EXPERIMENTS WITH A CORLISS ENGINE AT CREUSOT.

(*Continued from page 150.*)

WE stated in our last impression that the French horse-power is less than the English, and all the results obtained during the Creusot trials are qualified by this consideration. The French horse-power is reduced to English by multiplying it by ·9863, while the English horse-power is reduced to French by multiplying it by 1·0139. That is to say, 1014 French horse-power are 1000 English, or 988-horse power English are 1000 French. We must also call attention to an error, which corrects itself. Table I. is headed, "Without condensation, without steam jacket." This should read, "*With* condensation, without steam jacket." As the vacuum is given, however, the mistake is of no importance. Again, in the indicated horse-power column, close to the end, will be found an omission of several figures, and the words "Not accurately stated." The figures in the original are so inconsistent with all the others that we omitted them, feeling certain that they are misprints. The indicated horse-power is given in Experiment 21 as 347; in Experiment 22 as 344; while two powers are given for Experiment 23, namely, 261 and 184. The last figure here is obviously the only one which can be accurate. This will be seen in a moment if a comparison is made with the other figures in the table. Thus, for example, the highest power elsewhere recorded is 197, attained in the ninth experiment. The brake horse-power was 163; so that 34-horse power was consumed by the engine, or 19·8 per cent. nearly. In Experiment 21 the brake horse-power is 134, or a little more than one-third of the stated indicated horse-power, which is absurd. In Experiment 12, which was the most economical, the indicated horse-power was but 152 in round numbers, while the brake, or effective horse-power, was 123; the difference absorbed in engine friction, &c., being 29-horse power, or 12·5 per cent. A comparison of all the percentages of difference between the indicated and effective horse-power throughout the 23 experiments will be found very instructive. The effective horse-power is the return which a manufacturer gets for his money; and a very high economical result measured in terms of indicated horse-power may be anything but economical if expressed in terms of effective horse-power.

We may now proceed to consider the results obtained by further experiments. Among these we may first select those made to ascertain the value of compression. Arrangements were made for this purpose by which the exhaust-valve closed when the piston had yet to make 7 per cent. of its stroke. The results are set forth in Table II. We may compare Experiment 53, Table IV., with Experiment 68, Table II., which closely corresponds in point of cut off and pressure. It will be seen that with compression a saving of 6 per cent. was secured. The consumption of steam being, without compression, 12·20 lb., and with it 11·47 lb.

We may now compare the results obtained when steam was admitted to the jacket with those obtained when it was excluded. The best result obtained without the jacket with condensation was in Experiment 12, when the consumption of steam was 8·08 kilogs., or 17·62 lb. per I.H.P. per hour. The best run with steam in the jacket, given in Table III., is No. 26, when the consumption was 7·38 kilogs., or 16·20 lb. The jacket, therefore, saved about 1¼ lb. of steam per horse-power per hour, or a little over one-twelfth. But it must not be forgotten that the pressure in the latter case was nearly double that in the former. The best run with the jacket in use, the pressure being 64 lb. in the boiler, was No. 33, when the consumption was 7·87 kilogs., or a little over 17 lb., or, within a fraction, a similar result to that obtained in Experiment 12.

From Table IV. we learn what the value of the condenser is. The best economical result without condensation was obtained in run 51, when the consumption was 11 kilogs., or 24·25 lb., the cut-off taking place at very nearly quarter stroke, the boiler pressure being 78 lb. We can compare this with run No. 60, with steam in the jacket when the consumption was 9·62 kilogs., or 20·3 lb. nearly. The cut-off took place at as nearly as possible one-fifth of the stroke, and the pressure being 110 lb. The indicated horse-power was 240 in this run, while in Experiment No. 51 it was but 180. It is not easy to say, therefore, how much of the effect was due to the influence of the jacket, and how much to the fact that a greater weight of steam was passed through the engine per minute. The total quantity of steam condensed in the jacket seems in all cases to have been small. Thus, in run 60 the total quantity was 28 kilogs. in 30 min., or 56 kilogs., or 123·5 lb., per hour, or within a small fraction of ·5 lb. per indicated horse-power per hour, which seems to be much too small to be of value. This is due no doubt to the fact that the ends of the cylinder are not jacketted, but seeing that the consumption of steam is wholly measured by what takes place during the time the admission port is open, it is obvious that it is more important to prevent condensation taking place in the cylinder then than at any other time. If great condensation takes place during admission, the steam is wet during the whole stroke, and it is of the last importance to keep it dry. This wet steam, it is true, raises the toe of the diagram, but it only does this because re-evaporation takes place in the cylinder, and thus all the steam condensed is re-evaporated twice, once in the boiler and once in the cylinder, although it only does useful work once.

(*To be continued.*)

MR. TOWERS' FRICTION EXPERIMENTS.

THE results of Mr. Towers' experiments have now been before the engineering public for some time. Have they led to any modification in practice? So far as we are aware to none whatever. For example, Mr. Towers has shown that the pressure on the top of a bearing where the oil hole is almost invariably made, is so great that it seems to be practically impossible for the oil to remain just where it is most wanted. We cannot find, however, that many if any engineers supply oil at the sides of their bearings in

TABLE III.

With Condensation; with Jacket.

Number of experiment.	Duration of experiment, in minutes.	Initial pressure. kilogs.	Percentage of admission.	Vacuum in centimetres of mercury.	Revolutions per minute.	Horse-power. Indi-cated.	Horse-power. Effec-tive.	Consumption of steam, in kilogs. Total.	Consumption of steam, in kilogs. Per I.H.P.	Consumption of steam, in kilogs. Per E.H.P.	Weight of water condensed in jacket. Total. kilogs	Weight of water condensed in jacket. Per kilog. of steam used.
Boiler Pressure, 110 lb.												
24	73	7·34	0·055	69·5	58·8	143·4	112·7	1330	7·63	9·72	not measur'd	—
25	55	7·20	0·067	69·0	61·5	161·7	128·5	1103	7·45	9·37		—
26	80	7·30	0·067	69·5	59·9	157·0	124·8	1541	7·38	9·27	45	0·029
27	39	7·40	0·125	68·0	58·1	215·0	177·4	1100	7·87	9·53	35	0·032
Boiler Pressure, 89 lb.												
28	94	5·98	0·050	69·5	59·6	114·0	85·6	1412	7·90	10·53	43	0·030
29	102	5·86	0·055	70·0	59·6	125·5	95·5	1657	7·75	10·32	52	0·031
30	40	5·91	0·115	69·0	59·4	178·6	143·9	897	7·55	9·38	11	0·122
31	40	5·91	0·140	68·5	60·0	195·7	160·4	1021	7·83	9·56	15	0·015
Boiler Pressure, 64 lb.												
32	115	4·21	0·060	70·5	59·9	93·0	69·8	1457	8·27	11·02	37	0·025
33	92	4·21	0·090	69·5	59·6	119·0	92·2	1439	7·87	10·15	—	—
34	90	4·28	0·155	69·0	58·8	151·6	122·7	1765	7·76	9·58	32	0·018
35	71	4·35	0·200	68·0	59·1	177·2	148·0	1655	7·90	9·47	25	0·015
36	50	4·38	0·250	67·0	59·0	196·7	166·2	1357	8·30	9·80	22	0·016
Boiler Pressure, 50 lb.												
37	98	3·22	0·050	71·0	60·3	69·8	47·8	955	8·63	12·60	25	0·026
38	63	3·63	0·100	70·0	57·6	96·8	73·1	841	8·27	10·95	19	0·023
39	60	3·45	0·143	71·5	59·7	121·9	96·2	992	8·13	10·31	14	0·014
40	74	3·42	0·220	70·5	60·1	153·8	124·5	1603	8·46	10·43	23·5	0·014
41	50	3·53	0·290	68·0	59·5	181·0	148·5	1327	8·80	10·72	16	0·012
Boiler Pressure, 36 lb.												
42	73	2·25	0·190	70·0	60·7	112·7	84·5	1213	8·85	11·80	19	0·016
43	80	2·32	0·420	67·5	61·9	164·2	135·4	2166	9·88	11·98	24	0·011
44	40	2·47	0·580	66·0	61·1	182·5	155·0	1382	11·37	13·36	8·5	0·006
45	25	2·44	{admission during the whole stroke}	64·0	60·4	201·3	177·0	1238	14·77	16·80	2·5	0·002

TABLE IV.

Without Condensation; without Jacket.

Number of experiment.	Duration of experiment, in minutes.	Initial pressure. kilogs.	Percentage of admission.	Revolutions per minute.	Horse-power. Indicated.	Horse-power. Effective.	Consumption of steam, in kilogs. Total.	Consumption of steam, in kilogs. Per I.H.P.	Consumption of steam, in kilogs. Per E.H.P.
Boiler Pressure, 110 lb.									
46	78	6·77	0·130	61·7	149·5	127·0	2466	12·7	14·94
47	55	7·04	0·170	61·4	184·0	161·9	2024	12·0	13·63
48	25	7·17	0·200	63·6	220·0	196·7	1059	11·55	12·91
Boiler Pressure, 78 lb.									
49	66	5·18	0·155	62·0	123·0	104·6	1670	12·34	14·53
50	60	5·41	0·180	60·9	137·8	119·9	1645	11·95	13·73
51	60	5·39	0·245	60·0	180·4	161·3	1987	11·00	12·29
52	30	5·45	0·320	60·6	212·0	103·0	1148	10·82	11·90
Boiler Pressure, 50 lb.									
53	71	3·57	0·245	61·4	109·6	95·8	1586	12·20	13·93
54	70	3·60	0·370	61·1	149·0	133·3	2117	12·17	13·60
55	50	3·55	0·580	60·9	175·7	160·0	1976	13·50	14·83
56	25	2·45	{during the whole stroke}	60·6	147·0	136·6	1282	20·95	22·50

TABLE V.

Without Condensation; with Jacket.

Number of experiment.	Duration of experiment, in minutes.	Initial pressure. kilogs.	Percentage of admission.	Revolutions per minute.	Horse-power. Indi-cated.	Horse-power. Effec-tive.	Consumption of steam, in kilogs. Total.	Consumption of steam, in kilogs. Per I.H.P.	Consumption of steam, in kilogs. Per E.H.P.	Weight of water condensed in jacket. Total kilogs.	Weight of water condensed in jacket. Per kilog. of steam used.
Boiler Pressure, 110 lb.											
57	80	6·90	0·110	60·8	145·0	122·6	1973	10·20	12·07	50	0·025
58	60	7·30	0·130	62·0	180·0	154·7	1779	9·90	11·50	60	0·034
59	36	7·24	0·160	62·0	197·0	173·3	1187	10·00	11·36	37	0·031
60	30	7·28	0·200	62·7	240·0	214·5	1154	9·62	10·74	28	0·020
Boiler Pressure, 78 lb.											
61	70	5·41	0·165	61·1	139·0	118·8	1715	10·58	12·37	29	0·017
62	50	5·33	0·235	61·6	182·5	163·2	1484	9·75	10·88	18	0·012
63	30	5·48	0·300	60·5	207·0	188·5	1017	9·82	10·80	13	0·013
Boiler Pressure, 50 lb.											
64	70	3·70	0·230	60·5	109·5	95·8	1448	11·32	12·94	22	0·015
65	60	3·64	0·340	60·5	143·5	127·8	1617	11·28	12·64	18	0·011
66	50	3·25	0·580	60·3	170·8	154·5	2298	12·86	14·20	14	0·007
67	30	2·37	{during the whole stroke}	61·1	149·5	139·0	3096	20·70	22·25	4	0·0026

TABLE II.

Number of experiment.	Duration of experiment, in minutes.	Initial pressure. kilogs.	Percentage of admission.	Revolutions per minute.	Horse-power. Indi-cated.	Horse-power. Effec-tive.	Consumption of steam, in kilogs. Total.	Consumption of steam, in kilogs. Per I.H.P.	Consumption of steam, in kilogs. Per E.H.P.	Weight of water condensed in jacket. Total kilogs.	Weight of water condensed in jacket. Per kilog. of steam used.
Boiler Pressure, 47 lb.											
68	85	3·70	0·240	60·1	110·0	96·2	1789	11·47	13·1	—	—
69	75	3·72	0·375	59·7	142·0	127·0	2058	11·45	12·8	—	—
70	50	5·51	0·230	60·0	172·5	155·2	1362	9·48	10·5	25	0·018

order to get over this difficulty. It appears to be scarcely worth while to carry out a costly series of experiments if the lessons they teach are simply put by and ignored. There are, however, two sides to this as there are to every question, and it may be asked whether the information supplied by Mr. Towers is of any practical value? It must be admitted that, in the present day, a great deal is taught to engineers—and, indeed, to everybody else, from Board-school children up—which is of no use whatever; and it may be argued that machinery will not perform any better, or use less oil, or run cooler, or be less wasteful of power, because Mr. Towers has shown that the hitherto received statements concerning the various coefficients of friction are all wrong. This is not our argument, be it understood; but it is an argument which deserves some consideration, if for no other reason then because it seems to represent the view of Mr. Towers' experiments taken by practical machine makers. If it can be shown that bearings do not give any trouble now, and use very small quantities of oil, it may be asked, what does it matter whether the coefficient of friction is 0·01 or 0·001? It is a noteworthy fact that, although the Institution of Mechanical Engineers set these experiments on foot, its members seem to be quite content to place the results on record in their "Transactions," and do nothing more. Surely they are worth a better and fuller discussion than they have yet received.

The most troublesome class of bearings with which the engineer has to do are those of marine engines. It seems to be quite impossible to work them cool without employing quantities of cold water. The crack racers of the Atlantic—such, for example, as the Arizona or the Oregon—have spray pipes fitted over the crank pits; and from these a deluge of water is distributed during the whole run. The water is never shut off, save for the moment when a man feels the bearings to ascertain if they are running cool. There is besides a 2in. hose always ready for action. Why should all this be necessary? It may be said that the great heat of the engine-room tends to make the bearings hot. But the crank shaft stage in such ships as we are speaking of is not hot at all. The cylinders are away far up overhead. The boiler-rooms are shut off by the bulkhead. We have felt chilly in the crank-room, as it may be called, of one of these great ships. Why is it, again, that the bearings of a locomotive hardly ever heat? It may be taken as proved that if a locomotive is properly designed and properly worked there will be no trouble from hot bearings; yet the loads per square inch of surface are very heavy indeed. Take, for example, a big end brass; the bearing will be 4in. long and 8in. in diameter, the pressure on it with a 17in. cylinder and 120 lb. pressure will be 27,240 lb.; the bearing surface will be—allowing one-third of the total surface to take the strain—33in., let us say. Thus the load per square inch will be 825 lb., which is much more than is usually deemed safe. In small stationary engines, on the other hand, we constantly find that the bearings give a great deal of trouble. Why is this? Have the experiments of Mr. Towers thrown any light on the subject, or helped us to the reason why? We think not, or rather, we should say, that engineers as a body think not, for we still have hot bearings, Mr. Towers to the contrary notwithstanding. Our own explanation of hot bearings is that they are in nearly all cases due to some bending or pinching action. Heating can be set up by a very minute cause, and once it is started it will go on. In one out of many cases, in fact, which have come under our knowledge, where a crank pin heated persistently, the evil was due entirely to the circumstance that the crankshaft was too weak, and bent and whipped under the strain. It will constantly be found that crank shafts will run quite cool, unless the bearings are so far screwed down that the crank shaft has very little play. In other words, absence of "knock" and heating go together. The received explanation of this is that when the brasses are a loose fit the oil gets between the surfaces. This may be a partial explanation, but not a complete one, because it leaves the fact unexplained that bearings will not invariably heat because they are screwed up. When hot bearings are normal to an engine, we believe—we had almost said we know—that something is out of square; there is want of truth and accuracy. A slack brass is simply a crude expedient for obviating this difficulty. It permits the rubbing surfaces to play about and adjust themselves to each other. No properly-designed, properly-lubricated bearing wants to run hot. If it heats, it is driven to it, so to speak, against its principles. One reason why a locomotive runs cool is that provision is made for a great deal of self-adjustment. This is necessary in a machine which runs over a comparatively uneven and crooked surface. There is elasticity, and this serves a useful purpose. We too often find, however, in steam machinery that a partial and very mischievous elasticity is introduced by the employment of parts too small and light for their work. James Watt and the early engineers could not have got on at all if they had not made special provision for want of accuracy in workmanship. Thus the connecting rod was always connected to the beam end by one universal joint, and very often there was another at the crank shaft end of the rod. The piston rod and parallel motion, and the beam and the air pump rod, were all mutually accommodating. The result was that these old engines are running, many of them, to this day.

Returning once more to Mr. Towers' experiments, we ask for information as to whether anyone is acting on the discoveries—for they are nothing else—and if so, with what results? We confess that we have failed to discover anyone who is the better in any respect of them. This ought not to be the case. Everyone says that they are of great value; is it wrong to ask of what value? Are they worth something to the community in a pecuniary sense? if not, why not? Nothing is more to be deplored, we think, in engineering than that the intelligent, costly, and successful labours of a member of the profession should be thrown away. It reminds us of the work done by Government Committees, who take evidence and pursue investigations, extending over months, it may be years. Finally they report. But nothing comes of the report.

PRIVATE BILLS IN PARLIAMENT.

The various private Bills now before Parliament have made rapid progress during the past week, and although March has hardly yet been entered upon, many of these measures will be before Select Committees of one or the other House in the course of the next few days. Such advance as this has not been witnessed for many years, and always assuming that a sudden dissolution does not interrupt their career, the numerous schemes now under consideration are likely to receive more than usual care and consideration, and thus to be more satisfactory in the results. Recent occurrences suggest that before many more sessions are over radical changes will have been introduced into the method of dealing with these measures, but at the least it may be expected that these Bills will in future be hurried on to the Committee stage much earlier than they have heretofore. The Committees for forming the Select Committees and grouping the Bills are now hard at work making their selections; and on Monday some of the Committee-rooms will again be occupied by promoters, partisans, and opponents. One of the first Bills to be taken in hand will be the Manchester Ship Canal Bill—still the biggest scheme of the session. A week ago it seemed probable that a real effort would be made to bring about a joint Committee of the two Houses to settle this project once for all, and so avoid a double inquiry and two-fold expense. But when the Bill was proposed for second reading in the House of Lords on Monday no proposal in that direction was made, and the Bill passed the stage without comment. There was something mysterious in this collapse of the movement initiated a week ago, and inquiry traces the cause very much, if not entirely, to Lord Redesdale, whose rigid adherence to forms and precedents are a terror to all who dream of new paths in regard to private legislation. Going back to the few cases of joint Committees on record, Lord Redesdale takes the view that such instances involved wide general interests quite different from the questions raised by a private scheme of this kind, however large it might be. From this quarter, therefore, no encouragement was to be obtained, and that meant a good deal; but it is also true that the opponents of the Bill have shown no real desire to avoid the trouble and cost of a double investigation and contest. Under those circumstances, the promoters were not likely to take action, and so once more this great enterprise must pass through an ordeal in each House, commencing with the House of Lords. In the course of the discussion of the idea of a joint Committee it has been pointed out that during the present century there have only been joint Committees on Bills involving such issues as: (1) Railway Schemes for the Metropolis; (2) Parliamentary Deposits; (3) Railways; (4) Railways Transfer and Amalgamation; (5) Parliamentary Agents; (6) The Stationery-office; (7) The Channel Tunnel. None of these cases afforded a precedent, and apparently there was no sufficient ground for the creation of a precedent. The scheme has of course been before a hybrid Committee of one House, but that is a very different matter from a joint Committee of the two Houses. As to the prospects of the Bill, little of a definite character can be said. Some of the strongest opponents will continue their resistance—the Liverpool Corporation for instance; and it is worthy of notice that the authorities of the Bridgewater Navigation have again presented a petition. During the enquiry last session something like a mutual arrangement was arrived at between them and the promoters, very much to the advantage of the former, whose canal operations were jeopardised by the Manchester scheme; but the Bill having failed then, the understanding also lapsed. Therefore, the Bridgewater people must again act on self-defence and put in an appearance; but an agreement having been once effected, can no doubt be renewed.

The several tramway schemes for the metropolis have already aroused a good deal of controversy, and are likely to be prolific of dispute and contention. The Metropolitan Board of Works are naturally much interested in these undertakings, and they, in conjunction with the various districts directly affected, have in the past week come to a decision upon the schemes. They resolved not to consent to the Crystal Palace, Anerley, and Penge Hill Cable Tramway Bill; they agree to the Highgate, Finchley, and Barnet Bill, subject to certain conditions being complied with by the promoters; to refuse assent to the introduction of the Metropolitan Central Tramways (Holborn, Clerkenwell, and Islington) Bill, and to the North Metropolitan Tramways (Nos. 2 and 3) Bills, and the North-West Metropolitan Tramways Bill. Since that decision the last-named Bill has, we understand, ceased to exist for this session. The Highgate and Finchley Bill is also understood to have dropped. On the other hand, they decided to assent to the introduction of the Peckham and East Dulwich Bill on the promoters agreeing not to proceed with the line along Rye-lane until that thoroughfare had been widened—a very important condition which might be more often stipulated for—and certain necessary junctions provided for. The Board further determined to favour the North Metropolitan Bill on the promoters undertaking to omit tramways 3, 4, 5, and 6 extending from a point in the Clerkenwell-road, along Theobald's-road, towards Southampton-row, together with a junction proceeding along Gray's Inn-road to High Holborn. The London Street Tramways (Extensions) Bill was likewise assented to in its main provisions. Among the general schemes the following have now safely passed their second reading, and are ready for the Committee stage:—The Glasgow Water (Loch Katrine); the Liverpool Cathedral; the Glasgow Tramways; the Liverpool Improvement; the London Central Subway; the Columbian Market and Railways; the Brentford and District Tramways; the Eastern and Midlands Railway; the Hull and Barnsley Railway and Dock; the Manchester, Sheffield, and Lincolnshire Railway; the Midland Railway (additional powers); and several other Bills. The Parliament-street Improvements Bill was to have come on for second reading on Monday last, but it has been deferred for a month. With respect to the Tower Bridge Bill, Mr. Ritchie, one of the members for the Tower Hamlets, has given notice that he will move that it be referred to a hybrid Committee, composed of five members nominated by the House and four by the Committee of Selection.

Petitions against the numerous Railway Rates Bills continue to roll in, and must now amount to some hundreds. These Bills were to have been proposed for second reading on Monday last, but they were not taken, and cannot now be taken until Wednesday next. It is now, however, exceedingly doubtful whether they will be proceeded with at all, for apart from the widespread agricultural and commercial opposition to them, a Committee of the House of Lords have drawn up an amendment in the following terms, to be moved on the second reading of these Bills:—"That this House is not prepared to consider in a private Bill the policy of authorising the imposition of charges on traffic, the principle of which has not hitherto been sanctioned in a company's case, and that any general revision of the classification and of rates and charges should be effected by a general measure promoted by a responsible department of her Majesty's Government." This looks very like the death-knell of these proposals.

The Standing Orders Committee have recommended that in the case of the London, Chatham, and Dover Railway (Rates and Charges) Bill, and the East and West India Dock Company's petition to introduce a Bill, the Standing Orders with which they have not complied should be dispensed with in order that they may proceed; but they report that the Standing Order should not be dispensed with in the case of the Marble Arch, Regent-circus, and City Subway petition.

The same Committee have also reported that in their opinion the Standing Orders should be dispensed with in the case of the Islington—Angel—and City Subway Petition, and that the parties be permitted to proceed with their Bill provided that amended plans and sections be deposited in the Private Bill Office and with the Clerk of the Peace for the county of Middlesex, and that a clause be inserted in the Bill prohibiting the promoters from opening the roads at any of the points mentioned in the Examiner's Report, except between the hours of six in the evening and six in the morning, and then only for the purpose of providing a temporary bridge or roadway for carrying the traffic during the construction of the subway.

THE NAVY.

On December 2nd of last year the Earl of Northbrook rose in the House of Lords to move for returns respecting the ships built and building for her Majesty's Navy during the last four years. It will be remembered that during Lord Northbrook's absence in Egypt much excitement was caused by comparisons that had been made between the state of our Navy and that of other nations, and in consequence, shortly after his return from Egypt, the First Lord, in obedience to public opinion, made a statement in the House of Lords, while Sir T. Brassey on the same day explained in the House of Commons both what had been done and what was intended to be done in making the Navy thoroughly efficient. Long debates followed in both Houses, and the returns moved for were agreed to. Lord Northbrook's return, presented to the House of Lords, is now published, and contains not only a statement of the ships laid down by the Board of Admiralty since 1880, but also the total naval expenditure from 1865-66 to 1883-84.

In the year 1880-81 there were built or building seven armoured vessels, of which one, the Colingwood, was a barbette ship of 9150 tons displacement, 9500-horse power, built of steel, with an armament of four 43-ton guns and six 89-cwt. guns on the upper deck; three were partially-protected steam cruisers, sister ships, of steel, the Arethusa, the Leander, and the Phaeton, each of 3750 tons and 5000-horse power, with ten 89-cwt. guns. All these are set down as incomplete. The remaining three were partially-protected sloops. There were for the same year three gunboats and four special service vessels.

For the next year, 1881-82, the number of armoured vessels were nine, of which three were steel barbette ships—the Rodney, 9700 tons and 9500-horse, of steel, with four 64-ton and six 89-cwt. guns. The other two—the Impérieuse and Warspite—were each of 7390 tons and 8000-horse, of steel, with four 18-ton guns, and the same armament as the Rodney on the upper deck. The remainder of the armoured were one partially-protected steam cruiser—the Amphion—of the same material and size as the Arethusa, but with no armament for turret or barbette; two partially-protected corvettes, the Calliope and Calypso, each of 2770 and 3000-horse; and three were partially-protected sloops. All these armoured vessels except two sloops are set down as incomplete, and in only one case is turret or barbette armament mentioned. The same year saw seven unarmoured vessels complete, two gun vessels, three gunboats, and two special service vessels.

In 1882-83 we again find incomplete three steel barbette ships—the Benbow, the Camperdown, and the Howe—the two former of 10,000 tons each, the last of 9700: and each of 9500-horse. The first was armed with two 100-ton, and ten 89-cwt. guns; the two latter with four 64-ton and six 89-cwt. guns. The only other armoured ship for this year was a partially-protected sloop. Of the unarmoured vessels there were three gun vessels and five special service vessels, two of the former class incomplete.

In 1883-84 we find only one steel barbette ship, the Anson, of 10,000 tons and 9500-horse, with four 64-ton and six 89-cwt. guns. Two protected ships of steel were the Mersey and Severn, each of 3550 tons and 6000-horse, with two 13-ton and ten 89-cwt. guns. All these were incomplete. The unarmoured were six in number—namely, two gun vessels, one torpedo cruiser—the Scout—two despatch, and one special service vessel. The last was the only one completed.

The estimate for last year, 1884-85, was for three armoured and six unarmoured vessels, and no one of these is as yet complete. The date of the completion of all the heavier vessels is uncertain, and the earliest date given is January of next year, when one special service vessel is likely to be complete. Of the three steel armoured, one is a turret ship, the Hero, of 6200 tons and 6000-horse, with two 43-ton and four 89-cwt. guns, and the other two are classed as protected ships, the Forth and the Thames, each of 3550 tons and 5700-horse, with two 13-ton and ten 89-cwt. guns. Of the six unarmoured, two were gun vessels, one a torpedo cruiser, two gun and torpedo vessels, and one for special service.

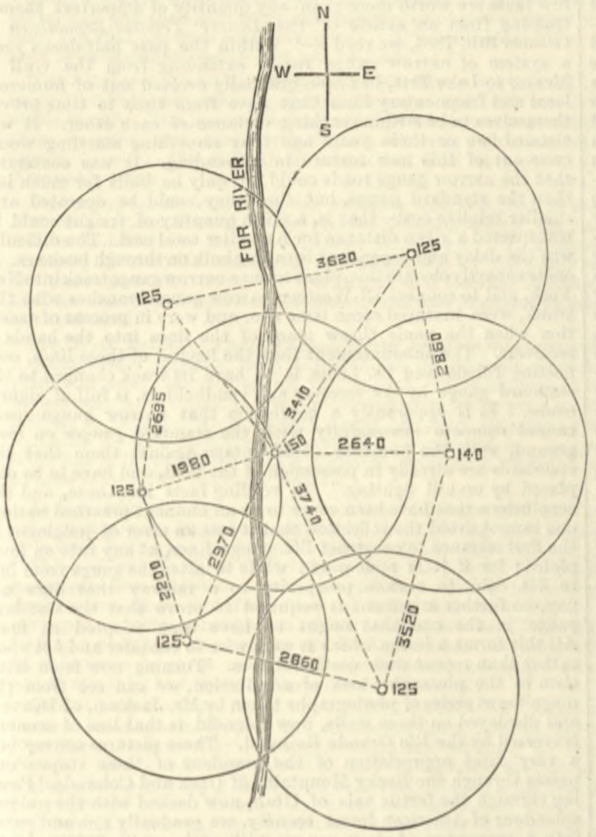
With the estimates for the coming year we have recently dealt. We will only, therefore, remind our readers that there are to be built in her Majesty's dockyards two armour-clad ships, one torpedo ram, one torpedo cruiser of the Scout class, and one new gun vessel; and by contract, two armour-clads, five belted cruisers, six Scouts, four new gunboats, and ten first-class torpedo boats—a total of thirty-two for the year. No probable date is assigned for the completion of any of these projected ships, and with regard to the ironclads, two of them are not yet ordered, and of two the type is not decided.

We now come to the statement which shows the total expenditure on shipbuilding for nineteen years up to 1883-84. The aggregate sum spent in that time is £29,515,244; in the first ten years the yearly average was £1,315,502, for the last nine £1,817,802. The lowest year of all is 1872-73, when only £809,087 was spent on shipbuilding; the highest is 1877-78, and next to that 1876-77, when £2,922,442 and £2,121,960 were so spent respectively. In 1878-79, the year after the great expenditure, the amount dropped to £1,508,049, and the next year again to £1,388,607. Since then the expenditure has continued to rise, from £1,426,349 in 1880-81 to £1,930,090 in 1883-84, the largest amount in any year except the two before mentioned. The total expenditure for the six years from 1875-76 to 1880-81 was £10,980,625, an average of £1,830,104; for the three years 1881-82 to 1883-84 the total was £5,379,604, or a yearly average of £1,793,201.

Mr. W. H. Massey has been appointed mechanical and electric light engineer to the Queen.

THE TOWER SYSTEM OF ELECTRIC LIGHTING.

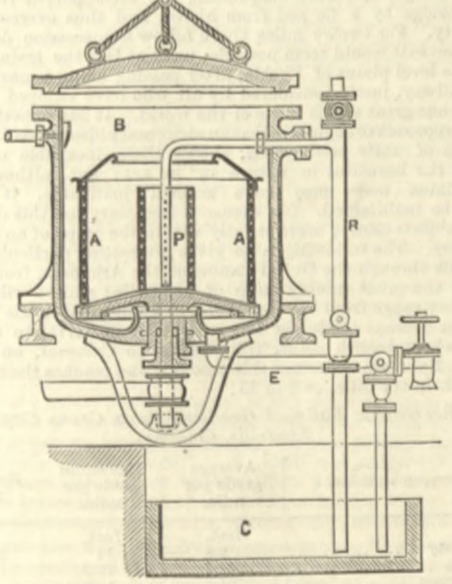
WE publish below a plan showing the manner in which the city of Elgin, Ill., is lighted by electricity, the lamps being placed at the top of lofty towers. The *Electrical World* says "the Van Depoele system is used, and the area illuminated is four square miles. It will be noticed that each tower is the centre of a circle, and that the circles are so arranged as to leave no portion of the area without light. The figures along the sides of the triangles composing the hexagon show the distances in feet from tower to tower. The height of each tower is also given. Mr. George S. Bowen, the president of the local company, remarks: It need hardly be said that the light



in Elgin and the manner of its distribution find almost universal commendation, and yet the opposition to the tower system was at first bitter, and was found in the various electric light companies as well as outside of them. The success in Elgin has almost entirely overcome the local prejudice, and the tower system stands pre-eminent as the one for city lighting. Elgin has seven towers, of which six are 125ft. in height, and one 150ft. On them is a total of twenty-nine lamps of 2000 candle-power each. The city contracts with the Electric Light Company—which owns the entire plant, towers and all—for five years, at 6800 dols. per year. Tower lighting has already been adopted by several cities, and promises to become even more popular."

APPARATUS FOR BLEACHING OR DYEING YARNS AND GOODS IN VACUO.

MANY attempts have been made to facilitate the penetration of textile fabrics by the dyeing and bleaching solutions, with which they require to be treated, by carrying out the treatment in vacuo, *i.e.*, in such apparatus as shall allow of the air being withdrawn—c. f. Ibid 249, 88. The apparatus shown in the annexed engraving—Austrian Pat. Jan. 15, 1884—although not essentially different from those already in use, embodies, the

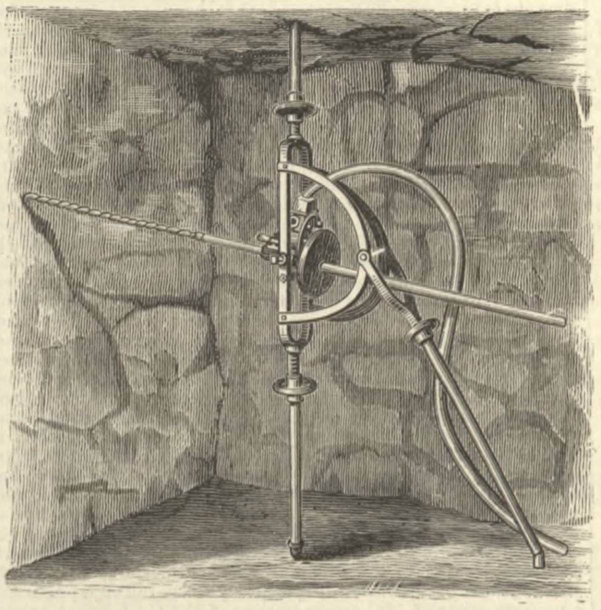


Journal of the Society of Chemical Industry says, some important improvements in detail. It consists of a drum A, the sides of which are constructed of stout netting, carried on a vertical axis working through a stuffing-box, which is fitted in the bottom of the outer or containing vessel or kier B. The air can be exhausted from B by means of an air pump. A contains a central division P, also constructed of netting, into which is inserted the extremity of the tube R, after being twice bent at a right angle. P is also in direct connection with the efflux tube E, E and R serving to convey the dye or bleach solutions to and from the reservoir C. The combination of the rotary motion communicated to A, which contains the goods to be dyed or bleached, with the very thorough penetration and circulation of the liquids effected by means of the vacuum established in B, is found to be eminently favourable to the rapidity and evenness of the dye or bleach.

THE LEGG ROTARY POWER COAL DRILL.

THE Legg rotary power coal drill, which we illustrate by an engraving from the American *Engineering and Mining Journal*, consists of a small rotary engine, hung in an upright frame, with points at top and bottom to engage, by adjustable screws, with the roof and floor of the mine, supported by a dog or brace to stiffen and hold the frame rigid, as the auger-bit is advanced into the coal or other material.

"Attached to the engine are feed nuts, that open and close upon a feed screw from 4ft. to 5ft. long. In one end of this screw is a square socket hole, into which is inserted the square end of the auger-bit, two of which are used for convenience, one 3ft. and the other 6ft. long, boring a hole $1\frac{3}{4}$in. or 2in. in diameter, as may be required. When ready to operate the drill frame is set 3ft. from the face of the coal, the short auger is inserted in the socket of the feed screw, with the bit end against the face of the coal. The feed nuts are closed upon the screw by means of a lever, the air is turned on—compressed air being the motive power used in mines—and the auger begins revolving at a rapid speed. In little more than a minute this auger is buried its full

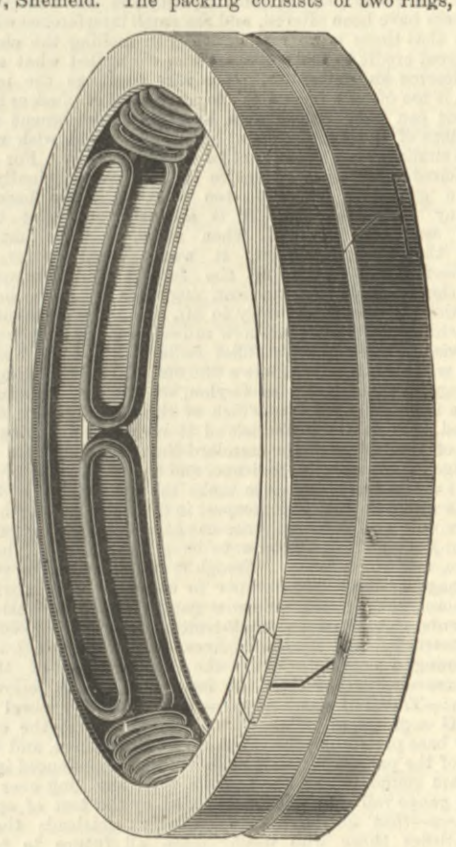


length in the coal. Then the feed is slowed by turning off the air, and the feed nuts are opened off the screw by reversing the lever. The feed screw is pulled back through the open nuts with the hand, and the short auger removed from the coal, and the long or 6ft. auger is thrust through a hole in the large gear wheel into a hole already made, and the square end again inserted in the socket end of the screw, the feed nuts closed upon the screw, and the air turned on as before. In less than five minutes from the time the drill frame began to get in place a hole 2in. by 6ft. is made in the coal, and the operator is engaged in removing the drill to another point in the mine to be drilled.

Several of these drills, which are manufactured by the Lechner Manufacturing Company, of Columbus, Ohio, are in use at the Columbus and Hocking Coal and Iron Company's mines at Longstreth, Ohio, and in other mines throughout the country, and are said to be giving the best of satisfaction. They are, of course, immediately available in those collieries where an air-compressing plant already exists."

LOCKWOOD AND CARLISLE'S PISTON RINGS.

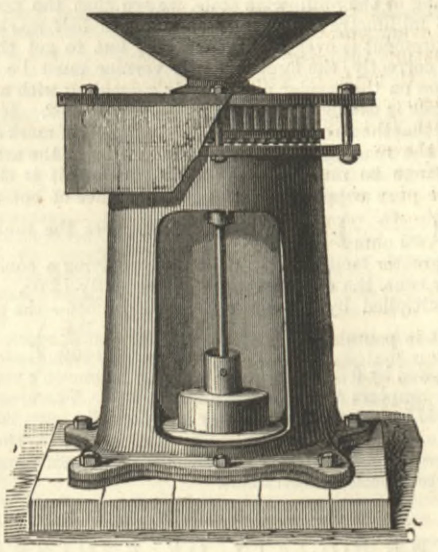
THE accompanying engraving illustrates a new form of piston spring patented by Messrs. Lockwood and Carlisle, Eagle Foundry, Sheffield. The packing consists of two rings, with a



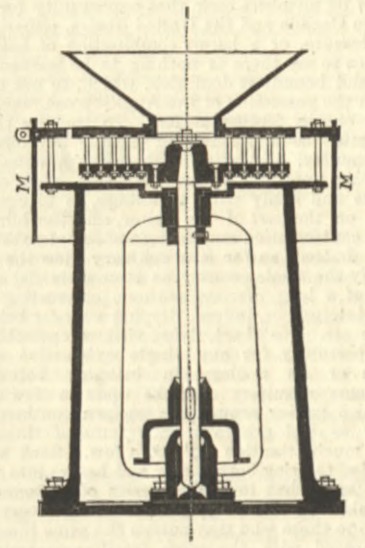
slut to each. The springs are of round steel partly disposed in flat coils, which tend to enlarge the diameter of the rings, and partly of flat plies, which tend to force the rings apart against the top and bottom of the piston head.

SCHNETZE'S FOUNDRY SAND MIXER.

THE acccompanying engravings illustrate a machine made by Messrs. T. B. Jordan, Son, and Commans, of Gracechurch-street, for mixing and pulverising foundry sand. The construction of the machine requires no explanation. An essential point obtained is the thorough disintegration of all clay particles contained in the sand which tend so much to blow and render the cast iron unsound if not finely crushed. Another point is the intimate mixing of the coal dust throughout the entire mass. By using sand thus prepared a much better skin is ensured. Disintegrating machines have been used in several instances already for this purpose, but their construction was generally a horizontal one, and, besides requiring considerable power to drive them, there were found reasons against the extension of their use. The "Adelaide" mixer, as this new machine is called, takes up but little space and cannot get blocked up, as there is but



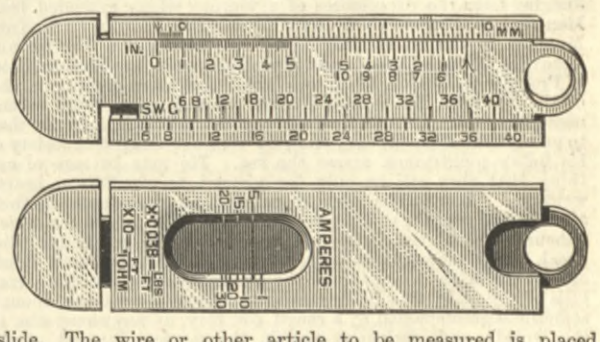
one set of pins on one disc, and the damp sand, loam, &c., is whirled outwards against an elastic ring and then falls to the ground. The steel pins can be replaced in a few minutes by any ordinary labourer when worn out, and beyond the wear of these pegs, there is nothing likely to cause a breakdown or any cost in repairs. The machine requires from 1 to 2-horse power, and is



capable of turning out in less than an hour sufficient sand to last a good size foundry the whole day. The machine is being largely used in Germany, and the greater attention which is now being paid to fine and small castings in this country will no doubt afford it an extensive field here.

TROTTER'S WIRE GAUGE.

THE accompanying engravings represent a new form of wire gauge manufactured by Messrs. Walter T. Glover and Co., Manchester. The gauge comprises four separate scales. The long scale marked s.w.g. gives the diameter in the new Board of Trade standard wire gauge. This differs but very slightly from the old Birmingham wire gauge; for instance, No. 12 b.w.g. has a diameter of 0·109in., and in the s.w.g. it has a diameter of 0·104in. Again, No. 16 b.w.g. is 0·065, while on the s.w.g. it is 0·064. The difference throughout the other numbers is only slight. The instrument is milled on the edges for convenience in holding, and is opened by pushing the eye at the end of the



slide. The wire or other article to be measured is placed between the jaws and nipped tight, the reading being taken on the scales. Very fine wires or soft materials should not be nipped too tightly, otherwise the reading will be too low. The s.w.g.—standard wire gauge—vernier is a peculiar one, and is read by observing the numbers of the graduations which coincide, the two numbers being identical. For instance, if a well-worn penny be nipped between the jaws, it will be found that the graduation between 16 and 20—that is 18—will be opposite the corresponding graduation; the thickness is therefore 18 s.w.g. A new penny will in the same way measure about 16 s.w.g., and with a slightly worn penny neither 16 nor 18 will coincide, but it will be found that the half length graduation corresponding to 17 on the slide, will be in more or less accurate correspondence with its fellow on the body, and the reading will be $16\frac{1}{2}$, 17, or $17\frac{1}{2}$, as the case may be. When 18 is opposite 18, it will be noticed that the graduation 12 on the lower scale, is opposite the graduation marked 10 on the upper or movable scale; but these numbers not being identical the coincidence of these lines must be neglected:—*e.g.*, if a No. 8 s.w.g.—standard wire gauge—wire be nipped, it will be seen that the inch scale reads 0·160, the millimetre scale a shade over 4—the exact size being 4·064—whilst the scale of areas registers—·020—this giving at the same time the current in ampères—20—that the wire will safely carry. The area multiplied by ·4 gives 8 lb. per 100ft., and so on throughout the other calculations as to resistance, horse-power, &c. As another example, put the 16 marks on the s.w.g. into coincidence. Looking at the mils scale, we see that the arrow head is just past the third division, and the wire is something more than ·06in. in diameter. To get the figure the vernier must be read, when it will be seen that the fourth mark coincides with a mark on the upper scale; hence the accurate reading is ·064in. Looking at the millimetre scale, we see that the arrow is past the 1 millimetre mark, and also past the half mark, hence the measurement is over 1·5 millimetres; but to get the measurement correctly, the figures of the vernier must be read. The division on the vernier most nearly coinciding with a division on the scale is the first; hence the reading is 1·62. If it had happened that the arrow head had not passed the half mark on the upper scale, the reading would have been 1·12. If the area found by the gauge be multiplied by 12·33, the result is the length in feet of pure copper wire having a resistance of one-tenth of an ohm $\left(\frac{\text{ft.}}{0{\cdot}1\ \text{ohm}}\right)$. For practical purposes the multiplier may with greater facility be 12; with wire having a conductivity of 98 per cent. the constant would be correctly 12·08. If the area be multiplied by 0·4—more accurately 0·386—the result is the weight in pounds of a length of 100ft. $\left(\frac{\text{lbs.}}{100\text{ft.}}\right)$. The area multiplied by 0·323 equals Sir William Thomson's very safe rule of 0·5 ampères to the square millimetre. The area multiplied by 0·0575 gives the horse-power lost per mile, with 1000 ampères per square inch. 42·8 divided by the area gives the resistance in ohms per mile. Other co-efficients will readily suggest themselves to practical electricians.

THE SOCIETY OF ENGINEERS.

AMERICAN ENGINEERING ENTERPRISE.

ON Tuesday, the 2nd inst., Mr. Arthur Rigg, C.E., read the following paper on this subject. It was well illustrated by photographs:—

It is well known that the British Association for the Advancement of Science paid a visit to Montreal in the autumn of 1884, and many of its members took that opportunity for visiting places of interest in Canada and the United States, either for purposes of study or pleasure, or a happy combination of both. Some have gone so far as to say there is nothing to be learned or observed in that wide and boundless dominion, which, to our unceasing satisfaction, is in the possession of the Anglo-Saxon race, and not under the control of any foreign nation. To suppose that men of the most energetic race on earth could possibly develope the resources of a new country, abounding with every potentiality of wealth, without doing anything a traveller from their ancestral home may not see and study with advantage, is to confess a want of observation on the part of the visitor, an utter blindness, indeed, that carries contradiction convincing and complete to any statement so absurd. Indeed, so far is a contrary view the fact, that one might petrify the whole country as it now stands, and then spend the length of a long lifetime without exhausting its boundless subjects of interest, or, indeed, dipping very far below the surface of what we see. No short, flying visit can possibly give enough time or opportunity for any single exhaustive study; so it needs little or no apology in bringing before my fellow engineers some desultory remarks upon a few of the many interests which gather around the western continent; and also it seems wiser to deal generally with some of these rather than attempt too much attention only to a few. Such a course seems best calculated to bring both writer and hearer into the unison of a rapid and somewhat imperfect series of disconnected observations, to awaken a wider range of interests, and very possibly serve as some help to those who may pursue the same line of travel hereafter. Compared with the more familiar excursions to foreign countries, those weary rounds pursued by ordinary tourists, the advantages of travelling in Canada and the United States are enormous. The English language everywhere prevails; our literature is studied in the long dreary winters with a zest and industry hardly suspected at home; the names of our best writers are familiar to the many, and are not restricted, as here, to the cultivated few; and with these advantages there prevails an all-abounding intelligence—a vast community of interests among all classes of the people. This also tends to soften the asperities of those class distinctions which are quite as strong in America as here, and the necessity for intercourse during long journeys over vast stretches of desert country leads to the formation of new, pleasant acquaintances, and becomes a bond of social union which the peculiar railway arrangements do much to facilitate. And none who have had even a short acquaintance with the country can fail to be struck with the innate courtesy and good nature of the born American, particularly of the West, for in that respect it stands in most refreshing contrast to what we find in the manufacturing districts of England, or in their own eastern cities, overrun, as they are, with—not always the best class—of immigrants from Europe. Judging from the experiences of a journey which extended from Montreal to Philadelphia, from Washington to Wyoming, from Montana to the Great Salt Lake, and thence *viâ* Denver and Leadville through Toronto and New York, past the eastern cities of Providence, Boston, and Lowell, and thus through every portion of the Northern States and Eastern Canada, one would recommend no greater treat or pleasanter travel to an Englishman than to go over the same ground, and mix with the delightful society of his fellow-countrymen across the sea. He may be sure of one thing, that they will be only too pleased to give him a hearty welcome. They will be proud to reciprocate his interest in their affairs; and there is nothing he may ever wish to see for which unbounded facilities will not be placed freely at his disposal. Even among the wild cowboys of the uncultivated West, amidst the dreary grandeurs of the Yellowstone, or over the barren hills of Colorado, he will meet with as hearty a welcome, though sometimes accompanied by a rough courtesy, as anywhere else in the world; and, curiously enough, the deepest interest of the people seems aroused, as they listen while their visitor tells some news of "the old country," which is the affectionate term invariably used to describe their fathers' distant home.

Steamboats.—Coming over the sea, familiar with the general English types of steamers, perhaps the first things that strike a visitor in approaching New York are the enormous ferry boats and river steamers, which ply without a moment's cessation throughout the year. These boats run between New York and the adjacent shores, or down the river to health resorts in the immediate vicinity. Their peculiar beam engines, and double tier of decks, give a somewhat uncouth appearance, judged by eyes accustomed to the more symmetrical lines of our river steamers. But yet a little examination shows how admirably these vessels are suited for their intended purposes; and some of them plying to Providence, or those of the more fashionable Fall River Line, are veritable floating palaces, provided with engines of enormous dimensions. These engines have only a single cylinder, that of the Rhode Island being 90in. diameter and 14ft. stroke, driven by 30 lb. steam pressure and making nineteen revolutions per minute. The Fall River steamer, the Pilgrim, has a cylinder 110in. diameter, with 14ft. stroke. Its paddles are 41ft. diameter, and paddle shaft 26in. No difficulty whatever seems to be experienced in the management, starting, or reversing of these powerful engines, and the vessels they control may be seen threading amongst the crowded shipping with the utmost facility; and even in the dangerous Hell Gate passage, now brilliantly illuminated by electric light, they are steered with a skill as surprising as it is completely successful.

Railways.—Immediately on landing the chances are that we become acquainted with the peculiar railway arrangements of America. Long heavy cars open from end to end, and supported by bogie carriages, have been often described. All are much overheated in winter by a stove in each car, with a range of hot-water pipes throughout its length, and to judge from the draughts caused by opening the hinder door, to say nothing of the forward door, one only shudders at the reduction in temperature which would occur by opening all the doors in an English carriage holding the same number of passengers when the thermometer is standing 20 deg. below zero. At the larger railway stations or depôts we do not see raised platforms, nor are the passengers obliged to keep upon any one spot, but are allowed to move freely over the boarded floors between the rails, and the loud bell, with which every locomotive is provided, gives warning of its approach as it moves slowly through the crowded stations. On all these locomotives there is a spark arrester, formerly constituting an enlargement of the chimney, but now generally constructed as a forward prolongation of the boiler. Nevertheless, fires are not unfrequently caused by sparks which escape notwithstanding all precautions, for the draught is so vigorously maintained that showers of ashes pour in a continuous hail on the tops of the carriages, particularly when the train is slowly dragged up the steep gradients with which most American railways abound. Some of the eastern lines vie with those at home in the excellence of their railways and station arrangements. These maintain a high rate of speed for their passenger traffic—a speed easily reckoned, as there are thirty-two spaces between the telegraph poles for every mile; and one may sometimes count this distance run in seventy seconds, not unfrequently in sixty-five seconds; while higher unauthorised rates prevail at the indiscretion of reckless engine drivers. Accidents do occasionally happen, but as Miller's system of coupler buffer is now used on all the trains, it prevents that secondary disaster of the carriages telescoping, which used at one period to be the invariable sequel to a collision. Accidents are always pretty fully described in local newspapers, and though it may be somewhat reassuring to see trees being cut down and burnt, lest they might fall upon the line during winter storms, yet it is not so pleasant to pass a gang of men setting fire to the *débris* of a wrecked train as the speediest method for removing it out of their way. Experiments upon different railway gauges have been carried out by various companies in the United States upon a scale of the utmost magnitude. They range from 6ft. to 2ft., but mostly approximate closely to our standard of 4ft. 8½in. So long as differences fulfilled a purpose of preventing the rolling stock of one company being used by another, a sufficient answer was given to those who desired and pointed out the advantages of uniformity. But now that great trunk lines unite all parts of the country, this question has assumed greater importance—an importance accentuated by the events of the Southern war twenty-five years ago. At that period, owing to nearly all the railways possessing a uniform gauge of 5ft., concentrations of the Confederate armies were effected with far greater facility than the numerous breaks of gauge allowed to the Northern hosts; and this fact shows what an enormous additional power is given to those who possess sensible railway facilities, and is denied to those who rely upon an imperfect system. Some of the Western railways have been laid with a 3ft. gauge for economical reasons only. At the present time a complete and extensive system is exhibited by the Utah Northern Railway, which follows down the western slopes of the Rocky Mountain Divide or watershed, including also the Rio Grande Railway from the Great Salt Lake to Denver, with many connecting branches. Thus a traveller has ample opportunities for making any observations he thinks fit upon narrow gauge passenger railways. These lines were constructed through vast stretches of uninhabited country and over difficult hilly regions; so it is only fair to those who decided their gauge to suppose that none anticipated the rapid development which this new facility of communication was destined to promote. Throughout the eastern and central States a standard of 4ft. 8½in. is being adopted by all main lines; for the break of gauge has been found an evil of intolerable magnitude, so, with a broad and statesmanlike determination, some companies have already grappled with the difficulty, while others are preparing to do so, and thousands of miles have been altered by stoppages of two and three days' duration. It has been wisely considered that those permanent evils attendant upon existing confusion would far outweigh the cost and temporary delay attendant upon an alteration of the gauge. Moreover, the extreme rapidity and ease with which long distances have been altered, and the small interference with traffic, shows that there is no real difficulty in making the change, and does great credit to the engineers who controlled what seemed so troublesome an enterprise. It is easy to allege the impossible, which is too often a mere cloak to cover want of pluck or ignorance, yet one can only reflect with absolute astonishment upon the assertions of those engineers at home who would wish us believe that a similar change could not be made in India. For a totally insufficient cause, that extensive country was originally saddled with a gauge of 5ft. 6in., too wide, as it has been proved, for any necessities, and it is a misfortune that the home gauge was not adopted when railways were first inaugurated there. Even now, it would seem better to face an inevitable problem of the future, to contemplate and copy the example of American engineers by preparing for an alteration all over the country to 4ft. 8½in. at no distant period; meanwhile constructing all new railways at the narrower gauge, otherwise we shall always afflict India with the intolerable evils which will always arise where a 5ft. 6in. and a metre gauge comes into continual contact. In Ceylon, at the present time, a discussion is progressing as to which of these two gauges should be adopted, as if in a separate island it mattered anything whether either of the Indian or the standard English gauge were adopted. To judge by American experience, and the conclusions of practical men, it would be far better to make the Ceylon gauge 4ft. 8½in., for this would be best and cheapest in the end. It is with pleasure that we note how common sense has at last prevailed regarding the Suakim-Berber Railway, now to be made 4ft. 8½in., instead of 1 metre, as first proposed. Though it might suffice to say that a 3ft. guage is obviously cheaper to construct than a wider one, yet those who advocate narrow gauges seem to consider their arguments reinforced by a statement that sharper curves can be constructed on narrower lines. But we all know that in turning a complete circle the circumference of the outer wheel travels further than the inner one, in the following proportion:—Travel of outer wheel = travel of inner wheel + $2\pi G$, where G = gauge of rails. This objection ignores the evils of a narrow base precluding the rapid passage of curves, and takes no notice of the patent fact that no difficulty is experienced in turning tram-cars round curves far sharper than anything ever seen on narrow gauge railways. Even regarded by the test of ephemeral cheapness—that common delusion which misleads the public and satisfies those who would leave all future to take care of itself—it may be remarked that in the level country 120 miles from Denver to Puebla the two gauges run side by side, as on our Great Western Railway here. Therefore, this additional cost ought in all fairness to be charged against whatever saving there may have been effected by adopting a narrow gauge on the main line; and thus the imaginary great economy calculated upon by the original promoters must dwindle considerably. It is an attractive and seemingly reasonable argument that when opening up a poor, extensive country, light tramways should be more suitable than railways; but much needless confusion is imported into all discussions on this matter, and incalculable loss inflicted upon districts ill-able to bear it, by regarding the inches between rails as the only point at issue. Indeed, it is beyond controversy that the average dimensions of human beings should settle those of railway carriages, just as in more practical times than the present they settled the size of carts and carriages, the widths of their wheels apart, and the most convenient units of length. In these days, however, we are told to settle the gauge first and the carriages afterwards, and this inversion of the natural process leads to an absurdity we see on the Rio Grande Railroad, where the Pullman cars are 8ft. 1½in. wide, and the distance between rails only 3ft. With such a disproportionately small base, the carriages rock considerably while passing over rougher portions of the road, or while slowly crawling round quick curves at the edges of precipitous elevations. No wonder if a feeling of insecurity should drive away mere business travellers, so damaging the prosperity of the line, and in some degree interfering with a complete enjoyment of some of the finest scenery to be found on either continent. But the advocates of narrow gauges have been untiring in their assurances that the break of gauge and its undoubted evils, which they are compelled to acknowledge, will vanish away when their system becomes universal; but let us see how these hopeful prognostications are realised in practice, for all of us will agree that a few facts are worth more than any quantity of imperfect theory. Quoting from an article of the *Denver Tribune-Republican* of October 6th, 1864, we read:—"Within the past half-dozen years a system of narrow gauge roads, extending from the Gulf of Mexico to Lake Erie, has been gradually evolved out of numerous local and fragmentary lines that have from time to time proved themselves to be within reaching distance of each other. It was claimed two or three years ago that something startling would grow out of this new feature in railroading. It was contended that the narrow gauge roads could not only be built for much less than the standard gauge, but that they could be operated at a smaller relative cost—that is, a given quantity of freight could be transported a given distance for a smaller total cost. The difficulty was the delay and expense of breaking bulk on through business. In order to partly obviate this, plans to put a narrow gauge track into New York, and to connect all Western narrow gauge branches with this trunk, were matured some time ago, and were in process of execution when the panic threw many of the lines into the hands of receivers. The announcement that the longest of these lines, connecting Toledo and St. Louis, is to have its track changed to the standard gauge by the receiver and bondholders, is full of significance. It is apparently a confession that narrow gauge roads cannot compete successfully with the standard gauges on level ground, with the immense disadvantage against them that the standards are already in possession of the field, and have to be displaced by up-hill fighting." In reading facts like these, and the conclusions that have been come to by an eminent practical nation, one cannot avoid the reflection that it was an error of judgment in the first instance to construct 3ft. gauge lines, at any rate on level plains; for if it is now worth while to alter the gauge from 3ft. to 4ft. 8½in. to restore prosperity to a railway that does not pay, no further argument is required to prove that the standard gauge is the one that ought to have been adopted at first. All this forms a lesson which it were wise to consider and act upon rather than repeat such costly failures. Turning now from criticism to the pleasanter task of admiration, we can see from the magnificent series of photographs taken by Mr. Jackson, of Denver, and displayed on these walls, how splendid is that line of scenery traversed by the Rio Grande Railroad. These pictures convey but a very faint appreciation of the grandeur of those stupendous passes through the Rocky Mountains of Utah and Colorado. Passing through the fertile vale of Utah, now decked with the unique splendour of American forest scenery, we gradually rise and enter into a succession of deep canons with rocky walls 3000ft. high, through the strange fantastic scenery of the Green River and across dreary deserts, until at last on the Marshall Pass an elevation of 10,854ft. brings us to the summit level of the railway. In one of the photographs before us, the zigzag course of the railway across this elevated table land may be seen winding its sinuous course over the summits of many hills, through long wooden snow sheds, past the edges of high and dangerous-looking precipices, and over wooden trestle bridges like the one 1850ft. above the sea-level at the Toltec Tunnel as shown by one of the photographs. As the train twists and turns to every point of the compass, it gains glimpses of lovely scenes down many untrodden valleys, while the night gives passage through deserts and over the Marshall Pass through the Black Canon of the Gunneston, until nestled in a quiet, secluded spot, the junction of Salida is reached. Here passengers for the rich mining districts of Leadville change cars, and after an excellent breakfast we start through the finest scenery which this region affords, the Grand Canon of the Arkansas. The ever-courteous railway officials provide an observation car upon which their passengers can ride and gain a full uninterrupted view of endless scenes of surpassing beauty. The sunlit aspect of such cliffs as the Currecante Needle are succeeded by deep and gloomy valleys where its rays have never entered. The narrowed river accompanies our course with unceasing roar of its many rapids; and so narrow does the passage become at times that in one place, as shown in a photograph, no foundation could be found for one side of the railway bridge, and the engineers were reduced to the necessity of supporting it by two girders thrown across the Royal Gorge, and then suspending the unsupported corners of their bridge by a tie rod from above, and thus overcoming the difficulty. For twelve miles there follow a succession of canons, where no exit would seem possible, until at last the train emerges into the level plains of Puebla, after passing along a most remarkable railway, justly considered by all who have enjoyed the sight of it as one great scenic route of the world. It has sometimes been made a reproach to engineers that an abnormal hideousness abounding in some of their productions, shows them incapable of appreciating the beautiful in nature or in art; but, although such an opinion may once have seemed justifiable, it can no longer be maintained. No excuse is necessary for this digression from subjects coming more strictly within the scope of an engineering paper. The following table gives interesting particulars of all gradients through the Grand Canon of the Arkansas, from Canon City to the great mining camp of Leadville; and it will be seen that they range from 18ft. to 150ft. in a mile, and in the Marshall Pass the average grade for fourteen miles is 217ft. to the mile. But a short branch siding from Hecla to Calumet, on the Rio Grande Railroad, surpasses this amount, and reaches the high total of 406ft. in the mile, or 1 in 13!

Rio Grande Railroad Gradients from Canon City to Leadville, Colorado.

Between stations.	Average grade per mile.	Maximum grade per mile.	Maximum ratio.
	feet.	feet.	1in.
Canon City	9·8	18	293·3
Parkdale	43·7	73·9	70·5
Texas Creek	34·0	73·9	70·5
Howards	33·8	73·9	70·5
Mathrop	39·1	73·9	70·5
Beuna Vista	52·5	73·9	70·5
Granite	70·0	73·7	71·6
Malta	76·8	75·0	70·4
Eilers	115·9	125·0	42·3
Brants	127·8	132·0	40·0
Laplata	112·6	125·0	42·3
Ow Junction	105·0	125·0	42·3
Leadville	145·0	150·0	35·2
Over Marshall Pass	211	217·0	24·3
Hecla to Calumet siding	—	370·0 406·0	14·3 13·0

The rapidity with which work is completed, both on Canadian and American railways, has often excited comment and surprise, and perhaps the most interesting example coming under the writer's notice may be found in the new cantilever bridge over that deep gorge which receives the waters of Niagara. This bridge carries a double railway track, and connects the opposite shores of Canada and the States. It was made by the Central Bridge Works, Buffalo, and is 910ft. long, was commenced on April 15th, 1883, and finished on December 1st in the same year, thus occupying only 230 days in construction.

(*To be continued.*)

RAILWAY MATTERS.

ORDERS have been issued to stop the work on the Jhansi and Manickpore Railway. About 40,000 men have been dismissed. It is believed that this is owing to the necessity of applying the funds to the pushing on of the frontier railways.

A DINING and luncheon saloon, with smoking room and ladies' and gentlemen's lavatories, is now attached to the 6.15 p.m. train, King's-cross to Manchester—Sheffield route—and to the 11 a.m. up train, due at 3.30. The saloon is 60ft. long, with twelve bogie wheels.

FOR the Rangoon Steam Tramways, worked by Messrs. Merryweather's motors, experiments have been made with Rangoon earth oil as fuel, and the result being satisfactory, an engine arranged to burn this fuel has been sent to Burmah. It is anticipated that a very large saving in cost of fuel will be made.

THE Scarborough and Whitby new line of railway was informally opened on Saturday, when a special passenger train was run the whole length. The line will be fully completed for traffic in about three months, and the North-Eastern Railway Company has agreed to work the railway in connection with its system on favourable terms.

IN concluding his report on the collision that occurred on the 17th January, at Fleur-de-Lis yard, near Pengam station, on the Brecon and Merthyr Railway, Colonel Rich says:—"It is most necessary for the safe running of the trains, and for the safety of the passengers who travel on the Brecon and Merthyr Railway, that the signals and points at all the stations and junctions should be interlocked."

MR. W. G. BAGNALL, Castle Engine Works, Stafford, has obtained a considerable contract from Government for portable railway plant and small locomotives for the Soudan. This railway, it is understood, will be used as a feeder for the wider gauge permanent railway to be laid down by Messrs. Lucas and Aird, conveying the materials for its construction and running alongside of it. As the order has to be completed within a limited time, it is intended to at once enlarge Mr. Bagnall's works.

IN concluding his report on the collision which occurred on the 1st January, near Penistone, caused by the breaking of a wagon axle from Rotherham and Sheffield, Major F. A. Marindin says:—"This accident furnishes a warning against the practice of placing passenger lines between running goods lines, which is sometimes done where there are four lines of rails; for, with lines so arranged, it is clear that the undeniable risk of accident, from the fouling a passenger line by a wagon leaving a goods line alongside of it, is twice as great as in cases where the two passenger lines are at one side, and the two goods lines at the other."

THE railway carriages for the new line which have been ordered in the Birmingham district are of the ordinary English third-class type, to hold fifty passengers each, and mounted on four wheels. Double roofs are provided, and the carriages are painted white. Railway supply firms read with interest that a portion of the plant and several locos., used in the construction of the Hull and Barnsley Railway, have within the last few days been removed from Barnsley to Hull *en route* for the Soudan. This will necessarily mean the replacing of this plant with new work. The effect upon the market of this activity in Government buying will, it is the belief of some traders hereabouts, be to improve the general demand for constructive ironwork and metalliferous manufactures. Such an outcome has been noted on previous occasions of special heavy ordering by the authorities. People who have had contracts to place, and who have been standing off the market, have at such times determined to delay no longer, lest manufacturers' books should be filled up with special work, to general buyers' manifest disadvantage.

THE city of Guatemala has recently been placed in direct communication with the port of San José on the Pacific Coast by the opening of a new line of railway. The total length of line is seventy-two miles—single track and the narrow 3ft. gauge. Very heavy gradients, deep cuttings, seven high trestle bridges, and considerable trouble with made ground on the Lake of Amatitlan were the chief engineering difficulties to be conquered. Between Esquintla and Palin, a distance of nineteen miles, the road rises over 3000ft.; the total rise between San José and Guatemala is within a few feet of 5000. The entire rolling stock was imported from the United States, as was also a small portion of the steel rails used, but the greater part of the latter was imported from England. The engines consume wood almost exclusively, coal being exceeding scarce in Guatemala, is only used on the steepest grades. The line from Esquintla has been built in a little less than a year, and the heavy work has been done entirely by natives. A branch line from Amatitlan to Antiqua, the old capital, is projected. The survey and, in parts of the department of Chiquimula, the actual work for the Northern Railway, which will connect Guatemala with Santo Tomas on the Gulf of Honduras, a distance of 160 miles, is being actively pushed forward. This line is being constructed by a forced national subscription.

THE usefulness of re-railing safety guards at bridges was illustrated on the 10th ult., when, the *Railroad Gazette* says, "as an express train on the New York, Ontario, and Western Railway was approaching the celebrated Lyon Brook viaduct at a speed of 30 miles per hour, on a down grade of 65ft. per mile, the tire on the leading wheel of the engine truck broke, and the truck was derailed only about 50ft. from a Latimer bridge safety guard, with which guard the entire road was equipped in 1882. The truck was immediately replaced upon the track on striking the safety guard, and the broken wheel was then held in proper line by the continuous guard rails until the train stopped, which was not until it had passed nearly over the bridge. No damage was done to either bridge or train beyond the breaking of the tire. The viaduct is one of the largest and highest in the country, 800ft. long and 165ft. high, and all the conditions were present—except absence of a safety guard—for one of the worst disasters on record. The wisdom of employing a cast iron watchman which neither eats nor sleeps nor walks up to the pay car was perhaps never more convincingly demonstrated." We shall not enforce the use of proper guard rails on our viaducts until a train with a prince or two in it leaves the rails and goes over a bridge, or runs into and cripples the ties and struts of a lattice girder, with results.

IN connection with the railway loans sought by New South Wales, it may be mentioned that in that Colony the total expenditure for railway construction has been £19,188,464, of which the sum of £16,905,014 was expended for lines opened for traffic. At the close of 1883, 1320 miles of line were open for traffic, and 597 miles were in the course of construction. The rolling stock consisted of 296 locomotives, 695 coaching, and 6386 goods, vehicles. The value of the railway materials, in the conveyance of which 121 vessels were employed, amounted to £275,149, and the freight and insurance to £18,984, making a total of £294,133. During the year 116,286 trains, of which 64,088 were passenger and 52,198 goods trains, were run, at a distance of 5,937,261 miles. The earnings amounted to £1,931,464, and the working expenditure to £1,177,788, or 60·98 per cent. of the earnings. 10,272,037 passengers travelled, of whom 3,398,169 were first-class and 6,873,868 were second-class. Included in these figures are 14,972 season-ticket holders, representing 3,640,612 journeys. The proportion percentage of these classes is for first-class passengers 17·89, second-class 46·67, and for season-ticket holders 35·44. The merchandise traffic consisted of 1,753,024 head of live stock, 361,006 bales of wool, 1,915,502 tons of minerals, and 816,918 tons of general goods. There was an increase of 397,746 in the number of first-class passengers, of 675,102 second-class, and 214,876 in the journeys made by season-ticket holders. The earnings per mile open were £1484, the expenditure was £905, the net earnings were £579. The earnings per train mile were 78·07, the expenses 47·61, and the net earnings 30·46. The net earnings were £753,676, yielding 4·48 per cent. to the capital invested on lines open for traffic.

NOTES AND MEMORANDA.

THE price of gas in Jersey City, U.S., is 2·00 dols. per 1000 cubic feet.

IN greater London last week 3456 births and 1948 deaths were registered, equal to annual rates of 34·7 and 19·6 per 1000 of the population.

THE stanniferous, or tin-bearing area in New South Wales, is estimated at 5½ million acres, or 8500 square miles. Up to the present most of the tin has been obtained from the New England District.

IN London last week 2709 births and 1569 deaths were registered. The annual death-rate per 1000 from all causes was 20·0 last week. During the first eight weeks of the current quarter the death-rate averaged 21·9 per 1000, against 24·3, the mean of the rates in the corresponding period of the five years 1880-84.

THE deaths registered during the week ending February 28, in 28 great towns of England and Wales, correspond to an annual rate of 21·4 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The six healthiest places were Portsmouth, Huddersfield, Hull, Halifax, Oldham, and Bradford.

IN answer to a question in the House on the 2nd inst., referring to the 110-ton guns, Mr. Brand said: "Three 110-ton guns have been ordered. One is to be delivered in October next, another in January, and the third in April, 1886. The price per gun is £19,500; the weight of the projectile is 1800 lb.; the charge is 900 lb. of cocoa powder; the muzzle velocity is 2020ft. per second; the maximum powder pressure is 17 tons per square inch. It must be understood that the velocity and pressure are only estimated, although they are based on the experience gained with the Italian guns."

BLAST furnace returns published in the United States show that there are now only 236 blast furnaces of all kinds in blast in the States, as compared with 363 in 1875. This includes 68 charcoal, 86 anthracite, and 82 bituminous. There are 435 out of blast as compared with 328 in 1875, and of these 159 are charcoal, 135 anthracite, and 141 bituminous furnaces. The weekly capacity of the furnaces on the 1st January was 66,747 tons (2000 lb.), while the capacity in 1883 and 1884 was respectively 106,184 and 83,125 tons. The tendency is to larger furnaces generally, and in charcoal furnaces in particular.

AT a recent meeting of the Edinburgh Royal Society, Professor Tait submitted a paper on "Condensation and Evaporation." He pointed out that the present mode of treating the conditions of a liquid in presence of its vapour were not rigorous, inasmuch as the pressure is undoubtedly different in the two parts, while in the surface layer between them there is a complex form of stress. If attention be confined to the isothermals of the interior parts of a liquid, or of its vapour, the present method will apply rigorously. With this proviso the isothermals under the critical point consist of two parts separated by an asymptote—one belonging to the liquid, the other to the vapour. This accords with the fact that liquids can be subjected to hydrostatic tension, and that Aitken has shown that true vapour cannot be condensed without a nucleus.

NEATSFOOT oil will not soften leather under all circumstances; neither is castor oil any better. Oil is not necessary to the pliability of leather—the leather of the ox, goat, calf, and kid. The *Scientific American* remarks that it is necessary that the leather be kept moist; but oil need not be the moistening means. But in order that oil may soften the leather, its way should be prepared by a thorough wetting of the leather by water. Much less oil is required if the leather is well saturated with water. The philosophy is obvious; water is repellent to the oil, and prevents it from passing entirely through the leather, holding the oil in the substance of the leather. The use of water for softening belts in factories is not inconvenient if advantage is taken of a holiday. At night the belts may be brushed clean and thoroughly wetted; then in the morning use the oil. A much smaller quantity is necessary to render the belt pliable than when no water is used.

A PAPER, entitled "A Suggestion for the Improvement of Radiation Thermometers," was read at the last meeting of the Meteorological Society by Mr. W. F. Stanley, F.R. Met. Soc. The author suggests that the radiation thermometer should indicate the amount of heat radiated by the sun upon a metal ball of a certain size, this being an object easy of uniform reproduction by mechanical means. For experiment he made three hollow copper balls, which were cast with ordinary filed cores, and were of different weights. These balls were turned to exact external diameter of 1·4in., with similar necks for the insertion of thermometers. The surfaces were oxidised by heating to resemble the oxidation produced by the atmosphere. In each of these balls a similar thermometer was inserted, closed in round the neck just sufficient to keep it steady by cotton thread soaked in paraffine. The three thermometers thus enclosed in the metal balls, when exposed to sunshine and placed at 2in. above a piece of black-board, appeared to register under similar conditions exactly alike. The experiments for three summer months gave from 6 deg. to 11 deg. difference between the sun and shade.

THE following on tempering is from the *Age of Steel*:—"When tempering cold chisels, or any other steel articles, heat to a very dull red and rub with a piece of hard soap, then finish heating, and harden in clear, cool water. The potash of the soap prevents the oxygen of the atmosphere from uniting with the steel and forming rust or black oxide of iron. The article will need no polishing to enable the colours to be seen. This will be appreciated when tempering taps, dies, or various complex forms not easy to polish. Never 'upset' a cold chisel; it is sure death to the steel. If you have a broken chisel to sharpen, draw out and cut off, never upset. It will cripple the fibres just as the straw is crippled when driven endwise. Make chisels short for hard, rough work. They transmit the power or force of a blow much better. Long chisels are apt to 'broom up' on the hammer end, as the long steel through which the blow passes has more chance to absorb the force of the blow. The harder the metal to be worked, the quicker the blow should be transmitted. Cast iron works much better with a short steel chisel and light hammer than if the blow was struck upon a very long chisel with a heavy wooden mallet. In one case the blow is delivered all at once, in the other it takes time, and much of the force is absorbed."

FOR making soluble glass, the following ingredients are heated in a reverberatory furnace until fusion becomes quieted: 630 lb. white sand, 330 lb. potash of 78 deg. This will produce 840 lb. of transparent, homogeneous glass, with a slight tinge of amber, but little soluble, even in hot water. To dissolve it the broken fragments are introduced into an iron digester charged with a sufficient quantity of water at a high pressure to make a solution marking 33 deg. to 35 deg. Baume. Distilled or rain water should be used. This solution contains silica and potash combined together in the proportion of 70 to 30. Silicate of soda is made with 180 parts of sand, 100 parts carbonate of soda (0 91), and is to be melted in the same manner as indicated previously. Soluble glass may also be prepared by the following method: A mixture of sand with a solution of caustic potash or soda is introduced into an iron boiler, under five or six atmospheres of pressure, and heated for a few hours. The iron boiler contains an agitator, which is occasionally operated during the melting. The liquid is allowed to cool until it reaches 212 deg., and is drawn out after it has been allowed to clear by settling; it is then concentrated until it reaches a density of 1·25, or it may be evaporated to dryness in an iron kettle. The metal is not affected by alkaline liquors. This glass is soluble in boiling water; cold water dissolves but little of it. The solution is decomposed by all acids, even by carbonic acid. Soluble glass is apparently coagulated by the addition of an alkaline salt; mixed with powdered matters upon which alkalies have no effect, it becomes sticky and agglutinative, a sort of mineral glue.

MISCELLANEA.

THE Royal Agricultural Society's Show next year will be held at Norwich.

PROFESSOR BONNEY will resign his post as secretary of the British Association after the Aberdeen meeting. Professor Bonney, it is said, feels compelled to take this step mainly on account of the inroads which the work of the Association makes upon his time.

UNDERGROUND urinals and water-closets have been constructed around the base of the Duke of Wellington's statue, on the western front of the Royal Exchange, wholly beneath the street pavement, and excavated in the mass of solid concrete which surrounded the foundations of the base of the statue.

AT a meeting of the Edinburgh Royal Society last month, Mr. Thomas Stevenson, president, delivered an address, in which he discussed the erection of training-walls at the mouth of the Mersey. He strongly condemned such a procedure, asserting that the inevitable result would be the silting up of the approaches to Liverpool.

THE history of the iron trade, as far as statistics relating to quantity produced, imported, and exported, and prices from 1830 to 1884, may be called history, is well and clearly shown by the edition just issued of Fossick's coloured chart, showing these facts graphically, and containing a chronology of the events affecting the iron and steel trades for the past fifty-four years.

THE copper-producing country in New South Wales covers an area equal to about 4,296,320 acres; but there are enormous tracts of country the exploration of which will increase the area. Some of the lodes at present in work are very large. The most important copper mine in the Colony at the present time is the Great Cobar Mine, and it also is the most distant from the seaboard, being 497 miles west of Sydney.

A CLOCK has been fixed in Bishopsgate-street on the twenty-four hours' system and with only one hand. The long minute hand and the figures around are placed as heretofore, but indicate the minutes only, which are marked from five to sixty. The figures of the hours are shown on a sunk dial under the upper dial, and the next hour figure appears instantaneously upon the minute hand completing its circuit of 60 minutes. Thus the solitary hand marks the minutes and the sunk space shows the hour.

THE trial trip of the new steam trawler Dolphin, recently launched by Mr. W. B. Thompson, Dundee, took place on Saturday, 21st February. The Dolphin has been built and engined by Mr. Thompson for the Lowestoft Steam Carrying and Fishing Company, Lowestoft, and is a screw steamer of the following dimensions: Length, 100ft.; breadth, 20ft.; depth, 10ft.; and has compound engines 17in. and 34in. by 24in. stroke, 100 lb. pressure, which during the trial developed 300 indicated horse-power at a mean speed of 11 knots.

THE annual report of State Engineer Sweet, of New York, states that the canals carried 654,588 tons of freight less in 1884 than in 1883. Mr. Sweet suggests a radical change in the Erie Canal, to make it a ship canal from Buffalo to Troy with a continuous descent, drawing all its water from Lake Erie, and furnishing a channel 100ft. wide and 18ft. deep. He advises that detailed surveys be made to determine the exact cost of this great scheme, which would probably be one hundred millions of dollars. Like former incumbents of the office, Mr. Sweet thinks that the Adirondack survey and topographical survey of the State should be placed in charge of his department, instead of being under independent commissions.

WRITING to the *Scientific American* on straightening old grate bars, a correspondent communicates "a fact that is not generally known, judging from the tons of old grate bars to be seen at the various junkshops, a large portion of which could be made as good as new. The bars, if not actually burned, can be brought back by heating the twisted portion to a very dull red, just enough to detect while in the fire; then nip the bar in a vice close enough to admit of its being shifted, bring a very gradual pressure on the other end with your hip, shifting the bar along so as not to take the warp all out at one place. With one heat I have taken three or four inches out of a bar. A very little beyond the right heat will cause them to break like old cheese."

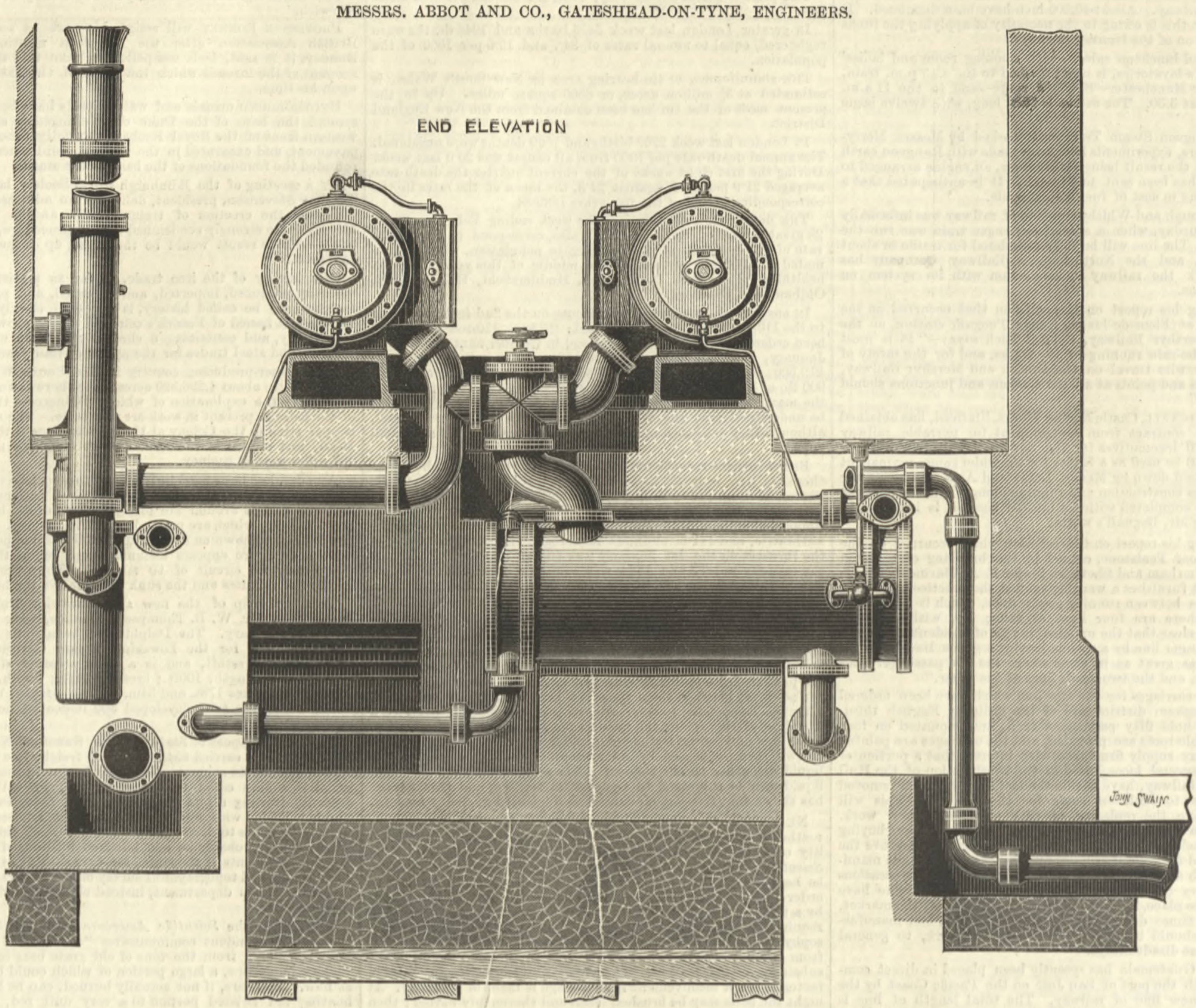
ON Monday Messrs. Raylton Dixon and Co. launched the Transition, built for Messrs. I. M. Linnard and Sons, to carry 2350 tons dead weight, and of the following dimensions:—Length, 267ft. over all; breadth, 36ft.; depth moulded, 19ft. 6in.; she has water ballast throughout. Her name indicates a transition from the use of iron plates to that of steel, made entirely in the Cleveland district, the angles and beams being from the works of Messrs. Dorman, Long, and Co., and plates made by Messrs. Bolckow, Vaughan, and Co. This is the first ship built entirely of local steel, but already the makers have contracted for many thousands of tons, and have their order books full for months to come. The Transition also refers to the use of triple expansion engines, having a steam pressure of 160 lb. per square inch, which is utilised in three cylinders, working direct on to three cranks, and thus giving great steadiness of motion as well as great economy in coal consumption.

ON Friday last the double twin screw passenger steamer Snowdrop left the Seacombe stage to take her trial trip on the measured mile off Waterloo. She is 130ft. long, 35ft. beam, and 6ft. 6in. draught. She is the second of two sister vessels built to the order of the Wallasey Local Board by Messrs. Wm. Allsup and Sons, Preston, from the designs and under the superintendence of Messrs. Flannery and Fawcus, of Liverpool. Both vessels are built of steel throughout and to the highest class of Lloyd's. They are divided into eighteen watertight compartments, and both main and saloon decks are of teak. The saloon on deck is 100ft. long, and provision is made for smokers in a roomy saloon at the after end of the boat, and a large cabin is also fitted up for their use below the main deck. The deck above the saloons affords a good promenade. The machinery consists of two complete pairs of compound surface condensing engines, having cylinders 18in. and 37in. diameter and 24in. stroke, with two steel boilers working at a pressure of 100 lb. Each pair of engines drive two propellers, one at each end of the vessel. On her trial trip a speed of 12½ miles per hour was attained, and the vessel proved to be very readily handled. Like her sister ship Crocus, she will be fitted with the electric light by the Manchester Edison Company.

IN the report on the London Water Supply by Mr. William Crookes, F.R.S., Dr. William Odling, and Dr. Meymott Tidy, for December, they spoke of the quality of the water supplied during the month, in respect to the smallness of the proportion of organic matter present, as being good, and as not differing appreciably from that taken note of in the preceding months. In their report for January they say, "There being some amount of discrepancy between this statement and that made in the report to the Registrar-General, we have, during the past month, taken care to verify the results of our daily full analyses of the water, by having each analysis performed in duplicate. Our results, thus obtained, agree closely with those of last month, and manifest the continued excellence in quality of the water. Thus, the mean quantity of organic matter in the water supplied by the Thames companies during the month of December was found to be 0·151 part, and the maximum quantity in any one sample 0·179 part, in 100,000 parts of the water; while the mean quantity in the Thames-derived water supplied during the past month was 0·137 part, and the maximum in any one sample 0·182 part, 100,000 parts of the water. This maximum quantity of 0·182 part of organic carbon would correspond to a little over three-tenths of a grain of organic matter per gallon." We must remind our readers that these reports are based on a large number of analyses of daily samples, and not like those of the report to the Registrar-General on a sample of the water of each company taken once or twice a month.

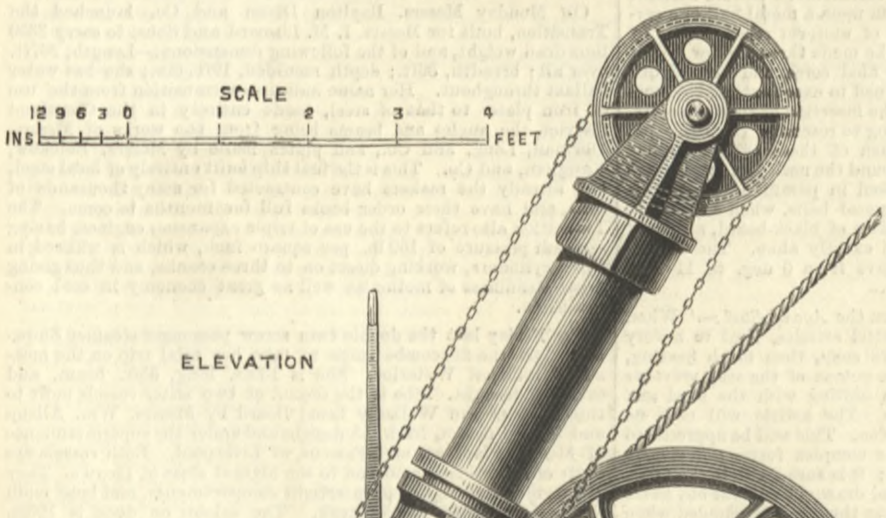
HYDRAULIC MACHINERY—PORT OF BUENOS AYRES.

MESSRS. ABBOT AND CO., GATESHEAD-ON-TYNE, ENGINEERS.

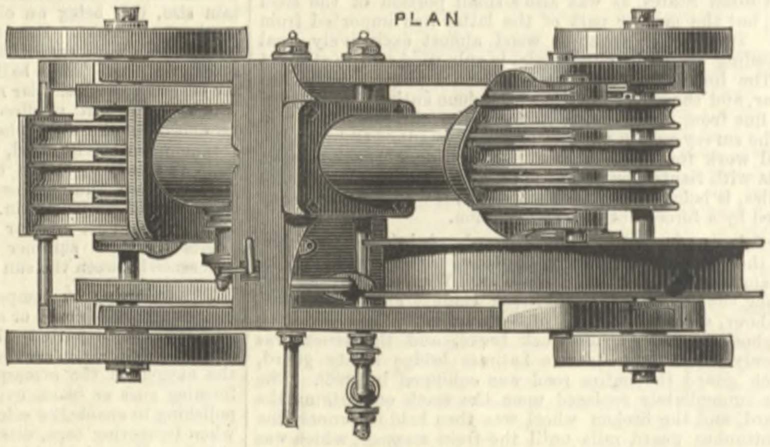


Great improvements have recently been made in the shipping facilities of the port of Buenos Ayres under the direction of the Riachuelo Commission. Some of the new machinery there erected we illustrate. It has been constructed by Messrs. John Abbot and Co., of Cannon-street London, and Gateshead-on-Tyne. Some time ago the Riachuelo Commission was appointed to carry out improvements at the port of Buenos Ayres, which have been ably executed by their engineer, Mr. Luis Huergo. The hydraulic plant is acquired for loading and discharging of vessels, and consists of engines, boilers, and machinery for providing the water under pressure, fixed and portable cranes, jiggers, or whip cranes; and in describing them we cannot do better than quote the specification from which they were made.

Boilers.—Two Lancashire, 6ft. diameter by 20ft. 3in. long, 2ft. 4in. tubes, fitted with four Galloway tubes and two steel expansion rings in each tube, and having complete set of mountings of most modern construction. Boilers were proved by water to 160 lb. pressure, and arranged to work at 80 lb. pressure per square inch.



MOVABLE JIGGER HOIST.

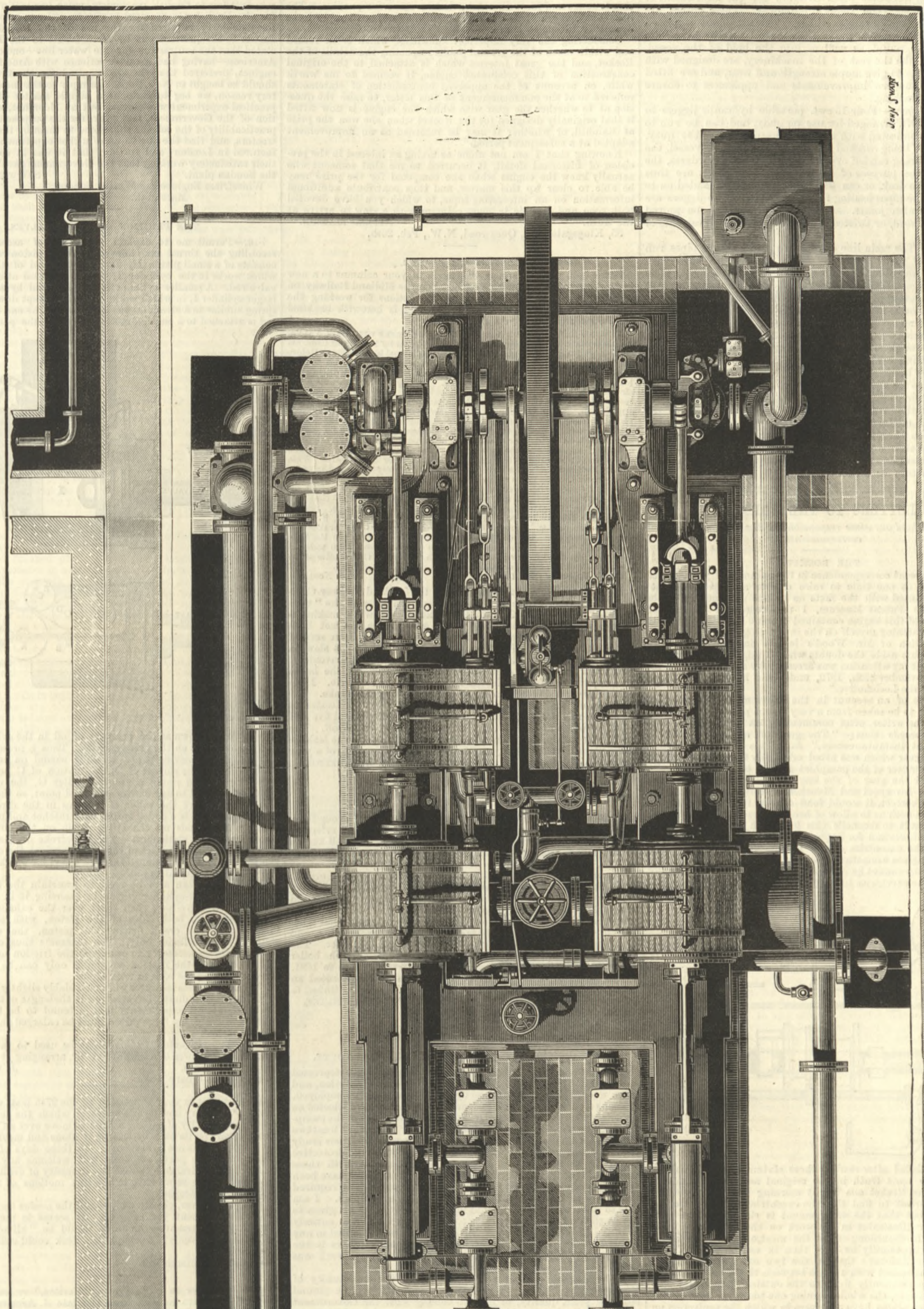


PLAN OF JIGGER HOIST.

Engines.—Pair of horizontal compound surfacing-condensing engines, capable of delivering 208 gallons of water per minute at a pressure of 700 lb. per square inch when running at sixty revolutions per minute. The high-pressure cylinder is 20½in. diameter, and low-pressure cylinder 28½in. diameter and 24in. stroke; arranged with variable expansion gear to cut off at any point between one-eighth and half the stroke, and provided with separate valves for shutting off the condenser if required, and exhaust direct into the air. The force pumps are placed at back of the cylinders, connected direct with the piston rod, and are of the double-acting type, with gun-metal ram and piston, with gun-metal lined pumps fitted with a special form of suction. Suction and delivery clack valves arranged for ready access. The engine is arranged to work its own air and circulating pumps for condenser; lift pump, for delivering water from the river about 70ft. away to the large tank placed above the boiler-house for supplying the force pumps with water and feed pump for supplying the boilers. The whole of the pumps are placed vertically against the side of the engine foundations, and are worked from the crank pins. The engines are also so arranged that one side can be thrown out of use at any time, while the other can be worked so as to develope power to work the air, circulating, lift, and force pumps, as well as its own force pump. The force pumps are made double-acting, with gun-metal rams 3⅝in. diameter, and pistons 5in. diameter, having the pump barrel also lined with gun-metal. The whole of the air, circulating, lift, and feed pumps are lined with gun-metal, and are fitted with steel rods, pins, &c., having extra large surface allowance for wear. The condenser is made circular, fitted with brass tubes and Muntz metal tube plates, and having all the requisite pipes, valves, &c., of the most modern and complete description. The engine was provided with all the most modern and complete fittings, valves, governors, &c.

Self-contained hydraulic crane.—Quay crane: One double-power to lift 10 and 4 tons respectively through a height of 60ft., the jib having a rake of 30ft. The lifting cylinders are placed vertically between the cheeks of pillar, and revolve with the pillar in strong pyramid-shaped iron pedestal securely fixed to quay with strong holding-down bolts, the two powers being got by having two rams, the one working in the other, so that when the light load has to be lifted the large ram is locked and the pressure acts on the small ram only, whereas when the heavy load has to be lifted the pressure is allowed to act on the large ram, and it carries the small ram with it. The turning rams are placed inside the pedestal at the base of the crane, and work horizontally. A raised platform and valve-house is also provided, placed on the quay at the side of the pedestal, so that the attendant has full view of the load from any point, and can also see into the hold of the vessel which is being loaded or unloaded. For these cranes see page 103 *ante*.

Portable cranes.—Seven 30 cwt. portable hydraulic quay cranes having 60ft. lift and a radius of jibs of 30ft., arranged to travel on wheels on rails spaced 10ft. apart, and arched to allow fully loaded trucks on ordinary 4ft. 8½in. gauge to pass underneath.



PORT OF BUENOS AYRES—PUMPING ENGINES FOR THE HYDRAULIC MACHINERY.

CONSTRUCTED BY MESSRS. J. ABBOT AND CO., GATESHEAD-ON-TYNE

(*For description see page 184.*)

The crane was arranged with cast iron counterbalance to ensure the stability of the crane down to the rails; the cranes are also provided with telescopic pipes to allow for the adjustment of the crane to suit the vessel's hatchway. These cranes are designed to deliver 80 tons per hour. The attendant is placed in a wood valve-house on top of the pedestal, thereby giving him a full view all round as well as into the hold of the vessel. These cranes, like the rest of the machinery, are designed with great care, so as to give ample strength and wear, and are fitted with all the modern improvements and appliances to ensure perfection in working.

Portable jiggers.—Four 15 cwt. portable hydraulic jiggers to lift through 50ft. arranged for use on quay, and can be run to any position connected with the pipes running along the quay, and capable of being worked from man on deck of vessel, the lifting chain being carried over pulley on vessel's yardarm, the latter acting the purpose of a crane jib. The goods are thus lifted on to the deck, or can be swung round and landed on to the quay. The pipes leading from the main to the jiggers are made with union joints, so that the jigger can be moved forward, backward, or twisted round to suit the requirements of the case.

Pipes, &c.—The main line of pressure and exhaust pipes run for about 1100 yards along the quay, and are provided with branches and valves at intervals of 30ft. for connecting portable cranes and jiggers, and are so arranged that the water used at the cranes is returned to a large overhead tank placed above boiler-house, and is used over and over again for an indefinite number of times, so that when the tank and pipes are once charged, there is no more water required except what little may be wasted through any slight leakage that may arise at the glands of lifting and turning rams. These were tested to 2500 lb. before leaving the works.

The roofings of the buildings were also made by J. Abbot and Co., of their usual light strong form, giving quite an elegant appearance to the interior of the building. The whole of the work was designed and carried out and delivered on board in Thames within the short space of five months, showing considerable despatch and efficiency. The work has now been fixed and started, and everything has gone together in a manner highly satisfactory to all concerned.

LETTERS TO THE EDITOR.

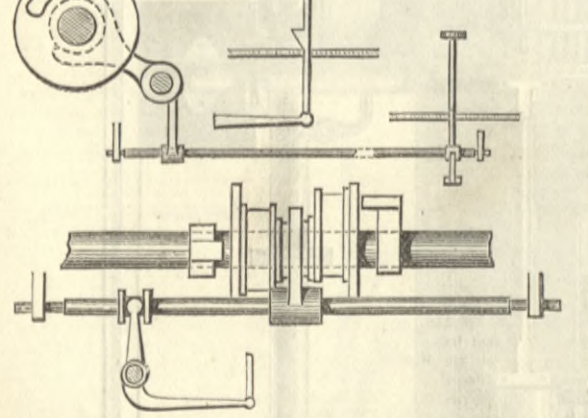
[*We do not hold ourselves responsible for the opinions of our correspondents.*]

THE ROCKET.

SIR,—The recent correspondence in the columns of your journal having tended at one time to raise doubts amongst those not actually acquainted with the facts as to the genuineness of the Rocket in the Patent Museum, I re-perused the information on the subject of this engine contained in some back numbers, with a view of enlightening myself on the interesting matter.

The publication of Mr. Wood's letters in the number for February 6th puts aside the doubts which I might have previously entertained, but my attention was arrested by a few words in the number for November 28th, 1879, under the heading, "Links in the History of the Locomotive."

In the course of an account in the above-mentioned number, which is stated to be taken from a very scarce pamphlet published at the time, the writer, after commenting on the death of Mr. Huskisson, proceeds thus:—"The gear of an engine can be reversed almost instantaneously," &c. This set me doubting respecting the gear which was fitted originally to the Rocket, for, presuming the writer of the pamphlet article to have been really acquainted with the gear of the engines which took part in the opening of the Liverpool and Manchester Railway, and that the statement was correct, it would lead one to infer that the gear then in use was such as to allow of being reversed while in motion, and it was difficult to reconcile this idea with the statement contained in THE ENGINEER for September 17th, 1880, in which it is asserted that the excentrics of the Rocket were driven by snugs "just as the engines are actuated in the penny boats," for by this method an engine cannot be properly reversed until it has actually stopped, and the excentrics take up their new position.



Not being satisfied after reading these statements, and thinking there might be some truth in the original assertion, I made an inspection of the Rocket one bright morning last week, and was somewhat surprised to find that the excentrics are not driven by simple snugs, but that the arrangement is similar to the gear which Pambour illustrates in his work on the locomotive, published in 1836, in describing one of the most approved engines of the time, such apparently as were then in use on the Liverpool and Manchester Railway; that is, the two excentrics are fixed permanently to a socket with a space between them, the excentrics having plates permanently fixed to the outside of each and concentric with the axle, the whole forming one piece but loose on the axle. These two plates have apertures in which the projection on the right or the left hand driver may be caused to enter according as the built-up arrangement is moved transversely on the driving axle, to the right or to the left, for forward or backward motion. Pambour, in his work above mentioned, does not describe the details of the mechanism for effecting this transverse motion, and leaves it to the reader's imagination, but simply states that it may by accomplished by means of a lever placed within the reach of the engineman.

I have sketched the actual arrangement now in the Rocket at Kensington, and send it herewith. It represents the gear as far as can be seen from a superficial inspection, and it will be seen that in this case the transverse motion is effected by a foot lever underneath the foot-plate, and which is close to the fire-box on the left of the engine. There is a catch on the vertical rod of this foot lever, which, by catching under the oval hole in the foot-plate through which it passes, would maintain the excentrics in one position—viz., to the right—but nothing is apparent by which to move or retain them in the opposite position to the left, and one might almost infer that motion in the latter direction was effected by a spring, but some part may be missing. The excentric straps are hinged to their rods to admit of the transverse displacement, but as regards the foot lever, it has the appearance of a very rough contrivance. It is evident that such an arrangement of gear would admit of reversing the engine without first bringing it to a standstill; indeed, it is difficult to see any advantage of this over the simple snugs and loose excentrics unless this were possible. The Sanspariel, which stands in the same museum, has simple loose excentrics, driven by snugs.

Considering the very imperfect knowledge which is on record and within reach of the general public respecting the details of the Rocket, and the great interest which is attached to the original construction of this celebrated engine, it seemed to me worth while, on account of the apparent contradiction of statements referred to at the commencement of this letter, to raise the question as to whether the gear with which the engine is now fitted is that originally designed for the Rocket when she won the prize at Rainhill, or whether it may be regarded as an improvement adapted at a subsequent period.

Knowing that I am not alone as taking an interest in the precision of historical detail, it occurred to me that someone who actually knew the engine when she competed for the prize may be able to clear up this matter, and thus contribute additional information on an interesting topic, to which you have devoted both time and trouble in your columns with a view to arrive at the truth. ALFRED MARSON.

35, Kingsgate-road, Quex-road, N.W., Feb. 26th.

CONTINUOUS BRAKES.

SIR,—Last week reference was made in your columns to a new or improved vacuum brake introduced on the Midland Railway on Monday, 16th inst. The circular of instructions for working the brake has been sent to me from Derby, and is herewith enclosed for the information of your readers:—

MIDLAND RAILWAY: THE AUTOMATIC VACUUM BRAKE WITH BALL VALVE.—This brake can be applied throughout the train by the driver from his engine, or the guard from his van. Engine-drivers' instructions: Before starting from any station see that your gauge indicates at least 18in. of vacuum, and that not less than this amount is maintained during the journey and while standing at stations. To apply the brakes, open the air valve on the engine. To release the brakes, close the air valve and restore the vacuum to the same amount as it existed before their application. When the engine is attached to the train and the brake pipes connected, put on the small ejector, and keep it on to maintain a constant vacuum during the journey. The large ejector may be used to raise a vacuum rapidly, or when the brakes require to be taken off again quickly; but in either case it must be closed again gradually. Guard's instructions: To apply the brake, lift up the lever of the valve. This admits air throughout the train pipe, and is to be only employed in cases of emergency. This valve opens automatically when the brake is applied with full force by the driver, and insures rapid action. See that all pipes between carriages are properly coupled together, and that the couplings on the end coaches are placed upon the stop plugs. See by your gauge that a vacuum of 18in. is maintained, and report, if otherwise, to the driver. General instructions: To release the brakes for shunting purposes—the engine having left the train—first see the hose coupling at one end of the train is off the stop-plug and then pull the cord which is fixed under the frame of each carriage. This admits air to the top side of the cylinder and the brakes come off by gravity.

Derby, February 12th, 1885. JOHN NOBLE.

It is satisfactory to find that at last the Midland Railway Company has become aware of the dangerous character of the "two-minute" brake; but it is to be deplored that when making a change something better than the new appliance has not been adopted. On and since the 16th inst. I have ridden upon several occasions with trains fitted with this brake, and find it slow in action, compared with air pressure. It is also very inconvenient, that when an engine is changed, or shunting performed, the brake goes on, and has to be released by hand on each vehicle. Difficulties have quickly become apparent in releasing the brake. For instance, on the 20th inst. the 10.35 a.m. train from Leicester to Bradford was delayed a minute and a-half at Silsby and five and a-half minutes at Barrow, as the brake would not come off. The piston rod packing is now new and in good order; yet some leakage takes place. What, then, may be expected in the course of a year or two? CLEMENT E. STRETTON.

Leicester, February 24th.

BLAKE'S IMPROVED VERTICAL BOILER.

SIR,—Permit me to call your attention to a letter in your issue of 12th December last, from Messrs. E. R. and F. Turner, referring to my recent improvement in the construction of my well-known boilers, and the perspective sketch given of the internal part of my boiler. In Messrs. Turner's letter they say:—"This"—meaning my improvement—"can hardly, however, be considered a novelty, as we have had exactly the same thing before the public since 1882, see engraving of which we enclose herewith." It is a pity you did not publish the engraving Messrs. Turner sent you; if you had it would have been seen that the allegation in their letter is not true. The internal part of my boiler is different to Messrs. Turner's, and I have no hesitation in saying an improvement and superior. The boilers now sold by Messrs. Turner are exactly similar to the boiler patented by me in 1878, and continued to be made down to 1881. I then ceased to make them, because I invented and patented an improvement, and have since 1881 to the present time continued to make my improved boilers. JAMES BLAKE.

Britannia Works, Newton Heath,
Manchester, March 2nd.

THE WATER SUPPLY FOR THE SUAKIM-BERBER ROUTE.

SIR,—At a time when British manufactures are more depressed than at any period in the memory of the present generation, and when the Home-office is besieged by deputations of the unemployed, it seems a curious fact that the Government should have selected an American firm as the favoured recipients of their orders for the pumping machinery on the Suakim-Berber Railway. There are at least two well known English firms who have made steam pumps their study for many years, and who would, but for the American protective tariff, be at the present time supplying America with these engines. It will naturally be supposed that these firms have been asked by the Government whether they could supply the required machinery before the orders were sent out of the country. I am able to state with certainty that no opportunity has been given to the English makers of tendering for the work—which is entirely in their line of manufacture—nor have they been consulted in any way whatever. The announcement in the public papers is the first intimation they have received that their special work was then being taken out of their hands.

If the English engineers had been given the opportunity of tendering, and had shown that they were unable on the ground either of price, quality, or time to comply with the Government requirements, they would have no reason to complain; but as the matter stands it appears a singular neglect of an opportunity to benefit the home industrial classes. AN ENGLISH ENGINEER.

London, March 4th.

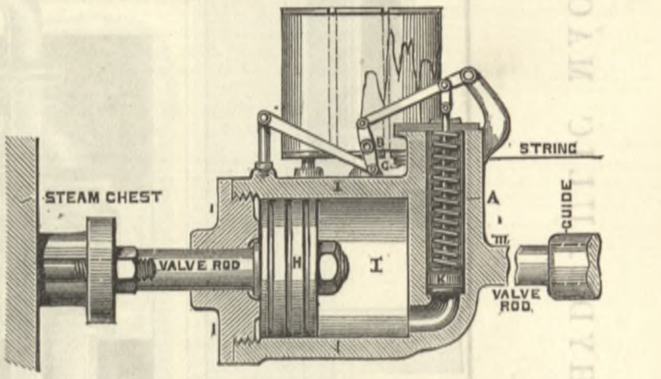
SIR,—The fact that questions respecting an order given by the English Government to an American firm for pumps for the above contract have been asked by several members in the House of Commons, we venture to submit, invests this subject with national interest and importance for several reasons. In the first place, it is well known that we have had for many years a depression of altogether unprecedented severity in our iron, coal, and other kindred trades, and this depression, as is equally well known, still exists. In the second place, the public is painfully aware that at the present time many thousands of our artisans are in a state of enforced idleness and their families starving. In the third place, ironworks, collieries, engineering, and other similar industrial establishments throughout the country are, for the most part, only partially employed, and in too many instances are entirely stopped, whilst employers of labour find themselves subject to diminished incomes and with the burthen of increased and increasing taxation to bear.

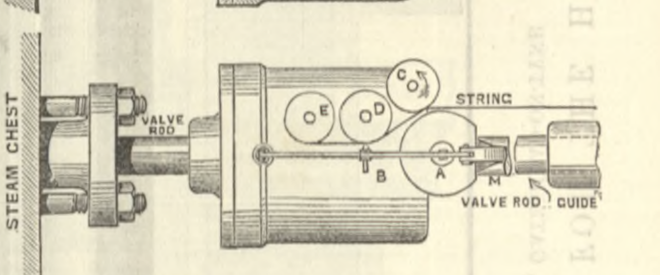
In the face of all this, and considering the notable fact that our ports are open to the free importation of machinery from the United States, whilst English machinery exported to that country is subject there to a heavy prohibitive duty, we would venture to ask, Is it fair to English machinists, much less is it a patriotic act, for the English Government to give an order to a foreign country for machinery required for the use of the British Army? In answer to the question put by Mr. Carbutt in the House, it was stated that the contractors for the water line—one of whom is an American—having had great experience with American pumping engines, preferred that the six required for the first fifty miles should be bought in New York. In reply to this most unsatisfactory reason, we beg to state, as a simple matter of fact, that a practical experiment was carried out at Aldershot, with the sanction of the Government, last year, for the purpose of testing the practicability of the scheme submitted to them by the present contractors, and that the pumps used in that experiment were manufactured in London; and further, that it was in consequence of their satisfactory working that the Government gave the order for the Soudan plant. S. OWENS AND CO.

Whitefriars Engineering Works, London,
March 5th.

THE FRICTION OF SLIDE VALVES.

SIR,—Permit me to explain a method of ascertaining and recording the thrust on slide valve-rods, piston-rods, &c. It consists of a small piston H, fixed on the end of the valve-rod, which works in the cylinder I, full of oil, also attached to the valve-rod. A smaller cylinder A is connected by a hole to the larger cylinder I, in which works a piston K kept down by a spiral spring similar to a steam engine indicator. The end of the piston-rod is attached to a parallel motion carrying the pencil B, which





travels up and down as the pressure of oil in the cylinder varies, due to the thrust on the valve spindle. Thus a pressure diagram is traced on the moving paper, which is wound on to the roller C off E, and over the surface of D, the motion of C being obtained by a string coiled round a grooved pulley G, the other end of which is attached to any convenient fixed point, so that on the in-stroke of the valve the roller C revolves in the direction of the arrow. Inside G is a coiled spring with ratchet and pawl arrangement, which winds up the string again on the out-stroke, the paper remaining stationary. The out-stroke of the rod will be made by the direct contact of the piston against the cover. At M the valve spindle is continued through the guide bracket, thence to the joint of the excentric rod.

This indicator can also be used to ascertain the friction on a piston of a double-cylinder engine by inserting it in a piston-rod instead of a valve-rod; then cover over the exhaust port, and admit steam on both sides of the piston, with the valve-rod disconnected, the crank driving the piston, the engine being worked by one cylinder only. The diagrams thus obtained will show the thrust necessary to overcome the friction on the piston. In the same way the friction on glands only can be obtained by merely allowing the rods to work alone.

The action of this indicator will unavoidably slightly alter the distribution of steam due to the variations in the length of the valve-rod, but if in practical experiments this is found to be too large for efficient working, the large piston must be enlarged and the smaller one diminished.

A similar arrangement to this might be used to take diagrams of the tractive power of a locomotive by arranging it between the engine and coaches. J. GOODMAN.

Brighton, February 21st.

SIR,—I notice in your impression of the 27th inst. what appears to me to be a very novel slide valve, in which the inventor overcomes the difficulty of getting a slide to move over an exhaust port with pressure on its back by leaving it alone and moving a part of the valve which is not so stubborn. In these days of high piston speeds and large ports engineers will welcome any simple and practicable contrivance by which the necessity of dealing with such enormous strains as we have in the link motions of most marine engines may be escaped.

I do not, however, clearly understand the *modus operandi* of the second arrangement you refer to. It seems to me that if the fulcrum pin be removed the valve would be "all adrift." Will the valve wear evenly? Perhaps Mr. Peck could enlighten us on these points. S. W.

Westminster, March 2nd.

SIR,—In answer to letter signed "Veritas," *re* balanced slide valves, I beg leave to state that the late J. Armstrong did not take the balanced valves out of the Iron Duke Great Western broad gauge engine. They were taken out many years before that gentleman became loco. superintendent. The balanced valves of that description are very old. The late Timothy Hackworth tried them in the Majestic steamer at Stockton fifty years ago.

Bristol, March 5th. EX-LOCOMOTIVE.

SIR,—Will you kindly allow me to correct an error in my last letter. The pencil ought to be fixed in one of the collars on valve spindle, so as to record variations in length of its stroke under different pressures; not on eye-piece, which would always have the travel of the excentric rod. VOLVOX.

March 3rd.

COMPOUND IRON-AND-STEEL ARMOUR PLATES AND STEEL ARMOUR PLATES.

SIR,—The diagrams in THE ENGINEER of the 27th of February, of the plates after the trials at Spezia, clearly show what might be expected from the percussive force of the shot from a 100-ton gun acting on the different materials of which they were made. The trials with the compound iron and steel plates of Messrs. Cammell and Brown's, Figs. 1, 2, 4, and 5, show that a complete breaking up of these has taken place. It was not so in the Schneider steel plates, as shown in Figs. 3, 6, and 7, as the conical shots passed clear through them, the cone part of the shot apparently wedging or forcing the plates asunder in its passage through, and forcing or wedging the displaced metal into the other parts of the plate. In accordance with the displacement of the metal into the plate itself in the passage of the shot, which, in these trials, would be somewhere about one cubic foot, so is the resistance or strength of the material of which they are made proved. In the case of these trials the steel plate clearly shows the greatest strength to withstand such terrific force; such being the case, it naturally occurs to one's mind why it should be so; why should plates of the same size and thickness, and of comparatively the same material, give on trial such different results.

A few remarks on this important subject, especially at the present time, when the nations of Europe are increasing their armaments, may not be out of place. I shall first open the question of the composite iron and steel plates and their manufacture, and show why they will not stand the same amount of force as steel plates, or what goes by that name. My first practical experiments took place as far back as 1862 in the testing of the shot-proof plates for the embrasures of the fortifications at that time being built by me for the Government. All classes of plates were put to trial—best Lowmoor iron, ordinary wrought iron, puddled steel, and what was at that time called homogeneous iron, or what I should now call mild steel of the finest quality. The result of many trials by the War Department was that the shot passed clear through the iron plates; through the puddled steel plates with fracture; but not through the homogeneous metal, although it was only half the thickness of the Lowmoor plate. The mild steel or homogeneous iron was therefore adopted to shield the embrasures. It is, no doubt, metal of this description that is employed by Schneider in the manufacture of his plates, being made in pots or crucibles in charges from 60 lb. to 100 lb., each workman pouring his charge into a dam until the required mass is collected for the cast, the mass never being allowed to get cool until it is shaped through the rolls. This is the usual way adopted in German works for large masses, consequently the molecules of the metal do not get their crystalline or prismatic shape until the mass is cooled at its finish. The strength of the mass will depend on the fineness of the atoms, and also on their close impact on each other. The construction of composite iron and steel plate is entirely different from a mild steel or homogeneous plate, and I cannot compare it in regard to its strength better than to a sound piece of English oak with a deal backing, the oak representing the steel face, and the deal the wrought iron back of the plate.

I had an opportunity some time since, at the Atlas Works, of noting the way armour plates are manufactured. In the first place, it takes about two tons of pig iron to manufacture a ton of finished iron plate, therefore one ton of iron is oxidised in the furnace per ton of finished plate in the many heatings it has to undergo. My experience in heating masses of iron is the deterioration of the metallic strength by oxidisation, and to build up an iron plate of many tons weight it has to undergo many weldings and coolings; and I have found in practice the larger the mass built up, the larger the crystals or prismatic atoms of the metal become, and therefore weaker.

The way in which these large masses of wrought iron are built up may be stated briefly. The puddler prepares his ball in the usual way, partly from refined plate metal, and partly pig. The ball is then shingled and rolled into a slab. These slabs are sheared, piled, and rolled three times, the slabs increasing in size every time, until a pile is built up large enough to form slabs 2in. to 3in. thick. These are then piled on each other, tier crossing tier, until the mass is large enough for the required plate, which is brought up to a welding heat in a furnace, and passed through the rolls. I leave the question of the quality of the plate to the practical man, as I am sure he will understand what it will be in masses of many tons weight each after the firing it has passed through; but my experience is—oxidisation takes place, or what the men call burnt iron. I should also question whether anything like the extreme of 25 tons tensile strain, with about a third elongation, has ever been produced in these large masses. About 20 or 21 tons per square inch will be nearer it, as I have found from experience.

To strengthen this weak mass of iron, I believe Mr. Wilson, of Messrs. Cammell, invented a process for facing the wrought iron plate with steel. This is effected by heating the wrought iron plate to a welding heat again, and by making the furnace into a mould, so that a charge of liquid steel can be poured on to the wrought iron plate of the necessary thickness, which combines in setting; when set it is rolled through the mills for the required thickness. The question is whether the steel does incorporate itself thoroughly on the face of the wrought iron plate; looking at the drawing of the plate, Fig. 2, experimented on at these trials, the face of steel appears to have left the iron plate backing, showing imperfect adhesion. Another question also arises in my mind—the unequal contraction and expansion of the two metals; it may not be of much importance, perhaps, in a plate, but in many of them fitted together and forming long lengths, as on the side of a ship, it would be of great importance. It cannot be to the advantage of the Government to have a composite plate of fancy construction to protect our ships or to make our guns of; a strong front on a weak back, to bring one body whose tensile strength extends to about 45 tons on the square inch on to another body whose extreme strength does not exceed 25 tons on the square inch tensile, more especially as the iron, the weakest, will cost at least four times as much to make as the finest homogeneous iron, seems to me against common sense. The latter may have any per centage of carbon added to it to make either soft or hard steel. If a hard face is required this can be done by casting one side on a chill, or temper it as steel is tempered.

It appears to me a fallacy to employ iron armour plates faced with steel at a greater cost, with at least 50 per cent. less strength than homogeneous iron or mild steel. The means of producing large masses are now not confined to one firm; but the question of uniformity of quality, that is, the uniformity of purity and fineness of the atoms, is not insured by the present two modes in operation for the production of the metal.

Those who make ingots, say, for 100-ton guns, have to employ several furnaces to prepare the charges, and I have no hesitation in stating that no two charges of the metal will be either the same in purity or in fineness of its atoms. To insure a uniformity of strength and fineness, the metal should all be refined and manipulated in one charge and in one apparatus. I believe the largest furnaces or converters in work have not more than 15 tons capacity. Furnaces will be constructed to manipulate masses just the same as machinery is produced to handle them. Why should we go on making plates of combined wrought iron and steel in the face of the recent trials against plates made of one metal, which showed their superiority? If we could not produce them of one metal, and of equal quality to our competitors, it would be a different matter; but I am sure what others can produce, either in steel or iron, we can, and the sooner for our credit we are at it the better.

SAMUEL R. SMYTH, C.E.

Smyth's Caloric Association,
12 and 13, Barbican, E.C., March 3rd.

FLOATING BREAKWATERS.

SIR,—The question of numerous harbours of refuge is such a national one—and is at the same time so necessarily associated with an inquiry after inexpensive methods, and thus with propositions for floating breakwaters—that the proposition to place one at Eastbourne has aroused much public interest. It is satisfactory and valuable that a floating breakwater should thus be given an opportunity of proving that shelter can be supplied in this economical way. But it would be equally a national calamity if the whole class of floating breakwaters were to be discredited through the possible or partial failure of one particular form of floating breakwater.

From several quarters I have had communications, and have also seen references made to others to the effect that the Greenway breakwater is either going to be put down at Eastbourne, or that that experiment is so similar that the Greenway breakwater must be content to stand or fall by the success or failure of the composite breakwater to be used there.

Not only in the name of fair play and myself, but, I venture to say, in the interests of truth in an important national question, I trust you will find space for the following description pointing out the peculiarities distinctive of these two forms of floating breakwater:—

1. The breakwater, Fig. 1, proposed at Eastbourne has no theory, except the general hope that the sea may be quieted by being broken up and hindered, as described lower down.

The Greenway breakwater, Fig. 2, has a simple, well-known, natural law as its basis, viz., that counter currents will nullify one another.

2. Messrs. Carey and Latham's adaptation of Mr. Leeds' plan only cleaves the water slightly below the surface.

The Greenway breakwater turns a column of water 10ft. or 15ft. deep.

3. Mr. Leeds' plan partly opposes the sea, and is therefore in danger of being carried away.

The Greenway breakwater only diverts, and is therefore in less danger.

4. They use the expression—apparently borrowed from me, for it is in none of Mr. Leeds' earlier descriptions of his plan—"dividing the waves;" but their form of breakwater is adapted to divide the water, not the line of the wave, for they divide it horizontally by a wedge that lies on its side.

The Greenway breakwater is vertical, and really divides waves, breaking up their line and turning portions against one another.

5. They estimate the cost of their breakwater at £18 a foot.

The Greenway breakwater is tendered for at £6 a foot.

6. Their mooring is complicated, experimental, expensive, and difficult of placing, necessitating calm weather and the use of divers.

The Greenway breakwater mooring is simple, depending chiefly on weight, and is recognised by nautical men as adequate; it is inexpensive, and gives no more trouble in putting down than an ordinary anchor.

7. Theirs, in fact, represents a beach (1), and a wall (2), steadied by a flooring (3), and anchored by chains over rollers to a beam (4) or girder, fixed at the bottom of the sea.

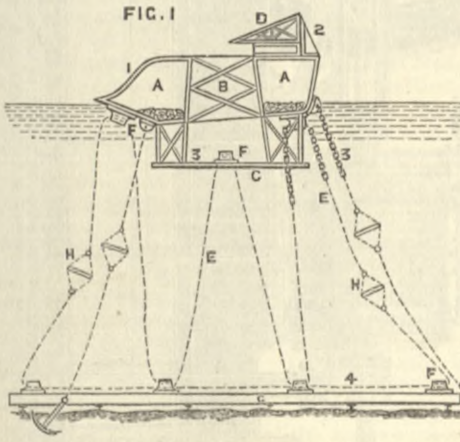
The Greenway breakwater is briefly a series of prisms with curved sides and three heavy anchors.

8. The idea of a beach or slope throwing up the sea is not novel.

The Greenway breakwater turning the sea against itself, and the more perfectly as the storm rages the fastest, is a novel and scientific plan.

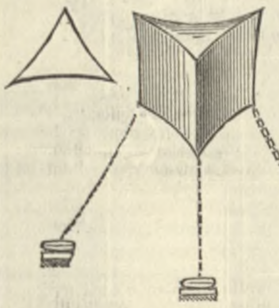
9. Their floating structure has no provision for relief.

FIG. 1



The Greenway breakwater, being sloped at the back, receives support and relief to the front mooring from the natural action of water rising violently in the line of that slope, in exact proportion to the force which assails it in front. The turnwater is thereby thrust upward and forward.

FIG 2



I believe every floating breakwater to have great advantages over solid ones in deep water, but as some forms of them have been tried and cast aside before, it is not right that the whole class should be indiscriminately judged as identical, and that such a simple and scientifically designed harbour as the Greenway breakwater should be made to stand or fall by the success or failure of one which does not claim to be based on the same principles, but in a comparatively complicated form.

E. C. GREENWAY THOMAS.

March 2nd.

RAILWAY SIGNALS.

SIR,—I was much interested in the report of Major F. A. Marindin on a collision which occurred on the 17th December, 1884, near West Croydon Station, on the London, Brighton, and South Coast Railway, in which he urges the desirability of distinguishing in some way between distant and home signal lamps at night, which is often felt. Sir, I can agree with him in his remarks on the above subject, as I think it is quite time something ought to be done in the matter, as I have to run over sections in which there are signal posts, with the distant and home signals and one post; and I hope that his remarks will not be slighted this time, as I think they were at the time when he made his report on the fatal accident on the Great Northern Railway at Hornsey, January 24th, 1882. In his concluding remarks on this accident, he says the lesson to be learned from this fatal collision is, that the whole system of fog signalling in use generally throughout the kingdom is a very weak point in railway working, and that the rule for working under the present system, weak as it is, required improvement. Even when fog signalmen are at their post, and are known by the drivers to be there, it must be remembered that in very thick fogs the flag-man and his lamp are frequently invisible, and that, therefore, a driver does not get any positive intimation when a signal is of such as it is when the signal lamp or arm is itself visible, but only a negative signal, on account of the non-explosion of two detonators, which may possibly have failed to explode, although upon the rail and intended to do so. The rule enjoining caution when running in a fog should be rigidly enforced. The risk, appreciable at all times during fogs, becomes the greater when the fog is a sudden one, for in such a case there must be, under the present system, an interval of time when the signals are not protected by any fog signalmen. It is to be hoped that as a result of this collision a further trial may be given to inventions for the improvement of fog signalling. Sir, as I have seen an invention tried and worked successfully on one of the engines on the Haydock Colliery Railway, belonging to Richard Evans and Co., Earlstown, gives a true and proper signal on the engine when he is passing a signal at danger, whether it is a distant or home signal. I think that if something of this kind was adopted on all railways, all drivers and pointsmen would be better protected in case of fogs coming sudden in the night time as well as day. I think it would also be a great saving in life and rolling stock. I hope that this will meet the eyes of the patentees of the above invention, and that they will give us a full description of it.

EXPRESS DRIVER,
London and North-Western Railway.

Liverpool, March 3rd.

PREVENTING INCRUSTATION IN BOILERS.

SIR,—We note in your issue of 27th ult. a sketch and description of a purifier for preventing incrustation in boilers, constructed by Mr. William Brown, of Stockton-on-Tees, to meet the emergencies of a very troublesome case. In the case referred to there was fortunately no lack of fuel at command, and it was found possible to construct a purifier which was practically a separate boiler. Should there not, however, have been a superabundance of gaseous fuel at hand, the case would have been extremely troublesome. It may therefore be of interest to your readers to know of a remedy in those cases where spare fuel is not available. We wish to direct attention to a boiler cleaner, requiring no heating, and which has now been for some years in successful operation with a large number of firms in the United States, and has been found to meet those cases where fuel is an item for calculation, and simplicity of working is desirable, may be of interest to your readers. It consists of a fan-shaped skimming pan, 7in. deep, and extending nearly to the shell in width, and is placed at the back end of the boiler, with its open side towards the front, the rear sides being partly above the surface of the water. A flow pipe connecting with the rear of the pan, and passing through the boiler shell, is connected with a settling chamber. A return pipe is connected with the settling chamber. A blow-off pipe is also provided.

As it is a well-known fact by all practical engineers that the impurities in water will come to the top when first subjected to the action of heat, and that the current in a boiler is from front to rear at the surface, caused by the heat being strongest in front, hence the practicability of this self-acting invention. When steam is generated a constant and steady circulation is produced from the front of the boiler to the pan, where the heavier sediment will be held, the lighter matter passing up with the current to the settling chamber, where, having left a 1¼in. pipe, and entering a large cylinder, the water spreads out and becomes comparatively still, thus precipitating all sediment to the bottom of the chamber, the pure water returning to the boiler through the return pipe, the circulation continuing so long as there is any pressure in the boiler. To clean out the pan and the settling chamber or cylinder, the blow-off is opened as often as may be necessary, according to amount of sediment in water used.

The settling chamber is made of boiler iron, tested at 200 lb. pressure to the square inch, and is from 36in. in length by 18in. in diameter upwards, according to the size of the boiler. Valves are attached close to the shell of the boiler, on the outside, so that in case of a pipe leaking it can be immediately shut off.

Some of the benefits of these machines are—they will remove all impurities from the water; old scales will drop entirely off, the cause being removed. They will preserve a boiler, also the engine, by preventing, more or less, grit working over with the steam; saving of fuel, making steam easier, and lessening danger of explosion by positively preventing a boiler from foaming. They are very simple in construction, and long-lasting.

We shall be pleased to give any further information to any of your readers who are troubled with bad water or scale in their boilers.

THOS. VEASEY AND CO.

Wool Exchange-buildings, Coleman-street, E.C.,
March 4th.

NEWTON'S THIRD LAW.

SIR,—I have read with interest and some amusement the ingenious solution of the action and reaction difficulty submitted to your readers by Mr. Muir. Of course, if there *is* no motion save at right angles to the strain, the whole difficulty is got over. But is not this begging the question?

It seems almost a pity to disturb Mr. Muir's simple, child-like faith, but I venture, notwithstanding, to ask him what is the solution of the difficulty presented by a crane lifting a weight? The resistance of the weight to be lifted is equal, according to Newton, to the strain applied to lift it; and this we know apart from Newton, because the pull is the same at both ends of the rope against the engine and against the weight. Will Mr. Muir kindly explain where the right-angled sliding action comes in here?

London, March 3rd. AN OLD STUDENT.

CLEOPATRA'S NEEDLE.

SIR,—My attention having been called to a notice in the issue of your valuable journal of the 23rd January last, under the heading of Literature, in which mention is made of the process adopted for the preservation of Cleopatra's Needle, I beg to inform you that it was Browning's Permanent Preservative Solution, manufactured by my company, that was, six years ago, so successfully used in the preservation of the obelisk; and you will observe, on kind perusal of the slip enclosed herewith, that this preservative was used in preference to any other. I should feel much obliged if you would kindly have these facts mentioned in your issue.

Indestructible Paint Company, WM. LEWIS PRATT,
27, Cannon-street, London, Secretary.
March 4th.

WORKS of considerable magnitude are being proposed to increase the supply of water to New York, and contracts have already been awarded for a new aqueduct which will cost from two to two and a-half million sterling.

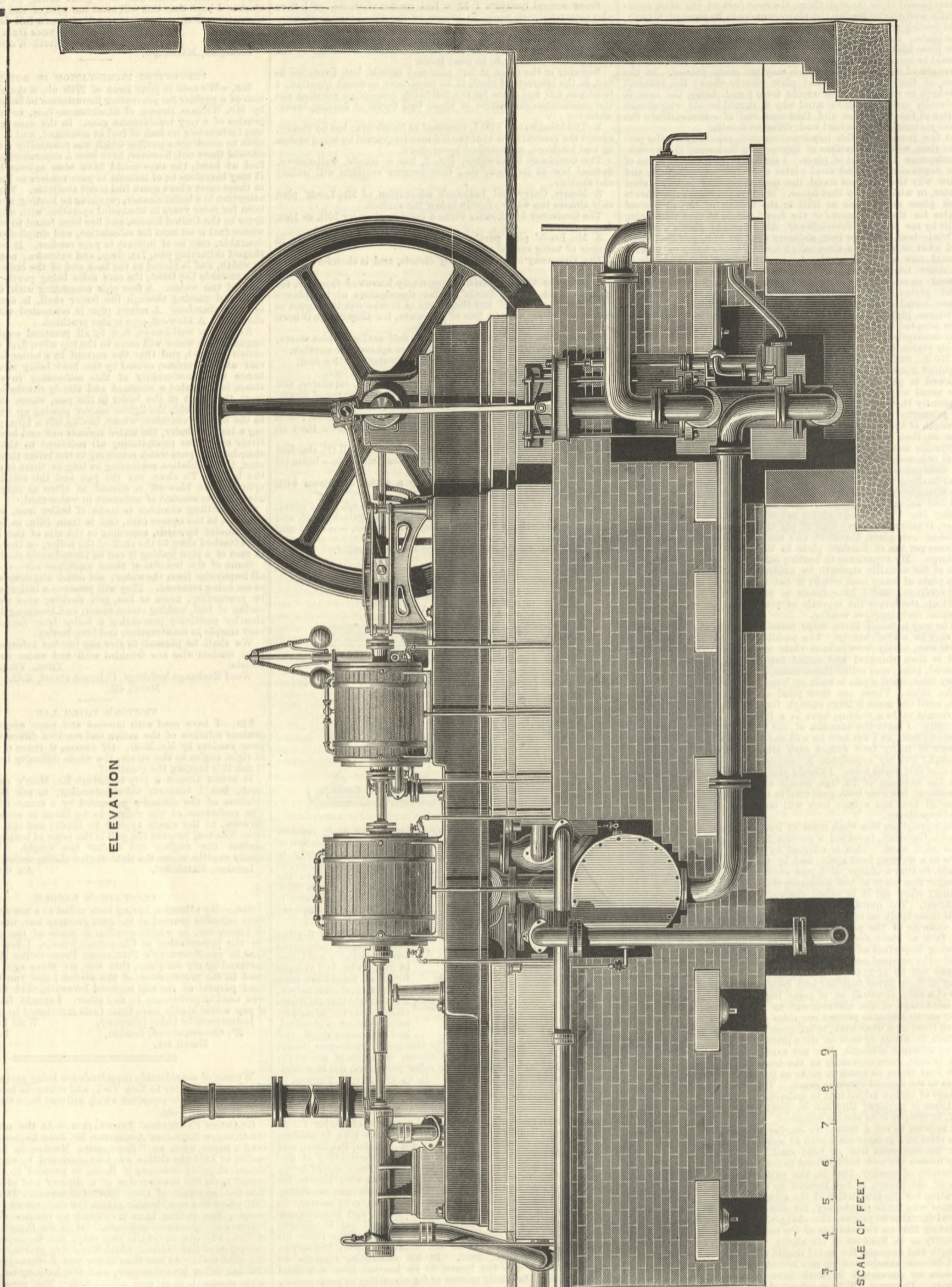
GLASGOW ENGINEERS' ASSOCIATION.—At the ninth meeting of the Glasgow Engineers' Association Mr. John Eaglesham, C.E., Ayr, read a paper upon an "Engineering Mission to Brazil." In the spring of 1884 the author was commissioned by the directors of a steam shipping company in Bahia to proceed to that country to report upon the construction of a slipway and other accommodation for the repair of their fleet of steamers. Describing in the first place to a considerable extent the customs and manners of the people, the author then proceeded to discuss the engineering features of the scheme proposed. Of all the Brazilian ports Bahia is the only one at which iron ships can be repaired, with the exception of Rio Janiero, which has a fine graving dock cut out of the solid rock. At one time there was a slipway at Colonia, but this has fallen into disrepair, and the hauling machinery having been removed, it is now abandoned. The present method of beaching the steamers at Bahia is as follows:—At low water the vessels, which for the river navigation are flat bottomed, and have only a draught of 5ft. to 7ft., are floated at high water above a series of logs placed at right angles on bearing logs, and forming what is technically known in this country as a "gridiron." The top of the log is about 2ft. above low water, and the workmen then make the necessary repairs until the water floods them out. The difference between high and low-water O.S.T. was ascertained to be 9ft. 5in. Although the largest of the company's steamers is only about 800 tons, it was decided to build the slipway large enough to accommodate a vessel of 2000 tons. The construction recommended was principally of timber, and the wood best suited for this purpose is the Periba, examples of which, and as well as of several other native woods, were shown. The cost of the wood at Bahia in the rough varies from 1s. to 1s. 3d. per cubic foot. Labour is dear. On the Parahyba Railway, in the vicinity of Pernambuco, labourers earn about 1 milreis—1s. 9d.—per day, native masons 2 to 2½ milreis, and carpenters 3 milreis per day. Afterwards the author described at some length the tramway systems of both Bahia and Pernambuco, also some of the leading features of the railways at present in construction in Brazil. The paper was accompanied by drawings illustrative of the proposed works, and of the tramway system of the town of Bahia.

PORT OF BUENOS AYRES PUMPING ENGINES FOR THE HYDRAULIC MACHINERY.

CONSTRUCTED BY MESSRS. J. ABBOT AND CO., GATESHEAD-ON-TYNE.

(*For description see page* 184.)

ELEVATION



TO CORRESPONDENTS.

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

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

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 1d. postage stamp, in order that answers received by us may be forwarded to their destination.*

E. B.—*There is no book of the kind published.*

J. T.—*Patent agents assert that there is. We hesitate to say that they are not right.*

C. R.—*Sennett's treatise "On the Marine Engine;" Binn's treatise "On Drawing."*

W. D.—*Apply to W. F. Stanley, Great Turnstile, saying in particular what calculations you want the slide rule to make.*

W. P.—*The total head of water when the tank is full will be 26·75ft. Multiplying this by ·433, we get the pressure in pounds per square inch, namely,* 11·58275 *lb.*

A. E. W. (Brierley-hill).—*It is just possible that Messrs. Spon, of Charing-cross, may have a copy of the old book you want. If they cannot supply you, you may get one by advertising for it.*

ANXIOUS.—*If your tanks are lined with Portland cement* 1in. *thick—one of cement to one of fine, sharp sand—and the whole subsequently coated over with a thin coat of pure cement, there ought to be no leakage. If there is, give two coats of red lead paint.*

H. C. (Shibden).—*The whole weight, whatever it may be—either that of the scale pan or that of the spring balance—must be used. As a spring balance weighs something, and as that weight is carried by the brake, why should it be left out of consideration? Years ago we published engravings of the Royal Agricultural Society's friction brake. You will find full particulars in a paper read by Mr. Rich before the Institution of Mechachanical Engineers. See the "Transactions" for* 1876, *page* 199.

COMPRESSED PAPER.
(*To the Editor of The Engineer.*)

SIR,—Can some of your numerous correspondents let me know the addresses of the principal makers of articles in compressed paper, such as railway wheels, &c.? M.

Belfast, February 27th.

THE RATCHET BRACE.
(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me who invented that useful tool the ratchet brace? In the *Mechanics' Magazine* for September, 1835, p. 441, there is a sketch of a very simple form of ratchet brace, and it is described as being a new thing, the correspondent who sends it attributing the invention to "a workman at Mr. Hague's manufactory." Mr. John Hague was a well-known engineer of the day, whose place of business was, I think, in Cable-street, St. George's-in-the-East. Is it possible to refer to an earlier reference to the ratchet brace?

London, March 2nd. ENQUIRER.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 10th, at 8 p.m.: Ordinary meeting. Paper to be discussed, "The Construction of Locomotive Engines, and some Results of their Working on the London, Brighton, and South Coast Railway," by Mr. Wm. Stroudley, M. Inst. C.E. Friday, March 13th, at 8 p.m.: Students' meeting. Paper to be read and discussed, "The Blasting and Removal of Rock under Water, and the Construction of a Deep-water Quay at Blyth Harbour," by Mr. Wm. Kidd, Stud. Inst. C.E. Mr. H. Hayter, Member of Council, in the chair.

ENGINEERING SOCIETY, KING'S COLLEGE, LONDON.—Tuesday, March 10th, at 4 p.m.: Paper to be read "On Fuel," by Mr. Collis.

CLEVELAND INSTITUTION OF ENGINEERS.—Monday, March 9th, at 7.30 p.m.: Paper "On the Gradual Reduction System of Manufacturing Flour by Chilled Iron Rolls," by Mr. Henry MacDonnell, Stockton.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, March 12th: "On Constant Electro-motive Force in an Electric Light Circuit," by Sir David Salomons, Bart., Member. "Electrical Definitions, Nomenclature, and Notation," by Mr. Andrew Jamieson, F.R.S.E., Member.

SOCIETY OF ARTS.—Monday, March 9th, at 8 p.m.: Cantor Lectures. "Carving and Furniture," by Mr. J. Hungerford Pollen. Lecture I. Types and fashions of the wood carvers' art. Wednesday, March 11th, at 8 p.m.: Fourteenth ordinary meeting. "Exploration, and the Best Outfit for such Work," by Major-General the Hon. W. Feilding. Mr. Francis Galton, F.R.S., will preside. Thursday, March 12th, at 8 p.m.: Applied Chemistry and Physics Section. "Recent Improvements in Photographic Development," by Mr. W. K. Burton. Friday, March 13th, at 8 p.m.: Indian Section. "The Present Condition and Future Prospects of Female Education in India," by Mancherjee M. Bhownaggree, late Secretary of the Alexandra Girls' English Institution, Bombay. Mr. Matthew Arnold, D.C.L., will preside.

THE ENGINEER.

MARCH 6, 1885.

STREET MAINTENANCE AND SUBWAYS.

WE may so accustom ourselves to some crude things in engineering work that we cease, or fail to see, where the barbarism lies. This is notably the case in London street or road making. If houses were built with doors that were fastened each night with spikes and had to be opened each day with a pinch bar, like packing-cases, we should probably come to the conclusion that though custom should be revered, and locks and bolts would be more costly than nails, the first cost would in the end be the smallest both in nails and doors, to say nothing of convenience and time saved. Failing to act upon such a conclusion would not, however, be one whit less inconsistent with our claims to be considered common-sense folks, than the way in which we proceed in reference to our London streets or roads. Many of these streets are made in a most costly way. They are dug out with great labour to a depth of over a foot, the bottom sifted and levelled, and then covered with a bed of about 6in. of concrete. This is carefully floated with cement mortar, and thus a bottom is made capable of lasting all time. Upon this is built a compound floor of wood blocks, asphalte, and other things, making up what is the best roadway modern road engineering has devised for towns where cost is not the first consideration. Such a roadway is made on the large scale at a first cost of from 15s. to 18s. per square yard. In London these roads are usually completed, and perhaps all the paraphernalia of construction removed, and even a week may have passed, when the water or the gas people come along with a new line of pipes, and they or the Postal Authorities with a new line of wires for telegraph purposes, proceed with picks, crowbars, heavy sledge hammers and big steel wedges to cut and smash the whole of this fine work to pieces so as to dig a trench for their pipes or wires in pipes. To take up this sort of road is a work requiring plenty of brute force. To do it for laying 3in. pipes such as those used by the Telegraph Department, which are placed at a small depth, and afterwards make good again, costs from 13s. to 15s. per yard; and this expenditure is repeated every time a pipe has to be laid or renewed. How often this has to be done is too well known by those who frequent such thoroughfares as Fleet-street and the Strand; and it does not need much calculation to show that this expenditure soon exceeds the cost of a subway, which could be made to take all these pipes and wires. As a mere question of cost of putting in and maintaining pipes and wires the gain would be very great, but the gain to London would be immeasurably greater than this when the loss involved in the frequent stoppage of important traffic is taken into account; and a further very serious loss also takes place. Once a new roadway, such as the kind above referred to, is taken up, although it is supposed to be afterwards made good—and the best is done to make it so—it is never the same as it was before being broken into. The whole fabric is more or less shaken. Between the part remade and the original there is always some irregularity of level; the road does not wear level, and it wears quickly; holes are formed, and what was an expensively but really well-made and fine road begins to want repair much sooner than would otherwise be necessary. The heavy work of breaking into and cutting out a bed of six or seven inches of concrete disturbs a large part of the whole, the continuity is gone, and the cost of maintenance is increased. To avoid this subways are needed; and though no design for a satisfactory subway, with a covering that at the same time would not in any way detract from the character of the surface for horse footing, has yet been made, there should be not the least difficulty in this. The removable covering need not extend the whole length of the subway, but even if this were thought best, there is no reason why a plate covering at the level of the concrete should not be made. Upon this the wood blocks could rest, and there would be no difficulty in making this part of the wood covering easily removable, and at the same time fix it so that as a road surface it should be as good as the other part of the road. Time and money would be saved in every part of the operation of laying pipes, repairs could be made when wanted, and interruption to vehicular traffic now extending over days and weeks would be reduced to hours and days. The enormous growth of London street traffic makes something of this kind daily more necessary, and it is becoming imperative.

THE TEACHING OF DYNAMICS.

WE have on more than one occasion called attention to the want of uniformity of definition which is to be met with in text-books of Dynamics, and to the inconveniences which result when the author having in one place given a certain definition, in another draws a deduction which must be erroneous if the definition be right. We have not the least hesitation in returning to this subject, because it is one which the rising generation of engineers has a great deal to do with. The modern student is often different from his predecessor in that he is of a more inquiring disposition, and less disposed to take on trust what is told him. The young engineer who now-a-days accepts as true any statement that he finds in a book simply because it is in a book, is rapidly becoming a *rara avis*, and it is well that it should be so; but the student has considerable difficulty in making himself heard, and however much he may find himself oppressed by the contradictions and inconsistencies manifested by his teachers, he is unable to enter any solid and useful protest. It is, then, in the interest of the student that we write. It is for his sake that we point out that defects exist in only too much of the scientific instruction of the present day which ought to be eliminated, and would be eliminated if the teaching of sound truth was not too often regarded as a secondary consideration. In what follows we do not profess to supply improved definitions. Our object is, in one sense, to be destructive, not constructive. It would, of course, be entirely beyond the space at our disposal and the legitimate character of an article like this even to attempt to cover a wide range of ground; we must, therefore, content ourselves with touching on a very few prominent facts, and we shall try to be as precise as possible. There is the greater stimulus to precision in that we have, we have reason to know, been misunderstood. Very recently we had something to say concerning Newton's third law, and we have been assumed to say that we disputed the truth of that law, which assumption is the direct contrary of the faith that is in us. We hold that Newton's third law is absolutely right; but we also hold that its consequences are very persistently ignored.

At the base of the whole science of dynamics lie Force and Motion. The precise meaning to be attached to these words is all-important; because as they are made to mean one thing or another, the explanations given of dynamical phenomena are or are not true. Teachers of dynamics, to do them justice, have recognised this for years, and we find, accordingly, that they all give definitions of Force and Motion. They explain, that is to say, what they understand the words to mean. Magnus, for instance, of University College, ten years ago defined Force in his "Elementary Mechanics"—a class-book used in University College—as "whatever produces or tends to produce motion." Professor Julius Wiesbach, in his great book, "A Manual of the Mechanics of Engineering," defines Force as "the cause of the motion, or of the change in the motion of material bodies; every change of motion, *e.g.*, every change of velocity, must be regarded as the effect of a force." This was written in 1877. Clerk-Maxwell, writing in the same year, defines Force thus in his "Theory of Heat":—"Force is whatever changes or tends to change the motion of a body by altering either its direction or its magnitude; and a force acting on a body is measured by the momentum it produces in its own direction in unit of time." Clausius, "On the Mechanical Theory of Heat," says on the first page, "Every force tends to give motion to the body on which it acts; but it may be prevented from doing so by other opposing forces, so that equilibrium results and the body remains at rest. In this case the force performs no work; but as soon as the body moves under the influence of the force, work is performed." This was written in 1879. Professor Tait, apparently overwhelmed by the difficulties involved in the conception of force thus defined, cuts the Gordian knot by asserting that there is no such thing as force. We quote from his "Treatise on Heat," published last year, page 15:—"Thus it appears that Force is a mere name; but that the product of a Force into the displacement of its point of application has an objective existence. Even those who are so metaphysical as not to see that the product of a mere name into a displacement can have objective existence may perhaps see that the quotient of a horse-power by a velocity is not likely to be more than a mere name," and again further down in the same page he says, "Force is the rate at which an agent does work per unit of length." The last authority we shall quote is a book to which we have already alluded, namely, "An Elementary Treatise on Dynamics," by Professor Williamson and Mr. Tarleton, of Trinity College, Dublin. These gentlemen do not give a special definition of Force, but content themselves with Newton's first law of motion: "A body continues in its state of rest, or of straight uniform motion, except in so far as it is compelled to alter that state by impressed force." We might go on to cite text-book after text-book, but no good purpose would be served. It is enough that we have here three distinct definitions of the meaning of the word Force:—(1) Force is that which produces or tends to produce motion; (2) Force is that which changes or tends to change the motion of a body; and (3) Force is the rate at which an agent does work.

Now, the student with brains will ask, and naturally ask, do all these teachers mean the same thing by the word Force? We have often been asked the question. It will be seen that while one school of writers, with Newton at their head, has no hesitation whatever in asserting that force is the cause of motion, Clerk-Maxwell does not assert anything of the kind. Maxwell was an eminently cautious writer, which is more than can be said of all his compeers; and we beg to call the attention of our student readers to the very careful way in which he refuses to say that force is the cause of motion. Force "changes" motion, but does not "cause" it. The difference is very marked—so marked that if Maxwell is right, then others—Clausius, for example—are apparently or really wrong. No doubt Maxwell had excellent reasons for refusing to say that force was the cause of motion; is the student to assume that Clausius, writing on the same subject, Heat, had equally good reasons for asserting that it was? Putting ourselves in the place of the student, we ask for him, Do Clausius and Maxwell mean the same thing? If they do, why did Maxwell limit his definition by the precise use of the word "change" in the way that he did? Turning to Tait's definition, he asks again, does Tait mean the same thing as Clausius? or the same thing as Maxwell? or something entirely different? He will say further that he has "always regarded force as an effort," and he can point to dozens of authorities who regard it in the same sense. But Professor Tait speaks of it as a "rate." How can a rate be an effort? How can a mere name be a rate? It forms no part of our purpose to answer the student on these points. Our object is served when we assert that it is unfair to the student, if his teachers leave him in doubt. Either he ought to be told that these three classes of definition exist, and that they all mean the same thing, or he ought to be told that they exist, and do not mean the same thing. The vice of the modern dynamical text-book—and of many other text-books as well—is that each author lays down certain laws, rules, and propositions, with a magnificent absolutism which ignores the existence of all other teachers, and never hints that his own definitions are not of universal acceptance. The student is kept in total ignorance of the fact that any other view can be taken of a given subject than the one he chances to be taught. He knows nothing of the circumstance that a wide diversity of definition exists concerning not a few fundamental propositions. Where, for example, can a text-book be found which tells the student what we have just told him? To what volume will he turn for the answer to the questions we have put in his name?

As a further illustration of the troubles through which the student is compelled to pass, we may cite a review of Professor Williams and Mr. Tarleton's book which appeared last week in *Nature*. We have no intention of criticising that review. We have every reason to believe that it was written by one in every way competent to deal with the subject. We quote the following passage from the review. The writer, referring to Professor Jameson's proposition, "Acceleration varies with pressure," says:—"Here we see at a glance the effects of want of system. Pressure, force, and effort are used as completely synonymous and interchangeable terms. Now, the first term has a perfectly definite meaning in science—introduced without definition or warning by our authors in Sec. 290 of the book, to the utter bewilderment of the reader fresh from p. 30—and it means something differing from force in exactly the same way as a linear inch differs from a cubic inch. As to the effort exerted in throwing a stone, we imagine that, if employed at all in scientific language, it would signify properly the work done, not the force applied; the two things differing as a square foot does from a linear foot. Of course, our authors do not require to be told this; but why muddle the student by giving him slipshod information which he must *unlearn*, if he is ever to make progress?"

What is the student who chances to come across the foregoing passage to make of it? If he turns to the paragraph 290 referred to, he will find in it not one word about pressure. It deals with the Equation of Energy. Is this, the student may ask, the same thing as pressure? We extract the following passage from the same review. It shows admirably how two different teachers use words in diverse senses. "On page (31) we find:—'If a uniform pressure [force] of 3 lb. [weight] produce a velocity [speed] of 10ft. [per second] in the first second, find the weight [mass] of the body acted on.' The insertions are ours, made with the view of showing how the question ought to be stated unless there is to be complete confusion of nomenclature."

The student will ask what is the difference between velocity and speed; he turns to his dictionary and he finds "Velocity, speed, quickness of motion," and "Speed, quickness, celerity, haste." Will it be wonderful if he should ask himself, "Why does this writer in *Nature* insist on 'speed' being used instead of 'velocity'? Do the words mean something in dynamics that they do not mean in every-day life? Where am I to find what they do mean in dynamics?"

Once more we repeat that we shall not in any way attempt here to answer these questions. Any careful student who will refer to more authors than one will find that the teaching of dynamics involves the setting before them of a series of puzzles or conundrums. If he would only stick to one author or one teacher, ask no questions, and absorb what he is taught all might be well; but the moment he leaves this safe road, begins to compare authors, to ask questions, to speculate for himself on the reason why of things, he finds himself, as we have said, face to face with riddles, for the answers to which he hunts in vain. The text-book of dynamics most wanted at the present moment is one constructed on the plan of giving quotations from the various authors whose books are recognised in the various colleges and schools wherever youth is taught, and reconciling their apparent inconsistencies when they are—as is often the case—only apparent, not real; and when this is not the case, setting before the student clear definitions of the meaning which each author intends to convey, and the nature of the evidence for or against him. The truth is that in all that concerns Matter, Motion, Time, Space, and their mutual relations, it is quite impossible to entirely exclude the metaphysical element. Metaphysics have been defined as "what one man who does not understand what he is saying says to another who does not understand him." We are very far from agreeing with this, but we fear that not a few text-books contain statements which are not fully understood by those who make them, and are therefore not intelligible to those who read them. Clear thinking makes clear writing; and if those who write text-books would learn that ordinary words used in the dictionary sense might answer their purpose, much trouble would be saved to the student. If the ordinary dictionary sense will not answer, then a special dictionary of Dynamical Terms ought to be prepared, accepted, and used by every writer on Dynamics.

BROKEN SCREW SHAFTS.

It can scarcely be deemed creditable in the present advanced state of engineering and mechanical knowledge that we should as yet be left to the difficulties and dangers which arise from an accident such as very recently took place on board the Peninsular and Oriental Company's steamship Poonah. A broken shaft is, taking the percentage of cases, so relatively rare an occurrence that shipowners seem to be content to run the risk of it rather than incur the cost at which it might be obviated. We say "might be" advisedly, because there is not as yet, so far as we are aware, any practicable method devised to guard against such a contingency. But had a different result followed in the case of the Poonah; had her commander, Captain Parfitt, been less of a seaman than he has proved himself to be, England might at this crisis in the military history of the country have had to regret the loss of many valuable soldiers. There is, therefore, a consideration far more important than that of mere economy to be given to this question—one which cannot be in the least balanced by the insurance which covers a monetary loss only. Of course we are cognisant of the fact that everything—every improvement that may be proposed—must have a money basis. Shipowners will not run ships the cost of constructing which is such as to preclude a paying return; and in these days of hard times for the shipping interest every item of outlay has to be closely scrutinised, and those to whom consideration of this subject may recommend itself must have their thoughts constantly given to this primary difficulty. Yet it seems to us that were the occurrences of shaft breaking referred to their primary cause, that comparative immunity from them might be secured at a cost which would not be held to be prohibitory.

The transmission of power is a subject to which much space in this journal has been devoted; but its transmission between the prime mover and the screw of a steamship has to be made under conditions wholly different to those which exist on land. In the latter instances we have always a fixed and immovable base upon which to act, while in a steamship—build her as rigidly as we may—we have a base which, under the wave movement of a ship, is constantly varying. Unless the screw shaft, which is, under our present practice, fixed as rigidly in a straight line as possible, can be made to possess such a modicum of elasticity as shall enable it to accommodate itself to the change of line to which its base is constantly being subjected, accidents such as we now treat of must be of not infrequent occurrence. At present a screw shaft has, in fact, largely to resist in its bearings the tendency of the ship to buckle, so to speak, under varying strains; and there can be little doubt but that it is to this resistance thrown upon it that not only are such accidents to shafts frequently due, but that we may find in it, to a great extent, the cause why, even with the best devised machinery, there is so great a loss between the power developed by the engines and that usefully employed in propelling the ship. It is argued by many, who are content to regard the difficulty as insuperable, that, given the possibility of overcoming it, it can only be by means of such complicated contrivances as will by themselves be a more fruitful cause of breakdowns than is the present truly simple arrangement. But we cannot shut our eyes to the fact that scarcely any improvement has been introduced with regard to steamship machinery to which an objection of this character has not been taken. When the compound engine was introduced cavilling was freely used upon the grounds we have stated, and much of it appeared almost unanswerable. There did seem to be a liability to derangement which might more than counteract the advantages to be gained. Yet the ultimate result has been that, despite such feared disadvantages, not a ship now goes to sea without compound engines. If there were such she could not possibly compete successfully under modern conditions of trade.

Any objection, therefore, which may be based upon such apprehension should not be permitted to operate conclusively against the adoption of any plan which some benefactor may yet devise. The subject appears to us to divide itself under two heads, the one being provision for alternative use, which, in the case of accident, should be available; the second the adoption of means which shall minimise the chances of the occurrence of such accidents. We have had suggested to us as being so far practicable as to be worthy of attention that all shafts should be duplicated *in situ*—that is to say, that the solid driving shaft should rotate within a hollow one of the necessary diameter, the latter being that to be held in reserve for use in case of failure of the solid shaft. Now we have ourselves seen in practice such a hollow shaft employed in the case of the duplicated De Bay propeller, and during the many thousand miles traversed by the agency of that screw in several different ships the section of hollow shafting never caused the least trouble. It is true that this section was short, being confined to some 12ft. or 14ft., but it was that nearest to the screw itself, and consequently placed under severe conditions as to strain. The flanges by which the several sections would have to be attached in such a hollow shaft would be of so much greater diameter than are used with solid shafting that there would be little to be apprehended concerning any possible weakness showing itself at those junctions. An objection may possibly be taken as to the increased tunnel space such duplicate shaft would necessitate, and the consequent loss of available tonnage room; but this, we contend, would not in practice prove to be so great as to constitute a fatal objection. A more serious difficulty would probably be found in the fact that the hollow shaft would form a covering which would detract from the accessibility of the solid shafts in case of required repair; but at sea, at least, such a course need not be resorted to, the hollow shaft in an event of this kind being at once substituted.

Passing from such a suggestion for an alternative shaft, we may remark upon another scheme propounded for giving to a solid shaft the amount of elasticity we have before referred to as being, in our opinion, the desideratum to be obtained. We have heard two methods named by which it has been thought possible to afford this measure of elasticity. One was to give the plummer blocks beds in which they might have the faculty of a certain amount of traverse, so permitting the keelson to pass out of true alignment without throwing the stress caused by its doing so upon the shaft. Another was that some elastic packing should be placed between the sectional joint flanges which would admit of a degree of variation from a true line at points divided only by the comparatively short limit of length of each section. The great obstacle to be overcome here would doubtless be the strain which would be thrown upon the coupling bolts, which must necessarily be of the increased length due to the thickness of the packing, as also that it would be incompatible with the safety of such bolts to afford them even the slight play required to enable that packing to compress and re-extend. It seems to us possible, however, that the use of a V-notched coupling might be made to supersede the use of bolts, or such a coupling as that used in Winans' cigar ship. With such there would always be a capacity for play sufficient to allow of the action of the elastic packing, while always maintaining a bearing face for the transmission of the power either when going ahead or astern. In the French Navy a universal joint is invariably used somewhere in the length of the screw shaft.

We do not pretend to write dogmatically on this subject. We only name such suggestions as we have heard discussed in the hope that the subject may receive that further consideration which we desire for it, and which all will admit to be greatly wanted. No well-found steamer, as we know, puts to sea without at least one spare section of screw shafting; but this can seldom be made available for making good disaster when a vessel cannot be docked. All the ingenious contrivances which engineers can apply at sea to aid in taking the strain off a damaged shaft are at the best but makeshifts, and rarely succeed in carrying a vessel through heavy weather. The true remedy to be sought will be found in first constructive principles, and it is to be hoped in every interest that an efficient application of these to secure the required end may soon be discovered.

THE YORKSHIRE COAL INDUSTRY.

YORKSHIRE is on the eve of another great strike in the coal-field. Ever since November, 1882, when the miners obtained an advance of 10 per cent. on their wages, the owners of various important collieries have been dissatisfied, and the discontent grew into something like action last summer, though extreme measures were overruled by more moderate counsels. It has been clear, however, during the last six months that the masters were more and more determined to seek a return of the 10 per cent. The Union officials evidently expected this movement, for they have repeatedly warned their constituents of its coming, advising them to be united and prepared for the struggle. In January it was stated in THE ENGINEER that the South Yorkshire Coalowners' Insurance Association had been formed as a kind of guarantee against strikes, the chief object being, in the event of any disputes with the miners, that the colliery proprietors should unite to help the brethren affected. In the matter of a pit being set down by the action of the men, the masters agreed to reimburse the owners of the pit. It was further stated that the first subject to which the Association would address itself would probably be the reduction of wages to the extent of 10 per cent. Since then affairs have rapidly progressed. The Association has become an accomplished fact, and is regarded as the most powerful confederation ever formed in the South Yorkshire coal trade. In West Yorkshire there is an equally strong Association, having its headquarters in Leeds. Both bodies are working together in this movement. Their committees have had many meetings, and these have been held in the most private manner possible. It was the desire of the coalowners to keep their intentions very quiet until the last Thursday in February, when they would have passed a resolution formally declaring the necessity of the proposed reduction, requesting the colliery proprietors to explain the situation to their men, and in the event of the men resisting the demand, to give the requisite notices to carry it into effect. Some member of the Association proved a leaky vessel, disclosed what was doing, and put the miners on their guard. Of course the employés were naturally anxious to have as brief a period of unrest as would serve to effect their object. The premature publication of their counsels has already disturbed the mining districts to a degree which, to say the least, is embarrassing. Probably there were more men "playing" last Monday than on any "St. Monday" for years. They could be seen in the different colliery villages, assembled in knots, talking over the situation by themselves. It is not likely that they will feel encouraged to labour hard to pile up stock to enable the coalowners to tide over a month's enforced idleness. On the other hand, they must live, and they cannot get the means to live unless they bring the coal to bank. Nine years ago a strike, which lasted eight weeks, was estimated to cost the Yorkshire colliers in wages alone £400,000. To this had to be added the loss of capitalists in keeping pits in good working order, in paying royalties, and in lost trade, a large portion of which went to the North, and has never yet been recovered. At that time 30,000 men were out of employment. If the present dispute should unhappily terminate in an open rupture, the industrial conflict will be on a still greater scale. Last year nearly 20,000,000 tons of coal were raised in Yorkshire alone, and it is estimated that fully 60,000 men, women, and boys were engaged in bringing it to the surface and getting it into the railway trucks. Of that number fully three-fourths will be affected by the present movement. Indeed, a considerable number of coalowners who are not in the Association have intimated their intention of joining the confederated employers in demanding a reduction, which, it is purposed, shall take effect as near as possible to the end of March. Already the Union officials are taking action. A conference has been held at Barnsley, to which representatives were invited from any pitstead throughout the whole of South and West Yorkshire. Their Association is now stronger than at any time since the memorable struggle of nine years ago. Mr. Benjamin Pickard, their principal leader, aspires to be the miners' representative in next session of Parliament, and he would scarcely counsel a surrender as he was on the point of asking his constituents to lead him on to St. Stephens. The outlook is decidedly gloomy, with scarcely a rift in the clouds. Mr. Pickard has suggested a sliding scale, and the coalowners have replied that they would consider any scheme he submitted in writing. There the matter ends for the present; and as for arbitration, its apostles are singularly silent during the crisis which may precipitate distress and disaster on thousands of innocent wives and children, as well as disorganise a great industry, and cause an army of men and boys to stand idly in the market-place.

THE PENISTONE RAILWAY ACCIDENT.

MAJOR F. A. MARINDIN's report to the Board of Trade on the collision which occurred at Barnsley Junction, near Penistone, on the Manchester, Sheffield, and Lincolnshire Railway, on New Year's Day, is unusually interesting reading. It will be remembered that a special down excursion train, from Rotherham and Sheffield to Liverpool and Southport, was struck by an empty coal wagon, forming part of a mineral train from Ardwick, which had left the metals of the up-line and run on to the down-line, just in front of the engine of the excursion train, and four passengers were killed and forty-seven others injured, many of them seriously. The Inspector reports that the line was in good order in all respects up to the point where the accident occurred, and there was nothing in the state of the permanent-way to account for the fracture of the wagon-axle, except that the ground was frozen, and in such a condition that any weak axle was likely to be severely tried. He therefore holds that the accident was beyond the power of any servant of the company to avert, and frees those in charge of the trains of the slightest blame. Major Marindin addresses himself chiefly to four points: (1) Whether the wagon which broke down was originally of such a pattern and construction that it was properly allowed to run upon the line; (2) whether at the time of the accident it was in good repair; (3) whether the regulations as to the examination of wagons at junctions were attended to in this instance; and (4) whether the flaws which were found in the axle which gave way were of such a nature that they ought to have been detected. The wagon, it will be remembered, belonged to the Shireoaks Colliery Company, and the Inspector, having seen the specification, finds there was nothing unusual in it, and that the dimensions were practically the usual dimensions. It was also in very fair running condition, and had been overhauled only about five months before the accident. It was examined at Dunford Bridge on December 24th, 1884, and is then said to have been, to all appearances, in proper running order. This disposes of three of the Inspector's four points. With regard to the fourth, Major Marindin states that the axle, which was of iron, gave way at a point 29¾in. inside the boss of one wheel, and 20½in. inside the other, at which point it was 4½in. in diameter. The metal was to all appearances of indifferent quality, and when analysed it disclosed a large excess of phosphorus in its composition, which will account for its being very brittle. Major Marindin reminds railway companies that no less than 141 axles of goods wagons broke in the year 1883, and, seeing how terrible might be the consequences of a very common accident to such wagons, he urges that too great care cannot be taken to insure that all wagon stock is built of such materials and dimensions as are fit for running at high speed, and that such stock should not at any time be allowed to deteriorate, or get into a bad running condition. With this object he expresses the opinion that it is highly desirable that all wagons commencing to run upon any line should either be the property of the railway company, or should be carefully inspected before being permitted to run, and vigilance should be used to secure that all the materials of which they are constructed are of good quality, and he recommends a systematic and periodical inspection of all descriptions of wagon stock, including a rigid examination of all axles after they have run for a specific time, and he adds the practical suggestion that wagons should bear a label showing that they have been passed for running by some railway company, and to be legibly marked with the day when they were last thoroughly overhauled. These regulations, he points out, can only be enforced by legislation, or by the united action of railway managers, for unless they are common to all railway companies, they cannot be effectual. Major Marindin points out in conclusion, that this accident furnishes a warning against the practice of placing passenger lines between running goods roads, which is sometimes done where there are four lines of railways. With lines thus arranged, he says, the undeniable risk of accident from the fouling of a passenger line, by a wagon leaving a goods line alongside of it, is twice as great as in cases where two passenger lines are at one side and the two goods lines at the other. It might have been useful if the inspector had suggested the probable life of a railway axle. So great is the risk attending a defective axle, it might surely be possible to state a maximum number of miles, after attaining which an axle might be supposed to have terminated its career; for although many might be perfectly sound when thus compulsorily retired, the one found unsound—though no flaws were visible to the naked eye—would amply justify the rule being rigidly observed.

ARCHITECTURAL AND BUILDING TRADES EXHIBITION.

AN exhibition of architectural drawings, accessories, building, decorative, and house art, and sanitary and ornamental manufactures, is being held in the Floral Hall, Covent-garden, under the auspices of the Society of Architects. The exhibition is not too large, and just large enough. One can look round the whole, gain some facts and hints, and perhaps make some purchases, and come away without being tired, and at the same time feeling that the exhibition has not been seen. There is a great deal that is of interest to architects and builders and to others concerned with the design, construction, sanitary arrangement, and decoration of houses; but there is no one thing in particular to which we can refer. Altogether about 100 exhibitors have contributed drawings, specimens, or models of their wares and inventions, and it may be said generally that the collection is a satisfactorily representative one. Some of the metal work, the hammered iron and the brass especially, affords evidence of the advance which has been made of late years in the employment of these materials after a long period of neglect in this country of the artistic possibilities of the smith's and the founder's craft; some of these specimens are very fine, notably a door *grille*, the centre part of which is formed with a spider web. On the other hand, some of the things are very ugly. A straining after effect in unsuitable material is too evident. Inventions for the ventilation of buildings and sanitary appliances form another important division of the exhibits. Several stands present good examples of mosaic work, of the ornamental application of brick and stone, of glass applied to decorative purposes and the exclusion of light, of wall papers free from all deleterious matter, and of woodwork for floors and interior fittings. One annoying feature is the nuisance caused by electric bells, which ring with irritating frequency in all directions. Locks, bolts, and bars of varied design fill other stalls. There are a few machines, notably a new treadle circular saw, intended for use in builders', pattern-making, and joiners'-shops, and to which we shall refer in another impression. The exhibition remains open until to-morrow night at 10 p.m.

WATER SUPPLY IN THE SOUDAN.

SOME not unnatural indignation has been manifested by English engineers because machinery for supplying the Suakim-Berber route with water is being furnished by American makers. The first statement made on the subject was to the effect that fifty miles of pipes and twenty engines, costing altogether 750,000 dols., or £150,000, had been contracted for by Messrs. Workington and Co. As was to be expected, the Government were challenged in the House, and it was then explained that the Government had nothing to do with the matter. It had all been settled by the contractors. It has not unnaturally been assumed that Messrs. Lucas and Aird, who are making the Suakim-Berber Railway, were the contractors referred to, but this is a mistake. The truth is, that the contract has been let to a Dr. Tweedale, an American, whose address is the Langham Hotel. He has ordered the necessary pumps from his countrymen, Messrs. Workington, but the pipes are being made—the larger part, at least—by Messrs. Russell and Messrs. Spence, the well-known tube makers. So far, matters are not quite so bad as they were thought to be; but we should like to know why the contract has been let to an American at all, and why a single penny of the money paid by the British taxpayer should be sent out of the country. The great advantage that Great Britain possesses over other nations in carrying on warfare is that she has nothing to pay to foreigners for the greater portion of the munitions of war. Thus the money spent on ironclads is virtually taken out of one of John Bull's pockets to put into another. But warfare will assume a totally different aspect if British taxes are to be employed to enrich the rival manufacturers of other countries while our own artisans lack bread. Here is a legitimate grievance for Mr. Swift.

FROM THE STRAND TO OXFORD-STREET.

BUT a limited number of our readers probably ever thread the maze of streets which lie between St. Martin's-in-the-Fields eastward towards Oxford-street, and they are therefore probably unacquainted with the steady progress which is being made by the Board of Works towards the accomplishment of that great desideratum—a really good street between the Strand at Charing-cross and the great northernmost thoroughfare. But the work is being pushed on with an activity which bids fair to soon bring about the fulfilment of this object. At the point where the new road will leave Oxford-street and enter Bloomsbury-street the required alteration is now approaching completion so far as demolition is concerned, and one new erection at least indicates the line which will be followed there. Few Londoners probably know much of that unsavoury locality—Dudley-street—which crosses from the north in a south-westerly direction towards Gerrard-street, Soho. Some undoubtedly will have visited it as affording a curious and painful instance of the wretched homes to which poverty compels many fellow citizens, and to such—if they again revisit it—a most striking change, indicative of the active progress we have referred to, will be apparent. The wretched cellars—until of late crowded by repairers of, and dealers in, cast-off boots and shoes—are now tenantless, and the windows, formerly crowded by the unkempt heads of the poorest classes, have been removed from their frames preparatory to the removal of the entire eastern side of the street. Similar progress has also been made in Great St. Andrew-street, which runs parallel for some distance with Dudley-street, and one side of which—the West—will be removed for a great part of its length. The work of pulling down for the new thoroughfare, therefore, advances apace, and full reconstruction will probably not be long before it is undertaken.

RAILWAY RATES AND CHARGES.

THE Sheffield Chamber of Commerce has decided to petition against the Bills of the three railway companies which affected that district—viz., the Bills of the Midland, Great Northern, and London and North-Western. This step has been taken in order to obtain a *locus standi* before the committee having charge of the proposed measures. It is contended that the Bills of the three companies named not only adversely affect the Sheffield district by the rates in many instances being considerably enlarged, especially with regard to the minimum charges to be made, but also that power is taken to charge an unknown sum for terminals, which, in the case of the heavy goods manufactured in Sheffield, might convert a profit into a loss. The feeling in the iron and steel districts of Yorkshire and Derbyshire is adverse to the proposal, which is tersely stated as an attempt to prop up dividends with new powers. While iron, steel, and timber have fallen, and labour is sought to be still further reduced, why, it is asked, should railway rates go up higher, and still higher? Our railroads are privileged monopolies. They stand as substitutes for our ancient highways and canals. The companies have the exclusive right to their use, and for this privilege, in which they are State-protected, they are expected, in return, to exist for the public benefit quite as much as for dividend-making purposes. Such powers as are now sought by the railway interest, which is undeniably powerful in Parliament, would, it is contended, operate most prejudicially against the heavy industries particularly, and more or less severely against traders and merchants generally. The borough and county members have been asked to be in their places when the Bills come on for second reading, that their progress may be effectually stopped at that stage, if possible.

THE FATAL ACCIDENT AT SHOEBURYNESS.

A BOARD of officers, under the presidency of Sir Charles Arbuthnot, K.C.B., is now sitting to inquire into the circumstances of the fatal accident which occurred at Shoeburyness on February 26th last. As reported in the daily papers, an experimental percussion fuse, designed by the late superintendent of the Royal Laboratory—Colonel F. Lyon, R.A.—was fixed in the base of the shell, and was being covered with a lead disc, when the shell exploded, killing or wounding mortally the superintendent of the School of Gunnery, Colonel Fox-Strangways, and the second experimental officer, Captain Goold Adams, R.A., as well as Colonel Lyon, Sergeant-Major Daykin, and Gunners Allen and Underwood. These were either killed on the spot or died in the course of a few hours. Major Bally, R.A., was also wounded; as well as Mr. Lowe, assistant manager of the Royal Laboratory; Mr. Rance, artificer; and Gunner Webb. There is no occasion here to recapitulate the exceedingly painful circumstances of this accident. It is only noticed to observe that it is under investigation, and cannot with advantage be discussed now. Colonel Lyon, Colonel Fox-Strangways, and Captain Goold Adams, were all three officers of high reputation, whose loss must be felt in every way far beyond the range of their departments.

LITERATURE.

Electrolysis: Practical information on Nickeling, Coppering, Gilding, Silvering, the Refining of Metals, and the Treatment of Minerals by means of Electricity. By HIPPOLYTE FONTAINE.* 1885.

A TRANSLATION for English readers of this work, by a writer who has been even more successful in the practical applications of the dynamo machine than with his pen, will no doubt ere long be forthcoming. In the meantime, the original work will be well received in this country by many electricians who, with its author, have recognised the fact that it is by no means certain that the most extended of these applications are to be found in the direction of electric lighting. Of this last contribution by M. Fontaine to electrical literature, we may say that the first and second parts will be of interest to the student and to the tyro who need to become acquainted with the main facts and laws which constitute a secure basis for practical work. The third part is important to the specialist in electro-plating, using this term in its widest signification; whilst the fourth part, which treats of the refining of copper and lead, and of the extraction of metals from their ores by means of the electric current supplied by dynamo machines, will be most acceptable to those whose attention has been directed to applications of electricity, which are for the most part prospective, and which may be of very great commercial importance. We must confess that our own interest centres mainly in the fourth part of the work, for the operations therein described are of interest not only from a metallurgical point of view, but also from the fact that they of necessity involve new applications of steam and other machinery upon an extended scale.

Rapidly glancing over Part 1 of the work, which includes chapters under the headings of Preliminary Notions, Laws of Electrolysis, Work absorbed in Electrolysis, and various tables, we notice, amongst a great deal of information that is accurately and concisely expressed, some confusion in relation to the practical (B.A.) units and the absolute (C.G.S.) units. After giving definitions of the B. A. units of resistance, current, potential difference, quantity and capacity, the author gives the Dyne and the Erg as the units of force and of work, and after observing that these very minute units may advantageously be superseded in practice by the kilogramme and the kilogrammetre, defines the watt as the product of volts into ampères. Now the watt is the practical (B. A.) unit of power or rate of work, *i.e.*, work divided by time; and the corresponding unit of work is not the (C.G.S.) erg, but a value ten million times as great, which was first proposed, under the name of the Joulad, by Mr. Desmond FitzGerald, and subsequently, under the name of the Joule, by the late Sir W. Siemens. The joule is, in fact, the volt-ampère-second, or the watt-second: its value is rather more than one-tenth of a kilogrammetre, viz., $\frac{1 \text{ kilogrammetre}}{g}$, or 101·926 gramme-metres—taking g at 9·811. It is true that M. Fontaine subsequently gives, under the heading "Electrical Work," the following rule, viz.:—"The quantity of energy contained in a current is equal in kilogrammetres to the product of ampères into volts, divided by g;" and he points out that, for practical purposes, the value of g may be taken at 10. But here the omission of time in seconds as a factor in the value for energy leads to a confusion between power or rate of work and energy, or work, which is the more objectionable by reason of its very general prevalence on this, as well as on the other side of the "silver streak." To take the example given by M. Fontaine, it is, we maintain, most incorrect to say that the *work* developed by a dynamo machine supplying a current of 10 ampères under a potential difference of 750 volts is $\frac{750 \times 10}{10}$ = 750 kilogrammetres, or 10-horse power; it is impossible to determine the work unless the time is given, although we know that the ratio of work in kilogrammetres to time in seconds is equal to 750, a ratio which corresponds to 10-horse power (French.) In Chapter III., on the "work absorbed in electrolysis," the words "per second" are brought into sufficient prominence as in two out of the three expressions:—

(*a*) work expended in decomposition—

$$\frac{I\,E}{g} \text{ kilogrammetres per second;}$$

(*b*) work absorbed in heating the conductor—

$$\frac{I^2\,R}{g} \text{ kilogrammetres per second;}$$

and (*c*) total work—

$$\frac{I\,E + R\,I^2}{g} \text{ kilogrammetres.}$$

It is to be observed that in France, as well as by writers of the old school of electricians in this country—who derived much of their knowledge from the study of such excellent old works as those of Blavier and Gavarret—the symbol I is almost invariably used for current; the pleonasm, intensity of current, signifying precisely the same thing as current, having been formerly employed in lieu of the simpler expression. In this chapter an important observation of our compatriot, Mr. J. T. Sprague, is formulated as follows:—"Law of Sprague. Those substances which, in becoming free, absorb the smallest quantity of intrinsic energy are liberated at the electrodes." The chapter ends with a description of the method employed by M. E. Marchese for the practical determination of the counter electro-motive force in metallic solutions, and of the true resistance opposed to the current by such solutions.

Chapter IV. contains, besides a number of tables derived from the labours of Mathiessen, many that are less well-known in this country, as, for instance, one by Lazare Weiller, on the "Relative Conductivity of Metals," in which mention is made of such compounds as silicium bronze, phosphorous bronze, silicated brass, antimonial copper, aluminium bronze, Dronier's mercurial bronze, arsenial copper, &c. Here we find also tables giving the specific resistance of various solutions—*i.e.*, the resistance in ohms of 1 cubic centimetre of the solution in question—a table of the chemical and electro-chemical equivalents of the elements and of some compound bodies; tables giving the heat developed in the formations of the more important oxides, cyanides, chlorides, bromides, iodides, and sulphides; a table specifying the energy in kilogrammetres and in horse-power hours—energy which is inaccurately designated as "force-motrice"—necessary to decompose a kilogramme of various metallic solutions, and also to deposit 1 kilogrammetre of the metal, and a table on "the limits of electrolysis," constituting a *résumé* of certain experiments by M. Berthelot.

Chapter V. commences the second part of the work, which treats of the various sources of electricity. We notice that the author claims for M. Becquerel the first invention of a battery on the type of the Daniell "constant" cell, viz., a couple constituted of zinc in a solution of zinc nitrate, and copper in a solution of copper nitrate; the solutions being separated by a diaphragm of gold-beater's skin. We observe also in the description of this cell the old error as to hydrogen being deposited on the negative element and oxidised at the expense of the oxygen contained in the copper salt. This mistake appears to us somewhat inexcusable in a work wherein the "law of Sprague" is brought into prominence; for surely the author must be aware that the intrinsic energy of equivalents of copper and sulphuric acid radical is less than that of equivalents of hydrogen and the same radical, and that therefore water cannot be resolved into its elements in presence of the compound $Cu\,SO_4$. The economic shortcomings of thermo-electric batteries are confirmed by an observation at the close of this chapter, where, again, the omission of the words per second would render the statement puzzling or unintelligible to many readers. "The heat supplied by a cubic metre of gas would develope a maximum of 5 kilogrammetres through the intermediary of a Clamond thermo battery; whilst the same quantity of gas would produce over 75 kilogrammetres in the improved Otto motors."

Chapter VI. is devoted to a description of some of the principal dynamo machines; whilst chapter VII. gives some useful information in relation to the total energy,

* Electrolyse : Renseignements pratiques sur le Nickelage, le Cuivage, la Dorure, l'Argenture, l'Affinage des Métaux et le Traitement des Minerais au moyen de l'Electricité. Par Hippolyte Fontaine. Paris, Librairie Polytechnique. Baudry et Cie., Editeurs.

THE STOCKPORT GAS ENGINE.

For description see page 193.

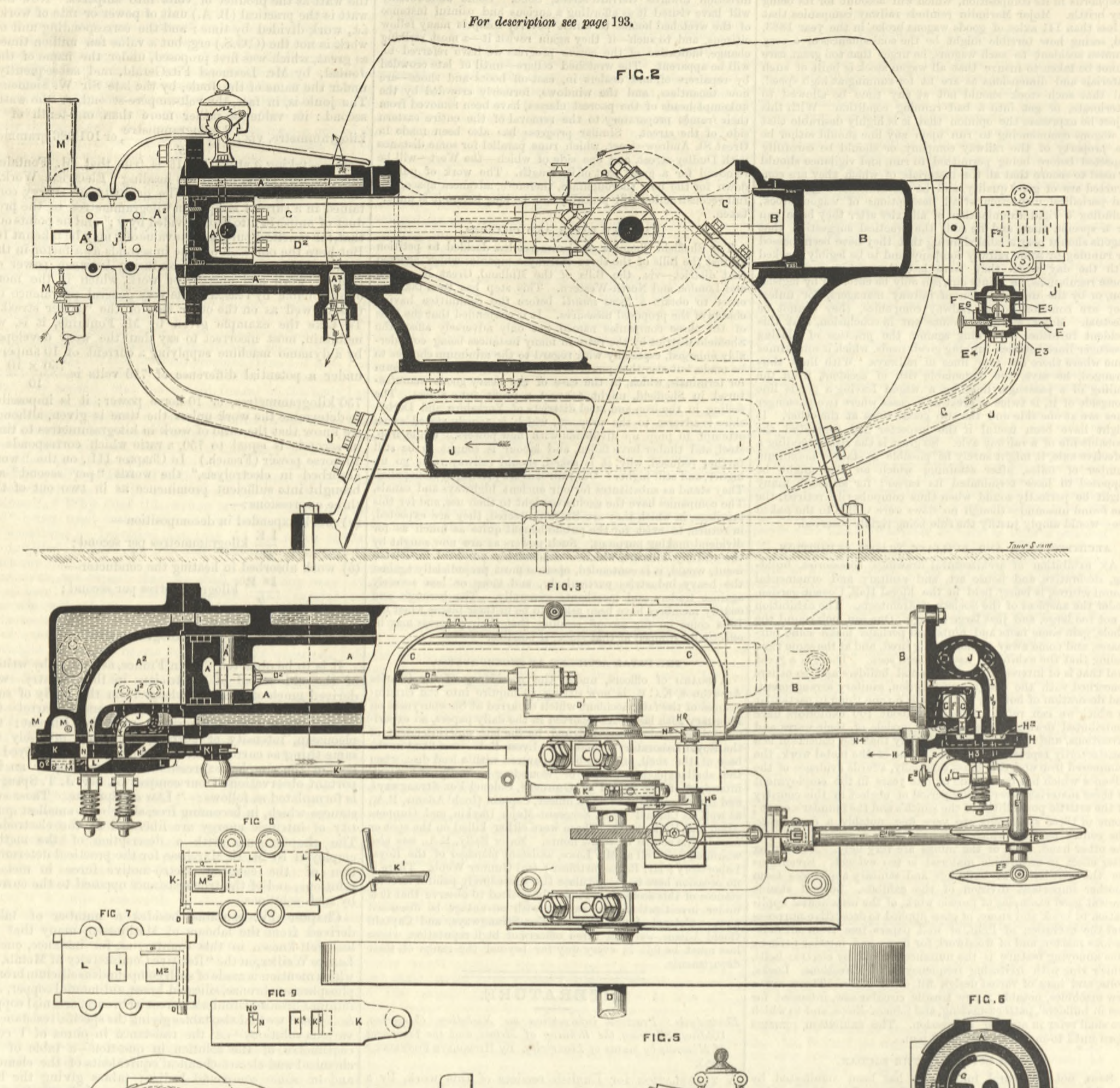


FIG. 2. FIG. 3. FIG. 4. FIG. 5. FIG. 6. FIG. 7. FIG. 8. FIG. 9.

electrical efficiency, and mechanical efficiency, of the various sources of electricity under different conditions.

As we have stated, the third part of the work treats of electro-plating or galvanoplastics. It constitutes a most valuable contribution to the technical literature of this subject. More especially does this statement apply to the long chapter (VIII.) on the electro-deposition of nickel, in which the extended experience of M. Pérille, of Paris, as well as a number of recipes and data from other sources, is placed at the disposal of the practical worker. Amongst a great deal of matter that is admirably set forth, the following—page 144—is one of the few passages in which we can find any necessity for adverse criticism.

"Electromotive force of the current. When nickeling was exclusively carried out by means of batteries, electroplaters, accustomed to baths of low resistance, always connected the elements in series, and were unable to obtain the true colour of nickel. The deposit was of a pale yellow, instead of having, as at present, the whiteness of silver. Experience shows that a good dynamo machine for nickeling should have an electro-motive force susceptible of being varied from 1 to 8 volts."

Here the context appears to show that the writer meant to say that the elements were connected, not in series, but in multiple arc. This no doubt is but a *lapsus*; but the heading of the paragraph—though M. Fontaine is by no means the only electrical writer employing the expression "electro-motive force of a current"—constitutes a solecism which should not be allowed to pass without notice. No doubt the author, and also his practical readers, understand very well what he means by this expression; but this does not alter the fact that its unscientific character would be shown by the impossibility of their defining its meaning. The current is the quantity of electricity which passes a section of the circuit at any point in a given time; it is also, mathematically, the ratio of the electro-motive force acting in the circuit to the resistance of the latter; in relation to other currents it can have absolutely but two points of difference, magnitude, and—as Mr. J. T. Sprague has shown—density. Current is the same in the shortest portion of a—total—circuit as in the whole length of the circuit; and it is impossible therefore to assign any definite value as "its electro-motive force." It is the density of the current—the quantity of electricity passing per square centimetre of cathode surface in unit time—which affects the character of a metallic deposit; and electro-motive force may be varied in any degree without influencing the result if the density be constant.

We must now pass to the fourth portion of the work, which the author—employing the term in a sense more limited than is usual — entitles "Electro-metallurgy." Here Chapter XIII. treats of the refining of copper and of lead by the current from a dynamo machine. In this comparatively new branch of industry, which may be said to be due to the practical recognition of the fact that "when the electro-chemical action at the anode is the converse of that taking place at the cathode, an almost unlimited quantity of metal may be dissolved and deposited by the expenditure of a given quantity of electrical energy," a single dynamo machine often precipitates over 10 kilogs.—22 lb.—of copper per hour. It may be well to exemplify the fact above stated. Let us suppose that a current of 1400 ampères is passing through an electrolytic tank in which the anode and the cathode are both of lead, and the electrolyte a suitable solution of the same metal. Nearly 12 lb. of lead will then be dissolved at the anode and deposited at the cathode per hour. If we now connect another electrolytic tank, similar to the former, in series with it, the resistance of the circuit may be nearly doubled. But if we then connect another series of two tanks in mutiple arc with the former, the resistance will be reduced to its original value. Assuming that the effective electro-motive force is not altered, an assumption which is not strictly correct, but is practically nearly so if the comparatively small "back electro-motive force" be reduced by the circulation of the electrolyte—the current will now be 1400 ampères as before, and the electrical energy expended will also remain constant. But as the current is now passing through two electrolytic (double) cells *in series*, the quantity of lead deposited will be double, *i.e.*, 24 lb. nearly. Calling I current in ampères, *n* number of tanks in series, E electro-motive force in volts, and R resistance in ohms, the expression for weight of lead deposited per hour—applicable under the assumption above-mentioned is

$$Pb = \frac{In}{117} = \frac{En}{R \times 117} \text{ lb. per hour.}$$

On the other hand, as M. Fontaine points out, the practical importance of the principle we have enunciated must not be overrated. "The force—energy—expended is, in effect, only one of the economic elements of the question, and when a head of water can be rendered available it is often the least important. The size of the installations and the quantity of metal under treatment may be effective causes of failure in a manufactory; for the interest of the capital engaged may become equal to, or even greater than, the gross profit realised by the operation itself. When a quantity of copper is refined by means of a given motive power, and it is wished to double production without increasing the motive power, it becomes necessary to augment fourfold the quantity of metal under treatment, which augments in very great measure the first cost of starting the manufacture. The capital sunk then becomes considerable when taken in relation to the annual amount of business.'

"The electrolytic refining of copper," says M. Fontaine, "has been carried into effect during the last ten years by the Norddeutsche Affinerie, at Hamburg; by MM. Œschger and Mesdach, at Biache; by M. Hilarion Roux, at Marseilles; at the Oker Foundry, in Saxony; at the mines of Mansfield; by the firm of Lyon-Allemand, at Paris; by M. André, at Frankfort, &c.; and in England by Elkington—who originated the process—and by the firm of Elliott, at Selly Oak, near Birmingham."

The electrolytic process of refining lead, due to M. Keith, is at present worked only by the Electro Metal Refining Company, of New York. It is stated that whilst the present treatment of base bullion in the dry way costs 30f. per ton, the cost of treatment by the Keith process would not exceed 10f., allowing a profit of 20f. per ton. The electrolytic bath in this case is a solution of sulphate of lead in acetate of soda. In this solution gold, silver, and antimony remain undissolved at the anode; iron and zinc remain permanently dissolved; whilst lead, with a small proportion of bismuth, is deposited at the cathode.

The last chapter—XIV.—of M. Fontaine's work is devoted to the electrolytic treatment of ores. Very little has as yet been accomplished practically in this direction; but, even prior to the advent of the dynamo machine, enough was done by MM. C. and E. Bequerel and a few other workers, to show that at the present moment there must be in this direction a vast field almost unexplored which, in the near future, may become productive.

THE STOCKPORT GAS ENGINE.

THE engine illustrated above and on page 192 is made under the patents of Mr. C. H. Andrews, of Stockport. It contains several features of notable interest. Fig. 1 is a perspective view; Fig. 2 is a side elevation; Fig. 3 a plan; and Fig. 4 an end elevation, all partly in section; Fig. 5 is a detached view of the governor and excentrics and the valve which regulates the supply of gas to the engine; Fig. 6 is a sectional elevation through the line A B Fig. 2; Fig. 7 is a plan view of the valve cover; and Fig. 8 a plan view of the valve cover and of the slide valve of the working cylinder; and Fig. 9 is a plan view of the slide valve; and Fig. 10 is a diagram of cycle of operations of the pistons in the power and charging cylinders. We may describe these by reference to the inventor's patent specification. *a* is the working and *b* the charging cylinder, with pistons a^1 and b^1 respectively shown cast in one piece with the web or frame *c*; to the crank shaft *d* is secured the crank d^1, which is connected by the rod d^2 to the piston a^1 in the working cylinder.

The admission of gas to the engine is controlled by a valve *e* shown, composed of two cones on one spindle and regulated by the governor—see Fig. 5; the gas passes through the valve *e* along the pipe e^1, through the gas bags e^2, past the conical regulating valve e^3 into a chamber e^4, where it remains under pressure until the diaphragm is depressed—in the manner hereinafter explained—and the mushroom valve e^6 opened, when the gas in the chamber e^4 and pipe e^1 passes through the valve e^6 into the pipe *f*; this pipe *f* intercepts or passes through the air supply pipe *g* and the gas passes through perforations in the pipe *f*, and mixes with the air in the pipe *g* at this point as shown at Fig. 3; during the out-stroke of the piston b^1 a charge of gas and air is drawn through the passage f^2 and port h^1 in the slide valve *h*, and so through the passage *i* into the compressing cylinder *b*, and when the charge has been compressed during the in-stroke of the piston b^1 it is driven from the cylinder *b* through the passage *i* and port h^2 in the slide valve *h* through the passage i^1 into the pipe or reservoir *j*. The pipe *j* conducts the compressed charge to a combustion chamber a^2 attached to and forming part of the working cylinder *a*; a part of the charge passes from the passage i^1 down a small pipe j^1 into a chamber above the diaphragm e^5; the pressure of the charge depresses the diaphragm e^5 and opens the mushroom valve e^6 and admits a fresh supply of gas as previously described. The slide valve *h*

THE STOCKPORT GAS ENGINE.

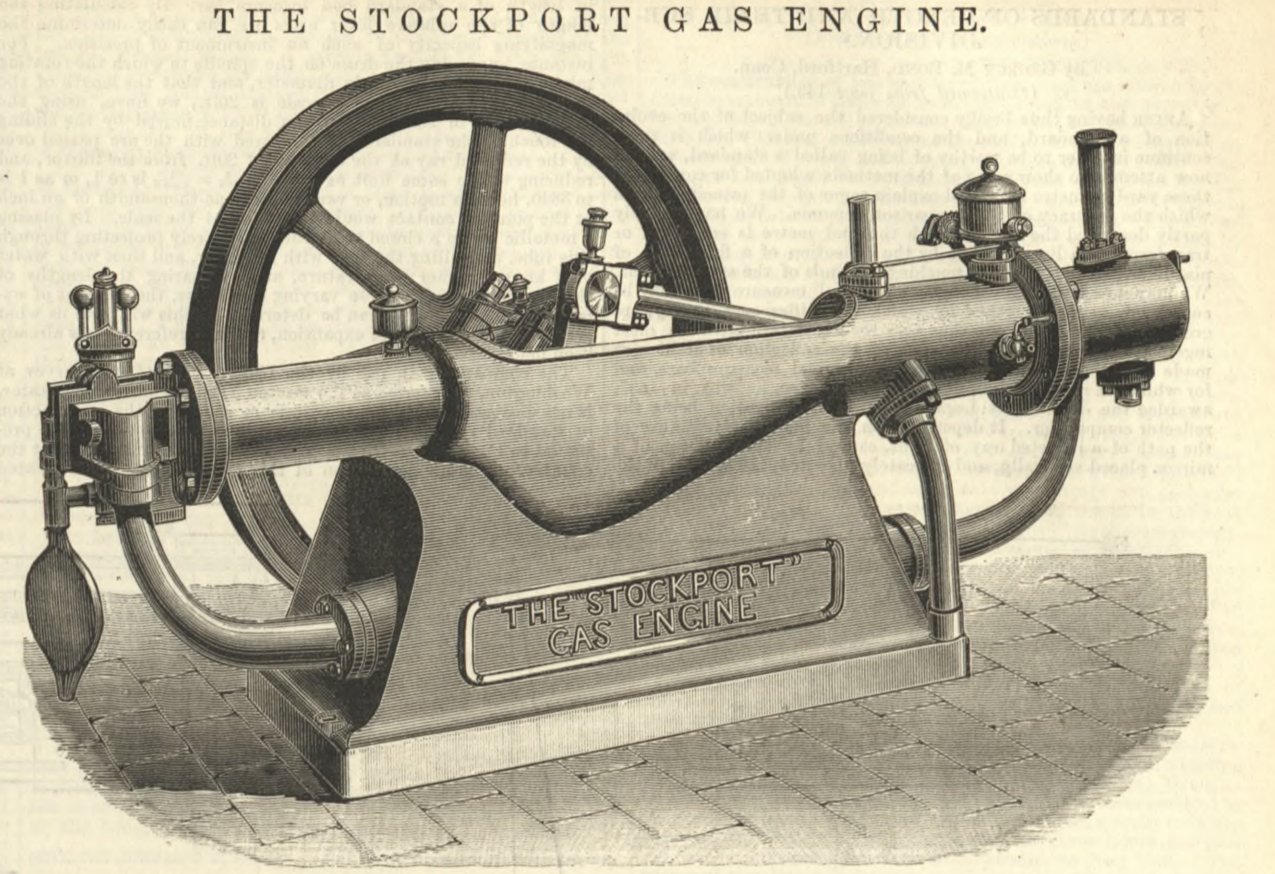


Fig.

controls the admission through the port h^1 and discharge through the port h^2 of gas and air to and from the cylinder *b*; the valve *h* has a cover h^3, and is connected by a rod h^4 and lever h^5 to a short shaft h^6 connected to a slotted lever h^7; a bowl k^6 on the strap of the excentric k^2 takes into the slot in the lever h^7, and so operates the slide valve *h* as the crank shaft *d* revolves. The admission of the charge of gas and air to the combustion chamber a^2 is controlled by the slide valve *k*: this valve *k* has a cover *l*, and is traversed by a rod k^1 connected to an excentric k^2 on the crank shaft *d*.

The operation is as follows:—During the outstroke of the piston b^1 a charge of gas and air is drawn from the point where they mix through the passage j^2, port h^1 and passage *i* into the charging cylinder *b*; on the return or in-stroke of the piston b^1 the slide valve *h* will have moved sufficiently to close the port h^1 and open the port h^2 and the charge is driven or forced through

a^1 has compressed the charge into the combustion chamber a^2 and begins its reverse or out-stroke in the position shown in Figs. 1 and 2 the slide valve *k* will have moved in the right-hand direction, and as the valve continues its traverse the flame in the pocket *n* ignites and explodes the mixture under pressure in the small chamber l^1 a moment in advance of uncovering the passage a^4 leading into the combustion chamber a^2; this preliminary explosion in the chamber l^1 and pocket *n* instantly ignites and explodes the main charge in the combustion chamber a^2.

The result of the explosion of the main charge is to propel the working piston a^1 outward until the edge of the exhaust opening a^3 is uncovered, when the products of combustion, being in a state of considerable tension, will rapidly escape during the traverse of the piston over the said openings a^3 and be reduced to about atmospheric pressure and, before the openings a^3 are

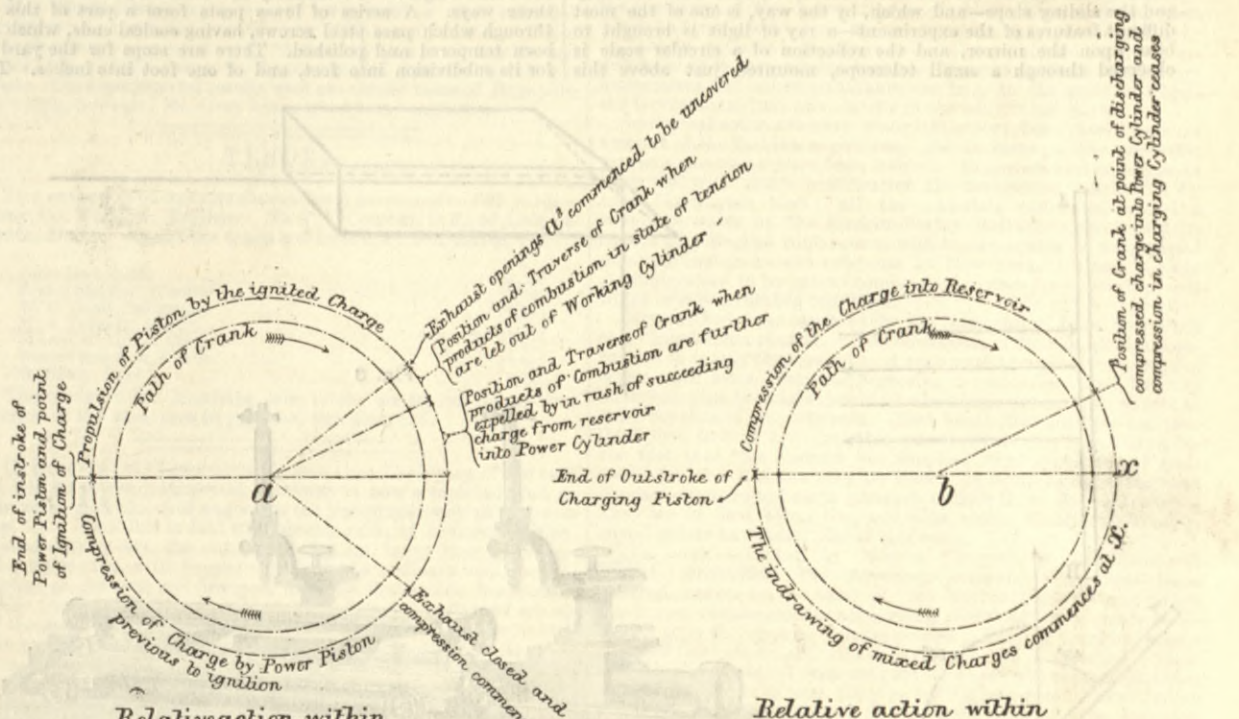


Fig. 10

the passage *i*, port h^2, and passage i^1 into the pipe or reservoir *j*.

The explosive charge is conducted through the pipe *j* and admitted to the combustion chamber a^2 of the working cylinder *a* through the slide valve *k* in the following manner:—When the piston b^1 of the charging cylinder *b* is about 1in. from the end of its in-stroke, the piston a^1 in the working cylinder *a* will be about 1in. from the end of its out-stroke—*i.e.*, near the exhaust openings a^3; at this time the ports k^3 and k^4 in the slide valve *k* will be over the small chamber l^1 in the valve cover *l*, thus opening a communication between the passage j^2 leading from the reservoir *j* and the passage a^4 leading to the combustion chamber a^2; the charge under pressure rushes from the pipe *j*, through the passage j^2 port k^3 into the small chamber l^1, and through the port k^4 and passage a^4 into the combustion chamber a^2; the charge drives before it through the exhaust openings a^3 any non-explosive vapour that may be contained both in the chamber a^2 and cylinder *a*; the piston a^1 on its return or in-stroke drives the charge before it from the cylinder *a* into the combustion chamber a^2 and compresses it ready for explosion, while at the same time the piston b^1 is drawing a fresh charge of gas and air into the cylinder *b*. During the in-stroke of the piston a^1 the pocket *n* in the slide valve comes over the passage o^1 in the valve cover *l* leading from the gas supply pipe *o*, and receives a supply of gas through the slot n^1 previous to reaching the master light *m*, where the gas in the pocket *n* is ignited. The master light *m* is kept constantly burning in the chimney m^1 in a division of or near the combustion chamber a^2; an opening m^2 in the valve cover *l* admits a current of air which causes the gas in the pocket *n* to be ignited. When the piston

again covered by the piston a^1 on its inward stroke the remaining products of the previous explosion will have been expelled through the openings a^3 by the next charge of gas and air admitted to the combustion chamber a^2 through the valve *k* as already described. A small portion of the effective stroke of the piston a^1 is thus sacrificed for the purpose of expelling the remaining products of combustion by the inrush of a fresh charge of explosive mixture.

When the slide valve *k* again moves in the left-hand direction, the waste gases in the ignition pocket *n* escape through the opening m^2 in the valve cover *l* previous to the pocket *n* receiving a fresh supply of gas which is ignited at the master light *m* as already described, and as the slide valve *k* moves in the right-hand direction the flame in the pocket *n* again causes a preliminary explosion in the chamber l^1, and so in this manner explodes the main charge in the combustion chamber a^2 at the commencement of each effective stroke of the engine. The engine as described is well made, and works remarkably well with about 30 cubic feet of gas per indicated horse-power per hour, but since our engravings were prepared some improvements have been made in the engine, which we shall describe at a future time, by which the consumption of gas has been very much reduced.

LAUNCH, ASTORIA.—On Saturday afternoon Messrs. Robert Thompson and Sons, Sunderland, launched the Astoria, an iron sailing barque, built to the order of Messrs. Peter Iredale and Son, Liverpool, and of the following dimensions, viz.:—Length, 240ft. breadth, 38ft.; and 21ft. 9in. depth of hold.

STANDARDS OF LENGTH AND THEIR SUBDIVISION.*

By GEORGE M. BOND, Hartford, Conn.

(*Continued from page* 143.)

AFTER having thus briefly considered the subject of the evolution of a standard, and the conditions under which it must continue in order to be worthy of being called a standard, we will now attempt to show some of the methods adopted for comparing these yard or metre bars, and explain some of the principles upon which the accuracy of the comparison depends. We have already partly described the way in which the end metre is compared or transferred to a line measure by the reflection of a fine point of platinum, without actually touching the ends of the standard bar. We may now notice how two standard end measure bars may be compared, using a method by which the differences, if any, are greatly magnified, and are thus very readily determined. A most ingenious application of the laws of the reflection of light was made by Joseph Saxton for comparison of end measure bars, and for which, in recognition of its value to science, he was, in 1837, awarded the John Scott Legacy Medal, his invention being the reflector comparator. It depends upon the magnified distance of the path of a reflected ray of light, caused by the rotation of a mirror placed vertically, and delicately pivotted, the spindle of the mirror being connected with a sliding bar by a fine watch fusee chain wound around the barrel of the mirror spindle. At the end of the sliding bar, to which this chain is attached, contact is made with the end of the standard to be compared, the other end of the standard being firmly abutted against an immovable stop. By first placing the standard bar in position, care being taken to have the bar supported, as you will remember, at the neutral points, and exactly in line, so that the centres of the opposite ends of the standard are against the contact surfaces of both the stationary and the sliding stops—and which, by the way, is one of the most difficult features of the experiment—a ray of light is brought to bear upon the mirror, and the reflection of a circular scale is observed through a small telescope, mounted just above this divided arc. This circular scale may be placed at any convenient distance from the mirror, say 15ft. or 20ft. It is evident that a very slight motion of the sliding bar G in the figure shown upon the screen—Fig. 1—will cause a ray of light, reflected from the mirror M, to which its motion is imparted through the small chain and drum, to move with a much greater velocity at the distance of the large circular scale R S, and, as the angle of incidence is equal to the angle of reflection, a motion of the mirror through an arc of 5 deg. would cause a motion of the reflected ray of 10 deg., as we may readily understand by taking the geometrical proof in illustration. A polished surface is placed so that the light strikes it squarely, or, in other words, at no angle whatever; it will evidently be reflected directly back to its source. Now, suppose it is rotated into such a position as indicated in the accompanying figure—Fig. 1*a*—which is just 45 deg. as compared with its original position, the light still coming from the same direction; it now strikes it at an angle of 45 deg., and as light is always reflected at the same angle as that at which it strikes a polished surface, its new path will be again 45 deg. from the plane of the mirror; but, as you will see, it is twice 45 deg. with respect to its incident path, and is thus reflected at an angle of 90 deg.

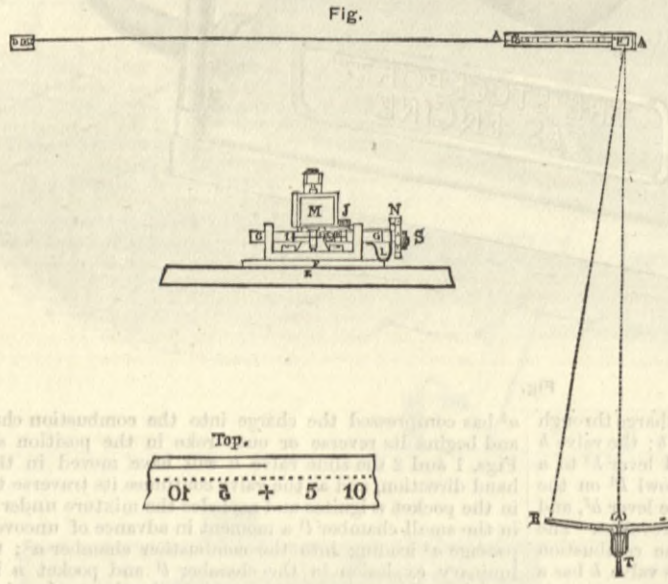
We can readily see how extremely delicate or sensitive to the slightest change of position this reflected ray becomes. As light may be said to have no weight, and consequently no momentum or inertia, it will quickly and certainly indicate the slightest change in length of a standard end measure bar. By calculating the length of the relative lever arms we can easily determine the magnifying capacity of such an instrument of precision. For instance, supposing the drum on the spindle to which the rotating mirror is attached is ¼in. in diameter, and that the length of the radius of the large circular scale is 20ft., we have, using the double angle in this relation, the distance moved by the sliding bar touching the standard, as compared with the arc passed over by the reflected ray at the distance of 20ft. from the mirror, and reducing to the same unit as $\frac{1}{8} \times \frac{1}{12} \times \frac{1}{40} = \frac{1}{3840}$ is to 1, or as 1 is to 3840, hence a motion, or variation of one-thousandth of an inch at the point of contact would be 3·84in. at the scale. By placing a metallic bar in a closed tube, the ends merely projecting through this tube, and filling the tube with ice water, and then with water of a known higher temperature, and comparing the lengths of the same bar under these varying conditions, the amount of expansion for each degree can be determined; this will give us what is called the coefficient of expansion, to which reference has already been made.

The comparator in use by the United States Coast Survey at Washington, designated as the Saxton Yard Dividing Comparator, is one designed by Mr. Saxton while in charge of the construction of standard balances, weights, and measures of length, to be presented to the different States, to insure uniformity throughout the country. A short description of this comparator may be quoted from a paper read by Professor W. A. Rogers before the American Academy of Arts and Sciences, April 14th, 1880, "On the Present State of the Question of Standards of Length," and from which, also, much that is of interest in regard to our subject matter for this evening has been obtained. Any one wishing to pursue the subject further, the paper entire, and the references contained at the end will be of very great assistance. "The Saxton comparator consists of a brass bed-plate, having V-shaped ways running the entire length. A slide carrying a microscope slides freely over these ways. A series of brass posts form a part of this bed, through which pass steel screws, having conical ends, which have been tempered and polished. There are stops for the yard and for its subdivision into feet, and of one foot into inches. There are also stops for the metre and for its subdivision into decimetres, and of one decimetre into centimetres. . . . The end stops for the yard and for the metre were, many years ago, set to correspond with bronze No. 11, at 58 deg. nearly for the yard, and with the iron metre at 68 deg. nearly. . . . The standards which have been distributed since 1856 have been transferred from these distances at the temperatures at which they are standard. The yard in actual use at the Bureau of Weights and Measures, therefore, may be defined to be the distance between two steel stops attached to the bed of the Saxton comparator which corresponds to the length of bronze No. 11, at 58 deg. nearly, and the meter may be defined to be the distance between two steel stops of the Saxton comparator which corresponds to the length of the iron metre corrected for the difference between its length at 32 deg. and at 68 deg. nearly. Recent comparisons indicate that these temperatures should be diminished, by a trifling amount, for the present distances between the stops both for the yard and for the metre."

Engravings representing the Saxton yard dividing comparator and also the Saxton reflecting comparator here shown, were obtained through the kindness of Professor J. E. Hilgard, Chief U.S. Coast Survey, by whom every facility was afforded me for examining the methods of comparison. The courtesy of Mr. Blair, assistant in charge, has aided me greatly in thus being able to illustrate the instruments now in use at the office of the Coast Survey.

Another form of a comparator, which has proved to be successful in the use of the means "for the end sought," in the comparison and investigation of standards of length, is that known as the Rogers-Bond universal comparator, which was constructed from plans proposed by Professor Rogers by the Pratt and Whitney Company, of Hartford, Conn., for their use in practically establishing standard gauge dimensions. A duplicate comparator of this form was also made by them for Professor Rogers for his professional work at Cambridge, and for the transfers and comparisons of standards used by the Pratt and Whitney Company as the basis of these standard sizes. The comparator at Cambridge is also used by Professor Rogers in determining the coefficients of expansion of the various materials used in the construction of standard yard and metre bars, and also for obtaining the relation between the length of the imperial yard and the "metre des archives." The solution of this latter interesting and difficult problem is fully given in a memoir by Professor Rogers, presented May 9th, 1883, before the American Academy of Arts and Sciences, entitled "Studies in Metrology," and to which reference may be had. The special features of the universal comparator are, as its name implies, the variety of the methods employed and the range of work that can be done in comparing standards; each independent method, when carefully carried out, producing similar results which serve to check or prove the comparisons. It includes a method for investigating the subdivisions of the standard by comparing each part of the total length with a constant or invariable quantity or distance.

Fig.



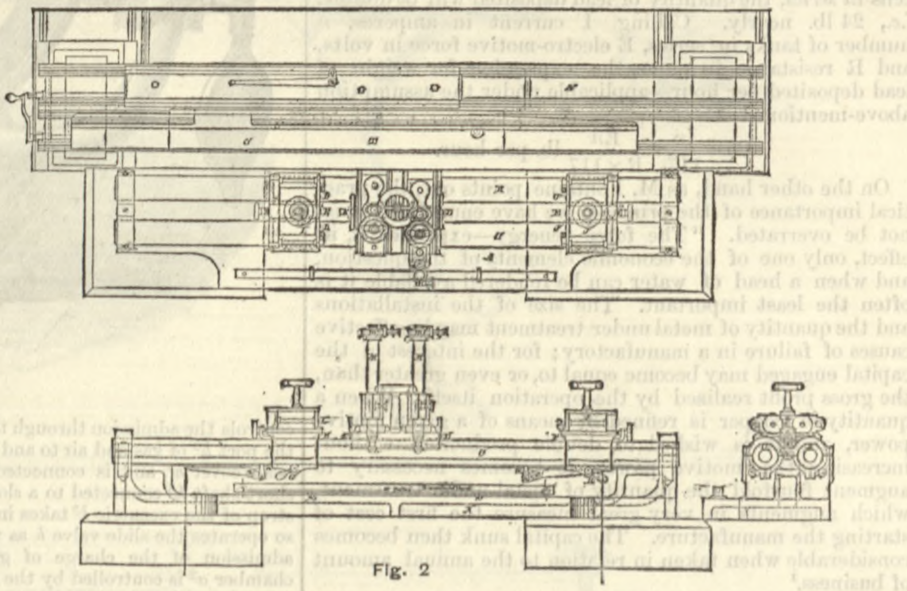


Fig. 2

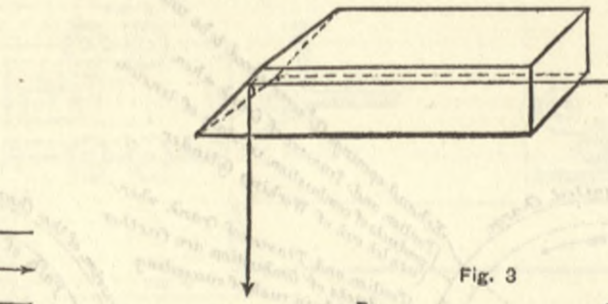


Fig. 3

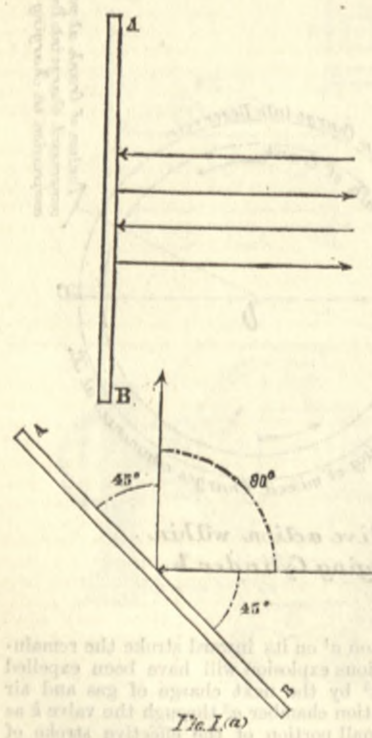


Fig. 1(*a*)

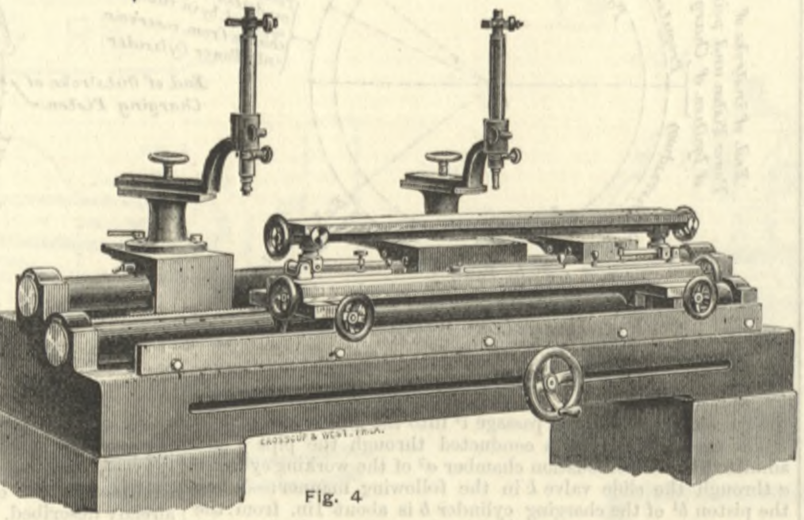


Fig. 4

By the aid of the diagram of the plan and elevation of this form of comparator, the aim being to exhibit principles rather than a picture of the instrument, we may be able to describe in a few words the main features of its construction—Fig. 2. A heavy cast iron base A is mounted upon stone capped brick piers, giving a permanent foundation to the apparatus. Upon this base, and reaching from end to end, are two heavy steel tubes, B and C, 3in. in diameter, ground perfectly straight, and being "true" when placed in the centres of a lathe, the object being to get a straight line motion of the microscope plate D, which slides freely on these true cylinders.

Flexure of these cylindrical guides is provided for by lever supports at the neutral points n and n^1. Fitted closely to these guides, and outside of the range of motion of the microscope plate D, are two stops, E and F, one at each end, as shown in the figure. These stops are arranged to be adjusted at any desired position along the guides, and are securely held by clamping on the under side by the handles G and H. These stops are each provided with a pair of electro-magnets, I and J, the poles of which do not come in contact with the armature seen at either end of the microscope plate. Contact is made at K and L, which are hardened steel surfaces, tempered and polished, and placed as nearly as possible in the centre of the plate and of the stops.

The magnets are intended to overcome the unequal pressure due to ordinary contact, a rack and pinion being used to move the plates. The magnets are used to lock the microscope plate at each end of its traverse between the stops. The use made of this sliding microscope plate and the stops we shall see presently. Beyond the main base just described, and supported also on brick piers, is an auxiliary cast iron frame N, which is provided with lateral and vertical motion within limits of zero and 8in. and 10in. respectively, for rough or approximate adjustment, and upon the top of this frame are two carriages O and O¹, which slide from end to end, a distance of about 40in. Upon these sliding carriages are placed tables T and T¹, provided with means for minute adjustment, for motion lengthwise, sidewise, and for levelling, thus permitting the adjustment of a standard yard bar quickly, and without the necessity of its being touched with the hands after being placed upon the table until the work of comparison is completed.

Before describing the operations necessary for a series of comparisons, it may be well to explain the peculiar fitness, for purposes of this kind, of the microscopes M and M¹ used in this connection. The tubes are 12in. long and 1¼in. diameter, the eye-piece micrometers m_1 and m_2 were made by Joseph Zentmayer, of this city, whose skill as an optician is too well-known to require further proof of their excellence. The objectives were made by the late Mr. R. B. Tolles, of Boston, and are each fitted with his illuminating prism. In order to use a microscope upon lines ruled on polished surfaces, or on any opaque material, some means for obtaining sufficient light must be employed to see them distinctly without the use of reflectors, which are often a source of error in standard work. In no other form of objective does this requirement seem better fulfilled than in that invented and made by Mr. Tolles. The objectives are each fitted with a prism of perfectly clear glass, placed just above the lower lens, and one end of the prism passes through the side of the objective. The inner end of this prism is bevelled—Fig. 3—forming such an angle of the end surface to the axis of the prism that light is refracted perpendicularly upon the surface of the bar, lines less than $\frac{1}{30000}$ of an inch in width being easily seen and separated with a 1in. objective. It may be said to "carry its own lantern," and with light so thrown, just where it is most needed, the bottom of the cut or furrow of a line cut by a diamond edge, as fine as that just stated—$\frac{1}{30000}$ of an inch—as well as the edges of the furrow, can readily be seen. This method of illumination has proved to be invaluable in the work of comparing line measure standards, especially so in the case of bars having the lines ruled on polished gold surfaces at the bottom of wells sunk one-half the depth of the bar, these wells being not over ⅛in. in diameter, as in the case of Bronze 1, and also of the bar now before you.

The first operation in the use of this form of comparator is to level the main base A, then sliding the microscope plate D from end to end of the steel tubular guides, having the microscope adjusted so as to be in focus upon the surface of mercury held in a shallow trough, over which the microscope passes, the curvature due to flexure of the guides is determined, and may be compensated for by counter-weights at the neutral points of support n and n^1. In order to test this sight line path of the microscope plate horizontally, the method of the stops is employed, or another method, which is that of tracing a fine line the entire length of a standard bar upon its upper surface, and reversing the bar, tracing another line very near the first and at an equal distance apart at

* A lecture delivered before the Franklin Institute, February 21st, 1884.

each end; then if this distance is uniform between the two lines the entire length, it is safe to assume that the path of the plate is a straight line horizontally, and at the middle the amount of curvature, if any, and also if regular, is readily determined. This method has been used by Professor Rogers with marked success. The stop method is to compare a line measure, or an end measure bar, on each side of the centre line of motion of the microscope plate, using one microscope, and comparing this fixed length with the constant quantity before referred to, which is the distance between the stops. Should the path be a curved one, the distance between the defining lines upon the bar will appear greater on one side than on the other in proportion to the amount of curvature existing. The length of the standard being the chords of circles of different radii, but by comparison with the stops, seems really to be different in length at each position, caused by the different distance, through a larger arc passed over by the microscope. By means of the proportion of similar triangles, the lengths of the radii may be very accurately determined. By placing different standards on one side of the line of the stops, they may be, by being compared with a constant quantity, compared also with each other.

Another method for comparing two or more standards is to place two microscopes one on each of two microscope plates upon the guides, at a distance determined by the length of one of the standards, and by replacing this one by a second, the coincidence of the lines in the eye-piece micrometer, or their variation, showing their relation. The microscopes may be placed horizontally in this same fixed relation, using the method invented by Lane, and which has been used in the office of the U.S. Coast Survey at Washington. A modification of this form of comparator—Fig. 4—made by the Ballou Manufacturing Company, of Hartford, Conn., for Professor Anthony, of Cornell University, is here shown. The instrument is mounted upon a single heavy base. Though not having the range of motion of the adjustable support for standard bars shown in front, as is possible with the original comparator, it possesses all of the conveniences for rapid adjustment and accuracy of movement. The right line motion of all moving parts longitudinally is governed by heavy cylindrical guides, and the same method of the "stops" is used in investigating the subdivisions of a standard bar.

There are five independent methods for comparing standards of length by the use of this form of comparator, but we will not dwell longer upon this part of the subject, but pass to the subdivision of standards of length, which is effected by the use of this same process—the microscope plate sliding between fixed stops—and which serves to beautifully illustrate one of the fundamental principles of science, that "things equal to the same thing are equal to each other," or, that the relation of different lengths each to a constant distance, establishes their relation to each other. This is accomplished in the following way: A yard, for instance, is to be subdivided into three equal parts, or into three separate feet. We divide the whole length by trial into three parts, then by setting the stops so that the microscope plate may move very nearly the distance represented by the first one of the three parts, by readings of the eye-piece micrometer carefully taken at each end of the path of motion of the microscope, using the finely ruled lines by which these three parts are defined, we obtain the length of this subdivision as compared with our constant quantity; then by sliding or moving the bar along under the microscope until the second part is in place, the same operation is again performed, and so for the third, thus determining the relation for each with this arbitrary or temporary standard; then by adding the differences between these separate parts and the constant length, and taking the mean or average of these differences, from which we subtract each difference, gives us the correction to be applied to each part in order that it shall be exactly one-third the total length, or, as in case of a yard bar, giving us exactly 12in., or a standard foot. The foot may then be subdivided in the same manner into twelve equal parts, establishing a standard inch, and further to eighths, sixteenths, thirty-seconds, hundredths, or thousandths of an inch. To illustrate this method, and to make plain the reason why these corrections so obtained are used, we can suppose a case of simply dividing a rod or a string in two parts. Now we know that for whatever amount one part is longer than the other, one half of this amount belongs to the shorter to make it exactly one-half the whole length of the rod or string; hence we have one-half the sum of the difference, and subtracting each difference from this half sum, would, in one case, give us a minus correction for the longer part, and a plus correction to be applied to the shorter.

A series of readings or observations using the microscope with the eye-piece micrometer, and having the subdivision of a standard yard into three equal parts, to determine, would be after this form:

First Foot. L.	*First Foot.* R.	*Second Foot.* L.	*Second Foot.* R.
3·68·5	3·98·2	3·57·4	3·87·3
3·68·7	3·97·8	3·57·5	3·87·7
3·68·3	3·98·5	3·57·9	3·86·9
Mean 3·68·5	Mean 3·98·2	Mean 3·57·6	Mean 3·87·3
	R – L = + 29·7		R – L = + 29·7

Third Foot. L.	*Third Foot.* R.	*Correction.* Σ
3·61·3	3·97·0	+ 29·7 + 2·1
3·62·0	3·97·8	+ 29·7 + 2·1 + 4·2
3·61·2	3·97·7	+ 36·0 – 4·2 ± 0·0
Mean 3·61·5	Mean 3·97·5	3)95·4
	R – L = + 36 0	Mean 31·8

The column under L being readings taken at the left or initial end of each foot, and R, readings taken at the right, R – L being the difference between the readings taken at each end of this subdivision of the whole length. The column under correction shows the amount in divisions of the micrometer needed to make each foot exactly one-third the yard. Under Σ these corrections are added as a check upon the accuracy of the work in case of a long column of corrections, as when the foot is subdivided into inches, or an inch into sixteenths or thirty-seconds. We have thus traced, briefly, the development of the standards of length from some of their rudest units to that of the present British Imperial yard and its copies, and the metre, and shown how the yard has in one way at least been subdivided within a limit of about one hundred thousandth of an inch, it remains now to show in what way these accurate subdivisions may be successfully applied to everyday use for work requiring more nicety, and in our next lecture it is hoped that our efforts may not prove unsuccessful.

(To be continued.)

THE PHYSICAL SOCIETY.

At the last meeting of the Physical Society, February 28th, Professor Guthrie, president, in the chair, Messrs. G. R. Begley and O. Chadwick were elected members of the Society.

Mr. I. C. McConnel presented two notes on "The Use of Nicol's Prism." The first note related to the error in measuring a rotation of the plane of polarisation due to the axis of rotation of the prism not being parallel to the emergent light. After pointing out that this error was to a first approximation eliminated by taking the mean of the readings in the two opposite positions of the Nicol, the author proceeded to push the calculation to a second approximation so as to get a measure of the residual error. This is given by the equation—

$$\frac{\theta + \theta_1}{2} - \psi = \text{const.} + \cdot 24\, r^2 \sin. \psi \cos. \psi$$

where θ and $180 + \theta$ are the two readings of the circle, ψ the angle between the plane of polarisation and a fixed plane, and r the angle between the axis of rotation and the incident light. This equation is practically correct for a flat-ended as well as an ordinary Nicol. The residual error cannot amount to 1′ in a rotation of 60 deg. if r is less than 2 deg. The optical properties of the Nicol tend to neutralise the geometrical error due to the rotation taking place about one axis and being measured about another.

The second note dealt with a new method of obtaining the zero reading of a Nicol circle. This is often defined as the reading when the plane of polarisation is parallel to the axis of rotation of the table of a spectrometer. A Nicol is fixed on the table, the light quenched by turning the Nicol circle, and the reading taken. The table is then rotated through 180 deg., the light quenched, and the reading taken again. The mean of the two readings gives the result required. It was described how the error due to the want of symmetry of the Nicol might be found and eliminated.

Mr. H. G. Madan exhibited and described "Some New Forms of Polarising Prisms." The first of these is by M. Bertrand, and has been described by him—*Comptes Rendus*, September 29th, 1884. The prism consists of a parallelopiped of dense flint glass of refractive index 1·658, the same as that of Iceland spar for the ordinary ray. The glass prism is cut like the spar of a Nicol's prism, a cleavage plate of spar being cemented between the two halves by an organic cement of refractive power slightly greater than 1·658. A beam of light traversing the prism is incident from the spar at an angle of 76 deg. 44′. The ordinary ray passed through without change, but the extraordinary ray is totally reflected at the first surface. The prism gives a field of 40 deg. M. Bertrand's prism has the great advantage of requiring only a very small quantity of Iceland spar, a substance that is becoming very scarce and expensive. The other prisms shown were, a similar one by M. Bertrand described in the same paper, a double image prism by Ahrens, described in the "Phil. Mag." for January, 1885, and a modification of the latter by Mr. Madan, described in *Nature* for February 19th.

Mr. Lewis Wright pointed out, as a practical objection to M. Bertrand's prism, that it was very doubtful whether a glass could be obtained of so high a density as to possess a refractive index of 1·658, and at the same time be colourless and unaffected by the atmosphere. He also remarked that the principle of the prism was by no means new.

Professor W. E. Ayrton read a paper by himself and Professor J. Perry on "The most Economical Potential Difference to Employ with Incandescent Lamps." The authors commenced by pointing out the importance of experiments being made on the lives of incandescent lamps in addition to experiments on efficiency. Referring to the experiments on life, given by M. Foussat in the *Electrician* for January 31st, they showed that if p be the price of a lamp in pounds, n the number of hours per year that it burns, $f(v)$ the life of the lamp in hours, and $\theta(v)$ the number of candles equivalent to the lamp, $f(v)$ and $\theta(v)$ being expressed as a function of the potential difference in volts, $\frac{p \times n}{f(v) \times \theta(v)}$ stands for the cost per year per candle, as far as the renewal of lamps is concerned. Also if H stands for the cost of an electric horse-power per year for the number of hours electric force is employed, and $\phi(v)$ the number of watts per candle, $\frac{H}{746} \times \phi(v)$ stands for the cost per year per candle as far as the production of power is concerned. The sum of these two represents the total cost per candle per year, and the value of v that makes this a minimum may be found either graphically or analytically. Solving the problem graphically for the 108 volt Edison lamps used at the Finsbury Technical College, where n may be taken as 560, and H = £5, they find that the minimum value of the total cost is given by $v = 106$. The curve connecting total yearly cost per candle with v they found to be very flat at this point, showing that the lamps may be burnt with a potential difference varying as much as 4 volts with only 5 per cent. addition to the annual cost. It is found that with certain types of incandescent lamps, the candle-power of the lamp varies as the potential difference minus a constant. The authors also find that, in rough photometric experiments, No. 8 sperm candles may be substituted for standard ones.

Mr. Macfarlane Gray gave an account of a most extended investigation upon the second law of thermodynamics. From considerations connected with the specific heats of liquids and gases, the author comes to the conclusion that the law is not true. The experimental results used are chiefly those of Regnault, to which, however, Mr. Gray has applied some corrections.

TENDER.

For extension of concrete sea-wall and promenade—602 yards—Bray, Co. Wicklow. Engineer: Mr. P. F. Comber, C.E., 37, College-green, Dublin. Quantities taken out by Mr. P. F. Comber, C.E.

	£
John Best, Leith	20,580
Brand and Son, Glasgow	17,733
W. C. Gault, Ballymena	17,335
W. J. Doherty, Dublin	16,335
Robert McAlpine, Glasgow	12,159
Robert Simpson, Dublin	12,015
B. Brady, Bray	9,721

The tender of Mr. McAlpine, who is the contractor for the first section of the work now in progress, was accepted.

Opening of the Bessbrook Tramway.—The laying of the rails of the Newry and Bessbrook tramway is now completed, and on Thursday last the first wagon on the permanent way passed over the line. The line is laid with double rails, of ordinary section, placed side by side, the outer rail being ⅞in. lower than the inner. The inner rails, with flanged wheels in the ordinary way, are the higher of the two, and designed to carry the electric locomotive, while the outer and lower rails accommodate the unflanged wheels of the goods wagons, the high rails inside acting as a flange to keep the wagons from going off the line. The contract for the electrical arrangements is in the hands of Dr. Edward Hopkinson, the dynamo-machines have been manufactured by Messrs. Mather and Platt, and the Ashbury Carriage Company, Manchester, is constructing the electrical locomotives.

River Pollution.—Professor Robinson, C.E., delivered an address at the Parkes Museum on the 26th February. Mr. Michael, Q.C., presided, and amongst those present were many well-known sanitarians. The lecturer pointed out the various attempts at legislation which had been made in the direction of amending the Rivers Pollution Prevention Act of 1876, and of forming Conservancy or County Boards. He was strongly opposed to the introduction of the standards proposed by the Rivers Pollution Commissioners, as not being sufficiently elastic. He pointed out that the Act of 1876 had been a dead letter, quoting the returns which were obtained last year by the Duke of Northumberland as evidence of this; and he maintained that the cause of this failure was due to the fact that the enforcement of the Act was left in the hands of local authorities, who were often the offenders themselves. A long discussion followed the lecture.

Engineering Society, King's College, London.—At a general meeting held on Thursday, February 19th, Mr. W. P. Adams read a paper on "Aerial Navigation," in which he dealt at length with the various projects which had from time to time been brought out. After reviewing the very earliest instances in which the subject was mentioned, the lecturer went on to describe the experiments of Mongolfier and other inventors with balloons of various kinds. Mr. Blackman's project for aerial navigation was then described in detail, although Mr. Adams regretted that this idea had never been really carried out, as he stated that it seemed to be thoroughly practicable. He then gave an account of electrical apparatus for propulsion in air, which, in his opinion, is the mode most likely to be adopted; describing the electro-motor which M. Krebs had constructed for Captain Reynard's balloon experiments, and giving details of its weight and efficiency. Mr. Adams then referred to the future of aerial navigation, and its probably more extended use for both military and civil purposes. The paper was followed by a discussion. At a general meeting held on Tuesday, February 24th, Mr. Duncan read a paper on "Recent Marine Engineering," in which he gave an outline of the steam shipping built and launched on the Clyde during the last twelve months.

AMERICAN NOTES.

(From our own Correspondent.)

New York, February 20th.

The construction of two new trunk lines from the interior to the Atlantic seaboard is likely to be accomplished in the course of a few months. One will be an extension of the Lehigh Valley from Buffalo to Chicago, which can be accomplished by the construction of forty miles of road, and by using two lines already built. This will give the Lehigh Valley the desired outlet to Chicago and the North-west, for which it has been seeking. The line is a good one, but little in debt, and is under excellent management. The second projected line will be a southern trunk line, and extend by water connection from New York City to Baltimore and Norfolk, and by railroad from Portsmouth to Weldon, North Carolina, passing through the centre of that State, through South Carolina and Georgia, to the point where it will connect with southern lines, with trans-Mississippi connections. The loan has just been completed for the construction of a twenty-two mile road in North Carolina, to perfect railroad connections in that State. A large amount of northern capital has been invested, in view of the prospective railroad construction, in mineral, timber, and agricultural lands, and steps are being taken to introduce immigration on a large scale. The manufacturing and commercial interests are anxiously awaiting the revival of railway enterprise, which will bring a demand for iron and steel that will engage the partially-employed capacity. No improvement has developed in the iron trade, and in commercial circles there is but little encouragement. The company has been organised with a capital of 10,000,000 dols. under the laws of New York, for the construction of steamships, which are to have a speed of eighteen knots per hour, to ply between some point on Long Island and a British port. A Bill has been introduced into the House of Representatives to authorise the registration of certain steamships as vessels of the United States, which is in the interest of this particular company.

The Congressional Committee has advised that the port of departure in the United States will be Fort Pond Bay, L.I., and that in Great Britain, Milford Haven.

The gain in distance by the proposed route, as stated to the committee, is about 170 miles at the English end of the route, avoiding the enclosed waters and currents and great dangers of St. George's Channel; and 118 miles at the other end, avoiding risks incident to the coasts of Long Island and New Jersey. From twenty to thirty hours in time will be saved. Ten days and three hours are now required to transport the mails from London to New York. The proposed new line will be able to deliver London mails in New York in six days and three hours.

A vigorous effort is being made in Congress to suspend the silver coinage, but it is doubtful whether it will pass.

Commercial failures are still numerous, and last year's average continues.

The intricate affairs of the Reading Company make an early adjustment impossible. The various committees and cliques, representing the opposing interests, are endeavouring to harmonise, in order to avoid the threatened foreclosure, and will in time, no doubt, accomplish their purposes, but only through concessions which will be tardily accepted.

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

(From our own Correspondent.)

The military necessities continue to occupy a foremost position in the condition of the heavy trades of this district, and the fears which this week exist that those necessities may possibly have to be largely extended if affairs with Russia should come to an untoward crisis, are causing increased importance to be attached by ironmasters and other manufacturers here to the position which the Government just now occupy in the consuming market.

Additional contracts have, since last report, been placed here on account of the Soudan expedition. As to some of the products, previous contracts have been trebled. Engineers and pipemakers have read with much gratification the assurances vouchsafed by Lord Hartington that "all the materials connected with the supply of water on the Suakim-Berber Railway route would be supplied by English contractors, with the exception of two special pumping engines now in existence at New York." These engines are understood to be patent condensing engines for converting salt water into a drinkable condition.

Surprise had been aroused by the information from New York and Philadelphia that H. R. Worthington, of New York, had contracted to supply the Government with twenty engines for pumping water, and some fear was beginning to manifest itself lest the American pipe founders should also be successful in their efforts to get a big slice of the business. That South Staffordshire can produce pipes to bear any desirable pressure has long been shown by the fact that this district has supplied large quantities of such goods for the Russian oil-pipe lines. It is understood that the Soudan pipes are to bear a pressure of 2000 lb. to the square inch. They are of 3in., 3½in., 4in., and 4½in. sizes. Considerable additional orders have been placed this week.

The work accepted by Messrs. Tangyes, of the Cornwall Works, contradicts the American canard. This firm have received orders on account of the Berber Railway and other Soudanese requirements, aggregating twenty-four of their well-known type of "Special" steam pumps. Some of them have been supplied from stock, and others have yet to be despatched. They have also had ordered pressure pumps, which will apply a pressure of from two to three tons, for pipe testing purposes. Other orders which the firm have received on the same account have included seven vertical boilers, numerous sets of pulley blocks, a large length of chain lifting tackle, portable cranes, fitted with large broad wheels for easy road travelling; screw jacks, forges, smiths' tools, &c. Prominent among the general foreign work which Messrs. Tangye have lately booked in their machine tool department, may be mentioned a good contract for wheel lathes and other machine tools for workshops in connection with the Buenos Ayres Railway.

The condition of the iron trade proper has not improved upon the week outside the additional work which has come to the mills by reason of the Government work. This benefits mainly the makers of tube strip, chiefly of large sizes, of tank plates, and of sheets; and the strip makers in particular will doubtless receive other good orders as the work for the expedition is turned out at the manufactories.

The laying down recently of improved machinery by the Pelsall Coal and Iron Company to allow of the manufacture of strip iron of a width which was not previously produced in South Staffordshire is proving very convenient. The company is rolling much of the strip—some of it 15in. wide—which is being used up by the tube makers in their Soudan contracts.

The production of sheets at date is in excess of requirements, notwithstanding that the outturn is being kept down by the running of the mills only part time. It is impossible, therefore, to get up prices; indeed, they are rather still declining. Singles are abundant at £6 10s. to £6 15s. at works according to quality.

It is illustrative of the competition of the North of England that brokers hereabouts are buying sheets from the Middlesbrough mills at £6 15s. delivered in the Thames, and tank plates at also decidedly under Staffordshire prices delivered London.

The demand for galvanised sheets in other than a few instances does not increase, although colonial and South American orders are fairly maintained. The inquiry for marked bars is very slow, and such works as those of John Bradley and Co. and other eminent makers are doing but little. If the mills are to be kept on briskly, about £6 10s. must be accepted for bars. At the £7 10s. figure only little is doing. Common bars are £5 5s. to

£5 10s. at works, and some brokers are buying at £5 18s. 6d., less 3½ per cent., delivered in the Thames. Hoops, the same purchasers are occasionally getting at less than £6 10s. delivered in London, though makers generally ask a better price.

The special steel of the Barrow Steel Company was quoted on 'Change to-day (Thursday) at £5 12s. 6d. per ton, delivered here, for slabs, and £5 15s. for tin bars, but vendors were open to some squeezing.

Messrs. Rollingson and Sons have just started a steel rolling and steel making works at Browford, Westbromwich, and the firm believe that they have a prosperous future before them.

Pig iron of Derbyshire, Northampton, and similar brands is going off in 500 ton lots, but sellers complain of the low prices which they have to accept. Derbyshire pigs were to-day to be had at 40s. 9d. delivered to consumers' works, but superior brands were 42s. to 42s. 6d. Northampton qualities were about 1s. less than the foregoing. Native part-mine pigs were 42s. to 45s., and cinder pigs, 36s. 3d. to 37s. 6d. All-mine were quoted at 57s. 6d. to 60s., but as hematites were to be had at less than 44s., it was only rarely that the figures named were obtained.

Minerals are not selling briskly. Furnace coal is 8s. to 10s.; mill, 7s. 6d.; and forge, 5s. 6d. to 6s. 6d. for best sorts. Durham foundry coke is quoted 22s. 9d.; Welsh best furnace, 14s.; and gas cokes, 10s. all delivered. Hematite iron ores are quoted 19s., and Northampton ores, 5s. 6d. to 6s. delivered.

In view of the large business which is done in black and galvanised iron between South Staffordshire and Australia, some remarks which have just been laid before the workpeople of the Swan Garden Ironworks, Wolverhampton, by Mr. J. Lysaght, who is the proprietor of this concern, and also of the great Bristol Galvanising Works, are of interest. Mr. Lysaght has recently returned from a visit which has extended almost round the world. He states that when in Australia he looked into the question of manufacturing iron there, but found that, although there is a superabundance of good ironstone, coal, and limestone placed most favourably, the question of wages will not permit production of finished iron for many years to come. Referring to the great extent to which galvanised iron is used throughout the whole of the Australias, Mr. Lysaght remarks that "Staffordshire shone reflected in the brightness of her productions, and literally covered the land with the industry of her men."

Much activity characterises the roof and girder department of Messrs. Morewood and Co., Woodford Ironworks, Soho. Their export contracts are at the moment principally for India, South Africa, and the Argentine Republic. The Empire work includes five large sheds, each 100ft. in length, for Southern India, and ironwork for a large tea warehouse, which will be 400ft. long by 50ft. broad. The South African work embraces a large shed, to be employed for drill purposes at Cape Town, which will be of 70ft. span, and similar in its principles of construction to the roof of the St. Pancras Station, London. Messrs. Morewood's contracts for the Argentine Republic include large sheds, some of which will be 300ft. long. Roofing work is in hand for Russia, and the company has recently despatched two roofs, each of 50ft. span, to Hong Kong. Their home contracts include constructive work for various parts of the United Kingdom. Ornamental principals are being manufactured for the new Town Hall at Pontypridd.

This district should benefit by the stores requirements which are just now being expressed by the Great Indian Peninsula Railway Company, and by the necessities for additional ironwork of the Midland, the Lancashire and Yorkshire, and other home railway companies.

Although not directly under order for the Soudan, yet Messrs. Griffiths and Browett, of Birmingham, are busy upon War-office and Admiralty contracts for camp kettles and general tin-plate and japanned wares.

The Council of the Midland Counties Trades and Labour Association has suggested a conference between representative colliery operatives and coalowners to try to arrange some scheme for the prevention of further wages disturbances in the South Staffordshire coal trade. The masters have, however, declined to hold such a conference if any of the operative members of the late Coal Trade Wages Board are elected to it.

According to Professor Lapworth, the source of wealth to Birmingham and its prosperity is the great coalfield of South Staffordshire, which he believes is the finest and most accessible field on this side of the Atlantic. This is, in his opinion, the secret of the past success of the town, since the abundance of coal has, he says, made the people independent and comfortable.

Traders here learn with satisfaction that Sir Bernhard Samuelson, Bart., M.P., has resolved to oppose the new Railway Rates Bills upon their second reading in the House of Commons. Every effort is being made to strengthen Sir Bernhard's hands, for manufacturers know that if the Bills pass the second reading it will take £100,000 to oppose them in Committee. Accordingly, town's meetings at Birmingham, Wolverhampton, and Kidderminster, along with the local authorities of Walsall, Dudley, and Cannock, have each, during the past few days, decided to oppose the Bills. The Birmingham manufacturers have further decided to raise a guarantee fund of £3000.

This week a national conference of miners is taking place in Birmingham. The president—Mr. T. Burt, M.P.—in his address, stated that one effect of the Franchise Bill would be to increase the number of miners' representatives in Parliament.

Messrs. Parkes and Ross, engineers, Tipton, have some ironwork in hand for the viaducts for the Suakim-Berber Railway. Messrs. J. Wright and Co., Tipton, are manufacturing a crane chain weighing two tons, and to carry a load of 150 tons, for a Sheffield firm, who are going into the pressed steel business. They are also making to order two Berryman patent heaters, each 40ft. high by 7ft. wide.

Tenders have just been sought from the Earl of Dudley's Round Oak Ironworks for steel sleepers for the Suakim-Berber line. If the work should fall to his lordship, the sleepers would be rolled out of basic steel blooms. Messrs. William Molineux and Co., Bulls Bridge Ironworks, Moxley, have purchased the Capponfield Works, Bilston, of the Chillington Iron Company, which were offered for sale by private contract. The sale price is currently reported to have been between £7000 and £8000. The manufacture of sheets will be mainly carried on. There are three sheet mills and one hoop mill.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is still no material change to report in the condition of the iron trade in this district, and any prospect of improvement seems to be as distant as ever. The weight of engineering coming forward either for pig or manufactured iron continues extremely small, and where business is done it is only at extremely low figures, with deliveries in some cases extending over the whole of the year. The prices at which business in the open market is alone possible are, in fact, so low that some of the leading pig iron makers decline to quote for orders on such a basis, and content themselves with occasional special sales on which they can get something near their list rates. Between finished iron makers and merchants there is a struggle going on with regard to a further reduction in prices which the dealers are endeavouring to force on, and although many of the manufacturers declare that they have already got to the lowest possible point, and that they would prefer to stop their works rather than take any lower prices, the tendency of prices is undoubtedly in the direction of a further downward move.

There was again only a very slow business doing in the Manchester iron market on Tuesday. Quoted prices were nominally unchanged from last week, but on the bases of quoted rates there are very few transactions. Lancashire pig iron makers still quote 41s. for forge and 41s. 6d. for foundry, less 2½, delivered equal to Manchester, with 6d. under these figures taken where offers are made; but even at this concession they are practically out of the market so far as the Manchester delivery is concerned, as there are district brands which can be got at quite 1s. per ton less, and where sales, which are very few, are being made by local makers, they are chiefly to customers in the more immediate neighbourhood of the works, and where there is a very considerable advantage in the delivered rates. Some of the leading makers of district brands are holding to 40s. 6d. for forge and 41s. 6d. for foundry, less 2½, as their minimum for delivery into the Manchester district, but 39s. 6d. to 40s., less 2½, are figures which would be readily taken in some cases. North-country iron is rather easier, and good foundry brands of Middlesbrough can be bought for delivery over the year, equal to Manchester, at 42s. 10d. per ton net cash.

For hematites there has been some little inquiry, but no transactions of any importance in this district are reported, and prices remain nominally at about 52s. 6d. to 53s., less 2½, for good foundry brands delivered here.

In manufactured iron there has been very little doing. There are offers from merchants at considerably under makers' prices, with the object of testing to what extent makers who are very short of work are prepared to give way. In a good many cases, however, a strong disposition is shown to hold to £5 10s. for good qualities of bars as the basis of quoted rates for delivery into this district, but both in Lancashire and North Staffordshire bars buyers have, during the past week, been able to place orders at £5 7s. 6d., with hoops to be got at £5 17s. 6d., and sheets about £6 17s. 6d. to £7 per ton delivered here.

The engineering trades continue in much the same condition as last reported, and so far as employment is concerned, it keeps about steady, the number of men out of work, though not decreasing, showing no material increase.

In railway carriage building there is a good deal of activity, and Messrs. Ashbury and Co., of Manchester, have secured the order for the whole of the coaches for the new Hull and Barnsley line, and these have to be completed by the end of June. In wagon building, however, there is very little new work giving out, and this branch of the trade is getting very slack.

Messrs. Collier and Co., of Manchester, have recently constructed several multiple drills for boiler making, and bridge and shipbuilding work in the Australian colonies, in which one or two new arrangements have been introduced. In these machines, which have been in several cases made with six, and in others with twelve drills, the bed is provided with T slots, two bottom carriages and transverse slides, so as to enable the plate, after being fixed on the slides, to be moved either longitudinally or transversely without unsetting the plate. This enables the machine to drill holes up to any pitch, 6in. centre to centre. The drills, and also the heads of the drills, are adjustable independently, and this enables odd pitches to be drilled and to get regular or irregular pitches as required, and each spindle can be wound up or down or thrown out of gear separately without stopping the machine. They have also sent out to the colonies a number of other tools, amongst them a specially arranged spring-making machine, which combines all the operations in the one tool; a double-ended rivet, bolt, and spike heading machine, in which the heading ram is worked in double bearings from the connecting-rods; a cold iron saw driven by worm gear, with saw 3ft. 6in. diameter, for taking in work up to 12in. square, the self-acting feed motion is obtained with screw and nut through centre of the bed, and coupled up to the traversing carriage actuated from the worm shaft by bevel gear, worm and worm wheel; and a plate edge or side planing machine, in which the principal novelty is that the girder ends are open, so that the machine will admit plates of any length.

An interesting paper on explosions in coal mines was read before the members of the Manchester Geological Society, at their meeting on Tuesday, by Mr. J. S. Burrows, of the Atherton Collieries. In the course of his paper, Mr. Burrows strongly condemned the continued use of the Davy lamp, of which thousands were still taken down into coal mines, notwithstanding the knowledge that they were absolutely unsafe in an explosive current of gas and air travelling at a speed of 8ft. per second. In spite, however, of the better lamps which were now obtainable, he was afraid we must expect explosions as serious as any in past years until the firing of any shot whatever, either in the coal, or for blowing roof or floor in the main roads, was totally prohibited unless all workmen were out of the mine, except the shot lighters and furnacemen, if any. The great points which must be looked to for the prevention of explosions in the future were:—Good management and discipline, ample ventilating power, large airways and judicious distribution of the air in the workings; the best possible lamps, which should be provided, cleaned and maintained by the mine-owners, and furnished with proper means of locking; as little powder as possible to be used, and no shots to be fired on any account when any workmen were down besides the shot lighters; and careful attention to first weights and dust. During the discussion which followed the reading of the paper, Mr. T. S. Martin, inspector of mines, expressed the opinion that too much importance had been attached to the publication in the newspapers of the warnings with reference to barometrical changes, and too little credit given to improved management and better appliances in the mines as the means which had contributed to the lessened number of explosions in late years. He did not himself attach very great importance to these "warnings" as a means of preventing explosions, and in his opinion the giving out of gas was much more affected by the "weighing" of the roof.

The coal trade remains in much the same depressed condition as reported last week. There has been no announced reduction in prices with the commencement of the month, but all classes of fuel are in very poor demand, and with stocks accumulating sales are pressed at under quoted rates to liberate wagons under load, and generally there is an easier tone in prices. At the pit mouth best coal does not average more than about 8s. 6d. to 9s. per ton; seconds, 7s. to 7s. 6d.; common round coal, 5s. 6d.; and burgy about 4s. 6d. to 5s. per ton. A good deal of slack is being thrown upon the market owing to the depression in the salt and chemical trades, and notwithstanding the lessened production of this class of fuel it is in some cases becoming rather a drug; for best sorts 3s. 9d. to 4s. is still being got, but common sorts are offered at 2s. 6d. to 3s. per ton at the pit.

The shipping trade has been extremely quiet, and steam coal delivered at the high-level, Liverpool, or the Garston Docks can be got at 6s. 9d. to 7s. per ton.

Barrow.—There is still a very quiet tone in the hematite pig iron trade, and business during the past few days has been very slow. The demand for pig iron of hematite quality is fairly maintained on home account, there being a large consumption by makers of steel; but the inquiry from the Continent, the Colonies, and from general foreign consumers remains inactive in reference to both Bessemer and forge qualities. There is not much prospect of improvement in the trade, and the only hope seems to be that spring orders will be booked to such an extent as will give a better tone to trade generally; but of this inquiries at present do not give much hope. There is no doubt that the present make of iron can be maintained even with the present demand, but stocks remain too large, and delivery orders are anything but pressing; and the work in the hands of makers, while such as to keep up the present state of semi-activity, is not such as will justify makers in increasing their output. Prices are easy at 44s. 6d., No. 1 Bessemer; 44s., No. 2; 43s. 6d., No. 3, net, at works, prompt delivery, with forward deliveries at 1s. per ton more money. Steel makers are not fully employed, and orders are coming in slowly alike from home and foreign consumers, but there is every week more and more prospect that the special steel trade, that represented in the production of mild and hard qualities of bars, suitable for almost every class of manufacture, is making progress. At present it represents about half the output of the works in this district, so that while the rail trade has to some extent fallen away, owing to scarcity of demand on the one hand, and the greatly increased facility of production on the other, another branch of industry has sprung up, and seems capable of more than maintaining the place occupied by a now inactive branch of the steel trade. Prices of iron and steel are unchanged. Iron ore is dull. Coal quiet. Shipping inactive.

A Derby contractor has commenced a difficult work in the strengthening of the Leven and Kent Viaducts on the Furness Railway.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

WHAT I anticipated last week has come to pass. The coal owners of South and West Yorkshire, meeting at Sheffield, have passed the following resolution:—"That this meeting is convinced that the present depression in the coal trade and the very low prices obtainable for coal, render in absolutely necessary that the 10 per cent. advance in wages given to the colliers in November, 1882, be taken off. It is therefore agreed that each colliery owner shall inform the colliers in his employ of this necessity, and endeavour to obtain such reduction, and, in the event of the colliers not acceding thereto, shall give notice to his men to terminate their engagements on the nearest pay day to March 31st next, and close his pits, if necessary, to enforce the same." On the following Monday the Council of the Yorkshire Miners' Association met at the miners' offices, Barnsley. There was a large attendance, over one hundred delegates being present. A resolution was unanimously passed to the effect that the Council was of opinion that the demand for a reduction of 10 per cent. "should be resisted by all and every legal means, and that each and every colliery of workmen are earnestly desired not to make any arrangements in the matter except by and with the full consent of the Yorkshire Miners' Association and the county generally." It was further agreed to hold a conference representing the whole Yorkshire coalfield on the 9th inst., at Rotherham, to discuss the wage question. Each colliery and pitstead is requested to appoint delegates to attend the conference. If the men, in general conference, maintain the position taken up by the Council at Barnsley, nothing can prevent a great strike at the end of March or beginning of April, as the coalowners, it is clear, will not recede from their position.

There is at last a prospect of a settlement at Denaby Main, where the prolonged dispute has caused serious suffering. The owners have offered to open the pit on Thursday for all who desire to resume work on the coaling prices offered to the men in the notices served upon them in December. Large coal, hand-filled, will be paid for at the rate of 1s. 6d. per ton, and for slack, shovel-filled, 8d. per ton to all-day wage men. Formerly, the men were paid a uniform price of 1s. 4½d. for coal and slack. The day men and others are offered work at the old rate of wages. All the men will be reinstated, but in the event of a 10 per cent. reduction being made in the district, a similar reduction will be made at Denaby. The company promises that ample police protection will be provided for those who return to work. The men say that if they return to work they do not expect that notices will be served upon them respecting the 10 per cent. reduction, as the Denaby Company are not members of the Coalowners' Insurance Society, and they believe full work will be carried on even if the men at the other collieries come out on strike.

There has been a good deal of work recently in the district collieries, and the output has gone to stock. This will be useful now in the event of prolonged idleness in the coalfield. The principal stocks of coal are in the wagons. Miles of coal-laden trucks may be seen in the sidings by the most careless observer. The first effect of a strike or lock-out would be to move these accumulated masses of fuel, turning dead weight into cash. I notice a local paper states that "whether the men come out or not trade will certainly be disturbed, and the fancy prices of two years ago are likely to be reached." I do not think there will be any great advance in value. Prices must go up somewhat, but supplies will be drawn very freely from Lancashire and Derbyshire when the accumulations are exhausted. Not a few competent judges incline to the opinion that neither the coalowners nor the general public will greatly benefit by the reduction of wages when it is obtained. Those who will gain most, it is urged, are those who need it least—the gas and railway companies and other large consumers. At present the gas and railway companies get "hards," the very finest of the coal, at 6s. per ton, which is surely low enough.

The Manchester, Sheffield, and Lincolnshire Railway Company has just built at its works at Gorton a saloon luncheon and dining car, which made its first journey to London on Monday. It is run jointly with the Great Northern Company who owns the line from Retford. The car is larger than any previously built by any other company. It is 60ft in length, is carried on two six-wheeled bogie trucks, and consists of dining room and smoking room, which are connected by a corridor; a retiring room for ladies and a lavatory for gentlemen; with kitchen, pantry, a space for refrigerator and general stores. These are made fire-proof by the use of asbestos in the lining of the walls, The car is built of teak, oak and Bessemer steel bars forming the frame; and the bogie trucks are of steel and iron. The internal arrangements are more than comfortable—they are simply luxurious. The seats and backs are upholstered in Utrecht velvet, the woodwork is of English and pollard oak, skilfully carved and "milled." Suspended from the roofs, which are prettily decorated, are several handsome lamps which afford abundant light; electric communication is provided from each table, the car is warmed throughout with hot air pipes, and ample arrangements are made for ventilation and dust prevention. The car is attached to the 11 a.m. express from Manchester, which leaves Sheffield at 12.5 p.m., and makes only one stoppage at Grantham in the run of 157 miles from Sheffield to King's Cross. I travelled in the car from Sheffield, and returned in it at 6.15 from King's Cross the same evening. Nothing could exceed the smoothness of the running and the comfort of the whole arrangements. The severe "S" curve at Retford was rounded at a good speed without any perceptible increase of oscillation. The dining arrangements, which are in the hands of Mr. Meyer, of King's Cros Hotel, are all that could be desired. The dining car will be a great boon for business. If the enterprise of the company is appreciated by the public, other cars will probably follow.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

AT the Cleveland iron market held at Middlesbrough on Tuesday last, a firmer tone was noticeable than for some time past. Consumers shewed a disposition to buy for forward delivery, but sellers were very wary, and sold only small lots for prompt delivery. No. 3 g.m.b. could not be had from merchants at less than 34s. 3d. per ton; that is 1½d. more than they were accepting at the close of last week. Makers quoted 34s. 6d. to 35s. per ton, and only two or three firms would accept the former figure. The demand for forge iron is somewhat quieter, the price being 33s. 3d. to 33s. 6d. per ton. The improved feeling in the trade is due in great measure to the increased shipments.

Some few sales of warrants have been effected at 34s. per ton.

The stock of Cleveland pig iron in Messrs. Connal and Co's Middlesbrough store was on Monday last 50,962 tons, being a reduction of 20 tons for the week. The decrease during the month just ended was 607 tons. At Glasgow their holding is 587,176 tons, or 7808 tons more than at the end of January.

Shipments of pig iron from the Tees improved considerably during the latter part of February. They reached a total of 63,456 tons for the month, or about 3000 tons in excess of what was shipped in January; Scotland took about the same as in January, viz., 30,130 tons; France took 7445 tons, Holland 5945 tons, Spain and Portugal 3505 tons, Germany 3160 tons, and Wales 2440 tons. Manufactured iron and steel shipments are also improved. The total for last month was 25,120 tons, as against 20,620 in January, There is no improvement in the finished iron trade, and prices remain the same as quoted last week. Steel manufacturers are now fully employed on orders for plates and rails.

Messrs. Armstrong, Mitchell, and Co. have just booked an order for two steel steamers, which will be built at their Low Walker yard. Messrs. Swan and Hunter, of Wallsend, have entered an order for two large steamers. Most of the shipbuilders on the Tyne, Tees, and Wear are now in full operation, and two or three launches have been made during the last few days. At Messrs. Raylton Dixon and Co.'s yard at Middlesbrough there are about 1300 men employed. This firm launched a steamer on Monday last, which was constructed entirely of Cleveland steel.

Messrs. Bolckow, Vaughan, and Co.'s directors recommend that the dividend for the year ending December 31st, 1884, shall be at the rate of 2½ per cent. per annum. They also propose to write off £40,000 from capital account to provide against depreciation.

Rapid progress is being made with the Scarborough and Whitby Railway. The rails are laid throughout the entire distance. The erection of stations, signals, and telegraphs is being pushed forward, and it is expected that the line will be opened for passenger traffic some time in May.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The iron market has shown much more than the usual activity this week, and a large speculative business is understood to have been done. Reports are in circulation with reference to an improvement in the steel trade and also as to some further orders for ships, including an Admiralty contract placed on the Clyde, and these have tended to give more life to the market. So far it does not appear that the inquiry for Scotch pigs has improved. There are ninety-three furnaces in blast as compared with ninety-seven at the same date last year. The shipments in the past week were 8575 tons against 6689 in the preceding week, and 7974 in the corresponding week of 1884. There is still a considerable increase in the stock of pig iron in Messrs. Connal and Co.'s stores, the addition for the week being upwards of 900 tons.

Business was done in the warrant market on Friday at 41s. 8d. cash. Monday's market was animated with transactions from 41s. 8½d. to 41s. 10½d. cash. On Tuesday forenoon the quotations advanced to 41s. 11d., but in the afternoon there were sellers at 41s. 10½d. cash. Business was done on Wednesday at 41s. 8d. to 41s. 6d. cash. To-day—Thursday—transactions occurred down to 41s. 4½d., but the market ultimately closed with sellers at 41s. 6d.

The current values of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 52s.; No. 3, 46s. 9d.; Coltness, 55s. and 50s. 6d.; Langloan, 54s. 6d. and 51s.; Summerlee, 51s. 6d. and 46s. 6d.; Calder, 52s. and 46s. 6d.; Carnbroe, 48s. 6d. and 46s.; Clyde, 47s. and 43s.; Monkland, 42s. 6d. and 40s. 6d.; Quarter, 42s. 3d. and 40s.; Govan, at Broomielaw, 42s. 6d. and 40s. 6d.; Shotts, at Leith, 51s. 6d. and 51s.; Carron, at Grangemouth (specially selected), 52s. 6d. and 47s.; Kinneil, at Bo'ness, 44s. 6d. and 43s. 6d.; Glengarnock, 48s. 6d. and 43s.; Eglinton, 43s. 3d. and 40s.; Dalmellington, 47s. and 43s. 6d.

The prospects of the Scotch steel trade have very much improved in the past week or two. It has been quite apparent for some time that the uniformly excellent quality and remarkable cheapness of mild steel was giving it a strong position in the market. A few days ago a meeting was held, at which most of the larger works were represented, when it was resolved to increase the price of steel angles and plates by 5s. a ton, bringing the quotation up to £7. The steel works in the neighbourhood of the Clyde are quite busy, the bulk of their orders at present being for shipbuilding materials. Although the shipbuilding trade is quiet, a growing proportion of the vessels under construction are of steel. The placing of six torpedo boats for the Admiralty with Messrs. J. and G. Thomson, of Clydebank, will still further improve the steel trade, as it is understood that the plates, &c., will be manufactured by a Lanarkshire firm having close relations with the builders.

Messrs. D. G. Stewart and Co., of Glasgow, have just received an order to supply 3000 tons of cast iron pipes for the Government of Sydney. It is understood that the contract was arranged through Messrs. Aitken, Lilburn, and Co., shipowners, Glasgow, by whom the pipes will be conveyed to the colony. The same pipemaking firm have also booked an order for 1700 tons of pipes for Kirkcaldy.

Messrs. Ker, Bolton, and Co., of Glasgow, are arranging contracts for the supply of malleable iron pillars, roofing materials, framing sheets &c. for workshops, and engine and car sheds required by the Singapore Tramways Company.

In the past week there was dispatched from Glasgow locomotives to the value of £18,150, two, worth £5950, going to Calcutta, and four, £12,200, to New South Wales; £5500 machinery, most of which went to India, £3200 sewing machines, £762 steel goods, and £24,680 iron manufactures of different kinds.

There has been a fairly satisfactory business in coals. The shipping trade at some of the ports is large, but at others somewhat backward at the moment. In the past week the coals despatched from Glasgow harbour aggregated fully 23,000 tons, while 7471 tons were cleared at Ayr, 3112 at Troon, 4500 at Grangemouth, 518 at Irvine, and 13 tons at Greenock. At Glasgow there has been a good demand for bunker coal for steam vessels. The coal shipping trade in Fifeshire is spoken of as in a very backward state, and the quantity despatched in the past month is fully 6000 tons less than in February, 1884. Stocks are accumulating at the depôts. At Bo'ness, on the south side of the Firth of Forth, the coal trade is likewise quieter than its wont, but a fair business is done at Grangemouth. The domestic inquiry is slackening in some directions, whilst in others there are better prospects for manufacturing purposes.

Messrs. William Baird and Co. have made a general reduction of wages at their Gartshore pits in the Kilsyth district.

During the past month 13,985 tons of new shipping were launched on the Clyde, against 28,730 tons in February, 1884. For the two months the output has been 24,745 tons, compared with 35,380 in the corresponding period of last year. Messrs. J. and G. Thomson, of Clydebank, have, as indicated above, received an order to build for the Admiralty six torpedo boats, of the same class as the Scout, which they have now under construction. No fewer than twenty-seven firms, ten of whom were on the Clyde, sent in offers for either one, three, or the whole of these vessels. These vessels will be entirely of steel, 225ft. in length, 36ft. in breadth, and 1600 tons displacement, and they will each carry fifteen guns—four 6in. guns on Vavasseur carriages, and eight Nordenfelt machine guns. Several orders for merchant vessels have also been placed within the last few days with Clyde builders.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

The coal trade is slack in all parts of the district. Cardiff sent away last week 123,723 tons of coal, and Newport 34,326 tons, with 17,000 tons coastwise. Swansea maintained its average, and there is a promise of a good week, having tonnage in for nearly 30,000 tons, as represented by forty steamers and forty-nine sailing vessels. House coal is dull everywhere, and great scarcity of orders is experienced in the Monmouthshire valleys. Even best samples are disregarded. Anthracite coal is also in little request, and the orders for best 4ft. are the only prominent ones. In the Neath district things are very quiet, and coalowners are actually getting supplies from the Swansea valley, finding it better at present to keep their own workings idle.

Notice is out at Garnant Colliery, Swansea district, which means either reduction or stoppage. Tyla Coch, in the Rhondda Valley, which was lately started by Mr. Evans, is "on stop," but I suppose only temporarily. It was understood that a capital of £10,000 would be required to float it successfully, and the delay in completing this has led to the stoppage. Eventually this place should pay. The Ocean seam has been struck there, and the Aberghorki is well pronounced. A competent engineer declares the 6ft. seam to be of splendid quality in this colliery.

I am glad to hear that the Hafod and Coedcae litigation is about ending.

A meeting of the Rhondda colliers has been held this week, principally to formulate a scheme for support at the miners' meeting, Birmingham. A chief feature is to get the collier properly represented in Parliament. When the coal trade is quiet, as it is at present, colliers are active in discussing social movements, and hence we have had no end of agitation here and there about "running in" Members of Parliament, "getting laws for employers and employed alike," as well as altering arrangements with their work doctors. At Plymouth Colliery and works new arrangements were made this week with the doctor by which the colliers were considerably benefitted.

It is a pity that no one starts a good building society in these quiet times, by which each collier would have his own house and garden. A complaint having been made with regard to timber at Nixon's collieries, it has been satisfactorily shown to have no groundwork of fact. I can affirm personally that at Merthyr Vale there is always an enormous stock, and the company generally holds 500 tons there and in the Aberdare Valley. A meeting of the Sliding Scale Committee has been held, and the result is that the colliers will have to submit to a reduction of 2½ per cent. from March 1st, as justified by the sales of the last four months, which show a considerable falling off in price.

There has been a good deal of feeling introduced into the Cardiff pilotage board lately; the majority have opposed an application of the Barry Dock pilots to have two representatives on the board, and now it is believed that the Barry men will have an independent board.

There is very little doing in steel rails at present. Most of the works are goirg on very slowly, the most conspicuous features in several of them being stocking and carrying out improvements. We are to have a share, it seems, in the Soudan Railway, and some consignments of rails will leave shortly *viâ* Newport. The steamer Topaz, I hear, has just arrived at the Alexandra Dock to load 200 tons of rails, the first instalment for Suakim. Independent of this, the exports of manufactured iron and steel have been few, the principal being a few hundred tons to Stockholm and Rotterdam.

The tin-plate trade continues in a very gratifying state. 1700 tons have just been shipped at Swansea for Baltimore and Philadelphia, and I note that large stocks are accumulating for further shipment in the course of a few days. Buyers in some cases are trying to force down prices, and are holding orders back in consequence of the makers' refusal, but there is plenty of legitimate business being done, and in some noticeable cases more is wanted than can be accomplished. In addition to ordinary coke and charcoal plates there is inquiry for special plates, roofing, &c. Prices are stiff, and there is a confident opinion that an advance is certain in the course of the next few weeks. April prices will, it is most likely, be "raised."

Iron ore is dull. Patent fuel is in good demand, and prices are firm. Arrivals of pitwood continue in excess of requirement, and prices in consequence are low again.

I see by the Forest of Dean's returns that the coal trade is well maintained. Last year nearly 800,000 tons were worked as compared with 713,443 tons. In iron ore there is, as may be expected, a great decline. In 1881 88,547 tons were worked, in 1882 78,494 tons, in 1883 63,270 tons, and last year only 55,677. This is a great decline since the palmy days of the Crawshays, say 1856, when the get was 109,263 tons.

Mr. Harpur, the surveyor and engineer at Merthyr, is retiring. A good deal of local feeling has been aroused as to the safety of the Torpantau Reservoir, to which I called attention, and a full discussion has taken place.

Naval Engineer Appointment.—Thomas A. Morris, engineer, to the Asia, for service in the Volage.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

24th February, 1885.

2463. Secondary Batteries, C. S. Bradley, London.
2464. Appliance for Violins, &c., S. Williams, Birmingham.
2465. Remedy for Asthma, &c., J. Girdwood, Belfast.
2466. Burnishing, &c., Photographs, A. Philburn, Ashton-under-Lyne.
2467. Warp Lace Curtain Machines, E. V. Smith, London.
2468. Hose Pipe Couplings, J. Gresham, Manchester.
2469. Folding Seats and Tables, J. M. Calton and W. Eglin, Glasgow.
2470. Sealed Pan capable of Removing Night Soil without Emitting any Smell, H. Abbot, Wolverhampton.
2471. Duplex Locking, &c., Apparatus, S. Hall, Derby.
2472. Vertical Boilers, T. T. Crook, London.
2473. Manufacture of Sulphur from Sulphuretted Hydrogen, J. W. Kynaston, Liverpool.
2474. Washing, &c., Skins from Potatoes, J. Nuttall, Rochdale.
2475. Drawing and Etching with a Pointed Instrument through Carbon, &c., A. C. Gray, Upper Norwood.
2476. Construction of Chaff-cutters, &c., J. W. Heaps, Halifax.
2477. Repeaters for Submarine Cables, M. G. Farmer, London.
2478. Obtaining Solid Caustic Soda from Fused Caustic Soda, W. Weldon.—(*Messieurs A. R. Pechiney et Compagnie, France.*)
2479. Reversing Gear for Steam, &c., Engines, J. H. Northcott, London.
2480. Cutting or Shearing Closed Envelopes, J. H. Northcott, London.
2481. Planing the Edges of Metallic Plates, R. H. N. Alleyne and C. Scriven, London.
2482. Lifts, &c., J. S. Stevens and C. Major, London.
2483. Motive Power Engines, G. T. Beilby, Glasgow.
2484. Ships' Riding Lights, W. Harvie, Glasgow.
2485. Internal Stoppers for Bottles, R. Taylor and J. Scott, Liverpool.
2486. Pistons for Steam Engines, A. H. Reed.—(*T. Barber, United States.*)
2487. Balanced Slide Valve, A. H. Reed.—(*A. Jackson, United States.*)
2488. Alarum Suitable for Street Doors, G. F. Andrews, London.
2489. Condensing Apparatus, G. Love, jun., London.
2490. Distributing Currents of Electricity, R. E. B. Crompton, London.
2491. Automatic Stop and Lock for Pawl Mechanism, J. E. Williams, Glasgow.
2492. Waste Water Preventer, F. Humpherson, London.
2493. Cartridges, H. J. Haddan.—(*L. Mandl and Company, Austria.*)
2494. Crabs for Raising and Lowering Heavy Bodies, G. C. Marks, London.
2495. Metallic Bedsteads, W. H. Davis, London.
2496. Long and Short Focus Cameras, J. E. Brown, London.
2497. Rails of Pianoforte Actions, J. Herrburger, London.
2498. Finishing Plush, Velvet, &c., C. Coget, London.
2499. Administering Injections, J. C. Mewburn.—(*M. Lowys, France.*)
2500. Use of Artificial Fuel, J. Barnett, London.
2501. India-rubber Pads for Horseshoes, T. S. Price, London.
2502. Tricycle, F. W. Jones, London.
2503. Coal-scuttle, W. L. Byers, London.
2504. Draw-off Valve, S. Wilkerson, London.
2505. Ball Castors, H. Jeynes, London.
2506. Attaching Buttons to Boots, &c., C. A. Day.—(*E. O. Ely, United States.*)
2507. Sealing Doors, &c., against Escape of Air and Gas, A. A. Common, London.
2508. Water-closet Apparatus or Fittings, A. A. Common, London.
2509. Electric Clocks, H. Aron, London.
2510. Preventing Explosions, &c., in Steam Boilers, J. C. Hargreaves, London.
2511. Printing and Delivering Tickets, &c., W. R. Lake.—(*W. R. Bacon, France.*)
2512. Time-pieces, W. R. Lake.—(*H. W. Hayden, U.S.*)
2513. Gloves, J. F. O. Weston, London.
5514. Steam Engines, H. Cutting, London.
2515. Hook Fastening for Boat's Davits, &c., P. Bath, London.
2516. Grinding Mills, W. R. Lake.—(*A. Zipser, Austria.*)
2517. Carriage for a Machine Gun, J. G. Accles, London.
2518. Beverages and Medicinal Preparations, P. Joske, London.
2519. Combined Bedstead and Bath, M. Brown, London.

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2520. Wicks for Lamps, &c., W. E. Hays.—(*F. Steffens, Germany.*)
2521. Punching Machines, J. Ford, Manchester.
2522. Harvesting and Straw-trussing Machines, J. Hornsby, R. Edwards, J. Innocent, and C. James, Grantham.
2523. Solitaires and Studs, A. J. Smith, London.
2524. Silos for Preserving Fodder, T. R. Carskadon, West Virginia, U.S.
2525. Intermediate Driving Gear for Paddle Wheels, J. Dean, Liverpool.
2526. Sewing the Linings in Hats, &c., J. H. Neave, Liverpool.
2527. Gas Lamps, S. Brown, Rotherham.
2528. Spring Lock, A. D. Melson, Birmingham.
2529. Cooking and Heating by Gas, &c., T. Fletcher, Manchester.
2530. Regulating Supply of Steam to Engines, A. Budenberg.—(*Schäffer and Budenberg, Germany.*)
2531. Valve Gear for Steam Engines, G. Cawley, Manchester.—11*th December*, 1884.
2532. Velocipedes, J. Hopwood, Manchester.
2533. Coke, J. A. Yeadon, Leeds.
2534. Making Fabrics, &c., Waterproof, S. H. Sharp, Halifax.
2535. Bedsteads, &c., W. H. McNeight, Dublin.
2536. Carriage Door Hinges, C. Bevan, H. Hallam, and C. Lowe Birmingham.
2537. Removing Incrustation from Pipes, &c., C. J. Flather, Southport.
2538. Holder for Sheet Music, &c., R. Wheatley, Birmingham.
2539. Trouser Grip, W. H. Williams, Birmingham.
2540. Securing the Fittings upon Stay Busks, R., H., and B. G. Simpson, London.
2541. Forks, S. Williamson, London.
2542. Hoists, J. Sunderland, London.
2543. Taps or Valves, J. Shanks, Glasgow.
2544. Churn or Washing Machine, J. Paton and W. Wallace, Glasgow.
2545. Embossed Ornamental Fabrics, J. and J. Robertson, Glasgow.
2546. Candlestick and Match Container, H. King, London.
2547. Easy Chair, J. A. Matthews, Gloucester.
2548. Square Polymeshed Rotary Screen, &c., J. Gregory, Lincoln.
2549. Patterns for Castings for Machinery, F. T. Willdey, Hammersmith.
2550. Hygienic Dust, Ash, and Cinder Box, &c., B. D. Dove, London.
2551. Connecting Hames, H. C. Lory, London.
2552. Sheep-shears, C. Burgon and C. G. Hallas, London.
2553. Treating Sugar-cane, H. J. Chapin, London.
2554. Organs, M. L. Lodge, London.
2555. Transmitting, &c., Electrical Signals, J. C. Mewburn.—(*M. Deprez and B. Abdank-Abakanowicz, France.*)
2556. Drying Textile Fabrics, &c., J. C. Mewburn.—(*Pieron and F. Dehaître, France.*)
2557. Clocks or Timekeepers, V. L. A. and C. N. Blumberg.—(*M. Redier, France.*)
2558. Trousers, M. King, London.
2559. Tobacco-pipes, A. F. Link.—(*E. and A. Haberer, Germany.*)
2560. Joints of Landing Nets, A. T. Allcock, London.
2561. Dumping Wagons, H. J. Haddan.—(*W. J. March, United States.*)
2562. Treating Tea, J. Sala, London.
2563. Tricycle, J. White and J. Asbury, London.
2564. Electric Batteries, D. T. Piot, London.
2565. Aerated Liquids, A. W. L. Reddie.—(*H. Robertson, United States.*)
2566. Ventilating Cowls, J. White, London.
2567. Weaving Wire Gauze or Cloth, W. Begg, London.
2568. Pyrometer, J. Frew, London.
2569. Ventilating Cowls for Ships, &c., J. Campbell, London.
2570. Actuating the Dampers of Steam Boiler Furnaces, J. Auld, Glasgow.
2571. Combined Composing, Distributing, and Justifying Machines, P. Jensen.—(*A. Lagerman, Sweden.*)
2572. Electric Meters, J. E. H. Gordon, London.
2573. Locks and Keys, R. Newell, London.
2574. Military Engine for a Shield and Fort, &c., J. Standfield, London.
2575. Electric Mains employed in District Lighting, J. E. H. Gordon, London.
2576. Lamps for Lighting and Heating, J. Simmonds, London.
2577. Barbed Fence Wire, O. W. Malet.—(*F. B. W. Malet, New Zealand.*)
2578. Distilling Ammonia from Liquids, H. Simon.—(*The Anhaltische Maschinenbau-Actien Gesellschaft, Germany.*)
2579. Conveyors for Flour Mills, M. W. Clark, London.
2580. Producing Azo Colours on Fibre, T. Holliday, London.
2581. Children's Chairs, J. Crook and C. W. Raffety, London.
2582. Tape for Covering Conductors, G. F. Rogers, London.
2583. Lubricating Commutators, &c., D. L. Salomons, London.
2584. Desiccating, &c., Leaves of Plants, J. Brown, London.
2585. Ticket Feed and Indicator, F. Mackinlay, London.
2586. Automatic Electric Switch and Cut-out, H. H. S. Cunynghame, O. E. Woodhouse, and F. L. Rawson, London.
2587. Electric Mains, J. E. H. Gordon, London.
2588. Removing Incrustation from Boilers, W. A. Barlow.—(*J. S. Meyer, Germany.*)
2589. Sewing Machines, G. F. Redfern, London.—(*C. F. Perenot and L. Schor, France.*)
2590. Pill-boxes, A. W. Watson, London.
2591. Nailing Machines, C. F. Gardner.—(*J. W. Brooks, trustee of the McKay Metallic Fastening Association, United States.*)
2592. Looms, W. R. Lake.—(*C. Coupland, United States.*)
2593. Electric Battery, W. A. Barlow.—(*Messrs. L. Encausse et Canésie, France.*)
2594. Preventing the Overturning of Liquids, A. M. Clark.—(*G. Trouvé, France.*)—8*th May*, 1884.
2595. Hydraulic Valves, C. Davy, London.
2596. Distributing Electricity, J. E. H. Gordon, London.
2597. Musical Instrument, W. Marshall, London.

26th February, 1885.

2598. Shearing, &c., Fabrics, E. Martin, J. W. Johnson, and E. Bamford, Halifax.
2599. Securing Spools in Shuttles, J. W. Gledhill and C. Roberts, Halifax.
2600. Combined Arithmetical Frame and Blackboard, T. Rushworth, Lewisham.
2601. Valves and Cocks, R. F. C. Tonge. Manchester.
2602. Taking-up Motions, R. Ingham and H. Livesey, Halifax.
2603. Shearing, &c., Woven Fabrics, W. P. Thompson.—(*F. Colbrant, France.*)
2604. Moulding Sand, G. Oulton, Liverpool.
2605. Velocipede Bearings, T. Hill and the Howe Machine Company, Glasgow.
2606. Sewing Machine Needle Bars, R. Lockhart and the Howe Machine Company, Glasgow.
2607. Cycles, T. Hill and the Howe Machine Company, Glasgow.
2608. Belt Stretcher, A. Hill, Manchester.
2609. Mathematical Compass or Callipers, G. Evans, Worcester.
2610. Gland or Stuffing-box, T. R. Summerson, Haughton-le-Skerne.
2611. Bearing for Shafting, Axles, &c., G. Weston, Sheffield.
2612. Loose Studs for Fixing the Laths of Bedsteads, J. W. Tiptaft, Birmingham.
2613. Bandage Winder for Surgical, &c., Purposes, T. Groves, Birmingham.
2614. Ornamenting or Illuminating Mirrors, E. Sarjeant, Birmingham.
2615. Liquid Transparent Enamel, W. E. Hart, jun., Wolverhampton.
2616. Presses, &c., J. T. Moore, Crewe.
2617. Seats, W. Eglin, Glasgow.
2618. Combination Stair Rod, F. W. Webb, Birmingham.
2619. Woven Wire Mattress Frame, W. H. McNeight, Dublin.
2620. Compound Furnace, C. P. Skrimshire, Blaenavon.
2621. Chucks for Lathes, O. Owen, London.
2622. Miners' Safety Lamps, J. C. Jefferson, London.
2623. Carriage Windows, G. Galloway and J. L. Kitson, Leeds.
2624. Applying Pedals to Pianofortes, H. T. Wedlake, London.
2625. Pneumatic Levers for Organs, &c., H. T. Wedlake, London.
2626. Spring Hinges for Doors, J. S. Stevens and C. G. Major, London.
2627. Cocks or Valves, A. Eiloart, London.
2628. Tobacco Pipes, D. Schwab, London.
2629. Cutting Frames for Boxes, &c., F. Myers, London.
2630. Locking Apparatus for Railways, &c., J. Steven, Glasgow.
2631. Cricketers' Wicket-keeping Gloves, R. G. Barlow and R. Pilling, London.
2632. Coffee-pots, T. Butler, Birmingham.
2633. Steel, &c., Castings, A. W. L. Reddie.—(*G. L. Roberts, France.*)
2634. Verifying the Weight of Goods on Delivery, W. B. Avery, London.
2635. Filter, A. M. Clark.—(*J. Mallié, France.*)
2636. Horseshoe Nails, J. H. Ehlers, Prussia.
2637. Cattle Food, C. P. M. Legg, London.
2638. Edificial Application of Cast Iron, W. Tomlinson-Walker, London.

2639. Spring Terminal for Electric Wires, B. Pell, London.
2640. Hydrocarbon Lamps, E. H. Oswald, London.
2641. Extinguishing Fire, J. Sinclair and J. Cottrell, London.
2642. Filter Presses, J. H. Johnson.—(*F. and R. Quarez, France.*)
2643. Furnaces for Burning Straw, A. J. Boult.—(*J. Abell, Canada.*)
2644. Water Filter, C. Price and H. Cleave, London.
2645. Extinguishing Fire, J. O. Spong, London.
2646. Rotary Apparatus, J. F. Phillips, London.
2647. Cleaning and Decorticating Seeds or Berries, R. C. Thompson, London.

27th February, 1885.

2648. Cramps, W. Hayhurst, Burnley.
2649. Metallic Ballot, Travelling, and other Boxes, F. James, Dresden.
2650. Tricycle which is Convertible into a Bicycle, W. C. Burton, Rawtenstall, and T. Dineen, Leeds.
2651. Liquid Electric Switch, A. L. Lineff and W. Jones, London.
2652. Miners' Safety Lamps, J. McKinless, Manchester.
2653. Draw Plate for Domestic Fire Ranges, &c., J. Bogg, Halifax.
2654. Apparatus for Stretching Woven Fabrics, J., E., and T. O. Arnfield, Manchester.
2655. Preparing Screw-propeller Blades to Resist Corrosion, W. Telfer and R. King, Glasgow.
2656. Casting Steel, T. Gilmour, Glasgow.
2657. Arc Electric Lamps, T. Stanley and A. H. Davies, Hyde, and C. Richardson, Walthamstow.
2658. Cricket Bats, W. H. Cleave, Birmingham.
2659. Construction of Box or Case, G. Blackman and J. Goss, London.
2660. Fire Lighters, P. and F. McNamee, Dublin.
2661. Apparatus for Coupling or Uncoupling Railway Vehicles, J. Cowan, Liverpool.
2662. Preventing the Formation of Scale in Boilers, &c., H. Aitken, London.
2663. Valvular Arrangement for Preventing the Passage of Steam, &c., H. Aitken, Glasgow.
2664. Parcel Handle or Holder, C. W. Benedict, London.
2665. Diminishing the Slipperiness Produced by Frost of Streets, &c., E. Young, London.
2666. Compensating Valve for Governing the Passage of Air, H. T. Wedlake, London.
2667. Pianofortes, W. H. Bliss, Anerley.
2668. Apparatus for Obtaining Motive-power, J. Gamgee, London.
2669. Heating Stoves, and in the Oil Burners thereto, E. Kauffman, London.
2670. Vessels for Galvanic Batteries, &c., W. Defries, London.
2671. Dynamo-Machines, A. F. Link.—(*A. G. Helios, Germany*)
2672. Metal Fencing, W. J. Smith, London.
2673. Machines for Opening and Bossing the Bobbins used in Lace Machinery, E. Whitehall, London.
2674. Ornamentation of Boots and Shoes, C. Chambers, London.
2675. Speed Indicators for Marine Engines, L. A. Groth.—(*F. F. Almquist, Sweden.*)
2676. Breech-loading Fire-arms, L. A. Groth.—(*J. Duval, Canada.*)
2677. Hydraulic Engines for Organ Blowing, H. Bamford, London.
2678. Covers for Cooking Utensils, A. M. Clark.—(*L. M. Goodale, United States.*)
2679. Burning Materials to Obtain Light and Heat, W. Boggett, London.
2680. Ladies' Tricycling Costume, J. T. W. Goodman, London.
2681. Detecting the Presence of Gas in Atmospheric Air, D. J. Blaikley, London.
2682. Joints Used for Connecting the Ends of Insulated Electric Conductors, F. R. Lucas, London.
2683. Tubes or Flues for Steam Boilers, J. A. Hopkinson and J. Hopkinson, London.
2684. Cooking Range, P. D. Hedderwick, London.
2685. Self-locking Electrical Testing Key, B. Pell, London.
2686. Trip Valve Gear for Steam Engines, R. Matthews, London.
2687. Hot Water Apparatus, J. A. Hopkinson and J. Hopkinson, London.
2688. Type Writer, E. W. Brackelsberg, London.

28th February, 1885.

2689. Stirrup Bars for Ladies' Saddles, F. V. Nicholls, London.
2690. Improving Decayed Vision, S. Mason and C. R. Huxley, London.
2691. Fastening Knob to Spindle, C. Billington and J. Newton, Longport.
2692. Breech-loading and other Small-arms, J. Gemmell, Glasgow.
2693. Obtaining Products from Coal, &c., F. J. Rowan, Glasgow.
2694. Regulating the Supply of Steam, C. T. Bullough, London.
2695. Dynamic-magnetic and Magnetic-dynamic Machines, A. Clark, H. Penman, and C. S. Kirkwood, Glasgow.
2696. Voltaic Batteries, A. Clark, H. Penman, and C. S. Kirkwood, Glasgow.
2697. Waterproof Material, T. W. Mountain, Manchester.
2698. Checking, &c., the Receipts of Money on Tramcars, &c., G. J. Thorpe and J. H. Richardson, Manchester.
2699. Preparing Sensitive Paper, &c., L. Warnerke, London.
2700. Carding Engines, G. Riedel, Germany.
2701. Assistant Bearing Springs for Vehicles, L. Sterne, London.
2702. Railway Keys, J. Elliott, Leeds.
2703. Bicycles, F. W. Jones, London.
2704. Artificial Lighting Apparatus, F. W. Gould, London.
2705. Milking Cows, &c., G. S. Frazey, London.
2706. Medicinal Compounds, C. Werner, London.
2707. Steering Vessels, E. C. H. Samsche, London.
2708. Lamps or Lanterns, E. Sommerfeld, London.
2709. Stoves, J. J. Royle, London.
2710. Gas Burners, J. J. Royle, London.
2711. Diminishing, &c., the Volume of Sound Produced by Wind Instruments, E. J. Day, London.
2712. Gas Engines, J. Atkinson, London.
2713. Purifying the Water of Steam Boilers, F. B. Dœring, London.
2714. Road Surface Boxes, O. Brown, London.
2715. Grate with a Removable Grating, J. G. Oliver, London.
2716. Book and Paper Cutting Machine, F. Didden.—(*T. Wildenberg, Germany.*)
2716. Filling Casks, &c., with Liquids, H. Woodward.—(*C. Ward, Canada.*)
2718. Self-closing Appliances, &c., for Doors, R. Adams, London.
2719. Railway Signalling Apparatus, H. J. Conolly and J. Aldridge, London.
2720. Gas, W. S. Oliver, London.
2721. Rackets or Bats for Playing Lawn Tennis, &c., F. H. Ayres, London.
2722. Safety Paper for Cheques, &c., C. D. Abel.—(*The Patent Papier Fabrik Zu Penig, Germany.*)
2723. Safety Paper for Cheques, &c., C. D. Abel.—(*The Patent Papier Fabrik Zu Penig, Germany.*)
2724. Purifying, &c., Saccharine Liquors, C. D. Abel.—(*La Société Nouvelle de Raffineries de Sucre de St. Louis, France.*)
2725. Billiard Tables, T. Pitts, London.
2726. Pocket Teeth Cleanser, J. H. Martin, London.
2727. Watches, &c., L. Weill and H. Harburg.—(*H. G. Borel, Switzerland.*)
2728. Filtration of Sewage, C. Price and H. Cleave, London.
2729. Stereo Matrices, E. Wright, London.
2730. Sewing Apparatus, C. F. Gardner.—(*E. Pocock, France.*)
2731. Locks for Doors, &c., E. E. Deacon, London.
2732. Shipping Coal, G. Taylor, London.
2733. Wire Cloth, B. Scarles, Clinton, U.S.
2734. Sewing Machines, W. David and J. Woodley, Cardiff.
2735. Waterproofing Artificial Leather, R. R. Gubbins and C. K. Farquharson, London.
2736. Discharging, &c., Fluid, &c., W. A. Barlow.—(*E. Grube and T. Lehmkuhl, Germany.*)
2737. Lubricators, W. A. Barlow.—(*E. Grube and T. Lehmkuhl, Germany.*)
2738. Treating Sugar-cane, G. Buchanan, London.
2739. Disinfectants, J. C. Stevenson, London.
2740. Drawers, E. C. Bourne, London.
2741. Galvanic Gas Batteries, G. F. Redfern.—(*Messieurs Wirth and Co., Agents for A. Bernstein, Germany.*)
2742. Plastic Compounds, R. E. Goolden, London.

2nd March, 1885.

2743. Field Cooking Apparatus, A. L. Lineff and W. Jones, London.
2744. Compressing Ensilage, T. Pearson, Glasgow.
2745. Metal Bobbins, J. C. Rouse, Halifax.
2746. Filtering Water, &c., A. J. Bell, Manchester.
2747. Secondary Batteries, W. Symons, Barnstaple.
2748. Drying Grain, J. Death, jun., Cheshunt.
2749. Ventilating Apparatus, E. H. Taylor, Dublin.
2750. Thread Winding Machines, J. Booth and J. T. Wibberley, London.
2751. Sash Fasteners, S. Hurst, Southport.
2752. Musical Tops, J. Whiteley, Rochdale.
2753. Self-adjusting Metallic Packing, E. E. Gabriel, Birmingham.
2754. Carbon Black, J. W. Davies, London.
2755. Automatic Match-box and Cigar-cutter, G. A. Hasler, London.
2756. Stiffening Cloth, A. Whowell, London.
2757. Beaming Frames, J. Lord, J. Whitaker, and H. Haworth, London.
2758. Securing Handles to Brushes and Brooms, R. Simpson, London.
2759. Regulating the Manner of Exposure in Photographic Apparatus, C. J. Wollaston, London.
2760. Boxes used in Annealing Metal Sheets, J. Tinn, London.
2761. Caustic Strontia, W. Weldon, Burstow.
2762. Utilisation of Phosphoric Acid, W. Weldon.—(*E. Lombard, France.*)
2763. Cloth-cutting Machines, W. Beecroft, London.
2764. Weighing Grain, &c., J. G. Bundy, London.
2765. Electrical Accumulators, W. R. Lake.—(*A. Marchenay, France.*)
2766. Fabrics W. E. Gedge.—(*C. Guy, France.*)
2767. Siphon Water Waste Preventer Cistern, E. A. Reynolds, London.
2768. Stoppers for Bottles, F. Walton, London.
2769. Utilising the Power of Waves, A. J. Boult.—(*J. Barrufel, Spain.*)
2770. Mixing Ingredients for Colours, G. Lösekann, London.
2771. Setting the Teeth of Saws, J. R. Cast, London.
2772. Refrigerating, O. Imray.—(*La Compagnie Industrielle des Procédés Raoul Pictet, France.*)
2773. Screwed Bolts and Nuts, J. Imray.
2774. Fixing Curtain Rods, &c., J. H. Sams, London.
2775. Refractory Materials, &c., W. J. A. Donald, London.
2776. Dynamo-electric Machines, W. H. Allen, R. Wright, and G. Kapp, London.

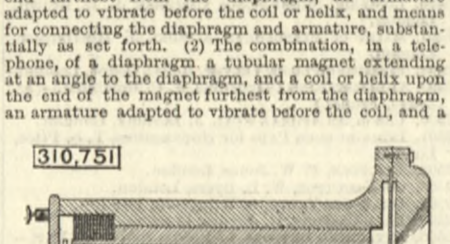
SELECTED AMERICAN PATENTS.

(From the United States' Patent Office Official Gazette.)

310,751. Telephone, *Henry E. Waite, New York, N.Y.—Filed April 25th*, 1884.

Claim.—(1) The combination, in a telephone, of a diaphragm, a magnet having a coil or helix upon the end farthest from the diaphragm, an armature adapted to vibrate before the coil or helix, and means for connecting the diaphragm and armature, substantially as set forth. (2) The combination, in a telephone, of a diaphragm a tubular magnet extending at an angle to the diaphragm, and a coil or helix upon the end of the magnet furthest from the diaphragm, an armature adapted to vibrate before the coil, and a

310,751

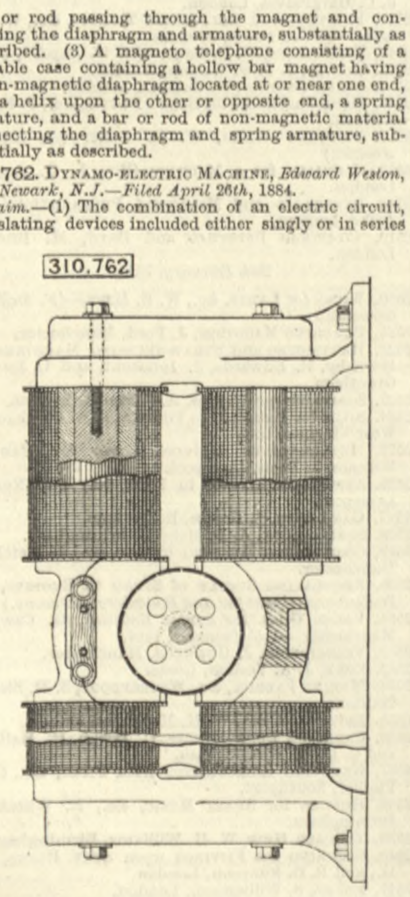


bar or rod passing through the magnet and connecting the diaphragm and armature, substantially as described. (3) A magneto telephone consisting of a suitable case containing a hollow bar magnet having a non-magnetic diaphragm located at or near one end, and a helix upon the other or opposite end, a spring armature, and a bar or rod of non-magnetic material connecting the diaphragm and spring armature, substantially as described.

310,762. Dynamo-electric Machine, *Edward Weston, Newark, N.J.—Filed April 26th*, 1884.

Claim.—(1) The combination of an electric circuit, translating devices included either singly or in series

310,762

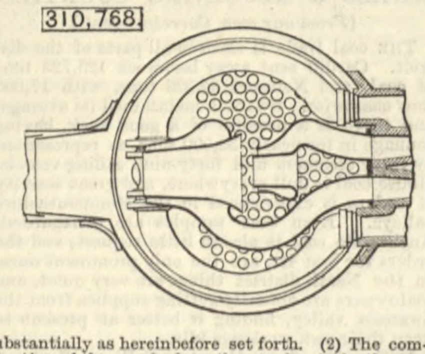


therein, and a derived field circuit dynamo machine having field magnets of such degree of sluggishness relatively to the number and character of the translating devices that injurious reaction upon its magnetic intensity by momentary or temporary variations of the translating devices is prevented, as and for the purposes specified. (2) The combination of an electric circuit, electric arc lamps or similar translating devices included singly or in series therein, and a derived field circuit dynamo machine having field magnets of such degree of sluggishness relatively to the number and character of the lamps or other devices that variations in the action of such devices have time to subside before any reaction upon the magnetic intensity of the field takes place, such as would increase such variation, substantially as described.

310,768. Exhaust Nozzle for Locomotives, *Bertha Wotapek, New York, N.Y.—Filed November 20th*, 1884.

Claim.—(1) The combination, with the smoke-box and the smoke stack, of the two exhaust nozzles placed concentrically one above the other and centrally below the smoke stack, and a receiving cone surrounded by the upper nozzle, through which cone passes the steam discharged from the lower exhaust nozzle, together with the gases drawn along by and with that steam,

310,768

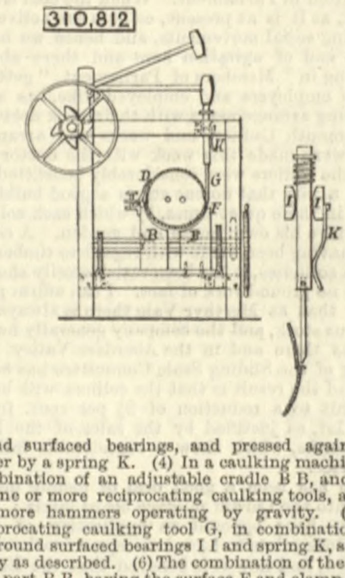


substantially as hereinbefore set forth. (2) The combination of the smoke-box, the smoke stack, the two annular exhaust nozzles placed concentrically one above the other and centrally below the smoke stack, and two receiving cones communicating with the interior of the smoke-box and surrounded, the one by the upper and the other by the lower exhaust nozzle, substantially as and for the purpose hereinbefore set forth.

310,812. Machine for Caulking Boilers, *Henry P. Folsom, Brooklyn, N.Y.—Filed June 3rd*, 1884.

Claim.—(1) The combination, with a supporting frame, of a movable boiler support or cradle and one or more automatically reciprocating caulking tools, substantially as described. (2) A caulking machine consisting of the following elements in combination, a movable and adjustable cradle B B, provided with clamp D or its equivalent and one or more reciprocating caulking tools, substantially as described. (3) The combination of a movable support for a boiler and one or more reciprocating caulking tools moving through

310,812

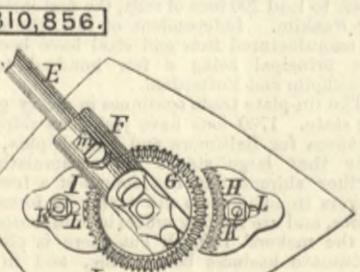


round surfaced bearings, and pressed against the boiler by a spring K. (4) In a caulking machine, the combination of an adjustable cradle B B, and clamp D, one or more reciprocating caulking tools, and one or more hammers operating by gravity. (5) The reciprocating caulking tool G, in combination with the round surfaced bearings I I and spring K, substantially as described. (6) The combination of the adjustable part B B, having the surface F and clamp D, substantially as and for the purpose described.

310,856. Adjustable Cultivator Shovel, *M. A. Twitchell, Kingsley, Iowa.—Filed April 5th*, 1884.

Claim.—(1) The combination, with a trapesium shaped plough blade sharpened at its four edges, concave, and centrally perforated, of a cylindrical standard E, a shank F, having a socket therefor, and a set screw *m*, and a bolt securing the shank reversibly to the centre of the said blade, substantially as described,

310,856.

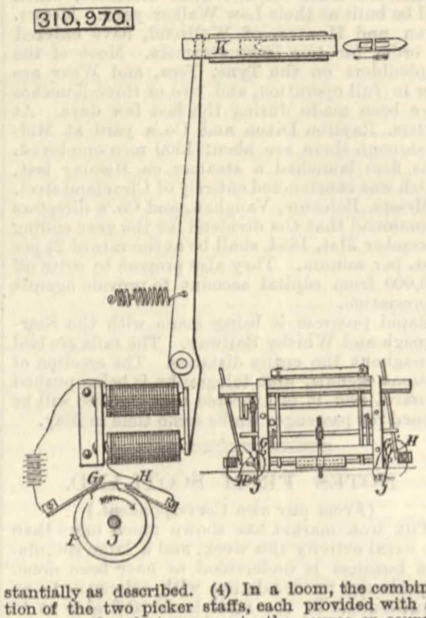


whereby a plough blade hung to present any side or corner forward may be turned around the standard to any angle with the line of travel, for the purpose set forth. (2) The combination, with the many edged blade J, of the bevelled serrated wheel G, pivotted thereon, the shank F, secured to the wheel G, and provided with a standard socket, and the buttons H and I, having serrated edges and slots L, and the bolts K, substantially as shown and described.

310,970. Shuttle Operating Mechanism for Looms, *Edward S. Winchester, Boston, Mass.—Filed September 10th*, 1883.

Claim.—(1) The combination of the picker staff pivotted near its lower end and provided with an armature, the electro-magnet to attract said armature, the source of electric supply connected with the magnet, the circuit opening and closing devices, and driving mechanism therefor, said members being constructed and organised for joint operation substantially as described and shown. (2) In a loom, the combination of the two picker staffs located at opposite sides thereof, the electro-magnets, the source of electric supply connected with said magnets, the circuit controlling devices, and operating mechanism for said devices, substantially such as described and shown. (3) In a loom, the combination of the two picker staffs located at opposite sides, electro-magnets acting to drive the two pickers forward, devices, substantially such as described and shown, to effect the excitation of the two magnets alternately, and the two pickers K, each having the cavity or recess to receive the shuttle, whereby the pickers are caused to drive the shuttle to and fro and the impact of the shuttle applied to return the pickers to their outer position, substan-

310,970.

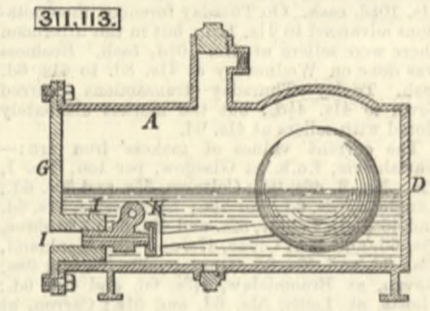


stantially as described. (4) In a loom, the combination of the two picker staffs, each provided with an armature, the electro-magnets, the source or sources of electric supply connected with said magnets, the electrodes G and H, the circuit controlling wheels I and J, and the shaft upon which said wheels are mounted, said parts being constructed and arranged for joint operation substantially as described.

311,113. Steam Trap, *William A. Foskett, New Haven, Conn.—Filed December 19th*, 1882.

Claim.—(1) In a steam trap, the case A, having closed end D and removable head G, said removable head having an inwardly extending hollow boss I, formed integrally therewith, valve seat connected with said boss I, compression block or valve K, pivotted to a projection or off-set from said seat, and a float connected with said valve, whereby said valve seat, valve, and float are attached to the removable head and

311,113.



rendered capable of being withdrawn from the case by said head G on its removal from the case, substantially as and for the purpose set forth. (2) In a steam trap, the case A, having closed end D and removable head G, a valve seat connected to said removable head, a valve pivotally connected to said seat, and a float connected with said valve, substantially as and for the purpose set forth.

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