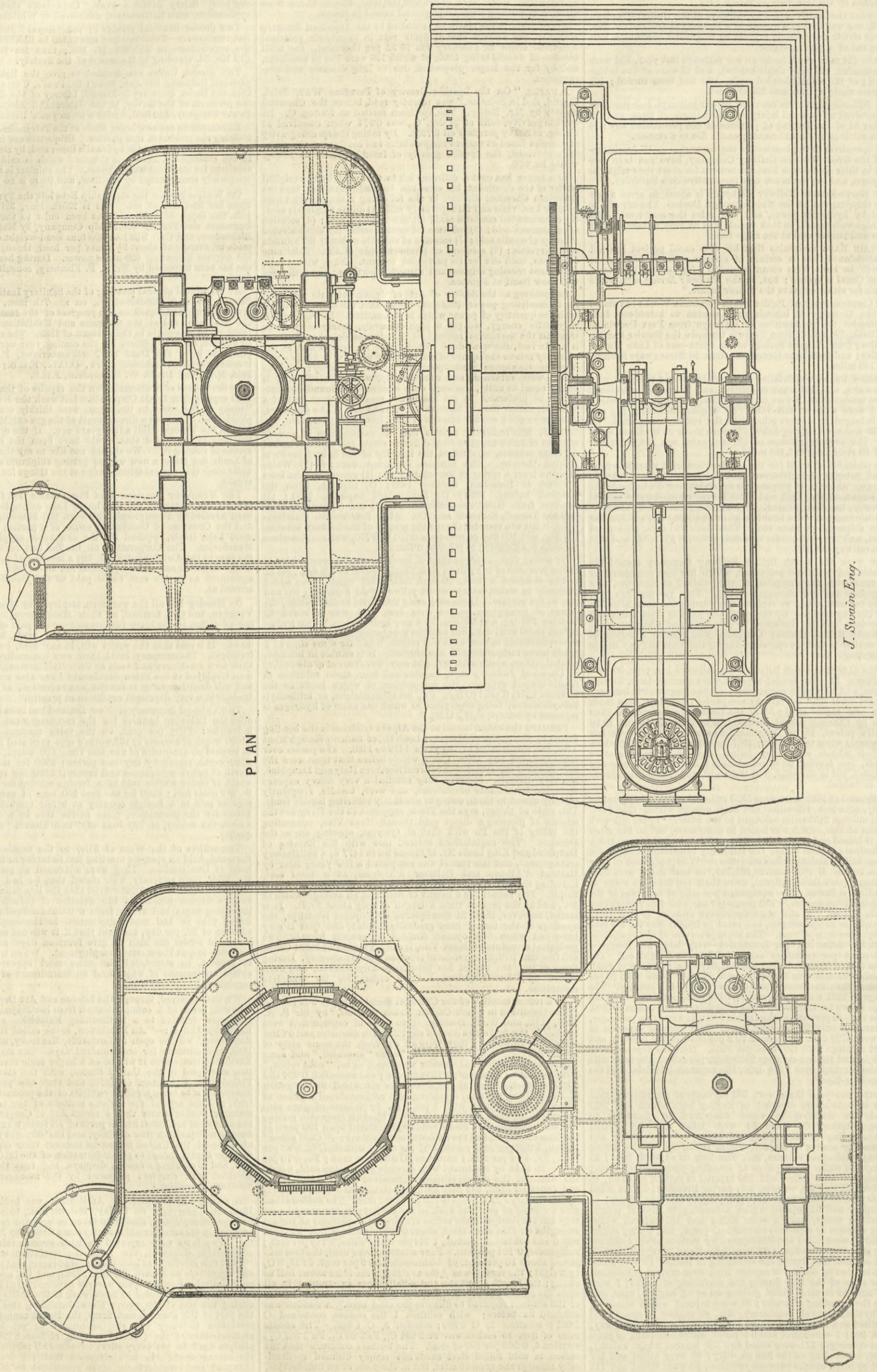
WE have received, through the Science and Art Department, the following precis of a communication from her Majesty's Consul at Baltimore, relative to a forthcoming Exhibition at Louisville, Kentucky, U.S.A.:—"An Exhibition, to be called the 'Southern Exposition,' will be open at Louisville, Kentucky, on 1st August, 1883, and continue for one hundred days. The manager of this Exhibition states that it will be on a larger scale than any Exhibition attempted in the United States, with the exception of the Philadelphia Exhibition of 1876, and that the purpose of the Exhibition is to bring together exhibits of the products, the industries, and the arts of the various sections of the country. The manager further states that a recent Act of Congress authorises the admission to United States ports of all foreign exhibits for the Southern Exposition free of duty, and has directed the Secretary of State of the United States to instruct their diplomatic and consular agents abroad to give information of the intended Exhibition, and to encourage foreign displays, and that they are to be provided with circulars prepared by the management of the Southern Exposition."

A MEETING of the Board of Arbitration was held in the Town Hall, Middlesbrough, on Friday, the 4th inst., to consider what further action, if any, should be taken in order to carry out more completely the arrangement recently come to to stop Monday working. Two firms were reported to have broken through. After considerable discussion the following resolution was passed:—"That this meeting has learnt with great regret that the employers and operatives at Messrs. Dorman, Long and Co. and the Hartlepool Malleable Iron Company's works have not acted in accordance with the Board's decision to limit work to ten shifts per fortnight during the rest of the year. Notwithstanding this infraction on the part of the above-named firms, the Board confirms its former resolution to carry out the agreement as set forth in the memorandum of the Durham meeting of March 19th, 1883, and pledges itself to use every effort to induce all parties to act up to the arrangement." It is understood that the Malleable Iron Company are henceforth to cease operations on Mondays. At Messrs. Dorman, Long and Co.'s works the millmen were again at work on Monday last, but the puddlers, notwithstanding great temptations offered to them, decided to abide by the decision of the Board.

BLOWING ENGINES FOR THE SOCIETE ANONYME DE ST. NAZAIRE.

MESSRS. W. AND J. GALLOWAY AND SONS, MANCHESTER, ENGINEERS.

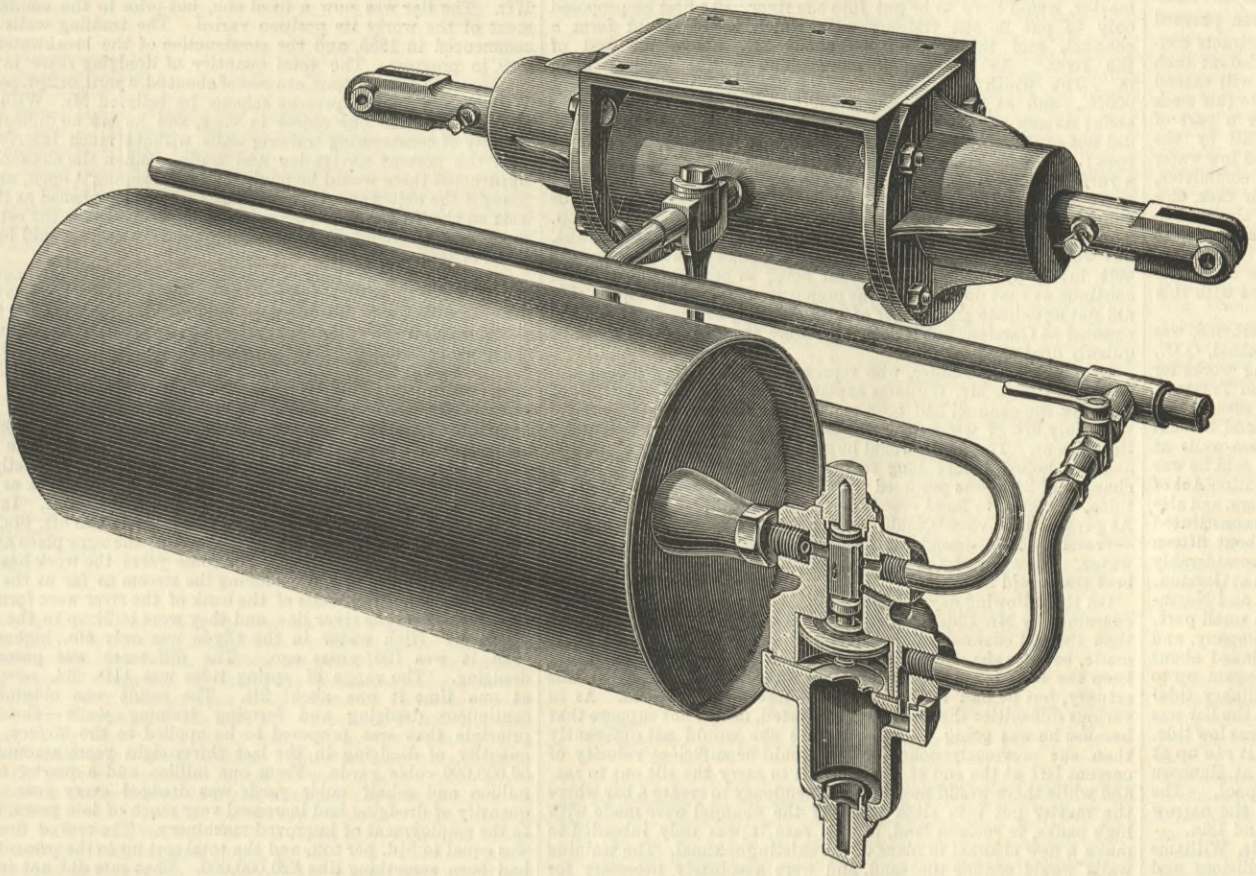
(For description see page 366.)

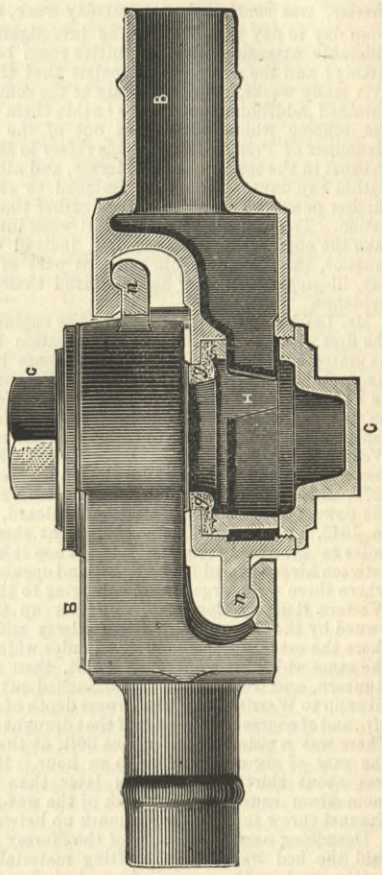


PLAN

J. Swain Eng.

THE WESTINGHOUSE BRAKE.





IN connection with an article on "The Failures of Continuous Brakes" in our impression of the 27th ult., we illustrated the Sanders-Bolitho automatic vacuum brake as used on the Great Western Railway. Above we illustrate the main parts of the Westinghouse brake as applied to a vehicle, some alterations having been made since we last illustrated the brake several years ago. The supplementary reservoir brake cylinder and triple valve are shown in position, and as fitted upon the engine, tender, and each vehicle of the train. Air compressed by a pump on the locomotive to, say, 70 lb. or 80 lb. to the square inch fills the main reservoir on the engine, and flowing through the driver's brake valve and main pipe, also charges the supplementary reservoirs throughout the train. When a train is running, uniform air pressure exists throughout its length—that is to say, the main reservoir on the engine, the pipe from end to end of the train, the triple valves and supplementary reservoirs on each vehicle, are all charged ready for work, the brake cylinders being empty and the brakes off. The essential principle of the system is that, maintaining the pressure keeps the brakes off, but letting the air escape from the brake pipe, purposely or accidentally, instantly applies them. It follows, therefore, that the brake may be applied by the driver or any of the guards, or if necessary by a passenger, by the separation of a coupling, or the failure or injury to a vital part of the apparatus, whether due to an accident to the train or to the brake; and as the brake on each vehicle is complete in itself and independent, should the apparatus on any one carriage be torn off, the brake will nevertheless remain applied for almost any length of time upon the rest of the train.

The triple valve, as will be seen, is simply a small piston. carrying with it a slide valve, which can be moved up or down by increasing or decreasing the pressure in the brake pipe. As soon as the air from the main reservoir is turned into the brake pipe, by means of the driver's valve, the piston is pushed up into the position shown, and air is allowed to feed past it through a small groove into the reservoir. At the same time the slide valve covers the port to the brake cylinder, and is in such a position that the air from the latter may exhaust into the atmosphere. The piston has now the same air pressure on both sides; but if the pressure in the brake pipe is decreased, the piston and slide valve are forced down, thereby uncovering the passage through which air from the reservoir flows into the brake cylinder between the pistons, thus applying the brakes. The brake pipe is shut off as soon as the triple valve piston passes the groove. To release the brakes, the piston and slide valves are again moved into the position shown, by the driver turning air from the main reservoir into the brake pipe. The air in the brake cylinder escapes, and at the same time the reservoir is recharged.

Fig. 2 represents two Westinghouse couplings connected. They are exactly alike in all respects, and an air-tight joint is made between them by means of the rubber washers. These couplings are so constructed that the air pressure within serves to tighten the joint, and they may be pushed apart by the separation of the train without any injury. Such an occurrence as already explained leads to the instant application of all the brakes on the train.

By closing the small tap shown between the brake pipe and the triple valve, the brake on any vehicle, if out of order, can be cut out of the system. A release valve is also placed upon each cylinder as shown, so that in the event of the brakes being applied by the separation of the train, or the breaking of a pipe, or when the locomotive is not attached, they can be released by allowing the air to escape from each brake cylinder direct. The Westinghouse brake has been made to comply thoroughly with the Board of Trade conditions. Many people, however, do not appear to understand all that is involved in the second requirement, which runs as follows:—In case of accident, to be instantaneously self-acting. This clearly implies: First, that accident to the train, or to any one of its vehicles, shall cause the instant application of the brakes to the wheels of every vehicle in the train without the intervention of the driver or guards. Secondly, that any injury, however caused, which may impair the efficiency of the brake apparatus, shall, in like manner, lead to the instant application of all the brakes on the train. It then becomes impossible for a driver to run his train in ignorance of any defect in his brake apparatus, because such defect at once discloses itself by applying the brakes and stopping the train. Thirdly, that each vehicle shall carry its own brake power in such a manner that the destruction of the brake apparatus on one or more of the carriages shall not affect the efficiency of the brakes upon any of the others. No continuous brake which does not comply with such conditions can ever be satisfactory.

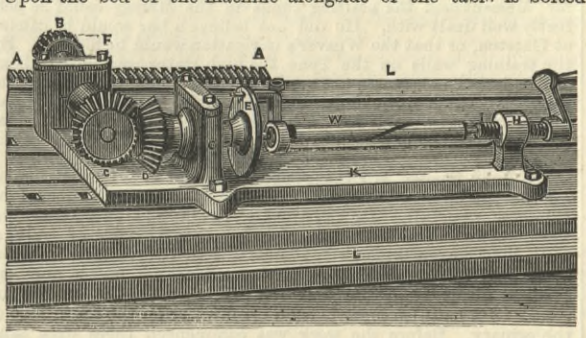
WILLOUGHBY'S HAIR-BRUSHING MACHINE.

THE accompanying engraving illustrates an ingenious adaptation of the now well-known hair-brushing machine which first made its appearance in London about the year 1862. It will be

seen that Stow's flexible steel shaft is employed to transmit motion from a treadle to the brush. The engraving explains itself.

CUTTING SPIRAL OR RIFLE GROOVES WITH AN ORDINARY PLANING MACHINE.

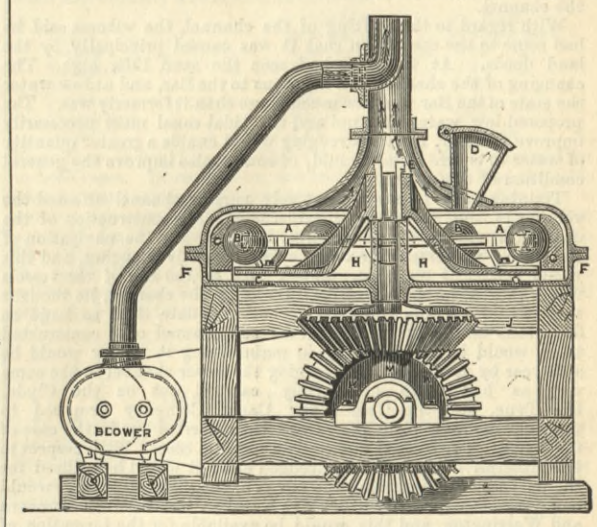
IT is often required to cut spiral grooves in cylindrical work, and our illustration shows how this may be done by the aid of a simple attachment fastened to an ordinary iron planing machine. Upon the bed of the machine alongside of the table is bolted



the rack A A, into which gears the pinion B, which is fixed to the same shaft as the bevel gear C, which meshes with the bevel wheel D. Upon the same shaft as D is the face-plate E, and in the spindle upon which D and E are fixed is a centre, so that the plate E answers to the face-plate of a lathe. F is a bearing for the shaft carrying D and C, and G is a bearing carrying the spindle to which E and D are fixed. H is a standard carrying the screw and centre, shown at I, and hence answers to the tail-stock of a lathe. A represents a frame or plate carrying the bearings F and G, and the standard H. L represents the table of the planing machine, to which K is bolted. The reciprocating motion of the table L causes the pinion D to revolve upon the rack A A. The pinion revolves C, which imparts its motion to D, and the work W being placed between the centres as shown, is revolved in unison with E, revolving in one direction when the table K is going one way, and in the other when the motion of the table is reversed; hence, a tool in the tool post will cut a spiral groove in the work. To enable the device to cut grooves of different spirals or twist, all that is necessary is to provide different sizes of wheels to take the places of C and D, so that the revolutions of E, and hence of W, may be increased or diminished with relation to the revolutions of B, or, which is the same thing, to a given amount of table movement.—*Scientific American.*

PULVERISER FOR DRY CRUSHING.

THE accompanying engraving shows a new arrangement of a machine well known in America. The *Engineering and Mining Journal*, in describing it, says:—"The Morey and Sperry Mining Machinery Company has recently modified the construction of the Howland Pulveriser, and, with slight alterations in the design, has adapted it to dry as well as wet crushing. The principal change made consists, as shown in the accompanying section of the dry crushing pulveriser, in the substitution of balls for rolls. Through the gearing K K the disc and cone H is rotated, carrying with it the balls B, which are carried by centrifugal force against



the concave annular ring C, which is cast in one piece of chilled iron, or is made of rolled steel in the same way as locomotive tires. The balls are surrounded by cages or guards A, in which they play freely. To give them greater strength they are connected by a heavy ring. At the points along which the balls slide over the disc, a piece of flat steel is dovetailed in, to protect it against wear. In dry crushing, the machine is covered with a hopper, to feed the machine, and air circulation is provided by a blower or a suction fan, the air passing upward through an annular space behind the ring C."

NEW RAILWAY TO CROYDON.—On Tuesday a Select Committee of the House of Commons passed a Bill authorising the construction of a new railway, commencing at Sanderstead, near Croydon, by a junction with the Croydon and Oxted branch line of the London, Brighton, and South Coast Railway, now in course of construction, and terminating at Dulwich by a junction with the London, Chatham, and Dover Railway, over whose whose lines running powers have been granted into their Victoria, Holborn Viaduct, and intermediate stations.

THE MANCHESTER SHIP CANAL.

The enquiry by the House of Commons Select Committee, of which Sir Joseph Bailey is the chairman, into the merits of the scheme for constructing a ship canal from Liverpool to Manchester, was continued on Thursday week, and has been pursued from day to day this week. The investigation still attracts considerable attention, the committee room being crowded at each sitting; and the prospect still exists that the inquiry will extend over many weeks, more especially as the committee have this week obtained additional powers to enable them to consider a part of the scheme which was struck out of the original Bill by the Examiner of Private Bills. This refers to the projected low water channel in the estuary of the Mersey, and although the committee, within two days, took a step designed to shorten their task, this further power will tend to extend rather than contract the investigation. The committee having last week intimated their desire to take the engineering evidence first, instead of last, as is the usual practice, the promoters opened this part of their case on Thursday, ill-prepared as they had declared themselves to be with this evidence.

Mr. Leader Williams, M.I.C.E., the engineer to the scheme, was the first witness called, and in examination by Mr. Michael, Q.C., he stated that he had had large experience in designing works for rivers and canals; as engineer to the Weaver Navigation Trustees, he had carried out extensive works on the Weaver; for seven years he was engineer to the Bridgewater Canal Navigation, and in that capacity he had constructed docks at Runcorn, and sea-walls at Weston Point, both on the Upper Mersey. He further said he was one of the commissioners under the Upper Mersey Navigation Act of 1876, and having described the powers of the commissioners, and also the powers of the Mersey Conservancy Board, which was constituted in 1842, he said the Mersey at present shoaled out about fifteen miles to Liverpool from the Bar. Then it narrowed considerably between Liverpool and Birkenhead, and opened out again at Garston, where there were large docks belonging to the London and North-Western Railway Company. Further up there was a small port, owned by the Shropshire Union Railway and Canal Company, and there the estuary was about three miles wide. It continued about the same width up to Weston Point, then narrowed again up to Runcorn, and from that point branched out as an ordinary tidal river up to Warrington. The lowest depth of water over the Bar was 9ft., and of course only vessels of that draught could enter at low tide. There was a rising tide of about 30ft. at the Bar, and it ran up at the rate of six or seven knots an hour. High water at Runcorn was about thirty-five minutes later than at Liverpool. The momentum caused by the rush of the water through the narrow channel threw the high-water mark up between 12in. and 18in.

Describing next the nature of the Mersey estuary, Mr. Williams said the bed was a light shifting material, partly silicious and partly sand, with an admixture of cinders from the upper river. The channel constantly changed its position. In 1875 it was close to the Cheshire shore, but in the following year it had gone right across the river—nearly three miles in one year—where it had practically remained ever since, with slight deviations. At Runcorn the channel was 200ft., but it widened out to a shallow stream at Garston. The proposed ship canal would enter the estuary at a point which was on low, flat, marshy land, and that portion of the canal, for a distance of five miles inland, as far as the first lock, would be a tidal canal. They would cut down a depth of 24ft. at low water to enable vessels to proceed to Manchester, and to pass from the canal to the bar at a suitable stage of the tide. They would have to cut a very considerable portion of the canal out of rock. Nearly the whole portion of the upper part of the canal would be through sandstone. Having once got into the estuary, there was only one course which engineers could adopt to improve it, and that was to make what were called training walls. Strictly speaking, these training or maintaining walls were not walls at all. They were a mass of rubble thrown up to form a channel. The walls would be kept in no case higher than the surface, and in most cases rather below. The channel would pass under the centre of Runcorn Bridge. It would pass the docks at Runcorn, where a large trade was carried on; and it would pass Weston Point, where also a very considerable trade was done. The mean width of the channel was 450ft., although at one point it was 600ft., namely, at Garston. The depth of the channel would be sufficient to give a draught depth of 24ft. at high water of an ordinary neap tide. The depth at low water would vary. The navigable depth would be 24ft. at neap tides and 31ft. at spring tides. Of course it would vary.

The Chairman asked what would be the depth of the channel at low water? Witness replied that the depth at the end of the canal would be 24ft. at low water. At a certain portion of the channel the depth would be 12ft. Continuing, the witness said that the proposed new line was laid out in accordance with the existing channels. To some extent the existing line was an unfortunate one, because in dredging the old channel they would have to go over what at low water was a sand bank. A larger quantity of material would, therefore, have to be dredged out in order to make the channel.

With regard to the shifting of the channel, the witness said he had come to the conclusion that it was caused principally by the land floods. At times he had seen the sand 12ft. high. The changing of the channel was injurious to the Bar, and at low water the state of the Bar was now much worse than it formerly was. The proposed low water channel and the tidal canal must necessarily improve the Bar, for the dredging would enable a greater quantity of water to enter. That would, of course, also improve the general condition of the estuary.

Training walls in a comparatively narrow channel affected the velocity of the water very considerably. The construction of the channel would have a great effect in improving the navigation of the river. At present the channel is constantly changing, and this would render it more permanent. As to the size of the vessels which they expected to be able to take up the channel, he thought they would be able certainly to accommodate them as large as 3000 tons and even larger. Were the channel once constructed there would be no difficulty in maintaining it. They would be able year by year to go on dredging the lower channel in the same way as had been successfully carried out on the Clyde, the Tyne, and the Tees. The Canal Company proposed to work on the same principle as had been carried out in the case of the rivers. The Tees is especially a parallel case. With respect to the material that would be dredged out; it would be utilised for the purpose of maintaining the banks of the channel. There would be a very large quantity of rock to be taken out between Runcorn and Warrington, and this would be available for the formation of training walls. He estimated that the quantity of rock that would have to be taken out is nearly four million cubic yards, and of that about one million would be used for the training walls. Taking the whole length of the channel from Garston to Runcorn, a distance of ten miles, they would have to take out about sixteen million of cubic yards. The cost he estimated would be 9d. a yard, which would altogether amount to £600,000. They would, of course, have the material for making the training walls for nothing. He had charged 2s. a yard against the Canal Company for the rock excavation only, blasting and dredging. The rock in the Tyne was very much harder than they would have to deal with, and it had to be taken out many miles to sea. What they had to deal with was red sandstone, which was very easy to blast.

Mr. Aspinall, Q.C., who appeared on behalf of the Liverpool Corporation, proceeded to cross-examine the witness. In reply to various questions, Mr. Williams said he had always understood that the Act of 1842 gave the Mersey Conservancy power to authorise such works as were now proposed, and he had carried out considerable works on the river without any powers but those they possessed. He had always supposed that the Board had power to authorise any work in the estuary for the improvement of the river. Their Act empowered them to widen, deepen, dredge, scour, and otherwise carry out, or authorise someone else to carry out, works to improve the river; and he certainly thought they could authorise the construction of training walls, although they were not mentioned in the Act of 1842. To make these walls he calculated that a million and a-quarter cubic yards of rock, or other hard matter, would have to be put into the river. At first he proposed only to put in one training wall, which itself would form a channel, and that would be about 2ft. above the bed of the river. As that sank more stone would be put upon it. The width of the channel at Garston would be about 600ft., and at Runcorn about 300ft.; and for those widths about sixteen million cubic yards would have to be dredged. He did not expect that any or much of the material dredged would be rock; otherwise the cost would be greater than his estimate of 9d. a yard. As to silting up during the dredging, he did not think there would be much of that; but at any rate as much would be gained by the increased scouring as would be lost by silting up. The training walls would not raise the height of the sand banks, but would fix them in their position. The channel at Garston was 40ft. in depth, and the fact of that being so proved that it would continue at that depth under the proposed new circumstances. He did not anticipate any danger of a bar forming at the mouth of the channel at Garston, but if such a bar were to be formed it could be quickly dredged out.

In reply to Mr. Bidder, who represented the Mersey Docks and Harbour Board, Mr. Williams explained that the original depth of 24ft. for the channel had been reduced to 12ft., because as there were only 9ft. of water over the Bar, that would be sufficient for the present. The depth would be gradually increased by dredging, and he hoped before long to have a depth of 24ft. When a channel of 24ft. was proposed it was intended to be independent of tides, in regard to large vessels going up the canal to Manchester. At present such vessels could only cross the Bar with certain tides—vessels of 20ft. draught must cross between half tide and high water. He was satisfied that the present line of channel was the best that could be proposed.

On the following day—Friday—Mr. Williams was further cross-examined by Mr. Bidder, in reply to whom he said it was not likely that the old channel would silt up while the new one was being made, because the scour round the end of the training wall would keep the channel clear. There were always two channels in this estuary, but he had never known the navigation stopped. As to various difficulties that had been suggested, he did not suppose that because he was going to assist Nature she would act differently than she previously done. There would be sufficient velocity of current left at the end of the channel to carry the silt out to sea, and while there would no doubt be a tendency to create a bar where the matter got into slack water, if the channel were made with high banks, to reclaim land, in this case it was only intended to make a new channel in place of the existing channel. The training walls would confine the sand, and were absolutely necessary for that purpose. Mr. Williams was also cross-examined by other counsel on points mainly other than engineering, and the committee adjourned.

The committee re-assembled on Monday, when

Mr. Williams was re-examined by Mr. Michael on behalf of the promoters. He denied that there was any danger of a deposit being formed at the end of the channel during the construction of the canal. The channel would be trained first of all, and having stopped the low-water course on lines to be approved by the Conservators, they would commence dredging at the lower end. If sand accumulated there he would simply dredge it out. The additional fall of the channel from Runcorn to Garston would be about 2in. to the mile. The average fall at present was 12in. to the mile. The fall might be removed altogether, as had been done in the case of the Clyde, and then a smaller quantity of silt would be brought down and deposited, admitting for the moment that there was likely to be any deposit at all. He denied that any of the works they proposed to carry out would injure the channel as it now existed at Garston. On the contrary, the line of channel proposed would greatly benefit Garston by maintaining deep water near the port. He had never known the depth vary on that side between Garston and Liverpool. The velocity of the current was enough to maintain the channel. With regard to Pluckington Bank, the matter deposited there was a varying quantity. The bank was important in regard to the ferry from Liverpool to Birkenhead, but only in that respect. It did not seriously affect the docks at Liverpool. Nothing that the promoters of the scheme proposed to do would tend to increase the deposit on the bank. It was an important fact that the channels joined together near Garston and opposite Hale Head. No other effect would be produced on the banks than had been created during the last half century. It was not possible that by the proposed mode of constructing the channel and the training walls any injury would accrue to the navigation of the river. The method of construction would be carried out gradually. The course of the channel might be rather circuitous at first, but it would generally be found that when they had got half way through one of the banks, and had got a long line of groynes out, the force of the current, impinging on that line, would go right through the remainder of the bank. The alteration of the channel, which would be caused during the progress of the works, would not place any additional difficulty in the way of piloting ships. At no time during the progress of the work would they bar the navigation.

Replying to the committee, Mr. Williams said the proposed works would certainly not injure the Bar; they would be more likely to increase the depth of water over the Bar. They would not in any way damage either the Bridgewater Docks or the Weaver Navigation; and there had long been a general public feeling that something ought to be done to improve the navigation of the Upper Mersey.

Mr. P. J. Messent, M.I.C.E., was next examined in support of the scheme, he being engineer to the Tyne Commissioners, and having carried out extensive improvement works on the Tyne, similar to those now proposed for the Mersey. Describing the operations on the Tyne, he stated that training walls had been constructed, and dredging to the extent of 66 million tons had been effected. Only a part of the matter dredged out was rock. At first the height of the walls was about half-tide—about 7ft. high at low water—but subsequently the depth was raised to the level of full tide. The walls were raised while the dredging was carried on, and no difficulty to navigation was experienced during the progress of the work. The depth of water over the Bar of the Tyne was originally 6ft. at low water, now it was 20ft. to 24ft. In 1860 the average tonnage of vessels entering the river was 154 tons, but now the average was 380 tons. He was acquainted with the Mersey, and he could see no difficulty in carrying out the proposed works, which he was sure would be successful, and would be of great advantage.

In the course of cross-examination by the several counsel, Mr. Messent said the shifting sands in the Mersey could be perfectly well dealt with. He did not believe a bar would be caused at Garston, or that the Weaver's navigation would be blocked. By the training walls on the Tyne the high water was raised about a foot, but the scour was not much increased. The works had considerably increased the tidal way of the river, but the velocity had been somewhat diminished in consequence of the enlarged area. About £4,000,000 had been expended on the works, and that came back in the shape not of rates on the town, but of shipping dues.

Mr. John Fowler, M.I.C.E., engineer to the Tees Commissioners for the last twenty years, was also examined by Mr. Michael on behalf of the Bill. He described works he had effected on the Tees, stating that he had constructed twenty miles of training walls between Stockton Bridge and the Bar, twelve miles from the sea. He had also reclaimed land for fourteen miles, and had dredged about 10,000,000 tons of material from the bed of the river. He had also constructed a breakwater on the south side of the estuary. Before the work was commenced there were sand banks which shifted with every spring tide, and formed sometimes three or four channels. The result of the works carried out so far was that, instead of there being 1ft. 10in. depth of water at Middlesbrough, there was 12ft. at low water, and instead of the depth of water between Stockton and Middlesbrough being 3ft. it was now 7ft. The works carried out had been of the greatest advantage to navigation. When the works were commenced the real depth of water at the Bar was 7ft., but it had increased to 17ft. The Bar was now a fixed one, but prior to the commencement of the works its position varied. The training walls were commenced in 1855, and the construction of the breakwater was now in progress. The total quantity of dredging done in 1882 represented 1,699,505 tons, at a cost of about 5d. a yard, or 2½d. per ton. With regard to the present scheme he believed Mr. Williams's plan would attain the object in view, and he saw no difficulty in the way of constructing training walls without much interference with the present navigation and trade. When the channel was constructed there would be no difficulty in keeping it open, and he thought the object sought would be as well accomplished as it had been on the Tees. The works would be beneficial to the estuary, as more water would be brought in, and thus there would be less dread of stagnant water.

On Tuesday Mr. Fowler was cross-examined at some length on behalf of the opposing interests, but he adhered to his view as to the perfect feasibility of the scheme. Mr. James Dear, engineer to the Glasgow Harbour Commissioners for the last fourteen years, was also examined for the Bill. He knew nothing about the Mersey, but he described what had been done to improve and deepen the Clyde, upon which works of very considerable importance had been carried out. In the course of his evidence he stated that he had been applied to for information in regard to those works by many foreign Governments, and by the promoters of the Manchester Ship Canal. The information he gave was perfectly impartial. The works on the Clyde commenced so far back as 1758, and the channel and harbour were very much deepened. In 1758 the depth of water in the harbour at high water was 5ft. 8in., and about 18in. at low water. It is now 26ft. at the same place at high water and 15ft. at low water. For some years the work has been confined to deepening and widening the stream so far as the river was concerned. The walls of the bank of the river were formed of rubble stone on the river line, and they were built up to the angle of repose. High water in the Clyde was only 4in. higher now than it was 120 years ago. The difference was gained by dredging. The range of spring tides was 11ft. 2in. now, and at one time it was about 2ft. The result was obtained by continuous dredging and forming training walls—the same principle that was proposed to be applied to the Mersey. The quantity of dredging in the last thirty-eight years amounted to 56,000,000 cubic yards. From one million and a-quarter to one million and a-half cubic yards was dredged every year. The quantity of dredging had increased very much of late years, owing to the employment of improved machinery. The cost of dredging was equal to 5½d. per ton, and the total cost up to the present time had been something like £20,000,000. That sum did not include the value of the plant, which was about £37,000. Bringing his experience to bear on the Mersey, he had no reason to believe that if the training walls were constructed similar results should not follow.

The sitting of the committee on Wednesday was occupied by the examination of Mr. Abernethy, who is the consulting engineer to the promoters of this Bill, and who gave evidence mainly upon the lines followed by Mr. Leader Williams.

THE CHEMISTRY OF THE BESSEMER CONVERTER.*

On Saturday evening, March 10th, Mr. J. E. Stead, F.I.C., F.C.S., metallurgical chemist, of the well-known firm of Pattinson and Stead, delivered an interesting lecture before the Cleveland Iron Trade Foremen's Association, in their usual meeting-place in Corporation-road, Middlesbrough. The president of the Association, Mr. J. M. Outridge, was in the chair. This was the last of a series of lectures upon the metallurgy of iron and steel, treating the subject in a popular way, and the iron trade of the Cleveland district is much indebted to Mr. Stead for the valuable information he has given them.

The lecturer began by saying that the Bessemer converter was by far the most important metallurgical instrument of modern times. It had become even more important during the last few years, since the discovery and practical development of the basic process, commonly called the Thomas-Gilchrist process, from the names of the inventors. By means of that system, as was well known, immense quantities of phosphoric pig iron which had before been deemed to be unsuitable for making steel had been rendered in a commercial as well as chemical sense available for the Bessemer process. This fact—for, notwithstanding the contrary opinions of some authorities, it was a fact—was of special importance to such districts as that of Cleveland, where there was made annually an enormous quantity of phosphoric pig iron, which might, by means of the new system, be converted into excellent steel. He was going to speak to them that night of the chemistry of the Bessemer converter, and he would try to show them how the process was conducted, with what kind of material, and what kind of steel was the result. He would also compare the ordinary, or acid Bessemer process, with the new basic system, pointing out their several differences, both as regards method and materials used. Before entering upon the chemical details, the lecturer exhibited upon a screen, by means of the oxy-hydrogen lantern, a series of views showing various kinds of Bessemer plants. These were (1) ordinary old-fashioned English Bessemer pit, with a converter on each side blowing in opposite directions; (2) a more detailed view of the converter, with plan of plug and arrangement of tuyeres; (3) a plan of the Barrow Hematite Iron and Steel Works; (4) a plan of the steel works at Rhymney, South Wales, where the converters are side by side, and blowing in the same direction. The lecturer pointed out the great convenience of the Rhymney plant, where the blown metal, after being converted into steel and run into a ladle, is conveyed upon a carriage away from the hot converting house to the casting house, where the centre crane had the full sweep of its radius for casting. He then exhibited a section of a basic Bessemer converter of the latest type, showing how its shape differed from that of the ordinary vessel, especially as regards the even taper from the body of the vessel to the nose, instead of the turned nose of the old-fashioned converter. This alteration had been made because it had been found by experience that during the basic process the quantity of slag and other things thrown out collected at the mouth of the vessel and nearly choked it up. It was in the lining of the vessel that the first departure from the ordinary Bessemer process was noticeable in the basic system. Mr. Stead then described the method adopted for ramming in the lining. The material for lining the ordinary vessel was ganister, the composition of which he exhibited on the screen as follows:—

	Sheffield ganister. No. 1. Per cent.		Sheffield ganister. No. 2. Per cent.	Good mixture. No. 3. Per cent.
Silica	from 85·0	to	92·0	91·2
Alumina	,, 4·0	,,	8·0	6·0
Peroxide of iron	,, 1·8	,,	2·5	1·7
Lime	,, ·1	,,	·3	·25
Oxide of magnesia	,, ·3	,,	·5	·25
Oxide of potassium	,, ·2	,,	·6	·38
Oxide of sodium	,, ·3	,,	·4	·32

What was wanted was a substance which would resist the action of very high heats and be of such a plastic nature when damp as to hold together when placed in the converter. Thus it was very necessary to have about 6 per cent. of alumina in the mixture, or otherwise it would be too sandy, and would be a useless lining. It is very important that in choosing ganister only such stones as are very free from the alkalies potash and soda should be selected, because these bodies when present only in moderately large quantity so affect the refractory properties of the bricks as to make

* Revised and supplemented by the author.

them readily fusible at a high temperature. The lecturer then showed the following:—

	Durham ganister. Per cent.	Durham fire-clay. Per cent.
Silica	97·81	69·18
Alumina	1·50	25·90
Peroxide of iron	·35	2·50
Lime	·10	·36
Oxide of magnesia	·15	·41
Oxide of potassium	·16	1·20
Oxide of sodium	·11	·45

They would observe that in the Durham ganister there was only 1·5 per cent. of alumina. This was not enough, and such ganister was unsuitable for lining converters. They would also notice that the fire-clay had 26 per cent. of alumina, but only 69 per cent. of silica. This, again, would not do, because it would melt away almost like treacle, because of the large quantity of oxide of potassium (K_2O) and oxide of sodium (Na_2O). A suitable mixture of the two would, however, do very well, and such mixtures were commonly used in this and other districts.

The next slide was a section of a Bessemer converter which had been used for some time blowing ordinary hematite iron. The lining, although worn away in some places, actually increased in thickness in others, large masses of very refractory slag collecting on the sides of the vessel, which it was necessary to chip off at the end of the week when the vessels were cold. This was no exceptional thing but very common.

The next slide gave the analysis of the material used for lining the vessels working on the basic system as follows:—

Basic linings.

	Per cent.
Lime	49·91
Magnesia	30·72
Alumina	4·50
Oxide of iron	3·46
Silica	11·41
	100·00

The noticeable feature of this was that, whereas in the ganister or acid lining the predominating constituent was silica, in the basic lining there was only 11 per cent. of silica, the great bulk of the material being lime and magnesia. Different experimenters had experienced difficulty in using ordinary lime or limestone as refractory lining; but Messrs. Thomas and Gilchrist had succeeded at last in making a basic lining that would stand well. There were two or three ways of making good basic linings. The chief one was as follows: —Finely ground magnesian limestone was moulded into bricks, which were then calcined in a kiln until all the carbonic acid was expelled and the substance had shrunk down to about half its original bulk; but they were in this stage ugly, shapeless things, quite unfit for building up a lining, so they were taken to a mill and ground up to a rough powder. This powder was mixed with from 9 to 10 per cent. of boiled coal tar—that is, tar from which the water has been all removed. If any quantity of water remained the lining would be liable to burst, owing to the slaking and consequent expansion of the lime in the composition. This mixture of tar and basic material is thrown in plastic lumps into an annular space which is formed in the interior of the vessel by the introduction of a cast iron shell, within which a fire is placed. The basic material as soon as it becomes hot melts and naturally fills up the annular space, and becomes quite solid after prolonged heating. Another method was to make bricks of this plastic material in either cast or wrought iron moulds, which, while in their moulds, are placed in an oven and baked, when the tar is coked and the material becomes converted into solid bricks. After cooling the mould is removed, and the bricks of perfect shape are simply built round the inside of the converter without any mortar whatever. When the vessel is ready molten pig is run in, and the converter being turned up, the blow begins. The following analyses of the metal charged during the ordinary acidic process were then exhibited:—

	Metal used 15 years ago. Per cent.	Metal used now. Per cent.
Carbon	3·5 to 4·0	3·0 to 4·0
Manganese	·1 „ 1·0	·1 „ 1·0
Silicon	2·0 „ 3·0	2·0 „ 3·0
Sulphur	·01 „ ·05	·05 „ ·15
Phosphorus	·03 „ ·10	·03 „ ·10

The lecturer pointed out that many years ago only such spiegeleisen as contained between 9 and 10 per cent. of manganese was available for Bessemer purposes, and the amount of manganese which it was possible to add, without making the steel too hard, was limited. Consequently the metal was required to be particularly low in sulphur, for it was a well-known fact that the effect of sulphur upon steel is to make it red-short so that it breaks when rolling. Manganese had precisely the reverse effect. The quantity of the latter required to neutralise the injurious effect of sulphur was from six to eight times its weight; and the old German spiegeleisen being capable only of adding from ·35 per cent. to ·4 per cent. of manganese, it was clear that the metal to work well should not contain more than ·05 per cent. of sulphur. At the present time, however, since the manufacture of better class English spiegeleisen, as much as 20 per cent. of manganese is obtained, and by increasing the proportion of manganese added to the steel a very much larger quantity of sulphur is admissible. Hence it is possible to make excellent steel now with metal which a few years ago would have been condemned as utterly unsuitable for Bessemer purposes. During the blow the object was to remove from the iron its silicon and its excess of carbon, so as to convert it into malleable steel. If they could arrange matters with ordinary hematite pig iron, so that the exact quantities of carbon and other things could be left in the blown metal it would be a good thing; but they could not do that, and they were, therefore, obliged to blow out all the carbon first of all, and afterwards, by the addition of spiegeleisen, replace it in proper proportion. Thus their first object was to rid the metal of its carbon and silicon, which was performed in from twenty to twenty-five minutes. The following approximate table was then shown:—

	At the start. Per cent.	After 5′ Per cent.	After 10′ Per cent.	After 15′ Per cent.	After 20′ Per cent.	After 25′ Per cent.
Carbon	3·5	3·6	3·3	3·25	2	trace
Silicon	2·25	1·0	0·5	0·2	0·1	trace
Manganese	1·00	0·35	0·2	trace	—	—

Thus they would see that the manganese all went in fifteen minutes; the silicon began to go immediately, and continued to burn away at about the same rate throughout, while the carbon did not begin to diminish appreciably until all the manganese had gone and nearly all the silicon. At first it seemed as though the carbon increased, but this was not so; the carbon remained about the same in amount, and, as the quantity of other things diminished, its proportion to the whole was of course increased. The lecturer then showed the following, which is a table similar to the foregoing, showing the action when very silicious pig iron is used:—

	At the start. Per cent.	After 5′ Per cent.	After 10′ Per cent.	After 15′ Per cent.	After 20′ Per cent.	After 25′ Per cent.
Carbon	3·5	3·6	3·3	2·5	1·0	trace
Silicon	3·0	1·75	0 25	0·9	0 7	0·5
Manganese	0·75	0 25	trace	—	—	—

Here, again, it would be seen that the manganese disappeared first; the silicon began at once to go rapidly, so rapidly indeed that the very great heat caused the carbon to commence to burn away sooner than usual, and the carbon disappeared almost while there was a small percentage of silicon yet remaining. This was what was called a hot blow, and it was desirable during a heat of this kind to add cold material. With such metal as this the blower is able from previous knowledge to ascertain a considerable time before the end of the process that the temperature is going to be excessive, and in such cases he reduces the temperature by the addition of cold scrap or pig metal. When the temperature is not excessive the silicon entirely disappears before the carbon; consequently the whole of the oxygen entering at the bottom of the bath goes to burn the last traces of carbon, which is therefore very rapidly effected, and the large flame of carbonic oxide at the mouth of the vessel suddenly drops, indicating at once to the blower that the operation is ended. But when silicon is present during the elimination of the last traces of carbon, the flame does not drop so suddenly, for the oxygen is then divided in its action between silicon and carbon. Consequently the burning of the last parts of carbon is not so rapid, and the flame, instead of falling suddenly, fades gradually away. When this happens the blower knows that he has silicon left in the bath, and continues to blow until dense brown fumes appear, which is an indication that the oxygen entering at the tuyeres, after burning all the silicon, is commencing to burn the iron. The sulphur and the phosphorus in the ordinary acid process are not affected to any extent; they apparently increase, but this is only relative, and is owing to the disappearance of other ingredients. It would be observed from the foregoing remarks that as the temperature of the metal is increased the relative attractions of silicon and carbon for oxygen approach each other. At first, when the metal is cool, the whole of the oxygen, practically speaking, is taken up by oxidising silicon; but after a certain period, when the temperature is considerably increased, the carbon begins to burn along with the silicon, and towards the end of the blow it will be seen from the analysis of the silicious blow that the attraction of carbon for oxygen is as great or greater than that of silicon. This question of temperature is of the very greatest importance in making steel castings free from blowholes, for if the carbon has a greater attraction for oxygen than silicon has, the addition of silicon to the bath for the purpose of producing sound steel will be of no benefit whatever, and that the so-called Terrenoire process of making sound castings must necessarily depend as much upon the correct temperature of the metal as upon the chemical constituents. The lecturer here strongly advised that very much greater attention should be paid to the proper adjustment of temperature at the time of casting in order that uniformly solid and homogeneous steel might be produced. The following table was then exhibited, showing the changes which take place when metal containing about 3 per cent. of manganese is used:—

	At the start. Per cent.	After 5′ Per cent.	After 10′ Per cent.	After 15′ Per cent.	After 20′ Per cent.	After 25′ Per cent.
Carbon	3·52	3·6	3·3	2·5	1·0	trace
Manganese	3·00	2·00	1·25	0·75	0·65	0·35
Silicon	1·25	0·60	0·20	0·10	trace	—

They would see from this that a considerable quantity of manganese remained in the steel at the end of the blow after all the carbon was removed, and in practice where such metal is used they can, by the aid of the spectroscope and by taking samples of the slag and metal a few minutes before the perfect elimination of the carbon, ascertain exactly when the proper proportion of carbon remains, at which point the metal is simply poured out of the ladle and cast in the ordinary way, no addition whatever of spiegeleisen being necessary. As manganese in burning gives out a considerable amount of heat it is not necessary when it is present to have more than half the usual quantity of silicon in order to give the heat necessary for the proper conduct of the process.

The lecturer then turned his attention to the basic process, and exhibited upon the screen the following table showing the composition of the metals commonly used in that process:—

Metals for Basic Process.

	No. 1. Per cent.	No. 2. Per cent.
Carbon	3·35	3·50
Manganese	·60	1·00
Silicon	1·30	1 00
Sulphur	·15	·12
Phosphorus	1·75	2·75

As they would see, the special difference between this metal and that which was charged in the ordinary converter was the large percentage of phosphorus, and it was to effect the removal of this element that the basic system was called into existence. When the metal is charged into the vessel about 15 per cent. to 17 per cent. of a well-burned lime is also put in for the purpose of absorbing the silica and phosphoric acid produced by the oxidation of silicon and phosphorus, which, if no lime were present, would assert themselves by eating away the lining of the converters, which would in such a case be rapidly destroyed. Later on he would endeavour to explain why it was that the old process failed to remove the phosphorus. He then showed a table giving the approximate rates at which the various substances disappeared from phosphoric pig iron during the blow:—

	At the start.	After 5′	After 10′	After 15′	After 18′
Carbon	3·50	3·55	2·35	0·07	trace
Silicon	1·50	0·50	0 09	trace	—
Manganese	0·71	0·56	0·27	0·12	trace
Phosphorus	1·57	1·60	1·43	1·22	0·08
Sulphur	0·16	0·14	0·13	0·12	0·10

From this it would be seen that, as in the ordinary acid process, the carbon at first increased slightly, and afterwards rapidly burnt away, while the silicon was speedily eliminated during the first few minutes of the blow. The manganese also is burnt out before the end of the operation, but not quite as rapidly as in the acid-lined vessel. Practically, no phosphorus is eliminated until the whole of the carbon has been removed. The reactions which really take place in the basic process had been very carefully and systematically investigated by himself, and were of great interest to those concerned in the chemistry of the process. The Bessemer converter had always been classed as a great oxidising apparatus, and looking at it as a whole it was so; but it would be quite as logical to state that the blast furnace, which they all considered to be a reducing machine, was also an oxidising apparatus. The fact was that they were both oxidising and reducing. In the blast furnace the oxygen entering in at the tuyeres oxidised the carbon in the coke, producing heat; but in the higher reaches of the furnace the gases so formed, and the unoxidised carbon, were very powerful reducing agents, and effected perfect reduction of the iron ore charged. In the Bessemer converter they also had a lower or oxidising part, and an upper reducing region. At the lower part, near the tuyeres, the oxygen rapidly entered into combination, not, as some would suppose, with the elements exactly as in the order shown in the ultimate analytical tables, but with the whole of the constituents all together, in the proportion in which they were present, producing a very highly basic oxide of iron cinder. This cinder, passing upwards through the column of metal which, owing to the rushing of air through it, is in violent agitation, reacts upon the silicon and manganese, and at the same time also upon phosphorus, producing silicate of iron, silicate of manganese, and phosphate of iron. As the cinder was more and more intimately brought into contact with fresh portions of metal, the greater part of the oxide of iron was reduced, the iron returning to the bath at the same time that the silicon and manganese were oxidised. These reactions might very briefly be described by means of chemical symbols thus:—

(1)—$Air + Fe_n = Fe\,O_n + N$.
(2)—$2\,Fe\,O + Si = Si\,O_2 + Fe_2$.
(3)—$Fe\,O + Mn = Mn\,O + Fe$.
(4)—$6\,Fe\,O + 2\,P = Fe\,O, P_2O_5 + 5\,Fe$.
(5)—$Fe\,O, P_2O_5 + 6\,C = Fe + P_2 + 6\,C\,O$.
(6)—$Fe\,O, P_2O_5 + 3\,Si = 3\,Si\,O_2 + P_2 + Fe$.

It would be seen from the last two reactions, Nos. 5 and 6, that as long as carbon and silicon existed in the bath, there being a large head of metal over the tuyeres, practically no phosphorus could be eliminated. If, however, the bath was shallow, or the tuyeres were caused to inject air forcibly upon the surface of the metal, there being on the surface at the same time a quantity of lime ready to absorb any silicic or phosphoric acid produced, the phosphorus might be and had been perfectly removed before the elimination of the carbon. Thus at the Blaenavon works, where Messrs. Thomas and Gilchrist made their first experiments in a stationary converter, in which the tuyeres were certainly not more than a few inches from the surface of the metal, in almost every case the whole, or at least a very great proportion of the phosphorus was eliminated by the time that the last portions of carbon were removed from the bath. The question might be asked, why the oxide of iron produced by surface oxidation is not reduced, remembering that the metal during the blowing process must necessarily be in a violent state of agitation, and therefore brought into intimate contact with the cinder formed at the surface. The explanation was very simple. When the phosphate of iron was formed at the top of the bath it instantly afterwards came into contact with highly heated lime, which completely decomposed it, phosphate of iron and lime reacting on each other and forming phosphate of lime and free oxide of iron; and this phosphate of lime was incapable of reduction by the carbon in iron, or by carbonic oxide gas. Hence no reduction took place. From the point of the termination of blowing forward the operations in the acid and basic processes were similar, only in the case of basic steel the greater part of the surplus oxygen contained in the bath was removed by Mr. E. W. Richard's process of adding fluid hematite pig iron containing silicon. To the blown metal was added spiegeleisen, by means of which the necessary carbon and manganese were put back into the metal—and by means of which, in the case of acidic steel, the surplus oxygen was also removed—which was thereby converted into malleable steel. The following analysis of spiegeleisen were then exhibited:—

	Old German.	New English.
Carbon	4·50 per cent.	5·20 per cent.
Manganese	10·00 „	20·00 „
Silicon	·50 „	·50 „
Sulphur	trace	trace
Phosphorus	·10 per cent.	·10 per cent.

The lecturer then went on to explain the reason why phosphorus could not be removed in the ordinary silica or acid converter; and to make his explanation perfectly clear, he placed upon the screen the following equations:—

$$3\,Ca\,O, P_2O_5 + 3\,Si\,O_2 = 3\,Ca\,O, Si\,O_2 + P_2O_5.$$
$$Fe\,O, P_2O_5 + Si\,O_2 = Fe\,O, Si\,O_2 + P_2O_5.$$
$$P_2O_5 + 5\,Fe = 5\,Fe\,O + P_2.$$

These reactions showed that phosphate of iron or lime, if formed in the presence of silica, were decomposed, silicate of iron or lime being formed, and free phosphoric acid being produced. But this free phosphoric acid could not exist as such, but was reduced, not only by the carbon and silicon, but even by the metallic iron itself. The lecturer explained that if a rod of pure iron was simply dipped in phosphoric acid, and heated to redness while in contact with it, a fusible drop of phosphide of iron would form at the extremity of the rod. The lecturer then placed upon the screen comparative analyses of the slags produced in the two processes, which were as follows:—

	Ordinary Slag.	Basic Slag.
Protoxide of iron (Fe O)	15·62 per cent.	9·13 per cent.
Peroxide of iron (Fe_2O_3)	1·57 „	—
Metallic iron (Fe)	—	—
Alumina (Al_2O_3)	1·02 per cent.	2·10 per cent.
Oxide of manganese (Mn O)	5·33 „	4·32 „
Silica ($Si\,O_2$)	75·70 „	16·60 „
Lime (Ca O)	0·94 „	47·08 „
Oxide of magnesia (Mg O)	0·09 „	4·62 „
Sulphur (S)	0·01 „	0·12 „
Phosphoric acid (P_2O_5)	Nil.	16·03 „
Bases	14·57 per cent.	65·15 per cent.
Acids	75·71 „	34·85 „

Referring to the loss or waste in Bessemer converting, the lecturer explained that a very great proportion of the present waste was due to projections from the nose of the vessel which was liable to be carried away with the rubbish of the Bessemer house. An analysis of an accumulated mass of such projections was exhibited as follows:—

	Bessemer Projections.
Free iron (Fe)	70·30 per cent.
Peroxide of iron (Fe_2O_3)	14·50 „
Manganese (Mn)	·11 „
Carbon	1·01 „
Silicon	·63 „
Sand	13·18 „
Phosphorus	·05 „
Sulphur	·06 „

The lecturer pointed out that, according to careful analytical data, not more than 2 per cent. of the metallic iron in the charge was actually burnt, and that if no loss occurred either in projections, scrap, or iron mechanically carried away entangled in the slag, the yield of steel should be 92·5 per cent. of the metal charged. In practice, however, the yield averaged from 3 per cent. to 4 per cent. less than this. In the basic converter, the theoretical yield was about 2 per cent. less than from the ordinary vessel, but in practice, owing to the large amount of slag produced, more particles of metallic iron were liable to be carried away with the slag, so that a yield of 85 per cent. was considered very satisfactory. The last slide exhibited was to show the comparative composition of basic steel and ordinary acidic steel as follows:—

	Acid.	Basic.
Iron	98·33 per cent.	98·46 per cent.
Carbon	0·35 „	0·35 „
Manganese	1·11 „	1·01 „
Silicon	0·08 „	0·03 „
Sulphur	0·06 „	0·11 „
Phosphorus	0·05 „	0·04 „
Copper	0 02 „	trace

From these it would be seen that the steel produced is very similar in both cases. In conclusion, the lecturer remarked that the basic process was making rapid progress, in a commercial sense, not so much in this country—although there were several new works being arranged for the process near completion—as on the Continent. Mr. Gilchrist, one of the patentees, had recently estimated that the make of that steel last year everywhere was about half a million tons, and that the make of the forthcoming year would probably double that quantity.

TENDERS.

GAS PURIFIERS AT BURY.

IN our impression for April 20th we published drawings and specifications for gas purifiers, &c., for Bury. Mr. J. Cartwright, Borough Surveyor. The contract is for purifiers and travelling cranes complete, the tenders for elevators being left over for further consideration. The following tenders have been received:—

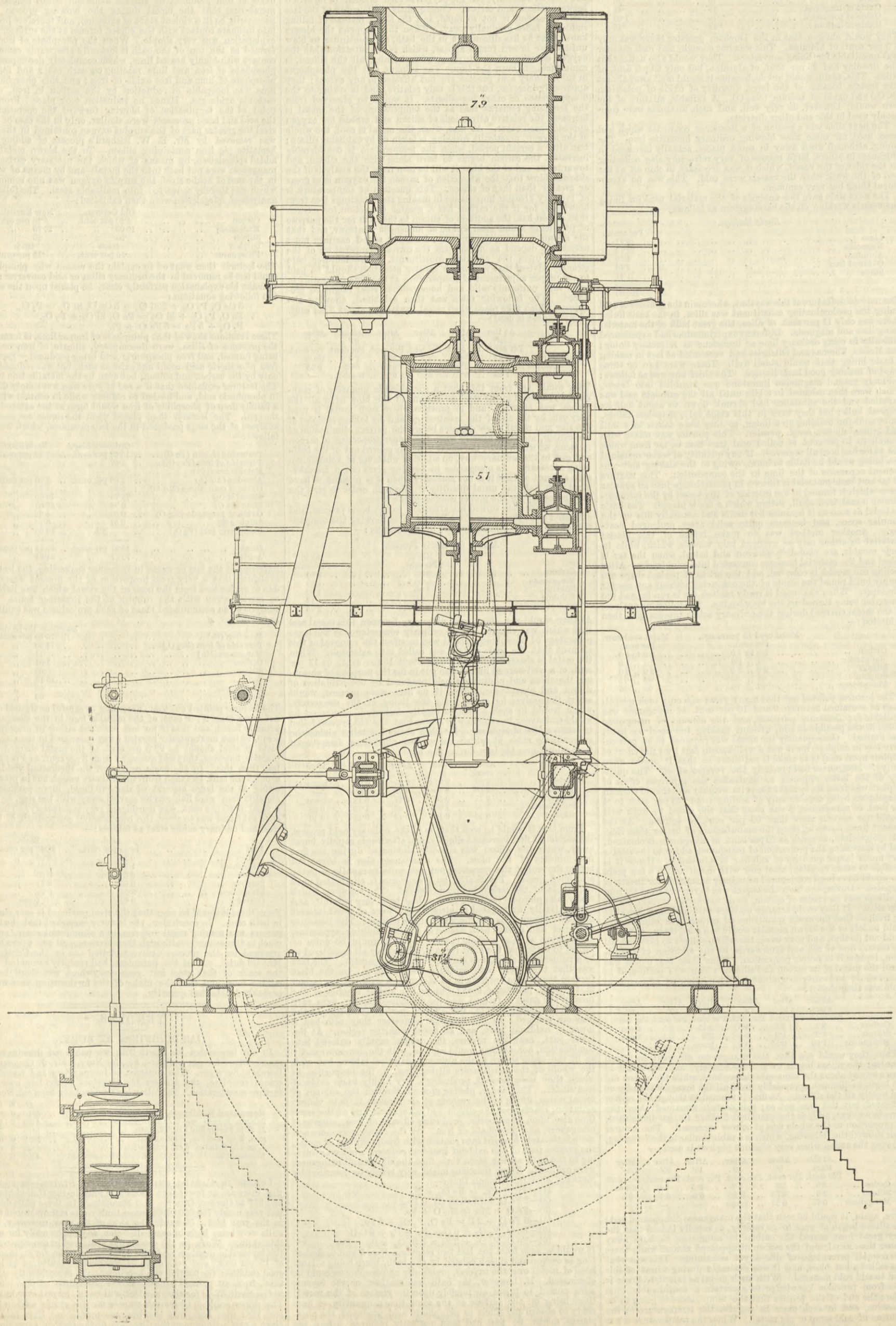
	£	s.	d.
Heenan and Woodhouse, Manchester	5910	0	0
Salman, Barnes, and Co., Ulverstone	4490	0	0
J. T. B. Porter and Co., Lincoln	5295	0	0
S. S. Stott and Co., Haslingden	5337	0	0
J. and S. Roberts, West Bromwich	4825	0	0
Newton, Chambers, and Co., Sheffield—accepted	4258	0	0

LUMBER IN CANADA AND THE UNITED STATES.—It appears that there are no fewer than 15024 saw mills in the United States, and 637 in Quebec, Ontario, and Manitoba. In these mills during last year nearly 750,000,000ft. more timber was manufactured than in the year 1881. Towards the close of the year, moreover, new mills were being built in every direction, so as to be ready for work this spring. Work in the woods has prospered in consequence of the favourable weather, and the lumberman looks for an increase of 15 per cent., and even more, if the weather continues to be in good condition for floating the logs down. It is confidently stated that, from all present indications, the production of pine lumber in the North-West for the year 1883 will be the largest ever known. The prices realised by manufacturers on the stocks sold in 1881 and 1882 were high, and the business profitable. This fact has given a great stimulus in the direction of the further expansion of the great lumber trade.

BLOWING ENGINES FOR THE SOCIETE ANONYME DE ST. NAZAIRE.

MESSRS. W. AND J. GALLOWAY AND SONS, MANCHESTER, ENGINEERS.

(*For description see page* 366.)



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

TO CORRESPONDENTS.

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

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

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

ALPHA.—*Say on what page in the impression for August 6th,* 1880, *is the statement to which you refer.*

A. D.—*Box's "Treatise on Heat" will answer your purpose. You can procure it through any bookseller.*

J. W. H. *The maximum velocity at which you can drive spur gearing depends mainly on the quality of the gear and the load. The speed you propose,* 2800*ft. of angular velocity, is very high, but we do not say that it cannot be attained with safety A velocity of* 2000*ft. per minute is quite practicable.*

EMBANKMENT OF A TIDAL RIVER.

(To the Editor of The Engineer.)

SIR,—Will you allow me to ask in your paper the following question? Does the embanking of a river, as in the case of the Thames, cause the tide to rise higher than before at a given point—as at Westminster Bridge? G. H. S.

London, May 7th.

SUBSCRIPTIONS.

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

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

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

Cloth cases for binding THE ENGINEER *Volume, price* 2*s.* 6*d. each.*

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

Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office order.—Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16*s.* China, Japan, India, £2 0*s.* 6*d.*

Remittance by Bill in London.—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16*s.* Borneo, Ceylon, Java, and Singapore, £2 0*s.* 6*d.* Manilla, Mauritius, Sandwich Isles, £2 5*s.*

ADVERTISEMENTS.

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

Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.

Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of THE ENGINEER, 163, *Strand.*

MEETINGS NEXT WEEK.

CHEMICAL SOCIETY.—Thursday, May 17th, at 8 p.m.: Lecture "On Photographic Action Studied Spectroscopically," by Captain W. Abney, F.R.S.

THE METEOROLOGICAL SOCIETY.—Wednesday, May 16th, at 7 p.m., the following papers will be read:—"Composite Portraiture Adapted to the Reduction of Meteorological and other Similar Observations," by Mr. G. M. Whipple, B.Sc., F.M.S., F.R.A.S. "Note on Atmospheric Pressure during the Fall of Rain." by Mr. H. Sowerby Wallis, F.M.S. "Meteorological Observations at Zanzibar, East Coast of Africa, during 1880-81," by Surgeon-Major C. T. Peters, M.B. "Diurnal Rainfall at Bangkok, Siam," by Captain G. H. Inskip, F.R.G.S. "New Method of Reading a Thermometer and a Hygrometer at a Distance by Means of Electricity," by Mr. Arthur W. Waters, F.G.S., F.Z.S. "An Integrating Anemometer," by Mr. William F. Stanley, F.M.S. "Observations on the Force of the Wind at Sea," by Mr. David W. Barker, F.M.S.

DEATHS.

On the 3rd inst., at 15, Palace-gardens-terrace, Kensington, HENRY F. WHYTE, C.E., aged 52.

On the 5th inst., at his residence, 73, Belsize Park-gardens, JAMES HUNTER, Engineer, of Bow, in his 75th year.

On the 6th inst., at his residence, No. 2, Palace-green, Kensington, Mr. ROBERT DAGLISH, C.E., late of Aston Hall, Cheshire, and of St. Helen's, Lancashire, J.P. for Cheshire and Lancashire, aged 74 years.

THE ENGINEER.

MAY 11, 1883.

LORD H. LENNOX AND THE NAVAL ESTIMATES.

THE question raised by Lord H. Lennox on the naval estimates is extremely important. On the relative power of our navy compared with that of foreign Powers depends our very existence in time of war, relying as we do on a supply of necessaries of life from abroad. Our trade in coals and manufactured goods, while of secondary moment, is, in all conscience, a serious enough matter. Indeed, of such fundamental weight are these considerations, that it would be almost madness to engage in war with any Power who might be reasonably expected to be able to stop our trade, or even very seriously diminish it. This is fully recognised abroad, as is evident in the recent effort made by Russia to raise a fleet of swift cruisers with this object. It is humiliating to contemplate England unable to make her voice heard in time of peace because she dare not contemplate war. This is really the corollary to what Lord H. Lennox represents as our position. Let us examine his statements, and what was urged in reply to him. In 1881 he estimated that the gross tonnage of the commerce of the world was 6,700,000 tons, of which that of England was 4,200,000, America 630,000, and France 420,000. Lord Lennox then urged the necessity of maintaining the relative strength of our navy in comparison with that of foreign Powers. He showed that Germany, Spain, and especially Italy have during the last few years built formidable ships, while France will soon have a fleet much more powerful than our own. She employs many more men in her dockyards and also builds more vessels by contract. To such an extent has this been the case, that at the end of this year "England would have built and completed eleven first-class ironclads, while France at the same period would have seventeen" according to the estimates; but he pointed out that the secretary to the Admiralty has shown that we fall far short of our estimates, and so the state of things is even worse than he represents. From inquiries he learned "that taking the ten years from 1872-73 to 1882-83, there was a total deficiency of 21,665 tons in the ironclad tonnage, as compared with the estimates. That represented in weight of hull at least five ships of the Conqueror type." That is, instead of 88,471 tons ordered by Parliament, only 66,806 had been actually executed. What was the result? On war threatening, ironclads could not be made in an instant, and hence, as an awkward substitute, the authorities have contrived to buy, at a great expense, such ironclads building for other Powers as could be had, which were, of course, objectionable vessels in many respects. He protested against money voted for shipbuilding being devoted to repairs. Then the delay in making guns and armour was outrageous. Was the 43-ton gun promised by Mr. W. H. Smith yet in existence? What about a 63-ton gun, of which he had heard, but did not see in the estimates? He maintained that France was constructing a gigantic navy, beating us in speed, weight of armour, and certainly in guns, and that it was necessary for England to "take some extra steps" at such a crisis to maintain inviolate the empire of the Queen in every part of the world." Sir T. Brassey, on the other hand, made a very different summary. He confined his comparison to ships able to go to sea in the years 1882 and 1885. He struck out, therefore, wood ships launched before 1867, because even French engineers estimated their life at fifteen or sixteen years at most. Grouping together in the first-class, ships with 9in. of armour and over 8500 tons, England had in 1882 ten ships, with an aggregate displacement of 96,000 tons, and France only 3, with a total of 22,000 tons. In 1885, England would have 15 ships of 140,000 tons displacement, and France 6, with 61,000 tons displacement. Of the second-class, that is, with 8in. armour and of under 8500 tons, England had, in 1882, 13 ships of 80,000 tons, and France 7 of 56,000 tons; and in 1885, England would have 16 ships of 101,000 tons, and France 13 of 93,000 tons. In the third class, that is, with from 4½in. to 6in. of armour, England had, in 1882, 13 ships of 104,000 tons, and France 12 of 50,000, whilst in 1885 England would have 12 ships of 98,000 tons, and France 5 of 40,000 tons displacement. He considered that while France had made extraordinary efforts in the period 1876—1879, she had since remained stationary; while our votes had increased from £3,123,000 to £3,754,000. He also pointed out that while powerful sea-going ships must occupy the first place, our resources should not be unduly concentrated on that class, but partly devoted to swift auxiliaries armed with light or medium guns, of which two or three would be made next year, as well as torpedo vessels. He maintained that the fact that our ships became obsolete in so small a proportion spoke eloquently for our constructors; and while we may regret that our later unarmoured vessels are deficient in speed comparatively, we now were building ships both armoured, and unarmoured, unrivalled in speed. We had no less than sixteen ships with a speed of from 16 to 17 knots, and he instanced the Collingwood as unequalled in fighting powers by any foreign ship of the same tonnage. Sir J. Hay remarked on the absence of sea-going powers of our light coast defence ships, which therefore could not be compared with those of France, and thought that the comparison of our forty-three ironclad sea-going ships with the thirty-five of France not at all satisfactory; also the fact that we are behind in guns. Sir E. Reed supported the statement that whenever the navy had anything to do the Government bought all the ships they could lay their hands on, and the consequence was that they got into the navy ships that no one was satisfied with. We may observe by the way that we presume Sir E. Reed referred to the Belleisle and Orion, together only 9440 tons, for the Neptune and Superb, together 17,700 tons, were his own designs. Where nearly two-thirds of the tonnage vessels thus purchased were his own, we should have expected him to have discriminated in his condemnation. Captain Price and Mr. W. H. Smith supported the view that the strength of the navy of England must be kept up, the latter considered that our guns were behindhand. Mr. Campbell Bannerman "was not prepared to go into a comparison of the ships of the two countries"—England and France—and preferred to point out that France in 1883 had 71,500 tons of iron and steel ships and 170,560 tons of steel and wood, while we had 334,910 of iron and steel and only 14,000 of wood. The Conqueror had her new guns, and the 63-ton guns would be ready in time for the Admiral.

With regard to this important discussion, it must be pointed out that statistics may be framed in so many different ways that we may be easily misled by them. It is necessary to recognise the important features of the whole question before we frame statistics. Here, for example, the main facts of the case are these: England was discovered in 1876 to possess a fleet more powerful relatively to that of other nations than had been generally recognised. France, however, whose attention had been occupied by recovering herself from the effects of the war with Germany, but who had in 1872 found that her wooden armour-clad ships were likely to be short-lived, had already made a new start, which was then stimulated further, and money freely voted to furnish her with a fleet which unquestionably will be very formidable. Italy reclassified her ships in 1877, and proceeded on a plan which is to be completed in 1888. The chief feature of her navy is the existence of four monster armourclads of 13,480 and 10,401 tons, carrying 100-ton guns, with 16 and 15 knots speed respectively. Germany has a navy powerful chiefly in defence, and the navy of no other Power need here be considered in our opinion, because if we guard against the French navy and the special ships of Italy, we shall fully meet the case of the others.

We must take our statistics, then, with regard to France, bearing in mind that the question is not one of the present year or of 1885, but that of the time when her increased efforts will fully tell. This we scarcely think has been done by Sir Thomas Brassey, though Lord H. Lennox's figures are also open to objection. Lord H. Lennox obviously uses round numbers and speaks rather loosely. He says, for example, that 70 per cent. of the carrying trade of the world is English, whereas 4,200,000 out of 6,700,000 amounts only to nearly 62·7 per cent. Then the fact that France appears to have exactly 10 per cent., and America exactly 15 per cent. of the trade of England, looks a little loose. However, we do not want to split straws. Without question the general conditions of trade are sufficiently nearly represented by Lord H. Lennox for our purpose. Indeed, Mr. Barnaby, in his diagrams at the United Service Institution, recently, presented the same state of things in a most telling way. In justice to the Admiralty, however, we must protest ourselves unable to understand Lord H. Lennox's statement that at the end of this year England will have only eleven first-class ironclads, while France has seventeen. We have gone over the list of our fleet and that of France and tried to see in what way such a line could be traced as to get any approach to this; but so impossible does it appear, that we think there must be some slip in figures, or that the speech is wrongly reported. On the other hand, Sir Thomas Brassey's favourable figures seem to be due to the circumstance that he selects a period when the French wooden vessels will have nearly disappeared, and when the chief of those we are building are finished, but before the full strength of the new French list is reached. The date at which a vessel is completed is, at best, uncertain. Let us, then, take from Sir Thomas Brassey's own book the French and English fleets now complete and building, without selecting any exact date. We will begin to follow his own definition as to classes. In his ten first-class English ships with 9in. armour, and over 8500 tons displacement, of 1882, Sir T. Brassey, we presume, includes the Devastation, Dreadnought, Inflexible, Neptune, and Thunderer turret ships, and the Alexandra, Hercules, Sultan, Superb, and Téméraire broadside vessels, though from his book the tonnage appears to be 95,150 tons—not 96,000 tons. The three French ships, we presume, are the Admiral Duperré, the Devastation, and the Redoutable, but by his book their total tonnage is 28,979 tons—not 22,000 tons. Now, we think it unfair to draw the line at 9in. of armour, because that suits the English ships better than the French. The French ships Friedland and Colbert have 7⅞in. and 8⅝in. of armour respectively, and are 8916 and 8617 tons displacement, and clearly correspond to this class practically. For example, they each carry eight 10⅝in. guns. The Téméraire carries four 10in. and four 11in. guns only. Further, the Hercules carries nothing larger than a 10in. gun, and her armour, though 9in. at the maximum, runs off to 5in., while the minimum of the Colbert is 7$\frac{1}{16}$in. Her displacement is 8680 tons, and the Hercules cannot claim to be in a class that excludes the two French ships because she happens to have a few 9in. plates on her belt amidships. In fact, a line is drawn that happens to suit the English ships, for until the Ajax and Agamemnon are in commission, there is nothing English that runs near the limit and misses it except the Monarch. We should probably weary our readers, however, if we followed on this track throughout. The chief matter, as we have said, is not the present, but the future. Now the French have many ships building that may not be complete in 1885, but soon afterwards. Perhaps, for present and future, the most unprejudiced summary that we can take is the total tonnage of every French and English ironclad ship in Sir Thomas Brassey's book complete and building. Of iron and steel-built ironclads of all classes England had complete in 1882 315,390 tons, and France 101,319 tons. Of wood-built ironclads England had 19,560 tons and France 166,412 tons; giving England a total of 334,950 tons against 267,731 tons, though this does not agree with Mr. Campbell Bannerman. Building, however, England had only the Ajax, Agamemnon, Colossus, Edinburgh, Conqueror, Collingwood, Imperieuse, Warspite, and Polyphemus, making up 65,840 tons; while France had the Admiral Baudin, Formidable, Foudroyant, Hoche, Majenta, Marceau, Neptune, Dugueslin, Caïman, Furieux, Indomptable, and Requin, with a total displacement of 105,144 tons, and of these the first two vessels each carry three 100-ton guns. Surely, then, it is apparent that the navy of France is gaining on our own at an alarming rate. Nor is the entire question one of total strength. Our commerce is specially threatened by the existence of ships of surpassing power and speed. Sir Thomas Brassey, speaking of the Italia, almost says that a ship one-twentieth of her value might intercept our commerce equally. This surely cannot be admitted. This vessel is sufficiently powerful to dispose of almost any single man-of-war very shortly with her 100-ton breech-loading guns at short ranges. How can any fleet of merchantmen have a sufficient strong convoy to protect them? We have no ironclad to come near the Italia and Lepanto, either in guns or speed. Their sixteen knots would enable them to be a complete scourge to our trade, and we have not yet heard of any way by which we should be able to "collar" them with our own fleet. We do not know the speed of the Admiral Baudin and Formidable, but the Inflexible is the only vessel approaching them in power and size in our navy. She has thicker armour, but is far behind them in guns, and probably in speed. These facts are ugly and serious. With our vast commerce to prey upon the existence of a very limited number of ships with greater speed and much more powerful guns than we possess is, in our opinion, intolerable. No statistics, in our opinion, yet given, meet the case. We may regard the attack of the commerce of other nations an object hardly worthy of our first-rate ships, but with the statistics before us we cannot expect them to look at ours in

the same way. Their main chance is to strike at it; our existence depends on it. It is surely our duty to provide for its security at any cost.

ELECTRIC LIGHTING.

Up to the present the advocates of electric lighting have had little reason to complain. A host of bubble companies has travelled the well beaten track pursued by all bubble companies sooner or later; but electric lighting has gained rather than lost by the downfall of men who sought only their own aggrandisement. The electric light has been recognised as a fact by Parliament, and rules have been made for the regulation of its use. Corporations and others have been won over to look on it with favour; and there is no reason to doubt that there is a great future before it. But electricians will soon find themselves face to face with a very serious difficulty. A demand will spring up for electric lighting, and it seems to be questionable if the demand can be supplied. We do not suppose there will be any trouble met with in obtaining the requisite plant, fittings, and appurtenances. The difficulty we anticipate is of quite another type. Corporations will, for example, begin to ask for estimates, and they will find that the cost of the light will be extremely high. In consequence they will decline to have anything to do with it. The question at issue is, Can electric lighting be done efficiently at a moderate price? If the answer is in the affirmative, well and good; if not, electric lighting must remain of limited application. It will be a luxury, like wax candles—not a necessary, like gas.

We do not propose to say here much concerning the first cost of electrical plant, such as dynamos and lamps. We shall confine our attention to but one point, and we think our readers, if they follow us, will see that this will supply food enough for thought. There is good reason to believe that the estimates which have been formed concerning the power required to obtain a given amount of light are erroneous, being altogether too small; and this holds specially true of incandescent lighting. It is now known that Mr. Edison does not profess to give more than about 120 candles per horse-power; that is to say, that but eight lamps can be supplied by one horse's power. This may seem a small matter; and so it is when small numbers of lights are dealt with. But 8000 lights would not suffice for more than a small town, yet 1000-horse power would be needed to supply them. The Fisheries Exhibition to be opened to-morrow is not a large place, yet Messrs. Davey, Paxman, and Co. have to supply 1000 indicated horse-power to light it. This means a very considerable expenditure, not alone in fuel and oil, but in the cost of engines, boilers, and attendance; and when, furthermore, it is borne in mind that to secure certainty of illumination all the plant and engine power ought to be in duplicate, it will be readily understood that the matter is one of considerable importance. An electric light installation becomes, in fact, a very large affair; and unless something can be done to reduce the demand for power, the use of electricity in lighting must remain more limited than it ought. The question, then, which electricians have to face is this: Can more light be got for a given expenditure of power? In dealing with this question it is well to bear in mind that no fixed relation of any kind exists between the light and the power required to obtain it. It is more than probable that the amount of energy actually converted into light is infinitesimal; but this cannot be settled, because we have no equivalent for light answering at all to Joule's equivalent for heat. If the return is very small, then it follows that the waste power must be very large, and that it may be quite possible to effect considerable changes for the better. Thus, for example, if a steam engine is found to be burning 30 lb. of coal per horse per hour, there ought to be no practical difficulty—and there is certainly no theoretical difficulty—in the way of providing a substitute to give a horse-power for say, 15 lb. of coal per hour. In other words, there seems to be in the case of the electric light a very large margin between the practically existing and the theoretically possible, and it will be easy to make any of our readers possessing a small knowledge of the subject able to understand in what direction improvement is to be sought. In the case of the arc lamp it is known that the light of about 1000 real candles, not nominal, can be had for the expenditure of 1-horse power, including the resistance of the engine, dynamo, and lamp. This is about nine times as much light as can be got from the same power with incandescent lamps. Arc lighting will always have its own sphere of usefulness, and the great improvements which have been effected in the construction of lamps and carbons renders the arc lamp of 1883 a very different thing from the arc lamp of 1880. But incandescent lighting is wanted for indoor work, and the incandescent lamp must be improved. For a considerable period it was held that light depended on current alone, and that power expended in obtaining a given result was also settled more by this than anything else. Current is the number of ampères per second which a given dynamo will produce without regard to the tension or pressure of that current; and to put what we have already stated in other words, it was thought that so long as a given current produced a given light the power must remain unaltered. It is now understood that all this is true only in a limited sense. It is known that it is more economical to work with high-pressure currents than with low. This statement has nothing to do with conductors or their dimensions. It is, of course, true of these, but in a different sense. We speak now of incandescent lamps; not of the leads or wire by which the light is got to them. The higher the resistance of the lamp, other things being equal, the smaller is the quantity or current of electricity required to give a good light, and the smaller is the power expended. To put this in another point of view, we may say that ampères multiplied by volts and divided by 746 gives horses power. Thus, let us suppose, that in a given case we have volts 10 and ampères 60; let the resulting light be represented by 100. Now $10 \times 60 = 600$ and $\frac{600}{746} =$ the horse-power required. If, now, we invert things, and have 10 ampères of current, with an electro-motive force of 60 volts, the power expended will be the same, but the light will be augmented. On this point we have ourselves no doubt at all; but it is proper to add that the proposition is not universally accepted as true. An indirect illustration is readily supposed. Let a given dynamo be driven by an engine of rather too little power, and with the governor out of gear. Let the engine be started with a broken circuit. If now we take one of the lead wires in each hand, and bring them together so as to close the circuit, the engine can be stopped in a couple of revolutions, as though by the application of a powerful brake; and yet the external work done is quite insignificant. An enormous quantity of electricity is produced of very low tension, and the internal resistance of the machine does the rest. Now let a couple of lamps be put in circuit—the experiment is best made with a small machine—and it will be found that the engine will run slowly. Let more lamps be added, and with each addition the engine will run faster and faster, the pressure and the throttle valve remaining unaltered, and the more lamps and the greater the external resistance the quicker the engine will run. As, however, we go on adding lamps it will be found that after a certain point has been reached the light will diminish, which means that there is a certain external resistance which gives a better result in any given case than any other resistance. A strict analogy may be drawn between the action and the influence of pitch on the speed of screw engines.

That Mr. Edison is well aware of the advantage to be derived from high resistance carbons is well known, and he has made them with a resistance of 75 ohms hot, and it is with the hot carbon that we have particularly to do. Mr. Swan is working in the same direction. There is no reason why 20 candles should not be got with less than one ampère of current, and if this could be attained regularly, much would have been achieved. About $1\frac{1}{3}$ ampère and 40 volts per lamp is good work now. This represents $\frac{40 \times 1{\cdot}33}{746} = {\cdot}072$-horse power per lamp, or about 10 lamps per indicated horse-power, and is the result claimed for the Ferranti machine when working in Cannon-street. If, however, the volts could have been got up to 50 and the ampères kept down below 1, the result would in all probability have been more light for the same power, always assuming that the carbons would stand the extra heating.

It is not, perhaps, too much to say that a great want at the present moment is some means of increasing the resistance of carbon filaments. The light appears to be more a function of resistance than of anything else. It is known, too, that after a certain amount of light has been got, a comparatively small addition to the power will nearly double the light, but at the risk of destroying the carbons, the strength of which when very intensely heated is extremely small; in fact, they are on the point of dissolution. Earth, sea, and sky have been ransacked for materials for carbon filaments, but there is reason to conclude that we must look rather to improvement in the process of manufacture than to materials for advances in the desired direction. In arc lighting it is essential to success that the carbons should be as good conductors as possible, because the light is produced on a different principle. To secure good conductivity it is essential that the carbons shall be thoroughly baked after they are shaped. It has been suggested that baking might, perhaps, be dispensed with in the production of filaments, but it has been forgotten that the process of manufacture is a baking in itself, and that even if it were not, the moment the current is turned on, the carbon is more highly heated than it could be by any baking.

So long as strenuous efforts are being made by electricians to attain a required result we have no fear of the future; but there would be grave cause for apprehension if they had reached the rest-and-be-thankful stage. There is some reason to fear that electricians are so well pleased with what they have already accomplished that they have no desire to exert themselves further; but they must remember that they will have to stand or fall by public opinion, and the most they can expect from the public is rigorous justice. Let us hope that, when the time of real trial comes, schemes now highly thought of will not be found wanting. What has been done as yet in electric lighting bears about as much resemblance to the real thing as the Stockton and Darlington Railway of fifty years ago did to the present railway system of Great Britain.

ENGLISH AND AMERICAN LOCOMOTIVES.

Every now and then we find American engineers expressing doubts concerning the superlative merits of the American locomotive. He who gathers his knowledge of American opinion on technical matters from the columns of the United States press will be certain to form a very inadequate and erroneous conception of its tendency. The United States press, as a whole, sometimes with justice and sometimes without, sometimes with sound information and sometimes without, systematically exalts all that is American, and persistently decries all that is not. The locomotives of the United States have not escaped; and the world has been assured over and over again that they are, without any exception or qualification, the best in existence. We know, however, that this is not the opinion of the well-informed railway men of the United States. They hold that their engines are good, sound, serviceable machines; but they admit, perhaps with reluctance, that they are not equal to English engines in economy of fuel. This admission has been made several times, but recently it has been repeated and insisted upon in more than one quarter. In a recent number of the *American Machinist* will be found a sensible article on this subject, written by Mr. Angus St. Clair. The article has been considered good enough to be worth reproduction by the *American Railroad Review*; so that we may assume that Mr. St. Clair's views are held to be worth notice at the other side of the Atlantic. Mr. St. Clair begins by saying:—"A proposal has been made and advocated in influential railroad quarters to have a few leading railroads combine to defray the expense of bringing a good type of British locomotive to this country for experimental purposes. Unrestricted competition has brought the price of transportation to the lowest terms, and railroad managers are eagerly searching for means of reducing working expenses. Locomotive supplies and maintenance form such an important portion of railroad expenditure that any method of improvement which would reduce their aggregate 2 or 3 per cent. would be beneficially apparent on the balance-sheet of many a struggling railroad company. Examination of the sheets which show the relative performance of American and British locomotives conveys the impression that our engines are far behind those running in England as regards economy in fuel and other expenses. From this has originated the desire to see a British locomotive placed upon one of our average roads, and subjected to a thorough test of its comparative economy and durability under the conditions imposed upon our engines in their ordinary service."

He next admits that "the American locomotive is far from being a perfect machine," and goes on to consider the respects in which he holds it to be defective, and he advances two somewhat novel theories to explain the reason why the American locomotive uses more fuel than its British rival. "The only feature," he holds, "about British locomotives which we could imitate with hopes of decided improved results is the open smokestack, and this is practically prohibited by our various state laws. By using a direct passage for the gases of combustion from the tubes to the atmosphere, British engineers are enabled to run their locomotives with much wider exhaust nozzles than ours, which permits the engines to make steam with a lower smoke-box temperature, entailing less waste of heat. Another element of economy comes in by lessened back pressure in the cylinders. Custom has made the cone and netting or other draught-stifling device an essential requisite of American soft-coal burners, and all over the States laws have been framed recognising them as a proper and necessary precaution against the raising of fires. Although the ordinary British locomotive, with its comparatively soft blast, throws no more sparks and raises quite as few fires as the engines smothered by our most approved spark-arresting appliances, no American railroad company could afford to run the unchanged British soft-coal burner, because they would be held responsible for the damage resulting from every fire that occurred within a mile of their track." But this is not all; Mr. St. Clair actually goes so far as to hint that an advantage would be gained by adopting larger driving wheels than those which find favour in the States. "Under the most favourable circumstances," writes Mr. St. Clair, "the velocity of the gases following the exhaust is very great, and admits of contact with the evaporating surfaces for only a minute period. Any arrangement which will retain the gases of combustion longer in contact with the heating surface would effect a direct saving in fuel, since more of the heat would be absorbed. This effect appears to be produced where the exhaust is slow enough to be seen distinctly pulsating on the fire. Between each exhaust there is a diminished rush of the gases, and the probability is that in these momentary pauses a largely increased percentage of the heat passes to the water. When a locomotive with driving wheels 66in. diameter is run at a speed of forty-five miles an hour, the exhaust occurs 15·3 times per second, while an engine with drivers 90in. diameter only exhausts 11·2 times in the same period. This decrease of nearly four exhausts per second must make a vast difference on the fire, which is not all accounted for by the greater volume of steam used in the slow exhausts to do the same amount of work. Accurate experiments might demonstrate the difference to be less than it appears, but the subject is certainly worthy of greater investigation than it has hitherto received."

While we admit that there may be some force in Mr St. Clair's arguments, we feel bound to add that we by no means attach as much importance to them as he does. As regards the first point, namely, the influence of the spark arrester, it is claimed by most United States locomotive superintendents or master mechanics—to give them their American title—that a well made spark arrester will not impede the escape of the steam and products of combustion in any way; but if we admit all that Mr. St. Clair says to be true, the fact can only concern the performance of the engine, which, working against a higher back pressure, will burn more fuel under given conditions of load and speed than another engine with a freer exhaust. Furthermore, the inspection of many diagrams taken from various types of American locomotives, leads us to believe that Mr. St. Clair exaggerates the augmentation in back pressure induced by the spark arrester. The truth is, that it is in the performance of the boiler and furnace that the American engine shows the greatest defects. English engines burning the best coal and heating the feed-water by returning a portion of the exhaust steam to the tender, evaporate without trouble 10 lb. of water per pound of coal consumed, and an average result of 8 lb. with second-rate coal is by no means unusual. But we venture to say that the duty of the American locomotive, burning soft or bituminous coal, seldom approaches this figure. Careful experiments, indeed, have demonstrated that an evaporation of 6 lb. of water per pound of coal is good rather than bad work. Thus we have particulars before us of American engines with 17 × 24in. cylinders. The boilers had each 160 tubes, 2in. diameter and 11ft. 6in. long, the total heating surface being 1254 square feet, the grates having an area of 15·6 square feet. These engines burned, when hauling a goods train of ten cars, weighing each, with its load, under 25 tons, 66 lb. of coal per mile. The passenger engines on the same line burn 50 lb. to the mile, with six cars, representing probably about 140 tons. The road is not heavy, and this is for both ways traffic. Such figures as these cannot be explained by anything but the bad performance of the boiler, and we may confine our attention here entirely to the difference between the American and the English system of making steam—for in this lies the true explanation of much of the contrast between the performances of the two types of engine.

The American engineer is troubled with sparks, and he attempts to get rid of the nuisance by going to the wrong

end of the boiler. He burns his coal by admitting all the air required through the grate, and he has smoke as a result. Consequently the tubes become foul very quickly, and this entails a high smoke-box temperature and waste of fuel. In this country we employ a totally different and very refined system. Each fire-box is provided with a fire-brick arch almost covering the grate. In the fire-door is fitted a scoop or deflector, and below the fire-grate is an air-tight ashpan. Some two or three hours before a fast train is taken out, the fire is made up, and permitted to cake together. By the time it is wanted we have in the fire-box 8 to 10 cwt. of coal all or nearly all red hot. When the train starts a dart is driven into the mass of coal. The whole is broken up, and, stimulated by the blast, a vast body of hot gas is produced. The ashpan dampers are nearly or wholly shut and the fire-door is opened. Almost all the air necessary for combustion is then forced down on the top of the fire, and meeting the gas rising up under the brick arch perfect combustion ensues, and the fire-box does its maximum amount of work. When the run is of moderate length, say, from London to Brighton, a distance of fifty miles, no more coal is put into the fire-box on the run, a single fire sufficing to complete the trip. On longer runs, a somewhat different system is pursued, the furnace being supplied pretty frequently with coal put with great care exactly in the right place on the grate, and the ashpan dampers and the fire-door are worked together, so as to admit the proper proportion of air at each, which varies with the condition of the fire. To a large extent the fire-box of the English locomotive is a gas furnace; but this is certainly not true of the American locomotive, in which there is no brick arch. The American fireman too thinks that he does all that can be required of him if he keeps steam, while the English fireman is not content with this, but endeavours to get all the steam wanted with the smallest consumption of coal. In a word, we hold that one of the most important differences which exist between the two types of engines lies in the way in which the furnace is worked.

While Americans are advocating the importation of an English engine for the sake of experiment, we are better off. At a station not many miles from London lies the American engine imported from the States by Mr. Eames a few months ago to teach Englishmen how to build locomotives. This engine does not appear just now to belong to any one in particular. It might be worth while to find out its owner and hire it for a few months. It might be worked on both the English and American methods, and no doubt valuable information would be obtained. Meanwhile it is satisfactory to know that even Americans begin to admit that English engines are possibly better than theirs. If this be the case, they will also concede that they are the best engines in the world—a fact which many of our colonists would have done well to learn long since. However, better late than never; and unless we are misinformed, the purchase of American locomotives for British colonies has dwindled down to merely nothing.

THE COLOUR OF DIAMONDS.

ON the 30th of October a note which had been referred to Professors Chevreul, Dumas, and Daubrée, was presented by Prof. Chevreul at the meeting of the Academy of Sciences. This note, by Messrs. Chatrian and Jacobs, was entitled "Application of the Law of Complimentary Colours to the Transitory Decolorisation of Diamonds which have a Yellow Colour." Among the diamonds obtained in South Africa, a great number have a yellow tint. This depreciates the value of the stones considerably. A white diamond, of good water, is valued at a price five to six times greater than that of a stone of the same size of a yellow tint. A report has been spread that we were about to know how to render diamonds colourless. Two dealers had purchased, at a very high price, some perfectly pure white diamonds; they were much astonished the next day to find that they had become yellow after a short washing. A lawsuit was the consequence. The operation consists in plunging the coloured stone into a solution of the complementary colour, from which it comes out white, but the effect is not one of long duration, for washing suffices to restore the crystal to its natural hue. A pale tint of violet suffices to restore whiteness to a diamond of the most pronounced yellow colour, without its losing anything of its transparency or lustre. It is pointed out by Mr. Mattieu Williams, in the *Gentleman's Magazine* for the present month, that the device is no novelty in principle, and that the laundress applies it systematically and avowedly in using the familiar "blue" for the purpose of neutralising the inherent yellowness of her results. Where pure water is abundantly used and grass bleaching is available there is no need —so far as linen and cotton are concerned—for this peculiar sophistication. All ordinary white silks and white flannels are dyed blue before coming to the market, the blue sometimes being in excess and plainly visible, as in "Welsh flannels" and some of the "China silks." Raw silk, as it is wound from the cocoon, varies from deep orange to pale lemon or greenish yellow. After bleaching or boiling in potash, that is when brought to what is technically known in Coventry as "boiled silk," it is dipped into pale aniline blue to neutralise its still remaining yellow tinge, when white silk is demanded. Hence the disappointment of those who purchase those white silk pocket handkerchiefs, which, after a few washings, become of a dirty yellow colour. Even the faint blue dye of white silk is too often weighted with acetate of lead, as may be easily proved by tasting samples of the silk of "China sewings," for example; acetate of lead has a sweet taste, hence its name of "sugar of lead," and cases have occurred of lead poisoning, to the extent of colic, where the seamstresses who sew the button holes of white waistcoats have persistently bitten off and sucked the ends of the silk they use when threading their needle. But it seems never to have occurred to any of these scientific men that the problem of the destruction of the colour in these diamonds has been more carefully inquired into and explained. Ten years ago a paper was read before the Naturforscherversammlung, at Wiesbaden, by Dr. Walter Flight, of the British Museum, South Kensington, on some researches carried out by Mr. Story-Maskelyne, M.P., and himself, on this very subject. It was stated that Mr. Costa, of Amsterdam, exhibited in 1867 at the International Exhibition held in Paris, a rose-coloured diamond of 29 carats, which, when exposed to diffused daylight, lost its colour in about four minutes; the colour was restored by heating the stone in burning German tinder, and remained as long as the diamond was screened from the daylight, when it again vanished in the same time. Experiments were made with two diamonds of considerable size from the Vaal River of an equally dull, dirty, yellowish hue. The one was reserved for comparison, the other heated in a porcelain tube to a red heat in a current of hydrogen, and allowed to cool in the tube. The heated stone was perfectly colourless till it came in the diffused daylight, and in a few minutes the dirty yellowish hue was quite recovered. The experiment was varied; the diamond was heated in chlorine in place of hydrogen, and even under mercury, and in each case the colour was completely restored, and the stone so treated was kept for three days in the dark, and it was not until the diamond so treated was exposed to the light that the colour returned to it. It took some six or seven minutes' exposure to the diffused daylight for the colour to be completely restored. It appears as if this phenomenon has something in common with the phosphorescence which certain diamonds exhibit in the dark.

RAILWAY TRAFFIC RETURNS.

THE statement of the receipts of the chief railways for the first four months of the present year is scarcely so favourable as that for the corresponding period of the past year. Possibly such enlargements of receipts as were shown last year could not be expected to continue; but it is rather surprising that there is on some of the chief railways a decrease that is comparatively large. Out of thirteen of the chief English railways not fewer than seven show decreases for the first sixteen weeks of the present year, when the total receipts are contrasted with those for the corresponding period of last year. The decreases vary from a few hundred pounds to, in one instance, £19,000. Of the other six railways the increases vary from about £6000 to, in the case of the Midland, nearly £39,000. It is noticeable that the increase is the most conspicuous in proportion in the case of the Metropolitan Railway, which has week by week recorded increases of from two or three hundred pounds to close upon £1000. In a few instances the decrease that had been begun in the earlier part of the year has now been lessened, and the returns generally for the past few weeks have been, on the whole, more favourable. It may be that the decrease in the instance we have noted is largely ascribable to the prolonged wintry weather, which has retarded traffic. The next few weeks do not afford much ground for comparison on fair terms, because the Whitsun holidays come at different dates, and this will affect the comparison of separate weeks. But as so large a portion of the half-year has now gone, it may be fairly expected that there will be very little increase on dividend, and that in the cases of some of the companies that have the most serious decreases there will be lessened dividends. Capital has been of late largely increased, and without a continual growth of the revenue lower returns are inevitable, because the rate of working expenses, though fluctuating a good deal on several lines, does not generally decrease. These fluctuations on the lines that feel them are so large as to set at naught all the calculations of dividends that are about this time indulged in, and the only safe remark that can be made is one of a general nature.

THE PATENT BILL.

IT is not impossible that the Government Patent Bill of 1883 will follow the road previously taken by many other Bills—that is to say, nothing more will be heard of it in the House of Commons this year at all events. Pressure of other business has proved too much for Mr. Chamberlain. Many inventors have refrained from going to the Patent-office in the hope that by waiting until January, 1884, they would effect a considerable saving in fees. They need wait no longer. It is almost safe to assume that the Patent Bill will not be passed this year. It is worth notice that Mr. Chamberlain's Bill has excited little interest. Our opportunities of forming an opinion are extensive, and they lead us to the conclusion that inventors as a class do not care so much for a change in the existing law as many persons believe. It may be that on this point we are mistaken; but it is at least certain that agitation in favour of a change has been confined to a small party. There has been nothing like a general rejoicing over a Bill which conferred considerable benefits on inventors, nor has the measure been fully criticised. For ourselves, we hold that the Bill is the best yet brought into the House of Commons, and we regret that it should be put on one side for a more convenient season.

LITERATURE.

Text Book of Military Topography. By COLONEL W. H. RICHARDS, Professor of Military Topography, Staff College; Including the courses of instruction at the Royal Military Academy, the Royal Military College, Sandhurst, the Staff College, and those of the Garrison Instruction. 1883.

THIS work takes the place of several unofficial hand-books. It opens with some capital introductory remarks, and then deals with scales, plans, and terms used, &c. We are glad to find that the use of "hâchures," or strokes in shading ground, has been superseded by soft pencil or brush shading, which offers the advantage of speed, besides its being a sounder system and less liable to lead to mistake. Lines should be reserved as much as possible to depict actual objects, and shades to depict slopes of ground. Contours at various levels of course are drawn in, but in red. The value of the plane table has been more fully recognised as it has come more into use. This was sure to be the case. Reconnaissance and the reading of maps are well handled. There is an admirable specimen of a road report folded in the pocket, which is very suggestive as to the notes which should be taken by officers. Descriptions of instruments, and of their use, including trigonometrical surveying, and sketching on horseback and on foot are given; and finally, notes on spherical astronomy and the use of instruments. This is, we think, the least satisfactory part of the book. It is always open to question how far it is wise to give the elementary theoretical explanations here supplied in a work of so practical a character and so much condensed as this. However, officers may have given their attention to other work, and may need some or all of it. What we, however, miss, is more to the point. In these days of telegraphy it seems a distinct omission not to give any information on obtaining longitude by comparing local times by telegraph, which is, of course, by far the quickest and most accurate method. Something surely might have been given about flashing signals, and a most interesting chapter might have been written on marching by stars at night. The experience in Egypt would have furnished a valuable example. We have heard of instances of this, but no trustworthy account has appeared. It would have been alike valuable and interesting to know the measure of scientific skill shown, and the measure of success and failure in various cases; whether, for example, it is true that two bodies of men unconsciously deflected outwards so as to miss an outwork, the contact with which would have certainly given a much earlier alarm to the army at Tel-el-Kebir than it received. Lastly, there is no index.

The Iron, Steel, and other Trades in 1882. *Sixth Annual Report to the Members of the British Iron Trade Association.* London: E. and F. N. Spon. 1883. 8vo., 155 pp.

THIS report contains statistics and observations thereon relating to the iron and steel manufactures of all the countries in the world in which steel, iron, and iron ores are produced in any noteworthy quantity. Statistics are also given relating to the tin-plate, shipbuilding, and coal trades, and to railway development and the numbers of persons employed in the different trades. There is probably crowded into its 155 pages more work than it is ever credited with. The chapter devoted to "railway development and the iron trade" is of very great interest, for it shows a great deal more than is probably proposed as its first object, namely, the mileage existing, the new mileage, and, thereby, the consumption in the past and the probable consumption in the future of rails. On the manufacture of steel the report is of interest, as showing the great increase in the manufacture of steel in different places and the growing output of converters, and the relative quantities produced by the Bessemer and open hearth processes. The statistics necessarily relate to years previous to 1882, as well as of that year, and thus afford at a glance an indication of the change of growth under the different heads of manufacture, home and export consumption and imports. The facts relating to shipbuilding are also of much interest. Among other things the statistics on this subject show that while 118 more vessels belonging to the United Kingdom were lost or broken up than were built therein and registered in the year, the tonnage of those built exceeds that of those lost by 554,664 tons, showing at once the great increase in the average tonnage of vessels now and a few years ago. The report is compiled by Mr. J. S. Jeans, secretary of the Iron and Steel Institute, and is evidence of great pains-taking and labour; but to follow it throughout all its bearings would require so much space that we can only commend it to those interested in the "iron, steel, and allied trades."

THE FISHERIES EXHIBITION.

No. I.

IF enthusiasm and influential support can do anything to excite general public interest in an exhibition of a special character, the International Fisheries Exhibition will be a success, in spite of the frequency with which the name of exhibition re-appears to invite and to satiate public curiosity. Of the special exhibitions which, by the aid of the lithographer and bill-sticker, have during the past few years striven for patronage, the Naval and Submarine was, perhaps, the most successful; and as the Fisheries Exhibition is on a much larger scale, is international, and includes in its objects of exhibition the apparatus required for fishing, from the smallest hook or artificial fly to the heaviest mechanical or steam trawling tackle and boats, it may be expected to be a success, especially as the pleasure or sporting side of fish catching will form no small part of the attraction.

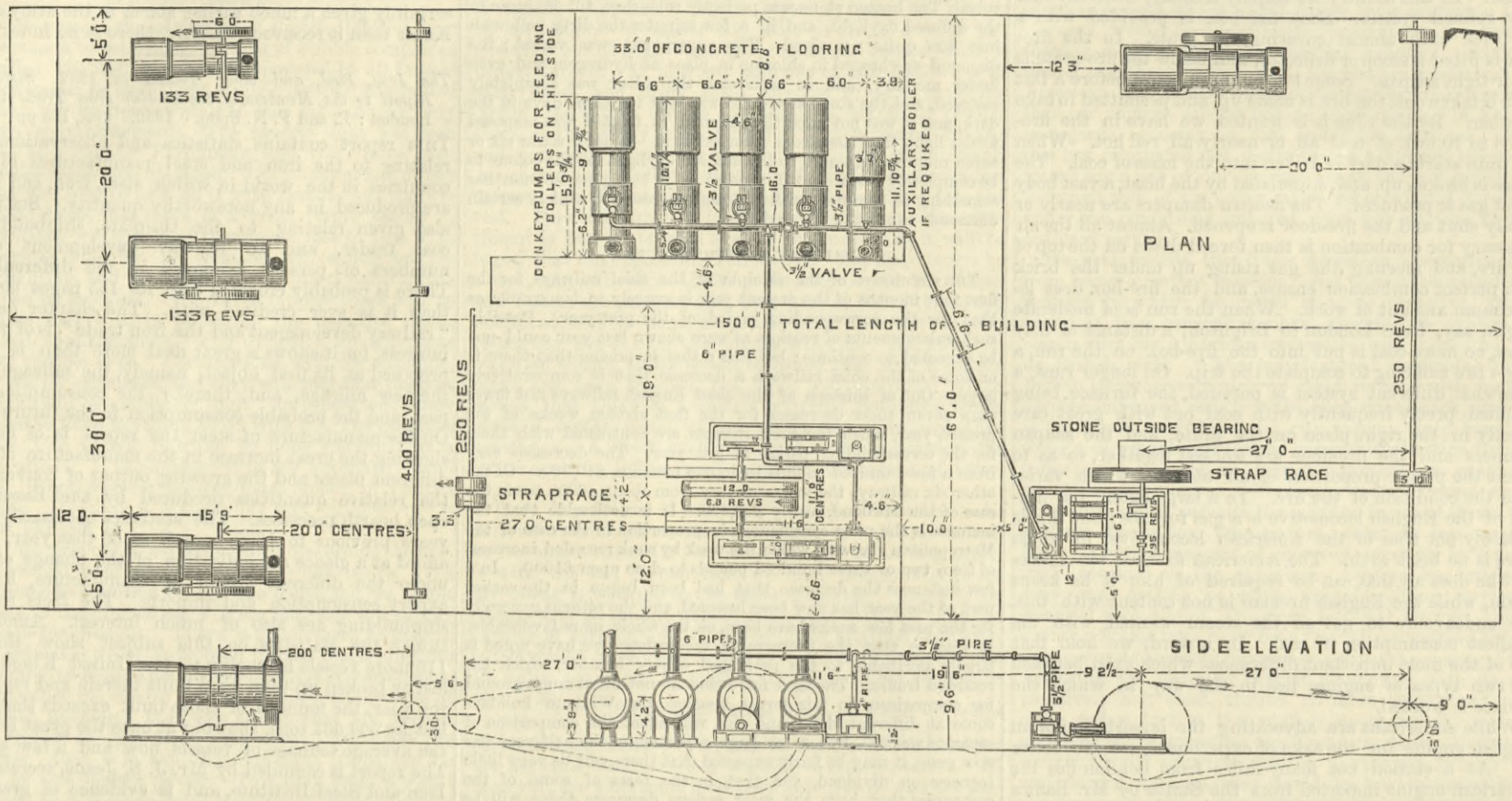
In our impression for the 9th February we gave an illustrated account of the Exhibition buildings reared in the grounds previously occupied by the Horticultural Society, and of the character and scope of the undertaking. For information on these subjects we may therefore refer the reader to THE ENGINEER of that date. The buildings are now so far complete, and some of the courts and departments sufficiently forward, to permit the opening of the Exhibition to take place on the day originally fixed—namely, to-morrow, the 12th inst.; but night-and-day work have been necessary during the past week to secure anything like decent order and completeness in these parts. The Prince and Princess of Wales will open the Exhibition with more than usual ceremony; and if the day is fine there will, no doubt, be a very large and influential attendance. The Prince of Wales, as chairman of the Royal Commissioners, has and will continue to take a leading part in the affairs, and for his accommodation a large and well-furnished pavilion has been erected close to the Netherlands Court.

Altogether about 300,000 square feet of ground have been covered, and an enormous quantity of material is already in place, though on Wednesday almost every part had the appearance of being in a hopeless muddle, unless it be the machinery-in-motion and the Chinese departments. There is not at present a large quantity of machinery on show, but amongst the machinery in motion will be found some of considerable interest for steam trawling and other purposes, including a good display by Messrs. Rose, Downs, and Thompson, of Hull, Messrs. Ruston, Proctor and Co., Mr. A. Dodman, Mr. S. Hindley, and the Vulcan Ironworks Company, Hull; Messrs. A. Ransome and Co., Messrs. J. and E. Hall, the Bell-Coleman Company, Messrs. Siddeley and Co., and others. Of some of this machinery we must say more hereafter, as well as of that for dealing with fish for manure purposes.

The Exhibition is to be lighted by electricity, and as it is to remain open until 10 p.m., the necessity for this will be seen. For this purpose a large shed has been erected next the machinery in motion, and in it will be the engines, boilers, and dynamo-electric machines. The size of this shed may be gathered from the plan we give on next page, which shows the arrangement of the engines and boilers. This shed will be one of the most attractive parts amongst those containing machinery in motion, and it is, therefore, to be regretted that it is being closely boxed in from the adjoining machinery in motion shed by woodwork and other partitions, the stand of Messrs. Rose, Downs, and Thompson, for instance, being backed by a canvas partition close to their machinery in such a way as

FISHERIES EXHIBITION—ARRANGEMENT OF ENGINES AND BOILERS FOR ELECTRIC LIGHTING.

MESSRS. DAVEY, PAXMAN, AND CO., COLCHESTER, ENGINEERS.



to limit the opportunity for its proper examination; and whatever this firm and other exhibitors may wish, it certainly seems at the least undesirable that this partition should be allowed to obstruct the free view of the electrical machinery which, with its 1000-horses power, will no doubt be popular. We hear that this boarding, corrugated iron, canvas, &c., will be removed, and no doubt the error will be corrected when the practical eye of Sir P. Cunliffe Owen is directed to it.

As above stated, a thousand horse-power will be put to work for electric lighting purposes, the whole of which is being furnished by Messrs. Davey, Paxman, and Co., of Colchester. The total power is made up as follows: A pair of fixed engines working on one crank shaft, as shown in the engraving, capable of developing from 350 to 400-horse power. One compound fixed engine of 250-horse power; three semi-portable engines with adjustable governors, and each capable of developing 100-horse power, and one portable engine capable of indicating about 80-horse power, all these engines being fitted with automatic cut-off gear, operated by the governors. Steam will be supplied by steel boilers of the locomotive type in the positions shown. A large number of dynamo-electric machines of the Siemens, the Ferranti, Gulcher, Elphinston, Vincent, Jablochkoff, and other types, will be fixed, while the lighting systems of Lever, Gaulard and Gibbs, Hawkes, and others, will be used. The machines will be driven through belts from pulleys on two shafts about 2ft. 6in. above ground, one being 5in. in diameter, and running at 250 revolutions per minute; the other, 3·5in. in diameter, running at 400 revolutions per minute, these high speeds in the shafting being employed so as to be able to dispense with large pulleys. Until more of the engines, and some of the machines are fixed, it would be premature to say anything on the arrangements of them in plan, but at present it certainly looks as though the arrangemeut was not calculated to secure the greatest freedom or the best arrangement of straps. Engines and dynamo-machines will we fear be very much mixed up, and confusion seems probable. However, as an attempt is to be made to get about 500-horse power at work for Whitsun Monday night, we may be able to judge of this very soon. We cannot help remarking, moreover, that the concrete, as it is called, on which the large fixed engine is placed is little better than gravel. It seems to have been made with unwashed loamy gravel and cement, and the latter has been killed by the loam, and we should not be surprised if the irregular crushing and settlement of this stuff causes some trouble with this pair of engines.

In other impressions we shall, when the Exhibition is more complete, give detailed accounts of the articles exhibited. Although it is to remain open for six months, it is a pity that preparations have been so much delayed. Supplementary to the remark above made as to the Chinese court, it may be stated that the catalogue of the Chinese department, with essays and notes on the Chinese systems of fishing, and other matters, has already been published by the Chinese Statistical Department of the Inspectorate-General, but no other is yet ready.

DEATHS OF TWO SCOTCH ENGINEERS.

The death is announced, in his 63rd year, of Mr. John F. Ure, C.E., lately a prominent member of the firm of Messrs. John Elder and Co., shipbuilders and marine engineers, Glasgow. Mr. Ure had been in poor health for a number of years. He had, on that account, been residing at Cannes; but he was on his way to London for medical advice when he was seized with paralysis, the shock proving fatal. Born in Glasgow in 1820, where his father was a solicitor in good practice, Mr. Ure had the advantage of a superior education, and he afterwards spent a number of years in the office of Mr. Andrew Thomson, C.E., Glasgow. It was while chief assistant to Mr. Thomson that Mr. Ure had his earliest experience of railway construction, on the Pollock and Govan line. He subsequently went to London, where he became confidential assistant to Mr. Rendel, and in this capacity he took an active part in the direction of many notable engineering works. Mr. Ure afterwards spent several years in India surveying Government railways. He was induced in 1853 to become resident engineer to the Clyde Navigation Trust, in which position he did much to advance the improvement that had already been commenced for the deepening of the river and improving its navigation and harbour works. The excellent work accomplished by Mr. Ure on the Clyde attracted the attention of the Tyne Commissioners, and he was induced to transfer his services to Newcastle. When he arrived there he found that scarcely anything had been done to improve the Tyne, except that a scheme had been reported on by many engineers of well-known ability, and the Commissioners did not appear to be at all agreed as to the course that should be adopted. The late Sir Joseph Cowen was at that time chairman of the Commissioners, and with his cordial support, he set to work and produced a transformation of the river even greater than had been effected at Glasgow. In fact, Mr. Ure found the Tyne at about the lowest possible point as a navigable river, and left it one of the finest waterways of its class in the world. His operations at Newcastle also served as a pattern and stimulus for the great things that have since been done on the Tees and other northern rivers. Mr. Ure returned to Glasgow to join the firm of John Elder and Co., from which, as we have stated, he retired some years ago on account of failing health. In every relation he was greatly esteemed, and his work on the Clyde and the Tyne will furnish him with a lasting memorial.

The other gentleman who has passed away is Mr. John Miller, of Leithen and Drumlithie, who died this week at his town residence, Melville-crescent, Edinburgh. Mr. Miller was a native of Ayrshire, having been born at Springvale in 1805. He was educated at the University of Edinburgh, and adopted the profession of a civil engineer, carrying through many railway works of great importance, among these being the Edinburgh and Glasgow and the Edinburgh and Berwick Railways. He gained some distinction in connection with his railway schemes by his success in maintaining a uniform gradient. As a partner of the Edinburgh firm of Grainger and Miller, he amassed a considerable fortune, and for the last twenty years his chief professional work consisted in giving his advice and aid as an engineering expert to the promoters of new railway schemes in Parliament. From 1868 to 1874 Mr. Miller was one of the representatives of the City of Edinburgh in the House of Commons. He held an influential position latterly as a country gentleman, and was connected with a number of prominent scientific institutions.

BLOWING ENGINES FOR FRENCH IRONWORKS.

English engineering firms have of late received a considerable amount of work from France, and in the Manchester district large French contracts for locomotives and heavy stationary engines have been executed by one or two of the leading firms. A considerable portion of this work has had to be carried out from French designs, which, though perhaps not such as the English firms would the most recommend themselves, seem to be either preferred by our neighbours across the Channel or are rendered necessary by the exigency of the requirements they have to meet. On pages 358 and 362 we give illustrations from the working drawings for a pair of compound high and low-pressure condensing blowing engines for high furnaces, which have been constructed by Messrs. W. and J. Galloway and Sons, of Manchester, for the Société Anonyme des Mines de fer de l'Anjou et des Forges de St. Nazaire, near Nantes, France. These engines have been constructed from French designs, and except that in construction they are built with greater strength than similar engines made in France, they may be taken as a fairly good representative types of French ideas. They consist of two vertical engines, the one having a high-pressure cylinder 32½in. bore, the other a low-pressure cylinder 51in. bore, with the respective piston-rods each connected to blowing cylinders having 79in. bore, and both steam and blowing pistons have a stroke of 5ft. 3in. The engines are so constructed that one can be disconnected from the other; and in the case of the high-pressure, worked as an independent high-pressure engine, whilst the low-pressure engine can be worked as a condensing engine, the steam in this case being reduced by a suitable reducing valve. On the intermediate pipe connecting the high and low-pressure cylinders is fixed an inter-heater, having a surface of 425 square feet. The steam valves are on the Cornish system, the exhaust valves of both cylinders having a constant lead and lift. The inlet valves are controlled by means of special trip gear designed by Messrs. Galloway and Sons, for effecting the suppression of the steam admission from every point ranging from ·1 to ·8 of the stroke. The air pump in connection with the low-pressure cylinder is 30in. bore 3ft. stroke, and is fitted with gun-metal liner, foot and delivery valves.

TRIER'S LUBRICATOR.

We illustrate by the accompanying engravings a form of lubricator, Stauffer's, which is acquiring favour amongst engineers and machinists because it requires so little attention and because the lubricating is effected so uniformly that only a very small quantity of the lubricant is used as compared with the quantity of oil used by any other lubricators. The lubricant is somewhat similar to petroleum jelly or vaseline, but has a certain quantity of vegetable material with it. We have tested the lubricator and the lubricant, and found them remarkably satisfactory. The lubricator consists of but two parts, the upper part containing the lubricant in the viscous form. This part is screwed upon the lower, and an occasional turn once in from three to twelve days is sufficient to cause the lubricant to flow in necessary quantity.

The construction is well seen in Fig. 1, while Figs. 2, 3, 4, 5, show different applications of the lubricator. Fig. 2 shows it connected to the brass by a tube-piece which is made specially for this purpose. Fig. 3 shows the lubricator screwed into the bearing cap, and the proper connection between it and the brass made by pouring in lead to fill the cavity. Fig. 4 shows similar

Fig 1

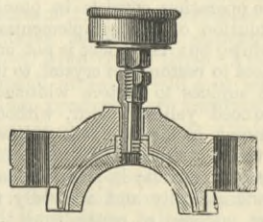


Fig 2

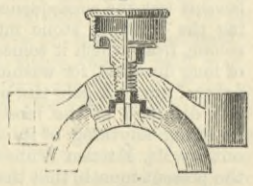


Fig 3

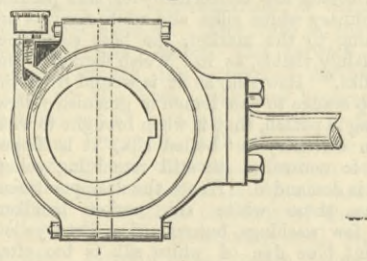
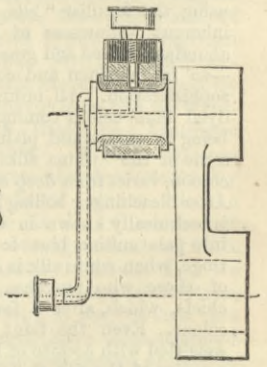


Fig 4



application to an excentric sheave; and Fig. 5 shows its application to a crank-pin.

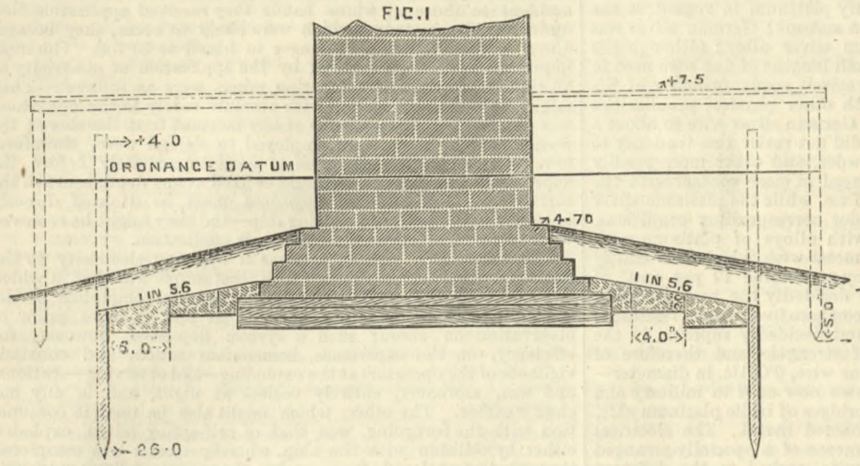
THE LEPANTO.

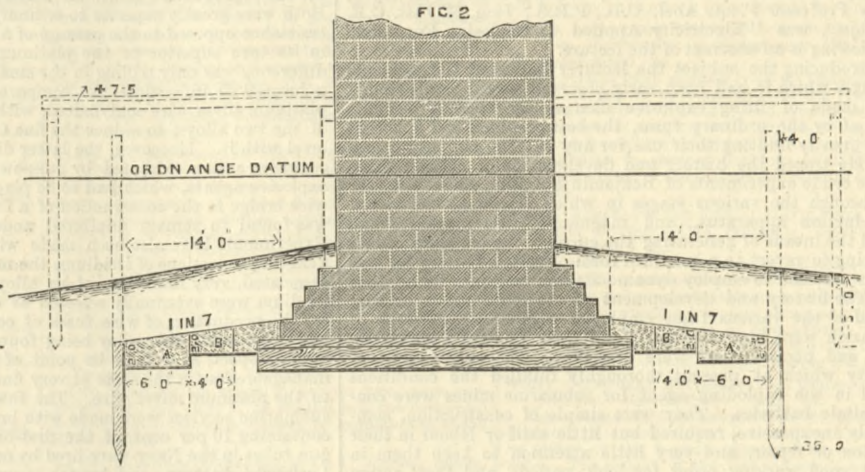
In our impression for April 13 we gave a general illustration of the Lepanto, and we minutely described her in our issue for March 23. We now give a view of the ship at sea, which will, no doubt, interest many of our readers.

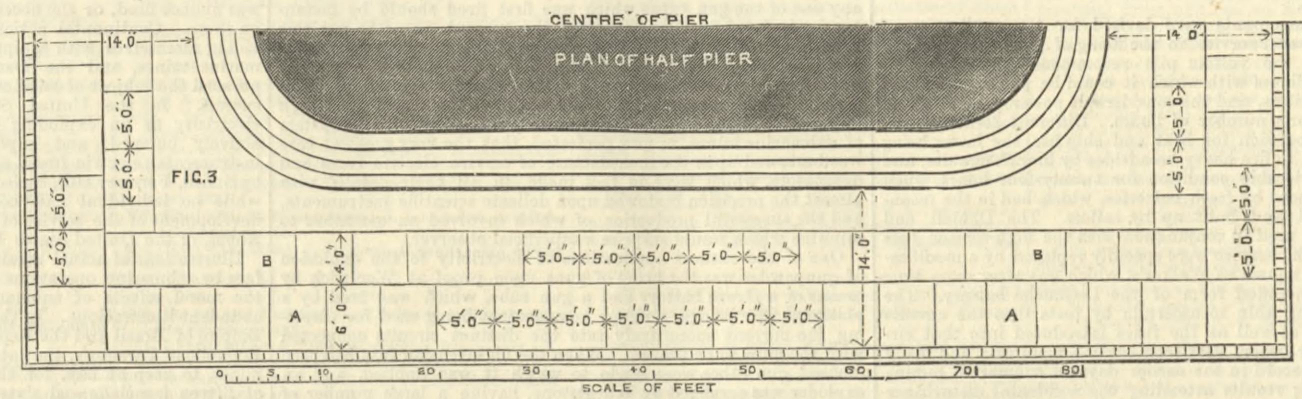
Naval Engineer Appointments.—Thomas G. Coomber, engineer, to the Hecla; Richard Harris, engineer, to the Merlin; William J. J. Singer, assistant engineer, to the Enchantress, vice Walton; and Holland Harrison, chief engineer, to the Pembroke, additional for the Calypso; George R. T. Cummings, engineer, to Hector, vice Hobbs; J. E. D. Graham, engineer, to the Invincible; and Joseph Wyllie, engineer, to the Pembroke, additional, for service in the Slaney.

WATERLOO BRIDGE RESTORATION.

SIR JOSEPH W. BAZALGETTE AND MR. EDWARD BAZALGETTE, MM.I.C.E., ENGINEERS.







To dig about, and lay bare the foundations of any heavy structure, is usually a delicate piece of work, but when that has to be done with the foundations of the river piers of a bridge, each of which carries about 11,000 tons, there is enough of the element of danger in the operation to confer upon it sufficient interest to make it an attractive piece of work. This, however, is what is being done with the piers of Waterloo Bridge under Mr. Edward Bazalgette, and a recent visit to the works showed us how necessary it has become that "something should be done" to prevent the ultimate destruction of a structure, and also that this something demands a very considerable amount of engineering skill and judgment. Above we give transverse sections of two of the piers and a half plan showing the nature of the protective work which is being carried out to prevent any further settlement of the piers, either through the gradual sinking of the foundations as a result of removal of bed material by scour, or the loss of support of the cutwater parts of the piers by the transverse fracture of the stones bonding these parts into the body of the pier.

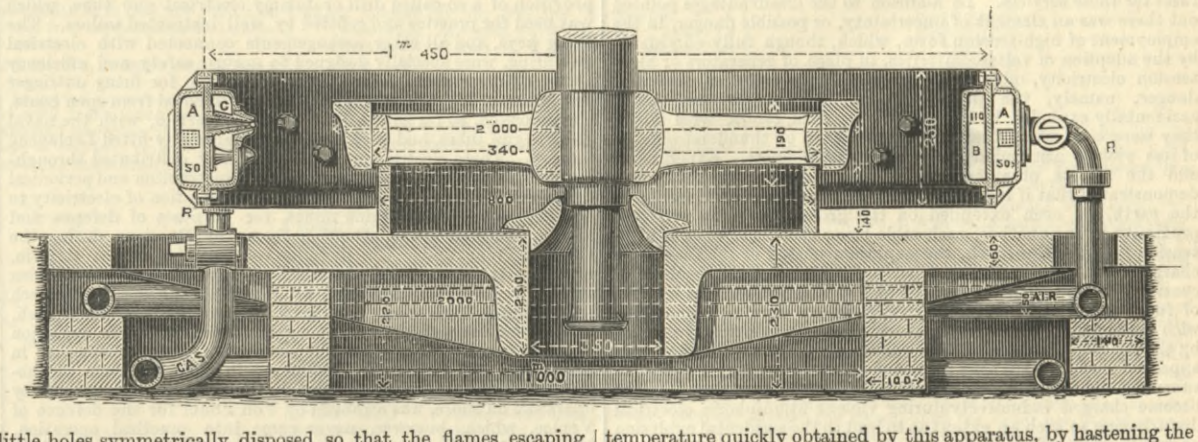
The works, which are now completed with respect to piers 1, 2, and 3 from the Surrey side of the river, comprise generally the formation of continuous aprons of concrete blocks surrounding the seven piers, and protected along their outer margins by a system of closely driven whole pile rock elm timbers, and the formation of similarly constructed aprons along the river faces of the eighth pier adjacent to the Victoria Embankment and of the Surrey abutment. These block aprons surround the piers for a width of 12ft. beyond the average projecting line of the 5in. elm planks which underlie the lowest course of masonry pier footings. These 5in. planks form the upper surface of the timber platform which supports each pier, and generally project upon an average at least 2ft. beyond the outer face of the lowest course of masonry footings. The formation of the concrete aprons and the pile-driving is partly conducted from a temporary staging or platform supported on piling at an elevation of from 7ft. to 8ft. above Ordnance datum, and commanding the whole area to be occupied by the permanent works. The piling, Fig. 1 and 2, for the support of the temporary staging is not allowed to penetrate the soil below the bed level of the concrete blocks, but if any do they have to be cut off to the level of the river bed. For many years the proprietors of the bridge before its purchase by the Metropolitan Board of Works had protected the foundation by heaps of rag stone, so that immediately following the erection of the temporary staging, the whole of this Kentish rag stone and any loose boulders, liable to injure the piling or divert its true course in driving, had to be removed. The permanent piles to be driven from the staging, previously noticed, Figs. 1 and 2, are of very fine American rock elm, 30ft. in length, and closely driven against each other, parallel with the external face of the lowest course of pier masonry footings, and at a distance of 14ft. therefrom. The piles are furnished with strong wrought iron rings in the ordinary way and shod with cast iron shoes weighing 70 lb., each secured to the pile with wrought iron straps. This close piling is driven so as to enclose completely one pier at a time, and so that its bottom extremity reaches to a depth of 26ft. below Ordnance datum, and its upper extremity 4ft. above Ordnance datum, in order that the upper portion may serve the purpose of a continuous water-tight dam around the enclosed pier. The dam thus formed is provided, above the surface of the ground, with a continuous external and internal double line of walings, and is rigidly strutted therefrom against the face of the bridge pier or against its projecting footings. The upright joints between the piles are caulked so as to exclude the river water. The dam is provided with a sluice valve, about 12in. diameter, under control from the staging above, to admit or discharge the tidal water. The sluice sill is fixed at such a level that any water accumulated within the dam, the surface level of which is below the top of the lowest course of masonry footings, cannot discharge over the sill into the river, this level being about 6ft. 6in. above the concrete apron in pier No. 4. The dam being only half tide, the work can only be carried on a little under half tide, and to empty the water from the dam at each tide considerable pumping power is employed. Three 12in. by 6in. chain pumps and one 16in. centrifugal pump empty the dam in a short time, and most of a half-tide period is thus available for work. The sumpt holes for these pumps are not placed more than 12in. below the lowest bed level of the concrete blocks, and they are lined, so as to prevent the passage of sand into them from within the dam. As soon as the space within the dam is pumped dry, a trench, slightly exceeding 6ft. in width, is excavated along the internal face of the protective piling from the original foreshore level to a level exactly corresponding with that of the upper face of the pile heads upon which the timber cradles supporting the bridge piers are founded. The upright face of the ground at the back of this trench is then planked and shored so as to maintain it immovably until after the lowering and final bedding of the concrete blocks A, Figs. 2 and 3. After this the ground at the rear of the A blocks is removed down to the indicated bed level for the reception of the B blocks. After the complete removal of the soil for the reception of these blocks, and before they are lowered into position, the runners, upholding the ground at the rear of the A blocks, are removed or cut off to the bed level of B blocks, two or three at one time, and the spaces caused by their removal immediately punned up solidly with fine liquid grout composed of six of Thames ballast to one of cement. After the concrete blocks A and B are placed, the space intervening between the back line of the B blocks and the first pier footing, or rather, from the bed level at the rear of the B blocks to the top corner of the lowest course of pier footings, is filled and rammed with Portland cement concrete, its proportions being six of ballast to one of Portland cement. The A and B concrete blocks are composed of clean-washed Thames ballast and Portland cement, in the proportions of eight of Thames ballast to one of Portland cement.

GAS APPARATUS FOR EXPANDING TIRES.

THE accompanying engraving represents an apparatus for this purpose, which was described in the *Revue Industrielle*, which states that:—The use of gas for putting tires on iron wheel centres effects a noticeable economy; but for renewing them, the cost is nearly the same as by the older processes. The apparatus for using gas mixed with air for heating tires consists of a tube $1\frac{1}{4}$in. in diameter, surrounding the tire at a distance of 1in. to $1\frac{1}{4}$in., and pierced throughout its interior circumference with little holes symmetrically disposed, so that the flames escaping from them strikes the tire at three points of its height. Finally a tape connected at one point with this circular pipe receives from a reservoir placed at a certain distance a mixture of gas and air. As is seen, this is a very simple way of heating, and its use is justified when putting on tires for obtaining an expansion a little in excess of one one-thousandth of the diameter, and where the time required to reach that expansion can be utilised in the preparatory operations. But the attempt made to apply it in removing tires has been unsuccessful; it has, nevertheless, often been necessary to cool the centre with water. To overcome this the apparatus here described has been designed. The gas burner is composed of two converging cones, of which the central one A receives air at a fixed pressure; the outer one B conducts the gas necessary for the mixture. When the proportions of gas and air are well observed, the jet, burning but not illuminating, leaves the blue tint and reaches the rose tint within about 4in. or $4\frac{3}{4}$in., the point where there exists the highest temperature.

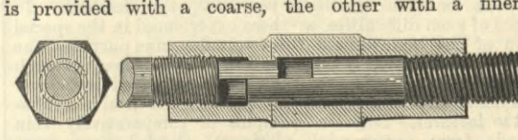
The chemical analysis of illuminating gas whose average composition is:—Hydrogen bicarbonate $C^4 H^4$, 9; hydrogen protocarbonate $C^2 H^4$, 74; oxide of carbon C O, 13; carbonic acid and carburets in vapour, 4; total, 100. This shows that it requires 7 litres of air for its complete transformation into carbonic acid. It is then important for the performance of the new apparatus that the quantities of air and of gas introduced be in these proportions. The outer one A receives the air at four points of its circumference by cocks R connected with a circular tube 2in. in diameter, which itself is fed by two channels. The second is the interior ring B which receives the gas likewise at four points by cocks R[1] connected with another annular tube, of 2in. diameter, and supplied at two opposite points with gas issuing from a meter under a pressure of $1\frac{1}{2}$in. of water. It will be understood that the cocks serve only to regulate the supply of gas and air for the thirty blow-pipe burners C which complete this apparatus. Observations made when this apparatus was working most favourably have given the following results:—Air pressure in the ring A, in height of column of water, 8·4in.; pressure of gas in the ring B, height of water, 0·3in.; consumption of gas per minute, measured by the meter under a pressure of 3·2in., 1 cubic meter.

Simple calculations show that by increasing the diameter of the burners from 0·16 to 0·224in., and keeping the supply of gas the same, with a fan blower, the necessary air can be furnished to the thirty burners, provided that this blower works under a minimum pressure of 5·6in. and supplies two cubic metres of air per minute—sufficient for two forge fires. Experience shows that a tire of 36in. interior diameter, and weighing about 460 lb., is raised to a temperature of 300 deg. (= 572 deg. Fah.) in eight minutes. The simple and cheap construction of the gas burner, the low cost of keeping it in order—almost nothing—and the ability to produce or extinguish instantaneously a fire, whose intensity can also be regulated, the regularity of the heat attained at all points on the tire, which is an essential matter for cast steel, are so many considerations in favour of its use for occasional work, and that which lasts but a short time. Finally, the high temperature quickly obtained by this apparatus, by hastening the process, reduces the labour required, and so justifies its use even where, in certain cases, the cost of gas would be more than that incurred if coal were used.



A NEW COUPLING.

FOR connecting small shafts and rods which must not have relative motion round their own axis, Mr. J. F. Pichler, of London, has proposed the form of coupling which is shown by the annexed engraving. One part to be coupled is provided with a coarse, the other with a finer screw,



and a screw coupling tapped correspondingly. The ends of the pieces to be coupled are stepped, and the two thus interlock as shown, and are pressed together by the coupling nut.

AT a meeting of the Leeds Town Council last week it was decided to light the Victoria Hall by electricity, and a vote in favour of expending £10,000 on electric lighting was passed.

THE INSTITUTION OF CIVIL ENGINEERS.

ELECTRICITY APPLIED TO EXPLOSIVE PURPOSES.

The fifth of the series of six lectures on the applications of electricity was delivered on Thursday evening, the 19th of April, 1883, by Professor F. A. Abel, C.B., F.R.S., Hon. M. Inst. C.E. The subject was "Electricity Applied to Explosive Purposes." The following is an abstract of the lecture.

In introducing the subject the lecturer indicated the principal advantages which it had been early observed would result from a certain mode of firing explosive charges by electric currents instead of by the ordinary fuses, the best of which had inherent defects, greatly limiting their use for any but the simplest operations. He traced the history and development of electric firing from the crude experiments of Benjamin Franklin, about the year 1751, through the various stages in which frictional electricity, volta-induction apparatus, and magneto-electric machines had supplied the means of generating the current, the tendency of late years being to revert to a modified form of voltaic battery for one class of work, and to employ dynamo-electric machines for another class. The history and development of the low tension, or wire fuse, and of the various fuses employed with electric currents of high tension were also discussed, and their relative advantages, defects, and performances were described. The only sources of electricity which at present thoroughly fulfilled the conditions essential in the exploding agent for submarine mines were constant voltaic batteries. They were simple of construction, comparatively inexpensive, required but little skill or labour in their production or repair, and very little attention to keep them in constant good working order for long periods, and their action might be made quite independent of any operation to be performed at the last moment.

When first arrangements were devised for the application of electricity in the naval service to the firing of guns and so-called outrigger charges, the voltaic pile recommended itself for its simplicity, the readiness with which it could be put together and kept in order by sailors, and the considerable power presented and maintained by it for a number of hours. Different forms of pile were devised at Woolwich for boat and ship use, the latter being of sufficient power to fire heavy broadsides by branch circuits, and to continue in serviceable condition for twenty-four hours, when they could be replaced by fresh batteries, which had in the meantime been cleaned and built up by sailors. The Daniell and sand batteries first used in conjunction with the high tension fuse for submarine mining service were speedily replaced by a modification of the battery known as Walker's, which was after some time converted into a modified form of the Leclanché battery. The importance of being able to ascertain by tests that the circuits leading to a mine, as well as the fuses introduced into that circuit, were in proper order, very soon became manifest; and many instances were on record in the earlier days of submarine mining of the disappointing results attending the accidental disturbance of electric firing arrangements, when proper means had not been known or provided for ascertaining whether the circuit was complete, or for localising any defect when discovered.

The testing of the Abel fuse, in which the bridge or igniting and conducting composition was a mixture of the copper phosphide and sulphide of potassium chlorate, was easy of accomplishment —by means of feeble currents of high tension—in proportion as the sulphide of copper predominated over the phosphide. Even the most sensitive might be thus tested with safety; but when the necessity for repeated testing, or even for the passing of a signal through the fuse, arose, as in a permanent system of submarine mines, the case was different, this fuse being susceptible of considerable alterations in conductivity on being frequently submitted to even very feeble test currents, and its accidental ignition, by such comparatively powerful test or signal currents as might have to be employed, became so far possible as to create an uncertainty which was most undesirable.

Hence, and also because the priming in these fuses was liable to some chemical change detrimental to its sensitiveness, unless thoroughly protected from access of moisture. another form of high-tension fuse, specially adapted for submarine mining service, was devised at Woolwich. This, though much less sensitive than the original Abel fuse, was sufficiently so for service requirements, while it presented great superiority over the latter in stability and uniformity of electric resistance; and, though not altogether unaffected by the long-continued transmission of test currents through them, the efficiency of the fuse was not affected thereby. Although high-tension fuses presented decided advantages in point of convenience and efficiency over the earlier form of platinum wire fuse, the requirements which arose, in elaborating thoroughly efficient permanent systems of defence by submarine mines, and the demand for a battery for use in ships which would remain practically constant for long periods, caused a very careful consideration of the relative advantages of the high and low tension systems of firing to result in favour of the employment of wire fuses for these services. In addition to the disadvantages pointed out there was an element of uncertainty, or possible danger, in the employment of high-tension fuses, which, though fully eliminated by the adoption of voltaic batteries, in place of generators of high-tension electricity, might still occasionally constitute a source of danger, namely, the possibility of high-tension fuses being accidentally exploded by currents induced in cables, with which they were connected, during the occurrence of thunderstorms, or of less violent atmospheric electrical disturbances. Experiment, and the results obtained in military service operations, had demonstrated that if insulated wires, immersed in water, buried in the earth, or even extended on the ground, were in sufficient proximity to one another, each cable being in circuit with a high-tension fuse and the earth, the explosion of any of the fuses by a charge from a Leyden jar, or from a dynamo-electric machine of considerable power, might be attended by the simultaneous ignition of fuses attached to adjacent cables, which were not connected with the source of electricity, but which become sufficiently charged by the inductive action of the transmitted current. It therefore appeared very possible that insulated cables extending to land or submarine mines, in which high-tension fuses were enclosed, might become charged inductively during violent atmospheric electrical disturbances to such an extent as to lead to the accidental explosion of mines with which they were connected. In a report by von Ebner on the defence of Venice, Pola, and Lissa, by submarine mines, in 1866, he refers to the accidental explosion of one of a group of sixteen mines during a heavy thunderstorm, as well as to the explosion of some mines, by the direct charging of the cables, through the firing station having been struck by lightning. Two instances of the accidental explosion of tension fuses by the direct charging of overhead wires during lightning discharges occurred in 1873 at Woolwich. Subsequently an electric cable was laid out at Woolwich along the river bank below low-water mark, and a tension fuse was attached to one extremity, the other being buried. About eleven months afterwards the fuse was exploded by a charge induced in the conductor during a very heavy thunderstorm. In consequence of such difficulties as these experienced in the special application of the high-tension fuses to submarine purposes, the production of comparatively sensitive low-tension fuses, of much greater uniformity of resistance than those employed in former years, was made the subject of an elaborate experimental investigation by the lecturer. Different samples of comparatively thin wires, made from commercial platinum, showed very great variations in electrical conductivity. Very considerable differences in the amount of forging to which the metal, in the form of sponge, had been subjected, did not importantly affect either its specific gravity or its conductivity, and the fused metal had only a very slightly higher degree of conductivity than the same metal forged from the sponge. The conductivity of very fine wires could therefore be but slightly affected by physical differences in the metal, and the considerable differences in conductivity observed in different samples of platinum were therefore chiefly ascribable to variations in the degree of its purity. It appeared likely that definite alloys might furnish more uniform results than commercial platinum; experiments were therefore made with fine wires of German silver, and of the alloy of sixty-six of silver with thirty-three of platinum employed by Matthiessen for the reproduction of B. A. standards of electrical resistance. Both were greatly superior to ordinary platinum in regard to the resistance opposed to the passage of a current; German silver was in its turn superior to the platinum silver alloy; although the difference was only trifling in the small lengths of fine wire used in a fuse—0·25 in.—while the comparatively ready fusibility of the platinum silver wire contributed, with other physical peculiarities of the two alloys, to reduce the fine German silver wire to about a level with it. Moreover, the latter did not resist the tendency to corrosive action exhibited by gunpowder, and other more readily explosive agents, which had to be placed in close contact with the wire bridge in the construction of a fuse, while the platinum silver was found to remain unaltered under corresponding conditions. Experiments have also been made with alloys of platinum with definite proportions of irridium, the metal with which it is chiefly associated, very fine wires of an alloy containing 10 per cent. of irridium were eventually selected as decidedly the best materials for the production of wire fuses of comparatively high resistance and uniformity, this alloy being found decidedly superior in the latter respect, as well as in point of strength—and therefore of managableness in the state of very fine wire, 0·001in. in diameter—to the platinum silver wire. The fuses now used in military and submarine services were made with bridges of iridio platinum wire, containing 10 per cent. of the first-named metal. The electrical gun tubes in the Navy were fired by means of a specially-arranged Leclanché battery, and branch circuits worked to the different guns; in broadside firing, it was important that the wire bridge of any one of the gun tubes which was first fired should be instantaneously fused on the passage of the current, so as to cut this branch out of circuit; in this respect the comparatively fusible platinum silver alloy appeared to present an advantage, hence the naval electrical fuses were made with bridges of that alloy. Uniformity of electrical resistance had become a matter of such high importance in the delicate arrangements connected with the system of submarine mines, as now perfected, that the very greatest care was bestowed upon the manufacture of service electric fuses and detonators, which were in fact made, in all their details, with almost the precision bestowed upon delicate scientific instruments, and the successful production of which involved an attention to minutiæ which would surprise a superficial observer.

One of the earliest applications of electricity to the explosion of gunpowder was the firing of guns upon proof at Woolwich by means of a Grove battery and a gun tube, which was fired by a platinum wire bridge, a shunt arrangement being used for directing the current successively into the distinct circuits connected with the guns to be proved. When the high-tension fuse had been devised, gun tubes were made to which it was applied, and an exploder was arranged by Wheatstone, having a large number of shunts, so that as many as twenty-four guns might be brought into connection with the instrument, and successively fired by the depression of separate keys connected with each. The firing of cannon, as time signals, was an ancient practice in garrison towns, but the regulation of the time of firing the gun by electrical agency from a distance appears first to have been accomplished in Edinburgh, where, since 1861, the time gun had been fired by a mechanical arrangement, actuated by a clock, the time of which is controlled electrically by the mean time clock at the Royal Observatory on Calton Hill.

Shortly after the establishment of the Edinburgh time gun, others were introduced at Newcastle, Sunderland, Shields, Glasgow, and Greenock. The firing of the gun was arranged for in various ways; in some instances it was effected either direct from the observatory at Edinburgh, or from shorter distances, by means of Wheatstone's magneto-electric exploders. At present there were time-guns at West Hartlepool, Swansea, Tynemouth, Kendal, and Aldershot, which were fired electrically, either by currents direct from London, or by local batteries, which were thrown into circuit at the right moment by means of relays, controlled from St. Martin's-le-Grand. About thirteen years ago, the electrical firing of guns, especially for broadsides, was first introduced into the Navy, with the employment of the Abel high-tension gun tube and voltaic piles. The gun tubes then used were manufactured simply for the proof of cannon and for experimental artillery operations, and were of very simple and cheap construction. Experience proved them to be unfitted to withstand exposure to the very various climatic influences which they had to encounter in her Majesty's ships, and in store in different parts of the world. The low-tension gun tubes, having a bridge of very fine platinum silver wire, surrounded by readily ignitable priming composition, was therefore adopted as much more suitable for our naval requirements. The arrangements for broadsides or independent firing, and also for the firing of guns in turret ships, had been very carefully and successfully elaborated in every detail, including the provision of a so-called drill or dummy electrical gun tube, which was used for practice and refitted by well instructed sailors. The firing keys, and all other arrangements connected with electrical gun firing, were specially designed to ensure safety and efficiency at the right moment. The electric detonators for firing outrigger torpedoes, or for other operations to be performed from open boats, corresponded, so far as the bridge was concerned, with the naval electric gun tubes, and were fired with a specially fitted Leclanché battery. These electric appliances were now distributed throughout the Navy, and the men were kept, by instruction and periodical practice, well versed in their use. The application of electricity to the explosion of submarine mines, for purposes of defence and attack, received some attention from the Russians during the Crimean War under the direction of Jacobi; thus a torpedo, arranged to be exploded electrically when coming into collision with a vessel, was discovered at Yeni-Kale, during the Kertsch expedition in 1855. Some arrangements were made by the British, at the conclusion of the war, to apply electricity to the explosion of large powder charges for the removal of sunken ships, &c., in Sebastopol and Cronstadt Harbours. In 1859 a system of submarine mines, to be fired through the agency of electricity by operators on shore, was arranged by Von Ebner for the defence of Venice, which, however, never came into practical operation. Early in 1860 Henley's large magneto-electric machine, with a supply of Abel fuses, and stout india-rubber bags, with fittings to resist water-pressure, were despatched to China, for use in the Peiho river, but no application appeared to have been made of them. The subject of the utilisation of electricity for purposes of defence, however, did not receive systematic investigation in England or other countries until some years afterwards, when the great importance of submarine mines, as engines of war, was demonstrated by the number of ships destroyed and injured during the war in America. The application of electricity to the explosion of submarine mines was very limited during that war, but arrangements for its extensive employment were far advanced in the hands of both the Federals and Confederates at the close of the war, men of very high qualifications, such as Captain Maury, Mr. N. J. Holmes, and Captain McEvoy having worked arduously and successfully at the subject. The explosion of submerged powder charges by mechanical contrivances, either of self-acting nature or to be set into action at desired periods, was accomplished as far back as 1583, during the siege of Antwerp, by the Duke of Parma, and from that period to 1854 mechanical devices of more or less ingenious and practicable character had been from time to time applied, to some small extent, in different countries, for the explosion of torpedoes. The Russians were the first to apply self-acting mechanical torpedoes with any prospect of success, and had the machines used for the defence of the Baltic been of larger size —they only contained 8 lb. or 9 lb. of gunpowder—their presence would probably have proved very disastrous to some of the English ships which came into collision with and exploded them. Various mechanical devices for effecting the explosion of torpedoes by their collision with a ship were employed by the Americans, a few of which proved very effective. But although in point of simplicity and cost, a system of defence by means of mechanical torpedoes possessed decided advantages over any extensive arrangements for exploding submarine mines by electric agency, their employment was attended by such considerable risk of accident to those at whose hands they received application that under any circumstances which were likely to occur, they became almost as great a source of danger to friend as to foe. The most important advantages secured by the application of electricity as an exploding agent of submarine mines were as follows:—They might be placed in position with absolute safety to the operators, and rendered active or passive at any moment from the shore; the waters which they were employed to defend were, therefore, never closed to friendly vessels until immediately before the approach of an enemy; they could be fixed at any depth beneath the surface—while mechanical torpedoes must be situated directly or nearly in the path of a passing ship—and they might be removed with as much safety as attended their application.

There were two distinct systems of applying electricity to the explosion of submarine mines. The most simple was that in which the explosion was made dependent upon the completion of the electric circuit by operators stationed at one or more posts of observation on shore; such a system depended, however, for efficiency, on the experience, harmonious action, and constant vigilance of the operators at the exploding—and observing—stations, and was, moreover, entirely useless at night, and in any but clear weather. The other, which might also be used in conjunction with the foregoing, was that of self-acting mines, exploded either by collision with the ship, whereby circuit was completed through the enclosed fuse, or by the vessel striking a circuit closer, whereupon either the mine, moored at some depth beneath, was at once fired, or the necessary signal was given to the operator on shore. Continental nations had followed in our steps in providing themselves with equipments for defensive purposes by submarine mines, and the Danes, Swedes, and Norwegians had pursued the subject of submarine mines with special activity and success. In the United States the subject of utilisation of electricity as an exploding agent for war purposes was being actively pursued, and important improvements in exploding instruments, electric fuses, and other appliances had been made by Smith, Farmer, Hill, Striedinger, and others already mentioned, while no individual had contributed more importantly to the development of the service of submarine explosions than General Abbot, of the United States Engineers.

Illustrations of actual results capable of being produced in warfare by submarine operations had hitherto been very few; but of the moral effects of submarine mines there had already been abundant illustrations. In the war carried on for six years by the Empire of Brazil and the Republic of Urugauy and the Argentine Republic of Paraguay, the latter managed, by means of submarine mines, to keep at bay, for the whole period, the Brazilian fleet of fifteen ironclads and sixty other men-of-war. In the Russo-Turkish war submarine mines and torpedoes were a source of continued apprehension; and the French naval superiority was paralysed during the Franco-German war by the existence, or reputed existence, of mines in the Elbe. The application of electricity to the explosion of military mines, and to the demolition of works and buildings, had been of great importance in recent wars in expediting and facilitating the work of the military engineer. The rapidity with which guns, carriages, &c., were disabled and destroyed by a small party of men, who landed after the silencing of the forts at Alexandria, illustrated the advantages of electric exploding arrangements, combined with the great facility afforded for rapid operations by the power possessed of developing the most violent action of gun-cotton, dynamite, &c., through the agency of a detonator. The application of electricity to the explosion of mines for land defences during active war was not an easy operation, inasmuch as not only the preparation of the mines, but also the concealment of electric cables and all appliances from the enemy entailed great difficulties, unless the necessary arrangements could be made in ample time to prevent a knowledge of them reaching the enemy. But few words need be said to recall to the minds of civil engineers the facilities which the employment of electricity to explosive purposes afforded for expediting the carrying out of many kinds of works in which they were immediately interested. Electrical blasting, especially in combination with rock-boring machines, had revolutionised the operation of tunnelling and driving of galleries; and, although in ordinary mining and quarrying operations the additional cost involved in the employment of fuses, conductors, and the exploding machine, was not unfrequently a serious consideration, there were, even in those directions, many occasions when the power of firing a number of shots simultaneously was of great importance. There was little doubt, moreover, that accidents in mining and quarrying would be considerably reduced in number if electrical blasting were more frequently employed. The conveniences presented by electrical firing arrangements, under special circumstances, were interestingly illustrated by a novel proceeding at the launch of a large screw steamer at Kinghorn, in Scotland, which was recently accomplished by placing small charges of dynamite in the wedge-blocks along the sides of the keel, and exploding them in pairs, hydraulic power being applied at the moment that the last wedge was shot away. In the deepening of harbours and rivers, and in the removal of natural and artificial submerged obstructions, the advantages of electric firing were so obvious that extended reference to them was unnecessary. A substitute for electrical firing, which had been applied with success to the practically simultaneous firing of several charges, consisted of a simple modification of the Bickford fuse, which, instead of burning slowly, flashed rapidly into flame throughout its length, and hence had received the name of instantaneous fuse, or lightning fuse. The fuse burned at the rate of about 100ft. per second; it had the general appearance of the ordinary mining fuse, but was distinguished from the latter by a coloured external coating. Numerous lengths of this fuse were readily coupled up together, so as to form branches leading to different shot-holes, which might be ignited together, so as to fire the holes almost simultaneously. In the navy this fuse was used as a means of firing small gun-cotton charges to be thrown by hand into boats when these engaged each other, the fuse being fired from the attacking boat by means of a small pistol, into the barrel of which the extremity was inserted.

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

(From our own Correspondent.)

The mills and forges are generally running full time this week previous to shutting down for the holidays. The length of the holidays will depend very much upon the state of individual masters' order books, but in the majority of cases the first two or three days of the week will be taken.

The meeting of the Iron and Steel Institute kept a number of the leading masters from 'Change this—Thursday—afternoon in Birmingham, and the amount of new business which was transacted was limited. Speaking generally, medium and common descriptions of manufactured iron were in better demand than best sorts. These last, however, in the shape of bars, are in fair demand from abroad, where they have an established reputation. And our Government are buying the Earl of Dudley's iron.

Strips and hoops rolled at the Round Oak Works were quoted as follows: From 6in. to 2¼in., not thinner than 14 w.g., up to 1¼in. to 1in., not thinner than 19 w.g., lowest quality, £8 12s. 6d.; single best, £10; double best, £11 10s.; and treble best, £13 10s.; ⅞in., not thinner than 20 w.g., lowest quality, £9 12s. 6d.; single best, £11; double best, £12 10s.; and treble best, £14 10s.; ¾in.,

114. SADDLES of BICYCLES, J. B. Brooks, Birmingham. —9*th January*, 1883.
168. TOOLS for SHEARING, T. Perkins, Hitchin, and S. Gilbert, Wansford.—11*th January*, 1883.
192. DOUBLING, &c., MACHINES, P. Smith and S. Ambler, Keighley.—12*th January*, 1883.
254. POROUS SILICIOUS MATERIAL, A. Frank, Germany. —16*th January*, 1883.
283. FITTING SCREW PROPELLERS, &c. A. Morris, London.—17*th January*, 1883.
406. CARPET LINING, A. Bruckner, London.—25*th January*, 1883.
459. SELF-ACTING COUPLINGS, W. Stableford, Oldbury. —27*th January*, 1883.
766. ENRICHING COAL GAS, A. Perkins, London.—12*th February*, 1883.
1010. GAS ENGINES, C. H. Andrew, Stockport.—24*th February*, 1883.
1163. TREATING PULMONARY, &c., AFFECTIONS, J. T. Dean, London.—A communication from H. Watermann.—5*th March*, 1883.
1580. FASTENINGS for GLOVES, &c., E. D. J. Neupert, Germany.—23*th March*, 1883.
1603. CUTTERS for BORING MACHINES, J. Wade, Halifax. —30*th March*, 1883.
1625. APPLIANCE to STEAMSHIPS to NULLIFY EFFECTS of COLLISIONS at SEA, W. N. Smith and R. R. Swann, London.—31*st March*, 1883.
1644. WORKING SECONDARY BATTERIES, J. S. Sellon, London.—2*nd April*, 1883.
1673. SULPHURIC ACID, W. Garroway, Glasgow.—3*rd April*, 1883.
1797. STAMPING MINERALS, J. H. Johnson, London.—A com. from N. W. Condict.—10*th April*, 1883.
1816. PRODUCING FRESH-WATER by DISTILLATION, J. Kirkaldy, London.—10*th April*, 1883.
1819. STEAM BOILERS, W. R. Lake, London.—A communication from G. Stollwerck.—10*th April*, 1883.
1875. PREVENTING WASTE of HEAT, E. Maw, Liverpool. —13*th April*, 1883.
1913. DRIVING GEAR, F. Jenkin, Edinburgh.—14*th April*, 1883.
2074. BOILER CLEANERS, J. F. Hotchkiss, Plainfield, Y.S.—24*th April*, 1883.
2084. WIRE ROPE, H. H. Lake, London.—A communication from C. C. Colby.—24*th April*, 1883.
2085. MAKING CORDAGE, &c.. H. H. Lake, London.—A communication from J. Solman.—24*th April*, 1883.
2143. CLINOMETER COMPASS, W. R. Lake, London.—A com. from E. F. MacGeorge.—27*th April*, 1883.
3204. ELECTRIC RAILWAYS, S. Pitt, Sutton.—A communication from L. Daft.—1*st May*, 1883.
2205. DYNAMO MACHINES, S. Pitt, Sutton.—A communication from L. Daft.—1*st May*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 5th May*, 1883.)

5288. REFINING CAST IRON, J. Wetter, New Wandsworth.—6*th November*, 1882.
5291. SPINNING WOOL, W. Turner, Bradford.—6*th November*, 1882.
5294. FININGS for SPIRITS, &c., J. Blum, London.—6*th November*, 1882.
5296. TAPPING CASKS, &c., G. W. von Nawrocki, Berlin.—6*th November*, 1882.
5299. FINISHING INTERIOR of HOLLOW-WARE, J. V. Hope, Wednesbury.—6*th November*, 1882.
5304. DYNAMO, &c., ELECTRICITY, H. Mayhew, London. —7*th November*, 1882.
5308. CLEANING GRAIN, W. R. Lake, London.—7*th November*, 1882.
5310. COOKING RANGES, J. G. Whyte, Bo'ness.—7*th November*, 1882.
5318. BOLTING MILL, W. R. Lake, London.—7*th November*, 1882.
5319. COMBING WOOL, &c., J. H. Whitehead, Leeds.— 7*th November*, 1882.
5324. ORNAMENTING GLASS, A. J. Nash, Wordsley.— 8*th November*, 1882.
5335. TOOL-HOLDERS, J. F. Allan, Brooklyn, U.S.—8*th November*, 1882.
5349. MINERS' SAFETY LAMPS, T. Thomas, Ynishir.— 9*th November*, 1882.
5383. WATER SUPPLY of BATHS, J. J. Tylor, London.— 11*th November*, 1882.
5386. SHEARING METAL PLATES, A. J. Lehmann, West Hartlepool.—11*th November*, 1882.
5483. PIANOFORTES, W. Fischer, Germany.—18*th November*, 1882.
5485. TRANSIT INSTRUMENTS, J. L. Clark, London.— 18*th November*, 1882.
5531. IMITATING LEATHER FABRICS, H. Loewenburg, London.—21*st November*, 1882.
5556. BREECH-LOADING GUNS, W. R. Lake, London.— —22*nd November*, 1882.
5557. TRIMMING SOLES of BOOTS, J. Keats, Bagnal.— —22*nd November*, 1882.
5561. COUPLING APPARATUS, A. S. Mildred, Middlesbrough-on-Tees.—22*nd November*, 1882.
5575. EXTRACTION of TALLOW, C. D. Abel, London.— 23*rd November*, 1882.
5771. SCREW PROPULSION of VESSELS, A. M. Clark, London.—4*th December*, 1882.
5845. HEELING BOOTS, &c., J. Keats, Bagnal.—7*th December*, 1882.
21. GAS MOTOR ENGINES, J. R. Woodhead, Leeds.—1*st January*, 1883.
429. METALLIC PENS, H. Hewitt, Birmingham.—26*th January*, 1883.
686. PLOUGHS, &c., T. Walker, Whitstable.—7*th February*, 1883.
827. GOVERNORS for STEAM ENGINES, J. Whitley, Leeds. —15*th February*, 1883.
866. HAT-PRESSING MACHINES, H. C. Birley, London.— 16*th February*, 1883.
927. SECONDARY BATTERIES, O. J. Lodge and J. S. Pattinson, Liverpool.—20*th February*, 1883.
944. SEPARATING GOLD from ORES, A. E. Scott, London. —20*th February*, 1883.

(*List of Letters Patent which passed the Great Seal on the 8th May*, 1883.)

4707. STAND for BICYCLES, G. E. Vaughan and J. Walton, West Bromwich.—3*rd October*, 1882.
5058. BATHING PIERS, G. G. Page, London, and R. Nunn, Salisbury.—24*th October*, 1882.
5353. CARBONS for ELECTRIC LIGHTING, H. C. B. Shalders, London.—9*th November*, 1882.
5354. STRETCHING TEXTILE FABRICS, J. Littlewood, Newsome.—9*th November*, 1882.
5358. TRANSPORTABLE BAKING OVENS, E. A. Brydges, Upton.—9*th November*, 1882.
5362. LAMPS, J. Ungar, London.—10*th November*, 1882.
5370. PACKING FRESH MEAT, W. P. Thompson, London. —10*th November*, 1882.
5376. GUARDS for CIRCULAR SAWS, J. Wetter, New Wandsworth.—11*th November*, 1882.
5377. BALLS for GAMES, J. Wetter, New Wandsworth. —11*th November*, 1882.
5380. VALVES, F. P. and E. J. Preston, J. T. Prestige, A. T. Cornish, and W. G. Simmons, Deptford.—11*th November*, 1882.
5387. REGULATING ELECTRIC CURRENTS, P. R. Allen, London.—11*th November*, 1882.
5388. COMPOUNDS of INDIA-RUBBER, A. Parkes, Bexley. —11*th November*, 1882.
5389. SUSPENDING, &c., HEAVY WEIGHTS, S. S. Sugden, Woodford.—11*th November*, 1882.
5392. RECEPTACLES for BISCUITS, J. Hall, Sheffield.— 13*th November*, 1882.
5396. GRINDING LAWN MOWER CUTTERS, T. H. Gillott, Royston.—13*th November*, 1882.
5399. METALLIC ALLOYS, A. K. Huntington, London.— 13*th November*, 1882.
5413. CIRCULAR SHUTTLES, F. O. Schmidt, Berlin.— —13*th November*, 1882.
5414. REGULATING ELECTRICAL CURRENTS, P. R. Allen, London.—13*th November*, 1882.
5441. LITHOGRAPHIC STONES, P. Stuart, Edinburgh.— —15*th November*, 1882.
5444. WEB PRINTING MACHINES, T. Sowler and W. Pattison, Manchester.—15*th November*, 1882.
5445. ORNAMENTAL TILES, &c., J. Wetter, New Wandsworth.—15*th November*, 1882.
5474. PRINTING MACHINES, W. W. Taylor, Ripon.—17*th November*, 1882.
5491. BOOTS, J. Wetter, New Wandsworth.—18*th November*, 1882.
5514. MAKING CAST TUBES of GOLD, &c., T. Morgan, London.—20*th November*, 1882.
5518. DISTRIBUTING ELECTRICITY, C. D. Abel, London. —20*th November*, 1882.
5519. INTEGRATING APPARATUS, J. Imray, London.— 20*th November*, 1882.
5532. LITHOGRAPHIC PRESSES, H. J. Haddan, London. —21*st November*, 1882.
5536. PURIFYING TOWN SEWAGE, P. Jensen, London.— 21*st November*, 1882.
5547. MOVABLE PARALLELOGRAMIC SUPPORT, A. Zwierzchowski, Paris.—22*nd November*, 1882.
5573. DRAIN PLOUGHS, S. Pitt, Sutton.—23*rd November*, 1882.
5592. CRICKET-BAT HANDLES, H. J. Haddan, London.— 24*th November*, 1882.
5594. DYNAMO-ELECTRIC MACHINES, C. D. Abel, London. —24*th November*, 1882.
5598. CONSTRUCTING STOVES, F. Greatrex, London.— 24*th November*, 1882.
5617. SHARPENING SAWS, W. R. Lake, London.—25*th November*, 1882.
5642. FORKS, &c., H. J. Allison, London.—28*th November*, 1882.
5692. COLOURING MATTERS, I. Levinstein, Manchester. —30*th November*, 1882.
5819. GAS MOTOR ENGINES, G. Whittaker, Manchester. —6*th December*, 1882.
5900. TOOL used as SPANNER, &c., W. R. Lake, London.—9*th December*, 1882.
5942. MOUTH-PIECES of CIGARS, &c., O. W. T. Barnsdale, Nottingham.—13*th December*, 1882.
6108. VELOCIPEDES, R. C. Fletcher, near Preston.—21*st December*, 1882.
6130. GAS ENGINES, A. M. Clark, London.—22*nd December*, 1882.
6180. PAPER BOARD, S. H. Hamilton, Bushnell, U.S.— 27*th December*, 1882.
6228. TELEPHONIC TRANSMITTING INSTRUMENTS, J. Imray, London.—30*th December*, 1882.
79. PRODUCING COLOURING MATTERS, C. D. Abel, London.—5*th January*, 1883.
547. WATER GAUGES, J. Dewrance, London.—1*st February*, 1883.
566. PROJECTILES for ORDNANCE, A. Longsdon, London. —1*st February*, 1883.
664. BELT FASTENERS, C. D. Abel, London.—6*th February*, 1883.
683. FIBROUS PADS, W. R. Lake, London.—7*th February*, 1883.
706. COLOURING MATTERS, I. Levinstein, Manchester. —9*th February*, 1883.
724. CARTRIDGES for BREECH-LOADING FIRE-ARMS, W. Gardner, London.—9*th February*, 1883.
973. DYNAMO-ELECTRIC MACHINES, J. Hopkinson, London.—22*nd February*, 1883.
1313. DYNAMO-ELECTRIC MACHINES, H. H. Lake, London.—12*th March*, 1883.
1347. DYNAMO-ELECTRIC MACHINES, H. H. Lake, London.—13*th March*, 1883.
1375. DYNAMO-ELECTRIC MACHINES, H. H. Lake, London.—14*th March*, 1883.

List of Specifications published during the week ending May 5th, 1883.

5525, 6d.; 2386, 8d.; 3261, 6d.; 4133, 6d.; 4301, 6d.; 4305, 4d.; 4323, 4d.; 4330, 6d.; 4339, 6d.; 4340, 1s. 6d.; 4377, 2d.; 4387, 2d.; 4391, 6d.; 4394, 2d.; 4397, 2d.; 4400, 6d.; 4403, 2d.; 4409, 6d.; 4412, 6d.; 4413, 2d.; 4415, 6d.; 4416, 6d.; 4117, 6d.; 4419, 6d.; 4421, 8d.; 4422, 6d.; 4423, 4d.; 4424, 2d.; 4425, 2d.; 4426, 2d.; 4429, 2d.; 4430, 6d.; 4431, 6d.; 4432, 2d.; 4433, 6d.; 4434, 2d.; 4435, 2d.; 4438, 6d.; 4441, 2d.; 4443, 2d.; 4444, 2d.; 4445, 6d.; 4447, 6d.; 4451, 6d.; 4457, 8d.; 4461, 2d.; 4462, 6d.; 4463, 2d.; 4464, 2d.; 4465, 4d.; 4467, 6d.; 4469, 2d.; 4489, 6d.; 4497, 4d.; 4510, 6d.; 204, 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.

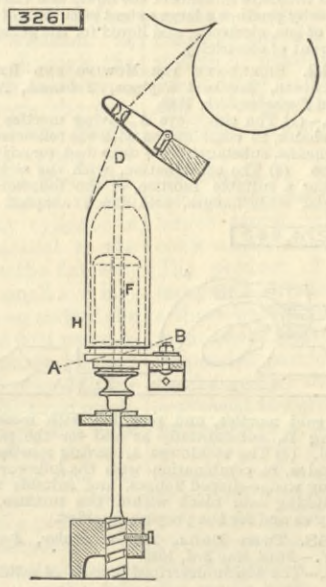
Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

2396. LAMPS and OIL FEEDERS, &c., *J. H. Radcliffe, Oldham.*—22*nd May*, 1882.—(*Provisional protection not allowed.*) 8*d.*

The articles are manufactured in cast iron, cast iron made malleable, and cast iron made malleable in combination with rolled metals.

3261. SPINNING and TWISTING, *J. Myers and B. Berry, Bradford.*—10*th July*, 1882. 6*d.*

This relates to an improved construction of rings. The rings A are made with inside circular projecting rings or flanges B; the said projecting rings or flanges are formed on the tops of ordinary rings, so that the yarn D is made to pass under the bottom edge of the cap



in the usual way, and over the top edge of the ring or flange B before winding on to the bobbin F or spool; and the yarn in passing from the cap H over the ring edge B or from the twizzle or eye or the flyer to the bobbin or spool, gives an uniform drag on to the yarn winding on the bobbin or spool, and with less ballooning.

3583. ELECTRIC LAMPS, &c., *G. Henley, Holloway, and S. Gedge, Westminster, executors of W. T. Henley, Plaistow, deceased.*)—28*th July*, 1882. 1s. 2*d.*

This relates to arc lamps and dynamo machines. In the inventor's arc lamp the upper carbon only is movable. The arc is struck by the action of two gripping levers, attracted to the cores of two electromagnets in the main circuit; when the current passes the carbon is gripped and raised. As the arc lengthens the grip of the levers is lengthened, and the carbon feeds by gravity. Various modifications of this plan are described and illustrated. The improvements in dynamo machines consist in placing the armature within the poles of the field magnets at each end, instead of causing it to revolve in front of them. The action of the dynamo is the same as that described in the inventor's patents, No. 5137, 9th December, 1880, and 130, 10th January, 1882. A mercurial commutator for short circuiting the alternate currents generated is also described.

4188. DEODORISING and DISINFECTING APPARATUS, *G. Nobes, Paddington.*—30*th August*, 1882. 6*d.*

The apparatus is designed so as to be attachable to every description of water-closet, urinal, sink, or drain, where other similar appliances cannot be so effectively or conveniently fixed, and to operate in such a manner as to measure a charge of disinfecting fluid for injection into the closet pan, urinal, sink, or drain each time the valves or taps are used.

4220. ELECTRICAL REGULATION of STEAM and other POWER ENGINES and PUMPS, &c., *A. W. L. Reddie, Chancery-lane.*—5*th September*, 1882.—(*A communication from A. Krizsa and J. Schaschl, Gratz*)—(*Not proceeded with.*) 4*d.*

Two solenoids are made to act on two cores connected with the valve of an engine, and the reciprocal motion thus obtained is utilised to regulate the speed of the engine.

4248. GALVANIC BATTERIES, *G. C. V. Holmes, Sussex-place, and S. H. Emmens, Argyll-street.*—6*th September*, 1882. 6*d.*

This relates to improvements in batteries by which a higher electro-motive force and stronger current is obtained, and partly to improvements on the provisional specification of S. H. Emmens, No. 4147, 30th August, 1882. The inventors use peroxide of lead powdered or in cakes, placed in a porous pot as one element, and zinc or lead in a solution of sulphuric acid in an outer pot as the other electrode. Other combinations are also described.

4260. ELECTRIC GOVERNORS for STEAM ENGINES, &c., *A. Blechynden, Newcastle-upon-Tyne.*—7*th September*, 1882. 10*d.*

This relates to various methods of actuating the valves of steam engines and the dampers of boilers by means of electricity, so as to control the speed of the former.

4270. APPARATUS for GENERATING ELECTRICITY, &c., *W. R. Lake, London.*—7*th September*, 1882.—(*A communication from E. Brard, La Rochelle, France.*) 1s.

This invention is based upon the fact that when a bath of melted nitrate is brought into contact with incandescent carbon a current is obtained. The inventor forms his generator as follows:—He makes bricks of a compound of wood charcoal and coke of a density higher than wood charcoal but lower than coal. Within these bricks are enclosed fine copper wires, which are united at one end where they form the negative pole. On one face of the brick is applied a thin sheet of nitrate, melted into the form of a tablet and enclosed in an insulating cover of asbestos paper or the like. This sheet also contains copper wires, which are united at one end to form the positive pole. On causing one of these bricks to burn a current is set up between the nitrate and the carbon.

4301. MACHINES for DISTRIBUTING WATER or other LIQUIDS, *J. T. Foot, Hammersmith.*—9*th September*, 1882. 6*d.*

A hose is connected to and coiled round a reel fitted to a frame on wheels, in such a manner that when the free end of the hose is connected with a supply of water, the water will pass through the entire length of hose—the whole or part of it being at the time coiled round the reel—through the reel, through a revolving elbow joint, and thence to delivery jet.

4304. ELECTRIC LAMPS, *J. G. Statter, Snapethorpe, near Wakefield.*—9*th September*, 1882.—(*Void.*) 4*d.*

This relates to the regulation of arc lamps. The upper carbon holder consists of a rack, in which gears a pinion fixed upon a spindle, on which revolves the armature of a continuous current dynamo. This armature is in the main circuit, and the regulation is effected by the weight of the upper carbon holder acting against the tendency of the armature to separate the carbons, which tendency is regulated by the resistance of the arc.

4305. TELEPHONE RECEIVERS or TRANSMITTERS, *C. A. Teske, Wandsworth.*—9*th September*, 1882.—(*Not proceeded with.*) 4*d.*

This relates to the construction of receivers or transmitters in which the diaphragm is dispensed with, and the vibration of the electro or permanent magnet itself is utilised for reproducing speech.

4316. SECONDARY or STORAGE BATTERIES, *F. J. Cheesbrough, Liverpool.*—11*th September*, 1882.—(*A communication from A. K. Eaton, Brooklyn, New York.*) 6*d.*

The inventor prepares his plates as follows:—Two pieces of zinc are covered on one side with varnish to protect the surface. One is then placed with the unprotected side uppermost in a shallow tray; a thin sheet of lead is placed on this, and the other zinc plate on this again, with its unprotected side downwards. A saturated solution of acetate of lead is then poured in until the lead plate is covered. By this means the thin lead plate becomes covered with an envelope of spongy lead. After having been thus prepared the plate is washed and pressed between sheets of asbestos paper and placed in a cell ready for use. The thin lead plate mentioned above is perforated before being put between the zinc plates.

4323. VEGETABLE PARCHMENT, *H. Hymans, Stepney Green.*—12*th September*, 1882. 4*d.*

The inventor claims the treating of vegetable parchment or parchment paper with a solution of carbonate of potash or caustic potash or of glucose, either alone or in combination with oleic or stearic acid—used either singly or together—and with glucose, gloy, or any other suitable equivalent.

4330. LOOMS for WEAVING, &c., *T. Blezard, Padiham, and W. Nelson, Darwen.*—12*th September*, 1882. 6*d.*

This relates, First, to an arrangemsnt of tappits and levers for operating the healds when weaving twills; Secondly, to an arrangement of brake which is applicable also to other machinery; Thirdly, to an arrangement of mechanism for preventing cracks or thin places, which are apt to occur in woven fabrics whenever the loom stops for want of weft; Fourthly, to apparatus for indicating the length woven.

4339. MANUFACTURE of WIRE CARD POINTS, *T. Morgan, London.*—12*th September*, 1882.—(*A communication from F. Gillet, Aix la Chapelle, Germany.*) 6*d.*

This relates partly to the method of shaping or grinding excavations on one or both sides of the wire, and cutting it in the middle of the excavation, thus forming sharp points.

4340. KNITTING MACHINERY, *S. Low and J. W. Lamb, Nottingham.*—12*th September*, 1882. 1s. 6*d.*

This relates to improvements in mechanism for the production of "fashioned" knitted work. By this machine the "fashioning" operation may be carried on simultaneously with the knitting, the "fashioning" taking place at either selvage alternately during the completion of succeeding courses of knitted work.

4350. APPARATUS for VISUALLY INDICATING ELECTRICAL SIGNALS, *B. J. B. Mills, Southampton-buildings.*—12*th September*, 1882.—(*A communication from J. U. Mackenzie, New York*) 10*d.*

This relates to visual indicators for use with telephonic, telegraphic, or other apparatus, which shall not only indicate the person who calls, but will show also who or what is wanted.

4352. MANUFACTURE of ELECTRODES, *W. Sinnock, New Cross-road.*—13*th September*, 1882. 2*d.*

This relates to means of manufacturing metal electrodes by which the same are perforated with numerous holes, so as to offer a large surface for action.

4377. LOCKSTITCH SEWING MACHINES, &c., *L. Silverman, Westminster.*—14*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates more especially to an improved thread bobbin or cop to be employed for the production of what is known as the under or lower thread; also to the shuttles for carrying such bobbins or cops through the loops formed by the upper thread, and to certain modifications in sewing machines to adapt them to the employment of the said thread bobbins or cops and shuttles.

4387. APPARATUS for AERIAL NAVIGATION, *U. Green, South Hackney.*—15*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the passage of balloons, &c., with their propelling mechanism and load in the air between any two points by means of a drum or pulley engaged in a rope or ropes stretched loosely along, or supported at joints above the surface of the ground, in such a manner as to allow of a portion of the rope being continuously taken up and dropped during the passage.

4391. SECONDARY BATTERIES, *N. C. Cookson, Newcastle-on-Tyne.*—15*th September*, 1882. 6*d.*

This relates to the preparation of plates. The inventor puts molten lead into a deep vessel having an orifice at the bottom pierced with a number of holes. The weight of the lead causes it to be forced through these holes, when it becomes consolidated into very fine filaments. These are gathered by a revolving drum, and can be interlaced one with the other or not as desired. The resulting fabric is then compressed and applied to a sheet of ordinary lead.

4394. FRONT of SHIRTS, *G. W. von Nawrocki, Berlin.* —15*th September*, 1882.—(*A communication from Messrs. S. Stern and Son, Bielefield, Germany.*)—(*Not proceeded with.*) 2*d.*

The shirt is made with a sort of double front, consisting of two front flaps, which can be used one after the other, and which, without needing to be buttoned, remain in their proper position.

4397. ORE CRUSHING and AMALGAMATING MACHINE, *S. Wekey, Strand.*—15*th September*, 1882.—(*Not proceeded with*) 2*d.*

This relates to a machine provided with two discs, one working over the other.

4400. SEPARATING TIN from SCRAP or WASTE METAL, *C. D. Abel, London.*—15*th September*, 1882.—(*A communication from F. A. Reinecken and L. Poensgen, Düsseldorf.*) 6*d.*

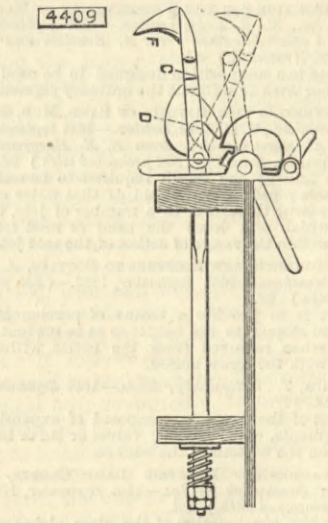
The separation of tin from scrap or waste metal is effected by means of a liquid which dissolves the tin, and by means of a series of revolving drums, through which the metal is made to pass consecutively and automatically, whereby labour is economised and a very perfect of the tin insured.

4403. PROTECTION of STAMPS and PAPERS from FRAUD, *S. Pitt, Sutton.*—15*th September*, 1882.—(*A communication from P. A. Tapponnier, Paris.*)—(*Not proceeded with.*) 2*d.*

The object is the protection of postage and other movable stamps from attempts to remove the obliterating marks.

4409. APPARATUS for "COUPLING" RAILWAY CARRIAGES, &c., *T. A. Brockelbank, London.*—16*th September*, 1882. 6*d.*

The inventor claims, First, forming the hook of the draw-bar with a stop or projection, and jointing the coupling hook to the draw-bar in such manner that it



will be supported in coupling position by the said stop or projection; Secondly, the improved coupling hook, comprising a head with two prongs F connected by a single shank C with a bifurcated portion D.

4412. LOCKING POINTS and SIGNALS by ELECTRICITY, *S. Brear and A. Hudson, Bradford.*—16*th September*, 1882. 6*d.*

This relates to means for locking and unlocking points and signals by the passage of the train. To carry the invention out, two sets of magnets are connected to batteries fixed in a signal cabin. One set of magnets is fixed to the ground, the other being allowed to work loose in connection with a rod and lever; the latter is fixed near to the side of the rails, so that the wheels of the train in passing over depress it, allowing the magnets to be attracted together and a spring bolt to enter a hole in a sliding plate, thereby locking the signal, until the train has passed over a similar lever near the next signal cabin, by which the circuit is broken, causing the magnets to separate and the spring bolt to be withdrawn.

4413. FASTENINGS of TIES and SCARVES, *H. Lenn, Strawberry Hill.*—16*th September*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to prevent ties or scarves from rising above the band of the collar, and keeping them from moving from the position in which they ought to remain.

4415. AUTOMATIC REGULATOR for REVERSING the MOTION of LEATHER ROLLING MACHINES, *E. Wilson, Exeter.*—16*th September*, 1882. 6*d.*

The inventor claims an arrangement for automatically reversing the motion of leather rolling machines, consisting of rollers or feelers, arranged so that they are alternately caused to rest upon the leather and travel in front of the roller, and upon passing over the edge of the leather the feeler in front of the direction of travel of the roller is caused to drop automatically, the motion so obtained being utilised to act upon any suitable arrangement of reversing mechanism.

4416. INCREASING the ILLUMINATING POWER of GAS, &c., *A. M. Clark, London.*—16*th September*, 1882.—(*A communication from V. Popp, Paris.*) 6*d.*

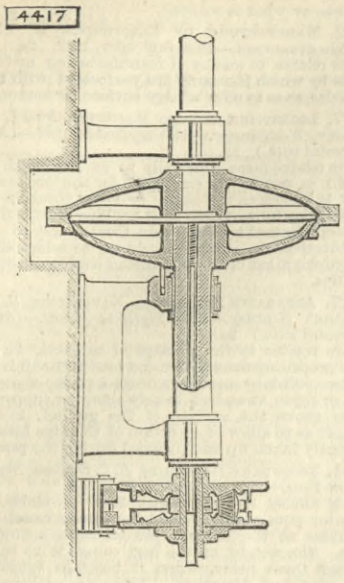
This relates to a system of lighting by mixing air or other gaseous supporter of combustion with illuminating gas or other hydrocarbon gas or vapour in suitable proportions, and burning the mixture at a suitable pressure in a burner of special construction.

4417. FRICTION CLUTCHES, *W. A. Barlow, London.*— 16*th September*, 1882.—(*A communication from T. Daimler, Wurtemburg.*) 6*d.*

The coupling consists essentially of two friction

bodies, the driving parts and the driven part, which

4417



are keyed on to their shafts, and thus prevent their moving in lengthwise direction.

4419. Electric Arc Lamps, *J. Brockie, Brixton.*—16*th September*, 1882. 6*d.*

This relates to the combination of a dash wheel filled with mercury or other similar substance, with the movable carbon in arc lamps, so as to regulate its rate of descent. The wheel or drum is divided into a number of partitions, which communicate with one another at the axis of the drum, and gears into the rack supporting the upper carbon holder. The core of a differential solenoid is made to operate the small wheel to which the drum is fixed, and which gears into the above-mentioned rack, by means of a lever and cam, and in this way the carbons are separated.

4421. Telegraphic and Telephonic Apparatus, *A. C. Brown and H. A. C. Saunders, Old Broad-street.*—16*th September*, 1882. 8*d.*

This relates to improvements in telegraphic or telephonic apparatus, which improvements are applicable where several subscribers make use of one line wire for communication as described in the present inventors' former patent, No. 1896, 1882. The object of the present invention is to simplify the use of the system there described, and consists principally of means for sending currents automatically into the line.

4422. Telephonic Telegraphy, *C. A. McEvoy and J. Mathieson, Adelphi.*—16*th September*, 1882. 6*d.*

This relates to a combination of a telegraph key with a Bell telephone for military purposes. The key operates upon an armature, which it causes partially to rotate in front of the poles of a permanent magnet. In this manner the movement of the key rotates the armature, and a current is sent to line, and received in the telephone, which remits clicks that can be read by the Morse code. The inventors also provide a coil of insulated wire in a case, which can be hung on telegraph wires. If the coil be connected with a telephone, the currents passing along the wires will produce clicks in the latter, which can be read as before.

4423. Composition for the Preservation of Wood, Stone, &c., *W. R. Lake, London.*—16*th September*, 1882.—(*A communication from A. Buzolich and T. K. Smith, Australia.*) 4*d.*

This relates to a composition designed to be used as a paint, either with or without the ordinary pigments.

4424. Preventing the Deposit of Sand, Mud, &c., in Rivers, &c., *W. R. Lake, London.*—16*th September*, 1882.—(*A communication from H. E. Hargreaves, Rio de Janeiro, Brazil.*)—(*Not proceeded with.*) 2*d.*

Pipes are laid at the depth required to be maintained. These pipes are perforated so that water can be caused to issue therefrom in a number of jets, the action of which will keep the sand or mud from depositing within the range of action of the said jets.

4425. Attaching Screw Stoppers to Bottles, *A. E. Nicholl, Streatham.*—16*th September*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to provide a means of permanently attaching the stopper to the bottle, so as to prevent it being lost when removed from the bottle without interfering with the screw action.

4426. Pumps, *T. Willoughby, Leeds.*—18*th September*, 1882. 2*d.*

The bucket of the pump is composed of expansion rings or segments, with valve or valves or lid or lids, fitted in or on the bottom of the bucket.

4429. Incandescent Electric Lamp Globes, *J. Crowder, Southwark Bridge.*—18*th September*, 1882.—(*Not proceeded with.*) 2*d.*

Relates to the construction of the glass globes and fastening of the conducting wires therein.

4430. Water Closets, *J. Imray, London.*—18*th September*, 1882.—(*A communication from R. H. Lecky and J. Hay, Pittsburg, U.S.*) 6*d.*

This relates partly to constructing the pan of a water-closet with a neck, having an inclined face covered by a valve worked by toggles.

4431. Secondary Voltaic Batteries, *A. Watt, Liverpool.*—18*th September*, 1882. 6*d.*

The inventor forms his plates by subjecting a stream of molten lead to the action of a jet of steam or air; the lead is thus disintegrated and carried forward in the shape of spray. It is caught on a board of insulating material or of lead.

4432. Holders for Bouquets, &c., *C. M. Tate, London.*—18*th September*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to provide means for holding bouquets, &c., on wearing apparel or upon articles of a portable character, such as whips, parasols, and the like, or upon harness.

4433. Knife-cleaning Machines, *C. W. Spong, London.*—18*th September*, 1882. 6*d.*

This relates to the employment of a tray or slab, which will enable two or more knives to be cleaned at one time.

4434. Galvanic Batteries, *S. H. Emmens and S. Mason, Soho-square.*—18*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to means for obviating polarisation, and obtaining a constant current of long duration, and is carried out by giving electrodes or fluids, or both, a rotary or reciprocating motion.

4435. Cans or Boxes, *J. F. Stoy, London.*—18*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the employment of a handle sliding in a groove.

4436. Base Material for Paint or Covering, *G. E. Church, Rhode Island, U.S.*—18*th September*, 1882.—(*A communication from A. E. Brochett, Branford, U.S.*) 4*d.*

The base material is composed of pine tar or Stockholm tar, caoutchouc gum (rubber), gutta-percha gum, gum shellac, gum copal, and linseed oil.

4438. Blind Roller Furniture, *J. W. Andrews, Whittlesea.*—19*th September*, 1882. 6*d.*

This relates to a means whereby the rollers can be held in any required position, while at the same time they can be quickly and easily released, so as to allow the blinds or other articles to be drawn up or let down.

4441. Apparatus for Use in Coupling and Uncoupling Railway Vehicles, *C. C. Braithwaite, London.*—19*th September*, 1882.—(*Not proceeded with*) 2*d.*

This relates to an apparatus used in coupling, in which a shaft, arm, or lever is provided with a device whereby the last link of a coupling chain attached to one vehicle may be grasped and passed over the hook of an adjoining vehicle, or may be lifted therefrom.

4443. Combined Spade and Pick, *H. McC. Alexander, Coleraine, Ireland.*—19*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a hinged combined spade and pick.

4444. Nails and Screws, *S. Beaven, Brazil.*—19*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the manufacturing of headless screw nails or wood screws from uniformly twisted triangular or fluted wire or rods.

4445. Gas Chandeliers, *E. Horton, Birmingham.*—19*th September*, 1882.—(*Not proceeded with.*) 6*d.*

This relates to means for raising and lowering the chandelier, and consists in using instead of the counterbalance weights and chain, a spring and wire rope.

4447. Treatment of Bark for the Manufacture of Paper, &c., *W. M. Riddell, London.*—19*th September*, 1882. 6*d.*

This relates, First, to the treating or subjecting bark or spent bark when enclosed in a tank to the process of steaming and washing for cleansing and softening; Secondly, subjecting such bark or spent bark, after it has undergone the cleansing and softening process, to the action of a tearing roller contained in a steam-tight closed tank.

4451. Appliances for Ventilating Tramway Carriages, &c., *G. W. von Nawrocki, Berlin.*—19*th September*, 1882.—(*A communication from Messrs. Dorn and Co., Hamburg.*)—(*Not proceeded with.*) 2*d.*

This relates to the employment of a ventilating, exhausting, or blowing fan, which causes an endless band containing advertisements to be revolved.

4456. Machine for Harvesting Sugar-cane, &c., *T. D. Stetson, New York.*—19*th September*, 1882.—(*A communication from W. C. Dollens and G. H. Zschech, Indianapolis, U.S.*) 10*d.*

This refers to machines for harvesting sugar-cane, Indian corn, and other crops which are usually planted in rows, and the stalks of which are to be cut at a more or less great distance from the ground, to be subsequently treated or utilised in the ordinary or any desired manner.

4457. Connecting Lamps to the Shafts of Bicycles, &c., *J. Lucas, Birmingham.*—19*th September*, 1882. 8*d.*

This relates to the means of connecting lamps to rotating shafts, but particularly to the shafts of bicycles.

4461. Dynamo-electric and Magneto-electric Machines, *J. W. Swan, Newcastle-upon-Tyne.*—19*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to an improved arrangement of the copper conductor forming the armature of a dynamo machine, which is designed to facilitate its construction.

4462. Chimney Tops, &c., *J. McPhail, London.*—19*th September*, 1882. 6*d.*

This relates to chimney-tops provided with apparatus for preventing down draught.

4463. Buttoned Boots, *C. Chambers, Highbury Vale.*—19*th September*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to an improvement in the uppers of buttoned boots, and it has for its object to avoid all seam, both at the back and front of the quarter.

4464. Apparatus for Driving Screw Piles, *T. Wrightson and W. Clark, Stockton-on-Tees.*—19*th September*, 1882. 6*d.*

This relates, First, to apparatus for putting down screw piles consisting of a ring and crosshead and ratchet on frictional pawls moved by mechanism on the crosshead; Secondly, apparatus for putting down screw piles by the application of water or fluid under pressure.

4465. Machinery for Manufacturing Biscuits, *S. Baruch, Podgorse, Austria.*—19*th September*, 1882.—(*Complete.*) 4*d.*

This relates to machinery for producing automatically and continuously two or more strips of biscuit ready for baking.

4467. Joining and Supporting the Ends of Rails on Railways, &c., *E. E. Talbot, Paddington.*—19*th September*, 1882. 6*d.*

This relates to the employment of casing plates.

4469. Vases for Flowers, *F. Barford, Hemel Hempstead.*—20*th September*, 1882.—(*Not proceeded with.*) 2*d.*

The vases are made of straw plait, Sennett plait, or Panama straw, combined with a flanged metal cup or pot to contain the flowers.

4489. Gas Motor Engines, *F. W. Crossley, Manchester.*—20*th September*, 1882. 6*d.*

The inventor claims an externally heated U tube, communicating by both its mouths with the space containing the combustible gaseous mixture, in combination with a reciprocating plunger, so arranged and moved that, at the desired moment of ignition, it causes a portion of the mixture to flow through the heated tube.

4496. Manufacturing Wire Netting, *M. A. F. Mennons, Paris.*—20*th September*, 1882.—(*A communication from F. H. Monmon, near Paris.*) 1*s.* 4*d.*

This relates to improvements introduced into the mode of and machinery for manufacturing wire netting with a view to the simultaneous production by one machine of netting of different widths and different sizes of mesh; as also (with certain modifications) to the simultaneous production of several pieces of netting of one width and one size of mesh.

4497. Gas Lamps, *J. Spielmann, London.*—21*st September*, 1882. 4*d.*

This relates to the construction and arrangement of gas lamps, wherein the gas and air supplying the burners are highly heated by the flame.

4510. Lamps Burning Mineral Oils, *J. Imray, London.*—21*st September*, 1882.—(*A communication from R. Ditmar, Vienna.*) 6*d.*

This relates to the construction and arrangement of lamps with cylindrical wick burning mineral oil, so as to increase the power and brilliancy of the flame by introducing into its middle a mixture of the combustible vapour of the oil with air.

4587. Apparatus for Regulating the Transmission of Power for Operating the Bellows of Organs, *J. Johnson and R. Talbot, Blackburn.*—27*th September*, 1882. 6d.

The object is to diminish or stop the action of the bellows automatically when they become full.

4589. Corset Busks and Clasps, *C. A. Snow, Washington.*—27*th September*, 1882.—(*A communication from C. A. Adams, Ashville, U.S.*)—(*Complete.*) 4*d.*

The object is to provide means by which the clasps may be turned around on the busk or steel, so that the busk may be withdrawn from the corset material when it is desired to wash the latter.

4605. Manufacture of Paper for Bank Notes, Share Certificates, &c., *J. H. Johnson, London.*—28*th September*, 1882.—(*A communication from E. Musil, near Vienna.*) 4*d.*

This consists in producing a yellow tinted fibre, and employing the same in the production of the paper.

5151. Manufacture of Iron and Steel, *E. F. Göransson, Stockholm.*—30*th October*, 1882. 6*d.*

The inventor claims in the manufacture of iron and steel when compressed air is used (as in the Bessemer process), subjecting the blast to the action of a cooling medium on its way from the blowing engine to the molten metal.

5525. Dynamo-electric Machines, *W. H. Akester, Glasgow.*—17*th September*, 1882. 6*d.*

This relates to improvements in dynamo machines, which consist mainly of a combination of two compound rotating armatures fixed on one shaft, with improved pole pieces, which the armatures almost touch. These armatures consist of several rings of soft iron wire, each ring having on it several copper wire coils combined with soft iron pieces having projecting parts and parts extending within the coils and round the ring.

6181. Parallel Vices for Machinists' Use, *H. F. Read, Brooklyn.*— 27*th December*, 1882.—(*Complete.*) 4*d.*

This relates to improvements in the apparatus for actuating the jaws.

127. Looms for the Manufacture of Velvet, *W. E. Gedge, London.*—9*th January*, 1882.—(*A communication from H. L. Morel and J. B. Poncet, Lyons.*)—(*Complete.*) 6*d.*

This consists principally, First, in an apparatus intended for the tension of the warp; Secondly, in a special tying up, whereby the usual tying-up blows are dispensed with; Thirdly, in the application to the loom of a weft feeder serving to prepare it for the requirements of the taking in of the weft; Fourthly, in a novel mode of working the Jacquard mechanism.

134. Rivetting or Eyeletting Machines, *W. R. Lake, London.*—9*th January*, 1883.—(*A communication from C. M. Platt, Waterbury, U.S.*—(*Complete.*) 6*d.*

This comprises an immovable receiver having spring jaws, a pivotted anvil-bearing arm united to a forked vertical lever by a link, an operating lever provided with a tripping device, &c.

150. Spooling Machines, &c., *W. R. Lake, London.*—10*th January*, 1883.—(*A communication from N. A. Baldwin, Milford, U.S.*)—(*Complete.*) 6*d.*

The chief object is the construction of a simple and automatic machine which will regularly and evenly lay the thread upon the spool in a positive and predetermined quantity.

204. Apparatus Employed in the Classification of Colours, *B. J. B. Mills, London.*—13*th January*, 1883.—(*A communication from J. Pittiot, Lyons.*)—(*Complete.*) 4*d.*

The apparatus has for its object, by means of some well-determined primitive colours, to present to the eye, in such manner as to enable it to be separately observed, all the intermediate shades obtained by the mixture, in various proportions, of two or a greater number of colours; and at the same time to indicate the exact proportion of this mixture.

267. Knitting Machines, *J. Adams, Philadelphia.*—7*th January*, 1882.—(*Complete.*) 6*d.*

This relates to several improvements in the general construction.

307. Alarm Guns, *W. Burgess, Malvern Wells.*—18*th January*, 1882.—(*Complete.*) 6*d.*

The inventor claims an improved alarm gun, consisting in the combination with the barrel of a combined breech-closing plunger and striker, and the means for guiding and retaining it in position in the breech.

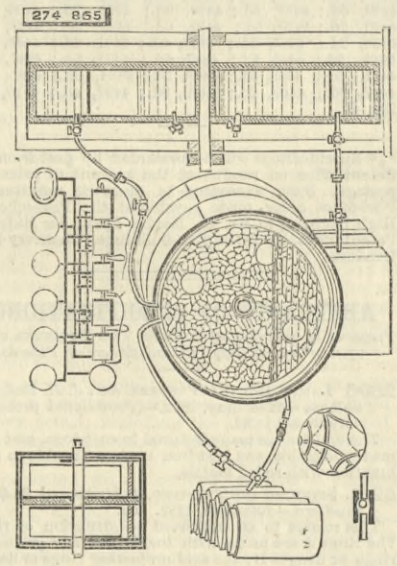
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

274,865. Electric Generator, *Samuel J. Wallace, Keokuk, Iowa.*—*Filed December 8th*, 1882.

Brief.—Two electrodes, made of conglomerates of coke, ores, &c., are rotated in chambers separated by a partition made porous below the liquid surface, and

274 865

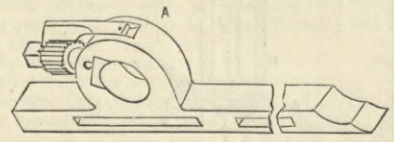


gases are admitted beneath, so that the rotation will cause an intimate mixture of the liquid and the gases, and thereby produce a large extent of surface of triple contact of gas, electrode, and liquid for the generation of a current of electricity.

274,942. Sickle-eye for Mowing and Reaping Machines, *Leonhart Hoffman, Tekamah, Nebr.*—*Filed December 30th*, 1882.

Claim.—(1) The sickle-eye A, having mortise *a* and slotted shank, in combination with the follower-block C, and means, substantially as described, for adjusting the same. (2) The combination, with the sickle-eye A, having a suitable mortise, of the follower-block C, formed with flanges, said block adapted to fit

274,942

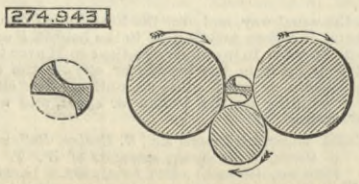


within said mortise, and provided with means for adjusting it, substantially as and for the purpose specified. (3) The sickle-eye A, having mortise and bevel sides, in combination with the follower-block C, having wedge-shaped flanges, and suitable means for adjusting said block within the mortise, substanially as and for the purpose specified.

974,943. Twist Drill, *Thomas Hooker, Syracuse, N.Y.*—*Filed May 3rd*, 1882.

Claim.—The within-described process of solidifying

274,943

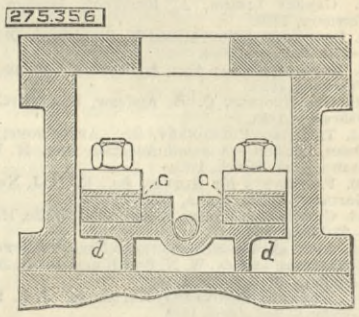


and finishing the cutting edges of twist drills, the same consisting in forming the drill with a diametric enlargement along the cutting edges thereof, and subsequently compressing said edges to the requisite diameter of the drill, substantially as specified.

275,356. Balanced Slide Valve, *Nathan W. Condict, Jun., Jersey City, N.J.*—*Filed January 9th* 1882.

Claim.—(1) The combination of a slide valve with balance bars secured within the valve chest and adapted to the back of the valve, substantially in the

275,356

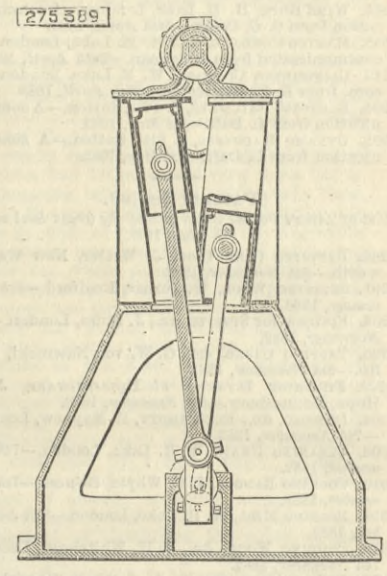


manner described. (2) The combination of a slide valve having wings *d d*, with balance bars G G secured within the valve chest and adapted to the valve and its wings, substantially in the manner described.

275,389. Steam Engine, *Samuel E. Jarvis, Lansing, Mich.*—*Filed August 10th*, 1882.

Claim.—(1) In a steam engine, the combination, with two steam cylinders placed at an angle to each other, of a jacket surrounding both cylinders, a single valve for governing the admission of steam to the cylinders and for directing the exhaust steam into a chamber between the cylinders, substantially as set

275,389



forth. (2) In a steam engine, two cylinders, set at an angle to each other and provided at or near their tops or ends with a steam chest, said steam chest having its exhaust port leading directly into an exhaust chamber formed between the said cylinders, substantially as shown and described.

CONTENTS.

South Kensington Museum.—Visitors during the week ending May 5th, 1883:—On Monday, Tuesday, and Saturday, free from 10 a.m. to 10 p.m., Museum, 12,244; mercantile marine, Indian section, and other collections, 4299. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 2888; mercantile marine, Indian section, and other collections, 521. Total, 19,952. Average of corresponding week in former years, 15,320. Total from the opening of the Museum, 21,952,679.