THE PARIS ELECTRICAL EXHIBITION.

No. XV.

The great and increasing interest taken in all that concerns the electric light, and the facilities offered by the Paris Exhibition, induced us to supplement our ordinary descriptive report of the exhibits by a special report on the electric light. Professors Ayrton and Perry having designed special instruments for making measurements with these intense lights, and having given great attention to the subject, were requested to prepare this special report. It will be found below. It is by no means exhaustive, nor is it intended to be. It deals for the first time with questions that have hitherto been carefully avoided, but which are of great importance. The general public necessarily look mainly to the question of total cost. How much candle-power do we obtain for a given lump sum? The answer to this question might easily be given, but, as a rule, a simple reply at present would be inconvenient. The electric light engineer's position is altogether different. He wants by experiments and experience to find out the weak places in a new system, and to remedy its defects. Hitherto very elaborate experiments have been made and published in most cases only as regards the steam motor and the dynamo machine; but now Professors Ayrton and Perry give us figures relating to the lamps as lamps. It will, no doubt, be carefully noticed that the authors seem to look upon some of their measurements as tentative, and hence not to be taken as expressing the absolute value of a lamp. They say, "when measuring the strength of the lights at Paris we were not able to extend our experiments on each lamp over a sufficient length of time to obtain an average result. independent of fluctuations of the light, due to the adjustment of the lamps not being the best for the particular strength of current passing through it." Whilst then we look upon the figures in Table II., where only one series is given, as altogether preliminary, we think it cannot for a moment be disputed that the figures in the remaining tables, however they may be considered, do forcibly and conclusively show—

(1) That the ordinary ideas on photometry need to be carefully reconsidered. If these measurements show anything, they show the simple photometric apparatus of Rumford, &c., to give inconsistent results. We can quite understand the results obtained by one method not agreeing with those obtained by a second method; but the results of each method ought to be consistent. The whole question of photometry is one of great difficulty, and of great importance, and the Paris Congress would have been far better employed if its members had spent their whole time in discussing this matter, and agreeing upon a simple practical system, than in changing the name of the Weber to the Ampère, and debating about still more abstract questions.

(2) That the economy of any incandescent system increases with the temperature to which the filament is raised is conclusively shown, the figures relating to the Maxim lamp being very exhaustive, which is the more satisfactory as hitherto little has been known concerning this lamp.

THE EFFICIENCY OF ELECTRIC LAMPS.

By Professors Ayrton and Perry.

In accordance with your request, we send you a report on the efficiency of a few of the more important systems of electric lighting exhibited in the Paris Exhibition. Any system of electric lighting must consist of three parts—the engine producing the mechanical power, the electric machine for converting the power into electric energy, and thirdly, the lamp for converting the electric energy into light. Until the commencement of last winter the distinct purposes of these three machines were rarely separated one from the other in any experiments made on electric lighting. As a rule, the horse-power developed by the engine was simply measured from an indicator diagram, and the light given out by some sort of photometer; but when a small number of candles per horse-power was obtained it was very difficult to say whether this was due to friction in the engine or shafting connecting the engine with the dynamo-machine, or due to imperfections in the dynamo-machine itself, or, lastly, to the fault of the special system of lamp employed for converting the electric power into light. It therefore appeared to us desirable in all experiments on the economy of electric lighting to distinguish between the performance of the three distinct parts of the apparatus employed in producing the light.

To measure the efficiency of the dynamo-machine as distinguished from that of the engine, it is necessary by means of a transmission dynamometer to ascertain the amount of power given by the engine to the dynamo-machine, and, in addition, the current produced by the dynamo-machine through known resistances. Such experiments have been made by Mr. Schwendler, Dr. Hopkinson, and others, and the results will be found in the published accounts of their investigations.

But a complete measurement of the efficiency of an electric lamp can be made without any reference whatever to the amount of work given by the engine to the dynamo, or to the goodness or badness of either of the latter, exactly as experiments can be made on the efficiency of a gas burner without considering whether the company's mode of making the gas is good; or on the efficiency of a turbine attached to the water pipes of a house, without any inquiry as to whether the pumps employed by the company at their works are good or bad. To measure the efficiency of a turbine it would of course be only necessary to ascertain the quantity of water used or passed through it in any time, together with the loss of head and the amount of mechanical work given out by the turbine during the same time. So in the same way the efficiency of any instrument for converting electric energy into any other form of energy can be ascertained. For example, if we desire to measure the efficiency of an electro-motor, or machine for converting electric energy into mechanical work, we have to measure the current in Ampères* passing through it, and the electro-motive force in Volts maintained between its two terminals. The products of these two multiplied by 0·00134 gives the horse-power expended in the machine. Part of this will be wasted in heating the wires in the motor, part in overcoming mechanical friction, and the remainder, which may be measured by a force dynamometer, can be employed in doing useful work.

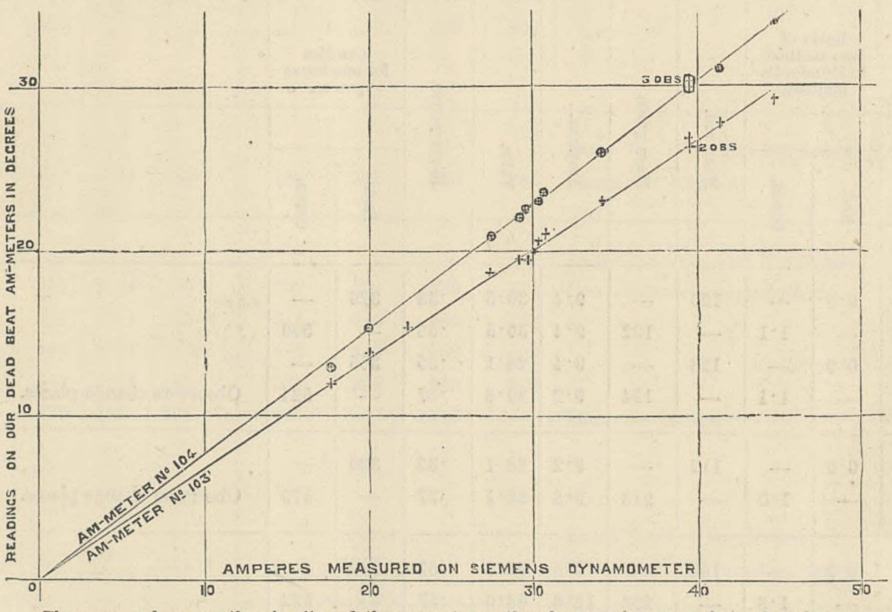
Such experiments—which, it must be remembered, are wholly independent of the goodness or badness of the mode of generating the electric current, or of the amount of heat produced in the wires connecting the electro-motor with the generator—have been made by our students during the last twelve months on a magneto-electric Gramme machine, running at different speeds, with various loads.

In the same way, if it be desired to measure the efficiency of an electric lamp, it is merely necessary to measure the current in Ampères passing through it, and the difference of potentials in Volts between the terminals of the lamp. The product of these two, as before, multiplied by 0·00134, gives the horse-power actually expended in the lamp, quite independently of the horse-power actually employed in generating the current. With the horse-power expended in the lamp must be compared the simultaneous illuminating power of the lamp in standard candles, and thus we arrive at the number of candles per horse-power expended in the lamp itself.

Such experiments, also, our students have been engaged at during the last twelve months with a Duboscq-Foucault and with a Serrin lamp, with different strengths of current, and with different fixed distances between the carbons; as well as, during the spring of this year, with incandescent lamps; and a sample of the results is given in Table I.

In making such experiments it is of great importance to be able to measure both current and electro-motive force rapidly with accuracy, so that all sudden changes may be recorded. For this purpose we have devised a dead-beat galvanometer, which measures the strength of the current directly in Ampères, but which can be calibrated by the use of a single Daniell's cell. This instrument—which we have called an Ampère-meter, or, for simplicity, an "Ammeter"—will be found described in the "Journal of the Society of Telegraph Engineers," No. 36, vol. x., 1881.

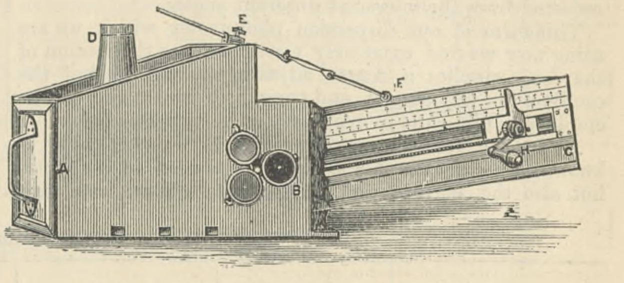
The proportionality of the deflections of our Am-meter with current may be easily tested, without the necessity of using strong currents, by turning the commutator to series, since of course the relative values of the deflections must be the same for the instrument in series as in parallel circuit. As a check to this, however, we thought it well at Paris to place three of our Am-meters in circuit with a Siemens dynamometer on an electric light circuit, and the curves above, or rather straight lines, show the results obtained with Nos. 103 and 104 used by us in our Paris measurements, the actual numbers being given in the table in the next column. Horizontal distances represent Ampères as measured on Siemens' dynamometer, and vertical distances the deflections in degrees on our two Am-meters respectively. The points corresponding with the third Am-meter are also in a straight line, but are not shown in the figure, as the instrument was not used by us in the experiments at Paris. It will thus be seen that not only can measurements be made of varying currents easily with our instrument on account of its dead-beat character, but that the deflections in degrees, at any rate for currents up to 50 Ampères, the strongest measured by us at Paris, are directly proportional to the current.



There was a lamp on the circuit, and the current was therefore varying somewhat. One observer of Siemens Dynamometer. One observer of three of our Am-meters. Only two of the Am-meters are given, because these two were the instruments used in all our Paris measurements.

We were not in a position to get any current we pleased, as our circuit contained electric lamps and a dynamo-machine. The less intense currents in the table were rather fluctuating, and as the Siemens dynamometer is not meant to measure varying currents, the consistency of the numbers is even more than could have been expected.

We have also constructed a dead-beat "Voltmeter," which, although it measures even large electromotive forces, can also be calibrated by the employment of a single Daniell's cell. A third instrument, an "Electric Power-meter," we have also designed to measure directly the product of the current into the electro-motive force—that is, the horse-power—and which can be used in place of the other two instruments when only the horse-power expended in an electric circuit is required. This instrument—which, like the two previous ones, differs from all other instruments previously designed, in that the calibration can be effected with much smaller powers than it is required to measure—will be found shortly described in a lecture delivered on the 24th March of this year, at the Society of Arts, as well as a dispersion photometer, arranged by us to measure even strong electric lights in a small space, and which has been employed by us, conjointly with other photometers, in the experiments contained in this report.



DISPERSION PHOTOMETER.

The special form of our dispersion photometer, which we employed at Paris, is shown in the accompanying engraving. It consists of a wooden box, A B, to which is joined a wooden tube B C, the joint being covered over with soft black cloth, to prevent extraneous light entering the photometer; A B contains the standard candle, for which D is the chimney. This candle illuminates a screen of tracing paper, while an exactly similar screen, cut from the same sheet of paper, is illuminated by a beam of the electric light passing down the wooden tube B C, and dispersed in passing through the thin double concave lens at H. The two pieces of tracing paper are, by means of mirrors, placed at exactly the same angle, reflected so as each to cover half the opening B, care being taken to avoid parallax by placing the head so that the intersection of the two mirrors is exactly in the centre of the opening. The wooden tube, B C, can, by means of the jointed rod E F, be placed at any angle with the horizon, so as to receive a beam from the electric light at any specified angle.

When using the instrument the tube B C is pointed at the electric light, so that the axis of the tube appears to pass through the arc itself. The concave dispersing lens is now moved parallel to itself along the tube by turning the handle H, until the illumination of the two screens is equal, the hole at B being closed by either the red or the green glass respectively. The intensity of the light in candles is then read off directly from the position on the scale of the pointer moving with H. It will be observed that there are three such scales passed over by the same pointer, the bottom one is used when the light is comparatively weak, and when it is 1½ft. from the end of the photometer, the middle scale when the light is stronger and requires that the end of the photometer shall be 3ft. away from it, and lastly, the top scale for the strongest lights when the end of the photometer and the light are placed at 5ft. distance. The numbers on each scale overlap one another—that is, a light which is so strong or so weak as to require the pointer to be put near one or other ends of one of the scales can be also measured on one of the other scales. The handle H gives motion to the lens by causing a pinion to run along a rack, a plate, shown in the figure, running between two guide rods preventing any turning of the lens and the slot in which the pin attached to the lens frame runs being closed by two india-rubber tubes, so that no extraneous

Comparison of two Am-meters made at the Office of Messrs. Rowatt and Fyfe at the Paris Exhibition.

Am-meter No. 103. Deflection in degrees.	Am-meter No. 104. Deflection in degrees.	Siemens' dynamometer Ampères.
27·4	31	41·18
29·4	34	44·83
26·9	30·1	39·68
26·4	30·2	39·68
21·0	23·6	30·73
19·4	22	29·20
26·4	30	39·7
20·4	24	—
19·4	22·6	29·57
20·4	23	30·93
18·4	21	27·5
11·6	12·4	17·74
13·4	15	20
14·9	—	22·43
22·7	25·8	34·07

* "Ampère" is the new name given by the International Electrical Congress to the practical unit of current, formerly called in England by proper consent a "Weber." The change was made, or rather the popular name was not authoritatively adopted, because Professor Helmholtz pointed out that in Germany the word Weber was used for a unit of current only one-tenth of the practical English unit.

light can enter. The above, it will be seen, is the application of our dispersive principle to the Bourguer's photometer. We originally adopted the Bourguer plan of two screens, one illuminated by the candle, and the other by the electric light, because this apparently furnished the only simple means of arranging a photometer by which a beam of light at any angle could be measured. We have since, however, adapted our lens dispersing principle to the Rumford's shadow method, and by a special arrangement of one mirror turning on an axis inclined to its plane, we are enabled to measure light coming at any angle from the lamp without introducing the error that would arise from variations in reflecting power if the light were reflected from the mirror at different angles.

This form of our dispersion photometer which we are using now we find extremely convenient, as the motion of the lens supplies a coarse adjustment, and that of the candle a fine adjustment, and the whole instrument can be employed quite close to even very strong electric lights.

As in the following experiments, it was desirable to know not merely the horse-power expended in the lamp, but also the current and electro-motive force, we employed two separate instruments rather than our Electric Power Meter. Not having one of our own Voltmeters for our measurements—the demand for these instruments being greater than the supply—M. Deprez was kind enough to lend us a dead beat galvanometer of 110 ohms resistance, and as this did not offer enough resistance to act alone as a shunt to an electric lamp, an additional resistance, varied in different experiments, was added. Actually, therefore, we employed one of our Ammeters to measure the current passing through the light, M. Deprez's galvanometer with a resistance box to measure the electro-motive force, and one of our dispersion photometers to simultaneously measure the intensity of the light.

When making a measurement the main circuit was momentarily interrupted by disconnecting one of the leading wires from the electric lamp to be tested and placing our Am-meter, to which two thick wires were attached, directly in circuit. The terminal of the Am-meter which was connected with the lamp was permanently in connection with one terminal of the high resistance galvanometer, the other terminal of the latter being permanently connected with one end of a resistance box. A comparatively thin wire attached to the other end of the resistance box was connected with the other binding screw of the lamp, so that the galvanometer and resistance acted as a shunt to the lamp, and thus the current passing through it measured the difference of potentials between the terminals of the lamp.

It will be observed from our table that we always give two measures of the strength of the electric light, as compared with that of a standard candle. One of these is the measurement when the two lights compared are seen through green glass, and the other when they are seen through red glass. It seems to us a very difficult matter to say what is the meaning of the strength of a light in terms of another light which is of a totally different colour, and although there is no doubt that the electric light and a candle are quite different in colour, the intensity of one is constantly expressed in terms of the other without reference to colour. If then, while awaiting the adoption of a better standard than a candle, the intensity of the electric light is to be measured in terms of that of a standard candle, it has seemed to us that the only method of comparison that can be employed without elaborate spectroscopic observations, is that of comparing the amounts of two very different kinds of monochromatic light in each.

The measurements given in Table No. II. occupied five evenings, not on account of any delay in carriage of our measuring apparatus from place to place in the Exhibition, since the three instruments employed could easily be carried by ourselves; but because so much time was necessary to persuade the owners of the various systems of electric lighting into giving us permission to make the measurements, even although, in order to economise time, we tried to obtain such permission during the day.

There are some other observations which showed a certain amount of inconsistency with one another and with the results given in this table, and which are not here given as they will be referred to further on. A column might have been added giving the value of the ratio of the electro-motive force to the current, and which would represent the resistance of the arc were there no opposing electro-motive force; but as there is no simple means of measuring how much of the opposition in a light to the current is due to resistance and how much to an opposing electro-motive force, we did not wish it to be inferred from our giving such a table that we regarded it as all due to the resistance.

Of course, it must be carefully remembered that the last column headed "Candles per horse-power" means per horse-power actually expended in the lamp. It is much more usual to state candles per horse-power expended in the engine, and as the efficiency of the best generators is about 80 per cent., and as in the case of a dynamo some portion of the work—which in an ordinary Gramme and Siemens machine is about one-half—is wasted in heating the coils of the machine itself, it may usually be assumed that upwards of $2\frac{1}{2}$-horse power is expended in the engine for every horse-power actually expended in the lamps themselves.

We do not consider that the last column, "Mean candles per horse-power," has any physical meaning, and we have merely added it because people have not yet acquired the habit of separating the two mono-chromatic measurements from one another. To persons who have not used our photometer, it may be necessary to say that our measurements will as a rule be found greater than those given by Rumford's method, or by any simple distance method of measuring. At first sight this seems to point to a defect in our photometer, and we regarded it in this light for some time, but after a very exhaustive examination of the possible sources of error in the use of our instrument, we have come to the conclusion that it is not our measurements that are wrong, but that Rumford's and other direct methods which are usually supposed to be perfect, may really give incorrect results.

An examination of Table 3, which gives the results of experiments made by both methods on a Foucault-Duboscq lamp worked by Grove's cells, will show that when the light examined is weak there is no great difference in the answers given by the two methods. This is further shown by the first results of Table 4, but in the remainder of the table it will be found that our photometer gives sometimes more than $1\frac{1}{2}$ times the answer which the direct method gives, and as a rule more discrepancy than this is observed with stronger lights. We have found that with strong lights sometimes we obtain the most varying results by the direct method, and at other times we get most consistent results. We are still investigating this matter, and although we are not yet prepared to state completely all the causes of the different results given by the two methods, we have proof that our method gives a nearer approximation to the light actually given out by the lamp; and this greater accuracy of our method arises from our measuring it at a place which is nearer to the lamp without

TABLE I.

Nature of lamp.	No. of cells.	Method of measuring light.	Strength of light. Red.	Strength of light. Green	Ampères.	Volts.	Horse-power.	Candles per horse-power. Red.	Candles per horse-power. Green.	Date.
Swan	20	Bouguer's	8·5	—	1·22	31·1	·052	162	—	May, 1881.
"	25	Bouguer's	23·6	—	1·57	41·4	·087	276	—	
"	30	Bouguer's	39·1	—	1·78	47·5	·119	338	—	
"	20	Rumford's	3·1	—	1·47	31	·06	51	—	October, 1881.
"	25	Rumford's	12·7	15·4	1·75	37	·087	146	177	
"	30	Rumford's	30·8	41·5	2·10	42·5	·12	257	346	
"	40	Rumford's	132	—	2·8	58·8	·22	544	—	
Maxim	20	Rumford's	0·25	—	1·2	31·5	·05	5	—	
"	25	Rumford's	2·6	—	1·5	38	·07	35	—	
"	30	Rumford's	6·8	—	1·8	46·7	·11	62	—	
"	40	Rumford's	26·3	31	2·3	61·2	·19	138	163	
"	48	Rumford's	87	105	2·8	67	·25	348	420	

TABLE III. *Foucault-Duboscq Lamp worked with Grove's Cells, City and Guilds of London Technical College, Finsbury, Oct., 1881.*

Ayrton and Perry's Photometer. 55in. from lamp. Candle-power. Red.	Green.	Rumford's method. D = 207in. d. in inches. Red.	Green.	Candle-power. Red.	Green.	Ratio of lens method to Rumford's method. Red.	Green.	Mean red.	Mean green.	Ampères.	Volts.	Horse-power.	Candles for one-horse power. Red.	Green.	
121	—	18·3	—	127	—	0·9	—	125	—	9·4	30·5	·38	326	—	
—	207	—	15·6	—	176	—	1·1	—	192	9·4	30·5	·38	—	500	
121	—	17·6	—	136	—	0·9	—	128	—	9·4	28·1	·35	365	—	
—	201	—	15·1	—	184	—	1·1	—	194	9·2	29·8	·37	—	524	Observers change places.
108	—	19	—	116	—	0·9	—	112	—	9·2	28·1	·35	320	—	
—	210	—	14	—	216	—	1·0	—	213	9·8	28·1	·37	—	575	Observers change places.
158	—	15·9	—	169	—	0·9	—	163	—	9·8	46·8	·61	267	—	
—	334	—	12·7	—	262	—	1·3	—	298	12·6	33·6	·57	—	522	
190	—	16·25	—	161	—	1·2	—	175	—	7·7	52·1	·54	324	—	
—	256	—	13·2	—	243	—	1·0	—	249	12·6	32·9	·56	—	444	
132	—	17·25	—	144	—	0·9	—	138	—	12·6	32·9	·56	246	—	Observers change places.
166	—	15·7	—	171	—	1·0	—	168	—	12·6	32·4	·55	305	—	
—	196	—	13	—	252	—	0·8	—	224	12·6	31·2	·53	—	422	
					Means	0·95	1·05								

The direction of the light was nearly the same to the two photometers.

TABLE II. *Experiments on some Electric Lights in the Paris Exhibition. All lights measured horizontally.*

Name.	Electro-motive force in Volts between the two terminals of lamp.	Current in Ampères flowing through lamp.	Horse-power expended in the lamp.	Candle power. Green.	Red.	Candles per H.-P. Green.	Red.	Mean candles per horse-power.
Crompton ..	37·7	25	1·26	2916	1849	2314	1467	1890
Joel, Semi-incandescent	6·6	44·2	0·39	70	60	179	154	166
"	7·1	45·0	0·43	75	70	174	163	168
"	6·6	50·0	0·44	75	68	170	155	162
Pilsen	36·8	10·33	0·48	780	512	1625	1066	1345
Brush	38	10	0·51	2025	961	3970	1884	2427
Sautier — Lemonnier. One lamp on A Gramme Machine ...	40	43	2·3	15376	5625	6685	2446	4565
Ditto.	45	42	2·54	15376	9025	6054	3553	4803
Maxim Incandescent ...	53·6	3·32	0·24	135	120	562	500	531
Maïkoff	45·3	8·3	0·50	397	307	794	614	704
Sautier Lemonnier. One of ten lamps on H Gramme machine ...	40	12·5	0·67	540	310	806	463	634
	"	"	"	*784	125	1170	187	678
Gravier	46·6	9·2	0·58	1023	349	1173	604	1189
Serrin	31·1	35·8	1·49	2448	938	1616	630	1123
Cance	51·8	16·7	1·16	3445	1156	2970	997	1983
Weston	33·7	21·7	0·98	2663	1024	2717	1045	1881
Maxim Incandescent ...	73	2·5	0·244	350	290	1434	1189	1311
	77	2·8	0·294	270	262	934	886	910
	77	2·8	0·294	350	350	1211	1211	1211
	81·3	2·8	0·305	422	350	1383	1148	1265
	85·3	3·3	0·377	512	360	1358	954	1156
Engine and dynamo machine running at higher and higher speeds ...	88	3·6	0·424	870		2050		
	105·5	4·6	0·650	1225		1883		
				†1370				

* This measurement of light was made on Rumford's Method.
† This lamp now broke.

TABLE IV. *Experiments on the Maxim Incandescent Light, at the City and Guilds of London Technical College, Finsbury.*

Ayrton & Perry's Photometer. 89in. from lamp. Candle power.		Rumford's Method. D = 219·5 values of *d* in ins.		Rumford's Method. Candle-power.		Ratio of lens method to Rumford's method.		Mean red.	Mean green.	Ampères.	Volts.	Horse-power	Candles per horse power.		Mean candles per horse-power.	Remarks.	
Red.	Green.	Red.	Green.	Red.	Green.	Red.	Green.						Red.	Green.			
																Lamp No. I. 26th October, 1881.	Student reading one of the photometers.
35	37	39·2	38·5	31	33	1·1	1·1	33	35	2·42	57	·185	178	189	183	Red measured before green. Observers change places.	
31	36	44·0	41·5	25	28	1·2	1·3	28	32	2·42	57	·185	151	173	162	Green before red. Observers change places.	
85	106	25·9	21·5	72	104	1·2	1·0	78	105	3·07	67·6	·28	279	375	327	Red before green. Observers change places.	
147	262	18·9	15·2	135	209	1·1	1·25	141	235	3·65	76	·37	381	635	508	Red before green. Lamp observed to be blackening, due to volatilisation of carbon filament.	
154	187	16·8	14·8	172	220	0·9	0·85	163	203	3·7	76	·38	429	534	482	Red before green.	
246	262	16·8	—	172	—	1·4	—	209	—	4·13	89·1	·5	418	—	—	No green Rumford measurement taken.	
—	278	—	14·3	—	237	—	1·1	—	257	4·16	89·1	·5	—	514	—		
206	—	16·0	—	188	—	1·1	—	197	—	—	—	—	—	—	—	This lamp broke on putting on 80 cells.	
					Means	1·1	1·1										
		D = 219·5														Lamp No. II. 26th October, 1881.	Students reading both photometers.
114	147	24·5	21	80	109	1·4	1·3	97	128	3·01	67·2	·271	358	472	415		
126	203	24	22·5	84	95	1·5	2·1	105	149	3·01	67·2	·271	387	550	468		
220	339	17	15·25	167	207	1·3	1·6	194	258	3·54	78·9	·374	519	690	604		
233	339	18	14·5	149	229	1·6	1·5	191	284	3·54	78·9	·374	511	742	626		
456	647	10·5	9·75	437	507	1·0	1·3	446	577	3·98	86·7	·462	965	1249	1107	Lamp seriously clouding.	
351	539	12·5	10·5	308	437	1·1	1·2	329	488	3·98	„	„	712	1056	884		
317	422	15·5	13·5	201	264	1·6	1·6	259	343	3·98	„	„	561	742	651	„ „	
305	377	16·25	13·0	182	285	1·7	1·5	243	331	3·98	„	„	526	716	621	The lamp now broke.	
					Means	1·4	1·5										
																Lamp No. III. 26th October, 1881.	Students reading both photometers.
228	297	17	14	167	246	1·4	1·2	197	271	3·68	77·7	·383	514	707	610		
438	589	15	11·5	214	364	2·0	1·6	326	476	4·10	86·4	·475	685	1002	843		
438	589	15·25	12·5	207	308	2·1	1·9	322	448	4·10	86·4	„	678	943	810		
713	790	12	9·5	334	544	2·1	1·5	523	667	4·49	95·0	·571	916	1168	1042	Lamp clouding.	
589	713	13	11·0	285	363	2·1	1·9	437	538	„	„	„	765	942	854		
598	646	14·5	11·0	230	363	2·6	1·8	414	504	„	„	„	725	883	804	„ „	
					Means	2·05	1·65										
		D = 225·5														Lamp No. III. 2nd November, 1881.	
—	—	22·25	19·5	103	134	—	—	—	—	3·84	86·7	·446	231	300	265	Lamp now broke.	
		D = 228														Lamp No. IV. 2nd November.	Students reading both photometers.
130	136	25·37	23	81	98	1·6	1·4	106	117	2·94	68·4	·269	394	435	414	Red measurement made first.	
228	380	17	14	180	266	1·3	1·4	204	323	3·54	78·9	·374	545	864	704		
380	692	14·5	13·5	247	285	1·5	2·5	314	489	4·24	85·8	·488	643	1002	823		
547	692	10·5	11·5	471	393	1·1	1·7	509	543	4·38	96	·564	902	963	933		
—	973	—	9·5	—	576	—	1·7	—	775	4·8	108	·695	—	1115	—	Lamp now broke.	
					Means	1·4	1·7										
									*							Lamp No. V. 2nd November.	
1118	—	9	—	641	—	1·8	—	880	—	5	104·4	·7	1257	—	—	Broke after first measurement.	

* In order to measure the efficiency of lamp No. V. for high electromotive forces before the clouding, arising from the evaporation of the carbon filament, had taken place, 90 Groves cells, producing a difference of potentials of 104·4 Volts at the two sides of the carbon filament, were at the commencement attached to this lamp. One measurement was taken when the lamp broke.

TABLE V.—*Foucault-Duboscq Lamp. Comparison of Ayrton and Perry's Photometer, with Rumford's Method of Measurement, 7th November*, 1881.

All through red glass.

Dispersion photometer, 81in. from lamp.	Rumford's method. Screen 225in. from lamp.		Rumford's method. Screen 609·5in. from lamp.	
Candle power.	Distance of candle.	Candle power.	Distance of candle.	Candle power.
1005a	6·9	1063c	25·7	562p
686a	7·6	876p	24·5	620c
756p	8·0	790a	23·75	658c
660p	8·25	743c	25·2	615a
643c	9·1	610p	24·6	615a
702c	10·0	506p		
Mean.		Mean		Mean
742		765		608

The letter affixed to each measurement is the initial of the observer, who usually went to another instrument as soon as he had made an observation, in order that personal errors might be eliminated. Each observer carried his red glass with him.

introducing the error which would necessarily arise in the measurement of the small distance of the candle if an attempt were made to experiment on a strong electric light with a Rumford's photometer put as near the lamp as we place our instrument.

As we have said, we are engaged in a complete investigation of this matter, and we content ourselves with here giving a few results obtained, in Table 5, on the 7th inst. in a room which seemed to have a perfectly clear atmosphere. In making these observations the three observers were continually being changed from one photometer to another, and the letters attached to each measurement denote the three observers. The numbers indicate what we have found to be a pretty general rule, namely, that Rumford's method of long distances gives a smaller result for the power of the light itself, sometimes much less than half the result obtained simultaneously in the same direction by the same method at shorter distances.

In an arc light the result may be partially caused by

TABLE VI.—*Simultaneous Measurements made on a Serrin Lamp worked by a Dynamo, 16th November*, 1881.

Ayrton and Perry's photometer, 150in. from lamp.		Rumford's method, screen 300in. from lamp.		Rumford's method, screen 600in. from lamp.		Electromotive force in Volts between the two terminals of lamp.	Current in Ampères flowing through the lamp.	Horse-power expended in arc.
Red.	Green.	Red.	Green.	Red.	Green.			
857	1406	1712	2975	856	1600	34	32·2	1·467
947	1406	1246	3600	900	1406	34	29·4	1·339
576	—	1406	3600	946	1773	34	26·6	1·283
947	—	1498	—	997	—	34	26·6	1·283
1600	6400	1406	7625	779	2130	32	28	1·200
1277	2844	1406	7625	900	3600	32	30·8	1·321
900	1201	1406	3600	1052	2399	32	28	1·200
900	1655	900	1837	638	1283	32	29·4	1·261
1143	3115	1837	3600	1024	2608	32	29·4	1·261
2194	2975	1111	3600	997	3265	32	29·4	1·261
		Screen now put at 480in. from lamp.						
—	5993	2070	4384	1111	3600	31	30·8	1·279
1175	3425	1914	3836	1210	4208	31	29·4	1·221
1143	3115	1544	4096	1837	3989	30	29·4	1·182
1052	5993	1264	4384	857	4445	33	26·6	1·176
1363	—	769	—	1246	—	—	—	—
Means:								
1128	3294	1433	4212	1023	2810	—	—	—

the fact that the intensity of the light in different directions, in the same vertical plane, is quite different, so that although care has been taken to place the near and distant photometers in the same horizontal plane with the arc, an error in placing the near photometer is more important than an error in the distant one, if the illuminated areas to be looked at are of the same size. This is the case when the Rumford or any ordinary distance method is employed, and evidently furnishes another reason why such a method must be inaccurate at short distances. But with the dispersion photometer this difficulty is not introduced, since the effect of the lens is to place under examination much the same small pencil of rays, however near it may be to the lamp. It will be observed that this difference, arising from the distance of the photometer, is as well marked in the long series of experiments that we have made with the Maxim incandescent light, and as it is not probable that there is any such great difference in the intensity in different directions with an incandescent lamp, it follows that some other cause must be sought. That the effect in question may be produced by dust particles of a very minute kind floating in the air we think highly probable, for our experiments show, first, that the greater the intensity of the light—that is, the greater the proportion of blue to red rays—the greater is this difference; secondly, that the difference is more marked when the experiment is made through green than through red glass, both results leading to the same conclusion, that it is the highly refrangible rays which strike the first screen, and which never reach the second screen at all, that cause the difference. But if this is the case, then it must be quite evident that in comparing the efficiencies of electric light—that is the number of candles per horse-power—the lights ought to be measured at short distances, such as the three or four feet we employ rather than the much longer distances necessary for accurate measurements by any of the ordinary direct methods. The loss which is caused by absorption or by reflection, from the minute dust particles in the air is undoubtedly a most important question, but is really a distinct inquiry, since it would obviously be most unfair that one electric light should be said to give fewer candles per horse-power than another, simply because in the many feet of air between the light and the distant Rumford's shadow photometer there happened to be greater dust absorption or reflection on the day the one experiment was made than on the day when the second was carried out.

When measuring the strength of the lights at Paris, we were not able to extend our experiments on each lamp over a sufficient length of time to obtain an average result independent of fluctuations of the light, due to the adjustment of the lamp not being the best for the particular strength of current passing through it. The observations given in Table VI. were made simultaneously with three photometers in the City and Guilds of London Technical Laboratory by competent observers, a Serrin lamp which had been carefully adjusted being employed, but the light from which, nevertheless, fluctuated somewhat, although the engine and dynamo machine were running fairly regularly. Only horizontal rays, as nearly as possible in the same azimuth, were received on the photometer screens, which in this and other similar experiments were each composed of a sheet of white blotting paper, and yet it will be observed that there is but a bad agreement in the results, even although no observations were taken unless the light seemed to be temporarily steady, and although each set of observations was made quite simultaneously on a signal being given. It also to be observed that there are no such great variations in the horse-power expended in the arc as there are in the light, although both the Am-meter and Volt-meter being very dead beat recorded every change in current and electromotive force.

From this it is quite clear that if one photometer only had been employed, and if only some three or four observations had been taken, the conclusion that would have been arrived at regarding the efficiency of the light, or number of candles per horse-power, would have depended very much on the distance at which the photometer happened to be placed from the light, and on which of the many results contained in Table VI. happened to be those included in the experiment.

A careful distinction must be made between such fluctuation effect as is shown in Table VI. and the variations due to the rays of light to the photometers being in different azimuths. For example, Table VII. shows the results of simultaneous measurements made in the same horizontal plane as the arc, the lens of the dispersion photometer being placed 115½in. north from the lamp, one of Rumford's screens 121in. east from the lamp, and the other 343in. south. At the shorter distances the measurements by Rumford's method for the stronger lights are rather inaccurate, as the candle was sometimes less than 5in. from the screen, and therefore its exact distance could not be determined with great accuracy. The lamp was a Foucault-Duboscq in good adjustment, and we used 100 Grove's cells so as to get a steady current. All measurements were made through red glass, and the observers changed places after each measurement, carrying their pieces of red glass with them.

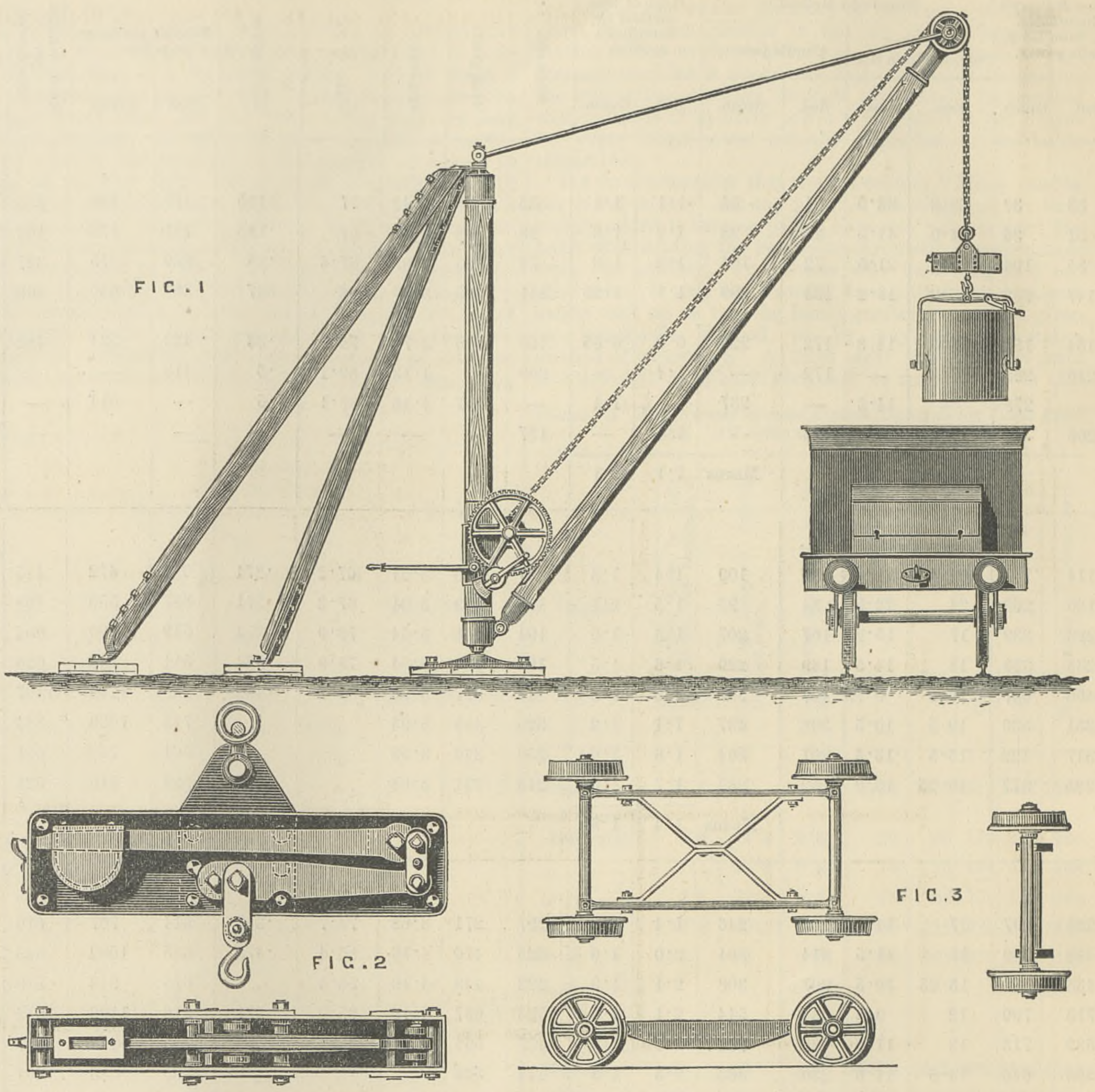
TABLE VII.

Ayrton and Perry's Photometer, 115½in. from Lamp North.	Rumford's Method. Screen 121in. from Lamp South.	Rumford's Method. Screen 343in. from Lamp East.
—	849	384
469	756	394
371	563	566
360	815	645
629	622	371
571	648	333
Means 480	708	449

Finally, therefore, we may conclude that to measure the efficiency of any special electric lamp, or number of candles it can give per horse-power expended in it, requires that a very considerable number of experiments should be made on that one lamp, burning apparently under constant conditions in order to eliminate atmospheric absorption and irregularities of burning which are not accompanied by variations in the amount of horse-power spent in the lamp.

W. E. AYRTON.
JOHN PERRY.

LOCOMOTIVE COALING CRANE—GRAZI-TSARITSIN RAILWAY.



LOCOMOTIVE COALING CRANE — GRAZI-TSARITSIN RAILWAY

WE illustrate above a crane designed and constructed by Mr. Urquhart, locomotive superintendent of the Grazi Tsaritsin Railway, South Russia. The crane weighs each box of coal, the net capacity of which is 50 poods, or 16·12 cwt. The crane is worked by four men at the handles; the empty boxes are lowered on to the trucks by a brake. Each crane has four to six boxes, so that between trains from 200 to 300 poods are ready for delivery when the next engine comes in; this takes from fifteen to twenty minutes in loading. The dynamometer, shown to an enlarged scale, being arranged for a fixed weight, is boxed in on all sides and cannot be tampered with.

BREWING IN ENGLAND.

No. V.

IN continuing these articles we cannot do better than give a description of the fine sixty-quarter brewery erected for Messrs. H. Mitchell and Co., Cape Hill, near Birmingham.

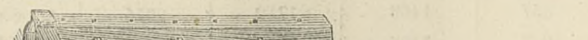
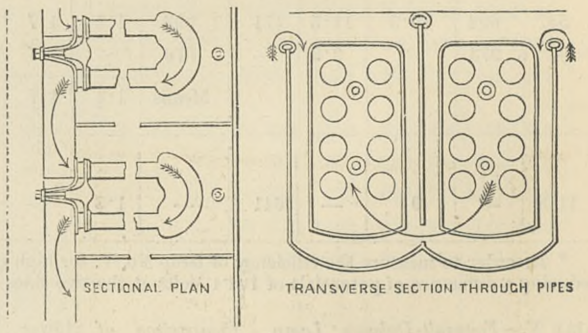
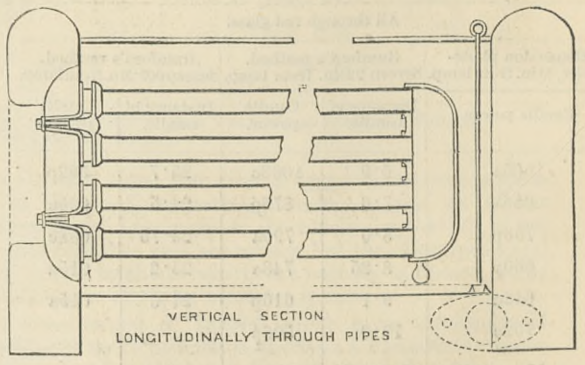


Fig. 10—WILSON'S REFRIGERATOR.

In our impression of the 21st ult. we published a perspective view of this brewery, and we now give further illustrations. The brewery is erected at the foot of Cape Hill. It is of bold design, and presents a commanding appearance from the main road. A large malting adjoins the brewery, built at the same time, with extensive cask-washing sheds and beer stores. The new offices and stables, which are to be constructed in connection with the brewery, will be placed some distance therefrom, so as to avoid any source of contamination of the materials in the process of brewing, which might be transmitted from these buildings as dust or effluvium if too close. The brewery is of red bricks with string courses, and moulded bricks are freely used in the cornice and panels, and elsewhere. The roofs are of



Figs. 10a.



SECTIONS OF WILSON'S REFRIGERATOR.

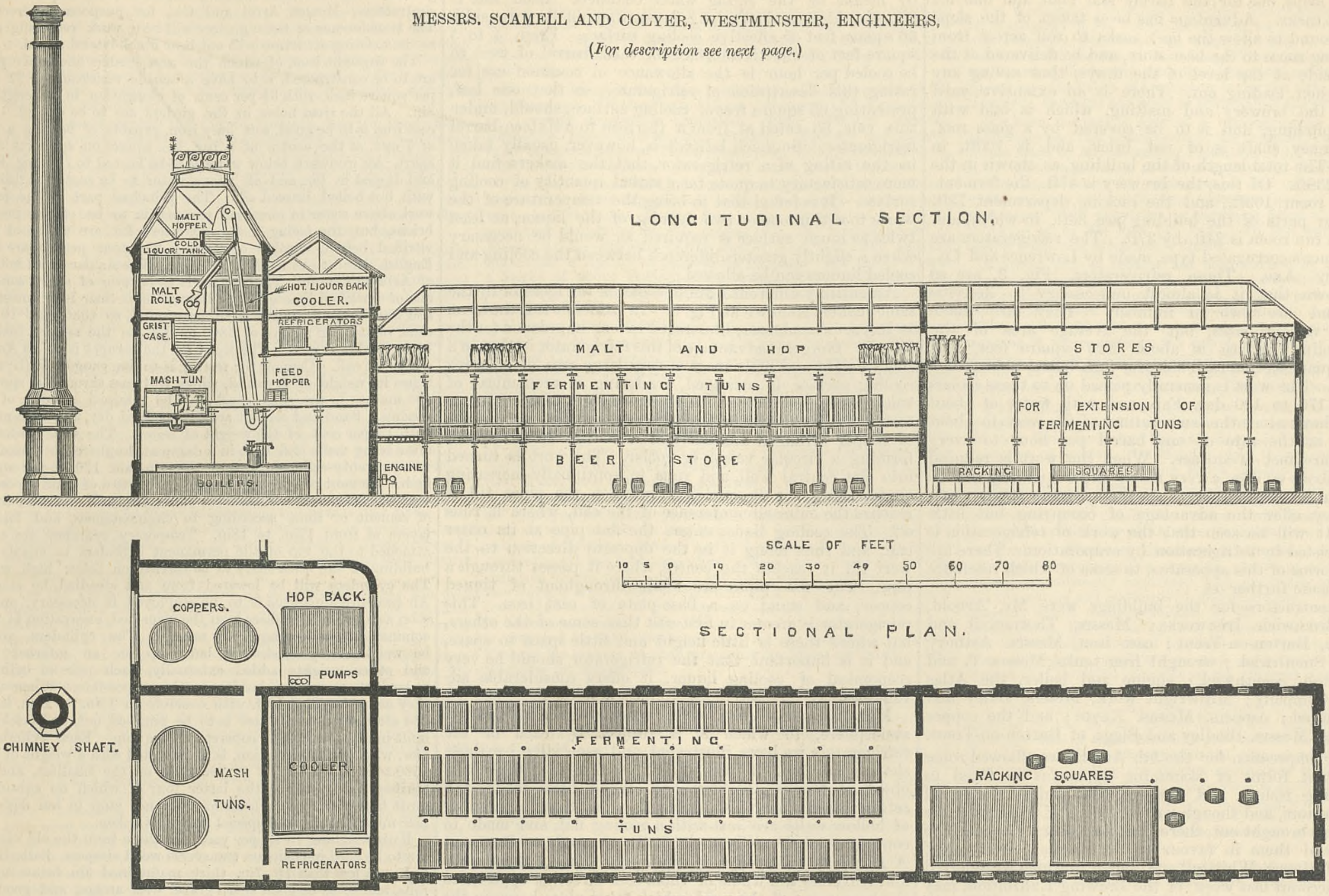
slate, with ornamental ironwork at top of the tower. The windows are fitted with glazed louvre sashes hung on pivots in sections. The malt and hops are taken in through the loop on the north side. The racking floor is laid with Claridge's patent Seyssell asphalte. A well on the south side of the brewery has been sunk to a depth of 300ft., by Mr. Chapman, of Manchester, upon his system. It yields an abundant supply of perfectly pure water.

The plant consists mainly of a cold liquor back, which is of cast iron, 20ft. wide and 4ft. deep, placed at the top of the building, Figs. 1 and 2, under the roof. The hot liquor back is of wrought iron, 8ft. 6in. wide and 4ft. 6in. deep, covered and heated by steam coils. The mash tuns are of cast iron, 11ft. 6in. diameter and 4ft. 6in. deep, are fitted with internal mashing machines, and externally with Steel's

SIXTY-QUARTER BREWERY.—MESSRS. MITCHELL AND CO., CAPE HILL, BIRMINGHAM.

MESSRS. SCAMELL AND COLYER, WESTMINSTER, ENGINEERS.

(*For description see next page.*)



FIGS. 1 AND 2.

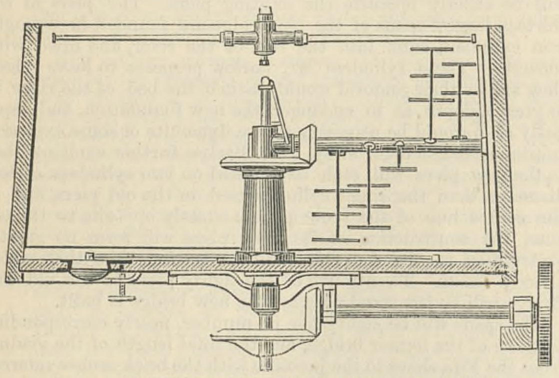


FIG. 5.—LAWRENCE AND CO.'S MASHING MACHINE.

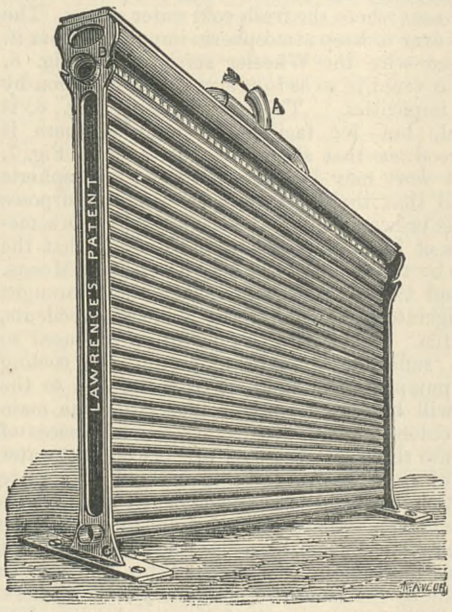


FIG. 3.—LAWRENCE AND CO.'S REFRIGERATOR.

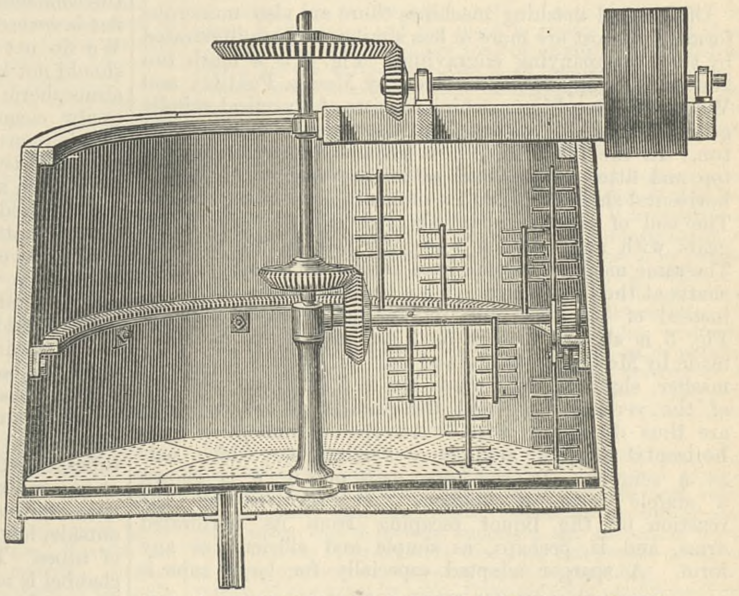


FIG. 4.—PONTIFEX AND WOOD'S MASHING MACHINE.

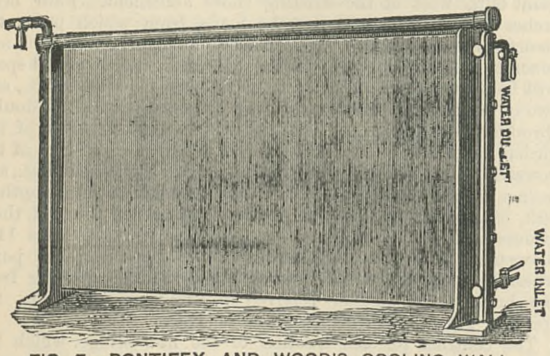


FIG. 7.—PONTIFEX AND WOOD'S COOLING WALL.

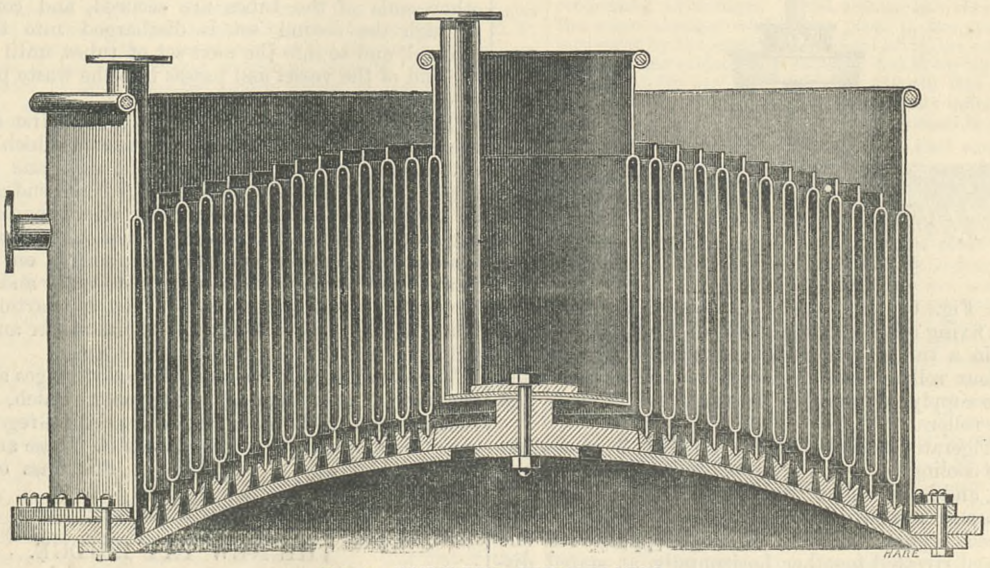


FIG 8.—WHEELER'S REFRIGERATOR.

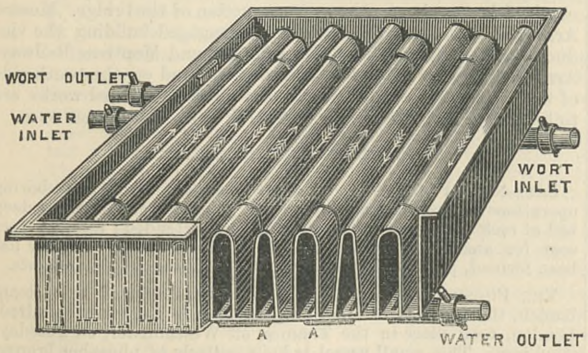


FIG. 9.—PONTIFEX AND WOOD'S COOLER.

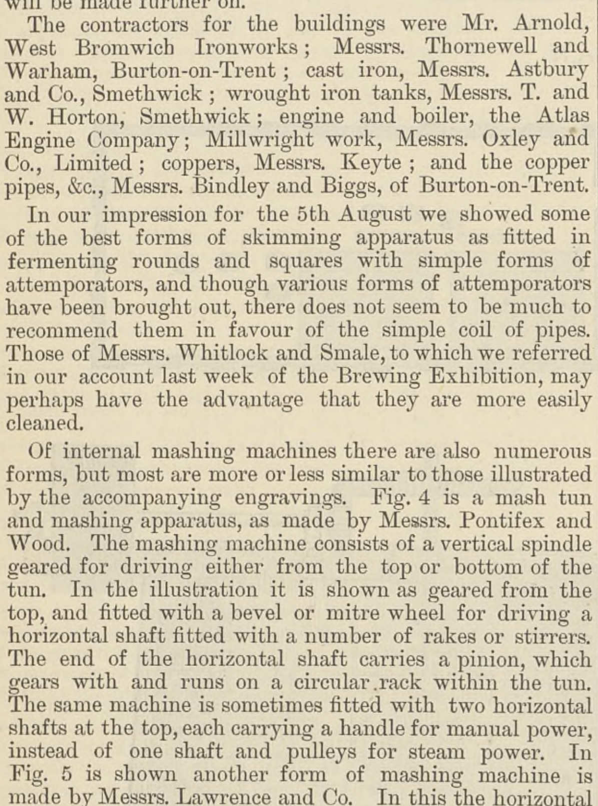
machines, mashing the grain, &c., into the tuns. The grains are let out at the bottom of the tuns through valves, and are carried by an endless conveyer to the grain tank outside the building, from which they are measured into the carts. The malt is carried up by the elevator to the malt hopper at the top of the building, from which it falls over the screen into the rolls, and when ground runs to the grist cases placed over the mash tuns. The coppers are 9ft. in diameter, heated by a furnace, and are situated in a separate building. The hop back is wrought iron, 14ft. 6in. long and 9ft. wide, and is in the same place. The worts are pumped from this building to the cooler, which is 25ft. long and 18ft. wide, and then through vertical refrigerators to large gathering squares of wood; it then passes to the fermenting tuns, which in this system of brewing are square and closed at the top. Of these there are seventy-two, about 3ft. 6in. by 5ft. and 8ft. in height. The yeast works out through the spouts into trucks below. Attemporators of a common form are fixed in the tuns. The racking vessels are of wood 21ft. in length, 15ft. wide, and 2ft. 6in. deep.

The malting, as before stated, adjoins the brewery, and is for 60 qr. steep. The building is arranged so as to allow the ground floor to form a beer store. The "working floor" is placed in the basement, ventilation being provided at both sides of the house by window and vacuum shaft ventilators in the centre, through the floors to the roof, where they are fitted with cowls. The barley and malt stores are placed over the beer store, and part of the upper floor is used as a spirit store; there are two separate loops, one for the barley and malt and one for the spirit casks. Advantage has been taken of the slope of the ground to allow the beer casks to roll across from the racking room to the beer store, and be delivered at the opposite side at the level of the drays, thus saving any lifting when loading out. There is an extensive yard between the brewery and malting, which is laid with granite pitching, and is to be covered by a glass roof. The chimney shaft is of red brick, and is 100ft. in height. The total length of the building, as shown in the plan, is 238ft. Of this, the brewery is 47ft., the fermenting tun room 109ft., and the racking department 75ft. The latter parts of the building are 36ft. in width, and the mash tun room is 24ft. by 37ft. The refrigerators are of Lawrence's corrugated type, made by Lawrence and Co., St. Mary Axe. These refrigerators, Fig. 3, are so well known that it is almost unnecessary to describe them, and are two in number. They are made in very various sizes, but the average area of the wort cooling surface is about 2·25 square feet, that is 1·12 square feet on each side, for each barrel to be cooled per hour. The wort is generally passed on to these coolers at from 170 to 180 deg. Fah., and with water at about 52 deg. they reduce the temperature of the wort to about 54 deg. at the rate of one barrel per hour to every 2·25 square feet of surface. When the wort is reduced only to about 60 deg. a very much larger quantity can be cooled on the same surface. As these coolers stand vertically they offer the advantage of occupying but little space. It will be seen that the work of refrigeration is much assisted by refrigeration by evaporation. There are several forms of this apparatus, to some of which reference will be made further on.

The contractors for the buildings were Mr. Arnold, West Bromwich Ironworks; Messrs. Thornewell and Warham, Burton-on-Trent; cast iron, Messrs. Astbury and Co., Smethwick; wrought iron tanks, Messrs. T. and W. Horton, Smethwick; engine and boiler, the Atlas Engine Company; Millwright work, Messrs. Oxley and Co., Limited; coppers, Messrs. Keyte; and the copper pipes, &c., Messrs. Bindley and Biggs, of Burton-on-Trent.

In our impression for the 5th August we showed some of the best forms of skimming apparatus as fitted in fermenting rounds and squares with simple forms of attemporators, and though various forms of attemporators have been brought out, there does not seem to be much to recommend them in favour of the simple coil of pipes. Those of Messrs. Whitlock and Smale, to which we referred in our account last week of the Brewing Exhibition, may perhaps have the advantage that they are more easily cleaned.

Of internal mashing machines there are also numerous forms, but most are more or less similar to those illustrated by the accompanying engravings. Fig. 4 is a mash tun and mashing apparatus, as made by Messrs. Pontifex and Wood. The mashing machine consists of a vertical spindle geared for driving either from the top or bottom of the tun. In the illustration it is shown as geared from the top, and fitted with a bevel or mitre wheel for driving a horizontal shaft fitted with a number of rakes or stirrers. The end of the horizontal shaft carries a pinion, which gears with and runs on a circular rack within the tun. The same machine is sometimes fitted with two horizontal shafts at the top, each carrying a handle for manual power, instead of one shaft and pulleys for steam power. In Fig. 5 is shown another form of mashing machine is made by Messrs. Lawrence and Co. In this the horizontal masher shaft is supported by a link from the top of the vertical shaft, and the circular rack and pinion are thus dispensed with. At the extremity of the horizontal masher arm is a vertical bar which acts as a scraper. In the upper part of Fig. 5 is shown a simple form of sparger. It revolves by the reaction of the liquor escaping from its perforated arms, and is, perhaps, as simple and efficient as any form. A sparger adapted especially for large tuns is



shown at Fig. 6. It is made by Messrs. Pontifex and Wood for fixing on the vertical shaft of the fixed mashing machine in a tun. It is suspended from a ring which runs on four rollers revolving upon stud axles in a fixed box. The supply of water is delivered to the pan just below the rollers.

The refrigerator or cooler shown in Fig. 7 is another of surface cooling type. It is made by the last-mentioned engineers, and is known as the cooling wall.

This cooler consists of two sheets or leaves of thin tinned copper, standing on edge opposite to one another, and rivetted together horizontally at stated distances; the spaces between the lines of rivets form zigzag channels for the passage of the water between the leaves, down the outside surfaces of which the worts trickle in a thin film, giving off their heat partly to the water and partly to the atmosphere, and are thus cooled before they reach the trough or receiver at bottom. The cooling surfaces are, therefore, simply flat copper walls, which can be washed down by a hose without difficulty. The water spaces are accessible for cleaning, so that the cooler may be always kept in its original state of efficiency, avoiding the objections which attach to refrigerators which do not afford ready access to the water spaces.

A long run of contact between the two fluids is obtained by means of the zigzag water channels. Each leaf is 5ft. 6in. high and 6ft. long, presenting on its two sides 66 square feet of effective cooling surface. From 4 to 5 square feet of effective surface for each barrel of wort to be cooled per hour is the allowance in common use for rating this description of refrigerator, so that one leaf, presenting 66 square feet of cooling surface, should, under this rule, be rated at from a thirteen to a sixteen-barrel refrigerator. So much latitude is, however, usually taken in the rating of a refrigerator, that the makers find it more satisfactory to quote for a stated quantity of cooling surface. It is found that to bring the temperature of the worts to within one or two degrees of the liquor, at least twice as much surface is required as would be necessary when a slightly greater difference between the cooling and cooled liquors can be allowed.

An entirely different form of cooler or refrigerator by the same makers is shown at Fig. 8. In principle it is the same as Rayner's condenser, illustrated in our impression for the 9th ult. The great advantage of this refrigerator is, that in a small height and little space a very large area of effective cooling surface is arranged, rendering it economical of water, and especially to be recommended where that is scarce. It consists of a flat pipe made of two thin leaves of copper arranged annularly in a continuous flat spiral, forming a circular vessel or cooler. The wort is turned into the central well, and runs in continually-increasing circles along the channel left between the pipes till it reaches the outer circumference of the coil, where it runs off. The cooling liquor enters the flat pipe at its outer end, and runs along it in the opposite direction to the wort till it reaches the centre, where it passes through a pipe. The flat pipes are made throughout of tinned copper, and stand on a base-plate of cast iron. This refrigerator is greater in first cost than some of the others, but where there is little height and little space to spare, and it is important that the refrigerator should be very economical of cooling liquor, it offers considerable advantages.

Many brewers object to the exposure of the wort to the atmosphere, to which it is subject by each of the refrigerators we have illustrated, and especially by those shown at Fig. 3 and Fig. 7. To overcome this objection Messrs. Pontifex and Wood have made the refrigerator shown at Fig. 9. In this a number of hollow walls are cast with a cooling flat, and made to connect at their alternate ends by channels, as shown at A A Fig. 9. The cooling water enters one of these walls and traverses the whole of them in a direction opposite to the movement of the wort, which takes place between the walls as indicated by the arrows. The wort thus leaves the condenser near where the fresh cold water enters. The flat is covered over to keep atmospheric impurities from it. We do not see why the Wheeler refrigerator, Fig. 8, should not be covered in so as to prevent contamination by atmospheric impurities. This refrigerator, Fig. 8, is easily cleaned, but for facility for cleaning there is nothing so good as that shown at Fig. 3 or at Fig. 7. In order that wort may be protected from atmospheric impurities, and that the water used for cooling purposes may be used as brewers' liquor, an economy which is sometimes a matter of great importance, and in order that the heat given up by the cooling wort may be utilised, Messrs. H. Wilson and Co., of Stockton-on-Tees, have brought out the refrigerator shown in the annexed woodcuts, Figs. 10 and 10a. In this case circular tubes are used so as to secure sufficient strength to permit the cooling water to be pumped through them from the well to the copper. As will be seen from our illustration the main vessel is an oblong square, divided across with spaces of 5in. to 6in.; into these sub-divisions are placed the water tubes, in sets of eight, the tubes being secured to a plate at one end which is attached to the side of the main vessels with two bolts. The water service channel runs along the outside, having divisions and branches leading to each set of tubes. The connection between the tubes and service channel is made by the same two bolts and elastic washers. The water entering at one end of the vessel, passes into the first row of tubes, and turns in the box to which the other ends of the tubes are secured, and coming back through the second set is discharged into the service channel, and so into the next set of tubes, until it reaches the end of the vessel and passes into the waste pipe, boiler, or cistern, as may be required.

The wort enters into the middle or the first division at the end of the vessel opposite to that at which the water enters, and traversing right and left, sinks and passes into the next space through the openings at the end and bottom of diaphragm; rising on the other side it moves from the end to the middle of the next division, and passes through the opening in the top of the plate, and so on, sinking or rising, and moving from middle to side, and *vice versâ* alternately until it reaches the last compartment, which being without tubes holds the thermometer and overflow valve.

There are, it will be seen, some advantages attached to the use of this form of refrigerator, which, it may be remarked, is on the same principle as the Gregory refrigerator, though an improvement upon it. These are, perhaps, sufficient by way of examples of this class of brewing apparatus.

THE NEW TAY BRIDGE.

In our impressions of the 4th and 11th inst. we gave general and detail drawings showing Mr. Barlow's design for the new Tay Bridge. On page 386 we give the completing illustration of this important structure. The mode of erection to be adopted presents few features of novelty, except where the large girders of 245ft. and 227ft. span are to be erected as shown at the lower corner of the illustration on page 386. For this purpose temporary iron stagings, in the form of a lattice girder loaded at top, and carried by two supports bolted to the piers, as shown, will be employed, instead of erecting the girders on staging, or floating them into place. Three sets of staging will be employed, so that one set is in course of removal while two sets are in actual use, the staging to be floated into place. The old bridge, so far as it exists, and with the exception of the girders, which are to be utilised, will be at the disposal of the contractors, Messrs. Arrol and Co., for purposes of erection. The transference of these girders will be a work requiring care, as the existing structure will not bear much lateral strain.

The wrought iron, of which the new girders and other parts are to be constructed, is to have a tensile resistance of 22 tons per square inch, with 6½ per cent. of elongation in a length of 8in. All the rivet holes in the girders are to be drilled. The cast iron is to be good, soft grey iron, capable of bearing a load of 7 cwt. at the centre of a bar 1in. square on supports 36in. apart. All ironwork below water is to be heated to 700 deg. Fah., and dipped in tar, and all above water to be coated as finished with hot boiled linseed oil. The principal part of the brickwork above water in piers and parapet is to be of red pressed bricks, but the facing of the cutwaters, &c., are to be of blue vitrified bricks, capable of bearing 250 tons per square foot, English bond to be used in all cases. The Ashlar work is to be of Arbroath stone. The mortar is to be two of sharp sand to one of unslaked lime equal to Barrow-upon-Soar Lias limestone, and the Portland cement is to be ground, so that only 10 per cent. remains on a sieve of 5800 meshes to the square inch, or 75 to the lineal inch. The wood for the parapet is to be American heart oak. Cement for testing is to be gauged with three times its weight of dry sand, which will pass through a sieve of 400 meshes to the square inch, but be retained on one of 900 meshes. Sand and cement are to be mixed dry, and then mixed with 10 per cent. of the weight of water. The test blocks are, after being made and kept in a damp atmosphere, to remain in water twenty-eight days, and then sustain 170 lb. per square inch. Cement mortar will be made with two of sand to one of cement. Concrete will be made of six of gravel and sand to one of cement or lime, according to circumstances, and laid in layers of from 12in. to 18in. Temporary cylinders are to be attached to the top of the permanent cylinders to enable the building of the brick shaft to be carried on below high water. The cylinders will be lowered from and steadied by staging. Air pressure apparatus is to be employed if necessary, and as soon as a cylinder is placed on the river bed, excavation is to be commenced by subaqueous means. The cylinders are to be weighted by brickwork built up on an internal ring, and other weights added externally, each pair of cylinders to be sunk as nearly simultaneously as possible. When down they are to be filled 10ft. with concrete in 18in. to 24in. layers, and after seven days water is to be pumped out, and brickwork built in and filled with concrete to the top. Each cylinder or pier, when sunk to position, is to be tested with a weight of from 1560 tons on the largest to 200 tons on the smallest, and left fourteen days, during the latter four of which no subsidence must take place. If subsidence does not stop in ten days the pier must be sunk and special measures taken.

Rails weighing 75 lb. per yard, and those from the old viaduct, are to be used in chairs on transverse wood sleepers. Ballasting is to be not less than 1ft. 7in. thick maintained 5in. below top of rails, and to be of good sharp gravel over arches, and good ash ballast over iron floor. The line of the new viaduct is 60ft. westward of the centre line of the old viaduct, and the new piers will be exactly opposite the existing piers. The piers of the thirteen largest spans of the old bridge are founded in wrought iron cylinders, sunk into the bed of the river, and filled with concrete. These cylinders Mr. Barlow proposes to leave where they are, as their removal would disturb the bed of the river to so great a depth as to endanger the new foundation, and especially as it would be necessary to use dynamite or some explosive substance to get them away. Mr. Barlow further explains that as the new piers will each be founded on two cylinders of less diameter than the single cylinder used in the old piers, and as the centre line of the same piers is exactly opposite to the old ones, the construction of the new piers will form no greater obstruction to the waterway and navigation than that which already exists. Twenty-five of the eighty piers of the old Tay Bridge will be left standing after the new bridge is built.

The spans will be eighty-five in number, nearly corresponding to those of the former bridge, and the total length of the viaduct from the Fife shore to the junction with the brick arches referred to will be 10,515ft. 6in., or within a few feet of two miles long. From the Fife shore the new viaduct is proposed to start at a point 60ft. west of the existing shore abutment. Four brick arches of 50ft. span will first be made, from which point the structure will consist of wrought iron piers resting on brick and concrete foundations. As in the old bridge, the central spans will be thirteen in number, namely, eleven spans of 245ft., and two of 227ft. On these spans the line—which will be double throughout—will run on the level of the bottom boom of the girders, as was the case formerly, and the girders will be of the bowstring type, as shown in our illustrations of the 4th inst., and have a maximum depth of 28ft. 9in., and a minimum depth of 20ft. 3in. The level of the under member of four of those girders will be 77ft. above mean high water, being thus 11ft. lower than in Sir Thomas Bouch's work. To reach the point where the summit level is attained there will be, counting from the brick spans already referred to, one span of 118ft., ten spans of 129ft., and thirteen spans of 145ft.

The contract for the erection of the new bridge, which has been placed with Messrs. William Arrol and Co., of Glasgow, involves an expenditure of £700,000, which is understood largely to exceed the estimate under the Act of Parliament obtained last session for the re-construction of the bridge. Messrs. Arrol and Co. are at the present time engaged building the viaduct over the Southesk for the Arbroath and Montrose Railway. Arrangements are made for the use of ground on the south side of the Tay, but it is understood that all the principal works are to be carried on in Dundee. The work is to be begun at once.

Salt near Fleetwood.—A short time ago, during some boring operations at Preesal, near Fleetwood, the men came across a deep bed of rock salt. The investigations were extended; samples were sent for analysis, and the result has been that a company has been formed, principally Glasgow and Middlesbrough merchants.

The Phosphor Bronze.—A private trial trip of this steam launch, the property of the Phosphor Bronze Company, Limited, London, took place in the Thames, off Westminster, on Tuesday, 22nd inst. This small vessel is built entirely of phosphor bronze, and her length is only 35ft., her beam being about 6ft., and she attained a speed of 12½ miles per hour, which, considering her size, is a good performance. The chief object of the company in having so small a craft built was to test the rigidity of phosphor bronze sheet and angle pieces used in the construction, prior to having boats built on a larger scale, the results having been beyond the company's expectation as regards rigidity, absence of vibration, and the speed attained. As we understand that the cost of phosphor bronze boats will not much exceed that of those made of steel, and as the metal is not subject to corrosion like iron or steel, and also retains its value, its use for steam launches and torpedo boats may be expected to extend.

RAILWAY MATTERS.

THE number of miles of railway open at the end of 1880 in Australia are—New South Wales, 849½; Victoria, 1199; South Australia, 667; Queensland, 633½; Tasmania, 172½; Western Australia, 90; New Zealand, 1258. Total, 4869½.

DURING the nine months ending 30th September last, 969 failures of tires, 3 of wheels, 6 of tunnels, bridges, viaducts, culverts, &c., and 458 of rails; 44 cases of trains running through gates at level crossings; 24 of the flooding of portions of the permanent way; 21 slips in cuttings or embankments; 1 fire in a train; and 2 other accidents on the railways of the United Kingdom caused no personal injury.

THE tunnel through the Col de Somport, near the Pic du Midi, in the Pyrenees, to which we have previously referred, is probably the next large work which will be undertaken in France. Its importance may be gathered from the fact that it will shorten the railway distance between Paris and Madrid by sixty-two miles, the Spanish line passing by way of Ayerbe, Caldearenas, Jaca, and Confranc, leading on the French side into the Gave de Aspe valley and Oléron. It has also considerable political importance.

A NEW iron twin-screw dredger of 700 tons, built and engined by Messrs. W. Simons and Co., was launched on the 23rd inst. complete from their works at Renfrew. It is named Neptune of Fleetwood, and is the property of the Lancashire and Yorkshire Railway Company, and is intended for the improvement of the ports in connection with their line. The Neptune is fitted with compound engines of 100-horse power and two boilers, and is the second dredger constructed by this firm for the Lancashire and Yorkshire Railway Company. It has been built under the direction of Messrs. Douglas Hebson and W. G. Ramsden, C.E., Liverpool.

IN reporting on the collision which occurred on the 11th August, at Ticehurst-road Station, on the Tunbridge and Hastings branch of the South-Eastern Railway, Major-General Hutchinson says that this collision is to be primarily attributed to the 8 o'clock ordinary train from Hastings having been allowed to leave Etchingham Station before "line clear" had been received from Ticehurst-road Station. Notwithstanding this, however, and some error by the engine driver in observing the signals, the driver, had he been provided with a continuous brake, could probably have avoided the collision. The up distant-signal at Ticehurst-road, only 525 yards from the up home-signal, is not sufficiently distant for a line on which express trains run.

OF the 392 axles which failed on our railways during the first nine months of this year, 198 were engine axles, viz., 182 crank or driving, and 16 leading or trailing; 29 were tender axles, 1 was a carriage axle, 151 were wagon axles, and 13 were axles of salt vans; 73 wagons, including the salt vans, belonged to owners other than the railway companies. Of the 182 crank or driving axles, 120 were made of iron and 62 of steel. The average mileage of 112 iron axles was 194,209 miles, and of 57 steel axles 178,931 miles. Of the 458 rails which broke, 348 were double-headed, 103 were single-headed, 3 were of the bridge pattern, and 4 were of Vignoles' section; of the double-headed rails, 251 had been turned; 245 rails were made of iron and 213 of steel.

IT will be remembered that a short time ago two London and North-Western Railway trains ran off the line near Leeds in three days. According to Major Marindin's report on these accidents, both must be attributed to the sharpness of the curve. It is a disgrace to railway engineers that a Board of Trade official should have to say of a piece of main line railway that it is "in its present state, clearly unfit for any passenger trains to run over, and is certainly dangerous for the passage of vehicles with long wheel base." In the second case the speed of the train was not high, and yet the leading carriage was broken up, so that the value of a brake which would, by coming into action immediately a coupling is broken, prevent the rear part of the train from telescoping into the front part has here another proof.

NEW railway schemes increase. At Glossop efforts are being made for the extension of the Lancashire and Yorkshire Railway from Holmfirth to Staleybridge, connecting Glossop also therewith by a branch line through Hollingworth. This would shorten the journey from Holmfirth to Manchester by thirty miles, and open up direct communication with the South Yorkshire coalfields, and also shorten the distance with Wakefield, Barnsley, and Hull. The people of Staleybridge are in favour of a more direct route through Millbrook to Holmfirth, leaving out the Longden and Glossop dales. There is a rumour, for which we can find no foundation, that the Midland Railway Company is arranging for the purchase of the entire undertaking of the Manchester, Sheffield, and Lincolnshire Railway. It is stated, however, that the company is anxious to purchase the Lincolnshire branch from Lincoln to Barnsley, with running power to Grimsby. The Midland has been pushing its passenger traffic in that direction; but it would be curious to find the Manchester, Sheffield, and Lincolnshire helping the Midland to cut them out in its—the Manchester, Sheffield, and Lincolnshire—district. The first passenger train on the Hull and Barnsley line was run on Wednesday from Barnsley to Howden.

DURING the nine months ending the 30th September the following accidents were reported:—43 passenger train collisions, by which 8 passengers and 3 servants were killed and 373 passengers and 15 servants injured; 57 passenger and goods trains collisions—1 servant killed, 158 passengers and 35 servants injured; 17 goods trains collisions—1 servant killed and 29 injured; 2 cases of trains coming in contact with projections from other trains—2 passengers and 1 servant injured; 60 cases of passenger trains leaving the rails—1 passenger killed, 51 passengers and 2 servants were injured; 13 cases of goods trains, engines, &c., leaving the rails—5 servants were injured; 15 cases of trains travelling in the wrong direction through points—2 servants killed, 14 passengers and 11 servants injured; 11 trains ran into stations or sidings at too high a speed—45 passengers and 1 servant were injured; 126 cases of trains running over cattle—46 horses, 29 beasts and cows, 86 sheep, and 4 donkeys being run over and killed; 44 trains ran through level crossing gates; 4 cases of bursting of boilers or tubes—3 servants injured; failure of 392 axles—injury to 1 servant; 1 failure of brake apparatus — injury to 14 passengers and 4 servants; 11 failures of couplings—16 passengers and 4 servants injured; 3 fires at stations, bridges, or viaducts; and 1 train struck by timber being loaded, and a passenger killed.

THE formal inspection of the line of tramways between Leamington and Warwick took place on the 17th inst. by Major-General Hutchinson, R.E., of the Board of Trade. The works, which were designed and carried out under Mr. E. Pritchard, C.E., were commenced in the latter part of June, 1881, and completed last month, the contractor being Mr. John Fell, of Leamington. The scheme comprises a single track, commencing at a point near the Avenue Station of the London and North-Western Railway Company at Leamington, and terminating at a point in High-street, Warwick. The length of the route is a little under three miles, and there are five turn-outs, or passing-places. The narrow places, or those points of the road which would not permit of the statutory width of 9ft. 6in. of intervening space between the kerb-stone and the nearest rail, occurs only in two instances, viz., Emscote Bridge over the river Avon and Smith-street. The former difficulty was overcome by the construction of overhanging footpaths of wrought iron on either side of the bridge, and the latter by the construction of the tramway on one side of the street. The permanent way is the Barker system, which consists of rolled steel rails 34 lb. weight per lineal yard, secured by cotters to cast iron continuous sleepers, 90 lb. per lineal yard, the sleepers resting upon a concrete bed. The gauge of the tramway is 4ft. 8½in., the road, in addition to passing-places, being paved for a width of 8ft. In Leamington wood paving was used, and in Milverton granite paving, and in Warwick the paving consists of granite, slag blocks, and macadam. The cost of construction, inclusive of every expenditure, represents some £4500 per mile of single road.

NOTES AND MEMORANDA.

IN the Australian colonies there were at the end of December, 1880, the following numbers of miles of telegraph lines in course of construction:—New South Wales, 501¼; Victoria, 132; South Australia, 515; Queensland, 567. Total, 1715¼.

THE following are the areas in square miles of the Australian colonies:—New South Wales, 310,937½; Victoria, 87,884; South Australia, 903,690; Queensland, 669,520; Tasmania, 26,215; Western Australia, 1,024,000; New Zealand, 105,342. Total, 3,127,588½.

THE population of the Lagos settlement is 75,270, against 60,221 ten years ago. Of these only 117 are "whites;" 12,633 are classed as "persons engaged in commerce," while 5592 are "traders, mechanics, manufacturers, and artisans." Farmers and agricultural labourers number 11,083; fishermen, 5695; other labourers, 6026; 45 of the whites are British, 9 French, and 45 German.

THE main chain of the Caucasus which crosses the great isthmus between the Black Sea and the Caspian, from north-east to south-west, and separates Europe from Asia, extends on a line of more than 1000 miles from its extremity in the neighbourhood of Anapa, at the entrance of the Sea of Azof and Baku and the Peninsular of Apscheron out into the Caspian. The crest averages a height of about 11,000ft., and several of its peaks rival the loftiness of the Kazbek, one of them, the Elbruz, overtopping it by at least 1200ft.

A SMALL cargo of vermilion upon being analysed in Germany, turned out to be red oxide of lead coloured by eosine. This, the *Oil and Colour Journal* says, is an entirely novel sophistication. The eosine was separated from the oxide of lead by digesting the product for twenty-four hours in very strong alcohol. A much shorter time is sufficient to colour the spirit enough to enable an expert chemist to detect the presence of this splendid organic colouring matter. Another kind of "vermilion" consists entirely of peroxide of iron, prepared especially to imitate the brilliant and costly sulphide of mercury, which it does very well, and is largely used in England, France, and America.

THE American agave furnishes a very strong fibre which might be employed for many purposes, if suitable machinery for the purpose were made. It has long been put to many uses by the natives of Southern Mexico and Yucatan, and coarse thread of great strength has been made from it elsewhere. There are several varieties of the useful plant, but the leaves containing the fibre also contain a good deal of gum and silica. It has, however, been found that the fibre of some varieties can be divided so finely as to be woven with silk. The fibre at present imported into London is prepared by hand, but machinery for the purpose is required. Perhaps the makers of rhea preparing machines can modify their machines for this purpose.

AT a meeting of the Chemical Society on the 17th inst., Mr. E. Wethered read a paper entitled, "On the Chemical Action of Decomposing Vegetable Matter on the Rock-forming Sediment of the Carboniferous Period." The carboniferous rocks of the West of England above the limestone consist of an alternation of arenaceous and argillaceous strata with seams of coal. The arenaceous strata are of two types—the millstone and the Pennant grit. In almost every case the argillaceous strata immediately follow seams of coal, and in the exceptions where a grit occupies this position it becomes in contact with carbonaceous matter more or less argillaceous. In this paper the author endeavours to show that the argillaceous rocks as compared with the Pennant grit have been originated by the action of certain products of decomposition, given off from decomposing vegetable matter, on the original sediments of which the rocks have been built up.

THE committee on photometric standards have presented their report to the Board of Trade. They find that the method of taking the average of three consecutive candle determinations to indicate the illuminating power of coal gas does not yield satisfactory results. Not only do sperm candles exhibit intrinsic differences which unfit them for use as a standard, but the method of using them permits of variations which introduce serious errors into this mode of testing the illuminating power of coal gas. After a series of experiments with various photometric standards submitted to them, the committee recommend the adoption of Mr. A. G. Vernon Harcourt's air-gas flame, in which the combustible gas is a definite mixture, prepared by the operator, of air and the vapour of light petroleum. The gas is burnt at a definite rate from a ¼in. orifice in a brass burner, and the height of the flame is adjusted to 2½in. At the same time they recommend that in official documents the quality of light furnished by coal gas, as shown by Mr. Harcourt's lamp, should be expressed as heretofore in standard candles.

THE land measure of Tunis is called *mechïa*, and corresponds to the *zouidja* of the Kabyles and the *djebda* of the Arabs of the Province of Constantine. It is equal to about 11 hectares (27 acres), estimated at the quantity of land which a yoke of oxen can cultivate in a season. There are no measures of distance, the Tunis natives reckoning simply by a day's march. The measures of weight and bulk in use are the *métal*, *coffis*, *ouïbe*, and *soss*. At Tunis the *métal* is equivalent to 16 kilogrammes, at Monastir to 18, at Sfax to 19, at Djerba to 32. The *coffis* evinces the same curious irregularity, being equivalent to 600 litres (1 litre=1¾ pint) in some places, while in others it is double that quantity. The usual measure in vogue for selling oil is that of 16 *soss*, or 58 litres, and for cereals the *ouïbe*, equivalent to 12 *soss*. Textiles are measured according to the nature of the material. English cottons, for instance, are sold by the *dra-arbi*, equal to 484 millimetres, Turkish silks by the *dra-turki*, or 637 millimetres, and Andalusian cloth by the *dra-audaluci*, or 667 millimetres.

THE atomic weight of bismuth formed the subject of a paper read on the 3rd inst. before the Chemical Society, by M. M. P. Muir. Dumas, by the determination of the chlorine in bismuthous chloride found the atomic weight of bismuth to be 210·44. Schneider, by converting the known weight of bismuth into the nitrate igniting and weighing the oxide, came to the number 208·005. Recalculating these numbers with the more recent atomic weights, we have—Dumas, at *w*, 209·86; Schneider, at *w*, 207·5. The author has for some time been engaged in revising the atomic weight of bismuth, but stated that his results so far are more negative than positive. He gives some results in the present paper, obtained by the analysis of bismuthous chloride, determining the chlorine volumetrically—full details of the method are given. He obtained a mean number 211·58; gravimetric analysis indicated 209·35, mean 210·46. The differences between the various numbers are, however, too considerable, and the author hopes to obtain better results by the synthesis of bismuthous iodide.

A PAPER on the "steeping" of barley was read at the last meeting of the Chemical Society by E. J. Mills and J. Pettigrew. The authors have carefully investigated the action of distilled water and of water containing known quantities of calcium sulphate and calcium carbonate on barley; the temperatures varied from 4 deg. to 11 deg. C. The general results obtained are that water in which barley has been steeped contains at least two albuminoid bodies, one of which is thrown down by metaphosphate—a quantity of sodic metaphosphate is covered with acetified water and occasionally shaken; the clear liquid over the undissolved salt is the reagent—in the cold, the other only on boiling. The first of these is almost wholly kept back within the grain by a gypsum solution and to a less extent by a chalk solution. The general effect of a calcic solution is to keep back the nitrogenous matter within the grain, but to increase the total amount of matter extracted. The authors examined the Burton water from Lichfield, which is in much demand for steeping and attribute its value to the nitrates it contains, which stimulate the germination. On the whole the authors recommend for steeping a water containing 0·1 per cent. of gypsum and a small quantity of calcic nitrate. They suggest that with soft waters, just enough water should be used to saturate the grain and no more.

MISCELLANEA.

THE large steel bridge over the Ganges for the Oude and Rohilkund Railway is to be built by the Patent Shaft and Axletree Company, and the whole of the steel, about 6000 tons, will be supplied from the Landore Siemens Works.

ON Wednesday intelligence reached Birmingham of the death from apoplexy of Mr. Joseph Nettlefold, at his northern residence near Pitlochry, Perthshire, on Tuesday. Mr. Nettlefold was for some time the partner of Mr. Joseph Chamberlain, President of the Board of Trade, and since their enormous screw manufactories passed into the hands of a company under the title of Nettlefolds (Limited), deceased has acted as chairman of the directorate.

WE have received a copy of a catalogue with well executed engravings and full descriptions of the injectors, ejectors, and elevators made by Mr. Alexander Friedman, of 15, New Broad-street, E.C. The apparatus is shown as applied for feeding all kinds of boilers, as elevators for raising water and other fluids, as bilge water ejectors, as ventilating apparatus and as chimney blast apparatus. The apparatus is shown as fitted to ships and for throwing up to 300 tons per hour. To this application of the ejector particular attention is drawn.

A NOVEL pair of scissors has been devised by Herr Sievert, of Dresden. The blades are represented by two circular steel knives, which slightly overlap at the edges, and are pressed together by two spiral springs. The knives are fastened to a pair of wooden rollers, with india-rubber rims, which grip and guide the cloth or paper as it passes between the knives, so that the latter may cut straight. These cutters are carried by two handles or levers which are held in the hand, and the cutting is effected by pushing the scissors forward, so as to cause the rollers to revolve.

A PRACTICAL proof of the perfection to which the electric light apparatus as applied to open spaces has now been brought, was afforded last week by Messrs. Hammond and Co., electrical engineers, of London. On Monday night they accepted a contract to light up by means of the Brush electric lamps the roads at Worksop, on the occasion of the Prince of Wales' visit to the Duke of Portland, at Wellbeck, and although a special engine had to be provided and nearly three miles of wire hung, the work was completed by Saturday night, when the lights were a perfect success.

"BERLY'S Electrical Directory of England, the electrician's *vade mecum*, containing a complete record of all the industries directly or indirectly connected with electricity and magnetism, and the names and addresses of manufacturers," is the name of a directory about to be published by Mr. J. A. Berly, 16, New Bridge-street, E.C. The value of a directory of this kind will be best individually estimated by those interested in electrical progress, inventions, applications, and manufactures. We would suggest that the titles of books on the different subjects might be added.

A FIRE, which at one time promised to be most disastrous, occurred at the Severn Tunnel Works this week, through a man igniting a cask of naphtha, and a good deal of damage was caused, but not to interfere seriously with the progress of this great work. The tunnel will lessen the London route from Wales by 30 miles, but there is work for several years yet. A seam of coal has been struck in the tunnel, and the fact is a suggestive one. We may have under-sea workings inaugurated by the Severn Tunnel. This has been a favourite idea for some time with certain geologists in Wales.

A ROUMANIAN mechanic, Traiano Feodoresen, recently submitted to the Chamber at Bucharest a project of a submarine vessel, and after examination of this by a committee the Government was authorised to meet the expense of construction. The vessel is to be capable of moving under water, at a depth of 30 metres, for twelve hours, without requiring renewal of air. Steam is the motor, and the speed is greater than that of sailing vessels. The vessel is simply sunk by opening certain valves, but return to the surface requires more complex operations. An electric light will render objects distinguishable at 30 or 40 metres. For renewal of air it is not necessary that the vessel rise to the surface; an apparatus, *Nature* says, can be sent up, which, by actuating a pump, forces air into suitable receivers.

MUCH more care and ability are employed by our engineering manufacturers in preparing and compiling the catalogues of their productions than was the case even a few years ago. It is recognised that purchasers want to know a little more of the construction of the machinery and apparatus than is to be learned from perspective views and very incomplete descriptions, consisting chiefly of mere unsupported statements of the capabilities of the things referred to. A catalogue of the manufactures of Messrs. Beck and Co., of Great Suffolk-street, S.E., illustrating their hydraulic, sanitary, and other fittings, of which a copy has been sent us, is an example of the improved modern, well-illustrated, descriptive book. Special attention is directed to their new water supply fittings, including standposts, penstock and sluice valves, hydrants, pumps, and fittings for sewerage works.

WRITING upon the new methods of making worts from raw grain, the *Brewers' Guardian* remarks that:—"Large and experienced manufacturers of glucose conduct their processes with such skill and regularity that they ensure obtaining a product of constant composition, but if brewers undertake this conversion for themselves it is not to be expected that they can obtain—at all events at first—products of the same regular composition. In the conversion of raw grain by acids, there are other conditions of success over and above the question of obtaining large extracts, for there is no doubt that in this respect the process offers considerable economical advantages. Until science has thrown more light on the exact changes which take place in the conversion of starch into sugar by the agency of mineral acids, brewers will do well to approach the subject with caution; but in saying this we have no wish to deter any from taking a step in this direction, for we believe the future of brewing will be greatly influenced by a correct appreciation of the advantages to be obtained by its adoption."

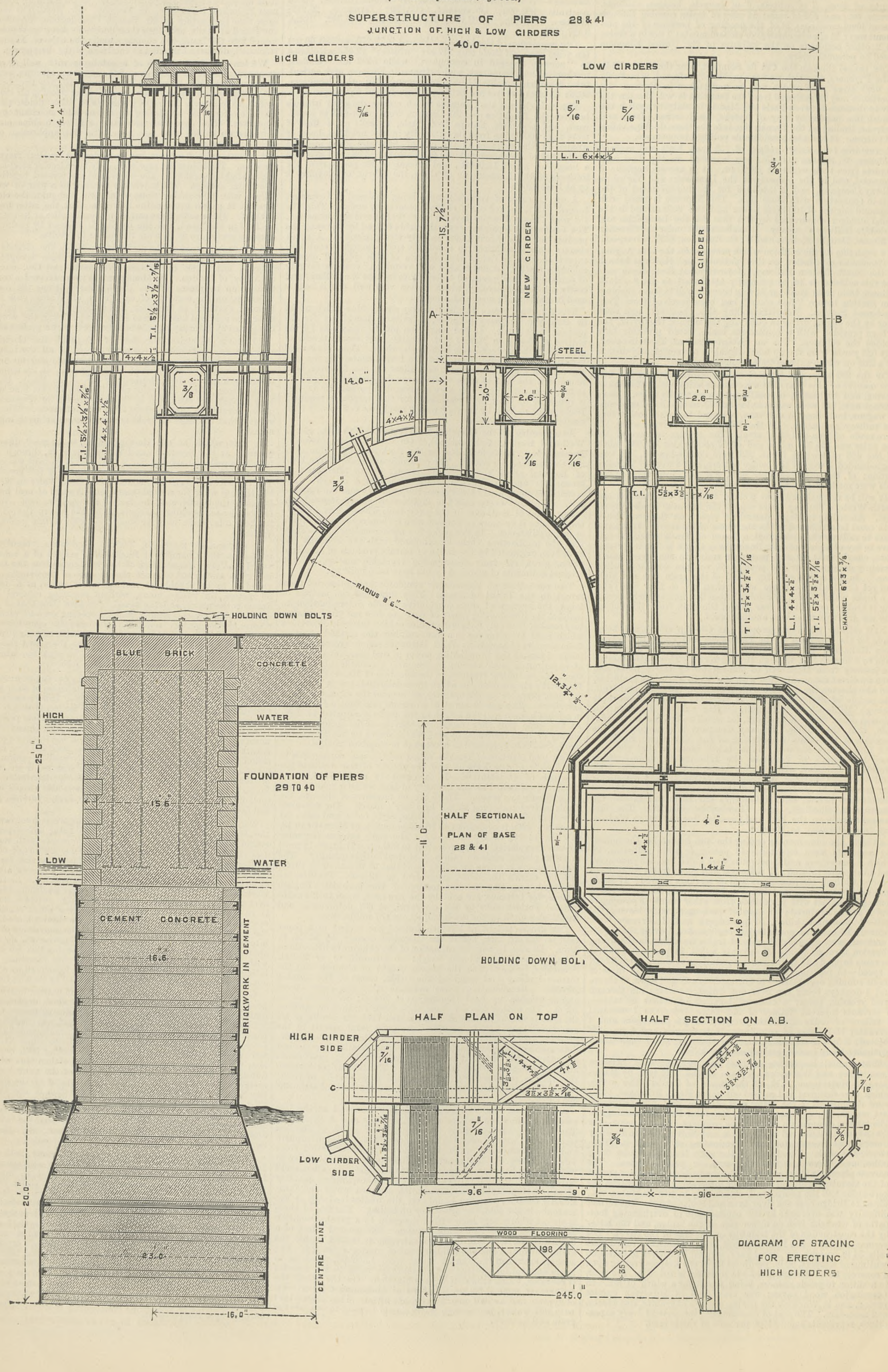
WE learn from official publications that extraordinary enterprise still characterises the French public works department for coast and inland navigation. The expenditure, under the new public works law, to the 30th September last, was £4,391,799 for the improvement of rivers, £6,218,110 for canals, and £6,812,988 for port and harbour improvements. Of these sums £1,245,263 were expended during the three months ending 30th September last, which is about one million sterling more than was expended during the same period last year. Amongst the more important of the works in progress are the improvement of the Rhône, of the Saône, and of the Seine, the construction of the Canal de l'Est and the Canal de l'Oise à l'Aisne; the junction of the Doubs to the Saône; the improvement of the canal of the Ardennes, and from Mons to Paris; and the port and harbour works at Dunkerque, Boulogne, Calais, Havre, Rouen, St. Malo, St. Servan, St. Nazaire, Bordeaux, Cette, and Marseilles.

AT a meeting of the Bath Microscopical Society, held on the 1st inst., Mr. Braham, F.C.S., introduced a new microgoniometer for measuring the angles of crystals, and gave an interesting address on the transparent crystals formed by the action of metals on carbon disulphide. Mr. Braham had sealed up in glass tubes fifteen different metals in carbon disulphide, and had subsequently examined them under the microscope. One year from the date of sealing them there were appearances of incipient crystallisation in most of the tubes. After two years' rest the tubes containing gold, antimony, and bismuth, showed transparent crystals, the shape of which coincided to the form which carbon takes in the diamond. He gave it as his opinion that it was impossible to conceive the time large diamond crystals had taken to form, and their purity depended on circumstances of large masses of matter in a solution crystallising heterogeneously until nothing but the pure element was left, and that a slow process of formation through ages completed it.

THE NEW TAY BRIDGE.

MR. W. H. BARLOW, F.R.S., ENGINEER.

(*For description see page* 384.)



TO CORRESPONDENTS.

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

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

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

A. (Longsight).—*Our leading article answers your question.*

J. N. T.—*For information concerning the Griscom motor, apply to the Electro-Dynamic Company, Philadelphia, U.S.A.*

A Student.—*The quantity of water which will reach the junction of the two pipes per minute is unaffected by the presence of the junction, and will be about* 666 *cubic feet per minute. We presume that the* 24*in. pipe is continued on to reservoir No.* 2. *The* 4½*in. pipe tapping the* 24*in. pipe will always be full, and assuming the fall to be* 60*ft. in the mile, it will discharge about* 22 *cubic feet per minute. The reservoir No.* 1 *will lose* 666*ft. per minute, reservoir No.* 2 *will receive* 666 — 22 = 644 *cubic feet, and reservoir No.* 3 *will get* 22 *cubic feet—all approximate figures.*

PATRICK MILLAR, OF DALWINSTON.

(*To the Editor of The Engineer.*)

Sir,—I shall be much obliged to any reader who will give me some information concerning the life of William Patrick Millar previous to the year 1786. I want more especially to know his birthplace, parentage, and occupation. L. M.

Barnsley, November 21st.

MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, Nov. 29th, at 8 p.m.: Paper to be discussed, "Forces and Strains of Recoil in the Elastic Field-Gun Carriage," by Mr. Henry Joseph Butter, M. Inst. C.E.

Chemical Society.—Thursday, Dec. 1st, at 8 p.m.: Ballot for the election of Fellows, and a paper by Dr. Armstrong, entitled "Researches on the Laws of Substitution in the Naphthalene Series," will be read.

Society of Arts.—Monday, Nov. 28th, at 8 p.m.: Cantor Lectures. "Some of the Industrial Uses of the Calcium Compounds," by Thomas Bolas, F.C.S. Lecture II.—Lime. The calcination of the carbonate in theory and practice. Influence of foreign bodies on the quality of the lime. Most favourable conditions for the decomposition of pure and impure forms of calcium carbonate. Cements and their uses, &c. Wednesday, Nov. 30th, at 8 p.m.: Third ordinary meeting, "The Distribution of Time by a System of Pneumatic Clocks," by Mr. J. A. Berly. Lord Alfred S. Churchill will preside. Friday, Dec. 2nd, at 8 p.m.: Special meeting. Discussion on the Society of Arts Patent Bill. The discussion will be opened by Sir Frederick J. Bramwell, F.R.S., chairman of Council, who will preside.

THE ENGINEER.

NOVEMBER 25, 1881.

THE COMBINATION OF MANUFACTURERS.

Our recent article on "Competitive Tenders" appears to have called some attention to this subject, especially with reference to the promotion of an Association of Contractors. Our contemporary, the *Contract Journal*, which appears to have previously mooted this idea, has reprinted our article in full; and makes what seems to be a happy suggestion, viz., that the authorities of the Crystal Palace should hold an exhibition there of contractor's plant, and should organise a congress of contractors, somewhat resembling that recently held at Liége, to accompany it. Contractors' plant is a branch of engineering in which much has been done, and about which little is known, and such an industry would, therefore, be very suitable for an exhibition of the kind patronised at the Crystal Palace. The interest would be much increased if the cranes, excavators, and other appliances could be seen in operation. The directors of the Palace would surely be able to find in their grounds some site where excavation would be advantageous, especially if effected at a nominal cost; and the spectacle of half-a-dozen diggers and cranes, competing with one another as to the number of yards they could raise and shift per hour, would be found, we believe, quite as attractive as the well-known implement trials of the Royal Agricultural Society. If the directors could also secure the co-operation of a few leading contractors and engineers, a congress, such as is suggested, might probably be organised; though this is a feature more familiar in connection with foreign gatherings than with our own. Whether on this would follow the formation of such an association as we have recommended would remain to be seen. Almost at the same moment with our first article, there appeared an announcement of no very good omen in this respect. A Manchester correspondent reported to the *Times* that the "National Federation of Associated Employers of Labour" had ceased to exist. Started in 1873, during the heat of the wages conflict produced by the high prices of that period, it has apparently been languishing for some time, and would have expired two years ago but that it was artificially kept alive to watch the progress of the Employers' Liability Bill. That Bill being now law, it has been suffered to perish; so offering, as is well put, one more illustration of the truth, that it is only in the presence of some extraordinary circumstances that employers can be induced to associate themselves together for any mutual effort which has not in its near prospect a pecuniary result.

We fear it would be possible to go further, and assert that, even in the presence of extraordinary circumstances, and in the view of immediate pecuniary advantages, the union of employers is generally a very doubtful and short-lived condition of things. In nearly all the great conflicts between capital and labour, the most striking feature to an outsider is this—that the men abide loyally by one another under almost any difficulties, while the masters do not. If the struggle ends in favour of the masters, the men will be found to have held out to the last, and to have come in as one body; if in favour of the men, the masters will be found to have yielded one by one, and thus to have been beaten in detail. The end of the great Nine Hours' strike in the engineering trades is a salient instance in point. It is well known that the failure of the northern masters to hold their own was due to the fact that a single firm in Sunderland was unable to face the consequences of further suspension of business; they yielded, and the ranks being thus broken, first Sunderland, then Newcastle, and finally the whole of England, gave way in rapid succession. Yet the masters asserted then, and have always maintained since, that the question was one of vital importance to them, while the pecuniary stake involved was undoubtedly immense.

Now, if in any struggle the combatants on one side are found ready to sacrifice private interests to the common cause, while those on the other side shrink from doing so, it is but natural that victory should be apt to incline to the former; and, consequently, it is not to be wondered at that in the struggles between capital and labour the advantage should so often have remained on the side of the latter; or that the Trades Unions of England should be able to indulge themselves in the pardonable self-glorification of which their recent congress gave a striking an example. If we look upon the difference in value between raw material purchased and finished goods sold as a sort of "gross profit" on a manufacture, which profit has to be divided between the master and the workmen, then it is impossible to deny that the master's proportion is much smaller, and the workman's much larger, than it was thirty or even ten years ago. Nor is it possible to deny, that this change is almost entirely the work of the Trades Unions; and they are entitled to take full credit for the achievement. It does not follow, however, that, to a disinterested spectator, the result appears to be all clear gain. A thorough-going trades unionist may, perhaps, look forward to the day when the capitalist shall simply be in the position of a money-lender, who supplies the cash with which the workmen may carry on their business, managing it as to them seems best, and paying whatever rate of interest they may find most convenient. This would be to carry on trade on the co-operative or republican, as opposed to the monarchical system. Now of the republican system of trading we, in common we believe with all thoughtful and practical men, entertain the deepest distrust, on the ground that it has been repeatedly tried, and has always ended in failure. This is not the place to argue the question in the domain of politics; but in matters of business—that is in any case where a large number of persons have to co-operate in carrying on a definite work—the proof from experience is clear and decisive. We will not linger over such obvious examples as that of an army or a fleet, in which a single commander is recognised as a necessity, even by the wildest of socialists. But ask a firm of shipowners if they would send a vessel to sea without a captain; ask the council of a proprietary school if they are prepared to do without a head master; ask the directors or the shareholders of a railway whether they would leave their permanent way department to be managed by a council of platelayers, or their locomotive department to the joint control of the running-shed foremen. We have chosen these cases because they are all those of persons who are vitally concerned in the good management of a certain enterprise, but who at the same time are not the actual managers themselves. But to any one reading these lines who is, or has been, a master, we would simply suggest that he should try to realise the state of things which would result if each shop were managed by a committee of journeymen, or even if a council of foremen were substituted for the works manager. Should anyone desire yet further evidence, we may simply point to the proved failure of the opposite system. Nobody can say that the principle of co-operation as applied to manufactures has not had a fair trial. Under the auspices of Mr. Thos. Hughes and his friends; and more recently under that of the trades unions, the principle of co-operation has been tried, not in respect to one trade, but to several, and with an enthusiasm and determination which would have led to success had success been possible. But of all these cases there is but one, so far as we are aware, of which it is even possible to argue that it has succeeded. This is the case of the co-operative cotton companies of Oldham; and of these it may be remarked, first, that many of them have, as a matter of fact, succumbed; secondly, that the production of yarn has become so much a mechanical process that the conditions of management are much simplified; and thirdly, that the management of the successful mills has been really left to a very few well-selected leaders. As a decisive instance on the other side we may point to the Ouseburn Co-operative Engine Works, which were started, just at the close of the Nine Hours' struggle, under the auspices of those by whom that struggle had been won, were carried on under conditions, as regards the command of borrowed capital, such as few private firms enjoy, and yet ended within a very few years in hopeless and unmitigated failure. So well has the lesson been taken to heart that no similar attempt has since been made, to our knowledge, by the engineering trades—a confession much more decisive than any in words could be, that the system is recognised as a mistake.

We hold, therefore, firmly by the principle on which the trade of the world has always proceeded, viz., that the master, who finds the capital, should manage the business. It may be objected by some that we have spent a very unnecessary amount of time in proving this. But an answer is that The Engineer is written, not for one class, but for many; and that there are not a few amongst the working men, and many more among their *doctrinaire* advisers, to whom the republican idea of management has a special charm. Assuming, however, that the continued existence of masters is acknowledged to be desirable, we have to consider how that existence may be secured; and it is obvious that for this purpose it is necessary that they should, on the average, reap such a return for the investment of their capital and energies in legitimate enterprise, as will encourage them to persevere in the same path. Now it is our firm conviction that this return has not, on the average, been reaped by English employers during the last fifteen years, and this in spite of the exceptional profits of 1872 and 1873. We do not, of course, say that money has not been made in many cases; but it has been made by an exorbitant demand for raw material; as in the case of the coalowners, or by happy invention; or by fortunate speculation, and not by the steady carrying on of legitimate trade. Taking the manufacturers in our staple industries as a whole, and remembering those who have failed, as well as those who have succeeded, we believe they would have done better for themselves if they had had their money invested at 4 per cent., and been free to apply their energies in other directions. If this be true, then, if England is to continue a prosperous nation, it is absolutely necessary that, somehow or other, the sum received by the employers out of the "gross profit" as defined above should be larger in amount. But in seeking to increase this amount, the employer stands between two fires. On the one side are his own employers—in other words, those whose orders he executes—always anxious, by every device of competition, to make that gross profit itself as small as possible. On the other side are his workmen, always striving that, whatever the gross profit may be, their own share of it shall be as large as possible, and shall in no case fall below a certain sum. With these two opposing forces both leagued against him, his chances, as long as he stands alone, would seem to be very unfavourable. Union, and union only, seems able to save him. A stable combination of British employers would be able to remove the evils of the competitive system on the one hand, and to resist any undue encroachments of the workmen on the other. It is from this conviction that we would urge upon masters to regard the unfavourable results of former combinations, not as warnings that all combination will be unsuccessful, but as lessons teaching how it may be made to succeed. What these lessons are we have not now space to inquire. We may point out, however, that the evidence is not all one way. Cases of successful combination among masters do exist, such as the Iron Trades Employers' Association; while the Board of Conciliation in the North, which assembled to do honour to Mr. David Dale, is a standing instance of how the principle of union may be applied to the advantage of all parties alike. If the great mass of British employers would only take such cases for models of what to copy, and the others we have mentioned, as warnings of what to avoid, we believe that they might yet form themselves into a united body, whose action would have the happiest effect, not only on their own interests, but on those of England and of the civilised world.

SIR FREDERICK BRAMWELL ON THE STEAM ENGINE.

Sir Frederick Bramwell holds a position sufficiently eminent as an engineer to make it advisable that he should speak cautiously in public, lest he should mislead men who would neglect the utterances of less able speakers. We do not think that Sir Frederick recognises the truth of this proposition. At all events, it is certain that more than once he has in public made statements and expressed opinions which coming from a less competent authority would be looked on as public manifestations of ignorance. If Sir Frederick Bramwell designed a bridge, totally neglecting all the principles usually observed in designing such structures, we should not think of asserting that he acted in opposition to the practice of other engineers because he knew no better; on the contrary, we should take it for granted at first, that he had some more or less occult reason for doing as he did. In the same way, when Sir Frederick makes statements in public concerning the steam engine which are, to say the least of them, not consistent with known facts, or are opposed to the results of experience, we ask ourselves what can he mean? Unfortunately, we have not as yet found the answer to our question.

A notable example of the facility with which Sir Frederick makes what if made by another engineer would be considered rash statements, is supplied by his presidential address delivered to the Society of Arts on the evening of Wednesday, the 16th inst. Sir Frederick very soon after he began to speak turned to the steam engine, and he then uttered a series of assertions concerning it which were as well as possible calculated to evoke controversy. No discussion, however, follows the delivery of a president's address; and Sir Frederick had certainly not the object of getting up a discussion to serve. It is fair to Sir Frederick Bramwell to let him speak for himself:—"We know," said he, "that the wasteful steam engine is one without condensation, without expansion, and one working at comparative low pressure. We know, on the other hand, that the economical steam engine is one with condensation, with expansion, and with high pressure; and further, we know that to enable great expansion to be really useful, in practice that expansion must be accompanied by the jacketting of the cylinders in which the expansion takes place." We admit the truth of the first proposition in the foregoing passage. Wasteful steam engines work with low-pressure steam, small expansion, and no condensation. But the second proposition is one the accuracy of which no engineer experienced in the use of steam will concede. To begin with, condensation is not essential to economy, nor is high pressure, and expansion if carried to excess may be productive of anything but economy. The modern locomotive excels in economy by far the larger number of condensing land engines. Its consumption may be safely taken as not exceeding 3 lb. of coal per horse per hour. If Sir Frederick will compare this consumption with that of mill engines as set forth say in the reports of Mr. Lavington Fletcher, he will find that condensation is not absolutely necessary to the realisation of a high degree of economy. Nor is high pressure, if the words are used in the sense of "excessively high pressure." For practical reasons it is found advantageous to use steam of 90 lb. to 120 lb. in expansive engines; but theoretically, steam of 50 lb. or 60 lb. pressure would be quite as economical. The most remarkable passage in the paragraph we have quoted is, however, that referring to jacketting. If Sir Frederick had said "I know," we might have passed the proposition by in silence. When, however, by using a plural pronoun, he implies that engineers as a body, represented by himself as their spokesman, know that expansion must be accompanied by jacketting, we lift up our voices in protest. This is just one of the things which engineers as a body do not know. It is one of the most vexed questions connected with steam engineering. Marine engine builders producing the most economical steam engines in the world, as often as not omit the jacket altogether; and we have failed to find that any conclusive evidence exists among shipowners proving that compound engines with jackets are much more economical than those without, or that a jacket effects any appreciable saving in the use of coal. Sir Frederick Bramwell knows exactly what the competitive steam engines did at the celebrated Cardiff competition in 1872. The winning engine, Messrs. Clayton and Shuttleworth's, used 32 lb. of feed-water per indicated horse power per hour. That engine was jacketted. It may surprise Sir Frederick to hear what is none the less true, that ordinary commercial portable engines, with unjacketted cylinders, made by Messrs. R. Garrett and Son, have been proved by prolonged experiments made day after day, to require not more than 33 lb. of feed-water per horse per hour, and this with about the same range of expansion, and under much the same conditions as the Lincoln prize engine. The Lincoln engine won because of its admirable boiler; but this is beside the mark. We mention the facts to show that nothing can be easier than to adduce practical proof that the value of the jacket is open to question, and is questioned daily by men of very great practical experience and no small theoretical knowledge. We are tempted as we read the report of Sir Frederick's address to conclude that he really knows very little about the steam engine. Of course we do not give way to the temptation, but Sir Frederick is very trying. Take, for example, the following passage. Speaking of the jacket he says:—"It might, or rather I should say it inevitably must, strike any one that this is a contrivance whereby, although the cylinder itself is kept hot, it can only be at an expenditure of a greater amount of steam by condensation in the jacket, than would have been condensed in the cylinder if the steam jacket were not used; because the jacket, having of necessity a larger surface than that of the cylinder, must condense more steam. We now know, however, thanks to the thorough investigation the subject has received at the hands of scientific men, why it is that, notwithstanding by the use of the jacket we do undoubtedly expose the steam to the action of a greater cooling surface than it would be exposed to were no jacket employed, the result of steam jacketting is a considerable economy, with expansive steam engines, in the total quantity of steam used."

Is Sir Frederick Bramwell aware of the fact that the steam condensed in a well-clothed cylinder by external radiation is probably less than 1 per cent. of the whole weight passing though that cylinder? The augmented surface of a properly jacketted cylinder, that is to say, one with a thin liner inserted, is not 10 per cent. greater than that of an unjacketted cylinder. The difference in loss due to the use of the jacket from external radiation is consequently probably not more than one thousandth part of all the steam passing through the engine—an infinitesimal quantity. It may be said that Sir Frederick was speaking to a popular audience and combatting a popular error, and therefore attached weight to an objection about which engineers know nothing. But then the way to deal with the error would have been to show, as we have done, that the quantity of steam condensed in a well-clothed cylinder by external radiation is so small that any moderate augmentation in its amount may be wholly neglected. Instead of doing this Sir Frederick left on the minds of those who heard him the impression that jacketting a cylinder does cause extra condensation by radiation to an injurious extent, although it is true that the loss is more than made up by the action of the steam envelope surrounding the working cylinder. But how the jacket operates for good Sir Frederick did not attempt to explain, although his explanation might have been conveyed in a very few words.

Sir Frederick referred briefly to the labours of Mr. Loftus Perkins, a gentleman who deserves success, although he has not commanded it. We believe, and have often stated, that he is entirely mistaken in his views concerning the steam engine; but we willingly bear testimony to his indomitable energy, and to his skill as a constructive engineer. He is now, we learn from Sir Frederick Bramwell, constructing an engine which is to carry a boiler pressure of 1000 lb. and to expand steam 350 times. We have not the least hesitation in saying that such an engine must be a failure. We will even go so far as to say that 1000 lb. of steam cannot be expanded in any engine 350 times. This contemplates a terminal pressure of under 3 lb. on the square inch absolute. Long before the 350 nominal expansions have been reached the steam will be all condensed. There is no conceivable system of jacketting which could be constructed which would prevent this result ensuing. During the trials which have been made by Sir Frederick Bramwell himself with the engines of the Anthracite not less than 47 per cent. of all the steam entering the engine was condensed in the first cylinder. It is true that this was, to a large extent, re-evaporated in the next cylinder. But there is a limit to this kind of thing; and in any case the result is that the water has to be reconverted into steam at the expense of something. It is not economical to evaporate water twice over to get power out of fuel. Leaving Mr. Perkins' proposed engine on one side, we come to the most remarkable statement made by Sir Frederick Bramwell in this connection. He is comparing the Perkins engine with the best modern marine engine. He begins by stating that the Perkins engine gives an indicated horse-power for 1·66 lb. of coal per hour, and he goes on:—"Some present who know that engines using only 100 lb. steam are reported to work for $2\frac{1}{2}$ lb. of coal per horse-power per hour may look upon the difference of $\frac{5}{6}$ths of a pound, which alone exists between these two rates of $1\frac{1}{2}$ lb. and $1\frac{2}{3}$ lb., as practically unimportant, and such a feeling is, I think, by no means unreasonable. It is easy to appreciate the value of the reduction made when $7\frac{1}{2}$ lb. of coal per horse per hour consumption is brought down to 5 lb., but it requires a little thought to enable one to perceive that a reduction from $2\frac{1}{2}$ lb. to $1\frac{2}{3}$ lb. is as large a percentage as is the reduction from $7\frac{1}{2}$ lb. to 5 lb.; but nevertheless it is so, and therefore the diminishing the consumption from $2\frac{1}{2}$ lb. to $1\frac{2}{3}$ lb. has the same effect upon the increase in the time during which a steam vessel can keep at sea without having to replenish her fuel as that due to a diminution from $7\frac{1}{2}$ lb. to 5 lb.; from which it follows that where a steamboat, worked with the very great economy of $2\frac{1}{2}$ lb. of coal per gross indicated horse-power per hour, could keep the sea for only fourteen days, one working with a consumption of $1\frac{2}{3}$ lb. could keep the sea for twenty-one days, a matter which is frequently of more importance than that of the mere saving in the cost of the coal itself. Again, it must be remembered that, in taking into consideration the cost of coal, that has not to be measured alone by the price paid for the fuel at the port where it is put on board, but also by the lost earnings of the freight displaced."

Now, we believe Sir Frederick Bramwell was present at Newcastle during the summer meeting of the Institution of Mechanical Engineers, and he probably heard Mr. Marshall's paper on the marine engine read. If so, he must be aware that modern marine engines which work with "the very great economy" of $2\frac{1}{2}$ lb. of coal per horse per hour are strictly exceptional. The greater number of compound engines use but 2 lb., and a very large number indeed get on very well with 1·75 lb., while engines burning but 1·5 lb. are far from being uncommon. Can it be possible that Sir Frederick Bramwell is ignorant of these truths? Is it not rather that he declines to believe the assertions made not only by engineers, but by shipowners? If he will take the trouble to inquire he will find that what we state is perfectly true; and that Mr. Perkins has not yet succeeded in producing an engine working at even 400 lb. on the square inch which exceeds in economy engines working with less than one-fifth of that pressure.

There is much more in Sir Frederick's address which deserves comment and criticism, sometimes adverse, sometimes favourable, but we have not space to deal with it now. On the whole, the address is a very good *résumé* of recent progress, but it is marred by evidence of haste in its preparation, and want of reflection on the part of the author, who appears, indeed, to be ready to lend all the great weight of his approbation to wild schemes without a moment's thought of the consequences. For example, he professed to approve of a scheme by which the signalmen on a railway could shut off steam and apply the brakes if a driver ran past the signals. Sir Frederick fails to see that if his plan were adopted the control of trains would be practically transferred from a class of very highly-trained, comparatively well paid men, to another class under paid, and altogether of a lower type; and that at the same time an amount of additional complication would be introduced at junctions and in station yards, among the points and signals, which cannot even be contemplated without dismay. The temptation to say something sensational to his audience proved, we fear, too much for Sir Frederick. Few of his hearers would be competent to criticise what he said, and in any case their mouths were sealed. Sir Frederick knows so much and speaks so well that it is much to be regretted that he should suffer himself to be demoralised by addressing a "popular" audience in a "popular" way. Sir Frederick is a man of science, or he is nothing. What such men say is always heard by others than those immediately addressed; consequently nothing is so essential to the speaker as minute accuracy. We did not think it possible that Sir Frederick Bramwell could, in the limited time at his disposal, do so much to prove that he knows nothing about the modern steam engine. It is a great mistake to try to talk down to the assumed level of an audience. If Sir Frederick had addressed an audience composed exclusively of engineers, he would have said different things; or, at all events, if he had said the same things, he would have said them in a very different way.

THE STRENGTH OF IRON PLATFORMS.

We have recently received two or three letters asking for information concerning the strength of iron platforms. These platforms are practically floors, capable of covering large areas, but they differ from the ordinary warehouse floor in an important respect. Concerning the strength of such structures, nothing has been written, most probably because they are hardly ever used. We do not know to what use our correspondents intended to devote them, and it is, indeed, more than likely that their questions did not refer to platforms to be really made, but rather to ideal constructions, to calculate the strains in which would serve admirably as an examination question. Whether our correspondents have or have not seen the full force of their queries we need not stop to inquire. It will suffice to say that the platforms they have written to us about possess certain properties which make them well worth a few minutes' attention; and it is, indeed, matter for wonder that they have not received more notice than has hitherto been given to them. We have used the word "platform" to distinguish between these and ordinary floors; but it will be seen in a moment that all that can be said concerning them will apply to any floor intended to sustain a heavy distributed load, such, for example, as that of a large granary, or of a cotton mill thickly covered with machines.

In order that the difference between the two types of structure, viz., the ordinary floor and the platform, may be understood, it will be well to begin by describing the first. It consists of a series of wrought or cast iron girders, extending from one side of the building to the other. On the lower flanges rest the ends of short iron joists, and the space between them is either filled up by jack arches or by buckled plates, or corrugated plates, or even by flat plates; in some cases timber planking is used. We have here then, first, the main girders, and secondly, the joists. Now in the platform the places of the joists are taken by other girders, equal in depth to the main girders, and rivetted to them. The result is that whereas in the floor we have a set of continuous girders crossing the space to be spanned in one direction, and a set of discontinuous joists in the other direction at right angles to the line of the main girders, in the platform we have two sets of main girders interlaced, so to speak, and continuous in both directions. It will be seen that the working conditions of the two structures are very different, and it will also be seen that weight for weight the platform is much the stronger of the two. It is by no means so easy as appears at first sight to calculate the strength of a platform, and this is, we presume, the reason why correspondents have written to us on the subject. To calculate the strength of a floor is a very easy matter. As a rule the joists, because of their short span, are much stronger than the main girders. If we take care of these last, the joists may be pretty well left to take care of themselves, we have only to ascertain the strength of the main girders, and, for the benefit of our younger readers, we may say here that this is most easily found by the very simple rule given by Mr. D. K. Clark, when of cast iron. To the sectional area of the lower flange add one-fourth of the sectional area of the web calculated on the total depth, all in inches; multiply the sum by the total depth in inches and by $2\frac{1}{4}$, and divide the product by the span in feet. The quotient is the breaking weight in tons at the middle. The distributed load may be twice as great. Here it is assumed that the iron has a tensile strength of 7 tons to the square inch, and weaker iron should not be used, and also that the cross section of the girder is of fairly good form—that is to say, with four or five times as much metal in the bottom as in the top flange. For castings less than 0·75in. thick the girder will be less strong, the tensile strength of the iron not exceeding 6 or $6\frac{1}{2}$ tons. To find the strength of a wrought iron girder solid rolled, to the sectional area of the bottom flange add one-fourth of the sectional area of the web calculated on the total depth, both in inches; multiply the sum by the depth in inches and divide by the span in feet, the quotient is the breaking weight in tons at the middle. A simpler rule is to multiply the breadth of the joist in inches across the flanges by the square of the depth in inches and by 0·6. The quotient, divided by the span in feet plus 1, is the breaking load at the middle in tons. Of course it is understood that these rules refer only to the ordinary rolled joists to be found in the market. To find the strength of rivetted wrought iron beams, such as are used for what we have termed main girders, find the sectional area of both flanges with their angle irons. To half the sum of these areas add one-fourth of the sectional area of the web, calculated on the total depth, all in inches. Multiply this last sum by the depth in inches and by 10, and divide by the span in feet. The quotient is the breaking weight in tons at the middle. It will be seen that the ultimate strength of the floor is that of the main girders; the joists add nothing whatever to it, and it is evident that almost the whole load is sustained by two walls only—those on which the ends of the main girders rest, unless, indeed there are cast iron columns as well. But whether there are columns or not, the end walls have only to support half the load on the rows of joists next them.

If we turn to the platform we find a very different state of affairs. The joists are now as strong as the main beams—assuming of course that they are properly secured to the main girders where they cross them—and all the four walls surrounding the space to be floored have now to take their share of the entire weight. A good example of the kind of structure we speak of is to be found in iron ships, in which the longitudinal stringers cross the frames and are made continuous by angle iron flanges and rivets at the ends, and by cover plates on the flanges at the points of intersection. We have to deal here with two sets of girders at right angles to each other. To calculate the breaking strains we may take the simplest case, and suppose that two girders only and of equal length are used crossing each other centrally and at right angles; if the load is applied at the middle of the length of each, and therefore at the point of intersection, it is clear that twice as much can be carried as if only one girder were used. It is also clear that if two girders were used at right angles, but that only one was continuous, the other being cut in two at the point of intersection, and supported only on the flanges of its fellow, the strength would be that of one girder only. In other words, by making both girders continuous, we double the strength of the structure, and, broadly speaking, this rule will apply to all square floors. Other things being equal, if we make all the girders continuous we double the strength of the structure. In calculating what its strength will be, however, the problem presented for solution is more complex in a real platform consisting of a number of girders than is the case when we have only one to deal with, because of the transmitted strains. If the main girder of a floor breaks it tumbles down, and with it go the ends of the joists which rested on it. But in a platform, even though a girder should break in one place, it would not necessarily fall down, because it might be sustained by the girders at right angles to it. Each case must accordingly be dealt with on its own merits, and it must always be remembered that any strain, no matter what its locality, will be extended through the whole platform, becoming less and less as we recede from the original centre of effort. This is not the case with a floor, the strains on which are localised by the want of continuity in the girders. To make this quite clear, it will suffice to place a weight on the wooden lid of a rectangular box. No matter where the weight is placed the whole lid will be strained. If, however, we substitute for the lid a grating of flat parallel bars not fastened together, it is evident that only those bars on which the weight rests will have any load to carry. As to the method to be adopted in calculating the strength of such floors, we can do no more than indicate general principles, referring our readers to any good work on strains on iron structures for further information. The first thing to be considered is, where would the floor give way under any given load, and in giving way what flanges would it tear asunder? This known, we have the key to the whole problem. But it must not be supposed that a platform is of necessity to be twice as strong as a floor. It will be seen that to secure this double strength something much deeper than joists must be substituted for them, and if these new girders are not put as close together as the joists were, then the designer may get into trouble with his jack arches, or their equivalent.

By this time our readers will be in a position to see that apparently a very great advantage would result from substituting in the construction of warehouses and other large buildings platforms for floors; but other things than mere strength have to be considered. The floor as now made is a very inexpensive structure. Girders and joists can be bought by the mile, and require no skilled labour to fix them. A platform is, on the contrary, a more or less costly structure. It must be built up in place and with great care by skilled labour. If it is not well made nothing will be gained. The junctions of the girders must be as strong as the girders are at any other place. This militates against the adoption of the platform. On the other hand it is indisputable that by its adoption much dead weight may probably be saved—often a matter of very considerable importance; and, furthermore, as the load will be diffused over all the walls of the building, foundations are less likely to give trouble, and less expensive footings, &c., will be needed. The advantages to be gained by substituting the platform for the ordinary floor may indeed be so great that engineers and architects called upon to design large buildings, such as mills and warehouses, will do well to calculate the cost both of the ordinary and of the platform method of construction, and we venture to think that in many cases it will be found well worth while to adopt the latter. Hitherto its use has been almost wholly confined on land to bridge floors, and notable examples may be found in the floors of some bridges on the Lincoln and Spalding Railway, between Sleaford and Nocton, constructed by the Great Northern Railway, and referred to in our impression for the 20th of May, 1881. The system is, however, seldom fully carried out, no attempt being made to render the girders as strong at the intersections as elsewhere. It is not remarkable, therefore, that very little is practically known about a system of construction which deserves more consideration than it has yet received.

VIENNA CITY RAILWAYS.

The project presented by Mr. Fogerty, still excites the liveliest interest in all circles in Vienna, and has been received with warm approval by the Government and the managers and authorities of the great systems of railways whose termini are now situated at such inconvenient distances from the central city. Largely attended meetings have been held at the railway officials' club, where a lecture, illustrated by diagrams, was delivered by Herr Obermeyer, the president of the club and traffic manager of the Westbahn, who is a warm advocate of the undertaking. At the meeting for discussing the lecture which followed, on the 8th inst., the Minister of Commerce, Baron Pino, was present, and expressed himself as personally enthusiastic in the matter. Baron Matzinger and Hofraths Pischoff and Willets, of the Austrian Railway Department, were also present, as well as a large number of general officers from the War-office, and officials of other State departments. Meetings have also been held at the Club of the Gewerbe-verein or Association of Manufacturers of Vienna, where an explanation of the project was given by request of the association, by Herr von Gunesch, Member of the Vienna Institute of Civil Engineers, who is associated with Mr. Fogerty in promoting the scheme. His Excellency the late Handels Minister presided, and the meeting expressed their unanimous approval at the conclusion of the lecture. A similar explanatory lecture was delivered in the second Bezirk of the Leopoldstadt by Herr Stiassny, Architect and Civil Engineer, and the subject was brought before the Wissenschaftlicher, or Scientific Club of Vienna, in a lecture delivered by Herr Abel, Architect, on the 14th inst., which was largely attended, and a unanimous vote given in its favour. The question is to be brought before the Vienna Institute of Civil Engineers and Architects on Saturday evening next by Herr Tilp, Central Inspector of Railways for Lower Austria. Several evenings will be devoted to the discussions, and the promoters of the rival schemes for underground railways, which have been recently brought forward, will also be heard in support of their project, which, however, they have not yet ventured to submit to the severe test of passing the very strict examination applied to all railway plans and sections by the Austrian Government Railway Department. The Eisenbahn Commission of the Municipality have not yet presented their report, and are involved in stormy discussions at each meeting. The petition of the Corporation for a further period of six months for consideration of the regulation of the Wien river before deciding on the city railways has been refused by the Handels Minister, who would only allow until the 15th of next month for decision, as the two projects are not necessarily connected. The Commission of leading Vienna architects, including Barons Ferstel and Hasnauer, Herren Schmidt and Hansen, who were requested by the Corporation to report on Mr. Fogerty's designs, have done so in very favourable terms. The artists, on the other hand, as is generally the case, object altogether to the introduction of railways into the city. The leading journals, such as the *Neuie Frei Press*, *Tagbladt*, and *Deutsche Zeitung* warmly support the railway, whilst the Radical organs of the Left party are violent in opposition, so that the whole matter bears at present somewhat the political aspect of a contested election in the Austrian capital. At a recent meeting of the electors of the large suburb of Hernals at which Baron Friedmann, U.P., well known in scientific circles in connection with improvements in steam injectors, presided, and made a powerful speech in favour of the Girdle Railway, resolutions were passed in favour of petitioning the Reichsrath on the question which Baron Friedmann undertook to present, and to move an interpellation to the Government as to the cause of delay. Similar meetings are being held in the other suburbs which are likely to be most benefitted by the projected lines, and are now devoid of the means of rapid communication. Professor Englehard, of the Vienna University, well known as a man of science and a statistician, also recently delivered a powerful address at a public meeting in the city on the question of the economical advantages which would result to Vienna from the construction of the railways on the plan proposed, which he advocated as the only true solution of a problem he has long studied, and compared the recent progress of Berlin in means of intercommunications with manifest disadvantage to Vienna, whose destitute position in this respect he attributed to the stupidity and ignorance of the Gemeinde. It is hoped that before the end of the year some satisfactory decision will be arrived at; but engineers who venture on such undertakings as that of Mr. Fogerty, in a country like Austria, must evidently calculate on hard fighting and be powerfully supported by the sinews of war.

A PROPOSED YORKSHIRE LINE.

Few of the railway projects that are shadowed forth in the statutory notices are more interesting or are likely to be productive of a greater contest than that which from Hellifield takes up the old Skipton and Kettlewell route, and passes north-east into the North Riding of Yorkshire. Some years ago one of the greatest contests in the session was over three proposals to form railways from the south-west Yorkshire district to the north-east. One of these had the weight of the North-Eastern Railway Co. behind it, a second was more or less supported by the Midland Railway Co., and the third was an independent and ambitious project contemplating the construction of a line starting from Sunderland and to pass on to the North Riding of York towards Skipton. The contest resulted in a compromise. A line was accepted between the Midland and the North-Eastern Railways, and the independent line was thrown out. Leyburn was taken as the starting point of the line, which ran through Wensleydale. That part from Leyburn to Hawes was made by the North-Eastern Railway Co., and the part from Hawes to the junction with its Settle and Carlisle branch was made by the Midland Company. But the need for a line doing what any of the three would have done has remained and increased; and there have been one or two slight attempts to supply the want. Two sessions ago Parliament granted powers for the construction of a line from Skipton to Kettlewell, and last session it gave powers for a line to near Aysgarth in Wensleydale. We believe that nothing has yet been done to carry out these projects; but there is now a more imposing proposal announced as intended to be laid before Parliament next session for its sanction. Starting at Hellifield and utilising the route proposed between Skipton and Kettlewell, the intended line will terminate more to the east of the Wensleydale branch of the North-Eastern Railway, and will thus form possibly a route between the great manufacturing districts of Lancashire and the east coast, towards which it is probably ultimately proposed to run. It is a revival indeed of parts of one of the three great schemes we have named as having been fought bitterly over some years ago. Until investigation reveals the promoters and opponents of the scheme, it cannot be said what are its chances of success; but it may be said that it would very materially benefit the growth of the trades of the north-east and of the Lancastrian manufacturing districts. There has been for the last score of years no addition to the facilities for traffic between those districts, and at the present time it may be said that the trade has outgrown the railway accommodation provided. Hence the need for the creation of what may be called a trunk line of railway between the north-east coast and the south-west of Yorkshire as well as Lancashire is great and is growing. It remains to be seen how far the schemes of the next session will meet that want, and how far they will pass into Acts; but if the North-Eastern board were to take upon itself the construction of such a line it would relieve its overcrowded Leeds northern line, and develope the through traffic.

LITERATURE.

Die Darstellung des Eisens und der Eisensfabrikate. By E. Japing Hartleben, Vienna, Pesth, and Leipzig. 1881.

This little book forms the first part of a series on "Eisen und Eisenwaaren"—in other words, on "Iron and Goods made of Iron"—which it is proposed should deal with iron from the point of view, not so much of an iron manufacturer or an engineer as of an iron merchant, who wants to know generally how the article he deals with is made, and under what conditions it is converted to its various ultimate uses. The preface remarks that no book has ever been written from this particular standpoint. Books designed for merchants are purely commercial, and say very little as to the characteristics and manufacture of any particular article, while books on iron are purely scientific and technological. This remark is, we believe, true; and it certainly seems as if there is room for a work which shall comprise a history of iron, so to speak, from its cradle to its grave—beginning, as metallurgical books do, with the mine and the calcining kiln, not stopping, as they do, at the merchant mill or the foundry, but describing both technically and commercially the various applications of finished iron, and tracing briefly the course of events in each case, until the implement or machine finds its last resting place on the scrap-heap. The only work, so far as we are aware, which can at all be said to meet this want is Dr. Pole's excellent treatise on "Iron as a Material of Construction;" but that book is written specially for engineers—that is, for the users, not the vendors of iron; it dismisses the manufacture of iron very briefly; and it takes no account of steel—a form of iron of which some knowledge is now indispensable.

The present volume, as we have said, deals with the first and most important part of the subject. It comprises the properties and classification of iron and steel, the smelting of iron ore in the blast furnace, the making of iron and steel castings from the pig, the manufacture of finished iron, including bars, plates, wire, tubes, &c., the coating of iron with tin, zinc, &c., forging and welding, cold working, as drilling, turning, &c., and finally the making of certain articles of general use, as bolts and nuts, nails, chains, spur wheels, cutting tools, &c. This last chapter seems somewhat out of place, unless it be considered as a connecting link between the general treatment of iron, and its special application to machinery and other articles.

The volume, which is written by a former manager of ironworks, now editor of the *Metallarbeiter*, displays the care and thoroughness characteristic of German work. Thus, in mentioning the various classes of iron, he is careful to give, with the German name, the English and French equivalents, *e.g.*, he speaks of "das halbirte Roheisen (mottled iron—fonte truitée)." This sort of information is very useful, especially to a merchant, and not easy to acquire, as technological dictionaries are often deficient. The descriptions of the blast furnace, puddling furnace, &c., are brief, but clear, and well illustrated by woodcuts. They of course relate mainly to processes actually used in Germany, but that to some extent increases their interest. The account of the ordinary processes of the foundry is fuller than we have seen elsewhere, and the same may be said as to wire manufacture; on the other hand, the chapter on plates and the description of pipe-making could be lengthened with advantage. The information as to strength and ductility is also meagre, and should be largely added to. On the whole, however, the book may be recommended as containing much which the student, whether his vocation be that of an ironmaster, an iron merchant, or an engineer, will find exceedingly useful, and which he will hardly be able to meet with elsewhere in anything like the same compass.

Ingenieur Kalender, 1882. By H. Fehland. J. Springer, Berlin.

This is a German representation of the well-known Molesworth's Pocket-book of English engineering literature. In addition to a pocket-book of the ordinary form, with blank leaves, &c., it comprises a separate supplement, which contains short rules on arithmetic, trigonometry, mechanics, and the construction of particular parts of machinery, such as rivetted joints, shafts, couplings, &c. The table of contents is on the outside leaf only, which, being of thin paper, is exceedingly likely to be torn off; and the pocket-book, which also contains a considerable quantity of information, has no table of contents at all—or we have failed to discover it, which is nearly as bad. This, as compared with Molesworth's synopsis of contents and extensive index, speaks but ill for German care and industry. The work is said to be meant for mechanical and metallurgical engineers, and the latter clause probably accounts for the introduction of a large amount of matter on blast furnaces, puddling, steel making, &c. Such information should be obtained from special text-books, and is out of place in a pocket-book, whose office should be to give everything an engineer can want when away from his library, and nothing more. The more purely numerical parts of the book, such as tables of weights and specific gravity, properties of chemical elements, expansions and melting points of metal, &c. &c., seem to constitute its most valuable feature, though even here it does not compare favourably with its English competitor. There are some useful tables for comparison of metrical and other systems of measurement; as to which we may note, with regard to a recent correspondence in our columns, that the length of the meter is given as equivalent to 39·3708 English inches.

ROBERT MALLET.

No. III.

When the East London Railway Co. was about to seek powers to use the Thames Tunnel, Mallet was called in to report on its strength and condition, and on the possible effect the passage of the railway so near the Greenwich Observatory might have upon astronomical operations. Besides a comprehensive series of palometric experiments, by which the possible effect of vibrations, caused by the trains running through the tunnel, on the transit and other instrumental observations at the Observatory were ascertained, he determined the actual strength of the tunnel and its materials. Several considerable masses of the brickwork were cut out of the tunnel, and prisms of from 1¾in. to 3¾in. square made from the separate bricks, and from bricks joined by the mortar. One set of these prisms gave a mean tensile strength of 142·17 lb. per square inch, or 9·14 tons per square foot; and another set gave from 9 to 11½ tons per square foot. Experiments upon the transverse strength of the brickwork gave, that of a prism 12in. square and 3ft. between supports, as calculated from smaller prisms, as 13·5 tons at the centre. The compressive resistance of the brickwork was found to be from 1360 lb. to 1712·4 lb. per square inch, or a mean of 107 tons per square foot. The resistance to compression was thus from 9·6 to 11·9 times the tensile resistance, or about as 10·7 to 1 The mean compression before crushing was 0·0569in. in a unit length of 12in. The resistance of the tunnel to fluid pressure from within was thus easily determined. The greatest unbalanced head of water that could be brought to bear upon it would be 21ft. which would only give a pressure of 0·5995 tons per square foot. The height of the tunnel being 16ft. inside, and thickness 2·5ft. at top and 1·5ft. at bottom, the tensile strain per square foot of brickwork would only be 2·38 tons. Taking the foregoing figures of tensile resistance, the minimum factor of safety would be 3·84, and the maximum 4·83. It would thus require a head of water of from 80·64ft. to 101·43ft. to burst the tunnel, allowing nothing for the support of the surrounding earth and clay. Taking the angle of repose of wet London clay at 30 deg., and the weight at 90 lb. per cubic foot, the lateral support would be 1·39 tons per square foot, which would add at least 50 per cent. to the resistance to internal fluid pressure, thus increasing the factor of safety from 4·31 to 5·3. The safety of the tunnel from exterior pressure is sufficiently indicated from what precedes. The palometric experiments were not conducted with a pair of telescopes and mercury trough, as previously adopted by Mr. Smith in 1846, when there was some talk of a railway through, or near, Greenwich Park, and in 1863, by Sir G. B. Airy, when it was proposed to make a railway through the Park, but a light steel bar, of uniform section, was mounted on a rigid stand, and its vibrations magnified by reflection, and recorded automatically, the result showing that no effect on the instruments in the Observatory was possible as the effect of railway traffic through the tunnel. From the experiments on the strength of the materials of the tunnel it will be seen that good work was put into it.

While speaking of the work that occupied him about the year 1856, we omitted to mention his system of muzzle-swivelling and hydraulic gun-mounting developed in the year 1856. These designs were first laid before Sir John Burgoyne in 1856, who, with some additions, sent them in 1858 to General Peel, then Minister of War. They included methods of muzzle-pivotting by means of a screw and link frame for elevating and depressing the gun in such a manner that all horizontal and vertical movements took place round its muzzle, principally in order that embrasure apertures might be reduced in size to something little larger than the exterior diameter of the muzzle. The arrangement also included a new traversing slide and gun-carriage, applicable either to casemates or to open parapets, and designs for mounting and training guns by hydraulic pressure. These designs were simple, and were specially recommended by Sir John Burgoyne for fair and impartial consideration. Perhaps it is almost unnecessary to say that Mallet never received any thanks for his designs, much less any recognition of his claims as an inventor of the system of traversing slide, which was appropriated by the Woolwich authorities a few years later, and also universally used by foreign Powers. The traverse slide included the very simple, but essentially important, application of excentric mounted rollers, by which the slide was raised by one movement of a hand lever for running forward for loading and back for firing. This was designed with a view to the larger guns that Mallet saw would soon have to be adopted by the Government, and for the working of which the commonly used handspike would be out of the question. These inventions were placed before the Ordnance Select Committee, and a more unfair report was never made than that by the committee on these designs. This committee would not recommend any of the designs for experiment, yet it is significant of the incapacity of the committee as then formed, that the larger part of the inventions have in principle been employed since. The committee could not conceive of any heavier guns than those in the service, namely, 87 cwt., 95 cwt., and 112 cwt. guns; and as against the proposed traverse carriage, they urged that those "heavy guns could be traversed with great ease and sufficiently quick to be directed on any vessel. Besides, this most remarkable of reports continued, "in addition to the handspike, the assistance of side tackle has been resorted to." It seems scarcely creditable, but the latter was a reason urged against the adoption or even trial of an arrangement, simple and effective, for effecting the traversing in a fraction of the time with less men, and it need hardly be said without "the assistance of side tackle." The most mortifying part of all this was that four or five years afterwards Mallet, in one of his visits to Woolwich Arsenal, saw numbers of traverse carriages being fitted according to his design, but the authorities exercised the Government right to appropriate anything.

In the year 1866 he was president of the Institution of Civil Engineers of Ireland, and his address on taking the chair was one of unusual interest.

At the Paris Exhibition of 1867 Mallet was appointed one of the jurors, and he undertook for this journal the preparation of a complete report of all that was of interest or importance in engineering science and practice. Of the completeness with which he carried out this undertaking, with the assistance of a special staff, our volumes for that and the succeeding year give ample evidence. Many of his articles are still the most complete which have ever been written upon their respective subjects, and we need mention no more than those "On the Trajectories of Elongated Rifled Projectiles on Striking and Penetrating Solid Resisting Media," 4th January, 1867, *et seq.*; "Theory of Colours: An Introduction to that of Oil Painting as a Decorative and Protective Art," 8th March, 1867, *et seq.*; "The French International Exhibition," commencing with 5th April, 1867, and in which special attention is paid to the civil engineering exhibits in drawings and models, including the construction, and in many cases the theory and construction, of some of the celebrated viaducts and bridges of France, including the viaducts of La Cere, Busseau D'Auhn, Du Midi and Montpelier and Rodez Railway, 3rd, 10th, 17th, 24th, and 31st May and 7th June; "Explosions of Powder Magazines: Investigations of the Laws of their Destructive Effects," 14th June; "Gems, their Cutting and Uses as Rock Borers," 6th September, *et seq.*; "French River Navigation, Barrages and Works," 18th October *et seq.*; "An Unwritten Chapter on the Metallurgy of Iron," 15th December, 1871, and others.

Just as he cleared the science of earthquakes from the cobwebs that had grown round it and hidden it in masses of conjecture and hypotheses built upon ingenious ideas never put to the test of either qualitative or quantitative measurements, so he cleared the way for a clear conception of the nature and origin of volcanic energy, by his elaborate paper entitled, "Volcanic Energy: an Attempt to Develope its True Origin and Cosmical Relations," and published in the "Transactions" of the Royal Society in 1873, but read before that Society in 1872. This is one of the finest contributions to the physical geology of volcanoes, and their relations to earthquakes and mountain structure, not that it makes any pretension to originality in that part which deals with the elevation of mountain chains by tangential or lateral pressures, for this was clearly enunciated by M. Constant Prevost over forty years ago—but it shows how the existence of mountain chains and valleys, so formed, the directions of which probably result from inequality in the rate of cooling, or of solidification of the material of the earth's crust in different parts, constitute lines of weakness, or lines of least resistance, along which the work of deformation resulting from the secular cooling of the earth's crust is mostly done. The theory enunciated by Mallet in this paper is pretty clearly defined thus by himself:—

"The heat from which terrestrial volcanic energy is at present derived, is produced locally within the solid shell of our globe by a transformation of the mechanical work of compression or of crushing of portions of that shell, which compressions and crushings are themselves produced by the more rapid contraction by cooling of the hotter material of the nucleus beneath that shell, and the consequent more or less free descent of the shell by gravitation, the vertical work of which is resolved into tangential pressures and motion within the thickness of the shell."

He was thus the first to show that there exist all the necessary conditions for the production of volcanic heat and energy by the transformation of work into heat, in the work arising chiefly from the descent of the crust of the earth as a terraqueous cooling planet; and, as we have already said, he at the same time colligated the phenomena of deformation of the earth as a spheroid; of mountain elevation and surface depression, including faults and fissures of hypogeal origin, and of vulcanicity, including volcanoes and earthquakes. All these he brought together into one category of origin as the results of the same simple cosmical mechanism, the energy of which has decayed and is decaying as the world grows older, and loses heat more and more slowly as compared with the rate at which it lost it when a molten spheroid covered with a thin but ever-thickening crust.

Careful and laborious experiments preceded this paper, and it is an example of the way in which he showed his utter dissatisfaction with any theory, geological or otherwise, that would not bear the test of "how much," the tests of mechanical and physical laws, and the direct application of measures. It is a paper which has done more to illustrate the application of thermo-dynamics in geology, and the necessity for a thorough mechanical and physical education to complete that of a physical geologist, than any other paper yet published; and it will probably ever remain the index to the origin of volcanic heat and energy. The experiments on the crushing resistance of numerous kinds of rocks which were carried out by him for this paper, and embodied in a table, are as unique. The table gives specific gravity, weight, crushing resistances, compressions, heat generated in crushing, and specific heat.

The experiments were numerous and on a large scale, in order that experimental errors might be eliminated as much as possible. The determination of the coefficient of expansion of slags representing molten rocks was made with very large masses, instead of the few pounds weight that had previously been employed for such purposes. He was rigidly precise in his experiments and experimental methods, and was never at a loss in devising means for the employment of existing data in the solution of a problem by indirect application when simple means were impossible. He was, as Dr. Gladstone has said in his life of Faraday, an "intellectual chieftain who could meet the prince of experimenters on equal grounds." The paper to which we have been referring had occupied many years of thought, and embodies the results of personal observations throughout a large part of Europe.

Those interested in earthquake and volcanic studies, and history, will find a most entertaining yet complete exposition of these subjects, and his own views in a book published by Asher and Co., entitled "The Eruption of Vesuvius in 1872, by Professor Luigi Palmieri; with notes and an introductory sketch of the present state of knowledge of terrestrial vulcanicity, the cosmical nature and relations of volcanoes and earthquakes, by Robert Mallet." The "introductory sketch" forms half the volume.

We have now occupied so much space in briefly describing some of Mallet's chief works, that we must conclude by giving simply the names of a few of his more recent papers. The Royal Society Catalogue of scientific papers, which does not give those of a technical character, contains the titles of no less than seventy-four by him, down to the year 1873. Since that time an addition to the paper on Volcanic Energy has been printed in the "Transactions" the Royal Society. A paper, "On the Mechanism of Stromboli," appeared in 1874 "Proceedings" of the Royal Society. Another "On the Alleged Expansion of Various Substances in Passing by Refrigeration from the State of Liquid Fusion to that of Solidification," appeared in the "Proceedings" Royal Society, 1875. Another "On the Origin and Mechanism of Production of the Prismatic or Column Structure of Basalt," "Phil. Mag.," 1875. "On the Mechanism of Production of Volcanic Dykes," Quarterly "Journal" Geol. Soc., 1876. One "On Some of the Conditions Influencing the Projection of Discrete Solid Materials from Volcanoes, and the Mode in which Pompei was Overwhelmed," Royal Geol. Soc. Ireland, 1876. "On a Circumstance Affecting the Piling Up of Volcanoes," and the last on "The Temperature of the Primordial Ocean of our Globe," both in Quar. Jour. Geol. Soc., 1880.

We should like to deal with the discussions which followed the publication of some of these papers; but this is impossible.

For many years, and up to the time of his death, Mr. Mallet was one of our ablest and most valued colleagues. Many papers of special character and interest under the authority of his name, will be found scattered through our volumes, every one of which bears evidence of deep logical consideration, and most of them of profound and penetrating research. He possessed extraordinary inductive powers, and his generalisations have proved themselves to be wonderfully accurate. Of his store of knowledge upon almost every scientific subject, none but those who knew him, and enjoyed his intimate acquaintance, could form an adequate conception; and it is those who knew him well who can best realise the loss the world suffers by his death.

Mr. Mallet had been nearly blind for seven years, and his recent papers were written by the hand of an amanuensis. He leaves a widow, two daughters, and three sons, Dr. J. W. Mallet, F.R.S., University of Virginia; R. T. Mallet, Chief Engineer Indian State Railways; and F. R. Mallet, F.G.S., H.M. Geological Survey of India.

LETTERS TO THE EDITOR.

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

PALLISER GUNS IN THE UNITED STATES.

SIR,—At the present time our external relations with other countries are not satisfactory, and for this reason great attention is being paid to gunnery, ships of war, forts, and warlike material of all kinds. For some time past guns lined with wrought iron, on the Palliser system, have been much experimented with, and very contradictory reports have been published concerning them. According to the latest information they have failed. They have not been found as strong as our own cast iron guns. Whether this statement is true or not we have, unfortunately, no means of ascertaining here; for Government inquiries are conducted in such a way, and there is so much wire-pulling and dishonesty of all kinds, that it is next to impossible to get at the truth.

I write now to you in the hope that the publication of this letter in your pages may induce an expert to give us some information as to what Palliser guns really are doing here. It may seem strange that an American should have to apply to Great Britain for information in this way; but the case is not unexampled. For instance, Mr. King, of the United States, was the first to tell Englishmen all about their own ships of war.

What I and many others want to have, is a trustworthy statement concerning the performance of Sir William Palliser's guns in this country, and, in addition, an explanation of the reasons why they are stronger than cast iron guns.

For example, let me suppose that the lining of a Palliser gun is 6in. diameter inside, and 12in. outside; the metal is wrought iron, and its tensile strength 20 tons per inch. The bursting pressure of such a tube is 17 tons on the square inch nearly. The metal removed to make room for it was of the same dimensions. If we take its tensile strength at 7 tons per inch, then the bursting strength of such a tube would be 5·8 tons per inch. It is clear enough that by putting in the wrought iron liner we should gain about 11 tons per inch in strength. But American guns have been for the most part cast of special Greenwood pig and other mixtures, and the tensile strength of this cast iron is as great as 16 and even 18 tons per inch. The gain, by inserting a wrought iron tube, seems to me to be very doubtful.

For any information on such points as those I have raised I myself and very many of my countrymen will feel much obliged.

Brooklyn, November 14th. C. A. W.

COLD-AIR MACHINERY.

SIR,—I have read the letter of Mr. J. S. Coleman in THE ENGINEER of November 18th, in which he describes an experiment which, it seems, he thought it worth while to make, in order to prove the well-known fact that cold cannot be produced by the compression and re-expansion of air unless work is done by the air in expanding; and he further goes on to say that he is about to submit a paper on the results of his experiments to the Institute of Civil Engineers. Mr. Coleman seems to think that his firm have the monopoly of all knowledge on the subject of producing cold by compression and expansion of air, as well as of the machinery by which it is effected—as witness their advertisements, cautioning the public against using any other than their machine—and he appears totally ignorant of what has been done before them by others in the same direction.

The principle which he enunciates in his letter is as well known and recognised, and as commonly acted upon, as any other well-known principle in science. That principle was carried out in Newton's patent, No. 13,234, A.D. 1850, which describes in full detail all the main features embodied in Bell and Coleman's machine, and has been adopted and carried out in many subsequent inventions, as Giffard's, Wirth's, Windhausen's, Sturgeon's, and others. Four years prior to the appearance of Bell and Coleman's machine, a similar machine was made and fitted up by Mr. Shaw, of Kilnap Glen, near Cork, in which he employed Sturgeon's air compressor for the compressing portion of the work, on the dry compressing principle, this being, I believe, the first time the injection of water into the compressing cylinder was dispensed with. Professor Tyndall, in his well-known work, "Heat a Mode of Motion," fully describes an experiment by which he proved the dynamic theory of heat. One might almost be tempted to think that Mr. Coleman was totally unacquainted with what has been done outside his own experience, and the present state of public knowledge on the subject. He might just as well have written you that he had ascertained that the injection of water into steam would cause it to condense, and promise a paper on the discovery.

Warrington, November 21st. J. W. DE V. GALWEY.

THE AWARDS AT THE MELBOURNE EXHIBITION.

SIR,—I have just perused with some surprise a paragraph in your issue of the 29th July bearing the above heading. In that paragraph you say: "If awards to new arrangements of 'valve-gear, or anything else, are to depend upon 'precedent or justification' in 'the works of the highest authorities,' it is, perhaps, not to be wondered at that those who make the awards get into hot water." I should be very much obliged, Sir, if you would inform me where else the jury should have gone, if not to the "works of the highest authorities"—that is to say, to standard books, to the pages of your own journal, and to existing successful practice, in order to verify their conclusions. The members of the jury, though in a majority of instances possessing extensive practical experience in making, using, and testing steam machinery, and being fully satisfied in their own minds as to the justice of their decisions, nevertheless, as an additional precaution, and in order to avoid the remotest risk of error, took the trouble to consult the best accessible authorities, including your own pages, and to compare with the best existing practice. What more any body of careful, conscientious men could have done I fail to see; and yet all their assiduous care and labour are dismissed by you with a remark which, however meant, certainly looks not unlike a sneer.

Again, Sir, I ask whether Jury No. 26 were not discharging a public duty in resisting the attempts of a small *coterie* of exhibitors and their agents to modify, in an utterly unjustifiable way, their awards? Would it be tolerated for an instant in a European exhibition that a number of interested parties should be allowed to overhaul the awards of an experienced and impartial jury? Surely the jury deserve your sympathy and commendation for resolutely opposing so gross an irregularity.

As for the valve—not valve-gearing, as you appear to assume—in question, I think you will join the jury in condemning it when you hear that it was a plain slide driven by an excentric, and with as much lap on the exhaust as on the steam side—a valve, in fact, that would almost abolish expansion, and set up a ruinous back pressure. If such a valve be right, you, Sir, as well as we, will have to unlearn much. I trust that you will see justice done in this matter.

W. C. KERNOT,
Royal Park, Melbourne, Chairman of Jury 26.
September 21st.

[The paragraph to which Mr. Kernot refers was certainly intended to express objection to the grounds upon which the award had been made, as reported in some of the Australian papers. The value of a new invention cannot depend on precedent or previous practice, as described in books or journals. It may act on a principle differing from anything previously applied in an article for accomplishing the same end; but it might be entitled to an award, though no "precedent would justify" the novelty. Mr. Kernot's letter, however, refers to questions which formed the ground for considerable difference of opinion at the Exhibition, and as these differences have not been fully explained in this country, we print his letter.—ED. E.]

WARMING RAILWAY CARRIAGES.

SIR,—I wish to call attention to Ancelin's foot warmers. Water, on account of its large capacity for heat, has hitherto been used as the best medium for retaining warmth; but, if certain fusible salts, such as acetate of soda, be used instead, a much greater quantity of heat can be stored up than in the same volume of water. Fused acetate of soda contains about four times as much useful heat as the same volume of water at the same temperature. It liquefies at about 59 deg. Cent.; the amount of heat rendered latent, or stored up as temporarily insensible heat, amounting to 94 calories.

A foot warmer of 11 litres—about $2\frac{1}{2}$ gallons—capacity, would contain about 33 lb. of acetate, and, supposing its initial temperature to be 80 deg. Cent., which is the maximum temperature of the water in the foot warmers when placed in the carriages, it would give out :—

	Calories.
First its sensible heat from 80 deg. to 60 deg.	225
Then its latent heat	1410
And finally its sensible heat from 60 deg. to 40 deg.	96
Total	1731

The same warmer, filled with water, in falling from 80 deg. to 40 deg. would give out only 440 calories; the acetate will give out, therefore, four times as much heat as the water—these theoretical data are fully confirmed in practice.

The external temperature of a warmer filled with acetate falls at the same rate as one filled with water, until a temperature of about 54 deg. Cent. is reached, this temperature corresponding with an internal heat of 59 deg., or the crystallising point of the acetate; it then remains nearly stationary for several hours, and afterwards falls at the rate of from two to three degrees per hour, down to about 40 deg., so that the durability of the heat is at least four times that of water; therefore, instead of having to change the foot warmers in railway carriages every two or three hours, which is the case where water is used, it would only be necessary to replace them every ten hours or so, if acetate of soda were employed, thereby effecting a saving of about 75 per cent. in the labour, and causing less inconvenience to passengers. With this warming process there is also a considerable saving of fuel, as, when warmers filled with water are taken out of the carriages and left in the open air, their temperature quickly falls to that of the surrounding atmosphere, and their average temperature therefore does not then exceed 10 deg. Cent. To fit them again for use they must be again re-heated to about 90 deg., and each warmer of 11 litres has thus to store up, in four operations, $80 \times 11 \times 4 = 3520$ calories; these warmers being at a maximum temperature of 80 deg. Cent. when they are put in the carriages, $40 \times 11 \times 4 = 1760$ calories will be utilised, that is to say, about 50 per cent. of the heat stored up.

In a warmer containing 33 lb. of acetate, and which has also cooled down to 10 deg. Cent., and been re-heated to 90 deg. Cent., there will have been stored up—

From 10 deg. to 40 deg.	$30 \times 0{\cdot}32 \times 15 =$	1
From 40 deg. to 60 deg.	$20 \times 0{\cdot}32 \times 15 =$	96
From heat of fusion	.. ..	1410
From 60 deg. to 90 deg.	$30 \times 0{\cdot}75 \times 15 =$	337
Total		1987

Out of which will not be utilised :—

	Calories.
From 10 deg. to 40 deg...	144
From 90 deg. to 80 deg...	112
	256

Warming by water necessitates therefore the storing up of 3520 calories, whilst warming by acetate only requires 1987 calories; there is also a further economy from the fact that the 1987 calories stored up in the acetate are stored up in one operation, whereas it requires four operations to accumulate the 3520 calories in the water.

The filling of the warmers with acetate is done once for all by taking simple but necessary precautions. The vessels should be perfectly air-tight, and the stoppers soldered down so as to prevent the loss of acetate, or the entry of any water into the warmers whilst they are being re-heated; this re-heating being performed by placing them vertically in boiling water. The acetate, being an extremely stable body, will last for an indefinite period.

The system has been tried in France by the Western and State Railways, and during this winter the number of warmers is to be considerably increased. A contract has been entered into with the Royal Portuguese Railways, and it is about to be adopted by the railways in Northern Italy. Trials have also been made on the North of Spain Railways, and in England the London and North-Western Railway have taken out a licence for 3000 warmers. I shall be happy to supply further particulars.

113, Victoria-street, Westminster. HENRY CHAPMAN.

THE LENGTH OF THE METRE.

SIR,—Our letter of 8th inst. was intended to show that the universal practice in England of assuming that the metre is equal to 39·37079in. was a serious error. The fact, as pointed out by "Uniformity" in your issue of the 18th inst., that the Act of 1878 confirms this error, does not in any way tend to correct or excuse it. At a very large expense, and by a series of experiments extending over some years, it was determined on behalf of the English Government that the French standard platinum metre at 32 deg. was equal to 39·37079in. of the English brass standard at 62 deg. For some of these experiments it was assumed that the co-efficient of expansion of platinum was 0·00000476 for 1 deg. Fah. This means that the platinum metre standard at 62 deg. would be equal to 39·37066in. of the English standard, also at 62 deg. Thus, at the present moment, at an ordinary working temperature of 62 deg., the metre as used in France, and, presumably, all other countries, is ·00827in. longer than that defined by our Act of Parliament. Where is the "uniformity" in this? Is it necessary or convenient that John Bull should have a special metre of his own of a different length to that used by the world at large?

This difference is not the inappreciable amount that "Uniformity" imagines, and even if it were it would be no excuse for the Act of 1878 using five places of decimals—39·37079—to express what would be nine times more accurately expressed by only two places of decimals—39·38. Having gone to great expense in determining the true relation, why should we then adopt one which has no existence in fact, and is more cumbrous to use?

"Uniformity's" concluding statement, that the bronze yard and platinum metre "cannot be strictly comparable," is a mistake, as the co-efficients of expansion being known, and also their relative length at given temperatures, it is a simple arithmetical sum to compute what the relation would be at any given temperature, within certain limits. JAMES CHESTERMAN AND CO.

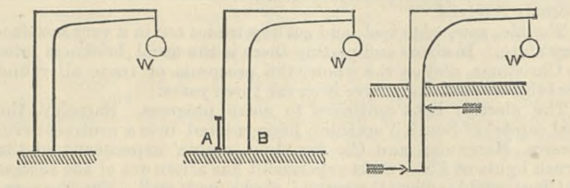
Bow Works, Ecclesall-road, Sheffield,
November 22nd.

THE STRAINS ON CRANE POSTS.

SIR,—I have read with no small amusement and a good deal of nterest the various letters which have appeared recently in your pages on the strains in crane posts. I am amused because all your correspondents, almost without exception, have failed to see the true point at issue, and in a very little time, if matters go on much further, they will have totally lost sight of the original question put by Mr. Pendred. Beyond any doubt he is quite right, and the strain on the breast of a crane post such as he has drawn is greater than the strain on the back, and it is greater by just the amount of the load on the crane, including in the term "load" that portion of the jib which acts as load.

Some of your correspondents maintain that Mr. Pendred is wrong, and that the load is the same back and front. The point is soon settled. Let Fig. 1 be a crane with a jib at right angles, or curved, it matters nothing; let us put this crane standing with a flat foot on a cast iron bed-plate, and leave it to itself. The result will be that it will tumble down. A tie must be put in at A to make it stand. In practice, ties of this kind are not used. The post is stuck in a hole, and the strains are taken at points shown by the arrows in Fig. 3.

FIG.1 FIG.2 FIG.3



Now, it is quite clear that these are the equivalent of the toe of the post and the tie A in Fig. 2. It is also clear that the strain on the toe of the post B, Fig. 2, is greater than the strain on the tie A. But A represents the back of the crane, and B represents its breast. The extra strain comes from above, downward. Action and reaction are equal and opposite. Therefore, if there is a certain strain of, say, 10 tons, in the last $\frac{1}{4}$in. of plate at the point B, there must certainly be 10 tons in the next $\frac{1}{4}$in. above that, and so on upwards. In like manner, if there be a tensile strain of 9 tons in the lowest $\frac{1}{4}$in. of plate at A, there must be 9 tons on the next $\frac{1}{4}$in. above it, and so on to the top.

The mistake your correspondents make is in supposing that the crane will, in practice, turn about an imaginary centre line or neutral axis in the middle of the width of the crane post. In practice it will do nothing of the kind. It will tend to turn about its toe, or about the equivalent of that toe, being frequently that part of a collar next the weight; and Mr. Pendred's safety valve theory not only expresses what takes place in practice, but expresses it with strict accuracy. If your correspondents could only dispense with the fact that a crane is not supported on a central point under the neutral vertical axis of the jib, they would be all right; but they cannot, of course, do this, and their abstract reasoning does not apply at all to the practical case. Q. E. D.

Cambridge, Nov. 21st.

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

(*From our own Correspondent.*)

STEADINESS characterises the iron trade this week. Orders for finished or pig iron are not arriving with the freedom of a month ago, yet vendors are so well booked that, with few exceptions, they maintain the prices of that date.

On 'Change in Birmingham this afternoon—Thursday—merchants were offering numerous contracts for delivery next quarter; but the prices which they wished to do business upon were those now current, and this being the case vendors generally refused to close. They believe that, certainly with the early part of the new year, if not indeed before that date, the crucial quotations of alike pig and finished iron will advance, consequent upon a rise in the official quotations of furnace coal. Therefore they refuse to tie their hands by filling their books with contracts at current rates. In pursuing this course makers act with wisdom.

The thin—stamping—sheet firms reported to-day that the demand was rather better than ten days ago. The price for ordinary gauges varies between £12 and £13 per ton. The quotations for the thinner gauges advance £1 per ton upon these figures according to the degree of thinness required. The demand is well distributed over home and foreign necessities.

Tin-plates, which are largely made by the same houses as produce thin sheets, are fairly active. The United States, the Australias, and the European Continent are the best buyers at date. Complaint continues to be made as to the difficulty of getting any advance in prices. And this is the more unsatisfactory since block tin is still going up.

Bars of best branded sorts are not by any means so active as vendors could like, yet compared with three months ago there is a decided improvement. With export buyers in particular these old standard brands still keep in much favour. The Earl of Dudley's common bars, rolled at the Round Oak Works, are £8 2s. 6d., and those of Messrs. William Barrows and Sons, the New British Iron Company, Messrs. Jno. Bradley and Co., and Messrs. Phillip Williams and Sons, are £7 10s. Sheets and plates of the same houses vary from £9 to £9 10s.

Medium and common quality bar makers announced that they were better employed than the marked firms, and there can be no doubt that the statement is correct. They have a wider field for their products, and at times such as these their prices are more likely to tempt buyers than those of the marked bar firms. Medium bars were this afternoon £7 5s. to £6 15s.; and common sorts, £6 10s. to £6 5s.

Galvanisers were again in the market for black sheets, and so, too, were merchants who have contracts in hand for Russia, India, and the Antipodes. Makers refused to give way on their former quotations of £8 to £8 10s. for singles, £9 10s. for doubles, and £11 for latens. It is this last gauge that is most in request for Russia, and upon these and upon doubles the mills are running very actively.

Hoop makers to-day were tolerably firm at £6 17s. 6d. to £7 for common sorts. Superior sorts were £7 5s. to £7 10s. The Continent is a good buyer of such iron at the present time.

Tube strip was scarcely so strong as a fortnight ago. There were makers who would have accepted 2s. 6d. per ton less than at that time.

Merchants' advices state that when the mail left Melbourne galvanised iron was going off freely at prices much better than could have been realised a short time previously. This advance was due to the telegrams which had been received from London, notifying the rises which were taking place in the home market. At Melbourne 100 cases of Emu brand—26 gauge—had been placed at £20 10s.; 100 cases Davies's 26 gauge had also been taken up at £20 10s.; Orb, 24 gauge was quoted at £20 10s.; 90 cases of this brand, 26 gauge, had found a purchaser at £21 15s., and the holders of this latter brand required £22 for assorted invoices; 50 cases stock had also been placed at £21. Bar and rod iron was moving at £9 to £11.

Sheet iron in the black was selling quietly when the mail left Melbourne. Assortments of Nos. 8 to 18 were quoted at £11, while for Nos. 20 to 26 £13 was obtained. Plate iron was in fair request at £11. Hoop iron for trade purposes was offered at £9 10s. Nos. 6, 7, and 8 drawn fencing wires were in request, sales being made at £13, £13 10s., and £14, thus showing an improvement. Tin-plates were offered at 15 per cent. advance on invoice for good assortments. For parcels of I.C. coke 18s. 6d. per box was quoted, and for smaller lots 19s. per box. Pig iron was also improving in value in Melbourne, owing to the continuous advance taking place in the home market. A shipment of 100 tons had been taken up at £4 12s. 6d., and since then purchases had been made at £4 15s. to £5.

In Birmingham to-day the supply of pig iron was decidedly in excess of the demand. This applies alike to native and foreign descriptions. Derbyshire pigs were priced at 47s. 6d. to 50s., but there were buyers who asserted their ability to secure supplies at 45s. Thorncliffe pigs were £3, without business.

Barrow hematites were quoted by agents at 72s. 6d., but consumers would not give the figure. Neither would they give the 75s. quoted on the open market for Tredegar hematites. Native all-mines ranged from £3 5s. for Shropshire makes of hot blast to £3 10s. for Staffordshire ditto. Cold-blast sorts were, as to both districts, £1 per ton higher than the figures just quoted. Part-mine Staffordshire were £2 15s. to £2 10s., and common sorts £2 5s. to £2 2s. 6d. as a minimum.

Coal was without any change in price, but the market is getting rather nervous again as to a possible early advance, for the movement amongst the colliers for an alteration in their favour of the sliding scale, by which wages are regulated, is gaining ground week by week.

The Hanstead Colliery Company has just started some fine new machinery. It includes a pair of splendid engines, which have been supplied by Messrs. Musgrove and Son, of Bolton, and which when experimentally started a few days ago worked grandly. The cylinders are of 44in., and the stroke is 7ft. The drum barrel, operated by the engines, is worked off the first motion, and is 22ft. diameter. The pit frame has been built of angle iron by the Horseley Engineering Company, of Tipton, and it stands about 80ft. high to the top of the pulleys. The back legs of the frame reach a height of 120ft.

There is no falling off in the activity lately noted at the leading engineering establishments about Birmingham, and the considerable business previously reported in tools and steam engines for the States promises augmentation of considerable importance when the new year has set in. Australia, France, and certain Eastern countries are buying steadily, amongst the work most in request being pumping engines, patent boilers, differential pulley blocks, hydraulic presses, and lifting jacks. Messrs. Watt and Co., of Soho, are pretty well full of work on account of the requirements of shipbuilders and of mining and waterworks companies. Refrigerating machinery is going away from the new works of Messrs. Pigott and Co.—late the Atlas Engineering Company. South America, India, and the colonial markets are demanding Root's patent steam boiler from the Patent Steam Boiler Company.

Wrought iron tubes continue to advance in price as the result of the operations of the association of makers formed in that trade. Discounts have lately been further reduced $2\frac{1}{2}$ per cent. off gas tubes and 5 per cent. off steam tubes. Gas tubes are now $67\frac{1}{2}$ to 70 per cent.; galvanised, 55 per cent.; steam tubes, 50 to 55 per cent.; steam tube fittings, 55 to 60 per cent.; and boiler tubes, lap welded, also 55 to 60 per cent.

An explosion of gas which has resulted in the loss of two lives and serious injuries to three men, took place early on Monday morning in the Deep Pit, Hanley, belonging to Earl Granville. The men who were killed were two firemen, who, after inspecting the pit with some fourteen others and a deputy overman, remained behind to attend to some repairs. Between twelve o'clock on Sunday night and three o'clock on Monday morning the barometer registered a depression of an inch.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—As I pointed out last week, the approaching close of the year is gradually tending to curtail business until after the holidays, and a lessened activity in the iron trade of this district is becoming a noticeable feature. Both smelters and finished iron makers, however, are full of orders, which will more than carry them over the year, and prices consequently are firm, whilst any tendency to "bear" operations on the part of merchants or dealers, which might be encouraged by the present inactive state of the market, is checked by the general belief in better trade and possibly higher prices with the turn of the year.

At Manchester on Tuesday there was a very quiet market, and for pig iron especially the demand was extremely dull. Lancashire makers report a few inquiries for delivery over the first quarter of next year, but the actual business doing, so far as new orders are concerned, is very small. Heavy deliveries are, however, still being made under contract, which are not only taking away all the present output, but are reducing rapidly the stocks at works, and makers are not only exceedingly firm at their full list rates, but are even indifferent about booking further orders at present prices, which for delivery into the Manchester district remain at 48s. for No. 4 forge, and 49s. for No. 3 foundry, less $2\frac{1}{2}$ per cent. Outside brands are without material change, so far as makers generally are concerned, the average quotations for Lincolnshire and Derbyshire irons delivered into the Manchester district remaining at about 48s. 6d. and 49s. up to 50s. per ton, less $2\frac{1}{2}$ per cent.; but there are sellers in the market at lower figures than these. In Middlesbrough iron there is still so little doing in this district that prices are simply nominal.

In the finished iron trade, although the demand is not so brisk as it has been, there is still plenty of inquiry both for shipment and home requirements, and one encouraging feature with regard to the future is the slowly but steadily increasing demand coming into the hands of merchants from the comparatively small users of iron throughout the district, which although still leaving plenty of room for improvement, is a satisfactory indication of a revival in trade generally. Finished iron makers continue very busy and prices are steady at late rates, the average quotations for delivery into the Manchester district being as under: Bars, £6 10s. to £6 15s.; hoops, £7 5s. to £7 10s.; sheets, £8 10s. to £8 15s.; tank plates, £8 5s. to £8 10s.; common boiler plates, £8 15s. to £9; with best qualities up to £10 per ton.

The metal market is very firm, with prices moving upwards. There is a considerable demand from consumers, but makers are very chary about quoting, especially for forward delivery.

For brass foundry work of nearly all descriptions there is a good demand, and especially for all kinds of steam fittings, the pressure to complete shipping orders keeping some of the makers on overtime; whilst for home requirements there is more doing than for some time past.

The engineering trades continue to show a slow but steady rate of improvement throughout most of the Lancashire districts. The last returns sent in by the various districts connected with the Amalgamated Society of Engineers again show a decrease in the number of men out of employment, as compared with the previous month, and the number of men now in receipt of out-of-work donation is only $3\frac{1}{2}$ per cent. of the total number of members in the Manchester district. The reports as to the state in the various Lancashire districts may be summarised as follows :—Manchester, improving; Liverpool and Birkenhead, Ashton-under-Lyne, Barrow-in-Furness, Blackburn, Bolton, Chorley, Heywood, Hollingwood, Oldham, Patricroft, Royton, Sutton, and Newton-le-Willows, moderate; whilst from Bury, Preston, Rochdale, and Wigan, trade is returned as bad.

The excursion made last week by the Manchester Geological Society into the West Lancashire coalfield was one full of interest to mining engineers. The primary object of the excursion was to inspect the long-wall system of getting coal in successful operation at the Wigan Coal and Iron Company's Sovereign Pit, West Leigh. By this system, which has been only recently introduced into Lancashire, the coal is got without the use of powder or any other explosives, and the members of the Society had an opportunity of seeing it in operation in the Wigan six or nine-feet seam—one of the most "fiery" mines in the district, in which nearly all the disastrous explosions of late years have occurred. The long-wall method of getting coal consists in working along an extended face, which at the Sovereign Pit is 700 yards in length. The face having been first spragged up, the collier "holes out the dirt" from underneath to a thickness of from 18in. to 36in., and in depth of from 2ft. to 7ft., according to circumstances, and the dirt holed out is formed into pack in the rear of the collier, who partially sustains the roof where the coal has already been got. The holing having been completed, the sprags are removed, and the roof—which, in addition to its weight, has a natural drag on the face of the coal, owing to the gradual subsidence going on over the pack formed of the dirt or metal holed out—brings down the coal without any other agency being required. The coal is then hauled out, the newly-exposed face again spragged, and the work goes on as before, the collier, as he follows up the face, leaving behind him — except where the drawing roads have to be kept open — a continuous pack or wall of dirt. In addition to the important advantage that all danger from shot firing is dispensed with, the mine worked on this system is more readily ventilated along an extended straight face than by the pillar-and-stall system, and the coal is got in a more marketable condition. The inspection of modern colliery surface plant at the Sovereign Pit, and at the neighbouring new Bickershaw Collieries, which have both been laid out during the last few years, also formed an interesting portion of the excursion. At the Sovereign Pit the Wigan 6ft. mine is worked at a depth of 375 yards, and the winding engines are of the ordinary horizontal type, with 36in. cylinders and 6ft. 6in. stroke, driving a winding drum with a diameter of 15ft. for the first lap, and performing 24½ revolutions for 381 yards. The ventilating arrangements consist of a Guibal exhaust fan, 40ft. diameter and 15ft. wide, driven by a pair of horizontal engines with 30in. cylinders and 3ft. stroke, and performing 35 revolutions per minute, producing an average ventilating current of 120,000 cubic feet of air per minute. At the Bickershaw Collieries, which are owned by Messrs. Ackers, Whilley, and Co., Limited, the Bickershaw mines are being worked at a depth of 475 yards, and the Crumbrook seam at a depth of 340 yards, whilst shafts have also been sunk to the Wigan mines at a depth of 645 yards. A portion of the mines are being got on longwall, and a portion by the pillar-and-stall system. For generating the steam power required for the winding, hauling, and ventilating engines, there are two boiler houses, the first containing eight double-flued Lancashire boilers, working to a pressure of 50 lb. to the square inch, and the second at present seven—but with foundations ready for eight—double-flued Lancashire boilers working to a pressure of 80 lb. to the square inch. The boilers in the second house, which have only just been put down, are 30ft. in length, 7ft. 6in. diameter, and are supplied with Cowburn's dead weight safety valves and Hopkinson's patent safety valves. Three engine houses have been erected. The first contains a pair of horizontal winding engines by Messrs. Baker and Valliant, of Wigan of 400-horse power, with 36in. cylinders and 6ft. stroke; the winding drum, which carries two 1¼in. round steel ropes, has a diameter of 16ft., and the winding is performed in thirty-two revolutions in 45 seconds, with a total weight at the end of the rope of nine tons. No. 2 engine house contains a pair of horizontal winding engines by Messrs. J. C. Stevenson and Co., of Preston, of 300-horse power, with 30in. cylinders and 6ft. stroke and winding drum of 15ft. diameter. No. 3 engine house, which has been erected for the newly-opened out Wigan mines, contains a pair of winding engines by Messrs. Scarisbrick Walker Bros., of Wigan, with 36in. cylinders, 7ft. stroke, and working up to 600-horse power. The winding drum, which carries a flat rope has a diameter of 18ft. 6in. for the first lap, going up to 19ft. 6in., and is fitted with Burn's patent brake. The winding from the bottom of the shaft, 645 yards, will be performed in thirty-two revolutions in 50 seconds. The system of ventilation is also the Guibal exhaust fan, which is driven by a pair of compound engines, with 17in. high-pressure and 30in. low-pressure cylinders, so arranged that in the case of one breaking down, the other worked at high pressure is sufficient to carry on the ventilation. The fan has a diameter of 46ft., with a width of 12ft., and is driven at forty-five revolutions per minute, producing a ventilating current of upwards of 230,000 cubic feet per minute. A special feature in connection with the ventilating plant is that two drifts have been provided to the fan, which is thus enabled to take in on both sides, and avoids the objectional one-sided pressure where there is but one drift. For ventilating the new pits to the Wigan mines a second fan, of the same proportions as the one now in use, is being erected, and when completed both fans will be so coupled together that, in case of accident to one, the other can be worked in connection with the whole of the pits, and will be enabled to supply sufficient ventilation to all the workings throughout the colliery. The surface arrangements at both collieries, I may add, met with general commendation from all the engineers present.

The demand for the better classes of coal is exceedingly dull consequent upon the extreme mildness of the weather, and stocks are accumulating; but fuel for iron-making and other trade purposes continues in very fair demand, and, although there is a little weakness here and there in house-fire coals, prices generally are being firmly maintained at late rates.

Barrow.—The hematite pig iron market has undergone no change of any moment since my last statement, and the business which is now being done is for delivery in the beginning of next year. I cannot say that a large amount of business is being done, and this will probably continue till the Christmas holidays are over. Makers, however, have orders in hand which will keep them busily employed for a length of time; in fact, till well on in the new year. By that time the wants of buyers will place them in a position to keep them fully going, as it is known that the wants of users are very considerable. The outlook for good trade during the winter is bright, and makers are sanguine that as the present orders are worked out they will be replaced by others, and the next year will see even a much better trade than we have seen during the past autumn. All round parcels of Bessemer were quoted at 62s. 6d. per ton at Works, and No. 3 forge at 61s. Inferior samples at 57s. The steel trade still occupies the good position which has been observable for some time past. I am informed that negotiations are being made for a few good contracts. The steel mills are working at their highest rate of output. Iron shipbuilders, ironfounders, engineers, and others fairly active. Iron ore in good demand at late values. Raisers are very well sold forward. Shipping moderately employed.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THERE are signs of trouble in the Derbyshire coalfield. At Unstone Silkstone Colliery the men have given notice to leave their employment, and the object is understood to be an increase of wages amounting to 12 per cent. The colliers employed by another company in the same neighbourhood—the Unstone Coal and Coke Company—have held a meeting, and come to the conclusion that they ought to have higher wages, but that it is not quite politic to strike work just now. At the Eckington Collieries the miners have demanded an advance of 7½ per cent. Mr. J. C. Colver, the managing director, has replied, stating that he hoped and believed there were better times approaching when the selling prices of coal, and also the wages of the workmen, would improve, but that at the present time it was quite impossible for the company to grant an advance in wages, and that if the men persisted in their demand the company would set down their pits. This decided reply has caused the colliers to pause.

In the Yorkshire coalfield—south and west—wages disputes are also beginning to crop up. The miners employed by Messrs. Newton, Chambers, and Co., Thorncliffe and Chapeltown, have requested—through a deputation of their number—a return of the 5 per cent. reduction recently conceded by the Thorncliffe miners. Mr. A. M. Chambers regretted that his company could not at present entertain the question of advancing wages. He did not wish to deny that trade had improved a little, and that it was still getting better, but prices had not improved to such an extent as to enable him to accede to the request. Mr. Chambers said his firm were desirous of establishing a sliding scale or board of conciliation for the future regulation of wages at Thorncliffe. The deputation replied that they were not empowered by their constituents to enter into an agreement of this kind, but promised to lay it before the miners for consideration.

The iron markets have been firmer again this week, and the impression is deepened that further advances in values are imminent. This impression is causing home and foreign railway companies to rush into the market with heavy orders for steel rails and other railway material. I hear of five orders for steel rails having been received since my last letter for 20,000, 10,000, 10,000, 6000, and 5000 tons. The prices are now yielding a profit.

Wagon builders are also well employed; the various parts of engines, which are made here, but go to Glasgow to be put together, are also largely ordered. Engineers are exceedingly well employed and are working extra time. The same remark applies to boilermakers and the ship-plate departments.

In the steel trade Bessemer is in brisk demand for casting and general purposes. A further rise in value is reported, but it does not appear to affect the demand. Crucible steel is also in greater request. Several excellent orders from distant markets have been recently received.

The file, saw, edge tool, and cutlery trades are in a very satisfactory state. In silver and plating there is the usual briskness prior to Christmas, and on the whole, the prospects of trade all round are brighter than they have been for three years.

The electric light continues to make progress. Barnsley, the coal capital of South Yorkshire, have entered into a contract with Messrs. Hammond and Co. for eight nights' experiment of the Brush lights at £50. This experiment has arisen out of the success at Chesterfield, where the system works very well. On the occasion of the visit of the Prince of Wales to Worksop last Monday night, the town was successfully illuminated by the Brush electric light.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A CHEERFUL tone pervaded the Cleveland iron market held at Middlesbrough on Tuesday. The attendance was good, and although the telegrams from Glasgow announced easier prices, there was no disposition to follow suit. The price of No. 3 g.m.b. was 41s. 9d. f.o.b., being about the same as it was the previous week. For delivery over three months 3d. per ton, and over six months 6d. per ton more was asked. Shipments have been good during the week, owing to the continued open weather. The stock in Connal's stores has decreased by 1990 tons, and now stands at 176,474 tons at Middlesbrough, in addition to 615,644 tons at Glasgow. Considerable speculation prevails as to what will occur when the six months' period, for which the restriction of output was agreed on, is at an end. There is an idea among many that the Cleveland ironmasters have been outwitted by their Scotch competitors, and that they will not prolong an arrangement which works less in their interest than in that of the Glasgow trade. However that may be, it is certain that several other blast furnaces in Cleveland are being prepared for starting, and these will certainly be put into blast should prices of pig iron increase, or even should the present level continue. The furnaces alluded to comprise three at Clay-lane, three at Norton, and three at Hartlepool, together capable of increasing the make of pig iron by 4500 tons weekly.

The manufactured iron trade continues firm. There is no change in prices, but order-books are well filled throughout the district, and now orders are not put on, except at full rates. Plates are quoted at £6 10s., angles at £6, and bars at £6 2s. 6d., all free in trucks Middlesbrough less 2½ per cent.

The steel trade is very brisk, and it is difficult to place orders at all for speedy delivery. Mr. E. W. Richards has returned from his tour in the United States, and it is expected that he will embody some of his foreign experiences in the presidential address which he will deliver at the next meeting of the Cleveland Institution of Engineers.

The coal market is less firm than it was two or three weeks since. This slight relapse is owing to a lessened demand for house coal on account of the continued mild weather.

The rolling mills belonging to the Tees-side Iron and Engine Works Co. are about to be re-started. They consist of bar and angle mills, which are of good design and in fair condition. The Imperial Works, late Jackson, Gill, and Co., at Eston, are also likely soon to be started, so that the bar trade which has recently been the best paying branch of the manufactured iron trade, may soon be the one most subject to severe competition.

Mr. Edgar Gilkes, of the late firm of Hopkins, Gilkes, and Co., Limited, is about to leave Middlesbrough for Norton, near Stockton-on-Tees. He will superintend the re-construction of the Norton blast furnaces, which will probably be re-started in the spring, or as soon as they are ready. The occasion of Mr. Gilkes' departure from the town where he has resided for so many years will be taken advantage of by his numerous friends to present him with a testimonial, for which subscriptions are already pouring in. There is no man who is more highly respected than Mr. Gilkes, nor any for whom more wide-spread and hearty sympathy has been felt during the troublous times recently passed through.

The shipbuilding trade at all the north-eastern ports continues extremely active, and large quantities of materials are being used. In view of the recent prolonged and calamitous strike at the Wear shipyard between the platers and their helpers, it has been thought desirable to consider the establishment of a board of arbitration to settle such differences for the future. The project is regarded favourably by several employers and by the leading representatives of the workmen. It is sincerely to be hoped that the movement will be successful; the present time is certainly most opportune. The belief is general that for the next year or two shipbuilding will proceed with great activity, and it is just under such circumstances that the prosperity which should ensue therefrom has heretofore been usually neutralised by strikes entered into successively by various grades of workmen. Should this again be the case, it would have the effect of giving a wonderful impetus to the shipyards which have been commenced in France, Germany, and elsewhere, and the effect of their competition would be certain to be felt severely in the future. It is therefore earnestly to be hoped that a board of arbitration will forthwith be established to embrace all the handicrafts connected with the building of iron ships.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow iron market has been comparatively steady during the past week, the prices of warrants being on the whole rather better than in the preceding week. The fluctuations in prices have been small and a fair business has been done. The demand for makers' iron for shipment and for home consumption continues satisfactory. The shipments are indeed exceptionally good for the season, the past week's figures being 11,153 tons, as compared with 7951 tons in the corresponding week of last year. Of this amount fully 3000 tons were despatched to the United States, France and Italy also taking fair quantities. A large amount of pig iron continues to be used in the manufacturing works at home, and the demands of home consumers are so good that prices of No. 3 makers' iron have advanced this week from 6d. to 1s. per ton. The deliveries of pig iron into the store have been about equal to those of the preceding week, viz., 2400 tons, and there are now fully 616,000 tons under the charge of Messrs. Connal and Co.

Business was done in the warrant market on Friday forenoon at from 51s. 3d. to 51s. 4d. cash, and from 51s. 7½d. one month; the afternoon quotations being 51s. 4½d. to 51s. 3d. cash and 51s. 7½d. to 51s. 6d. one month. The market was somewhat dull on Monday, when sellers were pressing sales. Transactions were effected in the forenoon at 51s. 3d. to 51s. cash and 51s. 4d. one month. In the afternoon the quotations were 51s. 1d. to 50s. 9d. The market was firmer on Tuesday, with business at 50s. 10d. to 51s. 2d. cash. On Wednesday transactions were effected at 51s. 2d. to 50s. 8d. cash. To-day—Thursday—a quiet business was done at 50s. 6d. to 50s. 4½d. cash and 50s. 9d. to 50s. 8d. one month.

In consequence of the steady demand for makers' iron, the prices are firmer this week all round, and as stated above, a decided advance has to be noted on No. 3. The quotations are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 59s. 6d.; No. 3, 52s.; Coltness, 59s. 6d. and 53s.; Langloan, 61s. 6d. and 53s. 6d.; Summerlee, 59s. 6d. and 51s. 6d.; Calder, 59s. 6d. and 52s. 6d.; Carnbroe, 53s. and 51s.; Clyde, 52s. and 49s.; Monkland, Quarter and Govan each 52s. and 49s.; Shotts at Leith, 60s. and 53s.; Carron at Grangemouth, 53s. 6d. (specially selected, 56s.) and 52s. 6d.; Kinneil at Bo'ness, 50s. 6d. and 49s.; Glengarnock at Ardrossan, 53s. and 50s. 6d.; Eglinton, 52s. and 48s.; Dalmellington, 52s. and 48s. 6d.

The shipments of pig iron to date for the year amounted to 521,469 tons, as compared with 610,284 tons in 1880, and 521,106 in 1879. There are 105 furnaces in blast, as against 120 at the same date last year.

Cleveland iron continues in steady demand, and the imports are upon a satisfactory scale. Those received during the past week amount to 6930 tons, being 680 tons over the corresponding shipments last year. To date these imports show an increase this year of 40,151 tons.

The malleable works, foundries, and engineering works are, almost without exception, very busily employed, and have very good prospects. Large quantities of manufactured iron are now being exported from the Clyde. Those despatched during the past week included £26,000 worth of machinery, of which a large proportion was sugar machinery for Fiji. There were besides £8100 worth of sewing machines and £25,000 worth of other articles, in addition to 525 tons of steel blooms, valued at £3141, for New York and the Mediterranean. Freights for shipments are high and very steady.

The coal trade is fairly active, and the demand for shipping qualities is good, although not quite so brisk as in recent weeks. It compares very favourably with the state of the trade a year ago. The inland and coasting demand is well maintained, and there is no quotable alteration in prices, although rather less money is obtained for dross, of which there is extensive accumulation at a number of collieries.

The miners of the Hamilton district were agreeably surprised on Monday to find that the coalmasters did not intend to carry their resolution of the previous Wednesday into effect, to withdraw the 6d. per day of advance which they conceded a number of weeks ago. It is difficult to foresee what effect this resolution will have upon the miners generally. Had the advance been withdrawn, the men in the different districts throughout the country would have been upon an equal footing, but there is now a probability that in those quarters where the extra 6d. has not been obtained, agitation will be renewed. It is understood that the ironmasters are opposed to the concession, but as the prices of iron are improving, it is possible they may be prevailed upon to join with the coalmasters in placing their *employés* on the same footing, as to wages, as the men of Hamilton, and several other large districts of Lanarkshire.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE is considerable interest shown at Swansea relative to the projected railway connection with the Rhondda, and an earnest and determined effort is to be made to carry the Bill. The necessary notices have been published.

In all parts of the district there is a good deal of hopeful incident taking place, and more speculative business is being done than I have had to record for some time in the coal trade.

The Clydach Railway is beginning to look in an advanced condition, and the Newport, Caerphilly, and Rhondda likewise. The steam navvy for the cuttings is doing good service. Not far from this line an old sinking has been cleared out and a level formed by a limited Cardiff company into the Nantgarw and Llantwit seam. Mr. Billings, contractor, is engaged in constructing an incline from this to the canal, and it is expected that 150 tons output per day will soon be obtained.

I see, too, that it is likely Craig yr Allt will be again worked, and not at all unlikely that efforts will be made to restart other collieries. The projected line from Rhondda to Swansea will have this effect in three several districts, in addition to increasing the development in the Rhondda. This, however, is already very great. From many collieries 1000 tons per day is now an ordinary occurrence. At this rate twenty years will see a remarkable change in this busy valley.

It is held by the able manager of one of the largest works in Wales that the law of supply and demand must keep coal prices low, the supply being still so abundant. But it must be admitted that the fact of half a century being the limit, at present output, of the best seams in Wales, must tell in price. I do not claim to have a gift of prophecy, but simply I have the opinion of the best authorities in Wales, and that is that there will be no more low prices. We have seen the lowest, and henceforth the tendency will be upward. Prices this week are firm, and coalowners look for higher.

Last week's totals from all Welsh ports of foreign coal shipments were large ones. Swansea sent 12,000 tons, or 3000 tons more than the previous week; Newport 29,000, and Cardiff 130,000 tons. Prices, too, are remunerative, and in all respects the condition of trade may be regarded as excellent. I see that the creditors of the Onllwyn and Dowlais Colliery Company are to send in their claims.

The first meeting in regard to the liquidation of the Gadlys Tinplate Company is to take place this week, and it is earnestly to be hoped that a restart is only a question of a little time.

The steel trade continues hopeful, and a good sign is shown by the tardiness of makers to book orders for distant deliveries. It seems to be regarded as certain that prices will improve. Welsh bars are quoted at £5 10s.; old rails range from £4 5s. to £4 7s. 6d. Steel rails remain unaltered, but the demand is brisk, and large American orders are being placed. The contract for the bridge over the Ganges for the Oude Railway has been secured by the Landore Siemens Company, Swansea. This will amount to 6000 tons.

A petition is to be heard shortly for winding up the Tawe Tinplate Company.

I am glad to note a slight change for the better in the tin-plate trade, but there is a wide scope for improvement.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

15th November, 1881.

4987. Boxes for Ribbons, J. Beagarie, St. Neots.
4988. Puring Hides, S. Pitt.—(*W. Maynard, U.S.*)
4989. Tassel for Umbrellas, A. G. Aaron, London.
4990. India-rubber, I. Livermore, London.
4991. Lockets, &c., C. E. Solomon, Birmingham.
4992. Centrifugal Drying Machines, A. Fryer, Wilmslow, and J. B. Alliott, Nottingham.
4993. Horseshoes, H. J. Haddan.—(*J. Billings, U.S.*)
4994. Treatment of Waste Products, H. J. Haddan.—(*P. Py, Meurad, Algeria.*)
4995. Recording the Speed of Vessels, C. E. Kelway and F. Dyer, London.
4996. Separating Solid Bodies, H. J. Smith, Glasgow.
4997. Lubricator, T. Allison & G. Senior, Milnsbridge.
4998. Driving Bands, M. H. Smith and F. Fleming, Halifax.
4999. Sewing Machines, W. Morgan-Brown.—(*N. Wheeler, Bridgeport, U.S.*)
5000. Air Pumps, C. H. Stearn, Newcastle-upon-Tyne.
5001. Starting Tramcars, H. B. White and B. Zieschang, Duncan-street, London.
5002. Dynamo-electric Circuits, S. Vyle, Middlesbrough.
5003. Water-closets, H. Barron & H. Raimes, London.
5004. Securing Tubes in Boilers, W. R. Lake.—(*J. A. Reed, New York, U.S.*)
5005. Velocipedes, E. J. Castle, London.
5006. Regulating the Production of Electricity, F. Wright, London, and F. A. Ormiston, Twickenham.
5007. Motor, A. M. Clark.—(*J. Sutcliffe, sen., U.S.*)
5008. Corrugated Tubes, S. Fox, Leeds.
5009. Casting Steel, S. Fox and J. Whitley, Leeds.
5010. Separation of Minerals, B. W. Hart, London.
5011. Permanent Way, J. Livesey, London.

16th November, 1881.

5012. Bilge Barrels, &c., R. E. Gibson and D. Pope, Liverpool.
5013. Looms, J. Thompson, Blackburn.
5014. Multiplying Power, C. Clowes, Stockbridge.
5015. Cooling Apparatus, J. F. Littleton, Battersea.
5016. Soaping Fabrics, J. Hawthorn, P. Hawthorn, and J. P. Liddell, New Mills, Derby.
5017. New Fire-arm, A. Dardelle, London.
5018. Gas-cooking Apparatus, W. T. Sugg, London.
5019. Boats, H. F. Phillips, London.
5020. Kid, A. C. Henderson.—(*T. P. Labrousse, France.*)
5021. Suppositories, B. Mills.—(*E. Gibbs, New York.*)
5022. Cold Air Machines, E. Hesketh, Dartford.
5023. Charging Syphons, T. Messenger, Leicestershire.
5024. Bicarbonate of Soda, E. Carey, H. Gaskell, jun., and F. Hurter, Widnes.
5025. Elevators, &c., H. Garland, Liverpool.
5026. Telephone Receivers, F. H. Higgins, London.
5027. Open Stoves, E. R. Hollands, London.
5028. Telephone Receivers, R. and M. Theiler, London.
5029. Felts, W. L. Wise.—(*A. Marthaus and A. Polster, Saxony.*)

17th November, 1881.

5030. Knobs, &c., W. B. Shorland, Manchester.
5031. Spinning Cotton, M. Dickie, jun., Stockport.
5032. Working Railway Signals, S. Brear and A. Hudson, Bradford.
5033. Artificial Marble, B. O'Neill, London.
5034. Soles of Boots, F. Hocking, Liverpool.
5035. Bottling Aerated Waters, J. T. Hayes, Essex.
5036. Burning Gas, J. A. B. Bennett, Worcester, and B. P. Walker, Birmingham.
5037. Dressing Grain, W. Korth, Belfast.
5038. Clips, F. Guillaume, Paris.
5039. Disinfecting Water-closets, T. Beddoe, London.
5040. Stoves, J. B. Petter, Yeovil.
5041. Set Squares, J. Sims, London.
5042. Locks, G. H. Wildes, London.
5043. Weighing Machines, F. H. F. Engel.—(*J. F. W. Schultze, Hamburg.*)
5044. Cultivating Land, R. C. Coulson, Stamford.
5045. Railway Brakes, J. McL. McMurtrie, Glasgow, and H. Smellie, Kilmarnock.
5045. Producing Aerated Waters, A. Price, London.
5047. Smiths' Hearths, A. Wilson, Handsworth.
5048. Recovering Rubber from Waste, C. A. Day, London.—(*N. C. Mitchell, Philadelphia, U.S.*)
5049. Self-lubricating Bearings, W. R. Lake.—(*P. Decauville, Paris.*)

18th November, 1881.

5050. Transmitting Signals, F. R. Francis and C. Donovan, London.
5051. Forming Grooves, C. H. Halcomb, Sheffield.
5052. Packing Joints, A. T. Gibson, Fleetwood.
5053. Telescopic Sights, L. K. Scott, London.
5054. Fastenings for Scarves, G. Hopkins, Birmingham.
5055. Bricks, &c., J. A. Davis, Ebbw Vale.
5056. Hot-air Engines, A. E. Robinson and H. Robinson, Manchester.
5057. Galvano-nickel-plated Sheet Iron, W. Morgan-Brown.—(*E. Schroeder, Leipzic.*)
5058. Pneumatic Brake Apparatus, G. Westinghouse, jun., London.
5059. Carding Cotton, E. Edwards.—(*P. Fleury, Gonnevelle, France.*)

19th November, 1881.

5060. Preventing Accidents in Hoists, S. Empsall, Halifax.
5061. Steam Engines, H. J. Coles, Southwark.
5062. Pistons, J. Hopkinson, Sheffield.
5063. Carriage Brakes, J. G. Mainwaring.—(*J. Höfken, Hagen, Prussia.*)
5064. Fireproof Floors, E. Homan, London.
5065. Treatment of Herrings, G. Leach.
5066. Shaping Wood, H. Haddan.—(*A. Wenzel, Berlin.*)
5067. Furnaces, W. S. Welton, London.
5068. Looms, J. L. Stewart, Bradford.
5069. Backbones of Bicycles, E. S. Wilson, Egremont.
5070. Telephonic Repeater, C. Moseley, Manchester.
5071. Telephonic Transmitting Apparatus, E. de Pass.—(*L. de Locht-Labye, Paris.*)
5072. Mills, E. Phillips, London.
5073. Pulping Turnips, W. N. Nicholson and W. Mather, Nottingham.
5074. Tricycles, G. D. Macdougald, Dundee.
5075. Slashers, A. P. Dickinson and W. Rosseter, Blackburn.
5076. Winding Gear, P. W. Pickup, Rishton, and J. Pilkington, Accrington.

21st November, 1881.

5077. Meters, H. H. Banyard.—(*W. Germutz, Vienna.*)
5078. Refrigerators, G. W. von Nawrocki.—(*P. Lochman, Prussia.*)
5079. Cleaning Wire Ropes, M. W. Parrington and C. Almond, Sunderland.
5080. Electric Currents, R. E. Crompton, London.
5081. Stereotyping Apparatus, F. Harrild, London.
5082. Inkstand, J. H. Kjellgren, Sweden.
5083. Whetting Scythes, A. J. Boult.—(*M. T. Jacquot and J. Thirion, France.*)
5084. Bottles, J. Pattison, London.
5085. Rendering Writing Paper Ink Absorbent, E. Detmold, Putney.
5086. Knitting Machines, H. M. Mellor, Nottingham.
5087. Cutting Horn, W. Hughes, London.
5088. Extinguishing Fires, R. C. Tucker, London.
5089. Combing Wool, A. Smith and M. Firth, London.
5090. Bottles, E. Edwards, London.—(*A. M. Hurel, France.*)

Inventions Protected for Six Months on deposit of Complete Specifications.

4977. Steering Vessels, G. Knowling, Spring-grove, London.—*14th November*, 1881.
4989. Puring Hides, S. Pitt, Sutton.—A communication from W. Maynard, New York, U.S.—*15th November*, 1881.
4993. Horseshoes, H. J. Haddan, Kensington, London.—A communication from J. D. Billings, New York, U.S.—*15th November*, 1881.
5004. Securing Tubes in Steam Boilers, W. R. Lake, Southampton-buildings, London.—A communication from J. A. Reed, New York, U.S.—*15th November*, 1881.

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

4698. Eyes of Pick-axes, W. Edwards, Wolverhampton.—*19th November*, 1878.
2184. Controlling Speed of Engines, J. H. Smith, Euston-road, London.—*5th June*, 1877.
4622. Applying Steam, T. Tuckey, Cork.—*18th November*, 1878.
4685. Circular Machines, H. Clarke, Loughborough.—*20th November*, 1878.
4686. Transmitting Electricity, E. U. Parod, Paris.—*29th November*, 1878.
4743. Supplying Furnaces with Fuel, J. and J. E. Newton, Oldham.—*22nd November*, 1878.
5194. Spinning Apparatus, H. Whitaker, Manchester.—*18th December*, 1878.
4664. Cement, F. Ransome, Lower Norwood.—*16th November*, 1878.
4705. Distributing Electric Currents, F. J. Cheesbrough, Liverpool.—*19th November*, 1878.
4780. Refractory Bricks, E. Riley, City-road, London.—*23rd November*, 1878.
4891. Ratchets, J. Brown, G. Rodger, and W. J. Cordner, Liverpool.—*30th November*, 1878.
4908. Spinning, H. J. Haddan, London.—*2nd December*, 1878.
5067. Cremation, P. Gorini, Lodi, Italy.—*11th December*, 1878.
5133. Cultivating Land, J. D. Garrett, London.—*14th December*, 1878.
4696. Electric Telegraph Insulators, C. E. Crighton, Newcastle-on-Tyne.—*19th November*, 1878.
4764. Knife Handles, W. H. Stokes, Birmingham.—*22nd November*, 1878.
4800. Propulsion of Tramway Cars, W. Eppelsheimer, Copthall-buildings, London.—*25th November*, 1878.
4700. Illuminating Gas, A. Miller, sen., and A. Miller, jun., Glasgow.—*19th November*, 1878.
4717. Ball Castors, H. B. Harding, Islington, London.—*20th November*, 1878.
4719. Forming Moulds, N. Moore and J. Crabtree, Keighley.—*20th November*, 1878.
4738. Thrashing Machines, T. and W. Nalder, Challow.—*22nd November*, 1878.
4762. Generating Electric Currents, J. T. Sprague, Birmingham.—*22nd November*, 1878.
4801. Vacuum Brake Apparatus, J. Gresham, Salford.—*26th November*, 1878.
5043. Explosive Torpedoes, B. J. B. Mills, Southampton-buildings, London.—*9th December*, 1878.

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

3938. Pumps, J. Evans, Wolverhampton.—*16th November*, 1874.
4060. Chairs, B. J. Grace, Newport.—*26th November*, 1874.
4101. Sewing Machines, T. B. Bishop, Regent-street, London.—*30th November*, 1874.
4121. Weighing Machines, J. Parkinson and H. Morgan, Liverpool, and P. Eadington, Lancaster.—*1st December*, 1874.
4002. Self-acting Temples, P. Goldschmidt, Manchester, and J. Chambers, Bury.—*21st November*, 1874.
4111. Water Gauges, L. J. Crossley and R. Hanson, Halifax, and J. J. Hicks, London.—*1st December*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 9th December, 1881.

3060. Trueing-up Bars, &c., W. H. Brown, Sheffield.—*13th July*, 1881.
3065. Propelling Ships, E. A. Brydges, Berlin.—A communication from J. B. Merkl.—*13th July*, 1881.
3080. Looms, J. Clayton and T. Richmond, Burnley.—*14th July*, 1881.
3089. Heating Water, &c., J. H. Fraser, Bromley-by-Bow, and E. J. C. Welch, St. Stephen's, Westminster.—*15th July*, 1881.
3092. Tentering Machines, F. Craven, Brighouse.—*15th July*, 1881.
3105. Metallic Plates, R. Jones, Abercarn.—*16th July*, 1881.
3119. Registers, J. Wood, Newport.—*18th July*, 1881.
3174. Fence Wire, A. C. Henderson, London.—Com. from M. Witte and Kamper.—*21st July*, 1881.
3175. Steering Apparatus, A. Figge, G. A. Köttgen, and H. Wedekind, London.—*21st July*, 1881.
3176. Carpets, E. Crossley, G. Marchetti, R. Cochrane, and W. Mallinson, Halifax.—*21st July*, 1881.
3184. Tanning, W. H. Cox, Bermondsey, London.—*21st July*, 1881.
3246. Pumps, H. J. Haddan, London.—A communication from L. Maneng.—*25th July*, 1881.
3264. Barrel-making Machinery, H. J. Haddan, London.—Com. from W. Stewart.—*26th July*, 1881.
3480. Combing Wool, J. Heaton, Bradford.—*11th August*, 1881.
3515. Ventilating Cowls, J. W. Gibbs, Liverpool.—*13th August*, 1881.
3672. Fuses, A. and J. Hunter, Glasgow.—*23rd August*, 1881.
3778. Opening Window Sashes, W. Leggott, Bradford.—*30th August*, 1881.
3780. Type-setting Machines, J. E. Munson, New York, U.S.—*30th August*, 1881.
3848. Steam Generators, J. Blake, Manchester.—*5th September*, 1881.
3904. Boat Boiling, G. W. von Nawrocki, Berlin.—Com. from A. Leuner.—*8th September*, 1881.
3989. Producing Cold Air Machines, E. Hesketh, Dartford.—*15th September*, 1881.
4023. Stitching Seams, R. H. Brandon, Paris.—A communication from the Morley Sewing Machine Company.—*19th September*, 1881.
4104. Treating Diamondiferous Blue-ground, A. J. Struthers, Hawick.—*23rd September*, 1881.
4120. Cutting Strips of Chenille, W. P. Thompson, London.—A communication from E. Lepainteur.—*24th September*, 1881.
4161. Wrought Iron Riggers, A. Goodwin, Southwark.—*27th September*, 1881.
4164. Chronographs, W. H. Douglas, Stourbridge.—*27th September*, 1881.
4180. Steam Boilers, C. W. King, Manchester.—*28th September*, 1881.
4211. Cartridge Feeder, R. H. Brandon.—A communication from the Gatling Gun Company.—*29th September*, 1881.
4212. Purifying Sewage, P. Spence, Manchester.—*29th September*, 1881.
4246. Purifying Hops, A. Walker, Edinburgh.—A communication from J. Walker.—*1st October*, 1881.
4339. Achromatic Lenses, N. Lazarus, Elgin-road, London.—*5th October*, 1881.
4569. Generating Apparatus, F. M. Newton, Taunton.—*19th October*, 1881.
4561. Destroying Putrescible Matter of House Sewage, J. B. Kinnear, Old-square, London.—*19th October*, 1881.
4605. Steam Boilers, J. and G. Tinker and J. and R. Shenton, Manchester.—*21st October*, 1881.
4910. Preserving Eggs, T. Stead, London.—A communication from K. H. Loomis.—*9th November*, 1881.
4988. Puring Hides, S. Pitt, Sutton.—A communication from W. Maynard.—*15th November*, 1881.

Last day for filing opposition, 13th December, 1881.

3111. Exhibiting Apparatus, C. M. and J. A. Elstob, Bishopsgate-street, London.—*16th July*, 1881.
3116. Raising Blinds, G. Furness and J. Robertshaw, Manchester.—*18th July*, 1881.
3128. Making Ice, E. Edwards, Southampton-buildings, London.—*18th July*, 1881.
3126. Boiler Tubes, F. H. F. Engel, Hamburg.—Com. from J. Empson and Co.—*18th July*, 1881.
3128. Looms, T. Singleton, Darwen.—*18th July*, 1881.
3130. Evaporating Apparatus, W. R. Lake, London.—Com. from J. A. Morrell.—*18th July*, 1881.
3134. Moulding Glass, T. and J. Humphreys, Hulme.—*19th July*, 1881.
3147. Germination of Grain, A. J. and A. Q. Reynolds, London.—*19th July*, 1881.
3156. Open Fire-grate, T. E. Parker, London.—*20th July*, 1881.
3164. Machine Guns, T. Nordenfelt, London.—*20th July*, 1881.
3165. Drilling Apparatus, J. F. Wiles, Old Charlton.—*20th July*, 1881.
3183. Paper Hangings, W. Cunnington and W. Cunnington, London.—*21st July*, 1881.
3193. Valve-gear, G. L. Lambert, Nottingham.—*29nd July*, 1881.
3204. Lawn-tennis Bats, C. W. Simons, Gloucestershire.—*22nd July*, 1881.
3219. Pulley Blocks, R. Priest, Stafford.—*23rd July*, 1881.
3223. Folding Furniture, T. Barnby, Birmingham.—*23rd July*, 1881.
3228. Telephonic Communications, J. Imray, London.—A communication from L. A. Brasseur and O. Dejaer.—*23rd July*, 1881.
3230. Paper Bags, T. Coates, Carlisle.—*23rd July*, 1881.
3267. Commodes, H. J. Haddan, London.—A communication from W. H. Daniell.—*26th July*, 1881.
3303. Artificial Stone, J. H. Johnson, London.—A communication from La Société Anonyme de Certaldo.—*28th July*, 1881.
3746. Consuming Coal, E. Kaulbach, London.—*27th August*, 1881.
3949. Oiling Apparatus, W. Currie, Belfast.—*13th September*, 1881.
3963. Checking Apparatus, W. M. Riddell and H. Wickens, London.—*14th September*, 1881.
4193. Electric Lamps, C. H. Grimingham, Newcastle-on-Tyne.—*29th September*, 1881.
4279. Printing Machines, H. Julien, Brussels.—*3rd October*, 1881.
4312. Treating Sewage, J. Hanson, Wakefield.—*4th October*, 1881.
4314. Drying Machines, R. Milburn, London.—*4th October*, 1881.
4340. Gas Motor Engines, C. T. Wordsworth, Leeds, T. Browett and H. Lindley, Salford.—*5th October*, 1881.
4380. Utilising Compressed Air, A. M. Clark, London.—Com. from C. W. Cooper.—*8th October*, 1881.
4408. Waterproof Compound, W. O. Callender, London.—*11th October*, 1881.
4471. Trowels, T. Tyzack, Sheffield.—*13th October*, 1881.
4541. Generation of Electro-magnetic Currents, R. Kennedy, Paisley.—*18th October*, 1881.
4571. Measuring Electricity, E. G. Brewer, London.—A com. from T. A. Edison.—*19th October*, 1881.
4726. Metal-dressing Machine, R. H. Brandon, Paris.—A com. from H. Pieper.—*28th October*, 1881.
4993. Horseshoes, H. J. Haddan, London.—A communication from J. D. Billings.—*15th November*, 1881.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 18th November*, 1881.)

2181. Fire-arms, W. W. Morton, London Bridge.—*19th May*, 1881.
2207. Working Brakes, J. Armstrong, Swindon.—*20th May*, 1881.
2213. Hydrogen Gas, E. S. Samuell, Liverpool.—*20th May*, 1881.
2229. Fire-grate Screens, S. H. Ogden, Manchester.—*21st May*, 1881.
2232. Frames of Pianofortes, T. J. Brinsmead, London.—*21st May*, 1881.
2244. Reamers, &c., H. Lindley, Salford.—*23rd May*, 1881.
2252. Annealing Furnaces, T. James, Tipton, and E. Handley, Birmingham.—*24th May*, 1881.
2253. Railway Signals, W. Morgan-Brown, London.—*24th May*, 1881.
2254. Brick-pressing Machines, H. Wedekind, London.—*24th May*, 1881.
2261. Permanent Way, J. Livesey, London.—*24th May*, 1881.
2295. Cleaning Screens, W. H. Price, Wrexham.—*25th May*, 1881.
2357. Screw Propellers, Captain G. Peacock, Starcross.—*28th May*, 1881.
2369. Electric Lamp, S. Cohné, London.—*30th May*, 1881.
2455. Fog-horns, J. Sturge and J. Grubb, Birmingham.—*3rd June*, 1881.
2469. Lock-stitch Sewing Machines, C. Pieper, Berlin.—*7th June*, 1881.
2552. Wood-pulp, F. Wirth, Frankfort-on-the-Maine.—*11th June*, 1881.

(*List of Letters Patent which passed the Great Seal on the 22nd November*, 1881.)

2246. Velocipedes, G. Singer, Coventry.—*23rd May*, 1881.
2257. Revolving Book Stands, J. L. Kirwan, London.—*24th May*, 1881.
2272. Secondary Batteries, J. W. Swan, Newcastle-on-Tyne.—*24th May*, 1881.
2278. Couplings for Shafts, A. Verity, Bramley, near Leeds.—*24th May*, 1881.
2280. Gas Engines, S. Ford, South Lambeth.—*24th May*, 1881.
2284. Steam Generators, G. Allibon, T. Turton, and J. Jones, Liverpool.—*25th May*, 1881.
2288. Weaving Gauze, W. Strang, Glasgow.—*25th May*, 1881.
2292. Laying Gas and other Pipes, D. Nichols, Leeds.—*25th May*, 1881.
2296. Ring Frame Bobbins, J. W. Wilson, Barnsley.—*25th May*, 1881.
2300. Cots, T. Hansell, London-road, Hertford.—*25th May*, 1881.
2302. Explosive Compound, S. H. Hinde, London.—*25th May*, 1881.
2307. Arm-pit Dress Shields, I. A. Canfield, Middleton, U.S.—*26th May*, 1881.
2313. Woven Fabrics, F. McCance, Belfast.—*26th May*, 1881.
2316. Collecting Fallen Leaves, A. Smith, Goudhurst.—*26th May*, 1881.
2318. Counteracting the Expansion of Railway Signal Wires, H. Whitehead, Bucknall, and T. Dodd, Winsford.—*26th May*, 1881.
2320. Finings, G. W. Ewens, Bedminster, Bristol.—*26th May*, 1881.
2330. Castors, A. C. Fontaine, Bennett-street, London.—*27th May*, 1881.
2344. Electrical Lighting, P. L. M. Gadot, Paris.—*27th May*, 1881.
2349. Ceilings, &c., W. Goodall, Liverpool.—*28th May*, 1881.
2387. Grinding Lawn Mower Cutters, &c., H. Gibbons, Hungerford.—*31st May*, 1881.
2412. Ornamental Surfaces, J. Cowan and O. Stuart, Liverpool.—*1st June*, 1881.
2418. Metallic Fencing, E. Steer and J. Sheldon, Birmingham.—*1st June*, 1881.
2425. Ordnance, W. Palliser, South Kensington, London.—*2nd June*, 1881.
2426. Looms, R. L. Hattersley, Keighley, and D. Bailey, Huddersfield.—*2nd June*, 1881.
2441. Calculating Apparatus, H. H. Lake, London.—*2nd June*, 1881.
2444. Middlings Purifiers, W. H. Dickey, London.—*3rd June*, 1881.
2450. Perforating Instruments, D. Gestetner, London.—*3rd June*, 1881.
2467. Fixing Wheels, &c., R. A. Hansell, Sheffield.—*6th June*, 1881.
2476. Mouthpieces, W. R. Lake, London.—*7th June*, 1881.
2480. Turbines, W. R. Lake, Southampton-buildings, London.—*7th June*, 1881.
2522. Chains, J. Imray, Southampton-buildings, London.—*9th June*, 1881.
2524. Purification of Gas, J. H. Johnson, London.—*10th June*, 1881.
2550. Type-writing Machines, A. D. Furze, Rome.—*11th June*, 1881.
2560. Utilising Volatile Liquids, W. R. Lake, London.—*13th June*, 1881.
2581. Stains for Polishing, C. M. Sombart, Magdeburg, Germany.—*14th June*, 1881.
2682. Soaps, W. Green, Florence-terrace, Thanet.—*18th June*, 1881.
2686. Parquet Flooring, A. Damman and A. Cassard, Brussels.—*20th June*, 1881.
2687. Governor, J. M. Gorham, New-road, Lincoln.—*20th June*, 1881.
2690. Lamps for Sewing Machines, E. P. Alexander, London.—*20th June*, 1881.
2734. Regulating Gas Burners, W. J. Brewer, London.—*22nd June*, 1881.
2742. Hot-pressing Sheets of Paper, H. H. Lake, London.—*22nd June*, 1881.
2750. Depositing Metals on Iron, &c., G. Bower, St. Neots.—*23rd June*, 1881.
2826. Electric Fuses, D. Johnson, Chester, and E. Spon, Liverpool.—*28th June*, 1881.
2876. Cleansing Sugar, H. E. Newton, London.—*1st July*, 1881.
2914. Compound Resembling Wood, C. D. Abel, London.—*4th July*, 1881.
3016. Velocipedes, G. L. O. Davidson, London.—*9th July*, 1881.
3454. Wire Netting, W. H. Johnson, Manchester.—*9th August*, 1881.
3478. Turning, &c., Metal, R. A. Lee, Westminster.—*11th August*, 1881.
3589. Weighing Machines, T. H. Ward, Tipton.—*17th August*, 1881.
3581. Indicating Weights, T. H. Ward, Tipton.—*17th August*, 1881.
3582. Water Waste Preventers, C. Winn, Birmingham.—*17th August*, 1881.
3694. Safety Gear, J. Musgrave and A. Walsh, Bolton.—*24th August*, 1881.
3725. Refrigerating Apparatus, H. D. Cogswell, San Francisco, U.S.—*26th August*, 1881.
3895. Horseshoes, T. Brown, Sheffield.—*8th September*, 1881.
3917. Short Forgings, A. Storer, Clapham Park, London.—*9th September*, 1881.
3943. Pneumatic Accumulator, J. Wetter, London.—*12th September*, 1881.
3985. Door and other Knobs, H. H. Lake, London.—*15th September*, 1881.
3995. Preserving Fruits, H. A. Bonneville, London.—*16th September*, 1881.
4233. Weighing Wool, H. J. Haddan, London.—*30th September*, 1881.
4289. Harrows, A. M. Clark, London.—*3rd October*, 1881.
4293. Producing Hydrocarbon Gas, C. D. Abel, London.—*4th October*, 1881.
4363. Knitting Machines, H. J. Haddan, London.—*7th October*, 1881.

List of Specifications published during the week ending November 19th, 1881.

4584, 6d.; 1514, 6d.; 1530, 6d.; 1550, 6d.; 1609, 6d.; 1612, 6d.; 1628, 6d.; 1629, 6d.; 1634, 1s. 8d.; 1639, 2d.; 1649, 1s.; 1651, 6d.; 1653, 8d.; 1657, 8d.; 1658, 6d.; 1661, 6d.; 1671, 2d.; 1672, 6d.; 1680, 4d.; 1682, 6d.; 1683, 8d.; 1685, 8d.; 1686, 4d.; 1687, 6d.; 1688, 6d.; 1691, 2d.; 1693, 2d.; 1694, 2d.; 1695, 2d.; 1696, 6d.; 1699, 2d.; 1702, 2d.; 1703, 6d.; 1704, 6d.; 1706, 6d.; 1707, 2d.; 1708, 6d.; 1709, 4d.; 1711, 6d.; 1713, 2d.; 1714, 8d.; 1715, 2d.; 1717, 10d.; 1718, 2d.; 1720, 4d.; 1721, 2d.; 1722, 4d.; 1723, 6d.; 1724, 6d.; 1725, 2d.; 1727, 2d.; 1729, 2d.; 1730, 4d.; 1731, 4d.; 1732, 8d.; 1733, 2d.; 1734, 4d.; 1736, 6d.; 1737, 6d.; 1738, 2d.; 1739, 8d.; 1740, 2d.; 1741, 2d.; 1744, 6d.; 1745, 2d.; 1746, 8d.; 1747, 2d.; 1748, 2d.; 1749, 6d.; 1750, 6d.; 1751, 6d.; 1752, 2d.; 1753, 6d.; 1754, 2d.; 1755, 2d.; 1756, 2d.; 1757, 6d.; 1758, 6d.; 1759, 2d.; 1760, 2d.; 1762, 6d.; 1763, 2d.; 1764, 2d.; 1765, 1s. 4d.; 1767, 6d.; 1768, 2d.; 1770, 2d.; 1771, 6d.; 1775, 6d.; 1776, 6d.; 1785, 6d.; 1790, 8d.; 1796, 6d.; 1808, 8d.; 1817, 6d.; 1845, 6d.; 1876, 6d.; 1890, 4d.; 1901, 6d.; 1940, 6d.; 1953, 6d.; 3307, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

1275. Preparation of Colouring Agents, *J. Young, jun.—20th April*, 1881. 2d.

This consists in mixing the prepared colouring matter when in a dry condition with oil in a mill, mortar, or other grinding apparatus.

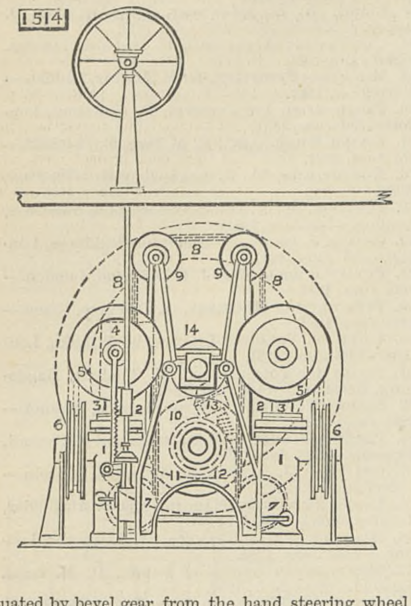
1550. Improvements in Means for Protecting Magnetic Needles from Local Attraction, *J. S. Gisborne.—9th April*, 1881. 6d.

The inventor surrounds the needle with several series of concentric segments, or other shaped pieces of iron, which also extend underneath the needle and meet in the centre. These pieces of iron are insulated from each other by ebonite or other material, or the inventor surrounds the needle by a coil of silk-covered wire, through which a constant or intermittent current is passing. The needle is thus preserved from local attraction, and the current, in the latter case, controls the polarity of the coil.

1514. Steering Apparatus, *F. W. Willcox.—6th April*, 1881. 6d.

In the drawing, 1, 1 are two hydraulic cylinders, each fitted with a stuffing box 2 adapted for either cup leathers or other packings. Through these stuffing boxes work two rams 3 3 having projections or collars upon their lower ends, to prevent them being forced out of the stuffing boxes in the event of a chain breaking, and crossheads 4 4 upon their upper ends, which crossheads have shoes that slide upon guide bars, and take off any side strain from the rams. Two cast iron sheaves 5 5 are carried by each crosshead (one at each side of the ram) and one 6 on the side of each cylinder, and at the base of each cylinder is also fitted a leading pulley 7, by which the chain is led to and from the tiller. Attached to the top of each crosshead is a recoil chain 8 connecting the two rams and passing over rollers 9 9 carried in brackets on the main frame. The object of this chain is to prevent either of the rams falling should a pipe burst. At the back of and midway between the two hydraulic cylinders is a chain wheel 10, by which the rudder chain can be operated by hand, when for any reason the hydraulic is not available. This wheel is keyed on a shaft, upon which is also keyed the worm wheel 11 driven by the worm 12 on a short vertical or inclined shaft 13

1514

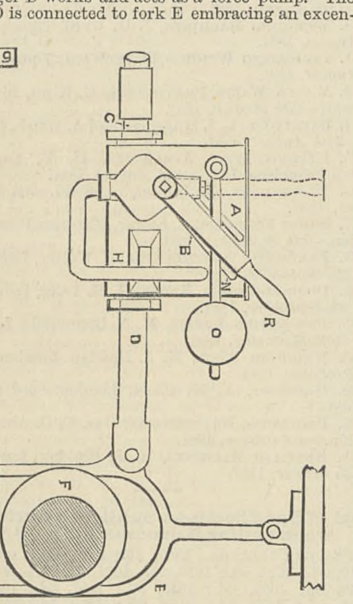


actuated by bevel gear from the hand steering wheel shaft 14. The chains are so led that the gear can be worked either by hand or power without the use of clutches.

1539. Brakes for Railway Vehicles, and Apparatus for Signalling between Passengers and Guards, *W. L. Jackson.—8th April*, 1881. 6*d*.

This relates to the employment of hydraulic pressure as a means of actuating the brakes, and consists of a cistern A containing water and placed under each vehicle, and beneath it is a cylinder B, in which a ram C works, and in a second cylinder in the same casting the plunger D works and acts as a force pump. The plunger D is connected to fork E embracing an eccen-

1539

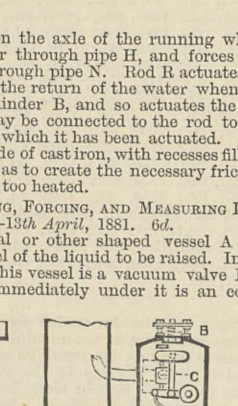


tric F fixed on the axle of the running wheels, and it draws water through pipe H, and forces it back to the cistern through pipe N. Rod R actuates a cock so as to prevent the return of the water when it acts on the ram of cylinder B, and so actuates the brake. A semaphore may be connected to the rod to show th carriage from which it has been actuated. The brake blocks are made of cast iron, with recesses filled in with soft metal, so as to create the necessary friction without becoming too heated.

1609. Raising, Forcing, and Measuring Liquids, *J. H. Kidd.—13th April*, 1881. 6*d*.

A cylindrical or other shaped vessel A is placed below the level of the liquid to be raised. In the cover at the top of this vessel is a vacuum valve B opening inward, and immediately under it is an equilibrium

1609



valve C to admit the steam from the boiler. This latter valve is opened and closed by means of levers on a horizontal shaft, which are operated upon by a hollow float G moving freely up and down a loose vertical rod attached to one of the levers. The vessel is provided with inlet valves I and outlet valves H.

1612. Power Looms, &c., *J., F., and G. Priestley.—13th April*, 1881. 6*d*.

This relates to weaving two distinct cloths connected by pile threads, and to split or sever the said pile threads, so as to produce two perfect piled fabrics.

1624. Improvements in Electric Telegraphs, *A. Muirhead and H. A. C. Saunders.—13th April*, 1881. 6*d*.

To facilitate the reception of messages on long submarine cable circuits, the inventors employ a double telephonic repeater in connection with the suspended coil or magnet of the receiving instruments; this repeater consists of three independent coils, the middle one suspended and movable between the other two. It is connected to the movable coil of a recorder and responds to the fluctuations of the cable current in the latter. The other two coils are fixed and connected to two separate telephones. A rapid series of current from a battery is caused to pass through the suspended coil. Sound is thus produced in the telephones varying in intensity with the proximity of the suspended coil to the fixed coils. The operator placing a telephone to each ear reads by sound the message transmitted. For automatic translation between submarine cables the inventors employ an arrangement of selenium cells, extending like the scale of a reflecting galvanometer in connection with two relays which are placed in a closed circuit with the series of selenium cells. The movable index of the receiving instrument controls a beam of light or heat, and by its motion determines the number of selenium cells influenced by the beam. An electro-motive force is thus created in the bands of cells which will be proportional to the amount of movement of the index. When the rate of signalling is such that minor signals tend to run together, they are automatically reproduced by mechanism in retransmission.

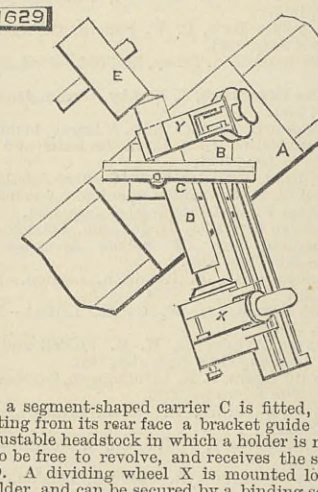
1628. Ventilating House Drains, *G. E. Mineard and T. Crapper.—13th April*, 1881. 6*d*.

This consists in ventilating house drains by setting up a downward current of air through the soil pipe and house drain by means of a gas or other burner placed in a heating chamber arranged to form part of an upcast ventilating shaft in connection with the drain, such stream of air carrying with it any sewer or other gases collected in the drain, and which by coming into contact with the flame of the burner are destroyed or rendered innocuous before passing to the atmosphere.

1629. Sharpening Drills, *E. E. Bentall.—13th April*, 1881. 6*d*.

This relates to apparatus for sharpening twist drills, the cutting edges of which are formed from a cone point and stretch across the drill from opposite sides to the axis. The drawing is a plan of the apparatus, and it consists of saddle A with annular bearings B to

1629



which a segment-shaped carrier C is fitted, and has projecting from its rear face a bracket guide to carry an adjustable headstock in which a holder is mounted so as to be free to revolve, and receives the shank of drill D. A dividing wheel X is mounted loosely on the holder, and can be secured by a binding screw, its object being to regulate the presentation of the cutting edges of the drill to the emery wheel or grindstone E. On the front side of the carrier is a projection to form a guide for the rear ends of a pair of gripping jaws Y to hold the drill firmly under the action of the emery wheel or grindstone.

1634. Looms for Weaving Tufted Fabrics, *W. Morgan-Brown.—14th April*, 1881.—(*A communication from G. Crompton.*) 1*s*. 8*d*.

This consists partly in two endless chains composed of links located below the warps, and having open bearings and flanges and chain wheels and means to move them and the said chains intermittingly, leaving the bearings uncovered just below the warps, combined with a series of carriages provided with journals to enter the said open bearings, and to be held down therein at times by the said flanges, and with a series of eye-pointed and tuft yarn spools carried by the said carriages. Several other improvements are described.

1639. Production of Nitro-benzole, *J. Deucker.—14th April*, 1881.—(*Void.*) 2*d*.

This relates to the economic manufacture of nitrobenzole, which is a base obtained from various qualities of benzole or naphtha for the production of aniline oils.

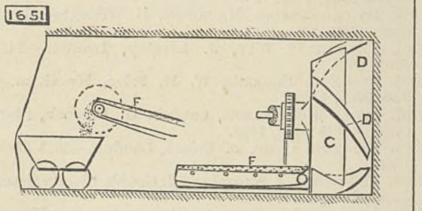
1649. Signals for Use at Sea, &c., *A. J. Boult.—14th April*, 1881.—(*A communication from W. C. Seaton.*) 1*s*.

This relates to the employment of a flash light used in conjunction with a red or green light.

1651. Apparatus for Excavating Tunnels, &c., *J. D. Brunton.—14th April*, 1881. 6*d*.

This consists in the employment of scoops D placed on the circumference of a revolving conical or cylindrical drum C, by means of which the fragments of rock

1651



or the broken up earth or material detached in the operation of excavating tunnels, levels, or galleries is collected, and is deposited on an endless travelling band F, by which it is delivered into wagons.

1657. Knitted or Looped Fabrics, *W. Thacker.—14th April*, 1881. 8*d*.

This consists in the production of knitted or looped fabrics by first forming the loops or stitches in the ordinary manner, and then putting more or less twist thereon.

1658. Manufacturing Sugar, *H. E. Newton.—14th April*, 1881.—(*A communication from A. L. Thibaut.*) 6*d*.

The steam is introduced either below the cage or basket and directly under the layer of sugar, or above the cage or basket, whence it is directed through suitable passages to the bottom of the layer of sugar.

1668. Curtains and Valances, *G. Hurst.—16th April*, 1881. 6*d*.

This consists in the arrangement of two or more curtains of any required width and length in combination with a valance, the adjacent edges of the curtains being capable of being separated by cutting or pulling out a draw thread or threads without producing any waste of fabric.

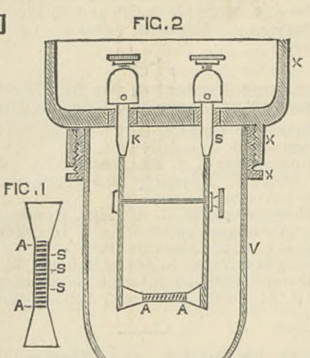
1671. Regulating and Controlling the Flow of Liquids, *G. H. Flood and D. Young.—16th April*, 1881.—(*Void.*) 2*d*.

This relates to improvements on patent No. 2466, A.D. 1880, and consists partly in constructing valve cocks or taps in such a manner that they shall be opened either by the insertion of a wedge between the valve or valve spindle and a roller or other suitable contrivance, fitted to or forming a part of the valve box, or by the withdrawal of the wedge from between the said parts, the former method being adopted in the case of valves opening against the pressure, and the latter in the case of valves opening with the pressure of the liquid, the wedge in either case being acted upon directly by the hand, or by means of a lever or a screwed spindle connected thereto.

1653. Improvements in Electric Lamps, *J. H. Johnson.—14th April*, 1881.—(*A communication from the Société La Force et la Lumière Société Generale d'Electricité.*) 8*d*.

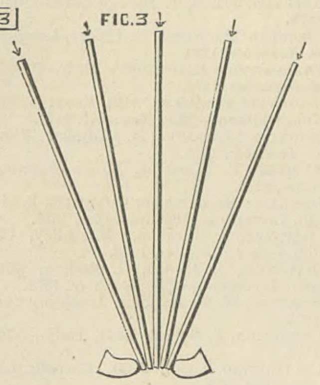
This invention relates to the form of materials used

1653



for electric lamps. In one form the carbon to be rendered incandescent as is shown in Figs. 1 and 2, the

1653



conductor A A being made up of sections S S. Fig. 3 shows another form for use when air is not exhausted.

1672. Walking-stick Sketching Easel, *A. J. Welsby.—16th April*, 1881. 6*d*.

The easel consists of a hollow stick or cane, into which another stick attached to the handle or head is telescoped, the latter being kept in its place in the stick or cane (either open or shut) by means of two screws.

1679. Improvements in Telephonic and Telegraphic Exchange Systems, &c., *Dr. J. N. Culbertson and J. W. Brown.—16th April*, 1881. 6*d*.

To work a central exchange system on a complete metallic circuit, the inventors employ ordinary switch boards with a number of insulated parallel bars, to which conducting wires leading to distant stations are attached. At right angles to these wires are a number of other insulated bars, to which any one or other of the first-mentioned bars can be coupled by insertion of a metallic peg at the point where the bars cross one another. One of the cross-bars of each switch board is ordinarily connected to earth. All the return wires from distant stations are connected to this bar, and where a number of similar switch boards are used, all these bars of the several switch boards are coupled together by a conducting wire. Thus the return circuit from all the distant stations will be conveyed through this wire, and the coupling of the wire from one station to the wire leading to another will be effected by shifting a single peg only, that is, one peg for each station. In central exchange systems where complete metallic circuits are not used, the inventors propose to have a return wire from each station, and to use a central system of earths, which are more under supervision, and can easily be made good. The invention also refers to a method of insulating the wires with asbestos and glycerine or similar substances, and also to a particular method of suspending said wires to keep them apart. The specification is accompanied by drawings.

1680. Hot Bed Frames or Conservatories, *A. Tyson.* 16*th April*, 1881. 4*d*.

This consists of jointed or hinged frames or roof flaps, in combination with jointed or hinged gable ends.

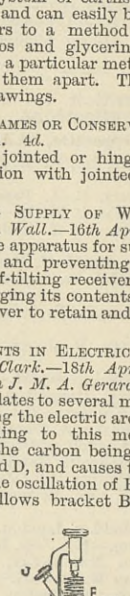
1682. Regulating Supply of Water to Water-closets, &c., *L. Wall.—16th April*, 1881. 6*d*.

This relates to the apparatus for supplying measured quantities of water and preventing waste, consisting of a hopper-like self-tilting receiver contained within a tank, and discharging its contents bodily thereinto, a weighted cabin lever to retain and right it, and a ball valve.

1685. Improvements in Electric Lamps or Regulators, *A. M. Clark.—18th April*, 1881.—(*A communication from J. M. A. Gerard-Lescuyer.*) 8*d*.

This invention relates to several modifications in the method of regulating the electric arc, one of which we illustrate. According to this method the current enters at N, and the carbon being separated passes through the solenoid D, and causes the armatures K F to be attracted. The oscillation of F releases the grip of the jaw L, and allows bracket B to descend. As

1685



soon as the carbons come in contact the current passes through them, coil D becomes inert, and the armatures are withdrawn by their springs, the one causing jaw L to again bind against the guide A, and thus arrest the descent of the bracket B, and the other causing the upper carbon to be suddenly separated from the lower one, thereby establishing the arc, the size of which is regulated by screw J. Should the resistance of the arc become too high, the current again traverses coil D and the upper carbon slowly descends. The feeding of the carbons is effected by continuous and insensible vibrations without jerks.

1686. Manufacture of Proteine Substances for Calico Printing, &c., *H. H. Lake.—18th April*, 1881.—(*A communication from E. R. von Portheim.*) 4*d*.

The materials employed for the manufacture of proteine substances, designed to be used more especially in calico printing, are fibrine, meat, caseine, gluten, and insoluble or coagulated albumen of eggs or blood.

1687. Stalls and Ventilating Apparatus for Cattle in Sea going Vessels, *H. H. Lake.—18th April*, 1881.—(*A communication from T. Utley and J. Fawcett.*) 6*d*.

The First part relates to an apparatus which affords a passage for air, and yet is so constructed that no water can flow through it into the ship; Secondly, to a stall, the floor of which can be kept in the best position to enable the live stock to adapt themselves to the ordinary motions of the vessels.

1688. Protectors for Soles and Heels of Boots and Shoes, *W. Beverley.—19th April*, 1881. 6*d*.

The protector for the sole is formed of india-rubber, gutta-percha, or a substance of similar qualities, and consists of a toe portion and of two wing or side portions. The heel protector consists of central and flange portions similar to those for the sole, but taking the general figure of the heel, and being in two side parts connected preferably by the flange therearound.

1691. Tricycle, *A. Wharton.—19th April*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in a means of constructing tricycles so that they may be entirely driven by hand and guided or directed by the feet.

1693. Automatic Sea Sounding Apparatus, *F. H. F. Engel.—19th April*, 1881.—(*A communication from W. R. R. Becker.*)—(*Not proceeded with.*) 2*d*.

To the keel or to the bottom part of the hull of the ship one end of a curved metal spring is fastened, and the other end slides in a slot or other convenient guide of the keel or ship's hull. To the centre of the spring one end of a rod is fastened, the other end of which is guided through a tube or packed opening upwards into the inside of the ship or to the deck or cabin. The rod communicates by gearing with a hand and scale showing directly the depth of water remaining under the ship's keel.

1694. Shuttles for Looms, *J. and E. Holding.—19th April*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in the application to the shuttle of a self-acting lever or spring, one end of which is curved or rounded and projects beyond the upper part of the shuttle, so that whenever any warp ends break and hang down into the shed, or if any other substance, whether hard or soft, forms an obstruction to the shuttle's passage through the shed, the obstruction presses the lever or spring downwards into the shuttle, and causes its other end to press the weft thread fast either against the shuttle tongue or other part of the shuttle and prevent the weft from paying out.

1695. Sugar-cane Crushing Machinery, *T. Dale.—19th April*, 1881.—(*Not proceeded with.*) 2*d*.

According to one modification, the steam engine cylinder is placed horizontally and fixed at one end of the bed frame with the piston rod guides overhung, so as to allow the fly-wheel to be placed between them and the bed frame. A part of the fly-wheel forms part of the crank, and the valve gear is arranged at the outer side.

1696. Improvements in Telegraphy, *S. Pitt.—19th April*, 1881.—(*A communication from Dr. A. Lugo.*) 6*d*.

This is an improvement on patent No. 1119, dated the 15th March, 1881, and its object is to construct a single cable or compound conductor, through which

1696

two or more independent circuits can be established without the disturbances caused by induction. The figure shows the invention as applied to a telegraphic and telephonic circuit, and requires no description. According to the inventor the currents, transmitted through one conductor of each circuit, will return through the other, and the inductive influence of the currents, passing through the two sets of conductors, will be equal and opposite, thus inductive action will be neutralised.

1699. Block Signalling for Railways, &c., *J. Wetter.—19th April*, 1881.—(*A communication from R. S. Jennings.*)—(*Not proceeded with.*) 2*d*.

This consists in providing the locomotive with valve operating mechanism, and the railroad with pipes running parallel with the latter, and with valves so arranged that when the locomotive passes certain points of the line it automatically operates the valves, thereby lighting or extinguishing an electric or gas lamp, and informing the engine driver of the train which follows on the same track whether the line ahead is occupied or free.

1702. Stoppers for Bottles, *C. G. Elers and T. Rowan.—19th April*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to improvements in stoppering that class of bottles and like articles in which the stopper consists of a cap having an internal ledge fitting under suitable projections on the exterior of the bottle neck.

1703. Machinery for Nailing Boxes, *B. J. B. Mills.—19th April*, 1881.—(*A communication from J. H. Swift.*) 6*d*.

This relates, First, to an improved arrangement of the driving gear and method of giving motion to the plunger crosshead; Secondly, to the method adjusting the table or platform of the machine for supporting the boxes whilst being nailed; Thirdly, to providing means for adjusting the plungers and nail guides to different thicknesses of work; Fourthly, to an improved construction of nail guide and die holder.

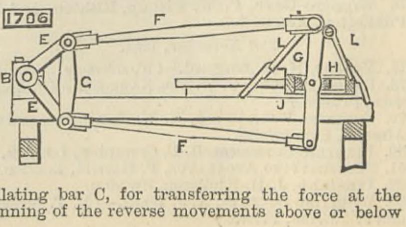
1704. Refining Camphor, *G. Atkinson.—19th April*, 1881. 6*d*.

This relates to the construction of apparatus for the manufacture of camphor tablets, and specially the construction of the baths, having a cover consisting of a number of pieces, and adapted to be heated so that the camphor sublimes on to the under surface o said pieces.

1706. Mechanical Movement, *A. M. Clark.—19th April*, 1881.—(*A communication from J. Harris, jun.*) 6*d*.

This relates to improvements on American patent No. 7902, A.D. 1851, for converting reciprocating into rotary motion, and it consists of an auxiliary crosshead J applied to the main crosshead H and having an independent to-and-fro motion at the ends of the stroke in connection with levers L pivotted to the

1706



oscillating bar C, for transferring the force at the beginning of the reverse movements above or below the plane of or direction of reciprocation. Means are provided for locking the auxiliary crosshead with the main crosshead; B is the fly-wheel shaft having double cranks E connected by rods F with bar C, and with each other by rod G.

1707. Pneumatic Balls and Gongs, *J. Newton.—19th April*, 1881.—(*Not proceeded with.*) 2d.

This consists of an ordinary ringing bell hung by a spring to a crank arm or carriage fixed on a spindle, the weight of the bell and its carriage being counterbalanced by a weight on an upright arm acted on by a return spring. The latter arm is connected by a jointed link with the end of a rod which slides through a glass guide, and is attached at its other end to an air bag or bellows. The latter is connected by a tube with the apartment whence the bell is to be rung, and is inflated by means of the usual press button or other appliance acting on an air bag at the other end of the tube.

1708. Boat Plug, *A. M. Clark.—19th April*, 1881.—(*A communication from L. H. Raymond.*) 6d.

This consists of a valve seating attached to the bottom of the boat in an aperture therein, and provided with a perforated neck having an external thread to receive a cap on the upper side, and with hinged valve on the lower side, this valve being protected by a suitable cage to which it is pivotted.

1709. Pulley Blocks, &c., *T. H. Ward and E. Howl.—19th April*, 1881.—(*Not proceeded with.*) 4d.

The bottom sheave is constructed in a similar manner to that adapted by Weston, but the two top sheaves are cast separate the one from the other, but arranged in such a manner that so long as these two sheaves are gripped together tightly they are to all intents and purposes equivalent to being cast as one, consequently they turn as a Weston sheave; but, when they are released from each other they run down by gravity independently in opposite directions by virtue of the half load hanging from each of those sheaves.

1711. Wearing Apparel, *J. Ramsay.—20th April*, 1881. 6d.

This consists of dresses, bodices, &c., formed on the stocking frame, whereby the ordinary process of cutting out such articles is dispensed with.

1713. Gumming the Flaps of Envelopes, *J. Wetter.—20th April*, 1881.—(*A communication from L. P. Boudier and J. F. Ellis.*)—(*Not proceeded with.*) 2d.

This relates to a machine in which the blanks are carried upon a table receiving a vertical movement by positive mechanism, the gum block for applying the gum to the flaps being attached to an arm connected to operating mechanism, which imparts a reciprocating movement to the block causing it to pass over a continuously revolving cam roller which applies sufficient gum to the block at each stroke of the arm to gum one blank.

1714. Heating and Cooking, &c., *C. R. Stevens.—20th April*, 1881. 8d.

The First part relates to apparatus for supplying hot water to baths, basins, and for other purposes, and the Second part relates to stoves and furnaces heated by gas, coal, or any other fuel.

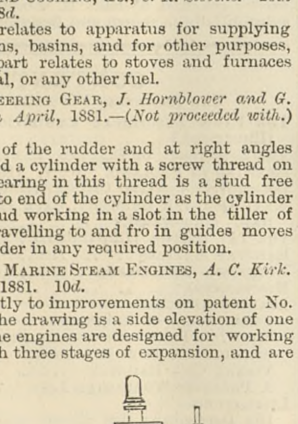
1715. Ships' Steering Gear, *J. Hornblower and G. T. Dove.—20th April*, 1881.—(*Not proceeded with.*) 2d.

Over the tiller of the rudder and at right angles thereto is mounted a cylinder with a screw thread on its surface, and gearing in this thread is a stud free to pass from end to end of the cylinder as the cylinder is rotated, this stud working in a slot in the tiller of the rudder and travelling to and fro in guides moves and holds the rudder in any required position.

1717. Compound Marine Steam Engines, *A. C. Kirk.—20th April*, 1881. 10d.

This relates partly to improvements on patent No. 577, A.D. 1881. The drawing is a side elevation of one modification. The engines are designed for working the steam through three stages of expansion, and are

1717



of the inverted cylinder class. The first or high-pressure cylinder 21 is placed above the second or intermediate cylinder 22; a third or low-pressure cylinder 23 being placed at the same level as the intermediate cylinder 22.

1718. Burners for Gassing Yarns, Silks, &c., *A. L. Dickens and C. Ogden.—20th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to constructing burners, so as to be capable of allowing the number of burning jets therein to be varied at will, according to the quality or requirements of the yarn or other fibre being operated upon.

1720. Treating Dolomites and Magnesian Limestones, *A. M. Clark.—20th April*, 1881.—(*A communication from J. B. M. P. Closson.*) 4d.

This consists in the manufacture from dolomite and magnesian limestones of magnesia, or products rich in magnesia, and free from caustic lime, by calcination (at such a temperature that the carbonate of magnesia is, but the carbonate of lime is not, decomposed) in combination with all or some of the following operations, viz., the separation of the impurities by a blast or by washing, the carbonation of any caustic lime that may have been produced by means of alkaline carbon or the removal of the lime

1721. Manufacture of Carbonates of Soda and Potash, *A. M. Clark.—20th April*, 1881.—(*A communication from J. B. M. P. Closson*)—(*Not proceeded with.*) 2d.

This consists in a process of manufacturing carbonate of potash or carbonate of soda from sulphate of potash or sulphate of soda and saccharate of lime.

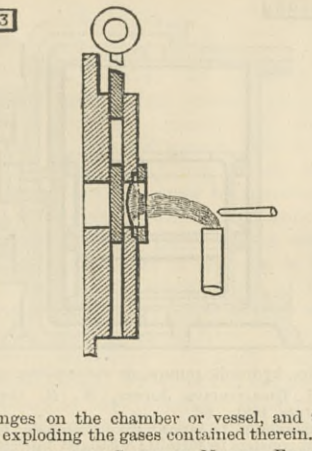
1722. Ring Frames for Spinning and Doubling Cotton, Wool, Silk, &c., *W. Lumb and J. Smith.—20th April*, 1881. 4d.

This consists in the employment of spindles with a slit or slits formed in them so as to make them elastic.

1723. Exploding the Gases in Gas Engines, *W. Watson.—20th April*, 1881. 6d.

This consists in igniting or exploding gases used in gas engines by applying heat externally to some part of the vessel, chamber, or tube in which the gases to be exploded are contained. A flame is directed against the side of the vessel or chamber, so as to make the interior red hot at the point where the

1723

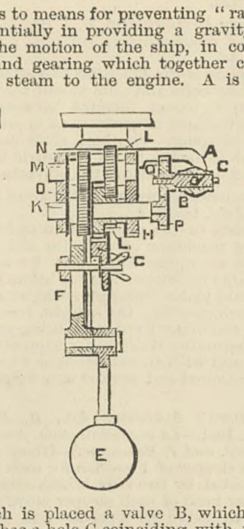


flame impinges on the chamber or vessel, and thus igniting or exploding the gases contained therein.

1724. Regulating the Speed of Marine Engines, *W. R. Lake.—20th April*, 1881.—(*A communication from O. B. Crane, T. M. Platts, and W. H. Howes.*) 6d.

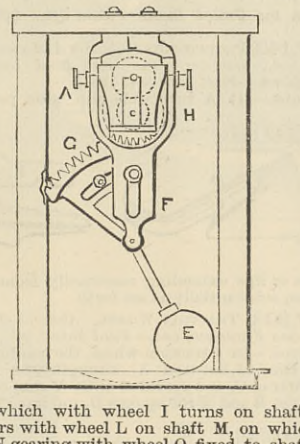
This relates to means for preventing "racing," and consists essentially in providing a gravity governor worked by the motion of the ship, in combination with compound gearing which together control the admission of steam to the engine. A is the steam

1724



pipe in which is placed a valve B, which when the ship is level has a hole C coinciding with the bore of the pipe, but which shifts with the ship, so as to close more or less such bore. The gravity weight or pendulum E is pivotted to the frame F, and has extending above the pivot a quadrant G engaging with

1724



wheel H, which with wheel I turns on shaft K. Wheel I gears with wheel L on shaft M, on which is also wheel N gearing with wheel O fixed to shaft K. On the end of shaft K is wheel P engaging with wheel Q on the stem of valve B.

1727. Compound for Making Castings, &c., *R. Lavender.—20th April*, 1881.—(*Not proceeded with.*) 2d.

This consists of sulphur mixed with rouge or oxide of iron in a finely divided state.

1729. Capsules for Bottles, Jars, &c., *L. Gros.—21st April*, 1881.—(*Not proceeded with.*) 2d.

According to one method, the capsule consists of two parts or pieces, viz., a tubular or cylindrical portion which surrounds the neck or mouth of the vessel, and a disc which forms the top or closing piece of the tubular or cylindrical portion. These two portions when united together form the improved capsule.

1730. Keyless Watches, *H. A. Dufrené.—21st April*, 1881.—(*A communication from Monsieur Vuillemin.*) 4d.

A rod or arbor provided at its upper end with the usual button gives motion to a bevel pinion, provided on its underside with ratchet teeth. The bevel teeth of the said pinion drive a pinion having bevel teeth, and provided on its periphery with spur teeth gearing with an intermediate wheel, which gears with a wheel on the barrel arbor. A contrite ratchet pinion moved by a spring operated by a push piece gears on one side with the ratchet teeth of the motive pinion, and on the other with a small intermediate wheel for setting the hands.

1731. Manufacture of Sulphate of Alumina, *A. A. Croll.—21st April*, 1881. 4d.

This relates to improvements on patent No. 3282, A.D. 1878, and consists in diluting the mass of sulphate of alumina or sulphate of alumina cake from the concentrated form in which such sulphate of alumina so manufactured is obtained before that mass has had time to consolidate or set.

1733. Steam Engines, *O. Trossin.—22nd April*, 1881.—(*Not proceeded with.*) 2d.

The object is to superheat the steam in compound engines by inserting in the lower part of the high-pressure cylinder a suitable furnace, whereby the necessary amount of caloric is imparted to the steam in such cylinder, while the steam is being admitted, and while it is being expanded therein.

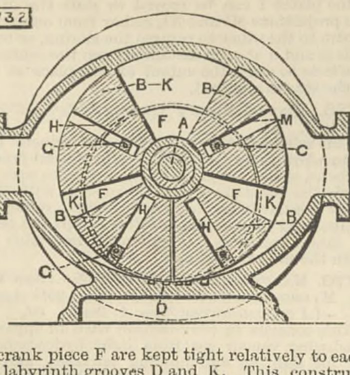
1734. Centrifugal Machines, &c., *B. H. Remmers.—22nd April*, 1881.—(*A communication from W. Angele.*) 4d.

This consists in separating solid and liquid matters by means of centrifugal machines, in which the revolving drum is formed with a solid or unpierced outer shell; or in which such drum is made of wire cloth or perforated metal and fitted with a movable casing, which masks or unmasks the perforations; or in which the drum is covered with a lining of cloth or other filtering medium; or in which division chambers or moulds are formed or fitted within the solid perforated drum to shape or mould the solid material retained.

1732. Rotary Engines, &c, *P. Jensen.—21st April*, 1881.—(*A communication from A. J. Atterberg.*) 8d.

The drawing shows one modification with crank pins G furnished with guide blocks M moving in slides H in the piston B, and the latter joined in the shape of hinges on the fixed centre A. The pistons B

1732



and the crank piece F are kept tight relatively to each other by labyrinth grooves D and K. This construction is particularly suitable to be used as water motor or water meter.

1736. Grinding Machines, *M. Bauer.—22nd April*, 1881.—(*A communication from A. Chéron.*) 6d.

On two standards are four bearings for four shafts, the first of which is furnished with a crank handle. On this shaft is a strap pulley, the rotation of which is transmitted to the second shaft by means of a strap pulley thereon; there is also on this second shaft a second strap pulley, by means of which the motion is transmitted to the third shaft; the latter carries a fly-wheel, a strap pulley, which receives the motion, and another strap pulley, which gives motion to the fourth shaft, on which are fixed a strap pulley and a grindstone.

1737. Nut Crackers, *L. A. Groth.—22nd April*, 1881.—(*A communication from M. Renz and A. Kaufmann.*) 6d.

This consists of two movable jaws, which are jointed at their outer ends and pivotted at their inner curved ends to fulcrummed handles, which are furthermore below the fulcrum provided with inner smaller jaws.

1738. Steam Engines, *M. Bauer.—22nd April*, 1881.—(*A communication from L. Fournier.*)—(*Not proceeded with.*) 2d.

According to one arrangement, a steam engine with two cylinders consisting of one casting is employed. The smaller cylinder may be furnished with a steam jacket.

1739. Stiffeners for Corsets, Dress Goods, &c., *E. P. Alexander.—22nd April*, 1881.—(*A communication from L. C. Warner.*) 8d.

This consists in a stiffening rib, blade, or strip composed essentially of the fibres of a grass obtained from a plant growing in Mexico, which fibres are bound together, and are known commercially as "Tampico" or "Mexican fibre."

1740. Umbrellas, &c., *J. C. Mewburn.—22nd April*, 1881.—(*A communication from A. Gruyer.*)—(*Not proceeded with.*) 2d.

This relates to the manufacture of the sticks of umbrellas from iron tubes, and to give them the appearance of wooden sticks.

1741. Raising Liquids, *P. Jensen.—22nd April*, 1881.—(*A communication from M. Honigmann.*)—(*Not proceeded with.*) 2d.

The apparatus acts as a suction and force pump for liquids.

1744. Preventing Explosions in Mines, &c., *C. D. Abel.—22nd April*, 1881.—(*A communication from O. Bustin.*) 6d.

This consists in the method of preventing explosions in mines by mixing with the explosive atmosphere a quantity of carbonic acid gas delivered from portable receptacles in which the gas is stored under pressure.

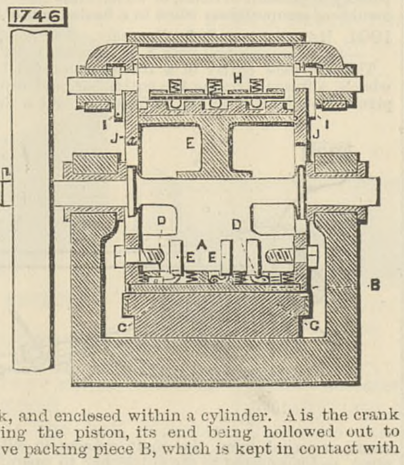
1745. Improvements in Electrical Batteries, *C. D. Abel.—22nd April*, 1881.—(*A communication from P. Jablochkoff.*)—(*Not proceeded with.*) 2d.

This relates to an accumulator of electricity which operates on the principle of secondary batteries, but differs from them in its construction and mode of action. It consists in rendering the electrodes more apt to become polarised by covering them with some sort of hydrocarbon or other oil. This oil operates like the oily coatings of static condensers of electricity, and retains the charge of electricity, in addition to the chemical action of polarisation which is going on.

1746. Rotary Engines, *J. Lyle.—22nd April*, 1881. 8d.

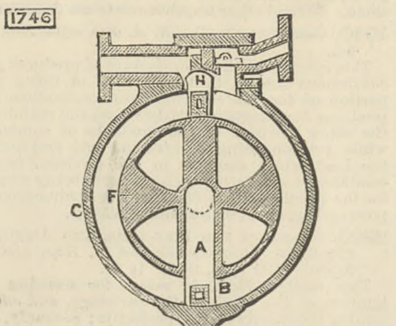
This consists chiefly in causing the force of the steam, hot air, or explosive agent to act in a direct manner on the travelling piston formed from the

1746



crank, and enclosed within a cylinder. A is the crank forming the piston, its end being hollowed out to receive packing piece B, which is kept in contact with

1746



cylinder C, the pawls D and weights E serving to balance the centrifugal force with which B would be thrown outwards. A barrel is attached to the piston to insure the steam exerting its power advantageously on the piston. The stop H extends outside the cylinder and is lifted by a wiper I actuated by the side covers J revolving with the piston.

1747. Castor for Chairs, Tables, &c., *W. R. Lake.—22nd April*, 1881.—(*A communication from A. F. Mauchain.*)—(*Not proceeded with.*) 2d.

The castors are provided with a spiral spring placed around a stem, whereby the castor is rendered elastic or yielding with respect to the furniture to which it is attached.

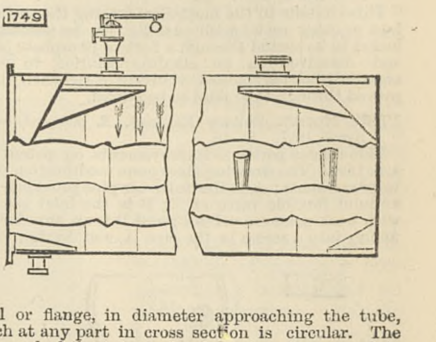
1748. Universal Rolling Mill for Rectangular and Flat Bars, *C. Pieper.—23rd April*, 1881.—(*A communication from E. Daelen.*)—(*Not proceeded with.*) 2d.

The rolls are not placed as usual, one above the other upon their whole length, but they are arranged in such a manner that only their ends project over each other from different sides. Each roll is, moreover, provided with a socket or hollow cylinder fitting over and rotating with the same, and working with its face or end surface in contact with the face of the opposite rolls. The groove or open space for the passage of the metal to be rolled is thus formed by the cylindrical surface of the supposed parts of the rolls, and by the end surfaces of the said sockets.

1749. Boiler Tubes or Flues, *W. H. Wood.—23rd April*, 1881. 6d.

Each section of the tubes is constructed concave to the fire and convex exteriorly, and so as to greatly resist external pressure. At the one end is formed a

1749



swell or flange, in diameter approaching the tube, which at any part in cross section is circular. The other end of the tube is also flanged, and arranged to fit in the former, when two or more, as required, are connected by rivetting at the flange.

1750. Steel Castings, &c., *J. Beardmore.—23rd April*, 1881. 6d.

The steel is cast in moulds made of bricks lined with fire-bricks or with other refractory material, and heated.

1751. Actinometers or Instruments for Measuring Light, *F. Hurter.—23rd April*, 1881. 6d.

This consists in measuring the intensity of light by causing rays of different refrangibility to be received by or pass through different colours, and to be absorbed by two sensitive parts of a differential thermometer, and measuring the difference of temperature thus produced, whence the intensity of the light may be ascertained.

1752. Screw Propellers, *C. Jones.—23rd April*, 1881.—(*Not proceeded with.*) 2d.

The blades of the screw propellers are constructed with the front part of metal and the back part of cement or other suitable protecting material, capable of being applied to the blades after they are cast or made, and so constituted as to adhere firmly thereto.

1753. Magazines or Cartridge Cases with Repeating Mechanism, *W. E. Gedge.—23rd April*, 1881.—(*A communication from L. Loewe and Co.*)—(*Not proceeded with.*) 2d.

This relates to improvements on patent No. 1448, dated 8th April, 1880, and consists essentially of improvements in the mechanical arrangements for the accurate function of the charge lid or cover of the magazine, in the mechanisms for filling cartridges into the magazine, and in the method of attaching the said magazine to the gun-stock.

1754. Pump Valves, *J. Wetter.—23rd April*, 1881.—(*A communication from J. I. E. Florentin.*)—(*Not proceeded with.*) 2d.

This consists in making the valve of lead, copper, leather, marble, or gutta-percha, with a lead core, and making the water or air passage conical above the valve, while the passage below the valve is preferably cylindrical.

1755. Reversing Gear for Engines, *R. C. Christian and G. Coates.—23rd April*, 1881.—(*Not proceeded with.*) 2d.

The quadrant which carries the valve rod is caused to oscillate on a pivot held at any given point in suitably curved slots, capable of moving freely in same as may be required.

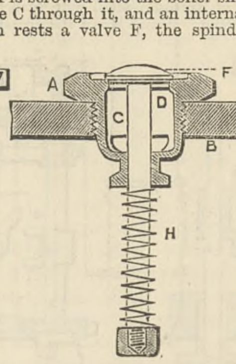
1756. Fastenings for Windows, *G. Walker.—23rd April*, 1881.—(*Not proceeded with.*) 2d.

This relates to means for preventing the fastener being thrust back from the outside, and consists essentially in the employment of a spring plate or of an equivalent spring catch piece.

1757. Safety Valve Plugs for Water Heaters or Boilers, *A. M. Taylor.—23rd April*, 1881. 4d.

The plug A is screwed into the boiler shell B, and it has a passage C through it, and an internal valve seat D, on which rests a valve F, the spindle of which

1757



extends downwards and is surrounded by a spring H. When the pressure becomes excessive the valve is lifted and the steam escapes.

1758. Wire Brushes, *G. W. von Nawrocki.—23rd April*, 1881.—(*A communication from C. E. Flemming, sen.*) 6d.

This consists in securing the elastic foundation of brushes to their backs by means of a strip of suitable fabric or material capable of being cemented to the back, such strip being sewn to the elastic foundation.

1759. Removing Debris from Tunnels, Driftways, or Adits, *C. D. Abel.—23rd April*, 1881.—(*A communication from E. Schrabetz.*)—(*Not proceeded with.*) 2d.

Boxes or receptacles are provided which are conveyed to and from the head of the workings along one or more overhead railways.

1760. Paste for Dressing Wounds, *L. A. Groth.—23rd April*, 1881.—(*A communication from Dr. P. Koch.*)—(*Not proceeded with.*) 2d.

The paste known as pasteboard is made supple by beating with hammers, and is then steeped in an alcoholic solution of about 100 parts of shellac, 200 parts of hard resin, and 100 parts of turpentine, common resin, or other resin, such as, for example, gum elemi. When the steeping is completed, the paste is placed in a drying apparatus furnished with arrangements for distilling.

1762. Improvements in the Preparation of Materials to be Employed for the Purposes of Electric Insulation, *J. A. Fleming.—23rd April*, 1881. 6*d*.

In place of vulcanite, ebonite, or glass, which are not easily workable with tools, the inventor makes an insulator of wood, so treated as to remove all water and acids from it, and then impregnated with melted paraffine wax, which is forced into it under pressure. The wax solidifies in the fibre, and converts the wood into a nearly perfect conductor. The apparatus used is of the usual type for such purposes. The insulator thus obtained is easily workable by tools.

1763. Gas Engines, *W. Watson.—23rd April*, 1881.—(*Not proceeded with.*) 2*d*.

This consists of two cylinders of similar construction with their respective pistons, one, on the inner end of each cylinder being closed, and are placed together in close proximity to each other on the same central line. When one piston moves outwardly the other moves inwardly, being so connected by rods and cranks together as to give motion therefrom to a fly-wheel, which imparts the required momentum and rotary motion; and the cylinders being thus arranged, a valve-box is provided at the closed end or foot of each cylinder, having two halves in each, one for the admission of atmospheric air, and the other for inflammable gas.

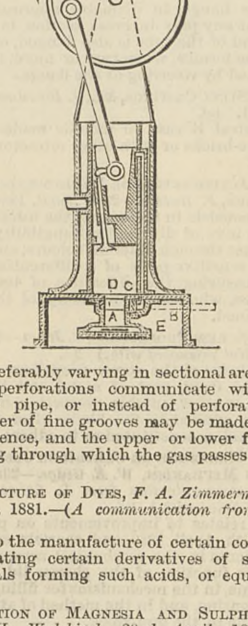
1764. Coating Metals with Tin, *A. Gutensohn.—23rd April*, 1881. 2*d*.

This consists in the method of coating the surface of lead or other metal with metallic tin by passing the metal to be coated through a bath of phosphate of tin, and dissolved in an alkaline solution to which ammonia has been added, a current of electricity being passed through the metal to be coated.

1765. Motive Power Engines, *B. Edwards.—23rd April*, 1881. 1*s*. 4*d*.

This relates partly to improvements on patent 760, A.D. 1880. The drawing shows one modification of the improvements; A is the inlet air pipe provided with an inlet flexible valve at E; B is the inlet gas pipe with back pressure valve C; and D is an annular ring fitting into a recess in the pipe A, and having round

1765



it a channel, preferably varying in sectional area, from which small perforations communicate with the interior of the pipe, or instead of perforations a sufficient number of fine grooves may be made in the outer circumference, and the upper or lower faces, or both, of the ring through which the gas passes to the pipe A.

1767. Manufacture of Dyes, *F. A. Zimmermann.—23rd April*, 1881.—(*A communication from J. F. Holtz.*) 6*d*.

This relates to the manufacture of certain colouring matters by heating certain derivatives of salicylic acid, or materials forming such acids, or equivalent materials.

1768. Production of Magnesia and Sulphate of Calcium, *H. Wedekind.—23rd April*, 1881.—(*A communication from H. Haenenschild.*)—(*Not proceeded with.*) 2*d*.

This relates to means to economically produce magnesia in a dense form, and simultaneously obtain or produce sulphate of calcium.

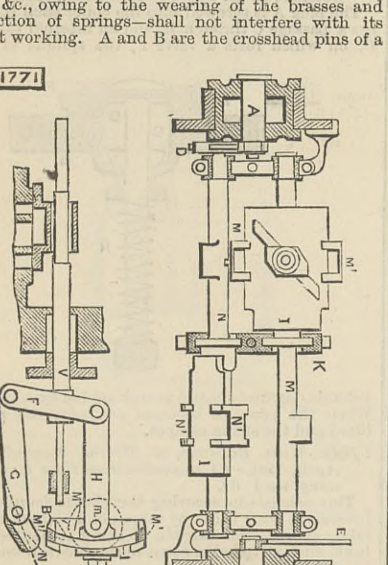
1770. Improvements in Receiving and Transmitting Apparatus of Printing Telegraphs, *W. J. Burnside—23rd April*, 1881.—(*Not proceeded with.*) 2*d*.

This invention relates to automatic printing telegraphs, and its object is to increase the rapidity of operation of the receiver and to provide improved means of maintaining the synchronism between the transmitting cylinder and the type wheel of the receiver. It is an improvement on the patent granted to H. von Hoevenbergh, on the 10th December, 1880, No. 5162.

1771. Valve Motions for Double Cylinder Engines, *D. Greig and M. Eyth.—23rd April*, 1881. 6*d*.

This relates to a valve motion similar in its effects to the link motion but entirely independent from the crank, so that the position of the crank shaft relatively to the cylinder—which frequently varies in locomotives, &c., owing to the wearing of the brasses and the action of springs—shall not interfere with its correct working. A and B are the crosshead pins of a

1771



double cylinder, and below them, one above the other, are two rock shafts M and N, the former actuated from pin B by bar E, and the latter by bar D. On each shaft are slotted projections M^1 and N^1. V is the valve spindle for A, and to it is jointed the straight link F, the ends of which are actuated by the link rods G and H, the former actuated by the crank pin of shaft N, and the latter by connection with the pin *m* of the die within the segment of shaft M; I is a plate carried by and able to slide along shaft M, and it has a diagonal slot, through which the back of the die passes. This plate is connected with a collar grasped by a double clutch ring K, which also takes hold of a similar collar connected with the shifting plate of the other valve. The ring K is worked by a lever in connection with the reversing lever of the engine, and by it the plates I can be moved to shift the dies along the projections M^1 and N^1, either from one side of the centre to the other to reverse the engine, or to set the pins *m* and *n* at such distances from the centres of the shafts as to cause the cut-off to take place at the part of the stroke required.

1775. Miners' Safety Lamps, *J. Fyfe.—25th April*, 1881. 6*d*.

This relates to the construction of miners' lamps so as to adapt them for burning solid or semi-fluid hydrocarbons, such as crude or refined paraffin scale or wax, or similar substances, and to combine with the other parts contrivances or arrangements, rendering the lamps safer than common safety lamps and less liable to cause accidents. Common oil may also be used with the improved lamps.

1776. Manufacture of Vapour Gas from Volatile Hydrocarbons, *H. Springmann.—25th April*, 1881.—(*A communication from A. Badt.*) 6*d*.

This consists in combination with an apparatus for producing vapour gas from light hydrocarbons, and air for lighting and heating purposes, and for the feeding of gas motors, of a carburetter arranged horizontally and provided with one or more partition walls, forming a channel for the circulation of air, and which is filled with wool purified of fatty matter, or with any other material adapted to imbibe the fluid hydrocarbon, and to allow the air to pass through it, the bottom of the said carburetter sloping upward in the direction of the air current.

1785. Churns, *H. Powell.—25th April*, 1881. 6*d*.

This relates to the manufacture of churns in which the dasher or agitator moves horizontally to and fro supported on slides placed at either side of the milk receptacle, the bearings of which slides are outside and cannot come in contact with the milk.

1790. Diving Costumes, *S. J. Woodhouse.—26th April*, 1881. 8*d*.

This relates, First, to the method by which a diver may carry in his dress a supply of compressed air, which may be purified and so continuously used; Secondly, to the method of carrying and purifying air in a diving dome; Thirdly, to the method of using compressed air to drive engines of any description in boats constructed for diving purposes.

1796. Railway Signals, *H. Morris.—26th April*, 1881. 6*d*.

Between the two rails and parallel with them are placed two bearings for convenience placed on the sleepers, which support a shaft, at each end of which is placed an arm or segment, the arc of the first one being about three times the size of the second. On the shaft is also fitted a counterpoise, so adjusted that when free it falls into a perpendicular position, and in doing so raises the two arms on the shaft into the same line of contact with a tappet or cam fitted on a shaft under the tender, by which means a gong is sounded on the tender.

1797. Halter Heads and Rope Reins for Horses, &c., *J. Goodrick, jun.—26th April*, 1881. 6*d*.

This consists in making the eyes of halter heads separate from the woven web, and either of cord or horsehide or of metal.

1808. Utilising Liquid or Gaseous Hydrocarbon as Fuel in Furnaces, *W. R. Lake.—26th April*, 1881.—(*A communication from J. W. and J. R. Houchin.*) 8*d*.

This relates to the construction of apparatus in which the liquid is not atomised, but converted into real gas by heat in a suitable report, and burned in numerous jets distributed uniformly over the grate surface.

1817. Artificial Stone, *W. E. Gedge.—27th April*, 1881.—(*A communication from G. Boden.*) 6*d*.

This relates to a block, slab, or other article of artificial stone, consisting of a face plate or shell of porcelain or its equivalent, and a backing or body of a suitable composition united thereunto.

1845. Fastening for Cravats and Neckties, &c., *J. Hinks, T. Hooper, and F. R. Baker.—28th April*, 1881. 6*d*.

The fastening is composed of a steel or elastic plate having a spring tongue raised out of the plane of the plate, and of a slide or sliding slotted plate working upon it, the said sliding plate when drawn over the spring tongue depressing it and taking it out of action, and when pushed off it permitting it to enter and fasten the neck or other band.

1876. Brushes, *G. W. von Nawrocki.—2nd May*, 1881.—(*A communication from T. B. Günzberg.*) 6*d*.

This consists in constructing brushes or pencils so that the bristles thereof can be more or less protruded from the sheath, socket, or ferule enclosing them.

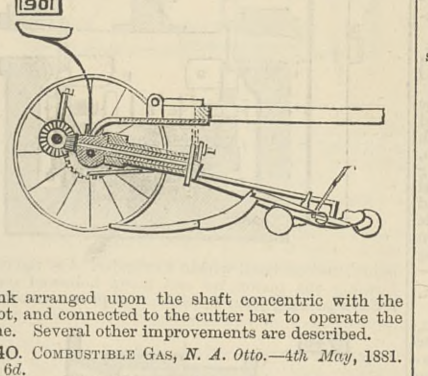
1890. Production of Pottery, *J. H. Johnson.—2nd May*, 1881.—(*A communication from P. Dodé.*) 4*d*.

This relates to the system or mode of producing pottery or ceramic articles, or substitutes therefor, by moulding compositions when in a heated condition.

1901. Harvesters, *E. P. Alexander.—3rd May*, 1881.—(*A communication from S. D. Maddin.*) 6*d*.

This consists partly of a frame supported by the wheels, a frame carrying the cutter bar, and centrally pivotted at the rear to the main frame, and a driving

1901



crank arranged upon the shaft concentric with the pivot, and connected to the cutter bar to operate the same. Several other improvements are described.

1940. Combustible Gas, *N. A. Otto.—4th May*, 1881. 6*d*.

This consists in the manufacture of producer gas by continuous action, in the method of using only a portion of the gas entering into combustion in the producer for generating producer gas and withdrawing the other portion of the products of combustion, while yet consisting of carbonic acid and nitrogen, the heat which remains in the producer from the combustion generating such products being employed for the decomposition of steam, or hydrocarbons, or pure carbonic acid into combustible gas.

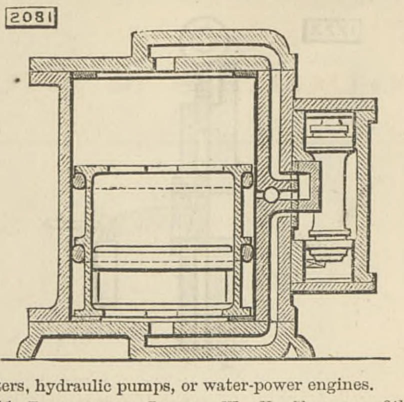
2923. Ordnance and Fire-arms, and Ammunition for Same, *Lieutenant-Colonel W. Hope and R. S. Ripley.—15th July*, 1880. 1*s* 2*d*.

This relates, First, to means for securing radial ignition of the whole of the cartridge, and of overcoming the inertia of the projectile; Secondly, to the use in cartridges of a tube strengthened in the unperforated part, so as to resist the discharge of the ignitor; Thirdly, to making the gun with a considerably elongated powder chamber of from 10 to 20 calibres long, and intended to be fired with long charges; Fourthly, to the use in projectiles of perforated diaphragms; and Fifthly, in a special arrangement of breech-loading mechanism.

2081. Fluid Meters, *B. D. Healey.—12th May*, 1881.—(*Complete.*) 6*d*.

This consists partly in the construction of a piston having two roller rings so arranged as to pass part of the pressure water for actuating the valves of fluid

2081



meters, hydraulic pumps, or water-power engines.

3011. Tobacco-pipe Joints, *W. H. Sharman.—8th July*, 1881. 6*d*.

This relates to pipes with a detachable mouthpiece, and it consists in forming a flanged tapered socket on the metal mount of the bowl, and a corresponding projection on the end of the mouthpiece, the two parts being secured together by sliding the projection into the socket.

3263. Skate Attachments, *H. J. Haddan.—26th July*, 1881.—(*A communication from F. Bittner.*)—(*Complete.*) 4*d*.

The sole plate of the skate has two claws, which can be adjusted by bolts and nuts to suit the width of the boot, which is forced forward between them, the claws being inclined inwards so as to prevent the sole of the boot escaping. The heel plate has two claws, one of which is moved by an excentric lever so as to grip the heel between it and the opposite claw.

3307. Weighing Machines, *J. Cluett and W. Hanchard.—28th July*, 1881. 6*d*.

This consists in the combination and arrangement in weighing machines of opposite and parallel side plates, with an upper fixed part for an equivalent skeleton frame for supporting the balancing or acting parts, the said plates being provided with inner fixed bearings for supporting the weight transfer lever or levers, and the upper fixed part being provided with swinging depending bearings for supporting the steelyard lever, and with an extension or fixed connection which is graduated and worked as a weight-indicating arm.

3342. Railway Sleepers, &c., *H. H. Lake.—2nd August*, 1881.—(*A communication from J. C. Rupp, J. H. Ray, and J. Hassinger.*)—(*Complete.*) 4*d*.

There is a sleeper of I section for each rail, the two being connected by two rods, which cross each other. On the upper head of each sleeper move sliding cheek pieces which serve as a chair and grip the rail between them, being secured in position by bolts and nuts.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

247,148. Plough-point, *Charles Anderson, South Bend, Ind., assignor to the South Bend Ironworks, same place.—Filed July 5th*, 1881.

Claim.—(1) A reversible slip nose provided with

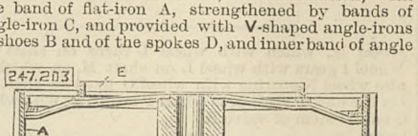
247.148

arms or lips extending rearwardly from its opposite edges, substantially as set forth.

247,203. Traction Wheel, *Almerin H. Lighthall, San Francisco, Cal.—Filed March 5th*, 1881.

Claim.—In a traction wheel, the combination, with the band of flat-iron A, strengthened by bands of angle-iron C, and provided with V-shaped angle-irons or shoes B and of the spokes D, and inner band of angle

247.203

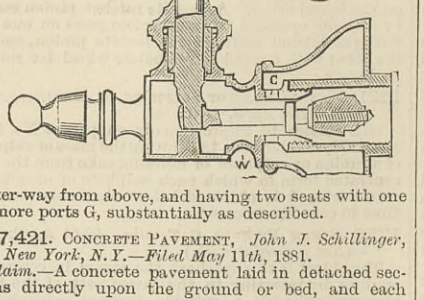


iron E, the interior web of which forms a bearing surface, against which the shoes of a brake may press, while the exterior of said web also forms a bearing surface for the shoes of an auxiliary brake, substantially as specified.

247,402. Faucet, *John M. Peck, New Haven, Conn., assignor to Peck Brothers and Co., same place.—Filed August 13th*, 1881.

Claim.—In a faucet having a valve arranged upon a spindle operating vertically, the body W entering the

247.402

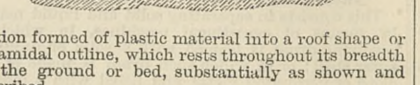


water-way from above, and having two seats with one or more ports G, substantially as described.

247,421. Concrete Pavement, *John J. Schillinger, New York, N.Y.—Filed May 11th*, 1881.

Claim.—A concrete pavement laid in detached sections directly upon the ground or bed, and each

247.421

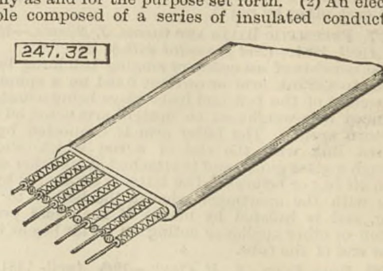


section formed of plastic material into a roof shape or pyramidal outline, which rests throughout its breadth on the ground or bed, substantially as shown and described.

247,321. Electric Cable, *Patrick B. Delany, New York, N.Y.—Filed July 16th*, 1881.

Claim.—(1) The method herein described of making lead-enclosed electric cables, the same consisting in arranging longitudinally in a flat lead pipe a series of insulated conducting wires, practically in the same plane, interposing between each conducting wire and the next adjacent conducting wire a bare or naked metallic wire, and compressing the cable so formed until the opposite sides of the naked wires are pressed against the opposite walls of the pipe, which are caused to partially embrace the conducting wires, substantially as and for the purpose set forth. (2) An electric cable composed of a series of insulated conducting

247.321

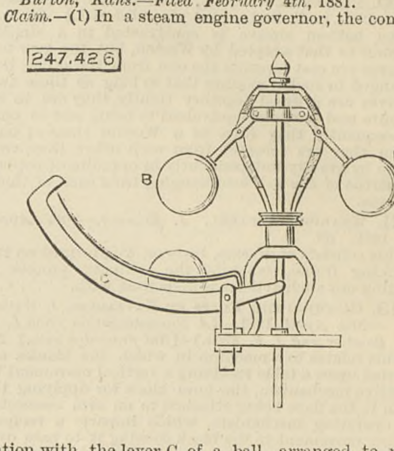


wires arranged in practically the same plane within a flat lead pipe, and separated by complete intervening walls of metal extending between and in contact with but not integral with nor attached to the opposite walls of the said lead pipe, substantially as described.

247,426, Engine Governor, *William Sneddon, Burton, Kans.—Filed February 4th*, 1881.

Claim.—(1) In a steam engine governor, the combi-

247.426



nation with the lever C of a ball, arranged to run loosely in a groove thereof, as and for the purpose specified. (2) In an engine governor, the grooved lever C ball running loosely in the groove post, sliding valve-stem, and fly-balls B, combined for operation, substantially as shown and described.

CONTENTS.

The Engineer, November 25th, 1881. PAGE

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—James Bartler, chief engineer, to the Pembroke, additional, for service in the Steam Reserve; William J. Cleverley, chief engineer, to the Asia, additional, for service in the Steam Reserve; George J. Fraser, engineer, to the Pembroke, additional, for service in the Osprey; Charles Lane, engineer, to the Victor Emmanuel, additional, for Hong Kong yard, vice Shapcott; Thomas Rule, engineer, to the Indus, additional for the Swiftsure, vice Lane; and William M. Feak, engineer, to the Penelope, vice Hughes.

South Kensington Museum.—Visitors during the week ending Nov. 19th, 1881:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,106; mercantile marine, building materials, and other collections, 2850. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 4 p.m., Museum, 1358; mercantile marine, building materials, and other collections, 271. Total, 14,585.