THE IRON AND STEEL INSTITUTE.

The proceedings of this body were resumed at the Institution of Civil Engineers, Great George-street, Westminster, on Friday morning, the 8th inst., Dr. Percy, F.R.S., presiding. The first paper read, of which we give a full abstract, was by Mr. F. W. Harbord on the

Removal of Metalloids in the Basic Siemens Furnace.

"Any process which comes forward as a rival to the puddling process must always be regarded with considerable interest. The basic Siemens process may now fairly claim to have established itself as a thoroughly practical method of dephosphorising, and I think that not only can soft steel of the finest quality be produced, but that the conditions of working in the furnace are peculiarly favourable to its production. The experiments here given were originally undertaken especially to study the removal of sulphur, and the pig used was purposely high in sulphur; but the investigation was afterwards carried a little further so as to embrace the other impurities. The experiments were made in a Batho furnace of five tons capacity, lined with basic material; the furnace, which is circular, has a suspended roof. The furnace was charged as usual, and when the bath was completely melted, two samples were taken every half hour from different parts of the bath; the mean analysis of these two samples was considered to fairly represent the composition of the bath. In each cast the charge consisted of about 60 per cent. pig, 30 per cent. steel scrap, and 3 per cent. of spiegel; and in the first two casts pig of the following composition was used, the scrap being principally ladle and hammer scrap:—

	White pig.	Mottled.
Carbon	2·61 per cent	3·20 per cent.
Silicon	1·27 "	1·50 "
Phosphorus	3·50 "	3·80 "
Manganese	·34 "	·50 "
Sulphur	·31 "	·230 "

No. 1 *experiment.*—The metal and scrap were charged in the usual way, and the charge was melted down in about four hours, when I commenced to take samples of iron and slag every half hour. In the following table I give the analyses of the various samples, each analysis being the mean of two samples:—

No. 1 *Experiment.—Series of Metal Samples.*

	1	2	3	4	5	6	7	8	9	10	Finished metal or steel.
	Taken when bath melted										
Carbon	·42	·23	·178	·094	·075	·07	·060	·05	·045	·05	·13
Silicon	·060	·070	·070	·050	·040	·045	·050	·045	·025	·010	trace
Phosphorus	1·220	1·180	1·000	·840	·700	·480	·330	·192	·116	·085	·065
Manganese	·080	·060	·088	·062	·064	·060	·085	·065	·080	·051	·51
Sulphur..	·23	·213	·206	·183	·170	·165	·157	·160	·137	·130	·125

It will be seen that, in melting down, about 98 per cent. of silicon, 93 per cent. of manganese, 40 per cent. of phosphorus, and 81 per cent. of the carbon have been oxidised. I anticipated that a considerable proportion of the impurities would be removed during this period, but I did not expect to find the metal totally desiliconised, and such a very large proportion of the manganese and carbon removed. I was therefore very anxious to confirm these results by another experiment, and in a few days I was able to sample another charge in the same way as the last. The charge in this case was about the same time in melting as No. 1, and the silicon, phosphorus, sulphur, and manganese were removed to about the same extent during the melting, but instead of carbon being reduced to ·42, 1·76 was left, *i.e.*, a loss of less than 30 per cent. as against 80 per cent. in the previous cast.

No. 2 *Experiment.—Series of Metal Samples.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	
Carbon	1·76	1·68	1·390	1·260	·84	·51	·40	·22	·09	·075	·075	·075	·07	·14
Silicon	·075	·075	·070	·090	·080	·060	·060	·040	·035	·030	·020	·018	·010	trace
Phosphorus ..	1·400	1·370	1·320	1·110	·990	·90	·81	·70	·62	·46	·30	·18	·085	·075
Manganese ..	·100	·100	·115	·090	·100	·080	·090	·075	·085	·100	·110	·125	·120	·37
Sulphur	·180	·169	·162	·150	·145	·140	·145	·147	·137	·133	·123	·120	·111	·089

"The two charges were supposed to be exactly the same. It is probable, however, that this last was rather greyer, as a larger proportion of mottled may have been charged; but this certainly is not sufficient to account for the great difference in the removal of the carbon. I considered these two casts to be fairly representative of the general

Series of Slags from No. 1 *Experiment.*

	1	2	3	4	5	6	7	8	9	10
Silica	22·90	—	—	—	—	—	—	—	17·20	—
Peroxide of iron.. ..	1·17	1·03	1·85	1·90	1·23	1·75	2·20	1·40	2·31	—
Protoxide of iron ..	14·90	10·40	7·20	5·94	5·91	6·61	9·09	9·91	13·30	—
Alumina	14·20	—	—	—	—	—	—	—	12·20	—
Protox. of manganese	3·69	—	—	—	—	—	—	—	2·64	—
Lime	28·00	—	—	—	—	—	—	—	33·60	—
Magnesia	1·70	—	—	—	—	—	—	—	2·27	—
Phosphoric acid	12·50	—	—	—	—	—	—	—	16·19	—
Metal iron	11·60	8·96	6·90	5·97	5·45	6·38	7·10	8·75	9·88	—

working, and have prepared a diagram showing, by means of curves, the percentages of silicon, phosphorus, manganese, and sulphur, which pass out in a given unit of time. I have also placed alongside, for comparison, similar diagrams showing the removal of the metalloids in the ordinary puddling and basic Bessemer processes. The vertical line is divided into percentages, and the base line into units of time, which may be roughly considered to represent half an hour. If we now compare these curves with those on the puddling diagram, we shall at once notice that there is a great similarity, and in fact almost identity. In the first two units of time, in the puddling diagram, practically the whole of the silicon and manganese, and 40 per cent. of the phosphorus, are removed, and during the melting period in the basic Siemens process very nearly the same percentages are oxidised. If we follow the phosphorus curves the whole way, they are practically the same until the end, when the Siemens curve goes up to 98 per cent or 99 per cent., whilst the puddling remains at 80 per cent. The sulphur curves are almost the same, about 5 per cent. more only being removed in the puddling furnace. It may be the experience of some ironmasters present that they get rid of more than 55 per cent. of the sulphur during the puddling, and there is no doubt that better results may be obtained by using the purest fettling. These curves, however, were not worked out from any special series of analyses, but are the mean of a large number of published results obtained in ordinary practice. In the Bessemer basic process we find that the ultimate removal is just about the same as in the Siemens, but that the rate of removal for any given unit of time is very different. Thus, in the case of phosphorus, we get a curve which is almost the reverse of the Siemens curve, as instead of passing gradually out, it practically all remains until the final stages of the process. I have not given a curve for the carbon, as the removal of this element showed such great variation that it could not be reasonably expressed by one. As the primary object in view was to investigate the removal of sulphur, we obtained a small lot of a most inferior white iron which had been made when a furnace was working very irregularly. The following is the analysis it gave:—

C.	Si.	P.	Mn.	S.
1·6	·37	3·56	·40	·488

The charge consisted of 70 per cent. of this pig, 30 per cent. of scrap, and 4 per cent. of spiegel, and samples of metal and slag were taken every half hour, as in the previous experiments.

No. 3 *Experiment.—Series of Metal Samples.*

	1.	2.	3.	4.	5.	6.	Finished metal.
Carbon	·05	·05	·045	too low to estimate by colour	too low	too low	·16
Silicon	·03	·018	—	—	—	—	trace
Phosphorus ..	·07	·068	·048	·04	·035	·030	·038
Manganese ..	·085	—	—	—	—	—	·78
Sulphur	·408	·34	·29	264	·24	·22	·20

With the exception of sulphur, the results obtained were so very different from the previous experiments, but I am able to offer an explanation. The furnace man could not get it to boil; and after giving it several doses of pig "to bring it up from the bottom," he tapped after the bath had been melted 2¾ hours. The steel produced in all three of the experiments worked well when hot, and even the high content of sulphur in the last does not appear to have affected its working properties. The very rapid removal of carbon, silicon, and manganese in the first experiment suggested that the varying composition of the slag must greatly affect the rapidity of such removal, and in the second and third experiments I took samples of slag before the metal was melted in order to see the nature of the slag which was acting upon the iron during the melting period. In each experiment the first sample was taken as soon as any slag was formed, when the charge was about one-third melted, and the second one when the charge was about one-half melted. They are marked A and B in each series. The numbers above each sample correspond with the metal samples in each cast. Comparison of these slags will, in a great measure, explain the varying rate of removal of the impurities in the three experiments.

Series of Slags from No. 2 *Experiment.*

	A	B	1	2	3	4	5	6	7	8	9	10	13
Silica	14·40	—	23·60	—	—	—	—	—	—	—	—	—	17·40
Peroxide of iron ..	6 81	·40	·73	3·80	·77	·90	2·60	2·30	1·60	1·17	1·17	1 90	1·64
Protoxide of iron ..	44·20	21·50	8 07	6·75	7·28	6·21	6·35	7·38	4·77	5·31	4·10	4·10	4·53
Oxide of manganese..	2·04	—	8·15	—	—	—	—	—	—	—	—	—	4 60
Alumina	6·80	—	7 00	—	—	—	—	—	—	—	—	—	7·50
Lime	14·00	—	38·10	—	—	—	—	—	—	—	—	—	44·00
Magnesia	·84	—	1·28	—	—	—	—	—	—	—	—	—	2·80
Phosphoric acid	10·00	—	12·45	—	—	—	—	—	—	—	—	—	15·75
Metal iron	38·90	17 09	6·79	7·93	6·10	5·40	6·90	7·41	4 80	4·90	4·01	4·53	4·63

Series of Slags from No. 3 *Experiment.*

	A.	B.	1.	2.	3.	4.	5.
Silica	8·5	—	12·0	—	—	—	9·20
Peroxide of iron ..	4·3	4·2	3·8	1·63	3·9	3·80	4·30
Protoxide of iron..	63·09	52·47	43·11	19·40	18·45	20·16	23·6
Manganese	4·25	—	6·81	—	—	—	2·07
Alumina	5·10	—	4·90	—	—	—	4·10
Lime	8·10	—	15·20	—	—	—	42·40
Magnesia	·63	—	·85	—	—	—	3·00
Phosphoric acid ..	5·50	—	13·30	—	—	—	12·30
Metallic iron	52·10	43·75	35·30	16·53	17·16	18·4	19·55

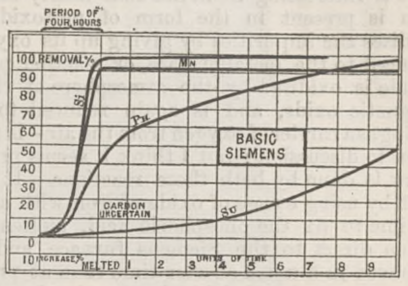
In the case of the first and second experiments, we start with a charge of practically the same chemical composition, and when the bath is melted we have the following results:—

	C.	Si.	P.	Mn.	S.
No. 1	·42	·06	1·22	·08	·23
No. 2	1·79	·075	1·40	1·00	·18

If we take No. 1 in each case we find that the first contained 14·9 per cent. of protoxide, and the second 8·0 per cent., so that the first slag should have nearly double the oxidising power of the second, supposing that this varies directly with the amounts of oxidising bases present. The silica was practically the same in both cases, but the lime was higher in the second experiment. If, now, we compare the slags in the second and third series, the removal of the impurities in proportion to the oxidising nature of the slag is very marked. In comparing these results we

Average Composition of Charge.

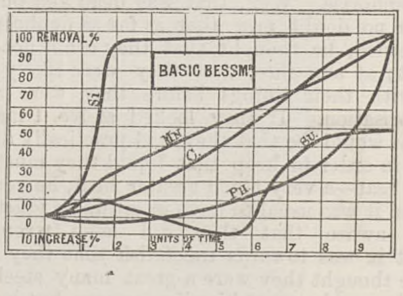
Total Carb. ..	2·300
Silicon	0·870
Phosph. ..	2·300
Sulphur ..	0·230
Mangan. ..	0·960



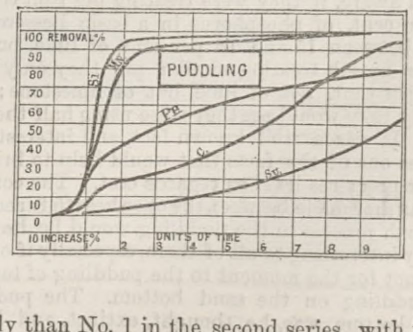
must remember that the amount of silicon in the charge No. 3 was only about ·28 per cent., and the carbon was also much less than in the other casts, so that the slag had a much better chance of performing its work. The samples marked A and B taken during the melting period will be seen from the tables to give:—

Second Experiment.			*Third Experiment.*		
A	Protoxide	44·20	A	Protoxide	63·09
	Peroxide	6·81		Peroxide	4·30
B	Protoxide	21·5	B	Protoxide	52·47
	Peroxide	·4		Peroxide	4·20

In the third experiment, therefore, during the whole melting period, the iron was exposed to the oxidising action of a slag which varies between 52 per cent. and 63 per cent. of protoxide of iron, whilst in No. 2 the slag only contains from 21 per cent. to 44 per cent.; and I think this, together with the low content of carbon and silicon in the bath, accounts for the complete removal of the metalloids during the melting. The very small content of lime in these slags—only 15 per cent., with 12 per cent. of silica in No. 1 slag, by which time practically the whole of the phosphorus had been removed—seems to make it probable that far less lime is required when a large excess of oxides is present. Within certain limits



the smaller the quantity of lime which can be used the better, not only on account of expense, but because any excess above that required to fix the phosphorus probably only dilutes the slag, and retards its oxidising action. This is confirmed by No. 1 in the first series, which contains only 28 per cent. of lime, but has done its work more



effectually than No. 1 in the second series, with its 38 per cent. of lime. The composition of the slag, with regard to the relative percentages of oxide of iron, lime, and silica, is an important point which requires further investigation. The sulphur does not appear to be much affected by the oxidising power of the slag, as about the same proportion has passed out in the three experiments, and it is possibly more a question of the time of contact than of the composition of the slag.

It is interesting to notice that nearly the whole of the iron is present in the form of protoxide. Whether it oxidises the impurities by giving up its oxygen, and being reduced to the metallic state, or whether part of the protoxide is oxidised by the atmosphere of the furnace into magnetic oxide, and is again reduced to protoxide—so acting as a carrier of oxygen from the air—is a question quite open to discussion; but I think it seems probable that the work is done by both these reactions. It seems possible that by using excess of oxide of iron with a fair proportion of lime to fix the phosphoric acid, molten iron might be taken direct to the Siemens furnace, and the metalloids removed in a much shorter time than at present, and thus the expense of remelting be saved. I am not sure that any great saving would be effected by this, but simply think that the above experiments suggest the possibility of good results. I am of opinion that by melting down hematite iron in a basic furnace, and tapping as soon as the bath melted, a very admirable material for steel castings would be obtained."

In the discussion Mr. Gilchrist said the paper gave a complete key to the successful operation of the basic open-hearth process. He thought it would be a convenience—it was not necessary, of course, but it would be an undoubted convenience—if he would insert before No. 1 the analysis by calculation of the charge before it was melted; and perhaps if he could add the analyses of the slag in line with it, so that they could look from one to another without turning over, it would be better. That, however, was only a very little detail. The three experiments completely confirmed one another. Taking 1 and 2, if they looked at the slag, which was really the most important part, they would see that the slag in No. 1 had a total of silicon and phosphoric acid amounting to some 35·4 per cent., and the oxides of iron to 16 per cent. In No. 2 they had rather more silicon and phosphoric acid; they had 36 per cent. as against 35·4, which was not a great difference, but there was an enormous difference in the oxidising material, namely, 8·7 as against 16, so that they would see there was nearly double. Then in No. 3, which was the most rapid case of dephosphorisation he thought he ever remembered seeing, they would see the same line followed out. The slag free of silica and phosphoric acid at the same period—that was No. 1—had only 25·3 of the combined acids, and they had nearly 47 per cent. of the oxidising material, oxide of iron; so that it was the same thing carried out, and it seemed to be running along in a style in which experiments did not always run, but which was extremely satisfactory when they did so. But taking No. 3 as the key of the position, he thought there were two elements which should be given a little credit. The first and the most important was the question of heat. It used to be said that if they had too much heat they could not dephosphorise. Well, that was dead and buried, and there was no doubt now that as far as dephosphorising was concerned, he thought that they could not have too much heat; at any rate, that they were likely to have trouble with their linings before they were with the dephosphorisation. If they looked at No. 1 material of No. 3 they would see that they had practically a wrought iron, and in order to keep that liquid they must have an enormous heat—a very much greater heat, he ventured to think, than it was usual to have in ordinary practice. He was well aware that they did keep wrought iron liquid, but it was towards the finish that they had that heat. He thought they were a great many steel makers present who could correct him if necessary, but he thought he was correct in saying that the ordinary English practice was that they had not at the period of melting, when the charge was just melted, sufficient heat in the furnace to keep wrought iron melted. And that was vitally important, because in order to get this oxidising condition of the oxides of iron, they must have a temperature that would keep the wrought iron liquid, otherwise they would have so much oxide of iron present in order for dephosphorisation that the stuff would not melt, and there was a regular mess, so that it was a question of heat. They wanted always to obtain that result, and there was no reason why one should not always obtain that result, but to do so they required enormous heat; that there was no difficulty of obtaining, by charging with the pig and scrap, or whatever they were using, sufficient oxide of iron and limestone. To show that there was no difficulty about that, it was well known that at some of the continental works they melted a charge of 8 tons, consisting of 80 per cent. of steel scrap and 20 per cent. only of pig. They melted that in one hour, a practice, he thought, which had not been equalled in England. The author of the paper had drawn attention to the comparatively small amount of lime that was used. That was very characteristic of the basic open hearth. As they were well aware, if they were treating pig iron containing 2 or 3 per cent. of phosphorus in a basic Bessemer, they required between 15 and 18 per cent. of lime, but in the basic open hearth treating similar pig they only required 15 to 18 per cent. not of lime but of limestone; so that practically they would see they were using half the amount of lime. It was a well known fact, and interesting fact, and it was one of the facts that would help to bring those two great processes level as regards cost. The comparison that the author made between the open hearth furnace or the open hearth process in the puddling would be, he thought, extremely interesting to all of them, especially if one would go back not for the moment to the puddling of to-day, but to the puddling on the sand bottom. The puddling on the sand bottom was, he thought, extinct, and had been replaced by puddling on an oxide bottom—that was practically a basic bottom—so that the puddling under acid conditions was dead. He ventured to think that making steel in the open hearth furnace on acid bottoms would also die, and that it would die as completely, and that that was not a visionary idea, was, he thought, confirmed by the practice of one of their continental friends—the name of the works he would rather not mention—where they were making 200 tons a week of steel from an 8-ton furnace, and they had an 8-ton open hearth basic bottom furnace; they charged 80 per cent. of steel scrap and 20 per cent. of hematite; that was to say, they started with ·08 of phosphorus, and they finished with ·002. He supposed it was used for some sort of Swedish, but, at any rate, using that material, they did 200 tons a week at least, and they had done it regularly for some time past, and continued to do it, and not only did they get that better quality, but they got what he remembered M. Schneider—he thought it was in 1879—said there ought to happen, they got an increased speed of working with basic sole, and the other was working with an acid or sand sole. They were both using the same material—steel scrap and hematite pig—and they got 25 per cent. more work out of the furnace using the same materials than they did out of the acid furnace; but now they could not see that comparison because they had made a change, and both furnaces were now basic lined.

M. Gautier said he could quite confirm this difference of the rapidity of the oxidation of the several elements of the different mixtures between the Bessemer and the open hearth processes. He had given them on authority some figures compiled from their practice in France in steel making with chrome iron bottom and phosphoric pig iron, a kind of basic process which showed that after a melting of four hours about 90 per cent. of silicon was oxidised, whereas only 60 per cent. of phosphorus was oxidised. Now, whence came that difference of rapidity of oxidation, which was illustrated in the diagram of Mr. Harbord, between the basic Siemens and the basic Bessemer. It looked to him, as Mr. Harbord said also, that that was a question of the composition of the slag. In studying the phosphorisation in smelting, which was very curious, they would see on the diagram that silicon and manganese had removed about 100 per 100, and silicon about the same, but phosphorus 0. To try this they had made in France the following experiments:—They took pig iron from the composition, like the Cleveland, 1½ per cent. of phosphorus and about 2·17, about 2 of silicon, and they had converted it into a Bessemer converter, and so stopping the blowing just when the flame was going down, like in a common charge with hematite pig iron, but without adding any spiegel or ferro-manganese at all. Of course they arrived at a metal with a proportion of carbon perhaps of about ·2; the phosphorus all remained because the converter was an acid lining. They had 1·7 of phosphorus; silicon was reduced to about nothing. He had not the figures, but speaking from memory, it was perhaps ·05 or ·06. They cast that in ingots, and afterwards, when it was so solid, some days after, they put it into an open-hearth furnace with a chrome iron bottom. They tried to melt it. He must confess that it was a little hard, because out of the phosphorus they wanted some elements to give a fusibility to this metal. They had no carbon, no silicon, but they only had phosphorus. After about double the time to melt this charge, they took samples, and were astonished to see that about all the phosphorus, or 95 per cent. of the phosphorus, was out. Of course, since they had no silicon at all in the metal, their slag was very basic, and the oxide of iron naturally had a very active action on the phosphorus, and all the phosphorus was got rid of. As to the composition of slag, he was very happy to see that some peroxide of iron was found. Mr. Stead, with whom he was speaking on this matter on the previous day, was also of the same opinion as himself, that generally the oxide made in the Bessemer charge or in the open-hearth furnace was not protoxide of iron. Perhaps it was protoxide, but it was oxidised after, and it was about of the composition of what he might call magnetic oxide—a combination of 1 of protoxide and 1 of peroxide; but he saw by those analyses this proportion of oxide was not always the same. The quantity of the peroxide which was the dissolution of the slag acted all the time upon the oxygen, and it was by the agitation of the mass that the oxygen was given to the bath in lieu of the source of oxygen from the air current of the flames. That was all that he desired to say upon this matter.

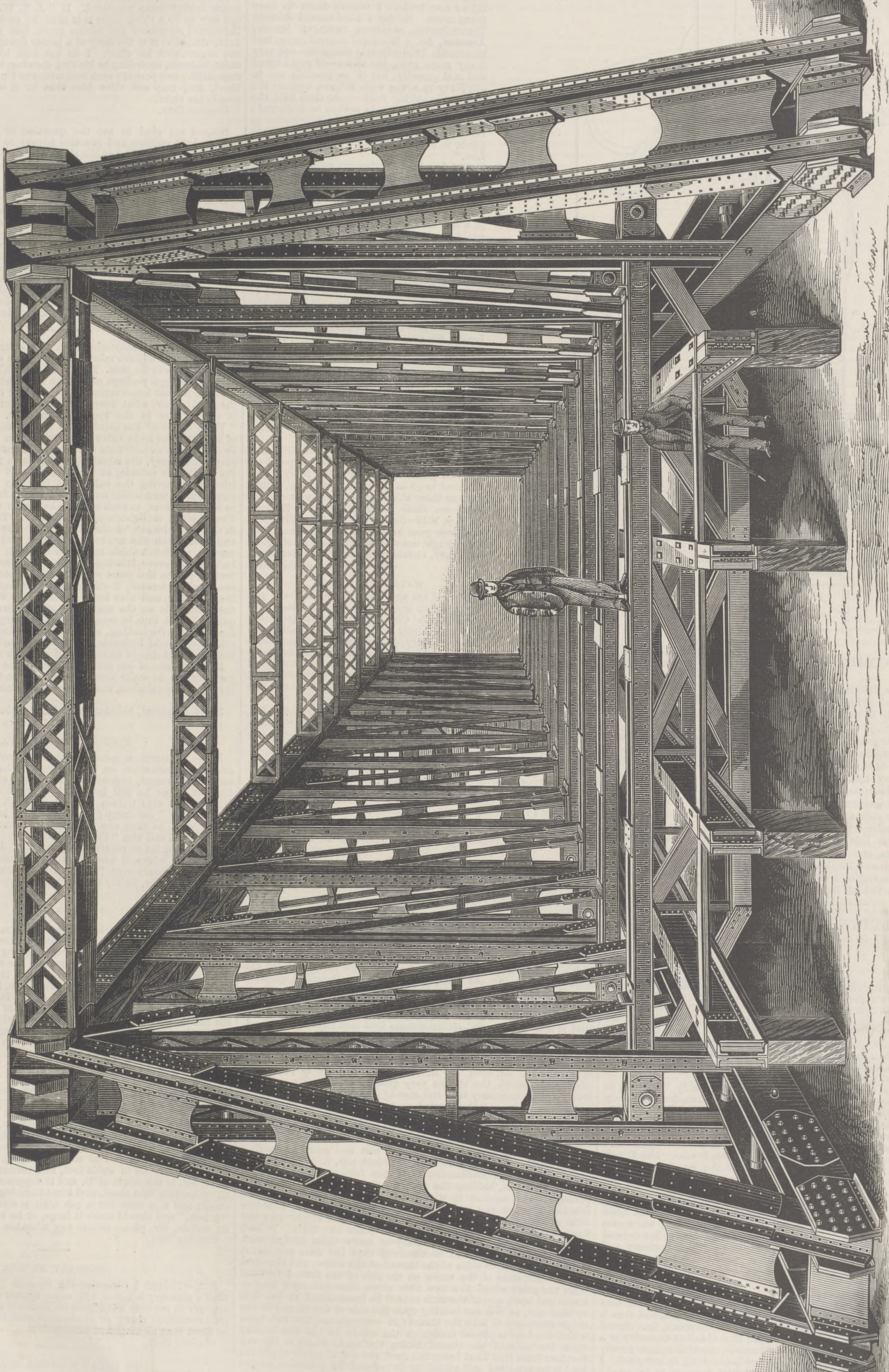
Mr. Stead said it was really the first paper they had had before the Institute upon the basic open-hearth process. He had pointed out to M. Gautier that in the Bessemer process, when the temperature was very low the magnetic oxide was produced; but as the temperature increased, the attraction for the oxygen by the metals and metalloids was very great, and peroxide then predominated. Now, as a matter of fact, the temperature at which those slags were drawn from the furnace was all of them of a very high character, and likely to leave protoxide in very large excess, and as a matter of fact they would see by the analysis that protoxide did predominate. There is another thing which struck him in looking over the diagrams of Mr. Harbord; that was, as to the question of the elimination of sulphur in the puddling process. Now, as a matter of fact, when pig iron with very little sulphur was charged into a puddling furnace, only about 50 per cent. was removed; but if they used pig iron containing a larger content of sulphur, a very much larger proportion was taken out. At one time he made some experiments in this direction with pig iron containing as much as 1 per cent. of sulphur, and in puddling that in the ordinary way he found that the sulphur was reduced from 1 per cent. in the pig to ·1 per cent. in the finished bar iron. This of course he thought had been taken from results obtained in puddling iron with small content of sulphur. There was not near so much elimination from a small content to commence with as there was when there was a larger quantity present. Another thing which would strike them at once in looking over those slags was, that in No. 1 experiment there was a very excessive quantity of alumina present. Now he would like to ask Mr. Harbord as to what the actual fact of that alumina in the slag really was? It always struck him that in a basic compound the alumina seemed to act in the place of an acid; and if that was so, it struck him that very likely the reason that the elimination in No. 1 experiment was not so great as in No. 3 was due to its acid character and the acid presence of alumina. They noticed in No. 1 experiment also that the lime was very small compared with the phosphoric acid, that the silica was in large excess, and together with the alumina would very greatly retard the absorption of phosphorus in the slag. Now, in that very interesting paper that had been circulated among the members at the meeting by Mr. Hilgenstock as to the nature of the compounds in basic slag, they would be interested to find there that the phosphoric acid exists as a tetra-basic phosphate of lime. He had brought some very interesting specimens from Middlesbrough, which would be exhibited for their inspection, which would show those very beautiful crystals. Now, in No. 9 sample of slag, No. 1 experiment, they would find there was 33 per cent. of lime and 16 per cent. of phosphoric acid. Well, the lime required for this peroxide to make tetra-basic phosphate of lime would be about 29 per cent., or 28½, so that they would see there was not a very large excess, and considering also that there was such a large quantity of silica present, they were not at all surprised that this phosphorus was not eliminated more rapidly. Turning over to the No. 3 experiment they would find an altogether different state of things. Silica, as Mr. Gilchrist pointed out, and phosphoric acid, were very low and the amount of oxide of iron and lime very high. The lime was in large excess above what was required to form tetra-basic phosphate of lime. The tetra-basic phosphate of lime crystals probably Mr. Harbord might have found something of this kind in his slag samples, and he would very much like to hear from Mr. Harbord if he had done so. Some months ago Mr. C. H. Ridsdale, the chemist of the North-Eastern Steel Works at Middlesbrough, and himself very carefully went into the investigation of the crystalline compounds in basic slag. He thought many of those present would remember that Mr. Purcell and himself had a very lively discussion on the subject some years ago, and it would be remembered also that that dispute was then as to how the phosphoric acid was really combined in the slag. Mr. Purcell demonstrated to his satisfaction, and probably to the satisfaction of some others, that it was really in combination with the iron, and he—Mr. Stead—held the other view, and analytically demonstrated to his satisfaction, which he considered conclusive, that the lime was really in combination with the phosphorus, and that the iron was perfectly free from it, and it was very interesting to know not only that Mr. Hilgenstock and others have confirmed his view, but that here they had actually in a specimen before them a crystallised phosphate of lime, and what was more, that another crystallised compound, which Mr. Hilgenstock had not mentioned, contained all the bases free from phosphoric acid—that is the metallic bases. There they had beautiful thick crystals of magnetic oxide, lime, magnesia, manganese, with only a very slight quantity of phosphoric acid present, in fact—they had the basis separate not combined there with silica or phosphoric acid, but in a perfectly free state. There were some other beautiful forms referred to there by Mr. Hilgenstock of the hexagon needle, and another compound also showing most magnificant appearances under the microscope—beautiful, pure transparent blue crystals, perfectly transparent, and consisting of a double silicate of tetra-phosphate of lime and silicate of lime in one form. Such a compound, he thought, had not really been discovered before. That was the result of their investigations with the basic Bessemer slag, and it would be very interesting indeed if similar experiments and examination could be made with slags from the Siemens furnace—experiments in which alumina preponderated in such large quantity. There was one thing more in reference to the paper of Mr. Harbord to which he wished to call attention, and that was as to the elimination of carbon.

Mr. Harbord, in reply, said he should be pleased to adopt Mr. Gilchrist's suggestion to make the comparison of analyses more complete, but, of course, the actual charge was shown upon the diagram. The small amount of lime used in the open hearth process, as Mr. Gilchrist had pointed out, was certainly a very important point, and he hoped further to investigate the matter. He thought, with M. Gautier and Mr. Turner, that the oxide of iron acted principally as a carrier. With reference to Mr. Stead's remarks as to sulphur in puddling, he might say that the results were taken from analyses of pig iron which did not contain a great amount of sulphur, mostly under a tenth. He had had some given him by friends in which practically the whole of the sulphur was removed. They were all picked experiments, in which very pure fettling was used and every precaution taken, so that he had not introduced those results. With regard to the alumina in the slag, whether it acted as an acid or base, he was rather inclined to think with Mr. Stead that it acted as an acid. Mr. Stead had also referred to the first and second series of experiments, and he understood him to say that the removal of phosphorus in the second was more complete than in the first series. He himself thought it was more complete in the first series, as the lime was less in that than in the second. It was hardly probable in that case that the alumina did act as an acid, or that it neutralised the effect of the lime, and that some of the phosphorus would pass back into the iron.

A paper was then read by M. Ferdinand Gautier on

The Casting of Chains in Solid Steel.

The casting of chains in solid steel appears, theoretically at any rate, to be a most difficult process, having regard to the conditions which it is necessary to fulfil, viz.:—(1) In order to arrive at an economical product which could compete successfully with ordinary wrought iron weight for weight, it is necessary to have a quick method of moulding the chains. (2) It is necessary to employ steel of such a character as to afford the most perfect security—steel that is quite solid, and absolutely without

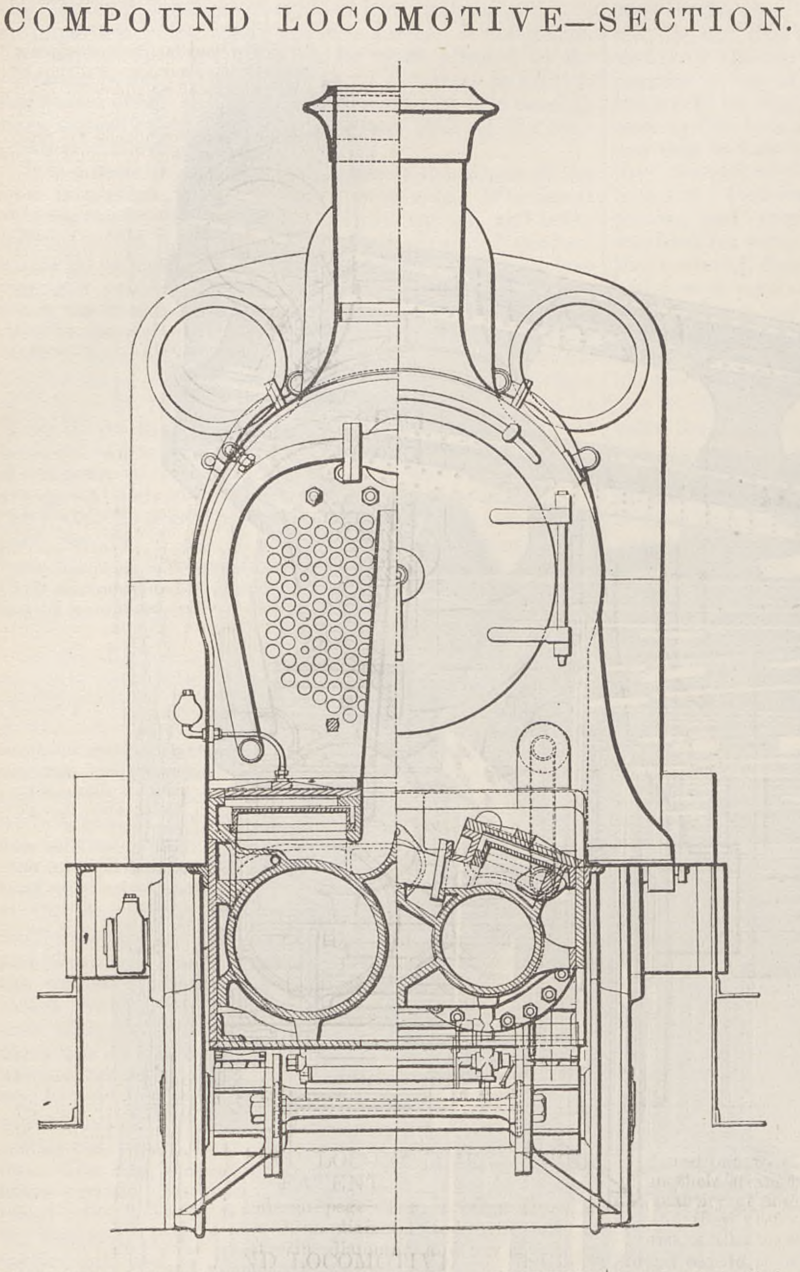


THE BUENOS AYRES AND ENSENADA PORT RAILWAY—BRIDGE OVER THE RIACHUELO.

MR. EDWARD WOODS, PRES. INST. C.E., ENGINEER.

(*For description see page 331.*)

COMPOUND LOCOMOTIVE—SECTION.



TANDEM COMPOUND LOCOMOTIVE — NISBET'S PATENT.

This engine, illustrated on page 324, was originally built in 1872, and had cylinders 17in. diameter and 24in. stroke, the driving wheels being 6ft. 7in. diameter, and having a bogie in front as shown.

In the arrangement illustrated the high-pressure cylinders are 13in. diameter, that of the low-pressure being 20in., the stroke remaining at 24in. The valve gear employed is Joy's, arranged in such a way that the high-pressure valves can be worked expansively, independent of the low-pressure valves, and *vice versa*, an arrangement which has shown decided advantages in practice. The steam passes directly from the exhaust of the high-pressure cylinder into the casing of the low-pressure cylinder, there being no intermediate receiver. The engine works with great freedom, and has shown excellent results in speed and power, as well as a marked decrease on its original consumption of fuel. This engine is at present working the passenger trains on the North British Railway between Edinburgh and Glasgow.

LETTERS TO THE EDITOR.

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

OUR NAVAL STRENGTH.

Sir,—I beg to call serious attention to the fact that a merchant vessel cut down the Northampton to the water's edge, and I am informed that nothing but the armour prevented the rent going deeper and endangering her safety. I believe her to have been rendered quite unseaworthy and unserviceable. Even worse will be the case with the twenty-two other modern ironclads when so rammed at their unarmoured ends. They would be sunk like the Oregon by a schooner. This seems to me an awful state of things, needing the strictest inquiry and experiment.

The failure of the Imperieuse, and consequently Warspite, as cruisers, causes me to call attention to what follows, for it is surely a matter of the utmost consequence that we should possess the very fastest and best war cruisers, which we cannot possibly obtain from the mercantile navy or even transports, for they could not be spared without ruin to our food supply, commerce, colonial and foreign communications, &c., during war with France. The *Times*, March 19th, 1881, reports the speech of the Secretary of the Admiralty, vaunting the anticipated perfections of the above-named ships.

I wrote to the press hoping to check such great blunders, feeling certain that a length of 315ft. and coal capacity of 900 tons could not give the necessary speed and fuel for an efficient war steam cruiser. A speed of 17 knots with 400 tons of coal at her normal draught would be almost useless, and it was false economy and prejudice against length to propose such cruisers to contend against vessels with speed up to an average of 19.5 knots to America.

The Imperieuse, though now 2ft. or 3ft. too deep, has only 900 tons of coals, to the French steamer Normandie's 1600 tons and 3000 tons of cargo with the same proposed speed, and thus a capacity for 4600 tons of coal. So with the Germans, &c. Speed and vast capacity for coals are the first and absolute necessity in a war cruiser. The Imperieuse in a head seaway must fail comparatively and punish her engines, even if her ridiculous rig is removed. I should at once try her with a Transatlantic steamer as far as she could get from Queenstown towards New York and prove her capabilities. I would also commence two vessels like the Umbria, one with double screw and engines, both divided from stem to stern by a bulkhead, &c., only lightly armed, and so prove whether the twin or single screw gives the greatest and most enduring speed. The former is undoubtedly the safest for the crew. These vessels would be otherwise useful and economical, like the Himalaya.

Foreigners have bought the Transatlantic steamers named below from Englishmen:—Elbe, Ems, Fulda, Werra, by Germany, Hammonia by Hamburg, Normandie by France, Stirling Castle by Italy. Thus the chief European maritime Powers have bought from us models, after which to build scourges for our trade, and the French have already built four like the Gascogne—to make the trip between Havre and New York in less than eight days, at an average speed of 17½ knots an hour—which, with the Normandie, makes five ready to injure our trade. I believe them to have many more. So far I have named thirteen Transatlantic steamers without Russia, America, &c. We have several very fast mercantile Transatlantic steamers—not very many more than the above—of great speed and coal capacity, but of no possible use to our Navy in a war with France, because the mercantile sailing fleet—more than half the whole—must remain in port or be destroyed; thus more steamers would be imperative to fulfil their duties, and so employ the private yards to build them—see "Mercantile Navy List."

As I fear that Parliament would not grant the means without proof of the necessity for fast war cruisers, I would entreat to have the whole matter inquired into. If in spite of Lord Brassey's statement it was proved that in a war with France the mercantile steamers could not be lent to the Navy, there would surely be no lack of funds to remedy such an awful want.

The effect of war upon our food supply is made clear by the following extract from "The Dawn of the Nineteenth Century in England," by John Ashton:—"In 1800 the average prices of corn and bread throughout the country were—wheat, per quarter, 113s.; barley, 60s.; oats, 41s.; quartern loaf, 1s. 9d.; and looking at the difference in the value of money then and now, we must add at least 50 per cent., which would make the average price of the quartern loaf 2s. 7½d.; and it became dearer, with bread riots, &c. &c." This with a population of only 16,000,000, which is now 35,000,000 and the quartern loaf 5½d., what could we do during a French war?

It is a matter for congratulation the getting power for the Admiralty to purchase its own guns—like the French Navy. But we need to go as far as they do, viz., manufacture their ships' guns at no extravagant rate—see their Navy Estimates—Exercise 1887, p. 1042—francs 17,738,746, or £700,550, and their guns have been efficient since 1867, but I know not where to find one on our side.

Torquay, October 14th. Thos. Symonds, Adml. of the Fleet.

WATER SOFTENING.

Sir,—I am again tempted to address you to supply an omission in my last letter with regard to the Clark process. This process is very extensively used, and its application will increase every day, as many engineers have found out to their cost the disadvantage of using alkaline water in their steam boilers. They are also of opinion that a small quantity of lime in the water acts on the plates as a preservative, and they prefer to soften the water by lime only, than run the risk of alkaline water.

I have one of my machines working at the waterworks here, softening by the Clark process all the water used for the steam boilers, and after four months' work I allow the chief engineer to speak for himself:—

Administration Communale de Bruxelles. Bruxelles, 14 Octobre, 1886.

Monsieur Howatson, 46, Boulevard Anspach, Bruxelles.

Je réponds à votre lettre de ce jour.

Votre adoucisseur, exclusivement employé à la chaux, réduit le titre de l'eau de 29° à 7°; les dépôts dans nos chaudières ont diminué dans le rapport de 1 à 4½.

Salut empressé.

(Signé) Th. Verstraeten, Ingénieur, Chef du service des eaux de Bruxelles.

Mr. Maignen condemns the Clark process. Can he produce a testimonial certified to by an engineer of the capacity of Mr. Verstraeten in favour of his anti-calcaire? Andrew Howatson.

Brussels, October 16th.

LOCK NUTS.

Sir,—Most engineers will have observed that "Lead Pencil" is not alone in being in doubt about the correct way to apply lock nuts. I think I am quite safe in saying that 50 per cent. of the lock nuts put on are put on with the thin nuts furthest from the work. That being the case, I think "Lead Pencil's" question should be answered more fully than either of your correspondents in your last issue have done; with your permission I shall try and throw some light upon the matter. In doing so I would point out that it is only in special circumstances that lock nuts are required. In all cases where the nuts are screwed down solid, as in making joints with cylinder covers, &c., or in the case of rods that are let together metal to metal, the nuts jam themselves, sufficient friction being created between the nut, screw, and cover to prevent it moving, although the strains vary greatly in intensity. Where lock nuts are necessary is in the case of glands, bearings, &c., that are adjusted to a certain point or to give a certain amount of pressure. In these circumstances it is requisite to secure the nut in a certain position, to resist, without moving, what really amounts to a succession of blows. To obtain a constant and sufficient amount of friction between the nut and screw to do so a second nut is provided; this second, or lock nut, it is necessary to screw down to the position required, then follow it with the first or principal nut, holding the lock nut in its position; screw the principal nut against it with sufficient force to develope the friction between the nuts and screw necessary to hold it secure from moving. To demonstrate the true position of the lock nut further, let a bolt be taken, upon which place two nuts. To lock them upon the screw it is necessary to screw them against each other, which done, it will be observed that the nuts are thrust against the opposite sides of the thread of the screw, and of course the nuts are clear of the screw on the side of the thread furthest from the point where the two nuts meet, consequently a load or strain put upon one of the nuts cannot be transmitted to the bolt by that nut, as it is not bearing upon the side of the thread of the screw necessary to take the thrust; in consequence, the nut upon which the load is placed transmits the strain to the one bearing upon the side of the thread facing the load, which is the one furthest from it. That being the case, the nut through which the load is transmitted can afford to be reduced in thickness, as the only work it has to do is to develope the friction necessary, while the nut furthest from the work has to carry all the load and half the strain developed in producing the friction necessary to lock the nuts upon the screw. If "Lead Pencil" will make a drawing of a screw with two nuts in section upon it, the nuts being, say, $\frac{1}{32}$in. easy, and draw them in the position they will take when jammed against each other, he will see at once that his chief has thought the matter out; but I am not at one with your correspondent who lectures "Lead Pencil" for questioning the orders of his chief. I think it is far better that men, whether draughtsmen or mechanics, should be encouraged to inquire into and understand the how, why, and wherefore of the work they are engaged upon, especially in details. How otherwise can we expect the rising generation of engineers to know their business thoroughly and be able to hold their own? W. W.

Hull, Oct. 13th.

Sir,—It is a pity that your correspondent, "J. T. W.," should use the *suppressio veri* even in a conversational form. "J. T. W.'s" then chief is not the man to leave a matter between himself and a junior draughtsman unsettled. If "J. T. W." was told nine years ago how to do a thing right it is time he gave up doing it wrong. He should remember the advice given last week by a correspondent, viz., that it is the duty of a junior draughtsman to obey, and not argue with his chief. I do not seek to convince him of his error, because, according to his own showing, that would be next to impossible; but perhaps such authorities as Unwin, Seaton, Sennet, Reed, &c., may not show him that he is wrong, but that other people are right. K.

October 15th.

Sir,—I am glad to see the question of lock nuts discussed, because both opinion and practice appear to be very undecided as to the relative positions of the thick and the thin nut; and as both arrangements seem to give satisfaction, it is perhaps a matter of little importance. I have never been able to get a satisfactory explanation of the action of the common lock nut, nor a good reason why one arrangement should be preferred; but after reading the letters in your last issue, I rather come to the conclusion that "J. T. W." and "A. E. C." are correct in saying that the thick nut should be on the outside; because, when effectually screwed up, all the strain is transferred to it. It is not, however, correct to say that the inner nut is merely a distance piece or washer. It is something more. By being subjected to the full pressure of the outer nut, it is compressed and has the pitch of its thread reduced, while the screw passing through it is stretched and has its pitch increased by the same amount. The nut thus being of a different pitch from the screw becomes a jam nut or lock nut. H.

Glasgow, October 15th.

Sir,—All the correspondents on this interesting and important subject seemed to have missed the point by omitting the most important factor in the case. Engineers, though not as a rule logicians, have to use logic perhaps more than any other class of men, and it is of the utmost importance to bring under review all the facts of the case. Now, what seems to have been omitted in this question is the tension in the length of the bolt. In last week's issue "Valve Spindle" has pointed out the distinction in the functions of lock nuts for slide valve rods from those for excentric straps. In such cases as lock nuts for slide valve rods, where a slight end play is necessary, the advantageous position for strength is to have the thick nut outside, as this nut has not only to overcome the friction of moving the valve, but has also the strain caused by jamming the thin inside nut on the opposite face of the thread. Let us look, however, at such cases as lock nuts for an excentric strap. The first nut is tightened, say, hard up. This produces a tension in the whole length of the bolt, except the part outside the nut and over which the next nut is to pass, and to obtain the greatest tension possible a thick nut must be used. On screwing up the lock nut, however, this tension is not interfered with, but merely a tension put on the short part of the bolt occupied by the lock nut itself, which tension, it will be seen, prevents the main inside nut from turning, and also lends assistance to withstand stripping, as the pressure is on the same side of the screw thread inside both nuts. It will thus be seen that for this purpose a thin nut is sufficient outside for locking, so that for bolts locked up in tension the thick nut should be inside, and for bolts locked up not in tension the thick nut should be outside, if strength alone is considered.

Perhaps some of our principals having the requisite tools will be good enough to make some experiments on this matter, and give, through your columns, the tensions obtained in the various cases. George M. Lees.

30, Howe-street, Edinburgh, October 16th.

MINE-VENTILATING FANS.

Sir,—I observe a correspondent, who calls himself "Grison," asks for information on this subject. I have been lately in the same predicament, and will tell him what explanations I got; but first, why does he call himself this queer name? In my French dictionary it says Grison means "an ass." Now, the next word, Grisou says "fire-damp;" so as I think he has got hold of the wrong word, to save any mistakes, if I have occasion to use his name, I will call him "Fire-damp."

Well, then, let us return to our mutton. As I said, I have sought information where it was to be found—not in books, oh no; as I think Shakespeare says, "Books are the companions of fools;" but I made inquiries, as my friend "Fire-damp" is now doing, and I was told that

$$h = \frac{V^2}{g}$$

is a formula only suited to fans covered up, and supplied with an expanding chimney like a trumpet, and was told that by this means the atmosphere was prevented going into the blades again, and baffling the centrifugal action, and the trumpet chimney saved the waste of the *vis viva* of the air, since it delivered the air into the atmosphere at a slow speed. But then, Sir, I argued what was the use of getting up a high speed on the fan blades, if you let it down again in a chimney, like the King of France who went up the hill with twenty thousand men, and when he'd marched them up to the top he marched them down again. And, then, Sir, fancy covering up a fan! Why the first law of nature is to let the wind away as fast as possible.

$$h = \frac{V^2}{2g}$$

is all we must expect from an open fan, and my friend did say he got all his information from a book issued by Spon, of 125, Strand, and called "Theories of Centrifugal Ventilating Machines." So as "Fire-damp" says he is in a dilemma, he had better get that book; and I was told he would there see the "equivalent orifice" explained fully; but as I learned, the formula he quotes is merely the *vena contracta* put in simple language for coal miners, who always talk of air in cubic feet, and vacuums in inches of water. That, Sir, is the origin of it, and it supposes a mine is compared to an orifice in a thin sheet, and some have big orifices and some have small; and if a man has a pit with a small orifice—well he's a "grison," and should make it large, or he will get no wind through it; and do, Sir, please excuse any mistakes of

October 16th. A Practical Man.

MASONRY ARCHES.

Sir,—Though I recognise the force of "A. S. H.'s" objection that a masonry is not of the same nature as a metal arch, yet it appears to me that until fracture occurs it is incapable of changing its direction at crown or abutments, and should rather be treated as fixed than as hinged at those points. F. E. R.

October 20th.

THE GREAT EASTERN STEAMSHIP.

Sir,—In your account of the voyage of the Great Eastern from Liverpool you incidentally say that the béton blocks with which Mr. Stoney built the wall of the Alexandra basin are 30 tons weight. This is incorrect, as they weighed 350 tons. In this tight little island men would not be found dead using mere 30-ton blocks. Even thus and in like manner do we work here.

Dublin, October 19th. J. M. G.

(*For continuation of Letters see page 334.*)

RAILWAY MATTERS.

A NEW railway has been inaugurated to connect St. Paul de Loanda, West Africa, and Ambaca, and it is said works have already been commenced.

THE Queensland Minister of Works has declined to accept any local tender for the supply of 1800 railway lamps. The reason given is that the tender is from 29 to 85 per cent. above the cost of the imported article.

THE Littlehampton Local Board of Health have approved plans for laying through the town a line of tramway to be worked by electricity, and the construction of an iron pier from the esplanade across the sands, so that visitors will thus be enabled to travel from the railway station direct to the pier head, and steamboats and yachts will have access at nearly all times of the tide.

MR. HENRY BOIS, the chairman of the Colombo Chamber of Commerce, at the recent half-yearly meeting, in speaking of railway extension, said the Chamber was not prepared to do anything which would tend to reopen the question of gauge. He thought it would be generally conceded, now that the railway was opened to Nanuoya, it would be highly inconvenient and undesirable to break the gauge at that point.

THE Brussels correspondent of the *Times* says:—"The statutes of the Congo Railway Company are being elaborated, and the company will be constituted in a few days. The enterprise is greeted with much sympathy in Belgium, and the concurrence of the principal financial and industrial establishments of the country is assured to it. The company will be of an international character, and consequently foreign capital will be allowed to participate in the venture." Kind.

A SUCCESSFUL and interesting narrow-gauge railway has been constructed by W. G. Bagnall, Castle Engine Works, Stafford, at Spezia, to ascend the Monte Cappuccini. The distance from the quay to the summit is about three kilometres. The railway winds to the top with a succession of heavy gradients, several being 7·1 per cent., and sharp curves from 34ft. radius upwards. The gauge is 80 cm. (31½in.). The engines, which have 10in. cylinders, make twenty journeys a day, and take six wagons containing 2½ tons of stone each. Mr. Bagnall says the idea was ridiculed by the engineers there, but the saving had proved to be fully 60 per cent.

THE report of the New South Wales Railway Commissioner for 1885 shows that the gross earnings were £2,174,368; working expenses, £1,458,143; net earnings, £716,215. For 1884 the figures were:—Gross earnings, £2,086,237; working expenses, £1,301,259; net earnings, £784,978. The net return for the year represents 3·37 per cent. on all the capital invested; £21,839,378 has been expended on lines which are open for traffic, and £3,123,594 on lines in course of construction; £2,909,715 was expended in 1885. The year opened with 1618 miles of railway, and closed with 1732. The Sydney and suburban tramways have returned 2·17 per cent. on the capital compared with 0·76 per cent. in 1884.

AN extraordinary accident happened on the Great Northern Railway, near Westgate station, Wakefield, on Monday. Through a mistake, it is said, of the signalman, the points were "struck," and an engine and tender, which fortunately had been uncoupled, went off the line, and rolled down the embankment near the foot of the prison. The engine sank into the ground, which had been rendered soft by the recent heavy rains, and the two men on it had a narrow escape. The tender turned a complete somersault, and alighted in a garden under-part upwards. The engine and tender were damaged, but the permanent way was undisturbed and traffic uninterrupted.

AT the recent meeting of the Central Uruguay Railway Company of Monte Video, W. Drabble in the chair, the directors' report stated that the profit for the year ended June 30th was £77,110. The decrease in the gross receipts of the line for the year was £26,060, or equal to 13·47 per cent., and the decrease in the net profit was £22,727, or 22·77 per cent., and the directors were compelled to recommend a dividend of only 5 per cent. for the year, as against 6 per cent. for the previous year. As to the Rio Negro Extension, the directors had had some disappointment, as they had not been able to complete their bridge, and did not expect to be able to do so till the end of the year, on account of the floods that had come down and interfered with their works. It was the largest and most important work ever undertaken in the River Plate.

THE *Railroad Gazette* record of American train accidents in August contains accounts of 52 collisions, 49 derailments, and 14 other accidents; a total of 115 accidents, in which 31 persons were killed and 117 injured. As compared with August, 1885, there was an increase of 23 accidents, but a decrease of 6 in the number of persons killed, and 55 in the number injured. These accidents may be classed as to their nature and cause as follows:—Collisions: Rear, 33; butting, 13; crossing, 6; total, 52. Derailments: Broken rail, 3; broken frog, 1; broken switch-rod, 1; broken bridge, 2; spreading of rails, 4; broken wheel, 5; broken axle, 5; broken truck, 1; accidental obstruction, 4; cattle on track, 3; land slide, 1; wash out, 3; earthquake, 3; misplaced switch, 3; rail removed for repairs, 1; malicious obstruction, 1; purposely misplaced switch, 3; unexplained, 5; total, 49. Other accidents: Boiler explosions, 4; flue collapsed, 2; broken parallel rod, 4; broken coupling, 1; runaway train, 1; bridge beam falling on track, 1; car burned while running, 1; total, 14. Total number of accidents, 115.

A GENERAL classification of the accidents on American lines last August is made as follows by the *Railroad Gazette*:—

	Collisions.	Derailments.	Other.	Total.
Defects of road	—	11	—	11
Defects of equipment	9	11	12	32
Negligence in operating	42	4	—	46
Unforeseen obstructions	1	14	2	17
Maliciously caused	—	4	—	4
Unexplained	—	5	—	5
Total	52	49	14	115

A division according to classes of trains and accidents is as follows:—

	Collisions.	Derailments.	Other.	Total.
To passenger trains	8	18	7	33
To a pass. and a freight.	14	—	—	14
To freight trains	30	31	7	68
Total	52	49	14	115

This shows accidents to a total of 167 trains, of which 55—32·9 per cent.—were passenger trains, and 112—67·1 per cent.—were freight trains.

THE quantity of coal sent from South Yorkshire and Derbyshire to London during September was 602,607 tons, as compared with 535,167 tons for August, and 564,755 tons for July. Of the September tonnage the Midland Company carried 190,399 tons; London and North-Western, 144,012 tons; Great Northern, 126,592 tons; Great Western, 66,389 tons; Great Eastern, 67,052 tons; other lines, 8163 tons. Fourteen collieries in Derbyshire sent 158,000 tons of coal to London, or more than one-fourth of all that entered by railway within the area of the City dues. Clay Cross contributed 25,600 tons of that total, the other leading Derbyshire collieries being Blackwell, 17,400 tons; Langley Mill, 15,600 tons; Eckington, 13,000 tons; Grassmoor, 12,700 tons; Birley, 12,700 tons; Staveley and Pilsley, 10,200 tons each. Messrs. Newton, Chambers, and Co., Thorncliffe, are again at the head, their tonnage from their South Yorkshire pits being nearly 37,000, about the heaviest tonnage ever forwarded by one firm or company in any month. Other South Yorkshire collieries calculated from 2500 to 4700 tons each. During the past nine months the quantity sent over the various lines to London was 5,248,773 tons, against 5,076,498 tons for the corresponding period of 1885.

NOTES AND MEMORANDA.

THE deaths registered in twenty-eight great towns of England and Wales for the week ending Saturday, October 9th, corresponded to an annual rate of 19·3 per 1000 of their population, which is estimated at 9,093,817 persons in the middle of this year.

SOME experiments lately brought before the Paris Academy by M. Luvini, combine with those of other observers—he considers—in warranting the conclusion that "gases and vapours, under any pressure, and at all temperatures, are perfect insulators, and cannot be electrified through friction, either with one another, or with solid or liquid substances."

IT is stated in a French paper that Professor Place, of the Cavalry School of Saumur, has recently applied electricity with great success to horses which prove refractory while being shod. A vicious beast will often give much trouble in shoeing. M. Place's method renders it at once traceable, and permanently cures its aversion to the forge. An electric shock is given through a bridle of special form.

AT a recent meeting of the Paris Academy of Sciences a paper was read on "A Kinematic Analysis of the Locomotion of a Horse," by M. Marey, who described and illustrated the movement of the fore-leg in the step, trot, and gallop. The tendency to economy of labour displayed in various degrees in the movements of all "animal machines" appears to attain the greatest perfection in the action of the horse, being, however, less evident in the trot and the gallop than in the slow pace.

ACCORDING to intelligence received at Hamburg, advices from the waters of Spitzbergen now confirm the former news from Iceland and from the mouth of the Pechora, on the Siberian coast, to the effect that the ice in the Arctic Sea has this year extended unusually far southwards. Spitzbergen, the sealers report, was found to be surrounded with an ice belt five to eight miles broad, and there was firm pack ice from Hope Island to Forland, about fifty-six miles. The great bays on the Storfjord, Hornsund, Bellsund, and Isfjord were quite inaccessible, and the sealers, after waiting all the spring and most of the summer, returned at the end of August, as there was no prospect of the Polar ice dividing.

A PAPER on comparative study of the actions of walking and running, together with the mechanism of the transition between these two movements, was recently read before the Paris Academy of Sciences, by MM. Marey and Demeny. In this paper, which complements the author's previous communications on animal kinematics, numerous differences are shown to exist between slow and rapid pace, the latter being characterised by moments of complete detachment from the ground and by other equally important features scarcely visible to the naked eye, but which are now clearly revealed by the chronophotographic and dynamographic processes. The paper was furnished with six diagrams illustrating the contrasts between both motions and the transitions from one to the other.

AT the recent meeting of the American Association, Dr. Thurston read a paper "On the Friction of the Non-condensing Engine." The friction of an engine has been supposed by De Pambour, Rankine, and others, to consist of a constant and a variable part, the resistance of the engine unloaded, the other the increase produced by the fact of its doing work. The last quantity is taken, by De Pambour, as ordinarily about 14 per cent. of the total resistance due the load. As the result of some experiments, a paper quoting Dr. Thurston says: "It is found that the friction of the high-speed non-condensing engine, such as is used in electric lighting, is, under standard conditions, practically constant at all loads, but is variable both with speed of engine and with steam pressure." Can the friction of an engine vary with increase of pressure without varying with increase of load?

GERMANIUM, the new element discovered by Dr. Clemens Winkler, has a melting point apparently somewhat lower than that of silver—that is, about 900 deg.—and at a temperature little higher than this it appears to volatilise. It crystallises in octahedra, is extremely brittle, has a perfect metallic lustre, and a grayish-white colour; its specific gravity is 5·469 at 20·4 deg. It is insoluble in hydrochloric acid, is readily dissolved by aqua regia, is converted into a white oxide by nitric acid, and into a soluble sulphate by concentrated sulphuric acid. Determinations of the atomic weight of germanium were made by estimating the percentage of chlorine in the chloride, $GeCl_4$, and the number 72·32 was obtained as the mean of four experiments, this number agreeing closely with the atomic weight of Mendelejeff's ekasilicium. The specific heat of the new element has been determined by Nilson and Pettersson, at temperatures between 100 deg. and 440 deg., with the following results:—

	1	2	3	4
Specific heat	0·0737	0·0772	0·0768	0·0757
Atomic heat	5·33	5·58	5·55	5·47

THE following, from an Italian source, is an interesting classification of the great ironclad warships of England, France, and Italy, as to their speed:—The fastest is the Italia, with a sea speed of 18 miles, while the Lepanto, Umberto, Sicilia, Sardegna, also Italian vessels, are credited with 17½ miles an hour. The Imperieuse, French, and Ruggioro de Lauria, Morosini, and Andrea Doria, Italian, are 17 mile ships. The Nile, Trafalgar, Renown, Sanspariel, Anson, Camperdown, Benbow, Rodney, Howe, Collingwood, Colossus, and Edinburgh, English, are 16 mile vessels. It should be remembered, however, that the Nile and Trafalgar are yet far from completion, and that one or two of the others have, as yet, had nothing more than a dock trial. The Duilio and Dandolo, Italian, are severally 15½ and 15¼ mile vessels; the Devastation, French, 15½ mile, and the Alexandra, English, 15 mile; the Foudroyant, Admiral Baudin, Formidable, Neptune, Hoche, Marceaux, and Magenta, French, having the latter speed. The Hercules, Dreadnought, Inflexible, Neptune, and Sultan, English; the Vauban, Amiral Duperre, Indomtable, Redoubtable, Temeraire, Terrible, Caiman, Requin, French, and the Affondatore, Italian, are below the 15 mile standard.

THE United States geological survey has learned from Mr. C. W. Cross, engaged in field work at Denver, Col., the particulars of a remarkable land-slide near Cimarron, Gunnison county, which was described in the local papers as an earthquake. *Science* says he found the locality about nine miles south of that town, on the east side of the west fork of the Cimarron river. Between the two forks of the Cimarron is a mesa capped by eruptive rock, the valleys on either side being eroded out of cretaceous rocks, apparently the clays of the Colorado group. The area involved extends from the base of the cliffs of eruptive rock forming the top of the mesa, down the slopes towards the valley bottom, nearly to the edge of the belt of timber. A great crumpling of the surface had taken place—throwing down forests in inextricable confusion, pushing the ground up into ridges, and leaving fissure-like depressions, the land slide involving an area of nearly two square miles. It was evident that the surface of the ground had become loosened from the underlying clay beds, probably in consequence of the sepage of water, and that a movement of the area, starting at its upper end, had been thereby instituted in the direction of the mesa. The lower portion having moved less, or not at all, the ground there had been most thoroughly ridged, fissured, compressed, and overlapped, in such a manner that trees had been overthrown, little ponds drained, and new ones formed, and the courses of small streams changed. Ranchmen living near by had perceived no tremor or other evidence of earthquake disturbance, nor could they tell when the movement took place; but they agreed in saying that the rainfall had been unusually heavy. Evidences were found of similar land-slides of earlier date, at various places along the valley, and it seems clear that such slides must have played an important part in shaping out the valley depression.

MISCELLANEA.

THE death is announced of the inventor of the stone-breaker, Mr. Eli W. Blake, aged 92.

A PERMANENT exhibition of patented inventions, improvements, and new productions will be opened at Toulouse on the 1st November under the patronage of the local Chamber of Commerce.

THE Boston Dock and Harbour Board have just placed an order with Messrs. Rose, Downs, and Thompson, of the Old Foundry, for one of the largest grain warehousing appliances in England. The machinery, which is constructed to treat 100 tons of the most bulky grain—oats—per hour, is perfectly automatic. The grain is conveyed to the warehouse from the quay side, weighed, elevated, and distributed in any floor without hand labour. The grain can be turned or discharged by the same machinery, which has many novel features, in part the suggestions of Mr. Wheeler, C.E., the engineer to the Commissioners. Among other East Coast warehouses fitted by Messrs. Rose, Downs, and Thompson are those of the King's Lynn Dock Company, who have placed three successive orders with the firm.

AT a gross cost of about £14,000 Cheltenham has been provided with new waterworks. The water supply is gathered from an area of two square miles, and will, it is believed, afford a supply of nearly a million gallons a-day. The reservoir, which covers an area of about twenty acres, has a maximum depth of 32ft., and a total capacity of 100,000,000 gallons. There are five filters, having a total area of 12,500ft., and are capable of filtering 900,000 gallons a-day. The filtering material is sand, which is washed by nine ingeniously-contrived machines, worked by a turbine moved by the surplus head of water from the reservoir. The machines were designed by the borough engineer, Mr. W. M'Landsborough, C.E. From the filters the water runs into five covered tanks of sufficient capacity to store up the water at a regular rate both day and night. The works were executed by Messrs. W. Hill and Co., of Westminster.

THE Willesden Paper Company has received four gold medals and honourable mention at the Liverpool International Exhibition. Messrs. Merryweather and Sons, of London, have also received an award of a gold medal in respect of their two celebrated types of steam fire engines, viz., their direct-acting twist bar engine as used in Liverpool, and the "Greenwich" as used in Manchester. Mr. A. G. Mumford, Culver-street Ironworks, Colchester, has likewise been awarded a silver medal for steam pumps and yacht engines. Mr. A. G. Mumford exhibited ten different sizes and patterns of his speciality "Favorite" donkey pumps, and two sizes single and double-acting "Colchester" pumping engines, also some very highly finished yacht and launch engines—single and double cylinders—high pressure and compound. The following are the jury awards to the Clyde shipbuilders for naval models at the above Exhibition:—Messrs. J. and G. Thompson, Clydebank, gold medal; Messrs. D. and W. Henderson and Co., Partick, silver medal; Messrs. Wm. Simons and Co., Renfrew, bronze medal; and Messrs. Russell and Co., Port Glasgow, honourable mention.

H.M.S. LAWRENCE, designed by Sir Edward Reed for the Indian Government, and built by Messrs. Laird Bros., of Birkenhead, was officially tried on the 12th inst. at the measured mile off the Mersey. The Lawrence is a paddle-wheel vessel, 208ft. long, 32ft. beam, and built of steel, so as to have a very light draught. She will be armed with light guns, which, combined with her considerable speed and light draught, gives her valuable fighting power on river service. She has two handsomely fitted saloons for the accommodation of Government officials and the ship's officers, and in addition has right aft a beautifully fitted drawing-room saloon for the accommodation of the Viceroy, for whose personal accommodation the vessel will be occasionally used. Electric light, special ventilation, complete outfit of spare parts, and all modern improvements have been fitted by the builders. The machinery consists of two high-pressure boilers, also of steel, and working at 80 lb. pressure, and a pair of highly-finished oscillating compound engines. The trial trip was made in the presence of a distinguished company, and was very successful, the vessel attaining a speed of 13¾ knots, and indicating considerably beyond her contract horse-power, without a single drop of water on any of the bearings. The Indian Government was represented by Sir Edward Reed, and the machinery was supervised by Mr. J. F. Flannery, who, in conjunction with Mr. Hudson, has assisted Sir Edward Reed during the construction of the vessel.

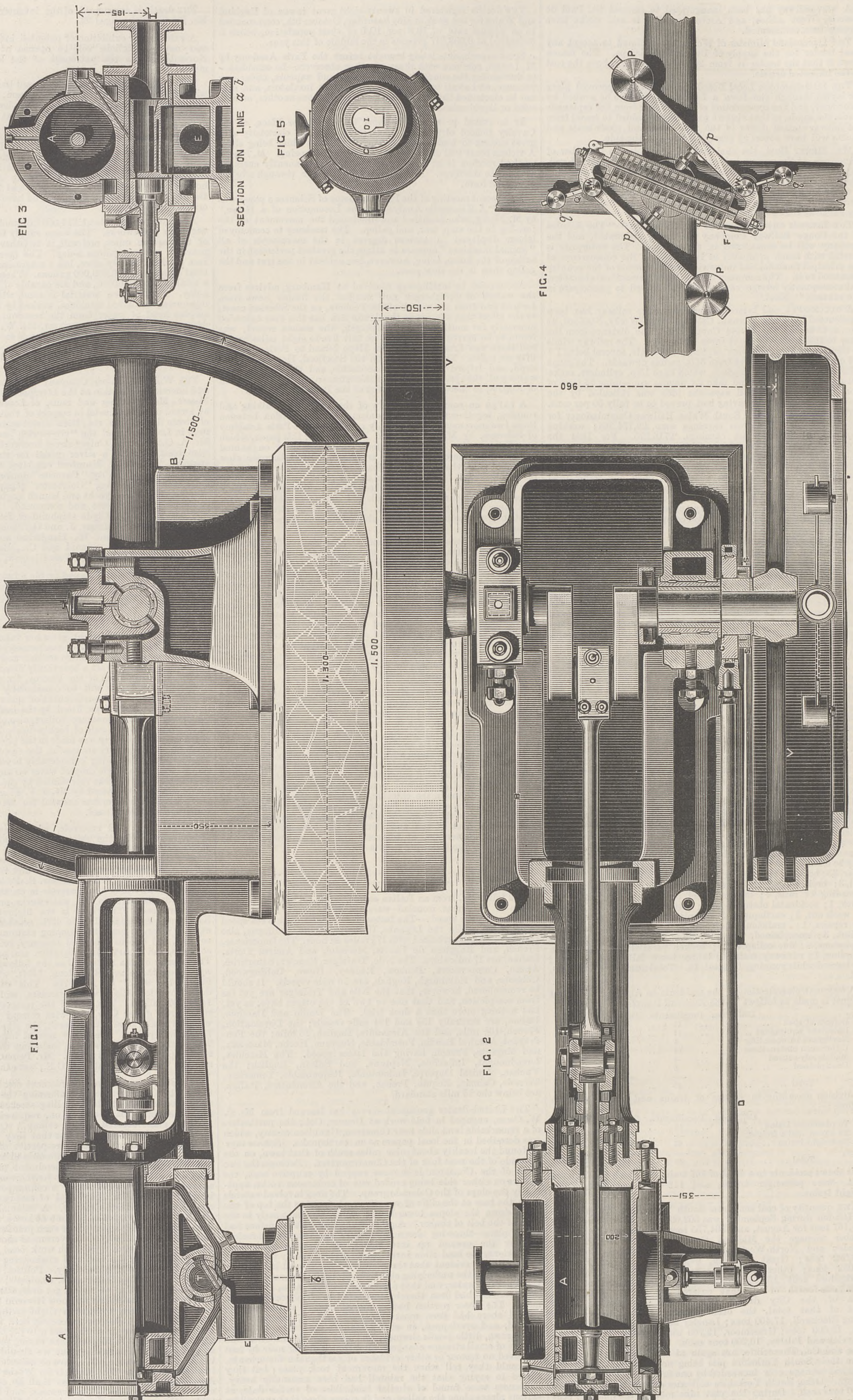
A NEW high level reservoir, which has been constructed at Kidderminster with the object of improving the water supply of that borough, was opened on the 27th ult., when the ceremony of turning the water into the mains was performed by Councillor Potter, the chairman of the Drainage and Waterworks Committee. It has been constructed under Mr. E. Pritchard, C.E., of Westminster. The site of the reservoir is on the Bewdley-road, some 1100 yards distant from the waterworks pumping station on the Stourport-road. This land is the highest available site near Kidderminster, and will give 43ft. greater head than from the existing reservoir near the pumping station. The new reservoir is covered, and is constructed of masonry, brickwork in cement and concrete, and is partly in excavation and partly in embankment. The interior of the reservoir has the following dimensions—being square on the plan—145ft. long, 145ft. wide, with an available height for water of 14ft. 7in. This capacity, after making deductions for pillars and buttresses, will provide a storage of 1,850,000 gallons. The roof of the reservoir is constructed of a rolled iron girder floor, and with cement concrete arches, upon which is placed some 2ft. of earth, the whole being supported by 72 cast iron pillars. There are several inspection and air shafts. The total cost of the reservoir, including the purchase of land, is stated approximately at £5800. Mr. Peirce, Assoc. M. Inst. C.E., and Mr. Tarbet, Student Inst. C.E., were the resident engineers.

IN the New South Wales Parliament considerable discussion has taken place upon a motion "affirming that all constructive iron work used in bridge building, rolling stock, locomotives, shipbuilding, waterworks plant, and so on, required by the Government, shall be manufactured in the colony." Of course, the position taken up by the Government was that they could not be bound to accept tenders in the colony irrespective of the quality and the cost of the work, and the Protectionists ultimately had to be satisfied with the passing of an amendment providing that tenders should be called for in the colony for the works specified, as well as abroad. The correspondent of a contemporary writes:—"There is, after all, room for a good deal of manipulation with regard to contracts placed in the colony. A colonial firm might secure a contract, and buy most of the iron at home, and there are cases in the neighbouring colonies where such practices have been common. There is no reason why the Government should not for a time pay an extra 10 per cent. upon such work *bonâ fide* performed in the colony, if thereby the iron and engineering industries can be permanently stimulated into activity. Political economists in England would condemn this 10 per cent. wholesale, and there is force in their arguments that we should get everything as cheap as we can; but the colony has people just now it would be glad to employ on such manufactures, even at a slight outlay. The New South Wales Government has quite recently been finding work for men out of employ, and in such cases a 10 per cent. bonus on colonial made goods would fall lighter than paying them their wages. That is, perhaps, an extreme case; but we should like to see the iron industry here advance. We have abundance of iron ore and coal in close proximity. The Minister for Works has now promised a deputation that in future tenders shall be called in the colony for all iron work required by Government, and if they find they can rely on the quality of the articles, and the price is not unreasonably higher than imported articles, the contracts will be given out here."

QUICK SPEED HORIZONTAL ENGINE.

MR. PROELL, DRESDEN, ENGINEER.

(For description see page 331.)



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J. C. B.—*Thanks. We have no room at present for such a contribution.*

G. R.—*It is quite impossible to say what a new motive power would save without knowing what the motor is to effect.*

S. H. T.—*Coat the machinery with white lead and some non-drying oil. You need not take the lagging off the boiler if the engine-room is kept reasonably dry.*

G. A. B.—*The arrangement would present no advantages over that now in use, and the float angles are wrong. You have made no allowance for the advance of the ship. If the float leaving the water stands vertical, it will act as a drag, opposing the ship's progress.*

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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.*

DEATH.

On Oct. 17th, at his residence, Seaview, Litherland Park, near Liverpool, George Allibon. Deeply regretted.

THE ENGINEER.

OCTOBER 22, 1886.

THE MARINE ENGINE OF THE FUTURE.

On the 13th inst. the third annual meeting of the North-East Coast Institution of Engineers and Shipbuilders was held in Newcastle-on-Tyne. Mr. W. T. Doxford, the incoming president, delivered his inaugural address. It was short, pithy, and eminently practical; admirable in every respect, and admirably suited to perhaps the most practical Institution existing in the kingdom. Mr. Doxford dealt with the prospects of work presented at the present moment to marine engine builders. He showed first that there has been a remarkable increase in the dimensions of steam vessels built during the last few years. Dividing the years which have elapsed since 1856 into six periods, he deduced from statistics supplied by Lloyd's Register, that there are afloat 7889 steamers of 200 tons and over, representing a gross tonnage of 9,855,560 gross; and comparing the first and the last of the six periods just referred to, he finds that the tonnage of steamers of 200 to 500 tons has increased fourfold; 500 to 1000 tons, sevenfold; 1000 to 1500 tons, twenty-fivefold; 1500 to 2000 tons, forty-threefold; 2000 to 2500 tons, thirty-sevenfold; 2500 to 3000 tons, twenty-eightfold; 3000 to 4000 tons, thirty-sevenfold; showing the largest increase in steamers of from 1500 to 2000 tons. Taking, however, the two latter periods, it will be found that the larger developments are now taking place in vessels of 3000 tons and upwards.

"It will be seen," said Mr. Doxford, "that the average increase in size has been very steady, although rapid, with the exception of the years 1876-80, when it practically remained stationary, the advance having been from 735 tons in 1856-60—leaving out the Great Eastern—to 1437 tons in 1881-86. This is a wonderful development to have taken place in so short a space of time as thirty years, especially when we consider that the art of shipbuilding is not of recent origin. Who can say how many thousands of years elapsed between the setting afloat of the first small vessel, and the date when the average size had increased to 735 tons? And yet in but thirty years we have doubled that average. The next important, I might almost say startling, fact, which is brought to light is that nearly one-half of the tonnage now afloat has been built since 1880—that is, within the past five and a-half years—that 44 per cent. of the total tonnage has been built since 1880, and since 1870 the enormous number of 6173 steamers was built, with a total tonnage of 8,150,086 as against only 1716 steamers of 1,705,474 tons for the previous fifteen years."

Mr. Doxford next proceeded to consider the condition of these steamers, and arrived at the conclusion that a very large number is obsolete. It is in the remodelling of the machinery of these vessels that Mr. Doxford sees the prospect of work representing about £2,000,000 per year for the next ten years. The question is, Can this enormous outlay of £2,000,000 be made to pay? On this subject he has no doubt whatever. His estimate leaves a balance of £6,000,000 as the cost of adopting triple expansion engines, against which we have a saving in fuel of £2,000,000; also a saving in wages, as there would be 2,000,000 fewer tons of coal to handle, besides other expenses. "To illustrate this, take a boat with engines indicating, say, 1200-horse power, but whose boilers are worn out. To replace these boilers with new ones will cost, say, £2000, and when done you have gained nothing in economy. But take out the engines and boilers altogether, and put in triple expansion engines and boilers of, say, 160 lb. pressure, which can be done for about £7000—excluding shipwork in both cases—and take the consumption of the old engines at $2\frac{1}{2}$ lb. per horse-power with 250 steaming days in the year, which gives a total consumption of 8000 tons, we have a saving—taking it at 20 per cent.—of 1600 tons per annum, or £1600 against the extra cost of £5000, or 30 per cent."

It will be seen that Mr. Doxford's calculations are all based on a few prominent assumptions. They are that the triple expansion engine must take the place of ordinary compound engines. That a saving will be effected thereby of 20 per cent. in fuel, and that the cost of fuel is £1 per ton. We are not disposed to dispute the general accuracy of these assumptions, but we are disposed to qualify them. In the first place, it is by no means certain that the consumption of coal by the triple expansion engine must be 20 per cent. less than that of the compound engine of the ordinary type. There are compound engines and compound engines; and although it is quite certain that in many cases the triple expansion engine has proved to be 20 per cent. better than its predecessor, we know that in other cases the comparison has not been so favourable, the saving not exceeding 15 or 16 per cent., or even less. It would be a great mistake to assume that the consumption of fuel in compound engines is already the least possible in all cases. We can cite an instance within our own knowledge where a vessel of about 1500 tons cargo capacity was fitted with compound engines some years ago. Recently she was refitted. A new boiler was put in carrying 90 lb. against 70 lb. carried by the old boiler, a new high-pressure cylinder was put in of rather larger diameter than that which it replaced; a new propeller was put on with smaller pitch, and the general result was that the speed of the ship was increased nearly a knot per hour with the same consumption of coal; or at the old speed—about 11 knots—with a corresponding reduction in fuel. Taking the consumption as varying as the cubes of the speeds, we find that, omitting fractions, 13 tons went as far with the remodelled machinery as 17 tons had done with the old machinery; in other words, the saving amounted to nearly 25 per cent. We have no intention of disputing the argument, which will, doubtless, be urged that this was an abnormal case; but we have no doubt whatever that numbers of steamers are now running which are capable of large reductions in their coal bills without the aid of the triple expansion system. Again, we may cite the case of a steamer of considerable dimensions with which Messrs. Jones, of Liverpool, have been carrying out an extended series of experiments. This vessel has triple expansion engines so arranged that the high-pressure cylinder can be disconnected at pleasure, and the ship worked either compound or triple expansion at pleasure. The result of trials extending over months—voyages being made alternately with and without triple expansion—is that when the three cylinders are in use there is a small saving of coal per indicated horse-power, but that the cost of fuel per voyage, or per ton per mile, which is the crucial test after all, is a little less with two cylinders than with three. This, of course, may be regarded, perhaps, as exceptional; but whether it is or not, it goes to prove that the triple engine does not in all cases give the enormous saving which it is the custom just now to attribute to it. It is admitted on all hands that very high-pressures are essential to the success of the triple system. But is very well known that these pressures cause a great deal of trouble even when engines and boilers are quite new. The representative of one eminent firm stated not long since that he had found it expedient to reduce his boiler pressures from 150 lb. to 120 lb., and it is rumoured that the machinery of two large steamers built in this country for the Australian local trade has gone almost to pieces after a couple of years work. We call attention to these things, lest too much should be expected from the triple system. Mr. Doxford, it will be seen, contemplates a continual outlay for ten years on triple engines. It is too soon, we fancy, to anticipate anything of the kind. It may be found before five years have elapsed that engineers and shipowners have gone too fast, and that from the saving of money spent on fuel must be made considerable deductions for renewals and repairs, inseperable from the use of high pressures. If indeed a new boiler could be got, the circumstances would be more favourable to the triple system, for it is not so much the engines as the boilers that are likely to give trouble. Mr. Doxford, to do him justice, recognises the importance of the whole question, and says, "Now, if the owner has to find this extra capital, it is the duty of the engineer and the shipbuilder to see that the amount is laid out in the best possible way; and this brings me to an important point. Have we, as engineers, now produced in the triple expansion engine the best type of engine for the work to be performed? We are only at the commencement of the transition from the compound engine with boilers working at 70 to 80 lb. to the triple expansion engine with boilers working at 150 to 160 lb., and already there are signs of a further step forward to quadruple expansion, or rather expansion in four cylinders; but, until we are in a position to adopt much higher pressures than even 160 lb., there will be no economy in fuel gained by the four over three cylinders, and as we cannot go very much beyond that pressure with the present type of boiler, shipowners have nothing to fear on that score at present; and yet it may be advantageous, in many cases, to use four cylinders when altering the ordinary compound two-crank engines to work at the higher pressure."

Before shipowners launch out into a large expenditure on triple engines, we venture to suggest that it would be prudent to try what can be done with the machinery they have. It is well known that there is no difficulty in working ordinary compound engines with steam of as much as 110 lb.—that is, the pressure carried in such ships as the Etruria, for example, with one high-pressure and two low-pressure engines. There are large numbers of steamers now running which carry only 80 lb., some not more than 70 lb. To put new boilers into such a ship will cost, says Mr. Doxford, £2000. It is more than probable that in many cases the engines are quite strong enough to stand an increase in pressure from 80 lb. to 110 lb. If not, let a new high-pressure cylinder be put in smaller than that which it replaces and let the steam be used more expansively. The cost of the alteration need not exceed in all £3500, or say one-half the outlay contemplated by Mr. Doxford. It will readily be seen that a saving of 10 per cent. in fuel in this case would pay as large a return on the capital outlay as one of 20 per cent. if a triple expansion engine at double the price were used. Put into a nutshell, our argument is that the double cylinder compound engine has not yet been made to do all of which it is capable, and that it should be given the chance before we plunge into a very large outlay on the adoption of a new type of machinery concerning the durability of which no information exists, because no complete sets of triple engines and boilers have yet been a sufficient time at sea to permit sound conclusions to be drawn as to their probable durability.

ACCESSIBLE BOILERS.

We have more than once thought it necessary sharply to criticise Board of Trade rules and the action of Board of Trade officials concerning machinery or steam boilers coming within their jurisdiction; and we have felt it to be expedient to point out that the action of that department of Government within its existing limits was not so good as to encourage a desire to extend its field of operations. We must say, however, that certain of its regulations are excellent, and such as we would like to see brought to bear on a more extended scale. One of these rules is that no boiler over which the department has control will be passed by its engineers unless every part is accessible for periodical inspection. It is not an easy matter to secure this condition with some forms of small boiler, but with this qualification, we are disposed to think that a greater number than is either supposed or necessary of boilers is so imperfectly designed that internal examination of every part is out of the question. It would be well if some member of the House of Commons would move for a return of the proportions existing relatively between boilers subject to the supervision of the Board of Trade, boilers under Lloyd's or other leading insurance or assurance company, and working under no independent control whatever. The return might be made to include boilers having more or less imperfect means of access for thorough examination. A general, though not expressed idea seems to prevail amongst boiler users, if not indeed amongst boiler-makers, that if internal access is provided it is enough; but those who hold this view overlook the fact that corrosion and wasting may and do take place externally as well as internally. If any intelligent person were shown one side of a piece of iron plate and asked to pronounce an opinion as to the uniformity of its thickness all over, his reply would be that he must see the other side before giving that opinion. Yet in the matter of boiler inspection this, or something very like it, is repeatedly done. It is true that experience of what causes corrosion and wasting is a safe guide if discreetly relied on. For example, a boiler so carefully set as to have its external surfaces always dry and protected from wasting influences will not need frequent inspection, but a very litt'e moisture in more or less constant action will do a great deal of damage. Wherever it is possible boiler externals ought to be made readily accessible. Every boiler inspector knows that many boilers contain places that cannot be thoroughly and properly examined on the inner faces of the plates, and which cannot be proved save by drilling, the drilling also being only practicable from the outside. Many boilers, also, are so defectively designed as to be unnecessarily inaccessible inside; the designers of such boilers appearing to have given so much thought to two essential points in a boiler that they overlooked the third. They were so anxious to get in the greatest possible tube surface, as well as the greatest number of stays, as to leave no passage room whatever for a man. If such designers would bear in mind that, assuming a given boiler to require a certain air-way area of tubing, if tubes of one diameter prevent access for examination, a very trifling alteration in the diameter and number of the tubes may give ample room. For example, suppose a return-tube boiler to require a tube air-way of fifteen square feet; then 309 tubes, three inches inside diameter, would give it. But using this number might entail so much reduction of passage-way as to prevent proper access to certain places; then the simple way out of the difficulty is to use a smaller number of larger tubes—as, for example, 284 tubes 3⅛in. bore. Indeed, the mere omission of two or three tubes, in many cases while reducing the theoretically correct air-way, would have practically no bad effect at all equivalent to the advantage of freedom of access gained by their omission. In the matter of stays, again, they are at times so fitted as to indicate bad judgment on the part of the designer, being so made as to be irremovable when the boiler is finally in its place—for example, on board ship in places where there is room to draw a tube, but not to draw a stay if made in one piece. The stays of such boilers ought, and in well-designed boilers are, so arranged that they can either be taken out of the boiler or else displaced within it when required.

That boilers explode even when under the supervision of eminent insurance companies, is no argument whatever against the principle of independent supervision in itself. Indeed it is only necessary to read the reports of the engineers to the different companies as to detected defects about boilers examined by them, to perceive the excellence of the principle, and we cherish the hope that it will be found possible at no distant date to find a way of applying it universally without exciting jealousy or distrust, or in any way hampering or obstructing trade. There is, however, some room for improvement in the type of inspector employed. We refer now to men or boys who are sent by owners into boilers to examine and report. Very many such examiners are thoroughly respectable and competent for the work, but we suspect that there are some who are not so qualified. As we have more than once pointed out in these columns, it is desirable that every man attending on, or taking charge of, a boiler ought to hold a certificate obtained by passing an examination. The same truth applies to those employed to get into boilers to examine and report upon their internal condition. It is sometimes argued that where an exploded boiler is found to be greatly corroded, that fact does not necessarily prove that examination even a few months before would have prevented the catastrophe, it being contended that corrosion sometimes, and without apparent cause, will take place and seriously damage a certain patch in a particular plate. Granting, for discussion sake, that such a thing is quite possible, the admission of the possibility only furnishes an additional argument for the need of thorough and free facility for internal examination of every part of a boiler, and for the regular making of the same. Indeed, if this chemical question is to be recognised, it follows logically that each new boiler ought to be more frequently examined than one that had been using a given feed-water sufficiently long to make apparent any spot on the plates susceptible of being corroded by it.

In connection with this highly important point of boiler design and boiler safety—its internal accessibility—we may point out that the introduction of corrugated flues has been attended with so much success that it would be well if engineers turned their attention to the study of how far the principle could be further adapted to supersede staying. It is already in successful application to the crowns of portable engine fire-boxes. One of the still disputed points about the use of steel in boilers is its liability or otherwise to crack. Cracking of fire-box flat plates is attributed to unequal expansion and contraction strains. A corrugated plate may relieve or accommodate itself by buckling; this relief is virtually denied to fire-box or combustion plates. Why should simple flat plates continue in use? The system of flanging by hydraulic pressure now takes a prominent and valuable place in boiler construction; it needs but a little consideration to devise how best to press ribs or corrugations in fire-box or combustion chamber plates while leaving flat margins for rivetting. This has indeed been done for many years by Mr. Haswell, in Vienna, and Messrs. Richard Garrett and Sons, of Leiston. We are inclined to think that less cracking would ensue, and also better means of inspection would be attained, and improved water circulation provided. In considering internal examination, engineers, insurance companies, and we wish we could add some Government body, such as an improved Board of Trade, should not lose sight of the need for facilities for external examination also. In this question of boiler inspection the examiner ought to "see both sides." Small boilers are of necessity difficult, and often impossible of access. For such the only trustworthy tests are the drill and the pump. Indeed, it is to be feared that there are boilers this moment at work through some parts of which a fitter's hammer could be readily struck. Boiler examination, unless it is thorough, is perhaps worse than no examination at all.

THE GREAT EASTERN STEAMSHIP.

As stated in our last impression, the Great Eastern safely reached Dublin on the 14th inst. She left Holyhead on Wednesday at 6 p.m., a stiff breeze blowing from the north-west, in tow of the tug Rescue. The voyage was quite uneventful. The engines did all that was expected of them, running at about thirty revolutions per minute, the big ship going at about 5 knots, while the screw was making over 12 knots. The sea was rough and the ship rolled a good deal. She reached Dublin Bay about 7.15 a.m., and lay-to for some time waiting for the tide. She was boarded here by Mr. Tallant, Dublin pilot, and, starting again a little before 9 a.m., she entered the Liffey and took up a berth alongside the North Wall, and about 11 a.m. she let go her anchor, and the process of securing her to the quay wall commenced. It was intended that she should have taken up a berth in the Alexandra Basin, but this was found to be unsuitable, and, as we have said, she took the berth which was clear. On Friday the Great Eastern was placed in some danger. Her tremendous height gave the furious gale great power over her, and early in the morning she was forced hard against the quay wall. The paddle-box sponsons being above the wall, and the fenders being ground to matchwood, the starboard paddle-wheel was squeezed between the hull and the wall, with the result that, as might be expected, it was seriously injured. This is a matter of small consequence, however, as it is certain that the wheels will never be used again as wheels; but the circumstance forcibly illustrates the risk that the ship's wheels must always have run. It now remains to be seen what will happen if the wind comes away strong on the ship's beam from the north or north-east. In that case she will have to rely on her warps to keep her from being blown across the river. We have always held that to take so huge a vessel to so small a river as the Liffey was injudicious, and we can only hope that Mr. De Mattos will have no reason to regret the move before the winter is over. We are sorry to find that war has been declared between the Port and Docks Board and the owners of the Great Eastern. The latter declare that they are quite within their rights in keeping the ship where she is; on the other hand, at a special meeting of the Docks and Harbour Board, a resolution was unanimously passed protesting against the occupation of the berth in which the Great Eastern lies without the authority of the Port and Docks Board, as it is considered quite unsuitable for her in many ways, and more particularly as the moorings at the berth in question are regarded by the Board as unsafe for effectually securing such a vessel in the event of a gale. The Board consequently repudiates all responsibility with respect to any damage or injury she may inflict upon herself, or, should she break loose, on other shipping in the river.

RAILWAY TRAFFIC.

There is a decided change in the volume of railway traffic of late, and a change—though not quite so general—in the value of the traffic. Down to about the end of July the receipts of the chief railways of the country showed a general decline. There were exceptions, such as the Metropolitan Railway, which was and is beginning to feel the benefit of the extensions it has made, and of the growth in the traffic which must now be looked for as continuous in the great city it serves. But the change which has set in since about August is widespread, though not universal. It has affected systems like the London and North-Western, Great Eastern, and Lancashire and Yorkshire most beneficially; but it has also benefitted companies whose returns do not show as yet an increase—it has lessened the rapidity of the decrease in nearly every case. For the half-year, so far, the traffic receipts of the London and North-Western Railway have been over £2000 weekly more than those for the corresponding period of the past year; the receipts of the Lancashire and Yorkshire — a much smaller line—show an increase of over £2000 per week also; the Great Eastern weekly receipts are increased by above £1000; the London and Brighton by about £1400 per week; and the London and South-Western, Great Western, and Metropolitan have all substantial increases to record. There are only two important decreases—that of the North-Eastern, whose receipts fell off by about £3000 per week in the first two or three months, and have now a slight decrease in some weeks and a slight increase in others; and that of the Midland, which was at the rate of £6000 per week, but is now at a much less rate. Such testimony is unmistakeable in its character. It is supplemented by the facts that the decrease of traffic on the Furness Railway has almost ceased, and that on some of the other small mineral lines there is a recovery. We must also remember that there have been reductions in the rates charged for goods and minerals on many important lines; and thus we may fairly arrive at the conclusion that, as a whole, the volume of the traffic carried has substantially increased in the past few weeks. As to the kind of traffic which gives the enlarged monetary receipt, it may be said that it is chiefly the passenger traffic: all the great English railways, without even the exception of the Midland Railway, have increased receipts for passenger traffic so far this half-year; but on many of them the goods traffic lags behind, partly for the cause named. On the Lancashire and Yorkshire the goods increase is the more prominent, and it may be hoped that its example will soon be the general rule.

RAILWAY RATES AND CHARGES.

The statement that railway rates upon heavy ironfoundry from Manchester to the ports had recently been almost doubled by a new classification of such goods by the carriers, is denied by the manager of the Manchester, Sheffield, and Lincolnshire Railway. Probably the denial is accurate; but even if it is, the correspondence which has taken place upon this matter opens up afresh the whole question of the railway charges for the conveyance of heavy iron goods from our inland districts to the place of export. The disadvantages which engineers and ironfounders whose works are situate a long distance from the seaboard, suffer in competition for foreign contracts with firms nearer the ports, should appeal to the generosity of the carriers. When, as now, trade appears to be on the eve of a revival, it would be a most fitting opportunity for the companies to come forward and assist the inland iron manufacturing centres by conceding some ease in rates. The heavy pipe-founders, and some of the other heavy iron-founding concerns of South Staffordshire, are just now complaining that they stand no chance of carrying off export contracts because of the heavy handicap which, in this matter, they are weighted with. Simultaneously other ironfounding and engineering concerns in the same part of the kingdom state that the carriers "lose no opportunity to take every possible advantage" of them, and that they have to be careful to get special quotations for the conveyance of almost all contracts of magnitude. This is not as it should be. Want of confidence such as these must hurt trade. Nor are the Staffordshire ironmasters without fresh causes of complaint. The pig iron makers are just now complaining that, in consequence of the higher rates which prevail for the conveyance of limestone from North Wales to the consuming furnaces than are charged from Derbyshire, many are practically precluded from bringing the Derbyshire stone. The distance from the two districts is much the same, and recently the Derbyshire rates were reduced. Inequalities such as these call for early removal, and as some of these changes have been recently made, the inequalities may be easily reduced.

BERTHON BOATS.

The French Government appear to be determined to increase the efficiency of their Navy in a very important respect. They have just given a very heavy order to the Berthon Boat Company, Romsey, for collapsible boats. The value of such boats as a means of landing troops can scarcely be over-estimated; and the fact that the French order is to be executed with all possible despatch is not without significance.

LITERATURE.

The Theory of Stresses in Girders and similar Structures, with practical observations on the strength and other properties of materials. By Bindon B. Stoney, LLD., F.R.S., M. Inst. C.E. New edition, 1886, 754 pp.

This is a new and enlarged edition of a book which has long been a favourite with those whose duties or inclinations lead them to study its subject. The first edition was one of the very few and best of the really practical books on the theory of strains, as stresses were then called. As a strain is the injury or change resulting from stress, Mr. Stoney has altered the familiar title to that which heads this notice. The general method of the first edition, if not of a second, has been preserved in this new one, but very extensive additions, and revisions paragraph by paragraph, have been made, bringing the whole book down to date, and in every respect in agreement with the best informed writers both as regards stresses in structures static and dynamic; on rivetting, and on the strength and tests of materials. The strength and properties of materials, as in other editions, form by far the larger part of the new bulky volume. It may be here remarked that for convenience of the reader the first edition of the work, which was published in two volumes, was very much to be prefered to the single volume; but the awkwardness or unwieldiness of the book might have been greatly lessened by printing it on strong thin paper. But that which is used is not so thick as that of the first edition.

Graphic statics receives some application with reference to several of the bridge and roof truss diagrams, all of which are exceedingly clearly executed as before—white on black; but the author only introduces it in sufficient cases to show its value in certain applications, and as an extension, by Clerk Maxwell's system, of the older method by parallelograms which he had used in his first edition.

In that part which deals with the strength of materials, the most striking revision is in that section which deals with the strength of rivetted joints, although there is ample evidence throughout the whole that the author has kept himself thoroughly conversant with all the recent research and the new light that has been thrown on many questions concerning the physical properties of materials, by those who have made intelligent and not merely mechanical use of the powerful and accurate testing machines now available in so many laboratories and works.

It is unnecessary to enter into detail in a notice of a new edition of so well known a book as that before us, and we may conclude by repeating that Mr. Stoney's book remains, as it has been, one of the best books, if not the best systematic treatise on the theory of stresses in girders and roofs, and the strength of the materials used in them, for practical engineers or students.

The Engineman's Pocket Companion and Practical Educator for Enginemen, Boiler Attendants, and Mechanics. By Michael Reynolds. London: Crosby Lockwood and Co.

Mr. Reynolds has already written some excellent contributions to practical engineering literature, and that now before us maintains his character. It is an octavo volume of 294 pages, and contains seventeen chapters of useful information, not merely on mechanical subjects, but on scientific subjects connected more or less closely with them. Chapter I. treats of metals—smelting and refining them; of alloys, patterns, moulding, casting; of wrought iron and steel. Chapter II. deals with adhesion, cohesion, specific gravity, ductility, air, heat, &c. Chapter III. is devoted to various forms of engines and their details. Chapter IV. tells the reader about water, heat, and steam. The succeeding four chapters are devoted to steam boilers and all that concerns their construction and working. Chapter IX. treats of accidents and defects about engines and trains, and how to deal with them. Chapter X. is all about the indicator. The next two chapters are devoted to arithmetic, mensuration, and certain mathematical rules. Chapter XIII. belongs essentially to a builder's or architect's pocket-book, and has no connection with the rest of the volume. Masons' and bricklayers' work, painting, glazing, and paper-hanging should find no place in it. The next three chapters treat of calculations of capacity and weight as applied to engine work. Chapter XVI. is all about virtual velocities of pulleys, the number of teeth in and the radii of tooth wheels. The last chapter embodies some lessons in the simple branches of algebra and trigonometry, together with some old friends of all engineers in the shape of tables of diameters and areas, squares, cubes, and fourth powers of numbers, and weights of square, flat, and round bar iron, and the composition of coal. The title of Mr. Reynolds' book implies that it is chiefly intended for the class of engineers commonly called working men.

The Design and Construction of Harbours: A Treatise on Maritime Engineering. By Thomas Stevenson, P.R.S.E., M. Inst. C.E. Third edition. Edinburgh: Adam and Charles Black. 1886.

That branch of the profession of the civilian engineer which engages in the construction of harbours has one advantage over that which constructs machinery. The books which are necessary to the former may remain in force as standards much longer than those which deal with mechanical, dynamical, and thermodynamic applications. This is perhaps not so true as at first seems, if we take into consideration the numerous improvements that have been made in the methods of carrying out the works of the harbour engineer;

but with the exception of the employment of different materials, most of the improvements relate to mechanical engineering matters. Of these, Mr. Stevenson's book tells hardly anything, and it would perhaps have been better had he placed the book in the hands of an engineer with time at his disposal, so that it might in constructive matters have been brought down to date. It is a revised edition, but it might very advantageously, although a standard work, have received numerous additions. The value of the book does not, however, rest on its treatment of the executive part of harbour engineering. Its high value is derived from its treatment of those questions of marine hydraulics, and wind and wave actions, the geological and hydrographic matters which are involved in the consideration of any project having for its object the formation of shipping or refuge harbours, the protection of channels and shores, and the preservation or improvement of estuaries. On these subjects this book will long remain one of the most important.

Dynamo-electric Machinery: A Manual for Students of Electro Technics. By Silvanus P. Thompson, D.Sc., B.A. London: E. and F. N. Spon. 1886. Second edition.

Few, if any, of the writers on dynamo-electric machinery have been so successful as has Professor Silvanus Thompson in placing the dynamo-electric machine, or, as it is now so generally called, the dynamo, before the student public in this book, which has now been published some time, and found to justify the high opinion we expressed of it in the first edition.[1] Time has proved the book to be of practical value, and this second edition, which will probably soon be followed by a third, is specially remarkable for the unusual ability which is throughout displayed in describing the object, the elements, the details, the construction and working of the machinery dealt with. The present edition contains one hundred and twenty pages more than the first, the various advances, practical and theoretical, that had been made in the interval between the two editions receiving ample notice. Our review of the first edition makes it unnecessary to speak at greater length of the second.

BOOKS RECEIVED.

The Gas Engine. By Dugald Clerk. London: Longmans, Green, and Co. 1886.

Circular Work in Carpentry. By George Collins. London: Lockwood and Co. Weale's Series. 1886.

The Conversion of English Timber. London: W. Rider and Son, *Timber Trades Journal* office. 1886.

Practical Mercantile Correspondence—French—English. A collection of French letters and forms, explanatory notes, and vocabulary of Commercial terms. By Chr. Vogel, Ph.D. London: Whittaker and Co. 1886.

Report on European Dockyards. By Naval Constructor Philip Hichborn, U.S.N. Washington Government Printing-office. 1886.

Transactions of the Institution of Naval Architects, vol. xxvii., 1886. Edited by G. Holmes, Secretary. London: Sotheran and Co. 1886.

History of the Theory of Elasticity and Strength of Materials from Galilei to the present time. By the late Isaac Todhunter, F.R.S. Vol. i., Galilei to Saint Versant, 1639 to 1850. Cambridge: The University Press. 1886.

Poor's Directory of Railway Officials and Railway Directors, 1886. First annual issue. New York: *Poor's Railroad Manual.* London: Effingham Wilson.

THE INSTITUTION OF MECHANICAL ENGINEERS AND THE YORKSHIRE COLLEGE, ENGINEERING DEPARTMENT.

The Institution of Mechanical Engineers held a meeting in the Yorkshire College of Science, Leeds, on Monday last, and though an ordinary general meeting, it was made the occasion of the formal opening of the Engineering Department of the Yorkshire College of Science. The proceedings commenced at 3.30 p.m. with the reading of the minutes of the summer meeting, held in London, followed by the reading of a paper by the late Mr. Robert Wyllie, of Hartlepool, "On Triple Expansion Marine Engines." The paper is one of considerable value, and will appear in full in our next impression, with the numerous indicator diagrams with which it was illustrated. It was well received, and affords further confirmation of the economy with which triple expansion engines and high pressures will work a ship, as compared with the ordinary, or compound, or twofold expansion engines, with the lower pressure at which they have hitherto worked. Inasmuch, however, as we cannot give the paper until next week, it is useless to give the discussion upon it until then. Only this one paper was read, and the further discussion upon it was adjourned to the January meeting.

The Marquis of Ripon, accompanied by Sir Edward Baines, Sir A. Fairbairn, Mr. J. Barran, M.P., Principal Boddington, and several members of the governing body and the professorial staff of the College, then entered the lecture theatre, and gave a cordial welcome to the members of the Institution present. A felicitous reply was made by Mr. Jeremiah Head, the President of the Institution, in the course of which he formally declared the new engineering laboratory, and other additions comprising the engineering department, to be open.

The members and guests were then conducted over the new department, which is the result of a suggestion made by the Council of the College that a number of engineers should form themselves into a committee for the purpose of ascertaining the extent of additions and improvements which were deemed necessary for an engineering department. On the recommendation of the committee of engineers, the raising of a fund of £10,000 was sanctioned for the purpose of providing a suitable building, equipped with all necessary scientific and mechanical appliances. The friends of technical education in Leeds and the neighbourhood responded generously, and the work was commenced without delay. The Leeds engineering firms have taken a very commendable interest in the affair—an interest which has produced excellent results, but which would not have been attained if the practical views of men who have very decided notions as to what is required had not been consulted in the organisation of the department. In the prospectus it is explained that "the work of the classes is not intended in any way to supersede the usual requirements of pupilage or apprenticeship in engineering, but to enable the learner to gain such a knowledge of the principles of his profession or trade as he cannot acquire by simply working in the office, in the field, or in the workshop." To this end the laboratories have been designed to afford the students facilities for the experimental study of the relations which the principles taught in the lecture-room bear to the problems met with in actual practice. It is well known that in many cases such facilities are quite impossible of attainment in the workshop, where the work must be turned out in the most expeditious manner. The laboratory work is intended to bridge over the gap which must otherwise necessarily exist between the purely theoretical and the practical parts of the engineer's training.

The new building forms an extension 60ft. in length, 43ft. in breadth, and in height, from the lowest floor to the highest floor, 48ft. The accommodation consists of three laboratories, a lecture-room, a drawing class-room, and other minor apartments. The laboratories—viz., the basement or engine-room, the machine-room, and the practical mechanics' laboratory—are lined with white glazed brick, which greatly assists the lighting, and gives to the apartments a bright and cheerful appearance. The basement of the building, which is only partially sunk below the ground level, and is amply lighted by large windows in the north and south fronts, will be occupied by the boiler, engines, furnaces, and hydraulic apparatus connected with the testing machine. A boiler is specially provided for experimental purposes, and a steam supply is also obtained from the main boilers of the College, so that steam may be had to heat the building, to work the machines, and also to heat up the experimental engine, without interfering with any tests as to coal consumption that may be in progress. The pair of experimental engines have been constructed by Messrs. John Fowler and Co. They are designed to work quite independently, so that either may be used to drive the machines while the other is being experimented upon. The smaller engine, which has a cylinder 6in. diameter and 12in. stroke, is designed to work as a high-pressure engine, with variable cut-off gear, controlled by the governor or by hand, at will. The larger engine, having a 12in. cylinder and 12in. stroke, will be arranged to work as a non-condensing, a surface-condensing, or a jet-condensing engine, with variable cut-off gear alterable by hand. A special form of drag link coupling is provided, by means of which the engines may be coupled with the cranks at any angle, and so coupled, the engine will be workable as a non-condensing, a surface-condensing, or a jet-condensing compound engine, using steam at any pressure up to 200 lb. per square inch. The clearance volume at each end of each cylinder, the volume of the intermediate receiver, and the stroke of the air pump can also be varied. Either cylinder may be worked jacketted or non-jacketted. All the necessary appliances will be provided for making complete tests of efficiency. It is further proposed to provide a gas engine, to be used both for driving the machines while the steam engine is being tested, and for illustrating the principles of that form of motor.

A special arrangement has been made for the carrying out of delicate experiments on the elasticity of metals. Two square flues are formed in the gable, extending throughout its whole height. These open below into a recess, and are closed at the level of the drawing class-room ceiling by glass partitions, which admit sufficient light to render the specimens visible throughout their whole length. One of these flues has an opening at every 12ft. in its height; the other has openings only into the drawing-class room. At each of these openings a cast iron wall box has been built into the wall, forming a strong and steady support for the cross pieces from which the specimens are suspended. In this way wires or light rods up to 55ft. in length may be tested, the lower ends being accessible for applying the loadings and reading the extensions. In some of the experiments now being carried out the loading is automatically applied at various rates, and the results recorded by an autographic apparatus designed by Professor Barr.

The boiler is designed for a working pressure of 200 lb. per square inch, in order that engine tests may be made at high pressure. The floor of the basement is of concrete, and in it two drains have been laid, with openings at convenient places to facilitate the carrying out of experiments on the flow of water, on centrifugal pumps, and other questions in hydraulics, for which purposes a large water supply has been provided in this part of the building. In the machine-room, which occupies the ground floor, the most noticeable piece of apparatus is a 100-ton testing machine of Wicksteed's single-lever vertical type. The machine is of exceptional dimensions. This was to have been shown at work on a specimen piece of steel of 3 square inches section, but as the steel was of over 34 tons, instead of under 30 tons per inch, it did not break, provision not being made for over, say, 110 tons. Other appliances in this room are a set of machine tools of the ordinary standard kinds, to be used for the instruction of students in the principles of the action of cutting tools. On the first-floor there are four rooms—the lecture-room, the practical mechanics' laboratory, the professor's room, and a small entrance room which will serve as a museum in which to exhibit objects of special interest to students of engineering. Tables fitted with gas, water, and steam for use in experiments relating to thermodynamics, and tools for light work in wood and metal, and for soldering, brazing, and other processes, are also provided. In the lecture-room accommodation is provided for eighty students, but over 100 persons can be comfortably seated on the benches. The lighting of the apartment is particularly good, the windows being very large and facing the north. The ceiling of the lecture-room is about 19ft. in height, and as this height is not required for the professor's room or the museum, a chamber has been arranged over these, to be used when required as a laboratory for special and photographic work. It is provided with appliances for carrying out the blue process and other branches of photography, and opens on to the flat, having a southern exposure. The drawing-class-room has abundance of well-diffused light admitted through large windows in the north wall and in the north slope of the roof; a system of electric lighting has been adopted for evening students. In connection with the formal opening of the department, an official document has been issued. It states that in the spring of 1885 a committee was appointed for the purpose of building and equipping the laboratory, the cost of which has been about £10,000. This committee felt it to be their duty, if possible, to raise the funds necessary for this purpose from engineers and their friends, and requested the Hon. R. C. Parsons and Mr. Joshua Buckton to do their best to obtain the amount required, and also to obtain annual subscriptions towards the maintenance of the department. To the present time they have received from thirty-six donors, whose names are as follows, the sum of £7878 15s.: Mr. Joshua Buckton, Messrs. Joshua Buckton and Co., Messrs. Richard Buckton and Son, Mr. Walter Buckton, Mr. Joseph Craven, Mr. John Craven, Mr. Henry Davey, Sir Andrew Fairbairn, Messrs. Fairbairn, Naylor, and Co.; Mr. W. Firth, iron merchant; Messrs. John Fowler and Co., Mr. Samson Fox, Mr. David Greig, Mr. Thomas Green, Messrs. Greenwood and Batley, Mr. T. W. Harding, Messrs. Hathorn, Davey, and Co.; Messrs. Holroyd, Horsfield, and Wilson; Messrs. Hudswell, Clarke, and Co.; the Hunslet Engine Company, Mr. E. A. Jeffreys, Sir James Kitson, Bart., Mr. J. Hawthorn Kitson, Mr. Kenneth Lupton, Messrs. Manning, Wardle, and Co., Messrs. R. Mountain and Son, the Hon. R. C. Parsons, Mr. Archibald Ramsden, Messrs. Shepherd, Hill, and Co., Mr. John Tannett, Mr. T. A. O. Taylor, Messrs. Taylor Brothers, Messrs. Taylor, Wordsworth, and Co., and Mr. Benjamin Walker. The above amount is made up of donations as follows:—One of £1400, one of £750, five of £500, one of £272, three of £250, three of £200, one of £147, ten of £100, one of £68, six of £50, two of £25, one of £21 15s., and one of £20. The amount stated yet leaves about £2200 to be collected. They have also received promises of two annual subscriptions of £20 each towards the maintenance of the engineering department. Sir John Hawkshaw, F.R.S., has also contributed the sum of £1000 towards the endowment of the Engineering Chair. The committee are anxious to pay off the above-mentioned debt as soon as possible, and will be glad of assistance with that object. Generally speaking, the engineering department may be said to be one of the best, if not the best, fitted out in the country, and the greatest credit is due to the College officials for their selection of a committee of engineers to guide them in the matter.

Upon leaving the College the members and visitors proceeded to the Victoria Hall, where they were entertained at dinner by the Council of the Yorkshire College, or, we might say, by the engineers of Leeds. In the course of the after-dinner speeches, Mr. Thomas Hawksley, M. Inst. C.E., presented the College with 250 guineas towards paying off the above debt.

[1] The Engineer, 31st October, 1884.

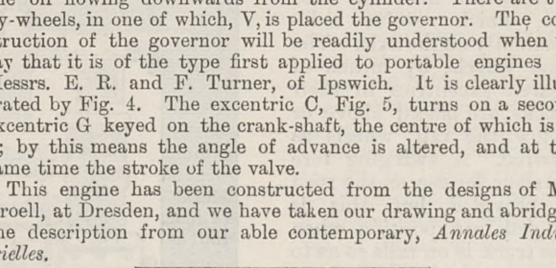
QUICK SPEED HORIZONTAL ENGINE.

On page 328 we illustrate a horizontal engine with Proell valve gear, which is a favourable example of foreign design. The cylinder is 7·87in. in diameter, and the stroke is 15·74in. The number of revolutions per minute is 180. The bed-plate it will be seen from Figs. 1 and 2 is in one piece with the two plummer blocks, and the piston-rod crosshead guide. The distributing valve T is circular and slightly conical; it is placed beneath the cylinder in order that it may be the better lubricated by the oil flowing downwards from the cylinder. There are two fly-wheels, in one of which, V, is placed the governor. The construction of the governor will be readily understood when we say that it is of the type first applied to portable engines by Messrs. E. R. and F. Turner, of Ipswich. It is clearly illustrated by Fig. 4. The eccentric C, Fig. 5, turns on a second eccentric G keyed on the crank-shaft, the centre of which is at *i*; by this means the angle of advance is altered, and at the same time the stroke of the valve.

This engine has been constructed from the designs of Mr. Proell, at Dresden, and we have taken our drawing and abridged the description from our able contemporary, *Annales Industrielles.*

STANLEY'S NEW SCALE.

The scale illustrated by the accompanying engraving has recently been made by Mr. W. F. Stanley, of Great Turnstile, and is one which will be found very useful and durable by mechanical draughtsmen. A short piece of metal, corresponding with the edge scale, is inserted in the centre of the width of the scale. This is intended to be used to set off small spaces by dividers, instead of using the end of the scale, which becomes

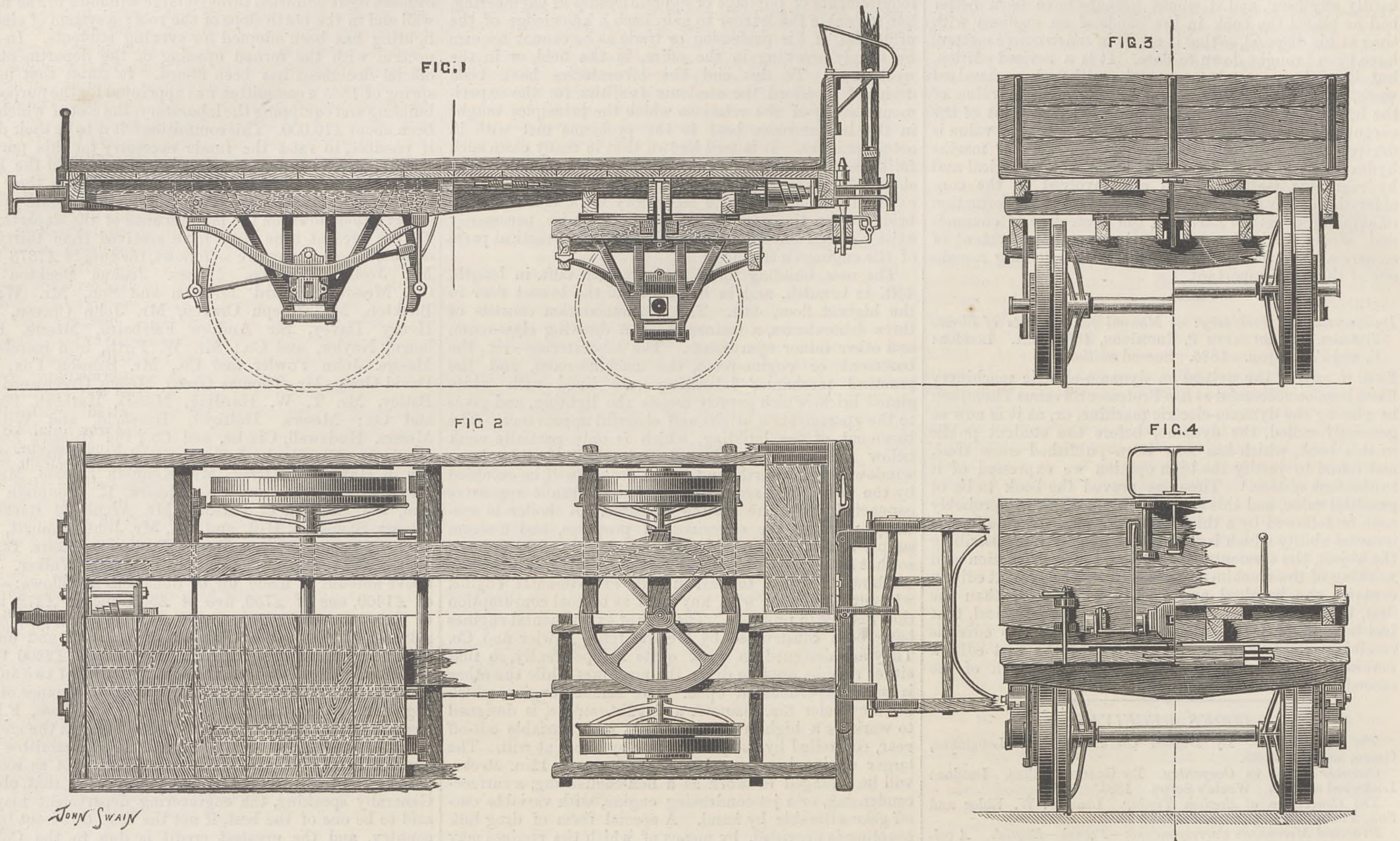


soon worn thereby. It can also be used to set the bow pencil or the bow pen, even when it contains ink, to radii of small circles, as the scale being of metal, any accidental spot of ink will not injure it. This will be found very convenient for finished drawings, where the setting of the bow pen to the pencil line previously drawn always tends to enlarge the centre hole and draw it a little on one side. The metal scale is sufficiently soft not to injure the point of the bows. Scales of four series of measurements have one piece of metal inserted at each end and on each side.

RAILWAY BRIDGE OVER THE RIACHUELO.

On page 325 will be found a perspective view from one end of the large pair of girders and transverse girders forming the main part of this bridge. Through pressure on our space we have to postpone further drawings and description of this bridge to another week.

PERRETT'S ROAD AND RAIL TRUCK.



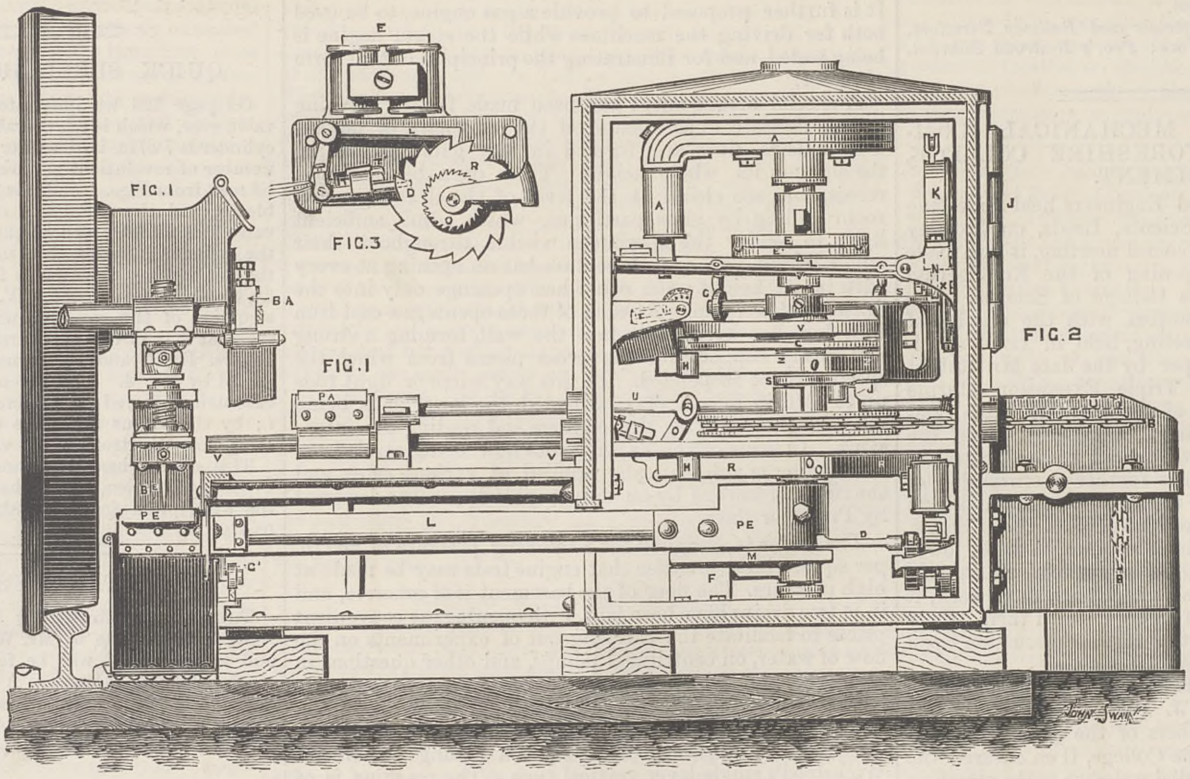
THE LIVERPOOL INTERNATIONAL EXHIBITION.

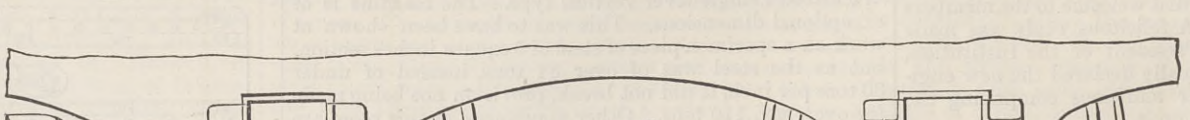
No. V.

In our impression of July 2nd last we noticed Perrett's road and rail truck, exhibited at Liverpool by the Falcon Engine Company. We now give engravings of it. The engravings show elevation, plan, and end views of the truck which is for 3ft. 6in. gauge, and to carry 4 tons. The weight of the truck with shafts and brake is about 30 cwt. Each axle carries four wheels, two flanged steel wheels for use on the rail keyed on the axle, which revolves in axle boxes in the usual manner, and two wooden wheels with broad tires for road use, which revolve independently on the axle. The road wheels, by means of geared excentrics in their stocks, are placed above or below the rail wheels as desired. A swinging fore carriage for use on the road is provided, but this is pinned into position when the truck is on rails so as to form a rigid wheel base. Brakes, which grip both road and rail wheels, are provided. The wheels are 2ft. 6in. and 3ft. diameter. The road wheels are fixed on the axles, and the axles revolve in axle-boxes carried by guards, so that when the truck is on the rail it is in exactly the same condition as an ordinary railway truck. The framework, being rigid and provided with a central buffer and draw, a number of trucks can be coupled together into a short train. When the truck is on the road, the road wheels are quite free to revolve independently of each other on the axles, which then remain stationary. The truck exhibited has been used on the Manchester, Bury, and Rochdale Steam Tramways with very satisfactory results.

A well-executed working model of a traction engine is exhibited next Mr. Webb's full size replica of the Rocket. It represents, at one-eighth full size, one of Messrs. Aveling and Porter's road locomotives as made in 1874. The engine is a complete working model, fitted with all the usual appliances, such as a drum with steel wire rope for winding loads over soft places, compensating gear for turning corners, brake, &c. It weighs complete about 70 lb. It has recently been fitted with a pair of Messrs. Aveling and Porter's spring wheels, the springs of which are of Timmis's section. With a steam pressure of 50 lb. it will draw 3 cwt. on the level with ease. The cylinder is 1in. diameter, by $1\frac{1}{4}$in. stroke. The engine will mount over an obstacle 2in. high. The boiler is lagged with Bell's asbestos millboard, cased with walnut-wood veneer varnished. This material is excellent as a non-conductor, as the entire thickness of asbestos and veneer in only $\frac{3}{10}$in.

It is said that about 80 per cent. of the accidents on railways are due to mistakes made by the signalmen and engine drivers, or to fogs. To avoid these it is assumed that automatic signal action, combined with manual action, is required so that they check each other, and prevents accidents through the failure of either the one or the other. The apparatus by which Mr. Snyers proposes to effect this is illustrated by the accompanying engravings. The apparatus is fixed on the permanent way, and is actuated by the train as it passes; the motion thus produced, which is mechanical and not electric, is carried to the signals which is thereby placed at "danger" attitude, at the same time the apparatus is "locked," *i.e.*, is so disposed that it automatically stops any other trains that should attempt to pass beyond it while in this locked position. This idea is not new, but has been hitherto impossible to realise on account of the great difficulty of actuating a body in a state of rest by another body travelling at a high velocity and *vice versâ*. Mr. Snyers proposes to overcome this difficulty by employing a metallic brush, which is attached to the engine, and which as it passes gradually, however, quickly presses upon a movable part of the apparatus called the "plate;" it can be made to press by any desired pressure, but the shock which would otherwise occur by the sudden contact between two bodies, one of which is travelling at a high velocity, end the other at a state of rest, will, Mr. Snyers expects, be done away with. On the other hand, when the apparatus is "locked," *i.e.*, at "danger" attitude, one part of it, called the "stop plate," presses against another brush also fixed to the engine. This brush being carried on levers, motion is imparted to it, which is carried to the brake or stop gear so as to stop the train. The apparatus are placed along the line at each block, and are locked, *i.e.*, placed at "danger" attitude by the train as it passes. As each apparatus is "locked" the rear one is unlocked,





SNYERS' AUTOMATIC TRAIN SIGNALLING APPARATUS.

i.e., placed at "line clear" by means of an electric current, which is controlled by a mercury contact which consists of a small glass tube containing a small quantity of mercury, and is sealed at both ends by suitable stoppers through which the conducting wire passes. At one end of the tube there is break of continuity in the wire, so that by the displacement of the mercury—the tube being held on a pivot—the contact is either closed or opened, according to the position of the tube. The automatic action might be employed alone, but to meet the objection alluded to above, the manual action can be retained, the signalmen have to work the signals as if the automatic action did not exist, and "tell-tales" or "checks" are arranged in the apparatus, which record any omission on the part of the signalmen. The same takes place if a train happened to be automatically stopped through the negligence of the driver in passing beyond a signal closed against him.

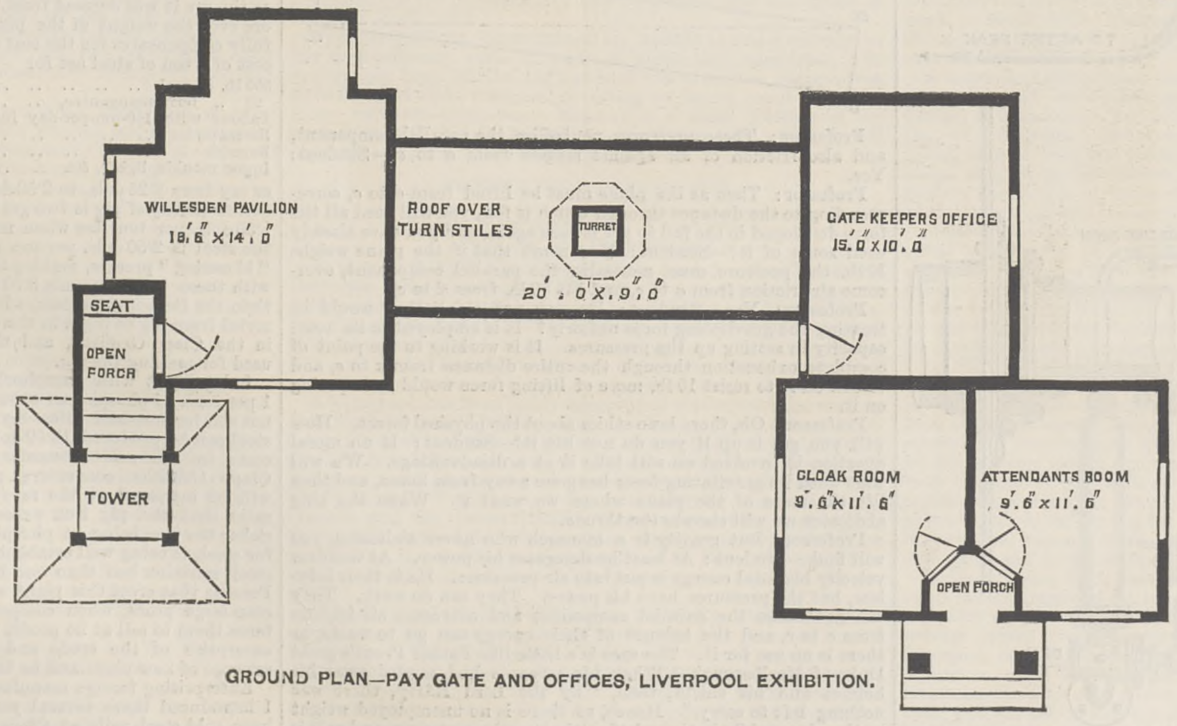
The engravings on preceding page show the side view of the apparatus as placed on the line with the relative position of the brushes and the longitudinal view of the brushes—Fig. 2. The brush, Fig. 1, B E, presses against the plate P E, which is carried on the lever L E, a slight rotary motion is thereby imparted to the axle on which are carried the arrangements for locking the apparatus, for actuating the circuit controlling devices and the signal. By means of the driving pin J carried on the disc S, the rod U, connected with the plate P [illegible], is pushed forward, so that the brush B A butts against the plate P A, thereby producing a motion of the brush which causes the train to stop as described above. This motion can be utilised as desired, but as the Westinghouse brake is in very general use, the engraving shows the brush fixed to a valve in connection with the brake. As the brush B A is always placed in advance of the brush B E, the above effect is not produced on the train that locks the apparatus. The other end of the rod U is connected with the signal. The chain B is for the manual working of the apparatus. T I are the circuit controlling devices which are controlled by the cam arrangement V and C. R is a strong steel spring which carries the axle back to its initial position when released by an electric current controlled by the locking of the apparatus, which, by polarising the magnet, Hughes A, frees the lock arrangement composed of the two toothed discs E and E' controlled by the lever L. As the axle when unlocked returns to its initial position, the two friction rollers C replace the lever against the magnet A. The Fig. 2 explains itself. It will be seen that the brush B E is carried on screws, by means of which its height above the line and the stiffness of the wires can be regulated at will, and also that the inclination of the wires is connected with the reversing gear, and varies according to the speed and for backward and forward travelling.

Some two years ago a paper was read at the Chemical Industry Society[1] and the Society of Arts, describing the interesting chemical combination of certain "metallo-ammonium" derivatives, and especially that containing copper, resulting in the important process and manufactures known under the term Willesden Paper, Willesden Canvas, and other products. We may refer our readers to the contents of this paper, June 6, 1884, as to the progress of the invention and the labour and enterprise required to bring the chemical and mechanical difficulties into harmonious working. The accompanying illustration will be recognised by those of our readers who have visited the Liverpool Exhibition and passed through the turnstiles of the Edge-lane entrance, of which this is a view.

In the paper alluded to it is stated next to slates and tiles this material stands pre-eminent as a durable roofing, whilst its strength, combined with lightness and flexibility, render it invaluable for practical use and service, especially in connection with up-country and foreign requirements. The following figures furnish the relative weights and covering power, as compared with galvanised iron:—100 square feet of Willesden roofing weighs 15 to 18 lbs.; 100 square feet of galvanised iron weighs 105 to 280 lbs.; one ton Willesden roofing covers 13,500 to 15,000 square feet, or 135 to 150 squares; one ton of galvanised iron covers 800 to 2170 square feet, or 8 to 22 squares. It is manifest that Willesden would come far cheaper than galvanised iron in any country where the cost of transit is heavy, especially in new districts where the means of communication with the seaboard are imperfectly opened up. Another advantage claimed is that being fibrous and comparatively non-conducting, the heat of a tropical sun is less felt than with iron or slate, and, on the other hand, the condensation of moisture from warm air inside a hut thus roofed or walled is all but imperceptible even on a cold night, whereas an iron building frequently causes inconvenient dripping of condensed water from the roof and small streams running down the walls. Where buildings are temporary or intended for subsequent removal, *e.g.*, officials' or workmen's huts or stores required in railroad construction, the lightness of the material and small space taken in packing in compact rolls give special advantages, and for more permanent structures it is equally serviceable. It is clean and exempt from the necessity of using pot and brush year after year to prevent perishing. It is well adapted for internal decoration. In case of fire the coppering and compactness of texture of the material render it far less inflammable than felted, wooden, or thatched buildings. It is rot and vermin proof, and escapes the ravages of the white ant. It is further claimed by the company that the method of construction, now perfected by many years' experience in all climates, offers great facility to artistic treatment at little expense, and that in point of economy and durability, the long record of roofing in all parts of the world establishes its success wherever right construction is followed and the overlap and grip of the sheeting are fully secured.

[1] Jl. of Society of Chem. Industry, March 29th, 1884.

WILLESDEN PAPER PAY GATE AND OFFICES, LIVERPOOL EXHIBITION.



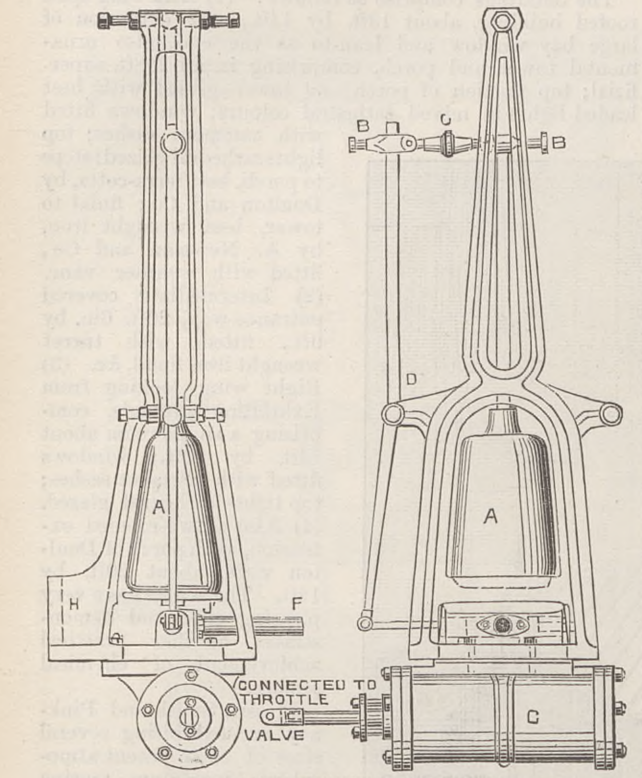
GROUND PLAN—PAY GATE AND OFFICES, LIVERPOOL EXHIBITION.

The tasteful structures shown in our illustration form an ornamental group at the Edge-lane entrance, comprising offices and cloak-room, and in designing them provision was made for their being manœuvred to make a four-roomed dwelling or other disposition to suit any required purpose. They are well adapted for shipment abroad, and would be suitable for a resident engineer's dwelling, railway or tramway station and offices, or for an exploration party—as also eminently adapted for a country gentleman's park, shooting box, cricket pavilion, &c.

The buildings comprise as follows:—(1) Left wing span roofed building, about 18ft. by 14ft., with extension of large bay window and lean-to at the end, also ornamental tower and porch, comprising in all 258ft. superficial; top portion of porch and tower glazed with best leaded lights in mixed cathedral colours; windows fitted with casement sashes; top lights cathedral glazed; steps to porch, best terra-cotta, by Doulton and Co.; finial to tower, best wrought iron, by A. Newman and Co., fitted with weather vane. (2) Intermediate covered entrance way, 20ft. 6in. by 9ft., fitted with turret wrought iron finial, &c. (3) Right wing looking from Exhibition grounds, comprising a single room about 14ft. by 10ft.; windows fitted with casement sashes; top lights cathedral glazed. (4) Also a two-roomed extension, with porch of Doulton ware, about 20ft. by 12ft. The whole has a very pleasing effect and demonstrates another practical achievement of chemical science.

Messrs. Smith and Pinkney are exhibiting several sizes of their patent atmospheric pendulum marine governor, for controlling marine engines, illustrated on the next page. A pendulum A is suspended from fine pointed centres and hangs in a vertical position. It can be adjusted to the trim of the vessel by a right and left-handed screw C, that connects the pendulum rod to a lever D, which works the piston valve G. This piston valve works in a chamber with both ends open to the atmosphere. There are two ports leading from this chamber to each end of a cylinder. The rod of the piston working in this cylinder is connected to the throttle valve of the main engine. A cock is fixed to the air side of the main condenser, with pipe leading to the centre of the governor valve chamber. The governor can be fixed on the bunker side, or any other position in the engine-room, with the pendulum working fore and aft. Thus, when the vessel lifts her stern out of the water, the pendulum remains in a vertical position, and causes the piston valve to open one of the ports of the small cylinder to the condenser, thereby causing a vacuum in one end of the cylinder, and the other end being open to the atmosphere forces the piston forward and closes the main throttle valve, and shuts off the steam. When the vessel returns to her normal position the reverse motion takes place, which opens immediately the throttle valve. This governor is purely an atmospheric governor, thus avoiding the use of steam, which is so objectionable in small cylinders, through rusting up the working parts when the machine is not in use. The patentee claims also another advantage for this governor. In heavy weather, when the engines are racing, the engineer can always reduce the vacuum, so as to relieve as much as possible the shock to the engine, and this governor only uses the power which at that time is not required.

The working parts of Messrs. Smith and Pinkney's governor are:—A, pendulum suspended from pointed centres, and always remaining in a vertical position, has a large wheel fitted on the bottom of the pendulum, to counteract the effect of the rolling or lurching motion of the ship. B B are screws to regulate the travel of the piston valve, and can be worked up and down on the pendulum rod, thus causing the valve G to move quicker or slower as required. C is the right and left-handed screw to place the valve in a proper position when the vessel is by the head or by the stern. D is the lever that is connected to the valve of the cylinder, and is worked on fine pointed centres, so that there is no danger of its setting fast with rust, and can be removed easily, and the piston drawn out if required. F is the pipe that is connected to the condenser of the main engine and the valve box of the atmospheric cylinder, and when the valve opens one port of the condenser, the other port is opened to the atmosphere, and the piston is forced to one end of the cylinder; and when the valve returns the piston is forced back, thus opening and closing the main throttle valve. G is the piston valve—it is made of brass, so that it cannot set fast in the chamber—which covers the ports, and the main piston remains stationary until the vessel



SMITH AND PINKNEY'S GOVERNOR.

lifts the stern and opens the port to the condenser. H is the part that bolts to the ship's side or bunker side, or on the engine columns, as may be most convenient. J is the wheel for relieving the friction of the pendulum weight when the vessel is heeling over, thus allowing the pendulum to work freely.

We also illustrate Coot and Adamson's governor. Fig. 1 shows a small double-acting steam cylinder C with a piston rod arranged so as to give the necessary motion to the throttle valve. Fig. 2 shows a 2in. or 2½in. sea cock, with stand pipe A arranged in about their position, relative to

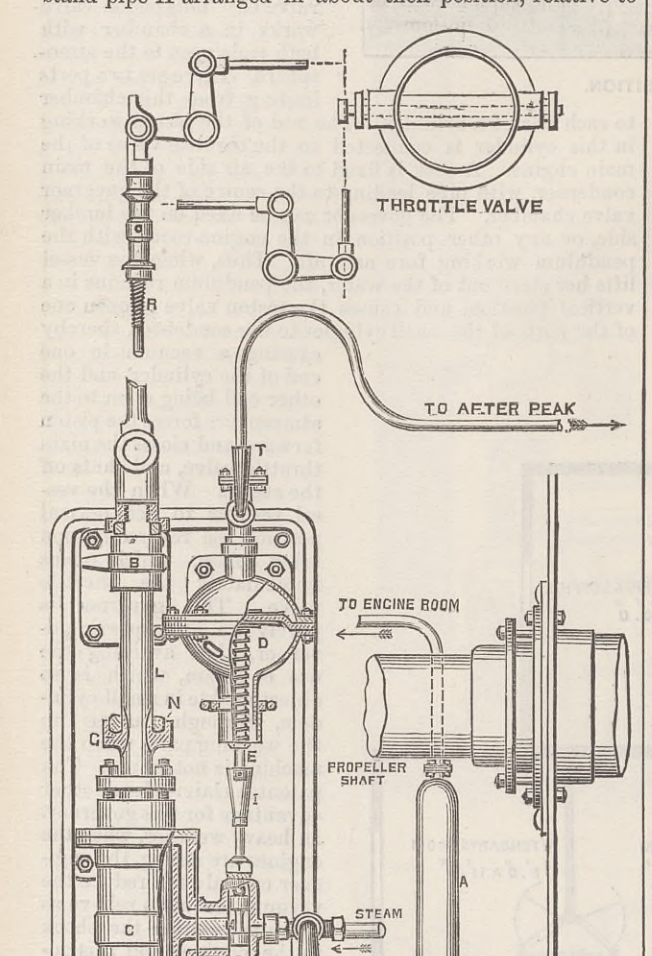


FIG 1 ENGINE ROOM — FIG 2 AFTER PEAK

COOT AND ADAMSON'S GOVERNOR.

the stern tube and shaft of vessel. The governor, Fig. 1, is placed as near the throttle valve as it conveniently can be, and consists of a small diaphragm D, connected to a pipe P from the stern; the diaphragm spindle E is connected to the small balanced valve H, by means of the adjusting nut I. As the ship rises and falls the diaphragm D and valve H does the same, and, the nut I being adjusted, steam is admitted to cylinder C at any point of the ship's immersion; the piston rod L is pulled down and the throttle valve is shut. At this point the collar F with the rubber washer N comes against the bracket B at a dead point and keeps the piston M from striking the end of the cylinder. As the stern of the ship moves down, the valve H moving with it, the steam is admitted to the other end of cylinder, and pushes the rod L and piston M back, and the throttle valve is opened, and the collar G with rubber washer N inside striking the other side of bracket B, and keeps the piston M from striking the end of the cylinder. On proceeding to use the governor, the engineer must see that the pipe from the stern is thoroughly drained of moisture, after which he must shut the drains, if any, and open the sea connection S; this being done, and the cock T also open, the diaphragm D and valve H are free to float, as the air pressure varies with the immersion of the ship's stern. The steam cock can now be opened, and the position of the valve H secured by turning the nut I—*i.e.*, lowering or raising the valve—until steam enters the governor cylinder at the proper moment. The rod R may now be connected to the throttle valve, and a proper anticipatory opening and closing of the throttle valve obtained. The principal advantages claimed are—(1) Its anticipatory movement to the racing of the engines. (2) Its small size, and the facility there is for using short connections. (3) The ease and certainty with which its movements can be regulated. (4) The internal parts being all made of gun-metal, there is no liability to corrode or set fast.

Messrs. John and Joseph Hughes, of Woodcock-street, Birmingham, exhibit a large collection of gun-metal and phosphor bronze castings for engineers, machine, and pump makers' use. They also show numerous very small and some complicated castings in the same material for machine and also for cabinet makers' purposes, and also in yellow brass. All these castings are very clean, and the pump barrels and bodies are at the same time very thin, clean, and sound. Various alloys of phosphor-bronze and gun-metal for engineering work, and of yellow brass, are shown in ingot.

LETTERS TO THE EDITOR.

(*Continued from page* 326.)

THE PROBLEM OF FLIGHT.

Sir,—Having been requested to present a paper on the soaring birds to the Mechanical Section of the American Association for the Advancement of Science at the Buffalo meeting, I gave them a brief account of observations and experiments, but nothing that had not been previously published.

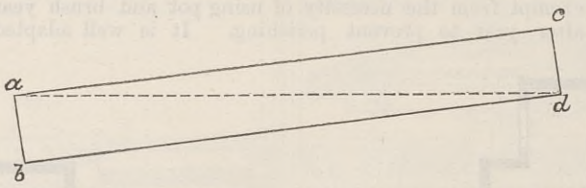
It was decided by the section that the subject could not be considered without artificial devices were produced which would act as I said the birds acted. That my statement of facts in regard to the birds were incredible, flatly contradicting recognised mechanical laws, and that I deserved censure for presenting the matter as I had done.

As nothing that I had said equalled in surprising features the statement of Charles Darwin, made thirty years before, of the South American condors, this decision of the august body surprised me. Surprise deepened into astonishment at the result of numerous conversations with individual members.

Had no statement of mine been made, and Darwin's the only presentation of the matter before the section, it would have been ample warrant for them to discuss the question of the ability of the gravitating force to carry a body manifesting it in a continuous horizontal path through the air. Such a question would have been eminently fit for the action of such a body. Practical effort might have been directed into useful channels by the discussion.

I give herewith a typical dialogue with a professor of mechanical science, as nearly as it took place as memory serves, as it shows the deplorable confusion of thought common with them all in regard to the Newtonian conception of attraction, and the nature of force in general.

Professor: Your plane acting under the resolved force moves against air pressures from *a* to *b*?—Student: Yes.



Professor: These pressures neutralise the parallel component, and also friction of air against motion from *a* to *c*?—Student: Yes.

Professor: Then as the plane must be lifted from *d* to *c*, corresponding to the distance through which it fell, you will need all the force developed in the fall to get it back again, and you have already used some of it?—Student: You mean that if the plane weighs 10 lb. the pressure must neutralise the parallel component, overcome air friction from *a* to *c*, and lift 10 lb. from *d* to *c*.

Professor: Yes.—Student: Do you not think that would be treating the gravitating force unfairly? It is employed to its total capacity in setting up the pressures. It is working to the point of complete exhaustion through the entire distance from *a* to *c*, and to call on it to resist 10 lb. more of lifting force would be imposing on it.

Professor: Oh, there is no ethics about the physical forces. How will you get it up if you do not lift it?—Student: If no moral question is involved we will take it at a disadvantage. We will wait until its gravitating force has gone away from home, and then lift the mass of the plane where we want it. When the king abdicates we will elevate the throne.

Professor: But gravity is a monarch who never abdicates, you will find.—Student: At least he delegates his power. At uniform velocity his total energy is put into air pressures. He is then helpless, but the pressures have his power. They can do work. They can neutralise the parallel component and overcome air friction from *a* to *c*, and the balance of their energy can go to waste, as there is no use for it. The case is a little like Father Prout's great Duke of Marlborough. When his servants had carried away his helmet and his shield, then, "by the Lord Harry, there was nothing left to carry." Hence, as there is no unemployed weight in the plane while in the act of setting up the pressures, and as it is doing that work every instant of the motion from *a* to *c*, the force overcoming air friction is entirely competent to lift it. How much force does it take to lift a body that has no weight to resist the lift?

Professor: That is metaphysics; 10 lb. is 10 lb., and you cannot reason it out of the plane.—Student: Maybe you can see it better to take a familiar illustration. If we use 100 lb. of material in making a balloon which displaces 100 lb. of air, it will rest in the atmosphere wherever placed. Suppose it at *a*; a very slight push would move it against air resistance to *c*. Does the force which moves the balloon from *a* to *c* "lift" 100 lb. of weight?

Professor: But the balloon does not fall; it is at rest.—Student: If the entire body of air had motion from *a* to *b*, would the push on *a c* lift weight?

Professor: The balloon is balanced by air pressure?—Student: Precisely what I have been trying to tell you was the case with the plane, only here the balance is more complete. Here it is balanced in every direction; there only in the plane parallel to itself. Here motion in any direction leaves the gravitating force, resisting air pressures to its total value undisturbed; there it is undisturbed by motion only in a parallel plane. Motion of translation in that plane in any direction is opposed by air friction only, and by no other resistance of any kind whatever.

Professor: There is no authority that I know of for treating the gravitating force in that way.

That Professor was a first-class mathematician. The calculus was a mere toy to him. He could fill a blackboard with innumerable hieroglyphics, through the mazes of which he could glide as unerringly as a sheep after the bell wether. Let him pursue a line of thought along which the symbols were so thickly placed that his hands could reach one before his feet left the other, and he was an acrobat of approved genius. But he had no mental stamina; he could not stand alone. He had no power of independent thought. Place a new idea before him, and he went sprawling.

October 19th. I. Lancaster.

PHOSPHORUS AND STEEL MAKING.

Sir,—Since the publication of my pamphlet of last year, the economy obtained by burning the producer gases made from coal with air in my furnace by my patented processes of 1882 and 1883, so as to produce complete combustion, and the dissociation of the elements in the flame, has been confirmed by my own experience and the recently published utterances of Mr. Frederick Siemens. Also two patents have been allowed me for processes for the dephosphorisation of iron.

But the economy by dissociation in the production of steel in the furnace here illustrated is not limited to the use of impure ores, as it is also economical with the purer qualities smelted from the Bessemer ores, of which grey forge—No. 4—mottled or white, are available with the pig and ore process, by which 6 cwt. of ore, of 69 to 70 per cent. iron to a ton of pig iron, produce 21 cwt. of steel ingots by the use of 300 lb. of coal, the steel being from 0·07 per cent. to 1 per cent. of carbon, as may be required. Eight casts of the soft steel are obtainable in twenty-four hours. The flame of dissociation acts chemically upon the metal, so that a purer and better quality is obtained than is had from same materials where the flame is not dissociated, and the ingots do not require to be cogged or bloomed before r[illegible]ing into the required form, such as rails, beams, and plates.

By the use of two h[illegible] the production of the furnace may be doubled. The hearth [illegible] the gas producer is for boiling and finishing the metal; the adjoining [illegible] is for melting and desiliconising the metal. The iron is desiliconised, and about one half of the carbon is removed, and the metal is then run from this chamber by an outside runner into the boiling chamber, where it is finished in about two and a-half hours; and, allowing half an hour for repairs, the operation may be accomplished every three hours. When the purer kinds of iron are treated both hearth chambers are lined with sand, and when phosphoric iron is used the melting chamber is lined with sand, and the metal desiliconised with ore, and the boiling chamber is lined with dolomite mixed with fluorspar, and the metal is dephosphorised by the flame of the furnace in conjunction with the use of fluorspar. By this means all of the phosphorus is removed but about one pound in a ton of iron; of the remainder a part combines with the lime worn away from the hearth, and that obtained by the fluorspar changing into lime, which slag so formed becomes phosphate of lime. Another part of the phosphorus combines with the fluorine of the fluorspar and becomes gas or vapour, and is conducted away from the furnace to suitable condensers, where it is condensed by cold water, thus forming hydro-fluoric acid and phosphorus. The acid is drained away and treated with milk lime, and becomes artificial fluorspar for use again.

Phosphorus is used for matches, calico printing, and other uses in the arts, and may be made into phosphate of lime for fertilising purposes. Phosphate of lime sells at 16 dols. per ton, and contains 8 to 10 per cent. of phosphoric acid, so that each one per cent of phosphorus becomes worth about 4 dols. per ton of iron for fertilising, and a 50 per cent. of iron ore yielding pig with one per cent of phosphorus becomes intrinsically worth about 2 dols. per ton more than a Bessemer ore containing the same amount of iron. It is preferred to erect furnaces of 10 to 12½ tons capacity per charge, so that one will serve a blast furnace making 80 to 100 tons a day of pig iron, and take the iron molten from the blast furnace to the steel furnace, and use the labourers in the casting house for moving the metal to and from the steel furnace, so that the expense for labour will be merely for the steel melters, engineers, and gas men over that usual about the casting house.

The slag from the pig and ore process weighs about 600 lb. per ton of steel, and contains 30 to 33 per cent. of metallic iron, which is used for smelting, and is worth per unit of iron as much as the ore it was derived from. The gain of 1 cwt. of steel from the ore over the weight of the pig iron used and the iron in the slag fully compensates for the cost of the ore used, so that the items of cost of a ton of steel are for

300 lb. of coal	at 2·00 dols. to 4·00 dols.	per ton
22 ,, ferro-manganese, ...	at 3 cents, per pound = 66 cents	,,
Labour with 100-ton-per-day furnace	40 ,,	,,
Refractories	40 ,,	,,
Repairs	30 ,,	,,
Ingot moulds, lights, &c.	25 ,,	,,

or say from 2·25 dols. to 2·50 dols. per ton.

The quality of pig is two grades under Bessemer pig, and sells at 1·50 dols. per ton less when made from same ore. The quality of the steel is 2·50 dols. per ton better even for rails, as it saves the "blooming" process, making the open hearth pig and ore process with these improvements 8·50 dols. to 9·75 dols. per ton less cost than the Bessemer process, where the loss is 13½ to 16 per cent. of metal from pig to ingot in the ordinary converter, and 20 per cent. in the Clapp-Griffiths, and the coal 1680 lb. when a cupola is used for melting the pig.

I claim that with phosphoric ores yielding pig iron containing 1 per cent. of phosphorus at same price per unit of iron—it does not sell for one-half price—by the means herein described, better steel can be produced 12·50 dols. to 13·50 dols. per ton less than it costs in the acid Bessemer process where the regular or Clapp-Griffiths converters are used respectively, and this will be increased at the rate of 4 dols. per ton of steel in the ratio that the pig iron exceeds 1 per cent. of phosphorus—the richer the iron being in phosphorus the more valuable it becomes for steel, it being well established that the quality is better as the steel contains less than one half of that made in acid process. Persons that erect this plant will probably for a considerable time reap large profit, when competition between Bessemer works will force them to sell at no profit, and at a loss, owing to the lack of enterprise of the trade and disinclination to incur the extra expense of new plant and be taught new processes.

Enterprising foreign manufacturers use my basic process—which I introduced there several years ago—with phosphoric iron, and have sold steel rails at £3 5s. per ton, which is equal to £3 for steel blooms from which the rail is rolled, which can be imported at less than 23 dols. per ton cost, as they pay 45 per cent., or 6·75 dols., *ad valorem* duty. Our manufacturers of Bessemer steel that do not make rails cannot make the blooms at this price, and those that roll rails are enabled to make large profits, as the duty on rails—17 dols. specific—prohibits their importation; so that unless cheaper methods are adopted here the demand for nails, beams, plates, and many other uses, will be supplied from this source. The use of this furnace and these Henderson processes relieves the steel maker of apprehension of legal interferences relating to the pretensions of the Reese and Thomas patents—which are owned by same parties, and serve to intimidate persons wanting to go into the business—as there is no similarity.

New York, September 14th. James Henderson.

AMERICAN NOTES.

(*From our own Correspondent,*)

New York, October 9th.

Imports of iron for the first eight months of this year foot up 717,335 tons, including tin-plates, wire rods, and rope, anvils, forgings, and chains, against 371,750 tons for the same time last year. During the first eight months of this year, we imported of dutiable merchandise 300,000,000 dols. worth, against 258,765,854 dols. worth for the same time in 1885. The value of the iron and steel imports for the eight months of this year are 24,164,398 dols., against 17,375,186 dols. The imports of iron ore this year foot up 715,667 tons, against 287,994 tons for the same time last year. The imports of tin-plate this year are 190,433 tons, against 162,434 tons for the same time last year. The importations of steel rails this year foot up 14,222 tons, against 1883 tons last year. Steel ingots this year 65,000 tons, and for the same time last year 15,000 tons. Wire rod importation this year 96,491 tons, against 54,131 tons last year.

The greatest activity prevails in all branches of the iron trade throughout the States. Prices have hardened a little in all lines. Crude iron is selling for standard makes at a little better price than a few days ago, and the consumers are everywhere placing their orders for winter delivery lest prices advance on them suddenly. There are specifications in hand this week for large supplies of plate and bridge iron. There is a general feeling that there are large requirements that will be presented this month and next, and that the placing of these orders will result in a sharp advance in prices for the small buyers who will follow.

Railroad building is being crowded along very rapidly, and new lines are projected, and will be pushed along as fast as possible through the winter. Car building is absorbing a great deal of iron and lumber, and there is scarcely any unsold capacity between now and January 1st. New mining and manufacturing companies are being organised. The latest is the Florence Land, Mining, and Manufacturing Company, of Tennessee, which controls 25,000 acres of iron ore land in that State. A new steel wire nail factory is being erected at St. Louis.

Manufacturers of iron and steel are making large purchases of mineral land in Northern Alabama. The annual convention of the United States Association of Charcoal Ironworkers will be held in Philadelphia on October 26th. All our shipyards are full of orders for tonnage for river and coastwise service. John Roach and Son have just secured a contract for two 3000-ton iron ships for the United States and Brazilian Line. The winter outlook for the iron trade points to a heavier demand than has ever been realised in the States. Stocks of material are low at all manufacturing points.

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

(*From our own Correspondent.*)

The much improved tone which characterised the Birmingham quarterly meeting is well sustained this week. Sellers of iron, alike raw and manufactured, are of opinion that the quarter into which trade has entered will be a period of greater activity and of better prices than for a considerable time past. Business on 'Change in Wolverhampton yesterday and in Birmingham to-day was again very satisfactory.

That the Cleveland iron should have risen between 1s. 6d. and 1s. 9d. on the week, making an aggregate advance of something like 4s. per ton, was quoted by ironmasters this afternoon as strong evidence that the improvement will be found to be lasting. They also adduced the advance in quotations of between 2s. 6d. and 7s. 6d. per ton in malleable iron in Scotland as further evidence in the same direction. There were not wanting some bold traders who suggested that November will possibly see a declared advance in the prices of Staffordshire marked bars. November is noted amongst consumers as a favourite month with the makers to advance prices.

Marked bar makers have, however, to meet an increasing competition from the steel makers, who are freely supplying bars to engineers and others at 10s. per ton less than marked bar quotations. An abundance of excellent steel bars are offered here from Wales at £6 10s. per ton, and prices go on up to £7 to £7 10s., according to temper. Steel bars made out of scrap ends are plentiful, at £5, but sellers will accept no responsibility as to the quality of these.

Blooms and billets and tin bars may still be had on very favourable terms. But buyers of best qualities are now rushing in to place forward orders in advance of Nov. 1st, from which date the Welsh steel makers have determined to advance blooms, billets, and tin bars 5s. per ton, thus recovering half of the reduction which was declared on September 1st last. The advance leaves Bessemer tin bars at Welsh works £4 10s. per ton for sizes 7in. wide by ¾in. thick; blooms, £4 for 3in. by 7in. size; and billets, £4 2s. 6d. for 2½in. square size. Tin-plate makers express great gratification at the course which the Tin Bar Association have determined to take, since it should materially strengthen tin-plate prices.

Common bar and strip makers are doing their best to take advantage of the upward turn in the market, and are asking an advance of 2s. 6d. per ton, and occasionally 5s. In the face of competition from South Wales and the North of England it is not an easy matter to get a rise, but some firms are very positive in their declaration that they will not book forward except at more money. The high price of pigs warrants the demand; £4 12s. 6d. to £4 15s. are now named as the minimum rates. Good merchant bars are £5 to £5 10s., and at 2s. 6d. or 5s. per ton higher the second branded qualities of the marked iron houses begin to come in. Orders in the bar trade are still of an irregular sort, but the prospects alike for the home and colonial demand are decidedly better than of late.

Export hoops are kept back at the moment from participation in the improvement by the circumstance that the shipping season to the wine countries of Europe is now over, and makers' books are rather bare of orders. Prices are quoted £5 5s. to £5 10s. per ton. Superior qualities are £5 15s. to £6, and on, according to brand.

The revival continues to be more manifest in the black and galvanised sheet branches than in any other department. These makers are certainly much better off. Black sheet mills, which up to a week or two ago were badly off for orders, are now fairly full, and will not accept further forward business except at a sensible advance. The amount of such advance varies according to the state of individual makers' order books between 5s. and 10s. per ton. Very few firms are getting 7s. 6d. advance, but nearly all are getting 5s. rise on doubles. Such sheets are this week mostly about £6 5s. to £6 10s., and lattens £7 to £7 5s. Up to quarter day plenty of doubles were to be had at £6 2s. 6d., but that price is not now permitted to buyers. "Woodford" sheets are quoted £8, and mild sheets £13 per ton.

Those galvanisers this week who are members of the Association will not depart on the open market from the official 10s. advance declared last week. Such advance, as far as can be ascertained, leaves the quotation for doubles at Liverpool at about £10 5s. per ton; some firms quote £10 10s. It is very questionable, however, whether many firms are getting the full rise. Recent prices have been very varied, since the individual brands on the market vary considerably in quality. Some firms outside the Association declare that they have been getting 17s. 6d. per ton more than certain Association makers.

Competition in galvanised sheets is, however, at the moment less keen, and merchants are offering an increased number of orders on colonial, South American, and Indian account. I am in a position to state that the total exports of galvanised sheets from all parts last month aggregated over 10,000 tons. Australasia was by far the largest market, taking 3800 tons, and the Argentine Republic came next with close upon 2000 tons. The East Indies and South Africa bought moderately, and unenumerated markets grouped under the head of "other countries" took 1500 tons.

There was no giving-way this afternoon in pig iron prices. Sellers of Midland sorts are assuming a very independent position, and buyers who have not previously covered their require. ments find themselves behind the tide. Representatives of some Midland and West-coast firms who have stocks still unsold were to-day in receipt of telegraphic instructions from principals to yet further keep the iron off the market. The rapid rise in North-country pigs has this week imparted much confidence to vendors. An advance in quotations of 2s. per ton on previous minimum rates prevails as to some Northampton, Nottingham, Derbyshire, Lincolnshire, and similar pigs. Some Derbyshire firms have closed their books at 36s. per ton delivered at stations in this district, and this week demand 37s. and 37s. 6d. per ton. Northampton vendors also quote 37s., but it is a fancy price.

Hematites are 2s. 6d. per ton stronger than a few weeks ago, and it is now hardly possible to get any quotation less than 52s. 6d. per ton delivered in this district for West coast and Welsh sorts, while some firms demand 55s. One local agency has taken orders during the past three weeks for some 20,000 tons of hematites alone, exclusive of transaction, in Midland pigs. Makers of mine Staffordshire pigs are demanding a 2s. 6d. per ton rise, making them 47s. 6d. per ton. All-mine makers are also stronger at 52s. 6d. to 55s. per ton. Common Staffordshire pigs are fetching more money by from 6d. to 1s. 3d. per ton according to the mixture.

I have just had the pleasure of inspecting at Messrs. Carrick and Brockbank's, iron merchants, Birmingham, a very interesting collection of specimens of Siemens-Martin steel plates and bars, made by the Consett Iron Company, Newcastle-on-Tyne. The specimens have been punched, bent, and twisted, and all of them exhibit great ductility, homogeneity, and, in fact, all the qualities of best Yorkshire and other high-class irons. The company's ordinary mild Siemens-Martin steel plates are made to stand Lloyd's and the English Admiralty requirements; whilst they make a special quality for flanging and other purposes for which tensile strength and ductility are particularly required. The company makes its plates from $\frac{3}{16}$in. to 1in. thick and up to 6ft. wide for rectangular, and 6ft. 3in. wide for circular or semicircular plates. One of the finest samples was a hollow cone with a wide flange, something after the shape of a Welsh hat, which had been stamped out of a disc. It was 8in. deep, 7in. wide at base, and 2½in. wide at the apex on the inside. The plate was $\frac{3}{16}$in. thick, and was wholly devoid of any appearance of cracking on the edge. Hydraulic machinery had been employed to press out the disc. Another sample also drawn down from a disc was of perfect basin shape, 7in. deep and 2ft. diameter across the face. As a demonstration of what Siemens-Martin plates can be trusted to do the collection is most convincing.

Engineers and machinists keep pretty steadily engaged, and the constructive ironwork manufacturers hold some fair contracts. The manufacturers of railway ironworks are best employed on foreign orders, the demand for home railways being restricted. More confidence, however, is manifest regarding prospects, and the impression among numbers of engineering concerns is that there are better times in store at no very distant date.

There is a prospect of increasing orders in the building trade. The Hull Corporation are about to construct a swing bridge across the river, and they are inquiring for tenders for the work.

The proprietors of the Plymouth Dock Waterworks are offering some big lines. They include water tanks, which, if secured by local manufacturers, will prove very acceptable.

The Indian railways have again large tenders on the market. The Madras Railway Company is requiring supplies of iron and steel, and the Southern Mahratta Company is inviting tenders for metals, fencing requisites, screws, nails, &c.

The Birmingham Cable Tramway Company has accepted the tender of Messrs. Tangye Brothers for the supply of over 250 tons of tee iron yokes, wrought iron tie bars, bolts and nuts, rolled iron girders, malleable iron pulleys and frames, inspection hatches and frames, side entrance doors, &c., required in the construction of the Hackley Cable Tramway. The contract for laying the lines between Colmore-row and Hackley has been given to Mr. Jacob Biggs, of Handsworth.

There is every prospect of the agitation in the nail trade being satisfactorily composed. A deputation from the men, finding that they could make no definite arrangements with individual firms, waited upon the masters on Birmingham 'Change on Thursday. Much sympathy was expressed for the men, and it was resolved to communicate with all the employers, asking for their consent to an advance in wages of 10 per cent. on the present rate of pay. If the majority of the masters consent to the proposal, it is probable that the increase will be at once paid.

The nut and bolt makers are likely soon to join in the general agitation for an advance in wages. Energetic effects are being made to strengthen the association, and the ultimate result will be a demand for the restoration of the 5 per cent. that was taken off wages in April, 1885.

The Birmingham brassworkers are unable to find a remedy for the unsatisfactory state of trade of which they complain. The matter has been left in the hands of the executive council, who have declared their intention of acting as far as possible in harmony with the employers. Meanwhile a mass meeting of the operatives will shortly be held in the Town Hall, when a full expression of their views will be given.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A new shaft, 12ft. diameter, is being sunk for the Thorncliffe Collieries near the village of Thorpe. It is intended to provide better ventilation for the extensive pits belonging to Messrs. Newton, Chambers, and Co. The workmen have just sunk through Parkgate seam of coal, and are continuing the sinking down to the Silkstone bed. The shaft, which will connect these seams, will provide better means of ingress and egress to two of the collieries.

A paragraph has been freely telegraphed throughout the country that inquiries for 100,000 tons of steel rails were now on the market. I am informed that this statement is substantially correct, though, as delivery is not to commence till next June, the contracts will not cause much increased activity at present. Fifty thousand tons are required for Victoria, and the remainder for South America, Canada, and the United States. These orders, it is expected, will be mainly secured by Welsh firms, though a portion may be secured by the Cumberland makers. It is believed that these orders will cause an advance in the prices of steel rails to £4 per ton.

The Mayor of Sheffield—Alderman J. W. Pye Smith—opened, on Monday, the South Yorkshire Mechanical and General Trades Exhibition. The object of the exhibition is to bring together in an attractive way the leading industries of the district, with a view to encourage and promote trade. There are more than 100 exhibitors, whose array of productions made in the important trade centres of the South-West Riding embrace an infinite variety of handicrafts and processes, from cutlery to weaving and glass-blowing. The exhibition is held in the headquarters of the Engineer Volunteers—a structure of iron and glass. In the temporary annexes the rain poured through the temporary roofing, to the discomfort of the exhibitors, who had to gather up their goods to prevent injury by the wet.

Messrs. William Jessop and Sons, Brightside Steel Works, Sheffield, have been awarded four gold medals at the Liverpool "International." One is for Hall and Verity's patent flexible crank shaft and coupling, another for Hall's patent anchor, a third for cast steel stern posts and rudders, and a fourth for marine engine castings and forgings.

Messrs. Lockwood and Carlisle, engineers, Eagle Works, the Park, Sheffield, have been awarded a gold medal for their patent piston rings and spring. This is the third highest award the firm have received for these specialities. Similar awards have been received by Messrs. John Brown and Co., and other firms, particulars of which will be given again.

Hematites, which really are the raw material for Sheffield, have gone up from 49s. to 52s. per ton. This is an advance of 3s. a ton in the fortnight, and is regarded as of exceptional importance. Other qualities of iron have similarly improved. Common forge iron has strengthened at least 1s. to 2s. per ton, the rate having advanced from 35s. to 37s. per ton. A large demand has set in from America within the last few months, which is the chief cause of the "boom." There is not much change to note in the home markets. In coal there is also a more active business. Better employment is being given, and the collieries are now taking from stock, which is an excellent sign.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—With the exception of a little wavering here and there in price, where sellers find that they have rather overshot the mark, the recent improvement in the iron trade of this district is being generally well maintained, and as regards hematites it would seem to be established on a thoroughly legitimate basis. The upward movement in these is being backed up by an increased weight of buying for actual requirements and for export, and the prospects of the steel trade are decidedly more healthy than they have been for some time past. So far as common pig iron is concerned the recent upward movement in prices, as I have previously pointed out, had its origin in a restriction of output, and there is not as yet any very materially increased weight of iron going into actual consumption; users, however, who have so long been buying supplies from hand-to-mouth have been induced to purchase more freely, and if not in all cases at the full advance the makers have been asking, there has been a considerable weight of iron bought, either for stock or forward delivery, at decidedly better prices than were obtained a few weeks back. In manufactured iron there is also more business stirring, and although makers have found it difficult to get up prices to any very marked extent, the downward tendency which previously existed has been effectually checked, and generally more money is being obtained on sales now being made.

The Tuesday's Manchester iron markets continue to bring together good attendances, and in some departments increased activity is maintained. As regards common pig iron, however, the weight of business offering has fallen off considerably, and at the advanced prices now being asked buying is only very slow. Lancashire makers still report a fair weight of orders being got, and they are firm at 36s. 6d. to 37s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester. For district brands quoted rates remain at 39s. 6d., less 2½, for Derbyshire foundry, and 37s. 6d., less 2½, for Lincolnshire foundry delivered into the Manchester district, but the full prices are not being strictly adhered to in all cases, and 37s., less 2½, is being taken for Lincolnshire foundry, with forge qualities, which continue in only very poor demand, to be got at 35s. 6d. to 36s., less 2½, delivered here. In outside brands offering here Middlesbrough iron is very firm, with an upward tendency, good foundry qualities being quoted at 41s. 4d. net cash, delivered equal to Manchester; but in Scotch iron, although quoted rates are generally firm, there are second-hand parcels offering at under makers' prices.

In hematites there is a strong upward movement. Considerable sales have been made at advanced prices, and No. 3, foundry qualities, delivered here are now quoted at 53s. to 53s. 6d., less 2½ per cent.

An improved business continues to be reported in manufactured iron, and works in most cases are now tolerably well supplied. Quoted rates have generally been put up about 2s. 6d. per ton upon the recent minimum prices, but the advance is not being got in all cases. Bars can still be got at from £4 17s. 6d. to £5 per ton delivered into the Manchester district; hoops are quoted at £5 7s. 6d.; and sheets at £6 5s. for singles, to £6 15s. for doubles. Some fairly large sales have been made of North-country plates, but the prices taken have been very low, in some instances as low as £4 17s. 6d. per ton delivered into this district.

In the condition of the engineering trade there is still no actual improvement to report. The inquiries which are put forward are perhaps more *bonâ fide* in character than they have been, but they are still few in number, and do not result in new work of very great weight.

Messrs. Goodfellow and Matthew, of Hyde, who are enlarging their works by the addition of new erecting and tool shops, and an extension of their foundry, have in hand a good deal of special work both for Government and private firms. Amongst the Government work are seven pairs of air capstans complete with the necessary engines, for Portsmouth Dockyard, which are being especially laid down for hauling ships about the docks. The engines work to about 60 lb. pressure, and the compressed air, which is carried about the docks to the position required, is conveyed to the capstans by means of pipes.

A simple and at the same time very effective joint ring for steam, water, gas, and other pipes has just been patented by Mr. Claude Carter, of Manchester, and is being made by Messrs. T. Worth and Co., of Droylsden. This joint ring is a combination of soft metal, such as lead, and rubber, so arranged that there is a soft metal ring of girder section, each side of which is filled with rubber; the flanges of the metal ring being flush with the surface of the rubber prevent the rubber from squeezing out sideways, as is frequently the case with ordinary rubber joints, whilst the soft metal ring would of itself form a joint where no elasticity is required. This new joint preserves all the elasticity of a simple rubber joint, whilst the soft metal ring not only prevents the rubber from being blown out or pressed in the pipe, but protects it from contact with the fluids or liquids contained in the pipe, which for chemical works purposes is an especially important feature.

A dull tone prevails throughout the coal trade of this district, and many of the collieries are not working full time. The continued exceptional mildness of the season is, of course, keeping back the usual winter demand for house fire coals, but there is no appreciable improvement in the demand for other classes of fuel for ironmaking, steam, and manufacturing purposes generally, and both common round coals and engine fuel are bad to sell with prices excessively low. At the pit mouth quoted rates remain at about 8s. 6d. to 9s. per ton for best coals, 7s. to 7s. 6d. for seconds, 5s. to 5s. 6d. common coals, 4s. 3d. to 4s. 9d. burgy, 3s. 6d. to 4s. best slack, and 2s. 6d. to 3s. per ton for common sorts.

In the shipping trade there is a moderate business doing, and an effort is being made to get some slight advance on the excessively low rates which have been ruling of late, 7s. per ton being now the average quoted prices for steam coals delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—The hematite pig iron trade of this district steadily maintains the improved position which set in a month or six weeks back, and the indications are still favourable to a further increase in demand and increase in prices. Makers are much better sold forward than they have been for two or three years past. They have contracted to deliver large parcels of pig iron, but they are at present disinclined to sell largely, with a prospect of an early increase in the value of pig iron. Stocks have gone down very considerably throughout the district, but in many prominent cases makers and holders generally are waiting the dawn of better trade and fuller values before further reducing the iron they have in stock. The business doing in Bessemer is especially large. The demand is from all quarters, and it is equally brisk on home, continental, colonial, and American account. Prices are steady at 44s. 6d. per ton net at makers' works for prompt deliveries of mixed parcels of Bessemer iron, and 43s. 6d. for No. 3 forge and foundry iron. The steel trade is briskly employed, and rail makers are very busy on heavy contracts for home, American, and colonial users. The demand is also very well maintained, and heavy orders are in the market from all sources. Prices are still quoted at £3 17s. 6d. per ton for ordinary heavy sections of rails, and there is a tendency towards a higher figure. In other departments of the rail trade there is not much doing. Steel in slabs and billets is being worked off for the American market, but there is little doing in plates. Shipbuilders have booked no new orders and their works are very indifferently employed. The Solway Hematite Iron Company, at Maryport, has decided to re-open its works, which have been closed for some months. Iron ore is in fuller demand, and large stocks have lately been cleared. Makers of iron are anxious to buy largely for forward delivery, but raisers of ore are reticent about increasing their forward sales at present. Prices are steady at 9s. to 10s. 6d. per ton at mines. Coal and coke are steady and firm at late prices. Shipping is well employed, particularly in metal exports, and freights are better.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The firmness which has now for some time been notable in the Cleveland pig iron trade still continues, and even gathers strength. When the smelters decided a few weeks since to restrict production they repudiated all idea of forcing up prices to an excessive or artificial extent, saying that they merely wished to maintain them at the level of cost of production, or only a trifle above. This good resolution seems now to be completely forgotten. They feel for the moment masters of the situation, and they seem disposed to push home their advantage to the utmost.

At the Cleveland iron market, held at Middlesbrough on Tuesday last, sellers asked 33s. per ton for No. 3 g.m.b., and though offered within 3d. of that price by numerous buyers, they resolutely refused to part with their iron. Shipments from the Tees continue very considerable; on Monday night they reached a total of 56,941 tons exported since the 1st inst., which is 7320 tons more than during the corresponding portion of last month.

Nevertheless the stock in Connal's warrant store is still slightly on the increase, 907 tons having accumulated during the week, in addition to what was there before, and raising the total to 300,628 tons.

Considerable activity prevails at the various steel works in the district, and prices are firm, in sympathy with the increased value of the material they use; the selling price, however, has not been advanced. Finished iron makers have, on the contrary, put up their prices 2s. 6d. per ton to cover, as they say, the extra cost they will now be put to for forge pig. Ship plates are quoted at £4 10s. per ton; bars, at £4 12s. 6d.; and angles, at £4 5s., all free on trucks at makers' works, less 2½ per cent. discount.

Hematite pig iron has risen in value, notwithstanding the increased number of furnaces making it. The quoted price for mixed numbers is now 43s. to 44s., free on trucks at makers' works.

The question of dephosphorising pig iron in Siemens furnaces by the application thereto of basic linings is receiving renewed attention. The recent discussions at the Iron and Steel Institute have given an impetus to the question, which is of such vital importance to the Cleveland iron trade; for whereas the cheapness of Cleveland pig iron formerly gave an advantage to it, and to all products depending upon it in every market of the world, now that advantage seems to be lost. This is because steel has so largely superseded iron, and, except in the case of rails, it is mostly made of pure hematite pig iron, and not of the phosphoretted pig of Cleveland. By far the greater part of the hematite pig irons which are converted into steel in this country come from imported and not from native ores; and as these can be delivered at least as cheaply to any other iron-making centre on the sea-board, Cleveland has no special advantage.

For purposes other than rails, and especially for ship and boiler building, steel made by the Siemens process has now virtually superseded all others; and the pig iron entering into the composition thereof has hitherto almost always been hematite, and not ordinary Cleveland.

But if basic-lined Siemens furnaces could really be made a success this might be altered. The experiments made at Brymbo, Butterley, and elsewhere have been watched with interest by many persons, but the commercial success obtained at those places has not hitherto been sufficient to encourage much extension of the system. It is also noticeable that Mr. Riley, of Glasgow, who has had a basic furnace for some time, would not say at the Institute meeting that he had been commercially successful with it, although he considered it had been practically successful.

But, after all, the few facts briefly stated on the same occasion by Mr. Gilchrist were more important as a basis for further action than any number of opinions or so-called experiences. Mr. Gilchrist started with the general principle that acid linings are wrong, whatever kind of converting chamber is employed, and whatever may be the amount of phosphorus in the pig iron used. He pointed out that silicious linings have been entirely superseded by basic ones in puddling furnaces, with the most beneficial results, and that there is no just cause or reason why they should be retained for steel making.

He then gave the result of certain experiences obtained at a large continental works. With ·08 of phosphorus in the charge, steel having only ·002 was obtained. An 8-ton furnace produced 200 tons of ingots per week. The charge, composed of 20 per cent. pig and 80 per cent. of steel scrap, was melted in one hour, and only 15 to 18 per cent. of calcium carbonate was used. Too much heat could not be employed, and 25 per cent. more work could be obtained out of a basic than out of an acid furnace, with the same materials.

If these few simple facts are true—and there is no reason to doubt them—Cleveland may still have a chance of using some of its phosphoretted pig iron along with steel scrap, and making good steel for purposes other than rails. But it is at the same time clear that by the Siemens-basic process phosphorus is not removed without cost proportionate to the quantity of that ingredient present; whereas, in the Bessemer basic process, the more phosphorus, within certain limits, the better.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron market has again been strong this week, and quotations of warrants have reached a higher figure than before. All parties admit that the upward movement is to a large extent speculative, but the restricted output is having a very firm effect on the market. Shipments are not quite satisfactory, being only 6531 tons for the past week, as compared with 10,175 in the preceding week and 8323 in the corresponding week of 1885. Of the, total, 5290 tons were sent abroad, and 1241 coastwise. To Canada 2046 tons were despatched, and 1275 to the United States, these American shipments being much larger than usual. The demand for America is mainly for the better classes of makers' iron and for hematite, the prices of both of which are advancing.

Since last report Messrs. William Baird and Co. have put out other three furnaces in Ayrshire, reducing the total number in blast to 66, as compared with about 90 twelve months ago. It is known that some of the makers' stocks are being greatly reduced, but there is still a weekly addition to those in Messrs. Connal and Co.'s holdings, the quantity added in the past week being upwards of 1900 tons.

Business was done in the warrant market on Friday at 42s. 1d. cash. An extensive business was reported on Monday at 41s. 2d. to 41s. 4d. Tuesday's market was strong, with a further advance to 42s. 6½d. cash, closing somewhat lower. On Wednesday transactions occurred at 42s. 5d. to 42s. 0½d. cash. To-day—Thursday—transactions occurred at 40s. 0½d. to 40s. 6d.

The values of makers' iron are firmer, as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 48s. 6d.; No. 3, 44s.; Coltness, 51s. 6d. and 44s. 6d.; Langloan, 47s. 6d. and 44s.; Summerlee, 48s. 6d. and 44s.; Calder, 48s. and 43s. 6d.; Carnbroe, 44s. and 41s.; Clyde, 44s. and 40s.; Monkland, 44s. and 39s.; Govan, at Broomielaw, 44s. and 39s.; Shotts, at Leith, 46s. 6d. and 44s. 6d.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 44s. 6d. and 41s.; Eglinton, 42s. 6d. and 39s.; Dalmellington, 42s. 6d. and 39s. 6d.

The arrivals of Cleveland pig iron in Scotland for the past week were 6531 tons, being 1792 less than in the same week last year. For the year to date there is a comparative falling off in these shipments to the extent of 46,858 tons.

The further advance in the prices of pig iron has rendered necessary a second rise of 2s. 6d. in the malleable iron trade, which is not too well supplied with orders generally. For shipment to America scrap iron is getting into great demand. The large pipe founders are very busy with extensive contracts, including those for the Bombay, Manchester, and Cardiff waterworks.

The past week's shipments of iron and steel goods from the Clyde embraced two locomotive engines, valued at £5500 for Calcutta, machinery worth £21,750; steel goods, £2023; and general iron manufactures, £20,380.

The Scotch coal trade has been active in the past week, and the shipments have been larger at most of the ports than in the corresponding week of 1885. With reference to the quantity sent from Burntisland, it should be stated that the demand was considerably larger than could be met, and a greater quantity could been taken had they been available. The week's shipments from Glasgow, were 19.891 tons; Greenock, 3136; Ayr, 7721; Irvine, 1325; Troon, 7370; Burntisland, 20,766; Leith, 3236; Grangemouth, 15,059; and Bo'ness, 4891. For all and main coals the inquiry is very brisk, but the demand for steam coals is slack. Household sorts are not yet in great demand for home use; but as the prices have gone up somewhat, it is not unlikely that there may be a disposition to anticipate the cold weather manifested soon.

The miners are still holding to their demand for a second 6d. of an advance of wages; but it is doubtful if they will succeed. Much depends upon the action of the ironmasters, the more influential of whom continue to refuse the first 6d. If the present excitement in the speculative department of the pig iron trade were to eventuate in an extended inquiry for the consumption and shipment of makers' iron they would only be too glad to blow in the furnaces that have been put out, and give the colliers an advance of wages.

The request of the Fife colliers for an advance has just been declined; Mr. John Connal, the secretary of the masters, writes to Mr. Weir, the secretary of the colliers, as follows:—"I am instructed to reply that the action of the miners in restricting their working time, in violation of the conditions of employment, precludes the possibility of the coalowners considering the application you make on their behalf. The result of the restrictive policy adopted has been an increased cost of production, and the small advance of prices intimated—but not yet realised—would not counterbalance such extra cost."

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The Welsh coast has been assailed by one of the fiercest storms in the memory of man, and as a result export has suffered both in coal and iron. Fortunately Cardiff had scored well before it burst, and the total coal exports of last week was a reminder of old times, 160,000 tons having been sent away foreign. Swansea, on the other hand, did not come off so well, and only 20,000 tons were exported. Newport is doing better, but is in anything but a tranquil condition, an account of the movement in promotion of the new Monmouthshire railway, to which I referred last week, which will divert the produce of the deep sinkings to Cardiff.

New coal projects are increasing in Monmouthshire. One at Bargoed is spoken of which will be carried down to the Brithdiv steam by the Rhymney Company, and another at Deri by the Dowlais Company. The Great Western Colliery Company, which has the advantage of being nearer port than any other Rhondda Colliery, has carried a motion for a new pit which promises satisfactorily. These movements augur well, and the Welsh coal trade may be regarded as looking up, even though prices are *statu quo*.

The Great Western coal traffic to London last month showed a material increase. The London and North-Western too is doing well. In September it carried 3600 tons from the pits of the Aberdare Company, 1800 tons from Waynes, 2000 tons from Fforchaman, 1200 tons from Bwllfa, 1500 tons from Cwmdare, and also good supplies from Ebbw Vale, Nantymelin, and Cwm Bargoed. The Great Western showed better in some cases. Thus from the Aberdare Iron Company it took 5000 tons, from Bwllfa 5000 tons, Fforchaman 1600, Nixon's Navigation 5000 tons, and Aberaman 2400 tons.

The ironworks collieries in Glamorganshire are busier. Plymouth collieries last month sent 2000 tons by the Great Western alone to London.

Iron clearances to Huelva, Bilbao, and Halmstadt have taken place, and more activity is to be seen in most of the iron and steel works. Extra men have been taken on at Tredegar, and the manager of the ironworks, at a public gathering in that place, referred with pleasure to the signs of improvement which were at last visible.

Prices for blooms, &c., have been advanced in some quarters 5s. per ton.

One thousand four hundred tons pig iron came into Swansea last week. Pig iron is advancing from 6d. to 1s. per ton. Good rail contracts are expected, both home and foreign. Now that the railway excursion season is almost at an end—and it has been a good one all round—some rail renewal business may be confidently looked forward to, and an increase in speculative steel sleepers.

The Taff Vale Railway is busy with its new branch, and this promises to figure materially in new railway movements ahead. I must commend the Taff Vale Railway for its enterprise. The rails are looking rusty that trend in the direction of Ynysybwl, but now that work has begun that line will soon be busy. To the Ynyscaedidwg colliery, again, a fine branch has been completed long before coal was won. Now in that direction again things look well.

Railways have suffered considerably coastwise. I have gone over a good portion of the North Welsh district which has been submerged. The Dolgelly line was covered, so was the line to Aberyswith, but Mr. Conacher and his staff proved equal even to the greatness of the occasion, and now commerce and passenger traffic run in the old equable course.

I am glad to report again well of the tin-plate trade. There are several works restarting; Worcester Works, the stopping of which created such alarm, are notified as once more going, and though the worthy proprietor only begins with day-to-day contracts, yet prospects will soon improve. Llantrissaint tin-plate works are said to be also about to start.

Evidently things look better both in the Swansea and Newport districts. Close upon 44,000 boxes were shipped from Swansea last week. Stocks this week are down to 118,367 boxes, against 136,867 boxes last week. If this does not move prices I shall be surprised. Siemens steels are now firm at 14s. to 14s. 3d.; wasters are even quoted at 12s. 6d. Makers are bent upon lifting prices, and as blooms and bars are advanced 5s., they have ample excuse, apart from the fact that the late quotations were most unremunerative.

Shipping has suffered tremendously on the Welsh coast, and insurers will have a long bill to pay. There is still a large percentage of sailing craft employed at the coal ports, and one substantial reason is that in slack times such as Wales has endured they are cheaper. "Steamers eat their heads off."

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The pig iron market in Silesia shows some promising signs of improvement, though as to prices not quite such as might be wished, for within the last few days considerable sales of forge pig have been made for inland use, which will keep the principal furnaces going to the end of next March, besides others of better quality for export. Twenty-five furnaces are now at work producing 7000 tons weekly. M. 42 p.t. has been paid generally, and for one good indent as much as M. 45 was accorded. Foundry pig stands at 48 and 50 M. p.t., and the foundries are pretty full of work, but it would require still more orders to cause the prices to rise from their present low level. The rolling mills are still well employed, as before noted, and especially large quantities of girders are rolled off to complete the building season orders; also considerable parcels for export are being sent away. Ship and other good qualities of plates are also in brisk demand, whilst thin plates and sheets are less called for. Steel rails are now quiet, since few orders have been worked off. Bars and girders stand at 85, fancy sections at 95 to 100, and plates at 130 to 140 M. p.t. At the last tendering at Dresden the prices Krupp and another works asked were 132·20 and 133 M. p.t. respectively at Leipzig or Zwickau. As to prices in Rhineland-Westphalia, they are lower now than in 1879. The cessation of the coke combination has produced a depressing effect upon the pig iron market. The furnaces are still working on slowly in spite of very weak prices, and only very few of them can realise any profit at all. The masters in Siegerland met recently to discuss whether they should not blow out all their furnaces, as none were working without loss, but at last it was decided to keep on a little longer with the benevolent object of not throwing so large a portion of the population out of work at this season of the year. Some, more spirited than the rest, resolved to throw out all their antiquated and put in new plant where required, including Cowper hot air stoves, in order to try and reduce their cost of production. The bar mills are as fully employed as when last reported, some indeed specially busy, but as the old orders are worked off new ones are not arriving to replace them, which is markedly visible in girders, as the building season is closing fast, from which cause offers are being pushed at exceeding low prices for this article. Bar iron is now M. 20 cheaper than it was in 1879, but the present lower costs of production do not compensate for this. Sheets are looking more healthy, as the combination has been prolonged to the 1st of April next year, which helps to steady prices, though it cannot raise them, as some large works have remained without the ring. Wire rods still keep in request, especially for export, and now the mills are again busy, whilst prices have also somewhat advanced. The steel industry has again relapsed into its former dulness through the competition from abroad at the last tendering for rails for the Rhenish Railway, when the Cockerill Company's offer was 101; that of the Bochum Union, 104·50; of the Steel Industry Co., of Bochum, 105; the Rothe Erde Co.—Aix la Chapelle—105·50; the Dortmund Union, 107; the Rhenish Steelworks, 107·50; the Gute-Hoffnung's Hütte, 107·40; and Bolckow, Vaughan, and Co., 113 M. p.t.

The iron combination in Belgium can only be called nominally in existence, for there is no control over the export prices; nevertheless, the inland prices are maintained, which looks like sacrificing their export business at the general expense, and in order to accomplish this the 10 p.c. reduction of output was inaugurated.

In France the prices are weakening, caused in part by the approaching close of the building season. M. Eiffie's great tower is to be constructed partly in iron and partly in mild steel. The probability of Creusot ceasing to make rails was pointed out three weeks ago, and this appears to be correct, as the company intends to go more fully into marine and artillery work, as is said, with the object of competing better with England and Germany. To this end an amalgamation is to be made with some one of the large marine establishments on the Loire, Garonne, or the Mediterranean, with the financial co-operation of members of the Comptoir d'Escompte.

The coke trade here is very bad, which reacts on the other coal mines which do not produce coking coal; so the market for coal all round is anything but satisfactory, and it seems far from improbable that many mines will have to be closed if no speedy improvement takes place.

Metals generally seem inclined to take a rise. Spelter at Breslau is marked at M. 255 to 274 p.t., according to brand.

The following paragraph concerning the newly subsidised Bremen Line to the East, emanating from a party who has just returned from China, has been published in the *Nat. Zeitung* of Berlin, and as it is always interesting to know what rivals say—trusting it will not be considered entirely out of place in this column—it is here given *verbatim*:—"Scarcely had the first of the so-called subsidised steamers again arrived at Shanghai, and already the passengers for the East Asiatic Line were in motion, in order to take advantage of the new means of transport. The following points are those which a passenger has principally to take into consideration, when he undertakes a five to six weeks' voyage. In the first place, he desires the greatest safety, which can only be had when he is assured of the seaworthiness of the vessel and the experience and caution of the captain. The second care is the speed of the vessel, then the victualling department and general comfort on board is taken into consideration, of course at the same time not forgetting the amount of the passage money. As regards safety, for a long time the English P. and O. Co., Cunard Line, White Star Line, &c. —had a certain preference as against the French Lines—Messageries Maritimes, Compagnie Générale Transatlantique—and not without reason, perhaps, although for a long time past a misfortune has seldom overtaken the French lines. At present the preference is given to the German lines, and the passenger feels a comforting sensation on board the North German Lloyd boats, on account of the well-known superior knowledge and composure of both the captain and the sailors. On board the English and French steamers, Chinese and Malay sailors are frequently found, and in case of danger these men are not to be depended upon, as is the case on the German vessels, where the sailors have in part been schooled in the German Navy." A paper of wide circulation in the United States—*Harper's Magazine*—lately wrote quite a long and enthusiastic article concerning the German captains, accompanied with excellent portraits of the several parties mentioned. "The speed of the fast Bremen steamers (in nine days from New York to Bremerhaven) beats all the other undertakings on the Atlantic and on the East Asiatic Line, and the Lloyd will be four days in advance of the other steamers. With respect to the third point, the meals on board the Peninsular and Oriental boats are far behind those on board the Messageries Maritimes lines, and only because there was no other competition is it to be accounted for that the public has so long quietly endured the incredibly stingy providing, the antiquated arrangement of the berths, and the unfriendly service, &c. On the Lloyd's boats it is found, on the other hand, that all the meals are abundantly and excellently supplied, and indeed habitual gourmands speak with great satisfaction of them. The cabins are roomy and tasteful, and the service is punctual and civil. The education of the captains, their dignified and friendly manner of intercourse with the passengers, stamps upon the whole company assembled an impression of gentility to be found nowhere else; and, finally, the passage money is about the same on all the lines, but the North German Lloyd is a little cheaper than that of either the French or the English boats."

With these remarks I can in no particular agree. I have travelled with foreign and English boats, and on once arriving on *terra firmâ* vowed never to go by a foreign if I could go by an English boat, especially in rough weather. It may be, perhaps, a matter of taste. I hope some one will break a lance for the P. and O. Company.

NEW COMPANIES.

The following companies have just been registered:—

Allen Machine Company, Limited.

Upon terms of an agreement of the 27th ult. this company proposes to acquire from John James Allen, of Halifax, his patent rights in respect of his gumming, pasting, sizing, and varnishing machines, and his automatic paper-feeding apparatus, and also of his registered "gumolene." It was registered on the 12th inst. with a capital of £50,000, in £5 shares. The purchase consideration is £7000 in cash and 1200 fully-paid shares. The subscribers are:—

	Shares.
*Thomas Wayman, M.P., Halifax, wool merchant	1
*J. Woodhead, M.P., Huddersfield, newspaper proprietor	1
*J. Haley, Cleckheaton, card manufacturer	1
T. England, Halifax, solicitor	1
J. E. Carter, Halifax, mechanical engineer	1
*J. Allen, Halifax, insurance broker	1
J. J. Allen, Halifax, inventor and patentee	1

The number of directors is not to be less than three nor more than seven; qualification, ten shares; the first are the subscribers denoted by an asterisk, and the Hon. Cecil Ashley, of 7, Cork-street, W.; remuneration, £100 per annum to the chairman, and £50 per annum for each other director.

Asbestos Fire-proof Paint Company, Limited.

This company proposes to take over the business of paint manufacturers hitherto carried on as one of the departments of the United Asbestos Company, Limited, together with the goodwill, letters patent, plant, stock, and machinery used in connection therewith. It was registered on the 7th inst. with a capital of £20,000, divided into 3500 ordinary and 500 deferred shares of £5 each. The subscribers are:—

	Shares.
*C. J. Mountford, Small Heath, Birmingham, paint manufacturer	100
W. White, 29, De Crespigny Park, Denmark-hill	100
*J. P. Sharp, Birmingham, architect, &c.	50
*J. R. Gittings, Park-lane Works, Birmingham, varnish manufacturer	100
F. Mundy, 26, Temple-street, Birmingham, advertising contractor	10
L. Barouche, 86, Colmore-row, Birmingham, chemical agent	10
E. A. Smith, 373, Lodge-road, Birmingham, cashier	10

The number of directors is not to be less than three nor more than seven; qualification, £100 in share capital; the first are Messrs. Howard Aston Allport, C.E., Dodworth-grove, Barnsley; Arthur Chisholm Moore, of 23, Essex-street, and the subscribers denoted by an asterisk; remuneration, £250 per annum. Each director will be also entitled to 5 per cent. upon the profits remaining for distribution after payment of 10 per cent. dividend upon both classes of shares, and also of 7½ per cent. dividend upon the amount of their invoices, to those members who have traded with the company. Mr. Charles Mountford is appointed first managing director upon terms of an agreement of the 10th ult.

Candillium Bronze and Bearing-Metal Company, Limited.

This company proposes to produce and manufacture candillium bronze and bearing-metal and other alloys, metallic substances and metals, and for such purposes to enter into an agreement with Reginald Wm. Scaife and others. It was registered on the 7th inst. with a capital of £20,000, in £1 shares. The subscribers are:—

	Shares.
H. D. Browne, 10, Draper's-gardens	1
J. A. Cameron, 10, Throgmorton-avenue	1
T. Gordon Fairbairn, 7, Great Winchester-street	1
N. J. Pertis, 4, Copthall-court	1
C. G. Tunks, 8, Draper's-gardens	1
H. Cooke, King's Langley	1
T. H. Potter, Hoddesden, Herts, stockbroker	1

The number of directors is not to be less than three nor more than six; the subscribers are to appoint the first; qualification, 100 shares; remuneration, £300 per annum, and also an amount equal to 10 per cent. of the profits in excess of sufficient for the payment of 10 per cent per annum dividend.

English-Italian Works and Contract Company, Limited.

This company proposes to obtain concessions and powers for the construction and working of public or private undertakings and works of all kinds, whether British or foreign, and to obtain from the Italian or any other Government, or from municipal, provincial, or other authority, all necessary powers for enabling the company to carry out any of its objects. It was registered on the 9th inst. with a capital of £250,000, in £10 shares. The subscribers are:—

	Shares.
W. J. Cordner, 63, Queen Victoria-street, merchant	1
O. J. Williams, 56, Tisbury-road, Brighton, engineer	1
J. Fyfe Meston, 50, Parliament-street, contractor	1
M. J. Burn, 9 and 10, Pancras-lane, solicitor	1
B. Hodge, 25, Davies-street, W.	1
W. Scott, 63, Queen Victoria-street, merchant	1
G. Rodger, Hill side, Sunderland-road, Forest-hill	1

The number of directors is not to be less than five nor more than seven; the subscribers are to appoint the first and are to act *ad interim*; qualification, 50 shares, or equivalent stock; remuneration, two guineas per attendance, or such other sum as the company in general meeting may determine. Mr. Oliver J. Williams is appointed managing director at a salary of £1000 per annum, and will also be entitled to a commission of £5 per cent. upon the net profits. If required to do so by the directors, Mr. Williams is to reside in Italy or elsewhere, and is to take charge of the Italian or other department of the business.

F. H. Perry and Co., Limited.

This is the conversion to a company of the business of opticians, scientific apparatus manufacturers, and electrical engineers, carried on by Messrs. Perry and Cox in Victoria-street, Liverpool. It was registered on the 8th inst. with a capital of £4000, in £5 shares. The subscribers are:—

	Shares.
*F. Hanson Perry, 70, Chatham street, Liverpool, optician and electrician	1
Mrs. J. M. Perry, 70, Chatham-street, Liverpool	1
*C. H. Thomson, 15, Birchfield-road, Liverpool, clerk	1
J. E. Banks, 23, Balmoral-road, Liverpool	1
W. Coppin, 181, Islington, Liverpool, engineer and marine architect	1
*F. W. Wetter, 18, Water-street, Liverpool, general broker	1
*W. J. Bland, Fairfield, Liverpool, clerk	1

The number of directors is not to be less than three nor more than six; qualification, 10 shares; the first are the subscribers denoted by an asterisk and Mr. Leon Perry; the company in general meeting will determine remuneration.

Oldbury Railway Carriage and Wagon Company, Limited.

This company was registered on the 11th inst. with a capital of £ 20,000, divided into 15,000 preference and 15,000 ordinary shares of £4 each, to take over the whole or part of the business property and liabilities of the Railway Carriage Company, Limited. The subscribers are:—

	Shares.
J. Harris Stretton, 75, Cornhill, solicitor	1
*J. Underhill, J.P., Wolverhampton	1
*J. Brooks, 28, Bell-street, Birmingham, paper dealer	1
*A. Higginson, 3, Westminster chambers, solicitor	1
*H. Wheeler, Edgbaston, Birmingham, managing director of a company	1
Perry Wheeler, Edgbaston, Birmingham	1
G. H. Newman, 75, Cornhill, solicitor	1

The number of directors is not to be less than three nor more than five; qualification, 100 ordinary shares or corresponding stock; the first are the subscribers denoted by an asterisk and Mr. John Kershaw; the company in ordinary meeting will determine remuneration.

Petroleum Power Company, Limited.

This company was constituted by deed of settlement on the 2nd inst., and registered as a limited company on the 18th inst., with a capital of £12,000 in £10 shares. It proposes to acquire from the Société Anonyme des Moteurs Inexplosibles au Petrole Ordinaire et au Gaz, Brussels, and to work and deal with petroleum engines, or engines actuated by the explosion or combustion of mixed gas, or vapour, or air; 1000 shares are taken up and are fully-paid. The members are:—

	Shares.
V. e de Roest d'Alkemade, Brussels	300
Baron Van Nyevelt, Brussels	300
J. Palmer, jun., 50, Finsbury-square, merchant	125
Julien Deby, C.E., 31, Belsize-avenue, N.W.	130
R. M. Moir, Christchurch-road, Hampstead	130
Adam Miller, Deanhurst, Hampstead, consulting engineer	10
E. H. Wigzell, 30, Finsbury-square clerk	5

Table A of the Companies' Act, 1862, will apply.

St. James's Electric Light Company, Limited.

This company was registered on the 7th inst. with a capital of £50,000, in £5 shares, to enter into a contract dated the 1st ult., with Hall and Partners, Limited, contractors, under which they undertake to acquire, for the benefit of the company, a site for an electric installation in the parish of St. James's, Westminster. The subscribers are:—

	Shares.
W. Hall, Penstone, Lancing, Sussex, contractor	1
F. W. Cutlack, 69, Ship-street, Brighton, contractor	1
H. Hunter, 16, St. Swithin's-lane, engineer	1
R. Harrison, 16, St. Swithin's-lane, engineer	1
J. H. Kirtley, 70A, Aldermanbury, solicitor	1
R. St. George Moore, C.E., 9, Victoria-chambers, S.W.	1
M. R. Ward, 10A, Great Queen-street, S.W., electrical engineer	1

The number of directors is not to be less than three nor more than five; qualification, £100 in shares; remuneration, £300 per annum. The subscribers are the first directors.

South Durham Salt Company, Limited.

This company was registered on the 11th inst. with a capital of £150,000, in £5 shares, to take over the business, assets, and liabilities of the Haverton-hill Salt Company, Limited, including the interests of the company in the Haverton-hill Brine Wells and Salt Works. The subscribers are:—

	Shares.
*W. G. Ainslie, J.P., M.P., 23, Abingdon-street, S.W.	1
*E. Wadham, J.P., Dalton-in-Furness	1
*A. H. Strongitharm, C.E., Barrow-in-Furness	1
*J. Vivian, C.E., St. Bee's, Cumberland	1
R. Grigg, Norton, Stockton-on-Tees, salt manufacturer	1
W. Peile, M.E., Whitehaven	1
John Webster, Whitehaven, solicitor	1

The number of directors is not to exceed nine; qualification, 100 shares; the first are the subscribers denoted by an asterisk. The remuneration of the board will be determined at the first general meeting.

Giona Sulphur Company, Limited.

This is a reconstruction of an existing company of the same name, possessing mines known as Giona, Gionateella, and Tenesta, near the town of Girgenti, Island of Sicily. It was registered on the 8th inst. with a capital of £40,000, in £1 shares, of which 35,000 are £6 per cent. non-cumulative preference shares. The subscribers are:—

	Shares.
E. C. Emett, 12, Wells-street, Gray's-inn-road, clerk	1
J. R. Swan, 77, Church-street, Stoke Newington, secretary to a company	1
Z. J. Worledge, 3, Newbold-street, Commercial-road, book-keeper	1
J. W. Seager, 85, Gracechurch-street, agent	1
J. T. Sprague, 117, Gothe-lane, Birmingham, electrician	1
J. D. Blount, J.P., Reading	1
P. H. Hall, 26, Basinghall-street, solicitor	1

The number of directors is to be three, and the subscribers are to appoint the first; qualification, £250 in shares; remuneration, £1 1s. to each director for every board meeting attended.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

11th October, 1886.

12,944. Cravats or Neckties, A. Havrenick, London.
12,945. Power Accumulating Apparatus for Tramcars, F. Jordan, London.
12,946. Weather Guards for Hansom Cabs, &c., E. Grimshaw, London.
12,947. Stretching Vellum on the Rim of a Banjo, G. H. Young and W. G. Coker, London.

12th October, 1886.

12,948. Cutting, &c., the Edge of Wall Paper, J. L. Lowe, Market Rasen.
12,949. Air-tight Caddy, C. H. E. Twist and J. Collins, Glasgow.
12,950. Lock Hinges, H. J. Allison.—(*B. C. Anderson, United States.*)
12,951. Nitrogenated Water, A. and L. Q. Brin, London.
12,952. Machines for Printing Fabrics, S. Knowles, Manchester.
12,953. Fire-extinguishers, A. J. Eastwood, Manchester.
12,954. Observing Apparatus, Fire-escape, or Lift, J. Aylward, Coventry.
12,955. Gas Taps, C. R. F. and R. P. S. Schloesser, Manchester.
12,956. Printing, &c., the Surfaces of Various Materials, P. A. Martin, Birmingham.
12,957. Watch Keys, Charms, &c., A. Martin, Birmingham.
12,958. Cleaning the Outsides of Windows, A. Rochford, Dublin.
12,959. Joints for Fishing-rods, &c., H. Whitty, Liverpool.
12,960. Type-writing Machinery, J. Becker, London.
12,961. Undergirding of Ships after Collision, G. Barnley, Wigston Magna.
12,962. Fancy Double Fabric Weaving, H. B. Broadhurst and E. Smith, Manchester.
12,963. Checking the Receipts of Conductors, J. S. Rhodes, Birmingham.
12,964. Baking Oatcake, W. Dewhirst, Bradford.
12,965. Rulers for Drawing Parallel Lines, J. Turner, Skipton-in-Craven.
12,966. Hot Plate for Keeping Dishes, &c., Warm, R. W. Boyd, London.
12,967. Edge-tools, J. Salter, Wednesbury.
12,968. Application of Delivery Rollers to Condenser Carding Engines, N. and R. B. Worsley, T. Crabtree, and T. Kellon, Manchester.
12,969. Chamfering, &c., Screw Nuts, R. S. Wood and E. N. Dunderdale, Manchester.
12,970. Utensils used for Cooking in Front of Fires, J. Turner, Skipton-in-Craven.
12,971. Pneumatic Buffers, E. Holt, Radcliffe.
12,972. Dragging Bristles into Lengths, W. S. Yates, Halifax.
12,973. Cutting Soap, J. Wright, Birmingham.
12,974. Rollers for Window Blinds, B. Dadley, Blackwall.
12,975. Blowing, Exhausting, and Pumping, F. H. Stacey and H. Wilkinson, Sheffield.
12,976. Regulating the Spring of Sheep Shears, T. Birkhead, Sheffield.
12,977. Locking, &c., Railway Carriage Doors, T. Osborne, C. H. Woodhouse, and J. T. Shipman, Sheffield.
12,978. Card Punching Apparatus for Looms, R. W. Sutleffe, London.
12,979. Electrical Communicating Apparatus, W. Chadburn, Liverpool.
12,980. Letter Racks, J. M. Porter, Leeds.
12,981. Book Rests for Pianos, &c., H. D. and C. E. Groves, Halifax.
12,982. Flying Shuttlecock, T. Fishburn, London.
12,983. Cigar Piercer, H. Agar and T. S. Griesbach, London.
12,984. Safety Lamp, A. N. J. Contarini and H. G. Owen, London.
12,985. Stoppering Bottles, &c., J. E. Black, Glasgow.
12,986. Washing and Absorbing Cases, &c., H. C. F. Stoimer, London.
12,987. Wooden Pulleys, P. M. Justice.—(*W. H. Dodge, United States.*)
12,988. Pulleys, &c., P. M. Justice.—(*W. H. Dodge, United States.*)
12,989. Indestructible, &c., Scythe Sharpener, G. S. Hinton, Upton Cressett.
12,990. Manufacture of Glass, &c., J. Armstong, London.
12,991. Protection from Warlike Missiles, C. Wraa, London.
12,992. Manufacture of Rivets, S. Arnold, London.
12,993. Seats for Places of Amusement, &c., E. L. White, London.
12,994. Fastener for Gloves, &c., E. Fisher, London.
12,995. Secure Loop Holder for Elastic &c., Cord, H. Coppin, London.
12,996. Waterproof Cloths, T. Carnelley, London.
12,997. Angle Clamps for Uniting the Corners of Boxes, &c., J. Scherbel.—(*T. Remus, Saxony.*)
12,998. Controlled Excavating Grab, J. W. T. Stephens, Kent.
12,999. Pressure Reducing Valves, F. Foster and H. M. Thomas, London.
13,000. Horseshoes, J. R. Cox, London.
13,001. Sodium Product, J. I. Watts and W. A. Richards, Liverpool.
13,002. Harvester Binders, A. J. Boult.—(*J. and T. H. Noxon, Canada.*)
13,003. Ascertaining the Presence of Obstructions to Navigation, F. D. Torre, London.
13,004. Harvester Binders, A. J. Boult.—(*J. and T. H. Noxon, Canada.*)
13,005. Perforating Machinery, M. H. Pearson and C. Bennion, London.
13,006. Spring Locking Devices for Drill Hoes, A. J. Boult.—(*T. H. Noxon, Canada.*)
13,007. Treatment of Sewage, J. C. Butterfield and H. H. Mason, London.
13,008. Seeding Machines, A. J. Boult.—(*T. H. Noxon, Canada.*)
13,009. Flexible Driving Shafts of Dental Engines, A. E. Ash, London.
13,010. Bathing Apparatus, O. Imray.—(*J. W. James, United States.*)
13,011. Manufacture of Pyroxyline, O. Imray.—(*G. M. Mowbray, United States.*)
13,012. Stopping Holes in Ships, C. H. S. Schultz, London.
13,013. Knitting Machines, P. M. Justice.—(*F. Wilcomb, United States.*)
13,014. Paper Folding Machines, E. Koenig, London.
13,015. Effecting the Heating of Water, A. and L. Q. Brin, London.
13,016. Envelopes for Postal Purposes, W. A. Barlow.—(*P. Graves, France.*)
13,017. Link Piece and Safety Clutch, L. E. Broadbent, London.
13,018. Electrical Apparatus for Starting Races, R. E. Phillips, London.
13,019. Gas Burners, W. J. Sawyer, London.
13,020. Brake for Tramway Cars, T. Cox, sen., and T. Cox, jun., London.
13,021. Fire-proof Shutters for Stairways, H. Dale, London.
13,022. Locking Device for Studs, H. H. Lake.—(*A. Combault, H. J. Rohdé, and F. F. Delpy, France.*)
13,023. Protecting the Soles of Boots, H. M. Kemp, London.

13th October, 1886.

13,024. Crinoline or Crinolette Steel, A. Whittle, Pendlebury.
13,025. Lock Lid for Teapots, &c., J. Reid, Hanley.
13,026. Sight-feed Lubricators, J. T. Hallwood Rochdale.
13,027. Lathe Carrier, R. Caunce, Nottingham.
13,028. Paper Tubes used in Spinning Machines, R. Beswick, Manchester.
13,029. Scraping and Cleaning Roadways, W. Dewar, Strathmartin.
13,030. Belt for Driving Machinery, W. Ingham, Middlesbrough-on-Tees.
13,031. Adjustable Countersink Bits, &c., T. W. H. Turnbull, Monkwearmouth.
13,032. Manufacture of Horse Nails, &c., W. H. Dorman, Strafford.
13,033. Syphon Flushing Cistern, M. J. Heighley, Liverpool.
13,034. Button Fasteners, F. R. Baker and T. Banford, Birmingham.
13,035. Gas Chandeliers, &c., G. J. Williams, Birmingham.
13,036. Tuning Pianofortes, F. A. Wardle, Longton.
13,037. Penholder with Finger-guard, &c., F. A. Naylor, Angleton.
13,038. Flat Portable Weighing Machine, &c., F. A. Naylor, Angleton.
13,039. Arrangement of Clasp for Fastening Corsets, R. Simpson, H. Simpson, and B. G. Simpson, Sheffield.
13,040. Corsets, R., H., and B. G. Simpson, Sheffield.
13,041. Coupling Railway Wagons, &c., T. A. Brockelbank, London.
13,042. Filters, G. L. Scott, Manchester.
13,043. Conveying the Adjustment of Gas Taps, W. Pepper, Stockton-on-Tees.
13,044. Necks and Stoppers of Bottles, &c., E. Brokenshar, Cornwall.
13,045. Carpenters' Braces, J. Thropp, Birmingham.
13,046. Bicycles, &c., C. and J. Neesom, and H. James, Bradford.
13,047. Ovens, G. Gledhill, Halifax.
13,048. Application of Trays to Pianofortes for Holding Cigars, &c., A. Hanson, Halifax.
13,049. Self-locking Nut and Bolt, T. R. Weston, Bristol.
13,050. Roller Bearings, G. Weston, Sheffield.
13,051. Valve for Tap-holes of Barrels or Casks, H. Morgan, Birmingham.
13,052. Sinking the Surfaces of Steel Dies, &c., W. Stanley, South Norwood.
13,052. Securing and Releasing the Doors of Railway Carriages, F. T. Page and O. B Granville, London.
13,054. Preparing Fibre for Textile and other Purposes, T. Honywood, London.
13,055. Cutting and Slicing Bread, J. F. Clarke, London.
13,056. Window Fastenings, A. E. Gray, London.
13,057. Musical Boxes, A. Browne.—(*A. Junod, Switzerland.*)
13,058. Electro-motors to Vehicles, M. Immisch, London.
13,059. Ornamental Metallic Chains, W. A. Bancroft and W. J. Bancroft, Birmingham.
13,060. Securing the Doors of Railway Carriages, A. J. Norman, London.
13,061. Machinery for Turning Over and Closing the Sockets of Shovels, &c., C. Leedham and W. C. Heaton, Leeds.
13,062. Stoppering Bottles, S. F. Pichler, London.
13,063. Chests for Packing Tea, &c., A. Andrews, London.
13,064. Gas Valves for Water Heating Apparatus, J. Winterflood, London.
13,065. Waste Preventing Valves, J. Earsdon, London.
13,066. Regenerative Gas Lamps, S. Chandler, sen., S. Chandler, jun., and J. Chandler, London.
13,067. Momentum Checker for Weighing Machines, W. B. Avery, London.
13,068. Medicine Measures, W. R. Macauley, London.
13,069. Iron and Steel Hooping, W. H. Gilrutl, Calcutta.
13,070. Guns and Projectiles, R. H. Ridout, London.
13,071. Files and Scrap-books, E. A. Kittell, and B. Park, London.
13,072. Pneumatic Railway Brakes, J. Imray.—(*W. Lillie, France.*)
13,073. Extracting Gold and Silver from Ores, A. Parkes, London.
13,074. Velocipedes, A. Peddie, London.
13,075. Hand Grenades, S. Norris, London.
13,076. Dish or Plate for Advertising Purposes, H J. Haddan.—(*E. Porrero, Spain.*)
13,077. Harness, P. A. Küchenmeister, London.
13,078. Shipping Coal, P. G. B. Westmacott, Newcastle-on-Tyne.
13,079. Valve Gear of Steam, &c., Engines, W. A. Kyle, London.
13,080. Exciting and Depolarising Battery Fluid, W. C. Goldner, London.
13,081. Forges and Forge Bellows, W. H. Beck.—(*A. Enfer, France.*)
13,082. Syphons for Holding Aerated Waters, E. Edwards.—(*J. Thieulin, France.*)
13,083. Machine Guns, &c., H. S. Maxim, London.
13,084. Horseshoes, G. H. Gregory, B. B. Anthony, and W. B. Carron, London.

14th October, 1886.

13,085. Inserting a Plate Underneath Harness or Riding Saddles for Prevention and Cure of Sore Backs in Horses, &c., J. Cottrell, Bristol.
13,086. Dyes, F. R. Japp, Chiswick.
13,087. Gas Motor Engines, J. Wright, Manchester.
13,088. Securing Pots to the Tops of Chimneys, E. Marland, Oldham.
13,089. Lubricating the Bearings of Machinery Spindles, &c., J. Marsh, T. Hargreaves, and J. Greenwood, Ashton-under-Lyne.
13,090. Envelope for Dry Sensitive Plates for Photographic Purposes, F. H. Anderton and G. W. Elliott, Sheffield.
13,091. Tarpaulin Wagons, &c., J. H. Fryer, Birmingham.
13,092. Closing the Orifice of Bottles, &c., A. and B. Travis, Dukinfield.
13,093. Ventilating Band for Hats, W. Whittaker, Manchester.
13,094. Perforated Emery Wheel for Saw Grinding, &c., R. Fenn, Guildford.
13,095. Disinfection and Extinction of Fires, A. Boake and F. G. A. Roberts, Stratford.
13,096. Steel, Iron, or Composite Ships, J. Greenhow, Stockton-on-Tees.
13,097. Self-adjusting Link for Chain Tackle, J. H. Parker and T. Mason, Birmingham.
13,098. Dress Goods, C. H. Priestley, Bradford.
13,099. Lowering the Glasses of Carriage Windows, H. Mulliner, Leamington.
13,100. Carrying Luggage upon Hansom Cabs, H. Mulliner, Leamington.
13,101. Cocking Hammerless Guns, W. Ford, Birmingham.
13,102. Printing on Footways, &c., G. Quarrie, Liverpool.
13,103. Street Orderly Bin, J. Ritchie, Glasgow.
13,104. Bottles for Aerated Waters, &c., T. L. Switzer, Newport, I.W.
13,105. Weaving Pile Fabrics, O. Drey, Manchester.
13,106. Permanent Way, J. J. Cleminson, London.
13,107. Buttons, &c., A. P. Bethell, Anerley.
13,108. Starting Gas Engines, H. N. Bickerton, London.
13,109. Regenerative Gas Lamps, J. E. Lewis, London.
13,110. Fastenings of Bracelets, &c., M. Davis, Birmingham.
13,111. Electric Lamps, W. Ward, Halifax.
13,112. Cleaning Carpets, &c., F. A. Collis, Glasgow.
13,113. Injectors, E. P. Howe, London.
13,114. Fixing or Suspending Sashes, W. Burnett and D. Petrie, Dundee.
13,115. Note-book, W. Kilburn, London.

13,116. Alarm Bell, J. McEwen, London.
13,117. Folding Portable Library Cabinet, H. J. Stanesby, London.
13,118. Horseshoes, J. Long.—(*S. Yergin, United States.*)
13,119. Watch Case Bands, E. Chatelain.—(*E. Keller and F. G. Dutoit, Switzerland.*)
13,120. Feed for Sewing Machines, A. F. Wileman, Ealing.
13,121. Automatically Giving an Electric Shock, W. B. Avery, London.
13,122. Delivering the Warp from the Warp Beams of Looms for Weaving, J. Cowburn and C. Peck, Manchester.
13,123. Automatic Fan, J. O'Connor and A. Spencer, Manchester.
13,124. Governors, J. F. Haskins.—(*G. D. Davis, United States*)
13,125. Circular Knitting Machines, W. Blake, London.
13,126. Reflectors for Incandescent Lamps, J. G. Lorrain and S. Waters, London.
13.127. Scavenger Mechanism for Spinning and Drawing Frames, W. A. Delmage, London.
13,128. Sugar Cane Mills, F. Swales.—(*H. Swales, Brazil.*)
13,129. Blowing and Beating Cotton, &c., J. A. Hart and Dr. C. Baynes, London.
13,130. Cranes and Hoists, P. G. B. Westmacott, Newcastle-on-Tyne.
13,131. Tricycle, B. Green and S. Lee, London.
13,132. Rockers for the Annealing Lier of a Flint Glass House, E. Moore, London.
13,133. Regulating Mechanism for Intermediate Belt Gear, H. H. Lake.—(*S. Jönsson, Denmark.*)
13,134. Bicycles, &c., H. H. Lake.—(*A. Sidwell, United States.*)

15th October, 1886.

13,135. Light Reflectors, F. W. Hayward, Norwich.
13,136. Hooking Cloth, H. W. and A. W. Brewtnall, Thelwall.
13,137. Machinery for Spinning Fibres, J. A. Leeming, Halifax.
13,138. Hand Drills, J. Glover, Halifax.
13,139. Preventing the Escape of Gas, A. Berriman, Devonport.
13,140. Drying Yarn, T. Mitchell, Bradford.
13,141. Marking Billiards and other Games, E. Smith, Poole.
13,142. Electric Indicator, E. O. Eaton, S. F. Huxley, J. T. Mayfield, and J. T. Todman, London.
13,143. Receptacle for Spirits, &c., S. L. Beveridge, Birmingham.
13,144. Chair for Binding Rails to Sleepers, McN. C. Bowie, Glasgow.
13,145. Connecting Warp to the Beam, G. D. Sykes, Huddersfield.
13,146. Sharpening Bits for Horseshoes, F. and S. A. Ward, Sheffield.
13,147. Stoppering Bottles, J. Senior, Sheffield.
13,148. House Drainage, T. Armstrong, Newcastle-on-Tyne.
13,149. Boxing Gloves, J. Sadler, Nottingham.
13,150. Cleaning Fire-arms, R. Morris, London.
13,151. Steel, F. Siemens and J. G. Gordon, London.
13,152. Friction Appliances for Pulleys, Speed Cones, &c., W. H. B. Vanes.—(*A. B. Vanes, Cape of Good Hope.*)
13,153. Typewriting and Printing, P. Barr, Glasgow.
13,154. Breech-loading Small-arms, T. Woodward, Birmingham.
13,155. Utilisation of Waste Steam, J. Williams, Liverpool.
13,156. Machines for Filling Bottles, J. Holt, Manchester.
13,157. Driving Mechanism for Velocipedes, S. Davies, London.
13,158. Railway Return and other Tickets, A. F. Pennell, London.
13,159. Sanitary Dust-bin, H. A. Price, London.
13,160. Boots and Shoes, W. P. Thompson.—(*M. C. Mullarky, Canada.*)
13,161. Binding or Filing Letters, &c., J. B. J. Jaillon, Liverpool.
13,162. Pulverising Ores, &c., E. Packard.—(*E. C. Griffin, United States.*)
13,163. Obtaining Heat and Light, H. C. Christopher, London.
13,164. Holding Open Sacks, &c., J. A. Winwood, London.
13,165. Fastener for Windows, &c., C. F. Grimmett and J. Cook, Birmingham.
13,166. Finishing Textile Fabrics, A. Whowell, London.
13,167. Extinguishing Oil Lamps, F. V. Smythe, Gravesend.
13,168. Liquid Cement, E. M. Knight and A. H. Hobson, Halifax.
13,169. Levelling Ground Surfaces, J. H. Walsh, London.
13,170. Lithographic Printing, E. G. Hollis, London.
13,171. Automatic Horse Hay Rake, H. Lees, Kilpedder.
13,172. Artificial Teeth, R. Stone, London.
13,173. Fabrication of Compounds of Bisulphate and Biphosphate of the Alkalies from the Neutralised Sulphates and Concentrated Phosphoric Acid, A. Packard, London.
13,174. Furnace Bars and Grates, M. Orval, London.
13,175. Hydraulic Motor, W. Fletcher, London.
13,176. Shipment of Coal from Railway Wagons, G. Taylor, London.
13,177. Machine Bottle Brushes, F. Slater, London.
13,178. Pistols, F. B. W. Roberts and H. R. Stewart, London.
13,179. Washing Linen, &c., G. F. Redfern.—(*P. Olassen, Belgium.*)
13,180. Lamps, &c., J. Methven, London.
13,181. Boots, &c., A. W. Osman, Leicester.
13,182. Soldering Fluid, T. Garton, London.
13,183. Hydro-carbon Lamp Burner, H. Ditchfield, London.
13,184. Portable Swinging Elevator and Depressor, G. C. Thorne-George and J. M. Copeland, London.
13,185. Aluminium, G. B. de Overbeck, London.
13,186. Combining Steam Engines with Dynamo-electric Machines, &c, P. W. Willans, Thames Ditton.
13,187. Advertising, J. Plimsaul, London.
13,188. Platen Printing Machines, H. S. Cropper and S. Thacker, London.
13,189. Cleaning Metals, H. J. Kirkman, London.
13,190. Displaying Advertisement, R. H. Scales, London.
13,191. Sewing Buttons Upon Cloth, H. H. Lake.—(*J. S. Collins, United States.*)

16th October, 1886.

13,192. High-speed Rotary Fork Cleaning Machine, W. E. Renshaw, Pendleton.
13,193. Road Sweeping Machine, W. T. Carter and J. Keeble, Bury St. Edmunds.
13,194. Lawn Tennis Bats, D. Allport, London.
13,195. Direct-acting Engines, O. T. and O. J. R. Flather, Isleworth.
13 196. Hydrants and Fire Cocks, R. Blakeborough, Brighouse.
13,197. Extinguishing Gas, J. S. Edge, jun., and F. W. Ticehurst, Birmingham.
13,198. Stands for Displaying Views, W. H. Richards, Birmingham.
13 199. Making Furniture Drawings, J. W. Adlam, London.
13,200. Rulers for Ruling Parallel Lines, G. W. Mohrstadt, Birmingham.
13,201. Presser Rollers of Machines for Sizing Yarn, C. Catlow, Halifax.
13,202. Automatically Opening the Doors of Hoists, J. Wright, Manchester.
13,203. Steam Traps, R. Pye, Halifax.
13,204. Link Belts, J. Blackwood, Glasgow.
13,205. Terra Cotta, J. D. Denny, Llangollen.
13,206. Indexing, G. Ramsay, London.
13,207. Adjustable Tobacco Cutter, C. and C. L. Parkin, Sheffield.
13,208. Electricity Meter, &c., E. T. Carter, Bristol.
13,209, Producing Mosaic by Enamelling Glass, W. Lutwyche.—(*A. Ceresa, Italy.*)
13,210. Wheels for Carriages, &c., J. K. Starley, London.
13,211. Life Protector and Snow Plough, R. H. Dickinson, Birmingham.
13,212. Excelsior Riding School, J. Rose, Boston.
13,213. Manufacture of Goloches, F. Miller, Manchester.
13,214. Hydraulic Mains, P. Innes.—(*J. Bremner, Peru.*)
13,215. Screws, H. Dalgety, London.
13,216. Violins, J. Gilchrist, Glasgow.
13,217. Stopping Engines, &c., J. Fothergill, W. Briggs and I. Briggs, Birmingham.
13,218. Showing Pattern Books, J. Line, jun., Birmingham.
13,219. Easel, H. Meunier, London.
13,220. Bicycles, &c., W. Hillman, W. H. Herbert, G. B. Cooper, R. A. Dalton, G. F. Twist, and A. Rotherham, London.
13,221. Bicycles, &c , W. Hillman, W. H. Herbert, G. B. Cooper, R. A. Dalton, G. F. Twist, and A. Rotherham, London.
13,222. Brown or Black Malt for Brewing, A. W. Gillman, S. and E. S. Spencer, and A. Perry, London.
13,223. Drilling Hard Substances, S. Godfrey, London.
13,224. Tubular Metallic Articles, S. Fox, London.
13,225. Locking Nuts, F. W. Rafarel, London.
13,226. Fire Bars, F. Goddard, London.
13,227. Treating Coal, &c., W. H. Hawkes, London.
13,228. Controlling the Supply of Water for Domestic Purposes, O. Brown, London.
13,229. Motor Engines, J. J. R. Humes, London.
13,230. Smelting Lead Ores, J. B. Clark and the Panther Lead Company, London.
13,231. Door Locks, W. S. Simpson, London.
13,232. Pen, &c., A. Butler, Leeds.
13,233. Decorating Ceramic Ware, J. G. Macintyre and F. Vodrey, London.
13,234. Bottles, H. Barrett, London.
13,235. Facilitating the Shipment of Coals, P. G. B. Westmacott, Newcastle-on-Tyne.
13,236. Loading Coal, &c., into Vessels, Sir W. T. Lewis, Aberdare, and C. L. Hunter, Cardiff.
13,237. Glasses for Lamps, P. Ward, London.

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13 238. Ingot Moulds, J. Havenhand, Sheffield.
13,239. Metal Pipes, G. H. Lloyd, Sutton Coldfield, A. L. Lloyd, Leamington, and H. Bewlay, Birmingham.
13,240. Cameras, J. E. Thornton, Manchester.
13,241. Boxes for containing Bottles Filled with Aerated Waters, D. Rylands, Barnsley.
13,242. Fire-proof Ceilings, &c., F. W. Floring and K. J. Mayer, Germany.
13,243. Swings or Swing Boats, J. Parker, Hull.
13,244. Stoves for Heating Purposes, C. Portway and A. Kibble, London.
13,245. Iron Bedsteads, &c , L. H. Brierley, Birmingham.
13,246. Cope Iron for the Sides of Lorries, &c., H. Muir, Glasgow.
13 247. Soles for Boots, &c., H. Walker, Sheffield.
13,248. Gas Burners for Cooking Apparatus, J. F. Wright and G. E. Wright, Birmingham.
13,249. Giving Medicated Vapour Baths, &c., S. Thompson, West Bromwich.
13,250 Mechanism for Actuating the Heckle Bars of Gill Boxes, I. Willems and E. Depoorter, Liverpool
13,251. Washing Casks, G. Thornley and T. Buxton, London.
13 252. Toy Torpedo, W. J. Brewer, London.
13,253. Bedsteads, &c., W. Cow and J. Cow, Glasgow.
13,254. Machinery for Dredging, G. T. Peters, London.
13,255. Supply of Water for Domestic, &c., Purposes, C. Garrood, London.
13,256. Concertinas, W. P. Dando, London.
13,257. Reversible Rowlock or Crotch, C. E. Stares, London.
13,258. Tone Regulating, &c., Stop, H. R. Schreiber, London.
13,259. Pressing Hops, G. Thornley and T. Buxton, London.
13,260. Perspective Drawings, R. E. Creasey, United States.
13,261. Boxes for Storing Food, &c., W. B. Williamson, London.
13,262. Framework for Tricycles, G. Singer, London.
13,263. Horseshoes, E. von Kleist and H. Michaelis, London.
13,264. Printing Several Colours on Paper, &c., I. H. Storey, J. Wilkinson, and H. Bateson, Manchester.
13,265. Doors of Bakers' Ovens, C. Rougeot, London.
13,266. Blast Furnaces, E. Walsh, jun., London.
13,267. Keyless Watches, J. Robinson, London.
13,268. Gear for Guns, C. H. Murray, Newcastle-on-Tyne.
13,269. Controlling Hydraulic Apparatus for Training Heavy Guns, &c., C. H. Murray, Newcastle-on-Tyne.
13,270. Wire-netting Machines, P. A. Newton.—(*E. Gilbert, United States.*)
13,271. Bearings of Steering Centres, G. J. Stevens, London.
13,272. Ventilating Railway Carriages, E. E. Haine, London.
13,273. Velocipedes, J. F. Haskins.—(*S. Elliott, United States.*)
13,274. Automatic Safety Water Gauge, J. Bullen, Manchester.
13,275. Holder for Sheets of Paper, E. J. James, London.
13,276. Treating Worts and Yeast, A. G. Fraser and G. Epstein, London.
13,277. Protection of Water-colour Drawings, &c., G. H. Ogston, London.
13,278. Composition for Architectural Purposes, C. Straub, London.
13,279. Facilitating the Exposing, &c., of Sensitised Material in Carriers for the purposes of Photography, F. Houghton, London.
13,280. Animal Trap, J. O. Spong, London.
13,281. Appliances for Novel Recreation Game, W. Stobbs and E. L. White, London.
13,282. Marking Boot and Shoe Patterns, F. A. Jones and W. L. Cottrell, London.
13,283. Tanning and Stuffing Leather, A. M. Clark.—(*J. B. West, United States.*)
13,284. Pigments, F. M. Lyte, London.
13,285. Frames of Umbrellas, &c., B. J. B. Mills.—(*Teste fils, Pichat, Moret, et Cie., France.*)
13,286. Treatment of Spent Lyes, A. Frank, London.

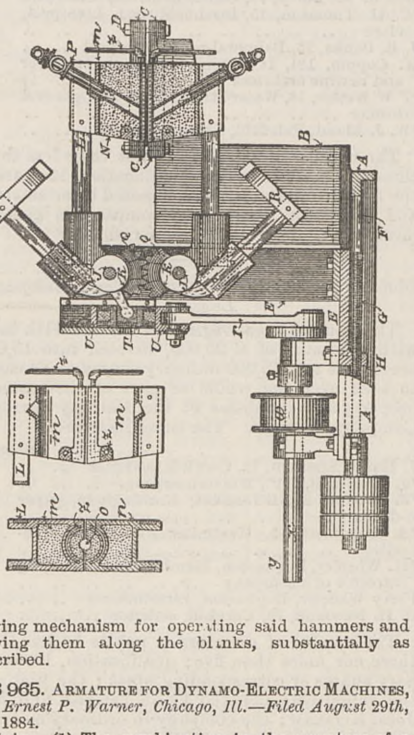
SELECTED AMERICAN PATENTS.

(*From the United States' Patent Office official Gazette.*)

346,828. Welding Machine, *John B. Root, Port Chester, N.Y.—Filed June 27th*, 1885.

Claim.—(1) In a machine for welding sheet metal blanks together, the combination of a clamp for supporting the blanks and holding them in position to be heated, blow pipes for heating the edges of the blanks, and a furnace structure inclosing the blow pipes and arranged to confine their action to the edges of the blanks, said blow-pipes and inclosing structure being mounted on travelling supports, adapting them to be moved along the edges of the blank, substantially as described. (2) In a machine for welding sheet metal blanks together, the combination of a clamp for holding the blanks in position to be welded, a hammering mechanism arranged to operate upon both sides of the blanks and mounted upon travelling supports adapting it to be moved along the edges of the blank while operating to weld such edges, and stationary

346,828

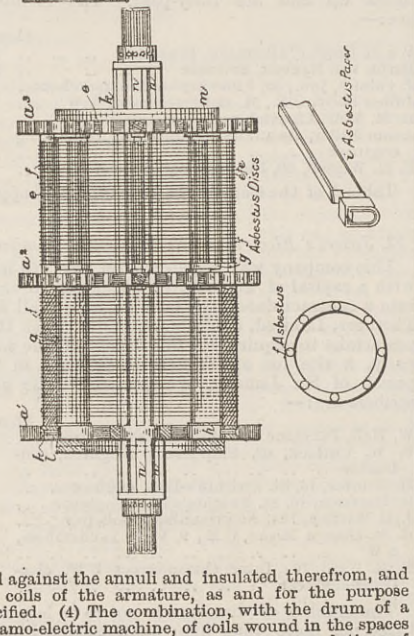


driving mechanism for operating said hammers and moving them along the blanks, substantially as described.

346 965. Armature for Dynamo-Electric Machines, *Ernest P. Warner, Chicago, Ill.—Filed August 29th*, 1884.

Claim—(1) The combination in the armature of a dynamo-electric machine, of the bars g, the thin soft iron rings, and the strips of insulating material l, interposed between said rings and the different bars or supports g, whereby the rings and bars are insulated substantially as and for the purpose specified. (2) The combination, in the armature of a dynamo-electric machine, of the brass rings a^1 a^2 a^3, provided with lugs b b, the shaft of the armature, and spiders for supporting the brass rings, substantially as and for the purpose specified. (3) The combination, with the brass rings or carriers provided with spaces for the coils, of yokes h, insulated from bars g, the bars g

346,965.

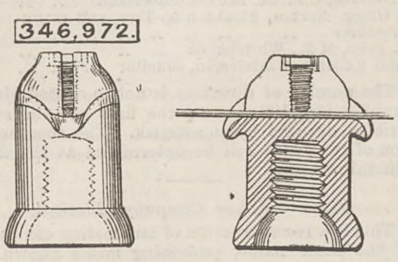


held against the annuli and insulated therefrom, and the coils of the armature, as and for the purpose specified. (4) The combination, with the drum of a dynamo-electric machine, of coils wound in the spaces provided thereon, as described, all the convolutions of each coil being included within its space on one side of the drum and distributed or divided between two or more spaces on the opposite side, substantially as specified. (5) The combination, upon the shaft of a dynamo-electric machine, of asbestos rings or circular pieces m m, and asbestos strips n n, substantially as shown and described. (6) The combination, with the coils of a dynamo-electric machine, of the shaft, the insulating rings m m, and the strips n n, placed upon the shaft, whereby the coils are insulated from the shaft, substantially as and for the purpose specified.

346,972. Telegraph Insulator, *John Wilson, New York, N.Y.—Filed November 2nd*, 1885.

Claim.—(1) The insulator constructed with a deep transverse notch in the upper end, adapted to receive and hold the wire when stretched through the groove, and also constructed with coincident vertical screw-threaded cavities in the walls of the notch, adapted to

346,972.



receive and retain a binding screw, in combination with it and the wire, and being screwed in from the top of the insulator on the wire lying on the bottom of the groove. (2) The combination of a binding screw with the insulator having the deep transverse notch in the top adapted for the stretched wire to lie in, also the coincident screw-threaded cavities in the walls of the notch for the binding screw, and also the wrench socket at the top for the head of the screw.

347,088. Steam Engine Indicator, *Walter F. Brown, Providence, R.I.—Filed December 12th*, 1885.

Claim.—(1) In a steam engine indicator or recorder, the combination, with the parallel mechanism, substantially as shown and described, and pivotted standard carrying said mechanism, of an elastic diaphragm removably secured to the enlarged head of a tube adapted to communicate with the interior of the engine cylinder, a spring lever mounted above and extending across the centre of said diaphragm, its free end having a universal or ball joint connected with said parallel mechanism, and a frame resting upon the centre of the diaphragm, said frame having a rod or stem adjustably mounted therein which connects with and partly supports the spring lever, the whole constructed and arranged substantially as shown, and for the purpose herein set forth. (2) In an engine indicator, provided with a paper-carrying barrel, and the pivotted standard D carrying the parallel mechanism and tracer, the combination, with the adjustably-mounted spring lever I connected with the parallel mechanism, substantially as shown and described, of the elastic diaphragm B, annular nut F, and tube C, the latter being adapted to connect with the interior of the engine cylinder, whereby the pressures of steam, air, vapour, or other gases within the cylinder are communicated to the diaphragm, thereby vibrating the said spring lever and causing the tracer to move vertically, substantially as shown and for the purpose set forth. (3) In a steam engine indicator or recorder, the combination, with the attaching tube C, having an enlarged chambered head C^1, mechanism for producing a parallel movement of the pencil, and the suitably mounted spring lever I of the metallic multiple diaphragms b, removably secured to the said chambered head C^1, substantially as shown and for the purpose set forth. (4) The combination, with the tube C, diaphragm B, nut F, and dog H, adapted to engage said nut, of the spring lever I removably secured to said dog, mechanism for carrying a pencil or tracer, a link L connecting said mechanism, a universal or ball joint i^2 connecting the link L to the free end of the said spring lever, the centre frame K resting upon the diaphragm, a rod r connecting the frame K and lever I, and means for vertically adjusting said rod, as set forth. (5) The combination, with the suitably mounted elastic diaphragm B and frame K, resting upon the centre portion thereof, of the spring lever I and rod or stem r, adjustably mounted in the frame K, said rod passing through the flattened or spring portion i of the lever, and being provided with an enlargement or head r^1, upon which the centre portion of said lever rests, substantially as shown and set forth. (6) As an improved article of manufacture, the steam engine indicator A herein

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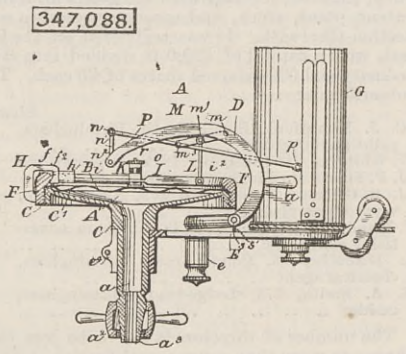
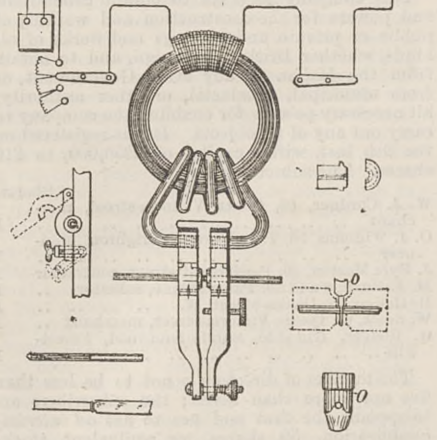


before described, the same consisting of the tube C, having an enlarged head C^1, provided with an elastic disc or diaphragm B, which is secured in place by means of the annular nut F, and forming the chamber A^1, a spring lever I mounted in a dog H attached to said nut, a frame K resting upon the centre of the diaphragm, having a rod r passing through and supporting the lever I, said rod being adjustably mounted in the frame K, an arm E adjustably secured to the tube C, having a paper-carrying barrel G mounted at its outer end, and further provided with a socket e, intermediate of the barrel and tube, a bent support or standard D mounted in socket e, the working lever P adapted to move the pencil or tracer in a vertical direction by means of links M n^1, pivotted to said standard, and the link L connecting the link M and the free end of the spring lever I, the whole arranged and adapted for use substantially as shown and set forth.

347,141. Apparatus for Electric Welding, *Elihu Thomson, Lynn, Mass.—Filed March 29th*, 1886.

Claim.—(1) In an apparatus for electric jointing or welding, a source of heavy currents and means for regulating the same, in combination with devices for holding the pieces to be welded, and with a means of imparting a pressure tending to force such pieces together. (2) In an apparatus for electric jointing or welding, the combination, with devices for holding pieces to be welded, of a coil wound upon an iron core and connected with a source of electricity, a secondary coil or circuit of low resistance, connections from said secondary coil to the holding devices, and means for varying the magnetic inductive effects of the core upon the secondary, as and for the purpose described. (3) In an apparatus for electric jointing or welding, the combination, with devices for holding the pieces to be welded, of an induction apparatus wound with two coils, one of low resistance as compared with the other, connections from the low resistance coil to the holding devices, and a source of electric current connected with the coil of comparatively high resistance. (4) The combination, with the clamping blocks and

347,141.



means for connecting the same with a source of electricity, of a stop plate O, having a thin portion, against which the parts to be welded may be abutted, and a thicker portion, against which the clamp blocks may abut, so as to determine their distance apart in the operation of inserting parts to be welded. (5) In an apparatus for electric welding, a regulable source of current of electricity and means of passing the same through the pieces to be welded and across their surfaces of contact, in combination with means for exerting a regulable pressure upon such surfaces, as described. (6) An apparatus for electric welding, consisting of a primary coil fed by alternating currents, means for regulating the effect of said currents upon the secondary coil in inductive relation thereto, clamps for holding the pieces to be joined, so as to contact with each other at the point of junction, and means for pressing said pieces together at the point of junction, as described.