THE MANCHESTER EXHIBITION.

On Monday last, the Manchester Exhibition was thrown open for private view, and the representatives of the press were specially invited to make an inspection of the building and its contents. We have already given a general description of the Exhibition and the special objects its promoters have in view, from which our readers will have formed a fair idea of its leading features, and it must be admitted, considering the magnitude into which it has grown since the project was first set on foot, and that only six months have elapsed since the erection of the building was actually commenced, it was certainly a bold step to invite critical inspection more than a week before the formal opening. It would have been altogether exceeding the bounds of any reasonable expectation which could be based upon previous experience of Exhibitions of anything like similar importance if the visitors had anticipated finding every exhibit in position and all the arrangements in working order. As a matter of fact there was the noise and bustle of workmen engaged on every side, and in some sections many of the exhibits were so far from complete that but little conception of their ultimate real character could be formed, whilst some of the important portions of the decorative work were in an unfinished state that robbed the building of much of the imposing effect it will ultimately assume. Sufficient advance had, however been made to give a very satisfactory general idea of the appearance the Exhibition will present in its completed state, and the marvel was that so much could have been effected in so short a space of time.

In what we have to notice with regard to the Exhibition, we shall of course confine ourselves chiefly to those portions in which our readers are most directly interested, and deal specially with the section devoted to machinery in motion, general engineering work, machine tools, and exhibits connected with the iron and steel trades and allied branches of industry. This is the most interesting, and, at the same time, the most advanced section of the Exhibition. With few exceptions, every important exhibit was in position, and most of them practically in working order, a result highly creditable alike to Mr. H. R. Jackson, the superintendent of this department, and to the various exhibitors who have so well responded to the appeals of the committee to have everything in readiness before the formal opening ceremony. We shall not in our present notice attempt a detailed description of any of the varied exhibits, but give a few further general particulars beyond those we were enabled to supply in our previous article, and a short sketch of the most characteristic features of the machinery and engineering section will be of interest. The machinery in motion department of the Manchester Exhibition, which is the largest covered area ever devoted to the purpose, is 546ft. long and 210ft. wide, and is made of seven 30ft. bays running the whole length of the building; there is also a gallery 10ft. wide and 12ft. above the floor, running round the entire section, and the total superficial area is 143,980ft., of which 76,500ft. is occupied by exhibits, which is independent of an adjoining building, 180ft. square, devoted to engineering exhibits of a stationary character. To show the importance of this section of the Manchester Exhibition, it will be interesting to compare it with the area assigned to machinery in the three Exhibitions held during 1886 in London, Liverpool, and Edinburgh. In London the area thus set apart was 25,000 square feet; in Liverpool, 45,000 square feet; and Edinburgh, 17,000 square feet; so that the area allotted to machinery in the Manchester Exhibition is more than half as much again as in the other three Exhibitions put together. In this building the columns supporting the roof are constructed to carry the main shafting, which is driven by four engines, developing about 200 indicated horse-power each, and these engines each drive three lines of shafting of varying length, the total amount being 2880ft. This length of shafting affords another means of comparison with previous Exhibitions. At the Paris Exhibition of 1878, in the English section there was 964ft. of shafting; in the Woollen Exhibition at the Crystal Palace, 618ft.; at the Inventions Exhibition, 800ft.; and at the Liverpool Exhibition, 600ft. There is therefore in the Manchester Exhibition three times the quantity of driving accommodation that has been provided at any previous Exhibition. The steam is provided by ten Galloway steel boilers, 30ft. long by 8ft. diameter, of 40-horse power each, and working to 100 lb. pressure, and capable of evaporating 80,000 lb. of water per hour. These boilers are set in one row, and make a very fine exhibit, running across one end of the building. From the boilers there is a main range of steam pipes 830ft. long, varying from 12in. to 7in. diameter, supplying steam to the electrical section, the engines, and the exhibits in the machinery section, and the engines and electric light arrangement for the fairy fountains and illuminations in the ground. There is a return exhaust pipe the whole length from 10in. to 20in. diameter, which is taken up to the boiler chimney to carry away the exhaust steam, and these pipes are placed in a culvert outside the building to prevent as much as possible the radiation of heat, always a great drawback in an Exhibition. Adjoining the boiler-house is the chief dynamo department, where the electricity is generated for 546 arc lamps, of which 470 are inside the Exhibition buildings, and 3500 incandescent lamps for the illumination of the grounds. To drive the dynamos ten engines have been put down, developing altogether 1200-horse power. The most prominent amongst these is a pair of specially designed vertical engines, by Mather and Platt, each indicating about 125 horse-power; then there is a small pair of vertical engines by Davey and Paxman of their ordinary type; a small vertical engine, a compound engine and a pair of high-pressure engines by Hornsby; a compound and a single low-pressure engine by Robey; one of Ruston and Proctor's engines; and a pair of compound engines by Yates, of Blackburn. The whole of the contract for the illuminated fountains has been carried out by Messrs. Galloway, who, in a separate building at the further end of the machinery section, have erected a compound engine of 200 indicated horse-power, driving dynamos for illuminating the fountains, and also a superposed horizontal compound engine of 185 indicated horse-power for working six ram pumps, which furnish water at a sufficient pressure to throw the jets the necessary height to make an effective display. These fountains, it may be mentioned, are on a much more extensive scale than any which have hitherto been constructed, either for London or elsewhere; and by the present arrangement the whole of the various water jets and electric lighting, with appliances for varying the colours, are worked by two men, which is a great improvement upon the London Exhibition, where about twenty men were employed under the fountains for the purpose of manipulating them and the coloured lights in connection therewith.

As to the general features of the machinery section, it is scarcely necessary to say that in the centre of the cotton industry, the most prominent is the large and varied display of all descriptions of machinery connected with the manufacture of textile fabrics, and these are not confined to cotton, but embrace the manufacture of woollen and silk. These exhibits embrace every process of manufacture in actual operation from the raw material to the finished goods, and a most complete and interesting panorama of the silk industry is presented from the eggs, larva, and moths of the various kinds of silkworm, through the various processes of reeling, throwing, spinning, and dyeing, up to the manufactured fabric in all its varied forms. Printing machinery of all the most modern and improved types is also very largely represented, and there is a varied collection of miscellaneous machinery altogether too numerous to specify. In the engineering department, the pump makers make a very good show, and locomotive engines form a very prominent exhibit; other heavy exhibits include steam hammers, fuel economisers, and the large driving engines put down by Messrs. Hick, Hargreaves, and Co., Messrs. John Musgrave and Sons, Messrs. John and Henry Wood, of Bolton, and Messrs. Daniel Adamson and Co., of Hyde. Machine tools are fairly well represented by well-known makers in the district, but there are several of the leading firms who are absent. The iron and steel industries are strongly represented by most of the leading firms in the country, Lancashire, Yorkshire, Scotland, and the North of England all contributing important exhibits, foremost amongst them being Sir Joseph Whitworth and Co., who have a most imposing collection of well-known productions. Chief amongst these are a hollow propeller shaft, 55ft. long, 18¼in. diameter, with a 10in. hole, and a collar at one end 34in. diameter; a complete set of forgings for a 68-ton gun, consisting of tube, 26½ tons; breech piece, 18 tons; B tube, 17 tons; five hoops, 40 tons; and breech screw, 23½ cwt., making a total weight of 102 tons; and a weldless steel boiler ring, 12ft. diameter by 6ft. 6in. long. One or two of the Sheffield firms also show some very massive exhibits, and Wm. Jessop and Sons have a cast steel spur wheel 16ft. diameter; a cast steel crank shaft, weighing 8 tons; a cast steel fly-wheel shaft, 7 tons; and a cast steel cylinder cover, 3 tons. The brief summary we have given will serve to indicate in some degree the general character of this section of the Exhibition, and in subsequent notices we shall deal in detail with such of the exhibits as are of special prominence or novelty.

NOTE ON TORPEDO BOAT TRIALS.

By Robert Mansel.

From The Engineer of the 1st inst. I learn that M. De Bussy has favoured the Institution of Naval Architects with a paper giving the results of speed trials, carried out at Cherbourg, upon a torpedo vessel; also, the further information: "The formula made use of in France to determine the speed corresponding to a given power is

$$v = m \sqrt[3]{\frac{\text{I.H.P.}}{\text{B}^2}}"$$

Obviously, by cubing the members of this formula, and modifying, we have:

$$m^3 = \frac{\text{B}^2\, v^3}{\text{I.H.P.}}$$

in which, if we write m^3 = C, B^2 = A, and I.H.P. = E, we should have

$$\text{C} = \frac{\text{A}\, v^3}{\text{E}}.$$

That is to say, the old-fashioned Admiralty mid area formula, with all its long-recognised imperfections, I fear, not in the least mitigated by the remarkably naïve expedient of substituting, for the well-known venerable coefficient C, the cube of its cube root.

As shown in my letters published in The Engineer during last spring, the old formula is based upon a true mechanical principle, but has been rendered valueless by being associated with a false hypothesis, viz., in a steam vessel the resistance varies with the speed, in the ratio of the products of the square of a lineal dimension by the square of the speed. Every carefully conducted set of experiments upon a steam vessel can be put into a shape to elicit what is the true law of this important fundamental quantity; and M. De Bussy's data furnish one other to the many proofs I have adduced as to its real form and value.

That the resistance varies as the square of a lineal dimension is so approximately true, that the slight error this hypothesis involves may be neglected, in view of the gross errors arising from the second or speed factor; and, since, in similar-shaped solids, the square of a lineal dimension is equally well represented, by the two-third power of the displacement, by the immerged mid area, or wetted surface, either of these three elements may be employed without influencing the comparative results of progressive speed trials—

$$\text{(I.)} \qquad \text{C} = \frac{\text{A}\, v^3}{\text{E}},$$

being the Admiralty mid-area formula. I have shown that a factor of the form

$$\frac{\text{Log.}^{-1}\, a\, v}{v^2},$$

multiplying the second member, is capable of reducing it to a quantity, represented by c, which is constant, so long as the conditions of trial, other than the power and speed, remain the same. That is to say, we have

$$\text{(II.)} \qquad c = \frac{\text{A}\, v}{\text{E}} \log.^{-1}\, a\, v,$$

or, resolving for E,

$$\text{(III.)} \qquad \text{E} = \frac{\text{A}\, v}{c} \log.^{-1}\, a\, v.$$

The curious fact to note is, that the quantities a and c remaining constant, under conditions, these conditions are not constant. Thus, in fine full-powered vessels, we have distinct evidence of each of these assuming three values, for low speeds, medium, and high speeds, respectively. The doctrine that the resistance varies as an increasing power of the velocity, under the square at low speeds and above the square at high speeds, is simply an indefinite, empirical way of assuming some kind of a relation between what ought to be two perfectly definite experimental facts, viz., the speed of the vessel, and the power expended to produce that speed.

M. De Bussy has stated the mid section of the vessel experimented upon to be 22 square feet, and other data, as reproduced in the following table:—

No. of trial.	Speed. Knots.	Revolutions. Per minute.	Power. Horses.
(1)	4·70	64·15	9·33
(2)	8·91	126·16	42·44
(3)	10·20	145·73	62·19
(4)	10·94	157·99	67·33
(5)	12·89	186·57	120·93
(6)	14·58	215·37	184·23
(7)	16·80	253·97	300·58
(8)	18·20	275·68	377·40
(9)	19·30	293·32	443·65

Following out the method of investigation given in my letters in The Engineer last spring, it will be found, for experiments (1), (2), and (3), we have the relation between power and speed, stated in general terms by Equation III.—the mid area formula—

$$\text{E} = \frac{22\, v \log.^{-1} \cdot 0888\, v}{29 \cdot 04} \quad . \quad . \quad . \quad (a)$$

Again for (3), (5), (6), and (7), this relation is changed into

$$\text{E} = \frac{22\, v \log.^{-1} \cdot 071\, v}{19 \cdot 11} \quad . \quad . \quad . \quad (b)$$

No. (4) contains a latent error of observation, which places it in contradiction to all the others; but not to diverge into side issues, pass it over for the present, and for (7), (8), and (9) the foregoing relations are changed into

$$\text{E} = \frac{22\, v \log.^{-1} \cdot 0425\, v}{6 \cdot 61} \quad . \quad . \quad . \quad (c)$$

The crucial test for the truth of these, is to calculate by them the power required for the respective speeds, and compare them with M. De Bussy's data, as follows:—

Formula (a).

Trial speeds		4·70	8·91	10·20
Product by ·0888	=	·4174	·7912	·9058
Log. v	=	·6721	·9499	1·0086
Log. 22...	=	1·3424	1·3424	1·3424
Subtract Log. 29·04	=	1·4630	1·4630	1·4630
Sum log. E	=	·9689	1·6205	1·7938
∴ E	=	9·31	41·74	62·2
By trial data	=	9·33	42·44	62·19

Formula (b).

Trial speeds		10·20	12·89	14·58	16·80
Product by ·071	=	·7242	·9152	1·0352	1·1928
Log. v	=	1·0086	1·1103	1·1638	1·2253
Log. 22	=	1·3424	1·3424	1·3424	1·3424
Subtract Log. 19·11 ...	=	1·2814	1·2814	1·2814	1·2814
Sum log. E ...	=	1·7938	2·0865	2·2600	2·4791
∴ E	=	62·2	122·0	182·0	301·4
By trial data ...	=	62·19	120·93	184·23	300·58

Formula (c).

Trial speeds		16·80	18·20	19·30
Product by ·0425	=	·7308	·7917	·8395
Log. v	=	1·2253	1·2601	1·2856
Log. 22...	=	1·3424	1·3424	1·3424
Subtract Log. 6·61	=	·8202	·8202	·8202
Sum log. E	=	2·4703	2·5740	2·6473
∴ E	=	300·8	375·0	444·0
By trial data	=	300·58	377·49	443·65

Contrasting these figures, no one can well deny their remarkably close agreement. Each equation satisfies the conditions for speeds in its own group, but would exhibit great discrepancies if applied to speeds in any of the others; and, in this way, it is made evident that the relation between power and speed, when extended over a large range of speeds, is not, as usually assumed, capable of being represented by one single curve, but is built up of the parts of three related curves, of the same species, with entirely different constants. That these are neither random nor guess-work figures will be best shown by appending the process for finding these constants for the mean values in formula (b) as follows:—We first calculate the values of the expression log. $\frac{A\,v}{E}$, for the speeds for which this formula holds good, thus:—

Trial speeds	10·20	12·89	14·58	16·80
Log. 22 ... ... =	1·3424	1·3424	1·3424	1·3424
Log. v ... ... =	1·0086	1·1103	1·1638	1·2253
Subtract Log. E ... ... =	1·7937	2·0825	2·2653	2·4780
Algebraic sum ... ... =	·5573	·3702	·2409	·0897

Now divide the difference of the first and last of these by the difference of their speeds; we obtain

$$\frac{\cdot5573 - \cdot0897}{16\cdot80 - 10\cdot20} = \frac{\cdot4676}{6\cdot6} = \cdot071 = a, \text{ as in formula } (b).$$

Next trial speeds	10·20	12·89	14 58	16·80
Product by ·071 ... ... =	·7242	·9152	1·0352	1·1928
Add sums, as above ... =	·5573	·3702	·2409	·0897
Sum, or log. c... ... ... =	1·2815	1·2854	1·2761	1·2825

Average value = 1·2814 = log. c ∴ c = 19·11, as in formula (b).

The reasons for this process will be obvious by a reference to Formula II.; since, by it, log. c = log. $\frac{A\,v}{E} + a\,v$. In an exactly similar manner, with the low and high speed groups, we obtain the values for formulas (a) and (c). Formulæ of this transcendental character are very sensitive; and the small errors of observation, which unavoidably occur in all such experiments, are at once made apparent by their disturbing effect upon the calculated formula values of the quantities log. E. and log. c. There is a curious relation, however. The variations arising from errors of observation equally affect each of these quantities, one result of which is: if, for all the trial speeds, we sum the values of log. E and log. c, as given by their formulæ, and from this sum deduct the sum of the observation values of log. E, the residue will be the value of the same multiple of the average value of log. c as the number of speeds for which the calculation is made. Thus, referring to the foregoing figures, for the mean speed trials, we have:—

Formula values. Log. E.	Formula values. Log. c.	Trial values. Log. E.
1·7938 ...	1·2825 ...	1·7937
2·0865 ...	1·2854 ...	2·0825
2·2600 ...	1·2761 ...	2·2653
2·4791 ...	1·2825 ...	2·4780

Sums 8·6194 +5·1255 −8·6195 = $\frac{5\cdot1254}{4}$ = 1·2814 = log. c. Mean value

Also the number of speeds, as divisor of algebraic sum.

This furnishes a useful collective check upon the numerical operations, and it is also obvious that the sum of the formula values of log. E is practically the same as the sum of the logarithms of the observed diagram values.

In one of his many thoughtful essays, Mr. Herbert Spencer has advanced this proposition—"Inquiring into the pedigree of an idea is not a bad means of roughly estimating its value," which I venture to enlarge by the *simile*—the author and his idea somewhat resemble complementary colours, which, by their contrast, mutually intensify as well as complete each other. Let me illustrate by an idea which for a long time has been current amongst mechanicians, but with its origin, value, and applications often very much misunderstood. I refer to the idea, in the case of a machine—say, for example, the steam engine of a vessel—developing power and doing work at different velocities; the indicator pressures are diminished by a quantity, special to the particular case, but which is *constant*, or uninfluenced by the rate at which the work is done. Now, exactly forty years ago, in the first course of lectures upon the general theory of mechanics, which the present incumbent of the Chair of Natural Philosophy in Glasgow University delivered to his classes, pointed reference was made to this principle, as an accepted fact of mechanical science, and the name by which it was designated, that of "Morin's constant." On the high authority of Sir W. Thomson, this distinguished *savant's* researches in this department of science had entitled his name to be permanently associated with the principle referred to. I am therefore not surprised to find in your issue of February 18th, a correspondent—"W. S.," Liverpool—has, very properly, called attention to this principle as having been long known; and as to the reference he has made to a paper of mine in "1876," or, it might have been, to long anterior ones, where this principle has been referred to or employed. I should be sorry if the impression were conveyed that I had advanced any claim to its discovery. All I have done has been to show that by its *proper* application to the theory of marine propulsion we were furnished with a fertile and efficient means of investigating one of its most obscure phenomena.

A reference to the papers of the Institution of Engineers and Shipbuilders in Scotland will show, in the spring of 1875, when speaking to the question, "The Difficulties of Speed Calculation," I made the following statements:—The first error to be met was this, "In every steam vessel the power expended by the engine in working itself, is in constant ratio to the gross indicated power," and to effect this, I stated, "we must obviously reduce the mean effective pressure on the piston by a pressure which, in each case, ought to represent the pressure necessary to work the engine, unloaded, at the speed of trial. Friction of the load and subsequent losses in the engine may then be considered as a constant fraction of the gross indicated power." This, obviously, is Morin's constant; only obtained by a somewhat involved process. In the spring of 1876 I published a direct method of determining this quantity, which at the same time involved the true law of the resistance; the value indicated by my earlier attempts, being founded upon the hypothesis of the resistance varying as the square of the velocity, gave, necessarily, an erroneous value; although in effect it was the same as a method published at the Institution of Naval Architects by the late Dr. Froude, about a fortnight subsequent to my publication of the correct solution. By this, the direct explicit value of Morin's constant is,

$$m = \frac{21{,}010}{d^2\,s} \cdot \frac{E}{N} \cdot \frac{1}{\text{Log.}(a-n)V}.$$

In which E and N are the observed indicated horse-power and revolutions of engines corresponding to the speed V of vessel; a and n, two small quantities depending upon those elements, and capable of being determined by two distinct experiments under the same conditions; also, in the case of compound engines, d and s the diameter and stroke of the high-pressure cylinder respectively.

The formula involves the values of d and s, which have not been published in the report of M. De Bussy's trial data, and we are therefore unable to apply it to the present case. In old times we read of Hebrew bondsmen constrained to manufacture bricks "without straw," and we may safely conclude the resulting bricks were somewhat inadequate as to quality. I shall simply offer a sample with the "straw" not wanting; and approximate, as nigh thereto, with M. De Bussy's data, as the circumstances will warrant.

From the Admiralty trial data tables we obtain—

H.M.S. Heroine, 7th September, 1882.

	Trial speeds. V knots.	Revolutions. N per minute.	Indicated power. E horses.
(1)	13·12	113·2	1466
(2)	12·43	108·1	1243
(3)	11·47	97·1	922
(4)	9·16	76·2	471

The remaining necessary data are d = 36, s = 2·5, whence, log. $\frac{d^2\,s}{21{,}010}$ = −1·1881; and I calculate the quantity $(a-n)$ = ·081 very nearly; hence,

	(1)	(2)	(3)	(4)	True speed for (2)
Trial speeds	13·12	12·43	11·47	9·16	12·50
Value of ·081 V =	1·0627	1·0068	·9291	·7420	1·0125
Add. log. N ... =	2·0538	2·0338	1·9870	1·8820	2·0338
Add. log. $\frac{d^2s}{21{,}010}$ =	−1·1881	−1·1881	−1·1881	−1·1881	−1·1881
Sum ... ... =	2·3046	2·2287	2·1042	1·8121	2·2344
Subtract from Log. E ... ... =	3·1661	3·0945	2·9647	2·6730	3·0945
Leaves value, log. m ... ... =	·8615	·8658	·8605	·8609	·8601
∴ Morin's constant ... ... =	7·27	7·34	7·25	7·26	7·25

In the foregoing, each trial gives its own value in testimony to the truth of the mechanical principles involved in the formula; and the very exception shown by the slight excess of value in (2) is only an indication that the reported speed 12·43, for that trial, is slightly erroneous, and that the data belong to the speed 12·50! Thus, in the last column, taking this for the speed, we get m = 7·25, and the average for the whole four experiments 7·26, which certainly is as near constancy as we have any right to expect.

Again, the relation of power and speed in this vessel will be seen to be:

$$E = \frac{D^{\frac{2}{3}}}{14\cdot83}\,V\,\log.^{-1}\cdot0851\,V;$$

and since the displacement is given at 3724 tons, taking the speed of (2) at 12·5 knots, we have the following calculations practically in perfect agreement with the trial data.

Trial speeds	13·12	12·50	11·47	9·16
Product ·0851 V =	1·1165	1·0638	·9781	·7795
Add. log. V_2 ... =	1·1179	1·0969	1·0518	·9619
Add. log. $D^{\frac{2}{3}}$ ... =	2·1043	2·1043	2·1043	2·1043
Subtract Log. 14·83 ... =	1·1712	1·1712	1·1712	1·1712
Log. E ... ... =	3·1675	3·0938	2·9630	2·6745

Formula.	Also check. Sums of Log. E.	Trial.
3·1675	... ...	3·1661
3·0938	... ...	3·0945
2·9630	... ...	2·9647
2·6745	... ...	2·6730
11·8988	=	11·8983

∴ E ... ... =	1470	1241	918	472 horses.
By trial ... =	1466	1243	922	471 ,,

To return to M. De Bussy's data; on forming the values of the ratios $\frac{E}{N}$ for trials (1), (2), and (3), we obtain:

	(1)	(2)	(3)
Log. E ... =	·9694	1·6278	1·7937
Log. N ... =	1·8072	2·1009	2·1655
Log. ratios... =	−1·1627	−1·5269	−1·6302

The difference of the values of the first and last of these, divided by the difference of their speeds, viz.: $\frac{\cdot4675}{5\cdot5}$ = ·085.

Now, calculate the values of $(a-n)$ V for these trials, and subtract this from the foregoing ratios, we obtain:

Trials.. ..	(1)	(2)	(3)
Trial speeds	4·70	8·91	10·20
Product ·085 V =	·3995	·7574	·8670
Ratios as above ...=	−1·1627	−1·5269	−1·6302

Differences = −2·7632 −2·7695 −2·7632. Average value −2·7653.

In an exactly similar way for the following we obtain $(a-n)$ = ·067; and the differences,

Trials (3) (5) (6) (7)
−2·9468 −2·9480 −2·9552 −2·9476. Average value −2·9494.

And, again, for (7), (8), and (9), we have $(a-n)$ = ·0425.

Trials .. (7) (8) (9)
Differences −1·3592 −1·3629 −1·3596. Average value −1·3606.

Hence, it follows "Morin's constant" is only constant, under conditions and changes *pari passu* with the values of the quantities a and c of our formulas. Thus, at low, medium, and high speeds, the above average values show that its values are in the proportions 1 : 1·525 : 3·94, or about four times greater at the high speeds than at the low. As previously noted, the want of the special values of d and s for these cases prevents the actual value from being determined.

A REMARKABLE TRIAL TRIP.

SOME years have passed since we gave an account of the trial trip of a torpedo boat built by Messrs. Yarrow and Co. That trip was remarkable, for it lasted three hours, during the whole of which period the boat was driven at full speed without hitch or check, and the speed attained was the greatest during the time that has been achieved through water. In a recent impression we gave some particulars of the trial trip of a boat built for the Italian Government by Messrs. Yarrow and Co., which attained the highest speed known, namely, as nearly as possible 28 miles an hour. On the 14th inst. the sister boat made her trial trip in the Lower Hope, beating all previous performances, and attaining a mean speed of 25·101 knots, or over 28 miles an hour. The quickest run made with the tide was at the rate of 27·272 knots, or 31·44 miles per hour, past the shore. This is a wonderful performance.

In the following table we give the precise results:—

	Boiler.	Receiver.	Vacuum	Revs. per min.	Speed.	Means.	2nd means.
	lbs.	lbs.	in.		Knots per hour.	Knots per hour.	Knots per hour.
1	130	32	28	373	22·641		
						24·956	
2	130	32	28	372·7	27·272		24·992
						25·028	
3	130	32	28	372	22·784		25·028
						25·028	
4	130	32	28	377	27·272		25·138
						25·248	
5	130	32	28	375	23·225		25·248
						25·248	
6	130	32	28	377	27·272		
Means	130	32	28	374½			25·101

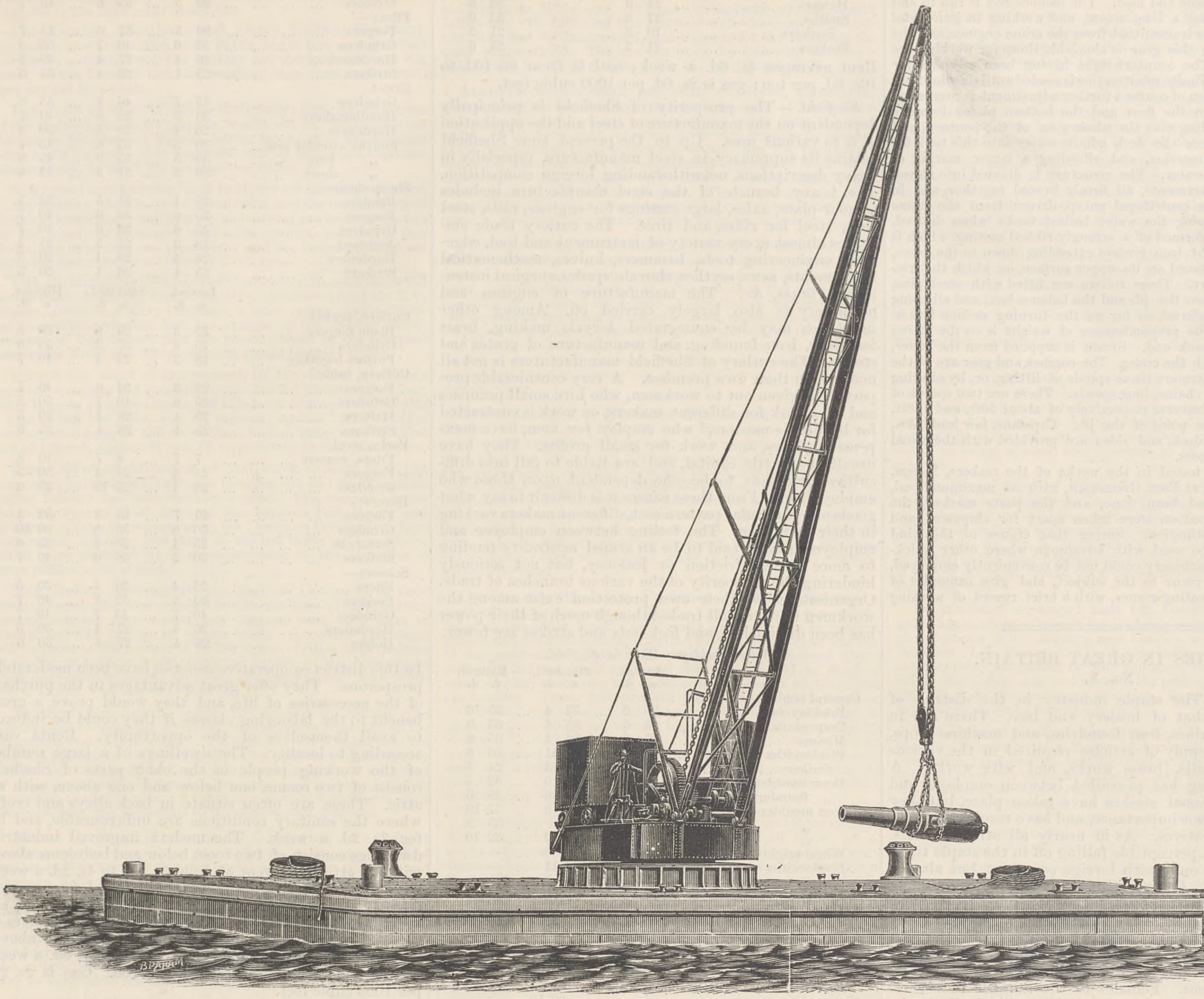
The boat is 140ft. long, and fitted with twin screws driven by compound engines, one pair to each propeller. These engines are of the usual type constructed by Messrs. Yarrow. Each has two cylinders, with cranks at 90 deg. The framing, and, indeed, every portion not of phosphor-bronze or gun-metal is of steel, extraordinary precautions being taken to secure lightness; thus the connecting rods have holes drilled through them from end to end. The low-pressure cylinders are fitted with slide valves. The high-pressure valves are of the piston type, all being worked by the ordinary link motion and excentrics. The engine-room is not far from the mid length of the boat, and one boiler is placed ahead and the other astern of it. Each boiler is so arranged that it will supply either engine or both at pleasure. The boat has therefore two funnels, one forward and the other aft, and air is supplied to the furnaces by two fans, one fixed on the forward and the other on the aft bulkhead of the engine-room. The fan engines have cylinders 5½in. diameter and 3½in. stroke, and make about 1100 revolutions per minute when at full speed, causing a plenum in the stokeholes of about 6 in. water pressure. Double steam steering gear is fitted, for the forward and aft rudder respectively, and safety from foundering is provided to an unusual degree by the subdivision of the hull into numerous compartments, each of which is fitted with a huge ejector, capable of throwing overboard a great body of water, a body of water equal to the whole displacement of the boat can be discharged in less than seven minutes. There is also a centrifugal pump provided, which can draw from any compartment. The circulating pump is not available because it has virtually no existence, a very small pump on the same shaft as the centrifugal being used merely to drain the condensers. These last are of copper, cylindrical, and fitted with pipes through which a tremendous current of water is set up by the passage of the boat through the sea. Thus the space and weight due to a circulating pump is saved and complication avoided. The air and feed pumps are combined in one casting let into the engine-room floor quite out of the way, and worked by a crank-pin in a small disc on the forward end of the propeller shaft. This is an admirable arrangement, and works to perfection.

The armament of the boat consists of two torpedo tubes in her bows, and a second pair set at a small angle to each—Yarrow's patent—carried aft on a turntable for broadside firing. There are also two quick firing 3 lb. guns on her deck. The conning tower forward is rifle proof, and beneath it and further forward is fixed the steering engine, and a compressing engine, by which air is compressed for starting the torpedoes overboard and for charging their reservoirs. A small dynamo and engine are also provided for working a search light if necessary. The accommodation provided for the officers and crew is far in advance of anything hitherto found on board a torpedo-boat.

The weather on the morning of Thursday, the 14th, was anything rather than that which would be selected for a trial, or indeed any, trip on the Thames. At 11 a.m., the hour at which the boat was to leave Messrs. Yarrow's yard, Isle of Dogs, the wind was blowing in heavy squalls from the north-east, accompanied by showers of snow and hail. The Italian Government was represented by Count Gandiani and several officers and engineers. In all there were about thirty-three persons on board. The displace-

TWENTY-TON FLOATING CRANE.

MESSRS. APPLEBY BROTHERS, LONDON, ENGINEERS.



ment of the vessel was as nearly as might be 97 tons. A start was made down the river at 11.15 a.m., the engines making about 180 revolutions per minute, and the boat running at some $11\frac{1}{2}$ or 12 knots. During this time the stokehole hatches were open, but the fans were kept running at slow speed to maintain a moderate draught. The fuel used throughout the trip was briquettes, made of the best Welsh anthracite, worked up with a little tar. The briquettes were broken up to convenient sizes before being put in the bunkers. This fuel is not of so high evaporative efficiency as Nixon's navigation coal; but it is more suitable for torpedo boat work, because it gives out very little dust, while the coal in closed stokeholes half smothers the firemen. Watering only partially mitigates the evil. Besides this the patent fuel does not clinker the tube ends —a matter of vital importance.

During the run down to Gravesend the small quantity of smoke given out was borne down and away from the tops of the funnels by the fierce head wind, and now and then a heavy spray broke on the bows, wetting everything forward. In the engine-room preparations were made for taking indicator diagrams. No attempt was made to drive the boat fast, because high speeds are prohibited by the river authorities on account of the heavy swell set up. The measured mile in the Lower Hope is on the southern oank of the river, about three miles below Gravesend. Just as the boat passed the town, in the midst of a heavy rain squall, the stoke-hole hatches in the deck were shut, and the dull humming roar of the fans showed that the fires were being got up. The smoke no longer rose leisurely from the funnels. It came up now with a rush and violence which showed the powerful agency at work below. A rapid vibrating motion beneath the feet was the first evidence that the engines were away full speed. As the boat gathered way she seemed to settle down to her work, and the vibration almost ceased. The measured mile was soon reached, and then in the teeth of the north-easter she tore through the water. The tide and wind were both against her. Had the tide and wind been opposed, there would have been a heavy sea on. As it was, there was quite enough; the water, breaking on her port bow, came on board in sheets, sparkling in the sun, which, the rain squall having passed, shone out for the moment. As the wind was blowing at least thirty miles an hour, and the boat was going at some twenty-six miles an hour against it, the result was a moderate hurricane on board. It was next to impossible to stand up against the fury of the blast without holding on. The mile was traversed in less than $2\frac{1}{2}$ minutes, however; but the boat had to continue her course down the river for nearly another mile to avoid some barges which lay in the way, and prevented her from turning. Then the helm was put over, and she came round. There was no slacking of the engines, and astern of her the water leaped from her rudder in a great upheaved, foaming mass, some 7ft. or 8ft. high. Brought round, she once more lay her course. This time the wind was on her starboard quarter, or still more nearly aft. The boat went literally as fast as the wind, and on deck it was nearly calm. The light smoke from the funnels, no longer beaten down by wind, leaped up high into the air. Looking over the side, it was difficult to imagine that the boat was passing through water at all. The enormous velocity gave the surface of the river the appearance of a sheet of steel for 1ft. or more outside the boat. Standing right aft, the sight was yet more remarkable. Although two 6ft. screws were revolving at nearly 400 revolutions per minute almost under foot, not a bubble of air came up to break the surface. There was no wave in her wake; about 70ft. behind her rose a gentle swelling hill. Her wake was a broad smooth brown path, cut right through the rough surface of the river. On each side of this path rose and broke the angry little seas lashed up by the scourging wind. Along the very centre of the brown track ran a thin ridge of sparkling foam, some 2ft. high and some 20ft. long, caused by the rudder being dragged through the water. There was scarcely any vibration. The noise was not excessive. A rapid whirr due to the engines, and a rhythmical clatter due to the relief valve on one of the port-engine cylinders not being screwed down hard enough, and therefore lifting a little in its seat at each stroke, made the most of it. The most prominent noise, perhaps was the hum of the fans. Standing forward, the deck seems to slope away downward aft—as indeed it does, for it is to be noted that at these high speeds the fore foot of the boat is always thrown up clean out of the water—and the whole aspect of the boat; the funnels vomiting thin brown smoke, and occasionally, when a fire-door is opened, a lurid pillar of flame for a moment; the whirr in the engine room; the dull thunder of the fans, produce an impression on the mind not easily expressed, and due in some measure no doubt to the exhilaration caused by the rapid motion through the air. The best way to convey what we mean is to say that the whole craft seems to be alive, and a perfect demon of energy and strength. Many persons hold that a torpedo boat is likely to be more useful in terrifying an enemy than in doing him real harm, and we can safely say that the captain of an ironclad who saw half a dozen of these vessels bearing down on him, and did not wish himself well out of a scrape, has more nerve than most men.

The second mile was run in far less time than that in which what we have written concerning it can be read, and then the boat turned again, and once more the head wind with all its discomforts was encountered. Events repeated themselves, and so at last the sixth trip was completed, and the boat proceeded at a leisurely pace back again to Poplar. Mr. Crohn, representing Messrs. Yarrow on board, and all concerned, might well feel satisfied. We had travelled at a greater speed than had ever before been reached by anything that floats, and there was no hitch or impediment or trouble of any kind.

The Italian Government may be congratulated on possessing the two fastest and most powerful torpedo boats in the world. We believe, however, that Messrs. Yarrow are quite confident that, with twin screw triple expansion engines, they can attain a speed of 26 knots an hour, and we have no reason to doubt this.

FLOATING STEAM CRANES.

The increase in the dimensions of sea-going steamers has so far exceeded any estimates which could have been made, even less than a generation ago, that many wharves and docks of comparatively recent construction have a depth of water altogether insufficient for vessels to be berthed near enough to the quay for discharging or loading, and but few of these have been designed with a view to the ultimate use of the powerful cranes which are required for dealing with the heavy and bulky loads which are now of constant recurrence. Where these conditions exist floating cranes seem to offer greater facilities than any other system of lifting machinery, because in most cases they can be used without interfering with the existing equipment or arrangements, and the crane illustrated is one of the types which have been most successfully used.

The crane illustrated by the accompanying engraving is capable of lifting to a load of 20 tons; the crane revolves entirely round, and the point of the jib describes a circle 70ft. in diameter; the height is about 70ft., and it will clear a vessel when moored close alongside the pontoon and standing many feet above water level. The pontoon is 80ft. long and 30ft. beam; the depth is 8ft., the draught being 4ft. 3in., and, as will be seen, the foregoing dimensions admit of the crane being laid between the vessel and the quay, and reaching to the centre of the largest vessel frequenting the port on the one side where there is deep water, and delivering on the quay on the other side. But as the crane may be moved to any part of the harbour where its services are required, it may be moored on the opposite side, and aid in loading or discharging or in manipulating heavy packages independently of the quay, or in effecting repairs to machinery, removing old and slipping new masts, and so forth. Cranes of this type provided with their own propellers will be referred to later on, but as tugs are always available, and there is ample space for manœuvring when the crane under consideration is used, it was deemed undesirable to incur the additional outlay for the propelling engines and accessories. The machinery for working the crane is arranged horizontally in the manner designed by Mr. C. J. Appleby, M. Inst. C.E., many years ago, and adopted by the builders, Messrs. Appleby Brothers, Limited, this being compact and very accessible, and giving a better distribution of strains than any other construction. The necessary stability is obtained by altering the position of the balance-box, and by admitting water ballast under some circumstances which will be referred to later on; and by using one or both of these means, the pontoon is always on an even keel, whatever may be the position of the crane and load. The balance-box is run in and out by gear driving a long screw, and working in gun-metal nuts; the power is transmitted from the crane engines, and the lever for working this gear is alongside those for working the other motions. The counterweight having been adjusted for loads within given limits, no alteration is needed until this limit has been exceeded, when of course a further adjustment is necessary. The space between the floor and the bottom plates forms a closed tank extending over the whole area of the pontoon, and a valve worked from the deck admits water into this tank for increasing the immersion, and affording a larger margin of stability in rough water. The structure is divided into eleven water-tight compartments, all firmly braced together, and in one of these is a centrifugal pump, driven from the crane engines, for emptying the water ballast tanks when desired. The roller path is formed of a strongly-ribbed casting, which is secured to wrought iron girders extending down to the floors, and it is machine-faced on its upper surface, on which the friction rollers revolve. These rollers are fitted with steel pins, and are fixed below the jib and the balance-box, and all being driven, it is immaterial, so far as the turning motion is concerned, whether the preponderance of weight is on the lifting chain or at the back end. Steam is supplied from the boiler, which revolves with the crane. The engines and gear are of the usual type, and there are three speeds of lifting, or, by altering the reeving of the chains, four speeds. There are two speeds of turning, giving a traverse respectively of about 80ft. and 160ft. per minute at the point of the jib. Capstans, fair leads, &c., are fixed on the deck, and sides are provided with the usual timber rubbing pieces.

The crane was tested in the works of the makers, Messrs. Appleby Brothers, at East Greenwich, with its maximum load, and after this had been done, and the parts marked, the machinery and pontoon were taken apart for shipment and re-erection at destination. Seeing that cranes of the kind referred to may be used with advantage where other quick-working lifting machinery could not be conveniently employed, it is proposed to recur to the subject, and give examples of other types of floating cranes, with a brief record of working results.

WAGES IN GREAT BRITAIN.

No. X.

Nottingham.—The staple industry in the district of Nottingham is that of hosiery and lace. There are in addition, coal mines, iron foundries, and machine shops, chiefly for the supply of articles required in the various factories and mills, brass works, and wire works. A fairly good feeling has prevailed between employer and employed, occasional strikes have taken place, but they have been of minor importance, and have resulted in little good to the operatives. As in nearly all other districts, there has been a perceptible falling off in the staple trade of the town, not only with foreign countries, but also in the home trade. Co-operative societies are not common, and those that have been started have not been very successful. The condition of the working classes is fairly good, their wages being sufficient ordinarily for the purchase of the necessaries of life, and in many cases much more, and the various members of a family can generally secure employment. Females to the number of several thousands are employed in this district, principally in the hosiery and lace factories and warehouses, as well as in their own homes.

Wages Paid per Week of Fifty-four Hours in Nottingham.—General Trades.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bricklayers	31 6	33 4	36 0
Carpenters	31 6	35 5	38 3
Masons	38 3	39 7	40 6
Blacksmiths	30 5	33 4	35 5
Strikers	—	25 4	—
Horse-shoers	25 5	27 1	30 5
Ironmoulders	27 11	32 9	35 9
,, Mansfield	27 11	31 9	—
,, Retford	23 10	29 11	31 9
Tinsmiths	22 11	26 6	30 5
Labourers	—	20 3	—

Wages Paid to Members of Trades Unions.

		s. d.
Carpenters	per hour	8
,, Retford	,,	6d. and 7
Stonemasons	,,	9
Amalgamated Engineers	per week	34 0
Blacksmiths	,,	29 3

Wages paid per Week of Fifty-four Hours in Lace Factories in Nottingham.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Smiths	32 5	33 4	36 0

Prices Paid per Week of Fifty-four Hours in Foundries and Iron Works in Nottingham.

	s. d.
Drillers	25 3
Fitters	30 3
Holders up	24 2
Moulders	32 5
Patternmakers	32 5
Planers	25 3
Rivetters	29 2
Smiths	34 2
Turners	25 3
Labourers	19 11

Wages Paid per Week of Fifty-four and Sixty Hours to Railway Employés in Nottingham.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Examiners	—	24 8	—
Fitters	—	34 0	—
Labourers	—	18 3	—

Wages Paid in connection with Coal Mines in the District of Nottingham.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bankmen	19 3	—	20 3
Bymen (contract)	30 6	—	42 6
,, (day)	21 3	—	30 6
Colliers	24 0	—	33 6
Enginemen	—	29 6	—
Fillers	28 6	—	32 0
Foremen (overlookers and underlookers)	37 6	—	39 6
Furnacemen	—	21 3	—
Hewers	24 0	—	33 6
Smiths	27 3	—	33 0
Strikers	19 3	—	21 3
Stokers	21 3	—	23 6

Rent averages 4s. 6d. a week; coal is from 8s. 10d. to 16s. 8d. per ton; gas is 2s. 6d. per 1000 cubic feet.

Sheffield.—The prosperity of Sheffield is principally dependent on the manufacture of steel and the application of it to various uses. Up to the present time Sheffield retains its supremacy in steel manufacture, especially in heavy descriptions, notwithstanding foreign competition. The heavy branch of the steel manufacture includes armour-plate, axles, large castings for engines, rails, steel shot, steel for rifles, and tires. The cutlery trade embraces almost every variety of instrument and tool, edge-tools, engineering tools, hammers, knives, mathematical instruments, saws, scythes, shovels, spades, surgical instruments, brass, &c. The manufacture of engines and machinery is also largely carried on. Among other industries may be enumerated bicycle making, brass founding, iron founding, and manufacture of grates and stoves. The cutlery of Sheffield manufacturers is not all made upon their own premises. A very considerable proportion is given out to workmen, who hire small premises and who work for different makers, or work is contracted for by "little masters," who employ few men, have inexpensive places, and work for small profits. They have usually but little capital, and are liable to fall into difficulties, and thus to become dependent upon those who employ them. From these causes it is difficult to say what goods of a particular pattern cost, different makers varying in their estimates. The feeling between employer and employed may be said to be an armed neutrality tending to more or less friction or jealousy, but not seriously hindering the prosperity of the various branches of trade. Organisations for their own protection exist among the workmen in nearly all trades, though much of their power has been diminished, and lock-outs and strikes are fewer.

Wages Paid per Week in Sheffield.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
General trades:—			
Bricklayers	25 0	33 4	35 6
Carpenters	25 6	33 8	35 9
Masons	25 0	33 4	35 6
Blacksmiths	25 4	32 11	36 6
Strikers	18 3	21 3	24 4
Brass finishers	30 5	31 0	32 5
,, founders	34 5	35 6	38 6
Iron moulders	35 9	35 9	37 10
,, Rotherham	23 10	—	35 9
,, Wakefield	29 11	31 9	32 10
Wheelwrights—wood	—	36 6	—
Blacksmiths	—	32 11	—
Strikers	—	18 7	—
Labourers	18 3	21 3	25 4

Wages Paid per Week in Iron Forges, Foundries, and Machine Shops in Sheffield.

	Hours.	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Ball furnacemen	50	—	50 8	—
Underhand	,,	25 4	30 5	36 6
Charcoal lumpers	,,	—	60 10	—
Puddlers	,,	—	32 5	33 5
Underhand	,,	—	22 3	—
Shinglers	,,	50 8	53 9	60 10
Assistant	,,	33 6	37 6	40 7
Bogiemen	55	—	25 4	—
Firemen	,,	30 5	35 6	45 7
Forgemen	,,	50 8	60 10	76 0
Furnacemen	,,	55 9	60 10	76 0
Hammer drivers	,,	—	30 5	—
Iron trailers	,,	12 8	16 3	21 3
Levermen	,,	—	32 11	—
Plate rollers	,,	60 8	65 10	81 1
Rollers	,,	40 7	45 7	60 10
Assistants	,,	27 4	30 5	33 4
Scale melters	55	—	35 6	—
Metal refiners	57	—	45 7	—
Tire rollers	57	55 9	56 9	60 10
Apprentices—according to age	54	5 1	9 2	12 2
Blacksmiths	,,	30 5	31 5	35 6
Fettlers	,,	26 4	26 10	28 4
Fitters	,,	34 5	35 6	36 6
Machinists	,,	24 4	32 5	36 6
Millwrights	,,	26 4	30 5	33 5
Moulders	,,	34 5	35 6	38 6
Patternmakers	,,	32 5	32 11	34 5
,,	,,	30 5	32 5	34 5
Turners	,,	24 4	32 5	36 6
Labourers	,,	18 3	21 3	25 4
Boilermakers' apprentices	,,	5 1	6 7	10 2
Backers	,,	28 4	30 5	31 5
Blacksmiths	,,	25 4	27 4	30 5
Enginemen	59	25 4	26 4	30 5
Flangers	54	27 4	28 4	30 5
Holders-up	,,	20 3	21 3	23 4
Rivet boys	,,	5 1	5 7	6 1
Rivetters	,,	28 4	30 5	31 5
Labourers	,,	18 3	18 9	20 3

Wages Paid per Week to Railway Employés in Sheffield.

	Hours.	s. d.	s. d.	s. d.
Carriage examiners	72	25 4	26 4	30 5
Fitters	66	25 4	28 4	35 6
Wagon examiners	72	25 3	26 3	30 6
Labourers	,,	16 3	18 3	20 3

Wages Paid per Week in Steel Works in Sheffield.

	Hours.	s. d.	s. d.	s. d.
Converting Foremen	45	—	30 5	—
Labourers	,,	—	20 3	—
Melting:—				
Cellar lad	60	5 1	7 7	15 3
Cokers	,,	18 3	20 3	21 3
Potmakers	,,	30 5	35 6	39 6
Pullers out	,,	28 4	29 5	30 5
Teemers	,,	35 6	36 6	40 7
Rolling foremen	48	—	45 7	—
Rollers	,,	—	36 6	—

Wages paid per week in the manufacture of cutlery, tools, &c.,

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Edge tools:— Piecework			
Forgers	40 7	42 7	55 8
Edge Tools:— Piecework			
Grinders	40 7	48 8	60 10
Hardeners	26 4	28 4	30 5
Strikers	30 5	35 6	45 7
Files:—			
Forgers	30 5	35 6	45 7
Grinders	35 6	40 7	55 8
Hardeners	26 4	27 4	30 5
Strikers	25 4	28 4	35 6
Saws:			
Grinders	45 7	46 8	55 8
Handlemakers	30 5	32 5	40 7
Hardeners	26 4	28 4	30 5
Smiths' circular saw	30 5	35 6	45 7
,, long ,,	30 5	35 9	45 6
,, short ,,	30 5	31 5	35 6
Sheep-shears:—			
Benders	28 4	31 5	32 5
Forgers	35 6	38 6	40 7
Grinders	35 6	38 6	40 7
Assistant	18 3	21 3	25 4
Hardeners	26 4	28 4	30 5
Strikers	25 4	26 4	30 5

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Cutlery, pocket—			
Blade forgers	20 3	35 6	50 8
Grinders	25 4	37 2	50 8
Putters together	15 3	25 4	40 7
Cutlery, table—			
Forgers	20 3	36 6	40 7
Grinders	35 6	40 7	50 8
Hafters	25 4	26 4	30 5
Strikers	25 4	26 4	35 6
Forks, steel—			
Filers, women	7 7	8 7	10 8
Forgers	24 4	25 4	30 5
Grinders	24 4	25 10	35 6
Razors—			
Forgers	40 7	46 8	50 8
Grinders	50 8	55 8	60 10
Setters in	25 4	28 4	35 6
Strikers	30 5	36 6	40 7
Scissors—			
Filers	25 4	26 4	30 5
Forgers	30 5	32 5	40 7
Grinders	40 7	43 7	45 7
Hardeners	26 4	27 4	30 5
Holers	26 4	27 4	30 6

In this district co-operative societies have been moderately prosperous. They offer great advantages in the purchase of the necessaries of life, and they would prove a great benefit to the labouring classes if they could be induced to avail themselves of the opportunity. Rents vary according to locality. The dwellings of a large number of the working people in the older parts of Sheffield consist of two rooms, one below and one above, with an attic. These are often situate in back alleys and crofts where the sanitary conditions are unfavourable, and let for 3s. 2d. a week. The modern improved industrial dwellings consist of two room below and bedrooms above, with an attic, at a rent of from 3s. 8d. to 4s. 2d. a week, according to locality. The average rent of four-roomed houses is from 3s. 7d. to 5s. 1d. a week. Houses of six rooms are from 4s. 8d. to 7s. a week. Large numbers of the working men are unmarried and lodge in the above-mentioned houses, paying from 2s. 1d. to 2s. 6d. a week. Coal is from 10s. 2d. to 15s. 3d. per ton. Gas is 2s. 2d. per 1000 cubic feet.

Examples of Cost of Living per Week in Sheffield.

	3 in family. s. d.	4 in family. s. d.
Bread and flour	2 1	4 1
Butter, cheese, coffee, milk, sugar, tea, &c.	5 11	2 6
Meals	2 1	4 0
Vegetables	0 10	1 6
Fuel and light	1 5	1 6
Clothing	2 1	3 7
Rent	4 2	4 1
Total	18 7	21 3
Income	20 10	25 4

Institution of Civil Engineers.—The association of the Birmingham students of this Institution held their seventh meeting of this session at the Colonnade Hotel, Birmingham, on Thursday evening, April 21st, Mr. C. Hunt, member of the Institution of Civil Engineers—vice-president—in the chair. Mr. H. L. Tarbet, student of the Institute of Civil Engineers, read an interesting paper upon the Wellington—Somerset—Waterworks, as designed by Mr. E. Pritchard, member of the Institute of Civil Engineers. The water supply is obtained by gravitation from springs at Westford to the pumping station—about 450 yards distant—whence it is pumped into a circular iron tank on the top of a brick tower, and then distributed in the town. The pumping machinery and gas engines are in duplicate, and each engine can work separately each or both set of pumps. Dowson's patent economic gas apparatus is adopted to drive the gas engines. The paper was illustrated by large diagrams, and an interesting discussion followed its reading.

Junior Engineering Society.—A paper on "Steam Jacketting" was recently read before this Society by Mr. R. G. Bleasby, who in introducing the subject said that although the steam engine had been in use for upwards of 100 years, we had even yet but an imperfect acquaintance with its theory. Of late years a few authorities had investigated the matter from a practical standpoint, and had produced results of much interest and value. The chief cause of steam engine inefficiency, incomplete expansion, continued to exist, because increased expansion entailed loss by condensation. Greater economy than at present was to be sought in using a cylinder material of far less conductivity for heat than that now in use. From a correct indicator diagram and knowing the quantity of feed-water used, the author showed how the existence of cylinder condensation could be proved, and proceeded to explain by figures the improbability of the change of temperature of the cylinder walls taking place through the whole thickness of the metal, owing to the very short time allowed for the change and the slow rate at which the passage of heat occurs. A passing reference was made to waste gas and hot air jackets, the superiority of steam jackets over them being shown, after which the beneficial results of steam jacketting were graphically indicated. Some practical considerations in the design, construction, arrangement and management of steam jackets were touched upon and examples given, the author concluding by observing that considerable economy was attainable from the use of efficient steam jackets.

RAILWAY MATTERS.

A SPECIAL meeting of the Midland Railway Company is called for Friday, May 6th, to authorise the directors to subscribe £100,000 to the Dore and Chinley line.

THE London, Chatham, and Dover Railway Company has built a nice new station at St. Paul's, but it is so arranged that passengers arriving from the country are dropped out into the street, where, however bad the weather, they must remain until they can get into a cab.

THE body of Mr. William Golightly, district engineer of the Midland Railway Company, was found on Wednesday on the line in the Matlock Tunnel, Derby, the head of the deceased being badly injured. It is supposed that he fell from a first-class compartment, in which his overcoat was found.

SOME good iron and steel and bridge work is being required by the Bombay, Baroda, and Central India, and the Indian Midland Railway Companies. The Bombay and Central are inviting tenders for the supply of Bessemer steel rails, springs, axles, cast iron chairs, and other iron and steel work; and the Indian Midland are requiring materials for a bridge of 250ft. span.

THE Birmingham Chamber of Commerce, in common with similar Chambers throughout the country, has received from Mr. E. C. Nepean, Director of Navy Contracts, a letter requesting the Chamber to ascertain whether it is the opinion of the leading manufacturers of that district that the prices quoted in the accepted tenders for Army and Navy contracts should be made public.

UNDER the head of trespassers, in the Board of Trade report of accidents and casualties in the United Kingdom last year, there is again an improvement, 285 killed—80 of these were suicides—against 305 last year, and 91 injured; against 126. Of other persons not coming in the above classification there were 52 killed and 71 injured, against 41 and 74 respectively in the year before.

THE Canadian Minister of Railways reports that the connection between the Dominion Government and the Canadian Pacific Railway has been formally severed. The company is now the sole owner of 3037 miles of line between Port Moody and Quebec. All the loans granted by the Dominion Government have been repaid, including one-third of the last thirty million dollars, which were cancelled by the reconveyance to the Dominion of seven million acres of land.

THE Italian Mediterranean Railway Company is now inviting tenders for the supply—in different lots—of 2000 railway covered wagons, open trucks, and luggage vans, 4000 pairs of wheels, and 2000 springs of various kinds. A certain preference will be given to the tenders of Italian firms. British firms desirous of sending in tenders should apply for details to the company at their head office in Milan; they may also apply to Mr. John Whitmore, British Vice-Consul in that city.

EFFORTS are being made in Scinde to induce the Government to construct a railway 240 miles long from Pali on the Rajputana line to Hyderabad, *viâ* Umarkote. It is urged that the line will present no engineering difficulty, and that, by shortening the journey from Delhi to Kurrachee by fifteen hours, it will prove of great mercantile and strategic importance, as well as a valuable protection against famine. A meeting in favour of making the line has been held, and memorials to the Government prepared.

MAJOR-GENERAL HUTCHINSON has reported on a "slight accident which occurred on the 3rd inst. at Youghal terminal station on the Cork and Youghal branch of the Great Southern and Western Railway of Ireland. No passengers or servants of the company were injured," and "no damage was sustained by the train." The report says:—"This accident would not have occurred had the points and signals at Youghal station been properly interlocked. The continuous brake with which the train was fitted did good service in enabling it to be stopped before any carriages left the rails." Surely Major-General Hutchinson did not go all the way to Youghal to tell the country this?

IT is stated that during last year forty-five American railways, with 7687 miles of line, 170,140,500 dols. of bonded debt, and 203,969,200 dols. of capital stock, were sold under foreclosure and transferred to new owners at greatly reduced valuations. This total of about 374,000,000 dols. far exceeds the record of foreclosure sales for any previous year. The total of the sales during eleven years included 373 railways sold, with 36,696 miles of line, and 2,152,000,000 dols. of capital, this being about 28 per cent. of the entire American railway plant. The above amount did not include foreclosure sales impending at the beginning of the present year, nor that of the Reading Railway, so that the record for 1887 is also expected to be unusually large.

IN a report on a collision which occurred on February 14th near Werrington Junction, on the Great Northern Railway, when the slip carriage of a down express became detached, and upon the train being stopped suddenly at a point 1324 yards north of Werrington Junction signal-box, this carriage ran into the rear brake-van, at about 11 a.m., at a speed probably of about 20 miles an hour, injuring passengers and guards, Major Marindin says:—"This accident furnishes another proof of the value of an automatic continuous brake, for with a train so fitted the accidental slipping of a coupling ought to apply the continuous brake all through the train, so as to bring the whole to a stand before the front portion of the train could leave the slip carriage for a sufficient distance for any serious shock to be caused by the collision between the two parts.'

THE Postmaster-General has addressed to all railway companies in the kingdom a communication calling attention to the provisions of the Post-office Act prohibiting the carriage of letters by railway companies, and calling upon them to observe the law in this respect. A contemporary says "the effect of this will be to prevent companies from carrying, as they have been accustomed to do, small parcels of which the majority have been parcels containing news for publication in the newspapers. The result of this will be that a very large proportion of the news now sent by train will have to be telegraphed, thus involving an enormous additional expense to newspaper proprietors, and the public must lose considerably in the way of news." This cannot be meant, for the public will surely send its parcels by what means it chooses, and will not stand an imposition of this kind by its own servant and establishment. It is much more likely that the intention is to stop the practice of traders of sending private instructions and orders in this way.

THE designs for the proposed railway bridge across the St. Lawrence, at Quebec, have been prepared by Sir James Brunlees and Mr. A. L. Light, M. Inst. C.E., Government engineer, of the Province of Quebec. The St. Lawrence at the point selected is only 2400ft. from shore to shore. But as the great depth of water prevents the construction of piers in the centre, the cantilever principle has to be adopted for the superstructure. Two massive piers of granite masonry will be built at a distance of 500ft. and 240ft. from the shores of the river in a depth of about 40ft. of water, and on these the enormous cantilever ironwork will be erected. The piers will be built sufficiently high to allow the masts of the largest ocean steamers to pass under the centre span. The dimensions of the bridge will be as follows:—Length of centre—cantilever—span, 1442ft.; length of northern shore span, 487ft.; length of southern shore span, 487ft.; total length of bridge and approaches, 3460ft.; height from high-water mark to bottom of bridge, 150ft.; height of piers above high water, 150ft.; extreme height of top of cantilever above high water, 408ft. The centre span will be 290ft. shorter than that of the Forth, which has a span of 1730ft.

NOTES AND MEMORANDA.

ACCORDING to Herr A. Sauer (*Zeit. Kryst. Min.*), amorphous carbon is widely distributed throughout the mica schists and phillites of the Erzgebirge. It is not identical with graphite or with anthracite. He finds that it is identical with the amorphous carbon described by Inostranzeff, and suggests for the substance the name of graphitoïd. The analysis gave the following results:—Ash, 73·85; C., 24·85; H_2O., 1·01; H., 006; Total, 99·77.

ALLOYED with a small per cent. of silver, aluminium loses much of its malleability, but with 5 per cent. of silver it can be worked well, and takes a more beautiful polish than the pure metal. With 3 per cent. of silver it is very suitable for philosophical instruments, being harder and whiter than the pure metal, and is not tarnished even by sulphuretted hydrogen. With small amounts of silver, it appears very suitable for scale-beams, and is now frequently used for this purpose. The alloy containing 5 per cent. of silver has often been suggested for coin of small denominations, as it is hard, bright, and retains its lustre in handling.

WHEN crossing the Atlantic, Professor Dennis, of New York, recently made some observations to test the purity of the ocean air. He had previously prepared capsules of sterilised gelatine. One which was exposed in a state-room on the main deck of the steamer developed 500 points of infection in eighteen hours; one exposed in the cabin on the main deck developed only five or six points in ten days; a third, hung over the bow of the ship for ten days, remained uncontaminated. We are not told what happened with other capsules, whether any in the state room showed but slight contamination, and whether any outside showed contamination.

THE production of Bessemer steel ingots in the United States during 1886 was 2,269,190 gross tons. Of rails, the output is computed at 1,562,410 gross tons. The production of Bessemer steel ingots in 1886 was 698,670 tons more than that of 1885, while the production of rails had increased by 602,939 tons. Of Clapp-Griffiths steel the output in 1886 is returned at 46,371 net tons, as compared with 21,647 net tons in the previous year. The number of converters completed at Midsummer, 1886, was fifty-eight. Assuming that this number was at work during the year, the average production of ingots per converter would be 40,845 tons. Sixty-nine per cent. of the total make of ingots in 1886 was converted into rails.

ON January 22nd last Professor Tyndall delivered a most interesting discourse on Thomas Young, and this is now published in pamphlet form. As a really great pioneer in modern science and scientific investigation and formulation, Young was one of the greatest of Englishmen. His lectures on Natural Philosophy are far too little read, and this may be said as much of many who are occupying the position of teacher as of those who are learners. Young first used the term *energy* in his lectures on "Collision," and some of those who are so much interested in dynamic terminology might read his eighth lecture as quoted by Professor Tyndall with advantage. Young said, "the term energy may be applied with great propriety to the product of the mass or weight of a body into the square of the number expressing its velocity. . . . The force thus estimated well deserves a distinct denomination."

PROFESSOR DI LEGGE, of the Campidoglio Observatory, Rome, has published in *Atti della R. Accademia dei Lincei*, ser. 4, vol. i., a discussion of the meridian transit observations of the sun's diameter taken at the Observatory during the years 1874-83. From May, 1876, the observations were made by projecting the sun's image on a screen, so that two or more persons could observe simultaneously, and thus determine their "personal equations" from observations made under precisely similar circumstances. Altogether, 5796 transits were observed on 2213 days, giving an average of 221 days per annum. The mean resulting horizontal semi-diameters of the sun, collected in biennial groups, show a progressive diminution, which, taking into consideration Auwers' researches on the subject—*Nature*, vol. xxxv. p. 496—are most probably due to change in the habits of the observers, as the table of mean annual personal equations given by Professor Di Legge would also lead us to infer. The mean values of the horizontal semi-diameter at mean distance found from each observer's transits are respectively as follows:—Di Legge, 961″·329 ± 0″·011; Respighi, 960″·760 ± 0″·013; Giacomelli, 961″·307 ± 0″·012; and Prosperi, 961″·356 ± 0″·014; the combined mean value being 961″·188.

AT a recent meeting of the Paris Academy of Sciences a paper was read on "The Relations that Exist between Cyclones and Concurrent Storms and Hurricanes," by M. H. Faye. From an attentive study of the synoptical storm charts of the United States Signal Service, the author is able to confirm the conclusions already drawn by M. Marié-Davy from the meteorological observations made at the Paris Observatory so far back as the year 1864. It is shown (1) that tornadoes, hurricanes, and hailstorms are simply secondary phenomena directly associated with the central cyclonic movement; (2) that in the United States their trajectories have no general relation either to the isobars or to the normal atmospheric currents; (3) that these relatively short trajectories are parallel to the vast cyclonic trajectories at the moment when these local phenomena arise; (4) that they all lie on the right flank of the cyclone itself, which may thus be regarded as a complex meteorological system accompanied on its right side by whole colonies of destructive tornadoes and hurricanes with their attendant waterspouts, hailstorms, and torrential downpours, all moving together across seas and continents. The whole movement is regulated by the simple law of the mechanics of fluids, which determines the formation of spirals or vortices in the upper atmospheric regions. The surprising variety of the physical effects produced by the movement is simply due to the descending vortex, which, as in our electric machines, suffices to bring into contact, and set in violent motion, aërial masses lying far apart, with their consequent differences of temperature, and aqueous particles either frozen or in a state of vapour or of positive or negative tension.

A HIGHLY interesting series of experiments on the erst permanent gases has recently been successfully carried out by M. Olszewski. The more permanent gases have not only been liquefied at pressures averaging only 740 mm. by aid of excessively low temperatures, but the boiling points, melting points, and densities of these so-called gases have been determined at atmospheric pressure. The glass tube in which the condensation was effected was surrounded by a bath of liquefied ethylene, which could be caused to boil by reduction of its pressure, and, by use of a specially constructed air pump, was reduced in temperature to −150 deg. C. When this point was reached the gas to be liquefied was admitted into the tube from a Natterer cylinder containing the gas at about 40—60 atmospheres pressure, and was readily liquefied. A hydrogen thermometer was used to determine the temperature of the liquid, and the boiling point of methane at atmospheric pressure was found to be −164 deg. C., that of oxygen −181·4 deg., nitrogen −194·4 deg., carbon monoxide −190 deg., and nitric oxide −153·6 deg. The melting point of carbon monoxide was also determined to be −207 deg., and that of nitrogen as low as −214 deg. M. Olszewski's nearest approach to absolute zero was −225 deg. for solid nitrogen. The density of methane at 736 mm. and −164 deg. was found to be 0·415, that of oxygen at 743 mm. and −181·4 deg. was 1·124, while that of nitrogen at 741 mm. and −194·4 deg. was found to be 0·885. The densities were determined—*Nature* says—by reading off the position of the liquid meniscus in the tube, volatilising a portion by means of an aspirator, and again reading off the height of the column, the volume of the volatilised portion being measured by the amount of water running out of the aspirator.

MISCELLANEA.

MR. R. SENNETT has been appointed engineer-in-chief of the Navy.

MR. SAMUEL SWARBRICK and Mr. Henry Dever have been appointed by Mr. Justice Chitty joint receivers on behalf of the debenture holders of the Hull, Barnsley, and West Riding Junction Railway and Dock Company.

A NEW dredger, recently built for the Whitby Harbour trustees, commenced operations a few days ago in the presence of a large concourse of interested spectators. This is the inauguration of a long-contemplated improvement. The new dredger has been built by Messrs. Simons and Co., Renfrew, at a cost of £6700.

IT is understood that the report of the Royal Commission of the Colonial and Indian Exhibition will be presented in the course of the next three weeks. After providing for a small deficit, not exceeding £3000, on the Inventions Exhibition, and a reserve amount to meet claims during the statutory period of six years, there will be a surplus of £25,000.

ACCORDING to the *Bulletin du Musée Commercial* a native of Japan has recently invented a new process by which paper may be manufactured with seaweed. Paper made in this way is very strong, almost untearable, and is sufficiently transparent to admit of its being used as window glass. It takes all colours well, and in many respects resembles old window glass. This appears to have much of the character of celluloid.

A NEW form of draught and dust excluder is being made by Mr. T. J. Porter, of Fleetwood, which is fastened on the inside of the jam of a door in such a manner that while it effectually excludes dust and draught, it does not affect the closing of the door. It consists of a mouldable material enclosed in a narrow cloth strip. It is neat in appearance, and, after dipping in hot water, is easily applied and moulded to fit the opening to be covered.

THE proprietors of Olympia have published a guide and show book of their great hall at Kensington and of the shows, exhibitions and so forth, that are to be held there. This show book of Olympia, as far as concerns the selection and composition of the text, is done by Mr. R. H. Dunning, and is well done, but it is published in the most awkward and absurd form, namely, a circle of 9in. in diameter bound to a projecting piece of straight only about 3in. wide.

IT has been arranged that the Geological Field Class, which has again been formed for studying systematically the geological features of the country near London, under the direction of Professor H. G. Seeley, F.R.S., King's College, will meet on alternate Saturday afternoons in May and June, commencing on May 14th. Particulars may be had from the principal mapsellers in the City, or from the honorary secretary, Mr. W. W. R. May, 16, Bethune-road, Stoke Newington, N.

THE Duke of Bedford has presented the Bedford Volunteer Fire Brigade with a Merryweather steam fire engine of the Greenwich type, costing, together with a large quantity of hose and gear, over one thousand guineas. At a recent trial at Woburn Abbey the engine raised steam from cold water in four minutes, and in 100lb. pressure in six to seven minutes; it delivers 750 gallons per minute, discharges a powerful jet to a height of 170ft., throws two, four, six, and even eight effective streams of water simultaneously, and can easily be drawn by two horses.

IN a lecture delivered at Liverpool last Saturday, Mr. W. Sugg, after reminding his hearers that one-fourth of all the gas rent might be saved by using good burners, said that the small Aladdin burners, with a consumption of 2½ft. of Liverpool gas, placed on a pedestal or a chandelier, give down an effective light equal to that given by twenty-eight candles. As compared with this, the ordinary burner using 5 cubic feet per hour for sixteen candles was referred to. But a still greater improvement is said to have been made by the Cromartie burner, which gives fifty candles for 4 cubic feet per hour.

AT a meeting on the 26th inst. of the Bath and West of England Society, the report, in the shape of a series of recommendations, of the special committee appointed to consider the working of the two departments known as "plant" and "works," was presented. The committee, among other alterations, recommended the amalgamation of the two departments, and the increase of the secretary's responsibility and remuneration. The recommendations, with a few slight modifications, were adopted, and an addition of £200 a year was unanimously voted to the secretary.

AT a meeting of the Lowestoft Town Council a letter from the Deputy-Mayor, Mr. W. Youngman, was read, submitting the design for the Jubilee Bridge which he proposes to erect over the Ravine, Belle Vue Park, and asking leave of the Lowestoft Council to make such erections as are necessary for the foundations, &c., on the south side of the Ravine. The letter further says: "After the same is completed, I desire to present it the Corporation, who, I hope, will be pleased to do me the honour of accepting it." Mr. Youngman said he had advertised in THE ENGINEER for designs and tenders for the bridge, and received half a score designs and applications. The one which he submitted was drawn by Mr. R. M. Parkinson, of the Eastern and Midlands Railway.

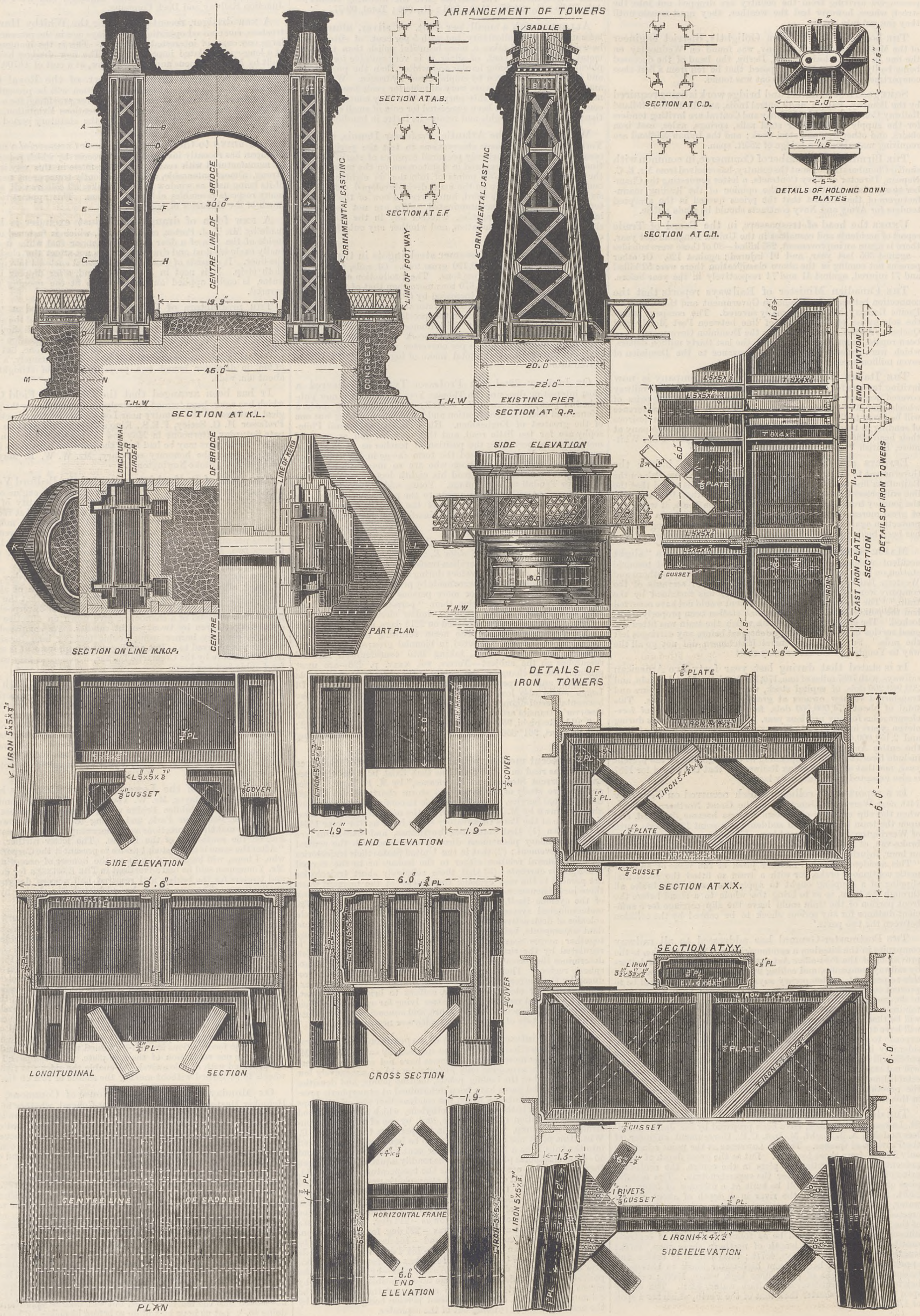
MESSRS. COLLIER AND Co., of Salford, have just constructed a lathe specially adapted for turning locomotive wheels after they are fixed on the axle, and it is arranged to turn the sides and tread of the wheel at one setting of the rest. The machine consists of a strong bed which is sunk level with the floor line, so that the wheel can be passed into the lathe without lifting. The headstocks are made proportionately strong to deal with wheels up to 6ft. diameter whilst fixed on their crank axles, and the spindles are provided with steel anti-friction washers, to prevent end-thrust. The loose headstock is movable on the bed by means of rack and pinion to suit different lengths of axles, and the face plate can be run at the same or different speeds, to enable, if required, a tire to be turned at one face plate whilst a wheel is being bossed at the other. The feed motions are self-contained with the bed, and give two cuts to one revolution of the face plate. The compound rests are provided with double swivels, to enable the sides and treads of wheels to be turned without moving the saddle or rest on the bed.

ON Monday evening, in the House of Commons, Mr. Henniker Heaton asked the Postmaster-General whether he was aware that in Paris *cartes télégrammes* similar to postcards are issued of various values inclusive of reply cards, which are collected every five minutes from special boxes and transmitted by pneumatic tubes to the General Post-office, and whether he would consider the advisability of introducing this system into London and other large towns. Mr. Raikes said "I am aware that in Paris, as also in Berlin and Vienna, there are systems of pneumatic tubes, by means of which letters, telegrams, and *cartes télégrammes* are distributed. The question of adopting such a system in London has been considered by my predecessors in office, and they came to the conclusion that it was not desirable, either in the interests of the public or of the Post-office, to establish it." The predecessors in office never have of themselves concluded that any new thing was desirable. They objected to everything, including the 6d. telegrams, which have proved a great success in every way. In Berlin people have been able for years to send letter messages by about an hourly delivery by pneumatic post for 3d. In London we have to pay 6d. at least for a few word telegram not much quicker. Fortunately for Mr. Raikes, on Monday night he added: "I have not looked into the matter myself, but will take an opportunity of doing so." Let us hope he will do so before he makes up his mind.

THE NEW HAMMERSMITH BRIDGE.—DETAILS OF TOWERS.

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

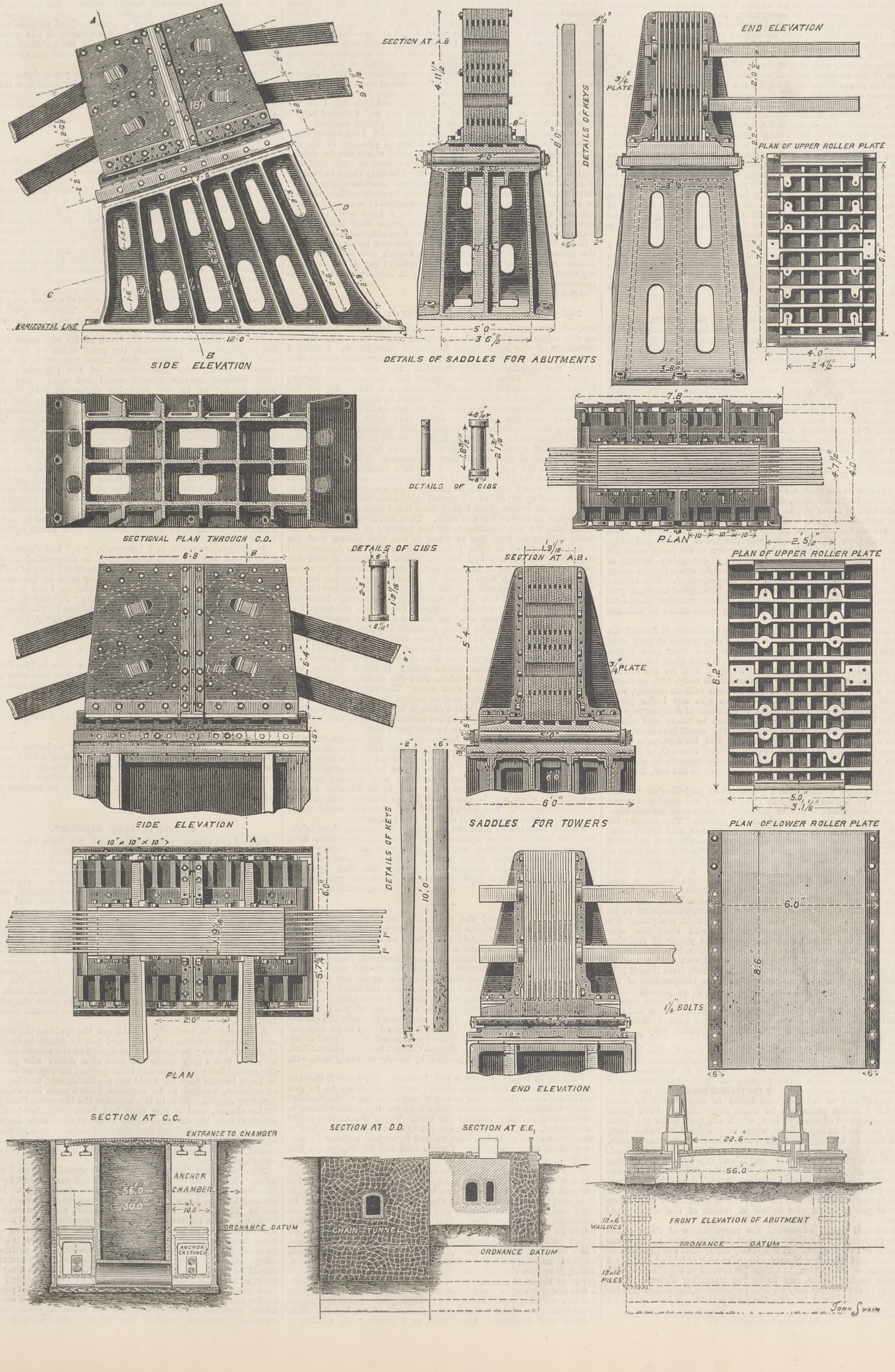
(For description see page 309.)



THE NEW HAMMERSMITH BRIDGE.—CHAIN SADDLES AND ANCHORAGE.

SIR JOSEPH BAZALGETTE AND MR. EDWARD BAZALGETTE, MM. INST. C.E., ENGINEERS]

(*For description see page 309.*)



LETTERS TO THE EDITOR.

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

NEWTON'S THIRD LAW.

SIR,—In the very excellent letter of Mr. Eddy, in your issue of the 25th March, he says of an engine "to start on, or accelerate, the motion from zero to uniformity, demands that the power exceeds the resistance by a small residual force." Why did he say that? He also says, "with an engine running with a uniform velocity the power and resistance are manifestly equal." Very true. The resistance is the friction, the disturbance of the surrounding air, &c., and, say, sawing a plank, which is fed regularly. Inertia of the working parts at uniformity is not resistance. Supposing the power to be constant, let the plank be pushed on to the saw harder and harder until the engine is stopped. Is there an instant from uniformity to zero at which the resistance is an imaginable fraction greater or less than the power? The momentum of the engine cuts no figure in the result, for it is power with its resistance the same as the other. Suppose the plank to be withdrawn, motion would increase to a point of uniformity again. Sawing would be no part of the resistance, but inertia of the parts would be. Disturbance of air, friction, &c., would increase until uniformity was reached, when inertia would once more cease to be resistance. If inertia were the only resistance the engine would be accelerated to infinity. It would be accelerated because action and reaction are equal, for in no other condition than change of motion does inertia become resistance. In other words, if the power be constant and inertia is the resistance, acceleration is required to enable them to equal each other.

Mr. Eddy, doubtless, is fully aware of this, and hence I am at a loss to know why he should say that in acceleration "the power exceeds the resistance by a small residual force;" and it seems to me that the application of the word "mystic" to either of the three Newtonian laws is to put upon language an unbearable strain.
I. LANCASTER.

Chicago, April 8th.

ARMOUR PLATES, SCHNEIDER *v.* SHEFFIELD.

SIR,—The *Sheffield Independent* of the 2nd inst. has just reached me, and it is with feelings of unbounded astonishment that I read therein the startling announcement that the Government is going to the firm of Schneider and Co., Creusot, for armour plates. This is a pretty pass to have come to. It was bad enough with German swords and cartridges and "Ferminy" shells; but this last announcement is a "poser." It is on our naval supremacy that our position in the world is at the present time said to chiefly depend, yet for such indispensable material for the construction of our ships of war as armour plates, we are reduced to the plight of application to a foreign firm, and their manufactory, too, in a country which is the chief rival of England upon the seas. This plight is all the more pitiable and incomprehensible as we have hitherto laid to our souls the flattering unction that in manufactures of iron and steel we were able to beat all comers, in quality at any rate.

It appears to me that, notwithstanding the pressing need there is for us to be in advance, as far as possible, of all rivals in the manufacture of naval war material, that the inherent conservatism of our manufacturers and authorities cannot be roused until these rivals are not merely equal to, but actually in advance of us. Then there is a hysterical, spasmodic abandonment of the old and adoption of a new *régime*, which, in its application to the navy, costs the country millions in cash, and exercises a disturbing feeling of distrust and anxiety, having a reflex influence extending to every part of our national life, which cannot be estimated. The critical point once over, back we go to the same lethargical mode of progression, and the same thing is in different matters done over and over again. No steadily progressing spirit seems to animate us in the least.

To take the case in point. The Creusot plates are, so far as I can gather, made wholly of steel, as against our system of part steel and part wrought iron, and it is contended they give better results on trial than ours. Well, Sir, this is only what might have been expected. We have discarded wrought iron for steel in the manufacture of ship plates for the mercantile navy, and, as shown in the case of the collision of the Arizona with an iceberg, with eminently satisfactory results. We have also our boiler plates made of steel, for a purpose where alternations of temperature are of daily occurrence and the metal subject to heavy and almost constant strains; and in this case also the result is calculated to inspire confidence in the material used. Yet, for a purpose where the most extreme test of the endurance and strength of the two metals can be met with, we adhere to a conglomerate of the two, and the result is that our plates are beaten in the test, and well they may be.[1]

I am, perhaps, writing with a preconceived prejudice against the compound plates, for in the year 1880, when I was employed in one of our armour-plate works in Sheffield, I advocated the construction of plates upon the "whole-steel" system. The reasons for this advocacy were the same then as I hold now, and briefly summarised are these: If steel, containing a percentage of carbon of from ·7 to ·9, is to be depended upon as a material for the front of an armour-plate, where the shock of impact of the projectile fired against it is most severe, I believe that, *à fortiori*, a mild steel backing would be better than a wrought iron. A mild steel, one containing not more than about ·15 per cent. carbon, is far less likely to be injured by overheating or any other casualty it may be subjected to in manufacture, subsequent to its being cast into the ingot, than the harder steel composing the front plate; whilst the advantage the mild steel has over wrought iron in strength, and consequently in power of resisting penetration, is nearly two to one. (2) The union between the two main parts of the plate. The hard front and soft back would be much more complete if these two parts were both steel than it is in the present system. I do not believe that the temperature of the steel used as the bond of union in our plates, as at present manufactured, is sufficient to ensure a sound weld. I have seen enough cases of unsoundness in this respect in the works; whilst the way in which the whole of the steel front has parted from the backing, in the testing of a plate at Shoeburyness, fully justifies me in this.

Again, and perhaps this is to the Constructors to the Navy as important a point as any other, the cost of production is much in favour of the whole steel plates. It stands to common sense that plates made—as is quite practicable—from steel, Siemens or Bessemer, which can be made at the present time for £5 per ton in the ingot, and of which three blows or casts would be sufficient for a 30-ton plate, can be made more cheaply than plates largely composed of wrought iron, which will cost quite the same sum as the steel in ingot form, when in the form of rolled bars, which have to be faggotted and welded in three or four stages, growing in size each time, until the size required has been obtained. Indeed, it is the amount of time and labour expended in the making of the wrought iron backing which causes the plates to be so expensive, as the material and manipulation expended on the steel part of the plate would cost nothing near the prices paid per ton for plates at the present time. The rapidity of production of the two kinds of plates would also be far in favour of the whole steel plates.

I have said that I advocated the manufacture of these plates seven years ago. My views were not adopted, and perhaps the reason is not far to seek. It is scarcely likely that the patentee of the compound plate would care, almost as soon as he had developed his method of production, to forego his reward in the shape of the royalties on his patent, and being the managing director of the company, it was pretty easy for him to persuade the others that his process was calculated to give the best results. Who was right I leave outsiders to judge.

The fact appears to be that the two large armour-plate producing firms in Sheffield have, so far as the manufacture of this speciality is concerned, degenerated into branch establishments of the Woolwich Arsenal. They have a monopoly of production, with the usual evil result of all monoplies; they have nothing in the shape of competitors to spur them to increased efforts, and as they are reaping a substantial profit as things are they do not seem to care to take the initiative. I wonder how they would prosper if they evinced as much apathy in connection with the other departments of their works as they do in this. I would not have rushed into print on this subject except for this, what I call the crowning insult to our steel-making industry. I recollect a correspondence on this subject in the columns of the paper where I have seen the announcement of the Governmental intention in the autumn of last year. I only saw part of this correspondence, not receiving the daily papers, but quite enough to show how little the heads of these Sheffield firms troubled themselves in the matter. Now comes the announcement of the predicament in which we are placed, and although I do not care to be one of those who say "I told you so," I cannot help a kind of satisfaction at seeing my views so completely verified.

The remaining question is, what is to be done? I am a Sheffielder myself, and should deeply lament the loss of prestige to the old town should she lose this manufacture, and I would not be dependent upon a foreigner for straws for a purpose of such vital importance as our Navy if I could help it. The only thing to be done seems to me for our authorities to let these manufacturers understand that if they do not know their own interests sufficiently well to keep pace with foreigners in the production of a class of article for the manufacture of which they, as I have said, hold the monopoly, that the Government will not nurse their interests for them by continuing this monopoly. Such an announcement would, I think, be enough. I do not for one moment believe that with the same material to work upon the French can beat the Sheffielders in the quality of the finished article; but I do wish that my townsmen would show more facility in investigations and improvements.
SHEFFIELDIENSIS.

April 11th.

[1] [Not to our knowledge.—ED. E.]

THE ROYAL AGRICULTURAL SOCIETY'S ENGINE TRIALS.

SIR,—I have read with much surprise the letter which appeared on this subject in your last issue, signed by Mr. H. D. Marshall, as president of the Agricultural Engineers' Association. I think I never read a letter that more obviously said everything except that which the signatories really thought. The real reason for the action taken by those who have signed the documents emanating from the Agricultural Engineer's Association is fear. All can see the back seat which they each think might be theirs as a result of the trials. The mettle, Sir, has left the firms who did battle years ago, and won the laurels on which they built a great trade. Jealousy is now greater than courage, and transparent excuses are given as reasons for supporting a policy which has already done a good deal of harm. The first reason given for asking a further postponement of the trials is trade depression. This surely should be a reason for welcoming the trials as a chance of showing to thousands of old engine owners that they possess engines so wasteful that it would pay them to put them on the scrap heap, and to show intending buyers that England still builds the best engines.

The second reason given is that there is not time enough in which to prepare an engine for the trials. This, Sir, is not a reason, but an excuse, for the signatories to the petition of December were ready with it as long ago as when it was first known that the R.A.S.E. proposed to offer prizes. But even if the Agricultural Engineers' Association had had no notion whatever of probable trials until December or January last, is that any reason for refusing to enter? The time would be equally long for all, for the "leading makers" as well as those who by inference are not leading makers. The world will not be misled by this excuse. Does any one of the "leading makers" suppose that trials are wanted of engines so different from what are offered now that firms who can make from three to eight or ten portable engines per week want more than six months to make a show engine? Are the engines which the leading makers now turn out admittedly so bad that they want more than six months for experimental work to find out how much better an engine can be made? If this is the case, it is high time that trials were made so that the makers of engines so bad were induced to mend their ways. The third reason given, namely, expense, is perhaps also an indication of the expectation by these makers that so great a change for the better is possible. It is, however, no more a reason for refusing to enter the competition now than it was a dozen or twenty years ago.

As to postponing the trials for another year for consultation with the Agricultural Engineers' Association, and with those so experienced in building the classes of engines referred to, it is very much open to question whether any benefit would be derived from any such consultation. The requirements are very definite, and the Royal Agricultural Society may not wish to be fettered by any reference to what may be considered by the leading makers to be the requirements. The Society may get what the world wants from others who cannot boast of such great experience.

I think, Sir, that no good can be done by postponing these trials, and the reasons urged against them show that firms who have greater facilities in every way now than they had twenty years ago must have some other reasons or fears that are not sufficiently creditable for publication. I hope, Sir, that there are firms who will make a good show on the Newcastle trial ground with a
COMPOUND ENGINE.

Lincoln, April 25th.

SIR,—I have perused the astonishing circular issued by the portable and traction engine builders of England with wonder. I am not surprised that they do not intend to compete; I am surprised that they should issue a circular.

The whole document is indeed a most remarkable production. In the first place, why do Messrs. Richard Garrett and Sons sign it? It is quite well known that the Leiston firm never has competed as a matter of principle. Are we to assume that the firm has changed its mind and would have entered an engine if more time had been allowed for building and testing it, or that times are too bad to let the firm incur the expense? I have no reason to doubt the perfect consistency of the firm; and I am well assured that in no case and under no circumstance would it have competed in the yard of the Royal Agricultural Society. Messrs. Garrett have, in point of fact, placed themselves in a false position by having anything to do with the circular.

Next let us take the excuse put forward. Why was it thought necessary to make any excuse at all; was it considered to be due to the engineers themselves, or was it held to be due to the Society? Surely nothing was simpler or easier than for the various firms to refrain from entering engines for trial. There the matter would have ended. The true reason has yet to be stated; but the fact is that heaven and earth has been worked by certain persons to prevent others from competing. I write with full knowledge on this subject.

Next let us consider the nature of the excuse, that time enough has not been allowed. Now I know as well as most men what a portable engine or a "racer" or a traction engine is, and I say that it is simply nonsense to assert that even a racer could not be built and tested in six months, and much more than that has been available. But again, what is this wonderful engine to be which might be produced if only great firms had eighteen months to do it in? Why, Sir, circulars have been distributed at the Smithfield Club Show and other shows, claiming for compound portable engines an unparalleled economy. There figures are given, which go to show that the compound portable or semi-portable engine is one of the most economical forms of steam engine ever made. I will not give any of the figures from these circulars, because your readers would at once identify the firms in question, and this might seem invidious. I am not attacking particular firms, but the whole Agricultural Engineers' Association as a public body making a public statement. The figures of merit put forward in these cir culars have never yet been tested for accuracy by any independent witness. Why should the firms publishing these circulars decline to permit an independent test being made by such men, say, as Sir F. Bramwell, Mr. W. Anderson, and Mr. Cowper? Is it not because they are afraid that the results obtained on their own brakes and in their own yards will not be obtained on the Royal Agricultural Society's brake? The circular talks of bad trade, &c. I cannot imagine a more certain way of killing trade than the public refusal of a great body of manufacturers to permit any public test to be made of the merits of the goods they are selling to the world. The effect of the publication of this circular will, I fear, be most regrettable, and this will be discovered when it is too late.

One thing is apparent, new and energetic young firms will go in and compete and carry away the prizes. I wonder how the Agricultural Engineers' Association will look then, when its members are told to stand aside and make room for younger men in the markets of the world?

Ipswich, April 25th.
OLD PORTABLE.

PROFESSORS AND STUDENTS.

SIR,—In my letter of April 15th I charged "J." with three gross inaccuracies in the use of scientific terms. How has he justified himself?

(1) Concerning "rate of acceleration," he says he has no doubt I have by this time seen the mistake into which I have fallen with regard to that. But I ask, How am I to see this mistake if "J." will not have the goodness to point it out? He refers me to Professor Tait. Well, I look up Thomson and Tait's "Elements of Natural Philosophy, par. 34, and I find—"Acceleration is the rate of change of velocity, whether that change take place in the direction of motion or not." The only conclusion I can come to, in my poor misguided way, is that "rate of acceleration" is rate of rate of change of velocity, &c.—a most obvious absurdity.

(2) I implicitly invited him to explain the meaning of the sentence he used—"But take the words acceleration of motion away from *g*, and we have vagueness and confusion." This, however, he has apparently not seen his way to do, since he makes no allusion whatever to the matter.

(3) I ventured to question the truth of his statement that "as far as physics are concerned, the great thing we have to deal with is energy," hinting that there was such a thing as matter inviting the consideration of the physicist; that, in fact, without matter energy could not exist; and I even went so far as to say that his statement that "energy is motion" is absurd. This he deals with in the only way open to a man who feels bound to make some answer while he cannot make a satisfactory one, viz., that of changing the subject. We find him no longer discussing whether energy is motion, but whether it is due to motion; whether it exists apart from motion; whether motion can produce or be produced by motion; and so on. He talks of narrowing the discussion down to a single point in the teaching of science. Well, if he will be good enough to keep the discussion to any or all of these three points, which are the main ones in his first letter, the question whether a further discussion carried on by and with him would lead to any good result might be more easily settled. Meantime, and until he proves these three statements to be scientifically accurate, he has failed to make good a claim to be numbered among scientific men whose opinions are worth hearing.

As regards my youth and ignorance, "J." has shown a perspicuity almost amounting to second sight in discovering the former, when it is remembered how slight was the hint I gave of my being a pupil of Professor Tait's. While if in my state of ignorance I am still able to discover errors in "J.'s" wisdom, I fail to see how I am in such a dreadfully bad way. I fancy "J." has no reason to be dissatisfied with me on the latter account! The tone of my letter was what I considered most appropriate to "J.'s" letter.

Edinburgh, April 26th.
J. T. N.

SUGAR IN MORTAR.

SIR,—About the end of 1886, a discussion arose in THE ENGINEER on this subject. Among many suggestions then and subsequently made therein, I have failed to notice the results recorded of experiments with saccharine, $C_6H_4 \langle {}^{CO}_{SO_2} \rangle NH$—*i.e.*, a compound not a sugar at all. I write therefore to inquire if no better results are obtainable by the use of orthobenzol sulphonic iodide or if the turning of a colour in coal tar extract into sweetness, would not tend to throw more light on what at present seems to be rather in a hazy and recondite condition, especially as regards ancient modes of mixing mortars.
S. M

April 25th.

ENGINE-DRIVERS' EYESIGHT.

SIR,—I can assure your correspondent, Mr. John Place, that the action which the Amalgamated Society of Railway Servants has been obliged to take, in order to protect its members from serious injustice, is not "rash," nor has such an important matter been discussed "without forethought or in ignorance." On the other hand, the Society possesses and has acted upon valuable and complete information given by both physicians, officials, and practical men. Mr. Place states that in Germany "actual semaphores and signal lights are used, and the examination is conducted by day and by night." This is just exactly the practical test to which the men in this country wish to be subjected. Your correspondent goes on to say that I wish for a "more lax test as regards the examination of locomotive-drivers' eyesight." It is perfectly clear that he either has not read or places a very wrong conclusion upon my previous letters. As I have said before, the Society desires the test to be "practical," and it is a fact that such practical test with actual lights and signals will in some cases be even more difficult and more hard to pass than the present theoretical test.

A man may be perfectly able to see the spots on the card, and sort the various colours of wool, and yet be unsafe to be upon an engine, as he may be unable to see signals at the required distance. To prove this I may quote the case of a driver who passed the theoretical tests, and was said to be perfect for express work; yet he knew himself that he could not see the signals, and he, fearing an accident, applied to be removed from a main line engine to a shunting engine. Now in this instance the theoretical test proved to be absurd, and if this man had been subjected to a proper practical test, his defective sight would at once have been found out. Suppose he had not had the good sense to give up main line work, he would, having passed the "theoretical test," have continued as an express driver, and perhaps long ago have caused a serious accident.

Mr. Place says there is more in the question than I seem to think. Would he be good enough to tell me to what he refers, because nothing in his letter tends to prove the assertion. Because some men fail to know the names of various shades of wool, it must not be thought that they are colour-blind, they are only colour ignorant. As a matter of fact it may be mentioned that some men who have failed to name the colours, have now received instructions from some of the girls in a Berlin wool shop, and from painters, and are now able to pass the theoretical test without difficulty. Another very important matter is the time when the test should be made. Ought a driver to be tested before he goes on duty, or after he has been at work ten or twelve hours? Cases have occurred in which a man could see the "dots" and pass after twelve hours of duty, but when again tested at the end of seventeen hours' work he failed. Of course the effect of wind, dust, and especially overwork, must at the end of a very long term of duty seriously impair the sight of a driver. On several lines in this country the "practical test" with signals and lights is considered, and in practice is found to be highly efficient, and I trust it may become general, in place of the unsatisfactory and purely theoretical tests to which the men so much object.

CLEMENT E. STRETTON,
Consulting Engineer, Amalgamated Society of Railway Servants.
Head Office, A. S. R. S., 306, City-road, London, E.C.,
April 23rd.

TENDERS.

NEW MAIN SEWERS.

CONTRACT NO. 1.—SECTION IV.—For the construction of about 2¾ miles of new main brick and pipe sewers for the Corporation of Leicester. Quantities, specification, and drawings by J. Gordon, M. Inst. C.E., borough surveyor:—

	£	s.	d.
James Dickson, St. Albans (accepted)	12,187	1	3
Frank Eyre, Sheffield	12,281	1	11
Reuben Clarke, Sheffield	12,986	19	7
S. and E. Bentley, London	12,990	12	8
T. Small and Sons, Handsworth	13,335	13	6
Chas. Baker and Sons, Bradford	13,809	1	1
Hy. Hilton, Birmingham	14,115	2	2
Nelson and Co., Cardiff	14,120	0	0
Enoch Tempest Leicester	14,436	5	1
Jno. Hill, Sheffield	14,560	5	6
B. Cooke and Co., Battersea	15,256	15	6
J. W. and J. Neave, Leytonstone	15,770	9	1
Geo. Law, Kidderminster	16,164	2	7
Jno. Pickthall and Sons, Merthyr Tydvil	16,560	4	6
Wm. Meats, Nottingham	17,131	19	6
Innes and Wood, Handsworth	17,178	10	0
Geen and Parker, Cardiff	17,992	3	5
A. Kellett, London	18,233	7	2
Jno. Edmondson, London	19,828	9	5
James Evans, Birmingham	20,641	7	1
C. Braddock, Southport	21,511	16	2

HARBOUR WORKS IN ALGOA BAY, CAPE COLONY.[1]

BY WILLIAM SHIELD, M. INST. C.E.

ALGOA BAY, on the south coast of Africa, is the principal harbour of the eastern province of the Cape Colony, possessing a partially sheltered anchorage and good holding ground. The harbour works which have been carried out there, from time to time, for improving the access to Port Elizabeth, which is situated in a bight formed by Cape Recife, at the western side of the bay, furnish an example of failure and remedial works on a sandy coast.

Port Elizabeth is the principal commercial port of the Cape Colony, its exports and imports being nearly equal to those of all the other ports taken together, including Cape Town. The values of its exports and imports for the thirteen years ending with 1882 were £35,201,718 and £33,349,661 respectively, as compared with £42,539,259 and £14,585,164 for all the other ports; and the tonnage of the vessels entering and leaving the port increased from 86,784 tons and 83,617 tons respectively, in 1864, to 825,157 tons and 838,241 tons in 1882.

Cape Recife extends about 6 miles to the southward of Port Elizabeth; and Point Padrone, forming the eastern extremity of the bay, lies about 43 miles to the eastward. The port is sheltered by land from S.S.E. round by W. to N.E. It is exposed between N.E. and E. by S. to a fetch varying from 10 to 43 miles; and from E. by S. to S.S.E. it is open to the Indian Ocean. The port is also exposed to very heavy rollers raised by south-west winds, which wheel round Cape Recife, and prove more trying to sea-works than waves produced by south-east gales. Westerly winds occur throughout the year; gales from the north-west are most common during the winter; and east to south-east winds are prevalent during the summer, from September to March. Westerly gales are generally the most violent; but very heavy gales occasionally blow from the south-east. The heaviest rollers approaching Port Elizabeth come from east—magnetic—to 20 deg. south of east, and cause an almost constant surf upon the beach, making landing somewhat difficult. The highest waves observed by the author were about 20ft. from trough to crest, in a depth of about 23ft.

Currents.—Numerous current observations were made by the author, with floats offering very little surface to the wind, and so adjusted generally as to indicate the current at a depth of 7ft.; and the direction and force of the wind were noted during the experiments. These observations, extending over about eight years, proved:—(1) That there are no appreciable tidal or other defined currents in the vicinity of Port Elizabeth. (2) That such currents as occasionally exist, with the exception of the shore currents, are surface currents produced by the wind, which change their direction and velocity with the wind. (3) That the shore currents are due entirely to wave action, and extend seawards in proportion to the height of the waves. (4) That in consequence of the exposure of the bay to south-east winds, and also owing to the direction of the rollers, the set along the coast is very frequently from south to north, especially in the season of south-east winds; but during the prevalence of north-westerly, northerly, or north-easterly winds in the winter, the set is in the opposite direction, and with westerly winds, and in calm weather, there is often no current at all.

Sand-Travel.—The travel of sand along the shore is frequently from south to north. With westerly winds, however, sand accumulates upon the beach, and still more with northerly and north-easterly winds, as they check the tendency of the waves to pass the sand on. This movement of sand does not extend beyond the action of the waves, and it is most readily checked by any impediment to its progress.

Tides.—The datum line at Port Elizabeth is the average low-water of spring tides; but good spring tides frequently fall 15in. lower, and have a range of 7ft.; whilst exceptional tides fall 18in. below it, and rise 8ft. The ordinary range of neap tides is from 2ft. to 2¼ft.; but sometimes the variation in water-level is less than 12in. The Agulhas current, outside the bay, appears to exercise a considerable influence on the tides, for when accelerated by easterly or south-easterly winds, it draws the water out of the bay, increasing the fall, and diminishing the rise of the tide; and when retarded by westerly or south-westerly winds it has the reverse effect. The wave disturbance produced by the volcanic eruption in the Straits of Sunda—distant about 5000 miles—on the 27th of August, 1883, reached Algoa Bay between 4 p.m. and 5 p.m. that day; three distinct waves, which appeared between 7.55 and 10.15 p.m., swung the ships anchored in the bay almost broadside on to their cables; and the undulations recorded by the self-registering tide gauge at Port Elizabeth showed a series of rapid rises and falls, with a maximum variation of water level of 5ft. 4½in. between 8.19 and 9.2 p.m., which did not entirely disappear from the tidal diagrams till about five days after.

Breakwater.—The want of shelter at Port Elizabeth from the south-east led to the construction of a breakwater, which was commenced in 1856—page 338, Fig. 1. This breakwater had a total length of about 1700ft., and consisted of a straight arm, 46ft. wide, projecting out from the shore, with a return outer arm, or shield, 63ft. wide. The deck level was 8ft. above high water. The first 330ft. from high-water mark, composed of stone walls with rubble filling between, was completed in August, 1857. The remainder of the breakwater was formed of pile-work, with a rubble wall on the exposed side, and rubble filling on the harbour side—page 338, Figs. 2, 3, and 4. The pilework was commenced in June, 1858, and had been extended 740ft. in September, 1860, into a depth of 17ft. at low water. In February, 1861, Mr. Warren, the resident engineer, reported the formation of a sandbank 3½ft. high, on the north side, at the outer end of the work. The filling in with rubble was commenced in November, 1861, at the seaward end; 21,021 tons out of 26,000 tons required to fill the breakwater up solid to low-water level had been deposited by the end of July, 1862, and the pilework of the shield was commenced in April, 1862. The straight breakwater was accordingly becoming a nearly solid structure, almost before the commencement of the shield. In September, 1862, Mr. A. T. Andrews, M. Inst. C.E.—then resident engineer at the Table Bay Harbour Works—advised that no more stone should be deposited, as he considered that sand would collect in the still water under shelter of the breakwater, and form a dangerous shoal, but that the shield might be filled up with rubble as designed. In April, 1863, Mr. Bourne—then colonial railway engineer—recommended that the breakwater, as well as the shield, should be filled up with rubble as soon as possible to quay-level, leaving only a length of 300ft. or 400ft. of pilework next the stone approach, at the shore end, to be filled up eventually if experience proved that no injury from silting was liable to result.

Silting in harbour.—The Harbour Board followed Mr. Bourne's advice, so far as regards the outer portion of the work; but instead of stopping the stone filling as soon as sand began to accumulate in the harbour, carried it on as rapidly as possible to the shore, in the hope of preventing the drifting sand, which followed up the filling, from coming in through the opening. The closing of the breakwater was completed in July, 1865; but serious silting up still continued on the north side, and by November the deposit in the harbour formed a junction with the advancing beach. Though the portion of the harbour used by vessels of 400 to 500 tons had been little affected by the accumulation of silt up to February, 1866, the beach continued to advance both north and south of the breakwater. In October, 1867, the low-water mark had advanced 750ft.; in December, 1868, it was within 200ft. of the shield; and by June, 1869, it had extended beyond the sea face of the shield, completing the destruction of the harbour—page 338, Fig. 1. A bank also had formed to the north-west of the shield, which, in 1869, rose to within 3ft. of low-water spring tides, and presented a serious obstruction to landing on the beach.

Schemes of improvement.—Sir John Coode, Vice-president Inst. C.E., was consulted for the first time in 1868; and he arranged for Mr. Charles Neate, M. Inst. C.E., to inspect the site. Mr. Neate, during his visit, recommended that an opening should be made at the east end of the straight breakwater, to arrest the rapid advance of the sand, and the construction of a jetty with the timber taken from the breakwater; and this work, having been approved by Sir John Coode, was carried out for a time under the direction of Mr. A. T. Andrews. In 1870 Sir John Coode recommended the following works:—(1) The opening out of the straight breakwater by removing all the rubble for a length of 500ft., and drawing such of the piles as were not required for supporting a viaduct. (2) The construction of a retaining bank, 1600ft. long, to the south of the breakwater. (3) The formation of an outer harbour by an extension of the shield, and an inner jetty 400ft. long. (4) Inner works, comprising an entrance basin, and an inner basin of 14 acres in the valley of the Baakens River. In consequence, however, of the complex conditions of the case, he recommended that these works should be carried out in sections, so that experience might indicate how far the desired results were or were not likely to accrue from their construction. The opening out of the breakwater was commenced in 1869, and proved a very tedious and difficult operation. In 1875 instructions were given by the Harbour Board for carrying out the retaining bank and the outer jetty forming the first section of the above scheme, and the author was appointed resident engineer for these works in 1876. After a personal inspection of the port in December, 1876, and owing to the enormous sand-travel and absence of any constant currents revealed by the investigations of the author, Sir John Coode recommended that a breakwater pier, nearly parallel to the shore, should be constructed at a distance out of about 3000ft., with return ends to keep off the swell, and provided with a fully-equipped quay, and with jetties projecting from it in a westerly direction, alongside which vessels of the largest class could discharge and load. The breakwater was to be connected with the shore by an open iron viaduct carrying two lines of railway. The in-shore works comprised the construction of a retaining wall, 2100ft. long, and the raising of the land thus reclaimed; the removal of the old breakwater to a depth of 3ft. below low-water spring tides—afterwards carried to 5ft. over the shield, and 7ft. over the remainder; the extension of the jetty 200ft.; and the construction of a bridge for two lines of railway across the Baakens River. The inner works were designed to afford speedy relief to the port, by removing the sandbanks which had been formed, and setting back the line of the beach as near as requisite to its original position. Before embarking upon these large works, the Cape Government arranged that Sir John Hawkshaw and Mr. Brunlees, Past-presidents Inst. C.E., should confer with Sir John Coode; and they reported their approval of the scheme in July, 1880. As the general local opinion was strongly in favour of having a dock for the port, Sir John Coode modified his design as shown on page 338, Fig. 7, providing a dock with jetties under shelter of the breakwater. The estimated cost of the work is £1,170,950; but up to the present time, the in-shore works alone have been executed.

Retaining bank or sea-wall.—The line of the retaining bank—page 338, Fig. 7—was designed with the view of causing the waves, which impinge upon it at an angle of between 60 deg. and 80 deg., to scour away the sandspit formed by the old breakwater, and to clear off the sand from the rubble filling of the breakwater, so as to admit of its removal by divers. A bank *a*—page 338, Fig. 5—composed chiefly of large stone and concrete blocks, varying in weight up to seven tons, was first carried forward at a level of 10½ft. above low water spring tides, and was followed up by a second bank, *b*, on the land side, which was always kept a little back from the end of the outer bank for the sake of shelter. The material was mostly tipped from wagons running on rails along the top of the banks, but some of the larger stones and blocks were placed by a crane. The lines of way were frequently displaced by the sea, but the expenditure on their maintenance was much less than staging would have cost. Seas washing over the bank made the rubble settle down, and formed a long slope on the inside of well-washed quarry chippings and grit, so admirably suited for concrete that the slope was kept fed with fine quarry materials for the purpose. The material for concrete, thus collected, generally contained sufficient grit to enable sand to be dispensed with. When the mound was sufficiently consolidated, a trench was excavated along the top in short lengths, within which blocks were formed *in situ*, in timber boxes lined with jute sacking. These blocks form a lower wall, or apron, 4ft. wide, and from 7½ft. to 8ft. deep—Fig. 6, page 338. Blocks of 40 and 20 tons were laid alternately, and the concrete of the 20-ton closing blocks filled up the grooves left in the ends of the 40-ton blocks, thus making the wall a continuous mass. Large stones, clean and well-bedded, were incorporated in all large masses of concrete, for the sake of economy. Levels taken for a considerable period on the top of the apron failed to indicate any appreciable settlement. Two gangs, of eight Kafirs each, mixed and deposited 41 cubic yards of concrete per day when the moulds and stages were fixed for them. After the completion of the apron, the rubble behind it was left to consolidate as long as possible before the crest wall was commenced. This wall was founded in the rubble, 2ft. below the surface of the apron, and was constructed in sections 8ft. long, with chamfered joints on the sea face. Each section or block, weighing nearly 18 tons, is keyed to the adjoining ones by vertical dowels, so placed that any block is free to settle without disturbing the work; but though the work was completed more than five years ago and has been assailed by heavy seas, no settlement is visible. The concreting was effected by two gangs of thirteen Kafirs each; and each gang mixed and deposited about 31½ cubic yards of concrete per day. After the completion of the crest wall, it was backed up with rubble, and a line of rails was laid on which a 7-ton steam crane travelled, which fed and trimmed the bank with large stone and concrete blocks. The bank eventually assumed a slope of about 4 to 1, at which it has stood for a considerable time. The cost of the concrete in the apron was £1 9s. 10d., and in the crest wall £1 3s. 1¼d. per cubic yard. The greater cost of the lower wall was due to its being tide work, and requiring extra precautions against the sea during construction. The total cost of the retaining bank, including the raising of the 16¾ acres of reclaimed land, amounted to £64,514; and its construction occupied about three and a-half years, having been commenced in May, 1877, and carried on, under the author's supervision, simultaneously with the removal of the breakwater.

Removal of the old breakwater.—The removal of the breakwater was commenced in September, 1869; and by March, 1871, a partial opening, extending 138ft. inland from the shield, had been made. In 1876, the rubble and piles had been partially removed along a length of 500ft. altogether—582 piles and a large quantity of sheeting having been drawn out by hydraulic presses and levers, and 169 piles sawn off under water by divers. The drawing of the piles was very laborious, as they were only roughly squared, and they were held so tight by the angular rubble that the 1¾in. chain cable attached to them was often broken. The removal also of the rubble below low water, prior to the construction of the retaining bank, was rendered very difficult by the deposit of sand, which could be only partially arrested by screens of sheet piling with canvas and dams of sand-bags. As many of the stones in the shield weighed from six to seven tons, a steam crane was procured capable of lifting them. The iron-wood piles of the breakwater, however, were so much eaten by the teredo that they were quite incapable of carrying this crane, which was a heavy machine. Accordingly fresh piles were driven into the rubble alongside the old ones, but could only penetrate about 5ft. or 6ft. into the mound. The staging thus formed was therefore not so rigid as could have been wished, so a short length of it was specially braced and strengthened, and the crane was lashed on it when not at work, in preference to bringing it back along the whole length of the breakwater, till its work on the shield was completed. The rubble along the remaining portion of the breakwater, being smaller, was removed by hand cranes. The rubble was only removed down to 5ft. below low-water spring-tides in the shield and 7ft. in the straight breakwater, as at this depth it forms a reef, on which heavy seas break, and in a measure protects the landing beach. The piles were subsequently broken off by a 19-oz. dynamite cartridge, placed in a 2in. hole bored in the pile at the level of the lowered rubble, and fired by electricity. Double-headed 80 lb. rails, which tied many of the piles together, being attached to them by 1¼in. bolts, were detached by two dynamite cartridges, weighing together 4·8 oz. The removal of the rubble was liable to be stopped by the accumulation of sand during fine weather and off-shore winds; whereas rough weather, which stopped the diving work, drove the sand away. The best time for work was after rough weather from the south-east, or after a strong westerly swell. As much of the rubble as possible was removed from the shield under shelter of the parapet, which was then taken away in short lengths as the stones supported the timberwork, and it in turn kept together the stones. The stone was removed first; and the timberwork was then cut away as quickly as possible, as it was liable to break adrift and injure the staging. When the shield had been sufficiently lowered for the sea to wash over it, the waves heaped up the rubble against the landward row of piles, and formed a bank, about 70ft. wipe, on the landward side of the structure. This inner row of piles was left to the last, to hinder the rubble being driven in-shore; and the removal of the rubble, thus arrested, was facilitated by a considerable portion of it being raised by the waves above low water. The bank of rubble, landwards of the shield, was mostly removed by small bags and spoons, guided by divers. The total cost of removing the breakwater was £38,500, or about £26 18s. 6d. per lineal foot removed, including 350ft. landwards of the retaining wall. Its construction cost £122,438. The success which has attended the remedial works is indicated by a comparison of the state of the port in 1876 and in 1884—page 338, Figs. 1 and 7—from which it will be seen that there are now two fathoms of water, where previously to the operations above described there was a bank of sand dry at low tide.

Bridge over Baakens river and other works.—A bridge carrying two lines of railway connects the works south of the Baakens river with the Midland system of railways. It crosses the river obliquely, with three spans of 30ft., and rests upon cylindrical columns, 2½ft. in diameter, founded upon concrete bases, and concrete abutments. Corrugated sheet-iron, No. 24 b.w.g. in thickness, formed the dams for the piers and south abutment, being stayed inside with timber framing, and weighted with rails so that the dam sank into the sand and gravel as the excavation proceeded inside. The dams for the piers were about 42ft. long, 6ft. wide, and 8ft. high; and they were perfectly watertight. The author thinks that this, as he believes, novel use of corrugated iron will be found satisfactory and economical where, as in the present instance, clay is expensive and difficult to obtain of good quality, The bridge, with its approaches, cost £4947. The principal other works recently executed at Port Elizabeth, under the author's supervision, comprised the removal of a timber jetty, 465ft. long and 60ft. wide, and the construction of two wrought iron jetties, 900ft. and 840ft. long respectively, at a cost of about £118,000, including equipment with steam cranes, &c. (page 338, Fig. 7), for facilitating the work of the port, which previously had been almost entirely conducted on the beach by means of surf-boats.

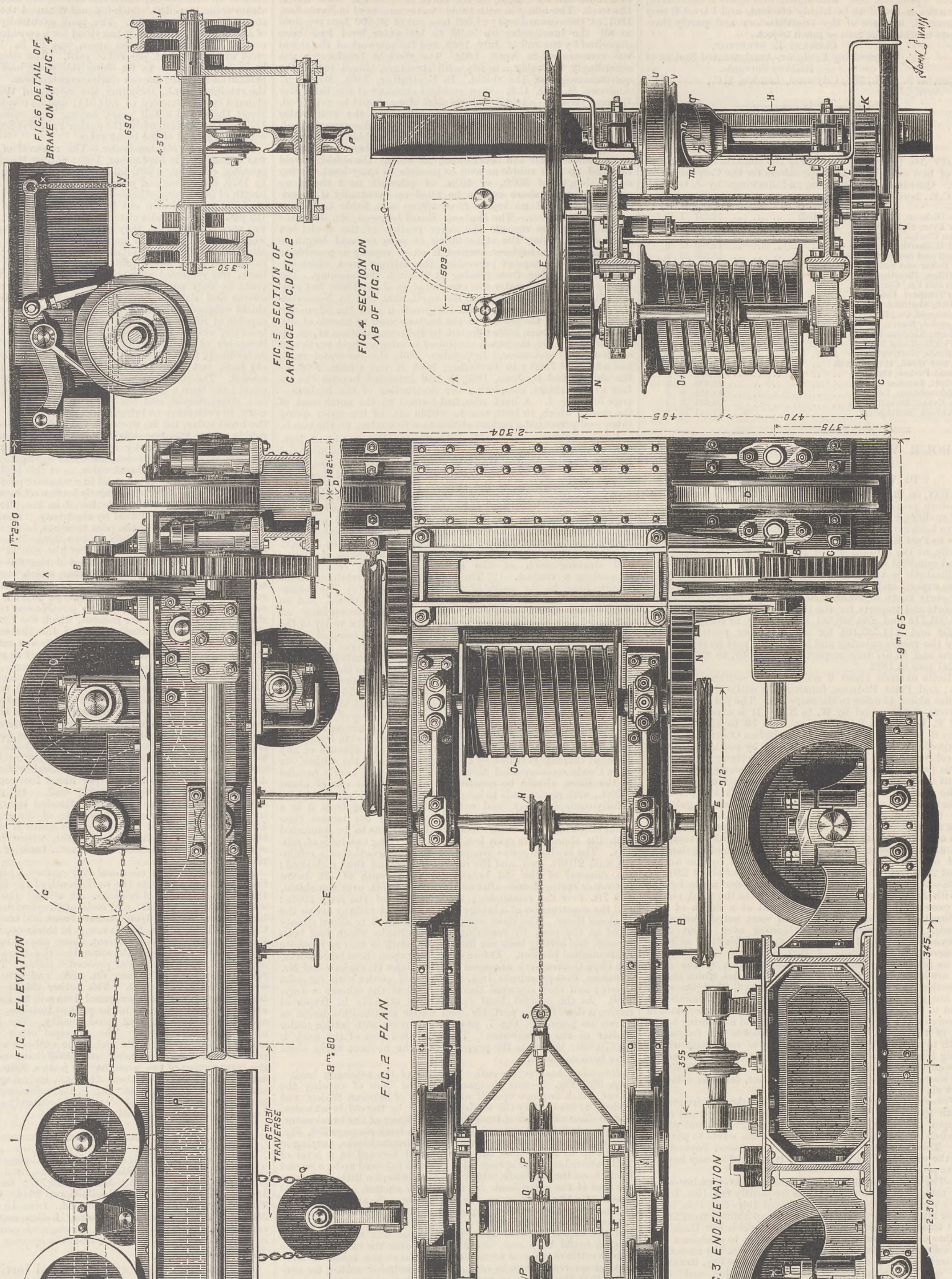
[1] Proc. Inst. Civ. Eng., vol. lxxxviii., Part II., from which our engraving is also taken.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending April 23rd, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 10,747; mercantile marine, Indian section and other collections, 3646. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m.: Museum, 1115; mercantile marine, Indian section, and other collections, 243. Total, 15,751. Average of corresponding week in former years, 16,625. Total from the opening of the Museum, 25,559,901.

A MEETING of the North of England Institute of Mining and Mechanical Engineers was held at Newcastle on Saturday last under the presidency of Sir Lowthian Bell. Mr. S. B. Coxon read a paper upon "An Improved Electric Safety Lamp, with Schanschieff's Primary Liquid Single Battery." This battery makes use of a salt of mercury. The advantages claimed for the battery, which is of simple construction, are, that the electric motor force is high and perfectly constant, that the internal resistance is very small, that it gives a perfectly steady current, and that it is cheap and durable. Three lamps of different sizes were exhibited. The smallest gives a light equal to two candles for eight hours, and the largest a light equal to four or five candles, for a similar length of time. The cost of the smallest is 17s. 6d. and of the largest £1 1s.; and the cost of maintenance from 1d. to 1½d. per shift. Mr. T. O. Robson gave a short description of a new sprayer for laying dust in mines now in use in the Redheugh Colliery. It consists of an ordinary water tub on wheels, capable of travelling along the wagon ways. From the tub a tube projects through a stuffing-box, having at its outer end a hollow perforated spherical end. Over the sphere is fitted another one also perforated, and fitted with a circular brush. The tube, external sphere, and brush are made to rotate by means of an endless chain and gearing connected with one of the axles of tub, and a stop valve regulates the supply of water. With this apparatus travelling at a speed of about four miles an hour, 100 gallons of water have been found sufficient to lay the dust in 1700 yards of wagon way, or, say, over a superficial area of 150,000 square feet.

TRAVELLING CRANE—PARIS, LYONS, AND MEDITERRANEAN RAILWAY WORKS, OULLINS.

(For description see page 337.)



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TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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

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

J. B.—*Your belt will transmit about 9-horse power.*

H. C. H.—*We regret that we are unable to supply you with the information you want. We have no recollection of the advertisement to which you refer.*

J. D.—*The ratio of the power to the weight, in systems of pulley work where one end of each cord is made fast above, is found by dividing the weight by 2 as many times as there are pulleys. Thus, let the number of pulleys be five and the weight 1000 lb.; then the power will be*

$$\frac{1000}{2} \; \frac{500}{2} \; \frac{250}{2} \; \frac{125}{2} \; \frac{62 \cdot 5}{2} = 31 \cdot 25 \text{ lb.}$$

TOWN SURVEYOR.—*You should ascertain as nearly as possible the quantity of water consumed per head of the population per diem in cubic feet. This will give the entire sewage discharge for twenty-four hours. Take it that half of this will pass into the sewers in six hours, and then calculate the number of cubic feet per second. To this must be added the rainfall. Assume that rain falls to a depth of ¼in. in twenty-four hours over the whole area of the district, and calculate the number of cubic feet per second that will have to be provided for. Add this to the volume of sewage per second in cubic feet, and you then have the total volume of liquid to be dealt with. Next assume any size of sewer tentatively—say, 2ft. in diameter. Calculate by the following formula the velocity of discharge, with the inclination of 1 in 630, or 8·38ft. per mile:—*

$$V = 0{\cdot}92 \sqrt{2 \, f \, hy}.$$

V = *velocity in feet per second.*
f = *the fall in feet per mile* = 8·38.
hy = *the hydraulic mean depth = the area of the sewer divided by the circumference, which is equal to 0·5ft. for a 2ft. barrel sewer.*

Having got the velocity by this formula, multiply it by the area of the sewer = 3·141 square feet in this case; and if this, the product, is found to be more or less than the total volume of rainfall and sewage to be dealt with, a smaller or larger size of sewer must be assumed and the calculation repeated. The formula applies to an egg-shaped or any other form of sewer. May we add that if you were qualified by education for discharging the professional duties of the post you hold, you would not be compelled to apply to us for information of this kind. We fear that corporations only too often make appointments for reasons with which professional fitness has little to do, and that really competent candidates are thus placed at a disadvantage.

MODERN FLOUR MILL MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—In your issue of the 22nd inst., under the heading "Modern Flour Mill Machinery," you make reference to the roller mill started by Mr. J. A. A. Buchholz for us as being in the year 1879. As a matter of fact, this mill was started in the middle of 1878. BARLOW AND SONS.
Bilston Flour Mill, near Bilston, April 27th.

MANGANESE AND MANGANESE ORES.

(*To the Editor of The Engineer.*)

SIR,—Being interested in the ferro-manganese trade of Great Britain, I should like to ask the following questions:—(1) What approximate quantity of ferro-manganese containing 60 and 80 per cent. metal mangan respectively is consumed annually in Great Britain? (2) Can you give the proportionate parts of all the minerals used to produce ferro-manganese of 60 and 80 per cent.? (3) Is it possible to produce ferro-manganese from Caucasian manganese ore independently of other manganese ores? The former, as you are aware, contains 85 per cent. peroxide, or 55 per cent. metallic mangan, ·12 per cent. silica, and ·20 per cent. phosphorus, and various other minerals. MANGANESE.
April 13th.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, May 3rd, at 8 p.m.: Ordinary meeting. Papers to be further discussed:—"Water Supply from Wells," in the London Basin, at Bushey (Herts), in Leicestershire, and at Southampton, by Messrs. Grover, Fox, Stooke, and Matthews respectively.

SOCIETY OF ENGINEERS.—Monday, May 2nd, at the Westminster Town Hall: Ordinary meeting. Paper to be read:—"Refrigerating Machinery on Board Ship," by T. B. Lightfoot, M. Inst. C.E., of which the following is a synopsis:—Earliest refrigerating machines for dead meat cargoes—Machines based on compression and then expansion of air—Laws of intrinsic energy of gases—Isothermic and adiabatic compression and expansion—Practical applications by Siemens, Kirk, Windhausen and Nehrlich, Giffard, Bell-Coleman, Haslam, Ellis—The author's machines illustrated and described—Steamship Fifeshire, carrying about 30,000 carcases of mutton—The Prins Frederik.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, May 2nd, at 8 p.m. Cantor Lectures: "The Chemistry of Substances taking part in Putrefaction and Antisepsis," by J. M. Thomson, F.C.S. Lecture I.—General division of the subject—Description of terms—Conditions affecting fermentation and putrefaction—General description of the more common forms of fermentation, *e.g.*, alcoholic, lactic, acetic, butyric, and ammoniacal. Wednesday, May 4th, at 8 p.m.: Ordinary meeting. "Agricultural Education," by J. C. Morton; the Right Hon. Sir Thomas Dyke Acland, Bart., will preside.

CHEMICAL SOCIETY.—Thursday, May 5th, at 8 p.m. Papers to be read:—"A Contribution to the Study of Well Waters," by R. Warington; "The Distribution of Lead in the Brains of Two Lead Factory Operatives Dying Suddenly," by A. Wynler Blyth; "Crystals in Basic Converter Slag," by J. E. Stead and C. H. Ridsdale.

GEOLOGISTS' ASSOCIATION.—Friday, May 6th, at University College, Gower-street, W.C., at 8 p.m. Paper to be read:—"On the Unmaking of Flints," by Professor J. W. Judd, F.R.S., Pres. G.S., &c.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Wednesday, May 4th, at 8 p.m., at Newcastle-on-Tyne: Business meeting. Adjourned discussion on "Triple Expansion *v.* Compound Engines from a Shipowner's Point of View."

DEATH.

On April 1st, at Ceară, Brazil, HENRY EDMUND PUNCHARD, student of the Institution of Civil Engineers, and a member of the Engineering Staff on the Ceară Harbour Works, third son of Mr. William H. Punchard, C.E., London, aged twenty-five years.

THE ENGINEER.

APRIL 29, 1887.

MR. F. W. WEBB ON RAILWAY BRAKES.

AT the annual meeting of the delegates representing the members of the London and North-Western Railway Mutual Insurance Society, which recently took place at Crewe, Mr. Webb, the locomotive superintendent, addressed the meeting, and took the opportunity of alluding to the question of brakes. Mr. Webb is reported to have spoken as follows:—"Then as to brakes. He asked them not to depend altogether upon the mechanical brakes, good as they were. A mechanical thing, like human nature, was liable to fail, though they had had fewer failures lately than ever. It had been suggested that to satisfy the requirement of the Board of Trade they should adopt an automatic brake, and he supposed they would do so. He therefore asked them, while transition was going on, to take care not to be led into confusion by the two systems. At the same time, an automatic brake would not have prevented such an accident as they had at Carlisle last week, when an extraordinarily low temperature had caused a complete block of ice in the vacuum pipe. It did not matter what the Board of Trade officials stated. They, as railway men, were quite as competent as anybody outside the company, and who could not possibly know all the little difficulties which they had to contend with, to devise the best methods for safety. Some of the papers, and the Board of Trade, made out that the London and North-Western Railway Company were most backward in the matter of the brakes, but on their line the first continuous brake was adopted many years ago and placed on the Irish mail." Mr. Alderman Whale, one of Mr. Webb's assistants, also referred to the working of the brake, and hoped the men would take Mr. Webb's words to heart, and "always endeavour during the transition state of the brake to use their utmost efforts to prevent running too far into such stations as Crewe, Preston, Rugby, and Stafford—why omit Carlisle?—which should be treated as terminal stations, and they should always have a little margin left to pull up in case anything might fail in the brake." There can be no doubt from the foregoing that Mr. Webb and his officers view the change to an automatic brake with no great enthusiasm, and that this the most recent experiment has as little of the elements of permanency about it as those previously made. The Carlisle incident alluded to by Mr. Webb, and which was near proving so disastrous, was no doubt the cause of this half-heartedness; but such have been the failures of every system of brakes tried by this company, that it is not unnatural that confidence should be entirely shaken in their own judgment. We have no doubt whatever that, had the brake at Carlisle been automatic, it would have frozen in the same way, as stated by Mr. Webb. In our analysis of the last issued brake returns—see ENGINEER of October 29th, 1886—we drew particular attention to the liability of the vacuum brake to be affected by frost and water, there being no less than forty-five such cases reported, and we showed that those against the automatic vacuum brake alone gave rise to no less than 243 minutes' delay.

Considering the history of the brake question on the London and North-Western Railway, Mr. Webb's cut at the Board of Trade was rather out of place. The Board of Trade has, at all events, been perfectly consistent throughout; whereas the North-Western, having made many changes, would not appear to have been so well up in the necessary requirements as Mr. Webb asserts. We have no doubt that when the repetition of the Carlisle incident does take place, this company will dub it a "Board of Trade accident," thereby following the example of those railway wiseacres who knew their own requirements so well as to object to the introduction of the interlocking of points and signals and the block system, and who at first tried to saddle the Board of Trade with the consequences of their own blunders in operating. We need hardly point out that it requires no special training on railways to decide upon the principles with which it is desirable a brake should comply, and as to whether it is worth saving life—if possible—whenever it is in danger; or only now and then. Mr. Webb boasts, in the same address, of having been connected with the London and North-Western Railway for thirty-six years; but it is hard to believe that he is even now an authority on the brake question, or one whose example is worth following. After repeated failures with various systems, another is selected which Mr. Webb assures us will, under conditions which there is no guarding against, prove as useless as the brake the company is now discarding; at the same time asserting, somewhat inconsistently, that they, "as railway men, are much better judges of what is desirable than the Board of Trade or anyone outside the company." As outsiders we, at all events, object to such inadequate measures for our protection, when greater safety can be procured.

It is not the action of the Board of Trade, however, but rather its inaction in this matter of which the public have to complain. Had the necessary powers been granted it some years ago, many lives and a vast deal of money would have been saved, and it seems not unreasonable to expect from the foregoing extracts that the sacrifice is still unfinished. We may mention, in connection with this subject, that the Railway Regulation Bill of Mr. Channing is again to be brought forward, and that it proposes to invest the Board of Trade with the power to enforce their recommendations; and at a mass meeting of railway men in Manchester on the 17th inst., a resolution approving the Bill, and authorising the chairman to sign a petition to be sent to Parliament in its favour, was unanimously passed. Mr. Edward Harford, general secretary of the Amalgamated Society, prominently referred to the question of continuous brakes, and his remarks are worth repeating:—"The next point of the Bill had reference to continuous brakes. It was thought that there should be efficient continuous brakes. The matter had been under consideration for a long time without anything being done, but if the Bill became law, he was in hopes that a speedy end would be put to the present unsatisfactory state of the question, and that the various railway companies would be forced to adopt a continuous brake which fulfilled all the Board of Trade conditions. These conditions were clearly set forth in a circular issued to the companies nearly ten years ago, and there should be now no difficulty in determining whether any brake actually fulfilled the conditions which the Board of Trade had laid down; for if that department of the Government was competent to decide the principles involved in their construction, surely they ought to be able to state definitely whether they do or do not fulfil such conditions. That the department is in doubt upon this point is clear from the expression used at the head of the abstract of the returns made by the companies of brakes which 'appear to comply with the conditions specified in the circular of the Board of Trade, and dated 30th August, 1877.' Under these circumstances, and finally to settle the point, the society had asked the Government to appoint a committee of experts to examine the merits of the several brakes reported as continuous and automatic, and report thereon, but that matter, like many others, was still under consideration. The experts whom he would recommend were men who worked the different kinds of brakes daily, and were therefore most competent to decide a question of this kind. There were scores of men present who, in an hour or two, while the inventors were disputing with each other on the relative merits of their inventions, could settle the matter without bias or prejudice."

The suggestion that a committee of practical enginemen—that is, those who have the daily operation of the various systems in their hands—should be allowed to make comparative experiments and report the results, is a very good one, but quite in harmony with Mr. Webb's remarks. It is abundantly clear that the railway men engaged in the manipulation of the brakes are disgusted at being ignored so long, and many very naturally feel that the comfort and safety already enjoyed by some of their fellows should be shared by themselves. In all brake experiments hitherto the main object has been to ascertain how soon a train could be stopped. We are well aware of the importance of powerful and instantaneous action, and that had this qualification been acknowledged as the test, the question would have been settled long since by the adoption of the Westinghouse brake; but an engine-driver views the matter from several standpoints which concern him all day long, and not only in emergencies. He is interested in anything that affects the steaming qualities of his engine—in the economy of coal and water—in shunting operations being facilitated and not obstructed; and that his complete control over a train—that is, his power of checking and releasing promptly, being independent of its length. It is well-known that there are brakes which, while they work well enough on short trains, and when all is in the best possible order, and so long as full steam can be maintained, are a source of the greatest worry and delay when the trains are long, or the joints not tight, and steam pressure has fallen, as it does very frequently. If such trials could be arranged, all these points would no doubt receive careful attention from the practical men most concerned, and some valuable and interesting information would be the result. Perhaps Mr. Webb would use his influence to promote the wishes of the railway servants in this respect, for there can be little doubt, to paraphrase his words, that they "as railway men are quite as competent as anybody outside the company," and that they "know all the little difficulties with which they have to contend" better than many of their officers.

THE WORKING OF THE EXPLOSIVES ACT.

The Eleventh Annual Report of her Majesty's Inspectors of Explosives, recently issued, refers to a very different state of things compared with that which existed prior to the Explosives Act of 1875. The trade in these potent compounds has enormously increased, and, but for the amendment of the law, very serious dangers would now menace the public. But the Legislature has interposed to such good purpose that what would otherwise have been a growing peril is now a well-regulated industry, concerning which much less apprehension need exist than that which would have been justifiable a dozen years ago. The law then in operation was absurdly insufficient. Among other defects the Act of Parliament limited the quantity of gunpowder to be carried in a van or barge; but there was no limit to the number of vans which might go in a line or which might be in a train. Colonel Majendie stated in evidence before the Select Committee on Explosive Substances, in 1874, that he knew on one occasion, on a leading railway, as much as 25 tons of powder sent in one train, being nearly half as much as the quantity that exploded at Erith. A police officer once reported that fifteen vehicles, conveying in the aggregate about 20 tons of powder, were detained for some time in one of the streets near Blackwall Stairs, waiting for the arrival of the barge to take the cargo. The proceeding was entirely legal, and there was nothing uncommon about it. It was "the usual practice." It happened once that a barrel of powder tumbled out of a vehicle, and was smashed open on the stones. The havoc which would have ensued had twenty tons of powder exploded in a crowded part of London may be inferred from the widespread mischief caused by the explosion of five tons of powder on Board the "Tilbury" barge in the Regent's Canal. This disaster occurred in time to emphasise the report of the Select Committee, presented only about three months before. It was the custom to stow gunpowder on board ship in the midst of a miscellaneous cargo of merchandise. On land, carriers' carts conveyed gunpowder as freely as barrels of beer or casks of butter, and it was officially reported that this explosive agent was carried with no more care than any other article of commerce. The time had arrived when this mode of conducting a perilous traffic could no longer be endured; and when we look at the variety and power of the more modern class of explosives, there is evident ground for thankfulness that the law received amendment and extension when it did. Yet so vast is the field that has to be covered, that it is only by degrees the action of the law can be made effective in all directions. Much depends on the local authorities, who require in most instances to be looked after by the Government inspectors in order that, in the first place, they may understand their duties; and, in the next place, be quickened in the discharge of their responsibilities. But year by year things are growing better, though the inspectors are still obliged to declare that the weak point in the administration of the Act continues to be its careless administration by the local authorities in some districts. Excepting the factories and magazines, which are under the supervision of the Government inspectors, together with places where explosive material is kept to a limited amount for private use, all the places of storage are under the control of the local authorities. Hence it comes to pass that unless a vigilant and effective system of inspection is maintained by the local officers, the Act is "practically inoperative" in respect to the greater number of places of storage for explosives throughout the country. Still there are many districts in which the local authorities are fulfilling their duty, enabling Colonel Majendie and his colleagues to report that the general working of the Act is, on the whole, very satisfactory.

Increasing vigilance on the part of the local authorities is materially diminishing the risks formerly connected with the conveyance of explosives by road. It is admitted to be possible that many offences against the salutary provisions of the Act are committed and not detected, the matter lying very much outside the purview of the Government inspectors. In a district in Devonshire the officer of the local authority discovered two cases of the illegal conveyance of dynamite. In one instance a carrier "conveyed in a carriage whilst carrying public passengers" as much as 200 lb. of dynamite, and finally left the consignment unguarded in the yard of his own house. In the other instance 60 lb. of dynamite were transmitted by a carrier on horseback, and ultimately deposited on the premises of a blacksmith. London is well protected in this particular by the Metropolitan Board of Works, and the knowledge of the fact appears to preclude any attempt to evade the law. The railway companies take peculiar care of themselves in regard to this matter. The Railway Clauses Consolidation Act gives them power to refuse the carriage of goods which they consider dangerous. The manner in which this power is exercised in respect to dynamite and similar explosives has been the occasion of frequent remonstrance from Colonel Majendie, but without effect. The prohibitory policy adopted by the companies cannot fail to induce the surreptitious conveyance of explosives, thereby producing direct public peril. The companies, on the other hand, are secure against pecuniary damage, since if an explosion takes place, they can plead that it arose from an infringement of their rules. That the practice of carrying dynamite by train, in hand-bags and portmanteaus, actually exists, may almost be called an "open secret." We know that it has been done in the past, and we are not aware that there is any change, however reprehensible the practice may be. Should any disastrous results accrue, the guilty parties would probably be sacrificed to their own folly; but others might suffer whose consent to share the risk was never asked, and most likely would not have been obtained. For the present there is no catastrophe to lament, which is perhaps sufficient to show how safely the companies might carry all kinds of explosives, legally manufactured, duly protected by regulations, and conveyed in suitable vehicles. As it is, there is reason for congratulation that no accident from the conveyance of explosives occurred during the past year. It has been otherwise with respect to manufacture, although the utility of the Act is well demonstrated by the reduction which has taken place in the number of fatalities connected with the manufacture of explosives, as conducted under the statute. During the eight years 1878-85 the average loss of life in manufacture was 8·25 annually, while the actual loss in 1885 was five only. Last year the sacrifice of life in manufacture fell still lower, only one death being thus recorded. In the four years immediately preceding the passing of the Act, the average number of deaths in the manufacture of explosives was 37 per annum. The average number of deaths per annum in the English and Welsh factories alone during the years 1868 to 1870 inclusive, when no system whatever of inspection existed, was 43. In considering these figures, we are called upon to note the fact that the number of licensed factories has risen from 55 in 1876 to 107 in 1886. In addition to the Act of 1875, there is the Explosive Substances Act of 1883, relative to the manufacture, possession, or use of explosives for malicious or unlawful purposes. In these days of dynamite alarm, it is reassuring to learn that the Government Inspectors during the past year have endeavoured, in conjunction with the leading manufacturers and dealers in high explosives, to effect an arrangement whereby the difficulties in the way of the acquisition of such explosives by evil-disposed persons for improper purposes should be sensibly augmented. Details, for obvious reasons, are not disclosed, but it is hoped that the arrangement will prove effectual for the accomplishment of the purpose in view. Four new explosives have been submitted for examination during the year. One of these, named Securit, has been approved, but the others, named Kinetite, Forcite and Vril, have been rejected. Sensitiveness to a glancing blow appears to have been the defect in each case. This report gives us no account of the new French explosive reserved for war purposes—melanite. More recently another explosive has been announced on the Continent, said to be the most powerful yet invented. Its present location is in Belgium. Perhaps no more will be heard of it, or it may prove too strong to be tractable. The importation of explosives into the United Kingdom during the year is officially reported to have been again very large, but differing only in a slight degree from that of 1885.

The general improvement in factories under the Explosives Act, reported a year ago, is said to be fully maintained, affording a marked contrast to the defects observable ten years ago. Similar commendation is afforded in the case of magazines. In respect to stores, continued improvement is reported, and some progress is observed in respect to registered premises. The local authorities are concerned in these last two matters. In their next annual report the Government inspectors will necessarily have to speak of the recent fatal explosion at Cradley Heath. By licence of the local authorities, 200 lb. of powder were stored in a building only six yards distant from a dwelling-house, in a populous neighbourhood, and adjoining a public way. The place was blown up, two children were killed, and four others shockingly injured. During 1886 there was an increase in the number and fatality of the accidents connected with the use of explosives, whereas there was a diminution in the number connected with the manufacture, keeping, and conveyance of these substances. Thus the excess occurred where the law had no application. Altogether the deaths were forty in number, and of these twenty-one were due to gunpowder. The most important and fatal of the gunpowder accidents was not immediately the result of an explosion, but was due to the inhalation of the poisonous gases given off by fired gunpowder. The remarkable and disastrous occurrence at the Crarae Quarry, Loch Fyne, last September, when seven persons lost their lives by powder gas and more than thirty were injured, will be fresh in the recollection of our readers. Colonel Majendie, in a long experience, is only aware of two similar accidents. One of these occurred in the Forest of Dean in 1872, when four lives were lost. The deaths from dynamite last year were fifteen. The improper thawing of nitro-glycerine preparations was the cause of some of these fatalities. In the general list of accidents we meet with some which seem almost whimsical in their origin, though sad enough in their results. In one instance two men hunting rats fired an unknown store of gunpowder in an ice-house. The place was blown up, the men were killed, and one of their dogs. In another case, a man, while quarrelling with his wife, upset some detonators into the fire, causing an explosion, by which the woman was seriously injured. Fires and explosions connected with petroleum are mentioned in the report, and it is to be hoped that the promised legislation concerning mineral oils, founded on the experience gained by Colonel Majendie in his recent visit to America, will effect further protection to the public, while yielding due liberty to trade. Concerning the Explosives Act, we may properly conclude by observing that it is evidently as good a piece of legislation as could be reasonably expected for such a purpose, and the duties of the Government inspectors are carried out with zeal and ability. Colonel Majendie is the chief, and with him are Colonel Ford and Major Cundill, R.A. Dr. Dupré, F.R.S., is the chemical adviser of the department. In a report by Dr. Dupré, mention is made of the fact that 1886 was happily free from outrages perpetrated by means of explosives.

THE EDUCATION OF ENGINEERS.

A paper on "The Education of Engineers" was recently read by Mr. Henry Dyer, C.E., M.A., before the Institution of Engineers and Shipbuilders in Scotland. The subject is of very great importance. This is admitted on all sides, but we use the words just now in a limited sense. We set on one side the influence on the future prosperity of this country which the training of the rising generation of engineers may have. We do not consider the value of success in training to those who make teaching a profession. We restrict ourselves to the parent and the son. The importance to both of the training which the latter receives dwarfs all national considerations. These become of no moment in the eyes of the parent. The son is not likely to think of them. To the man who has no son to be educated, the influence of a system on the future of a nation may be a subject of considerable interest. To the parent it possesses no interest whatever. The result is that those who write about education being, generally speaking, free from family cares; or too prudent to bring their sons up as engineers, treat the whole matter in what is virtually an unpractical way. They may do much harm by limiting facilities for teaching, and we doubt if they do any real good. They are not in touch with those whom they fain would influence; and what they have to say does not therefore produce much beneficial effect. With Mr. Dyer's paper we have no special fault to find. Much that it contains was sensible, a good deal was repetition of an old story. The discussion which followed it was of more value, because hard-headed men spoke, and spoke in some cases very much to the point. We wish now to try and put the question in a point of view too seldom occupied by it, and divesting it of some theory and a good deal of clap-trap, to consider what is really the object which parents wish to attain when they make engineers of their sons.

The sole purpose which any parent or guardian has in view when he makes his son an engineer is to enable him to earn his living. In other words, he wants to give the young man such a training that he can, when trained, go and earn or make money. This is in nine hundred and ninety-nine cases out of a thousand the sole purpose actuating the parent or guardian. We need not concern ourselves with the exception. Now that professional training which will give the best pecuniary return is *the* best training. It is not impossible that some of our readers will hold up their hands and exclaim that this is dreadful doctrine, that the true object of education is to open the mind, develope the faculties, &c. We need not go over the old story. Whether the doctrine be dreadful or not, it is true. The hard stubborn fact is that if a young man, when he has finished his training as an engineer, cannot earn money enough to support himself, his training has been a disastrous failure, and this no matter how much his mind has been developed. In the present day everyone unpossessed of independent property lives by selling wares of some kind. The wares which the young engineer has to sell are his powers of being useful to his employer. No matter how admirable his education may have been, unless it has provided him with wares to sell, he must starve or live on his parents or friends. Now the tendency of the present methods and means of education is to turn out trained young men who have nothing to sell that the world wants to buy. Mr Hyslop, in the course of the discussion on Mr. Dyer's paper put the truth very forcibly. "That the present condition, he said, "of university education for engineers was anomalous must be patent to every one who was at all conversant with the subject, for who had not heard it remarked amongst practical engineers, civil or mechanical, that the university certificate was hardly worth the paper on which it was written. Many sad cases of disappointment had occurred through young men being led to place too great faith in purely university training, and it too frequently happened that a young man of twenty or twenty-one years of age, after working hard for several years to obtain the certificate, found on presenting himself at an engineer's office that his diploma, of which he was so proud, was practically worthless; that he himself was considered to be not only useless, but rather a nuisance, and that he was told if he wished to be an engineer, he must go and serve his apprenticeship. Such a case came under his own notice very recently, and similar cases must have occurred in the experience of most gentlemen present." "But," we hear it said very often, "this high type of university education must be given, in order that we may not fall short of the foreigner. Without it he will beat us on our own ground." Let us test this argument by facts, and see what it really comes to. There is in this country at present a very considerable number of Germans, all of whom have received a high-class training of its kind in their own country, where they could find no employment. What positions do they hold here? With a few exceptions, they are employed in drawing-offices, and they contentedly earn salaries on which an English draughtsman finds it hard to keep body and soul together. They are popular here because they are quiet, orderly, accurate, temperate, and very, very cheap. The superior education which these poor Germans have received bears little fruit for them at all events. Why should it bear more for the English student? There is no answer to this question save one. There is no reason. The truth is that at a university a young man spends the best years of his life learning what is of no possible use to him afterwards, while he leaves unlearned nearly everything which would make him valuable. Here is a case in point which occurred not long since within our own knowledge. A young man received a university training, and he acquitted himself well. He obtained by interest, which he was not without, one or two engagements of a very subordinate type as a mechanical engineer. At last the head of a firm, doing a large business, impressed with the value of a university education, and the apparent ability of the man himself, determined to give him a chance. He appointed him manager of a department in his works, and he gave him a good salary. For six months he left him to himself; at the end of that time he went into accounts, and found that the cost of the department, in which much work was done by the piece, had augmented by nearly 20 per cent., with a proportionate falling off in output. He had an interview with the young manager; asked for explanations, and gave some. The result was that after expressing his disappointment, he gave him another chance for three months. At the end of that time things instead of being better were rather worse, and the young man had to admit, with tears in his eyes, that he had undertaken duties of which he knew nothing. "It is," he said, "all so different from what one learns at college." The end was that he gave up engineering altogether and emigrated. We cite this case to illustrate the proposition we have often put before our readers, namely, that the university or technical school teaches much which is not wanted, and leaves untaught much that is wanted.

The reason for this is not far to seek. The men who teach, with few exceptions, never having carried on business themselves as engineers, are lamentably ignorant not only of much that an engineer ought to know, but of what it is an engineer ought to know. The business of the mechanical engineer is, as we have said, to make money; and those who carry on the work of education in technical schools would, we fancy, be astounded if they knew how little of the information which they spend so many years in imparting is ever used or ever can be used in the shops of a mechanical engineer. Their notions on the subject are altogether too magnificent. Mechanical engineers ought to be flattered by the assumption that they must have an adequate knowledge of the higher mathematics, more than a smattering of chemistry, a thorough training in physics, and so on. All these things are admirable in their way, but they will not help a young fellow to make money as a mechanical engineer unless they are backed up and supplemented by information of a very different character. Three to five years may now be spent in obtaining a university training, during which a great deal is, as we have said, taught that it is entirely unnecessary for the engineer to learn, and a great deal is left entirely untaught which he ought to have at his finger ends. This, we shall be told, implies that university education is too wide and too high. Another dreadful doctrine; dreadful, perhaps, we repeat, but true.

Let it not be supposed, however, that we deprecate all technical instruction, and advocate a return to the old system of apprenticeship and no training. Very far from it. We desire to see university and technical school training altered and adapted to the purpose for which it is intended. It must be used to supplement shop training, not to supersede it. The weak point in university training is that it is all theoretical. The weak point in the old apprenticeship system was that it was all practical. The time which a pupil has at his disposal is limited, let us say, to five years. Three of these may be spent in college, certainly not more; two in the shops, with, in addition, a portion at least of the very long vacation which most universities grant. Each year's training at the school or the college should be complete in itself, and adapted to the age and requirements of the pupil. No hard-and-fast rule can be laid down as to the division of work. We are ourselves disposed to put it thus: When a young man has money, so that he will, when "out of his time," be able to take a junior partnership, he should spend two years in college, two years in the shops, and wind up with one year of college training, because, owing to his position, it is not probable that he will ever use his hands at the vice or the lathe. If, on the contrary, he is likely to find himself in such circumstances that he will have to support himself somehow, then two years at college and three in the shops will be best, because a good workman always stands a chance of earning money as a fitter, erector, &c., and may live where the college trained man would starve. This is especially true of the colonies. In saying this we intend nothing more than to throw out a suggestion. Circumstances alter cases, and so much depends on the former, that no hard-and-fast rule can be laid down for the latter. Not only is the time to be spent in college or in the shops an open question, but the very nature of the training which the student is to have. For example, it is possible for a boy to read up certain subjects, which, from an engineer's point of view, have little or nothing to do with engineering, and by passing an examination in these to get a scholarship, and so education for practically nothing, the subjects used to pass in never perhaps being touched again. The whole question has been invested with difficulties and perplexities which are entirely unnecessary. If the heads of colleges would take counsel with some of the leading firms of mechanical engineers, it would be easy so to modify existing courses of instruction that a student instead of leaving college with a smattering of a dozen things in his head, would possess a sound and comprehensive training in a few of those subjects likely to be of real use to him in after life. "It is of more importance," once said an authority, "that an engineer should know the rule of three than the first six books of Euclid, and to speak German will be better for him than familiarity with logarithms." It is quite possible for a man to be an eminently successful engineer who has not had a college training. We never heard of a man who had nothing but a college training to rely on being a successful engineer.

OUR STEAMSHIPS.

The valuable official record issued by the Registrar-General of Shipping shows some indications that the decline in the number and tonnage of steam ships belonging to the United Kingdom is about to be arrested. For several months the statistics show that there has been a heavier loss than has been replaced, but for the latest month for which the figures are available there was an increase. In March we added to the register for the United Kingdom, either by building or by purchase, 35 steamers, 3 of which were wood and the remainder of iron or steel. The wood vessels were of small tonnage—73 net register in the total, and the other 32 were of 25,567 tons; so that the total additions of steam shipping to our register for the month were to the extent of 25,640 net tons. On the other hand there were removed from the register 27 iron and steel steamers and 4 wooden built. The 27 vessels had an aggregate tonnage of 14,031 net, and the 4 had a tonnage of 67 net. Thus, in a sentence, 25,640 tons were added and 14,031 tons were removed; that is as far as steamships are concerned, and it is evident that there has been a gain of over 11,000 tons. But there has been in the same time a loss in the sailing vessels. There were 6337 tons of sailing ships added to the register in the month, but the removals were to the amount of 21,760 tons, so that, balancing, 15,423 tons were removed from the merchant fleet of ships. Although the loss of ships was a little more than that of the gain of steamers on the month nominally, but not in effect, as far as the United Kingdom is considered, there is also the colonial register to be remembered, and the figures as to this for the same period show briefly a loss of nearly 2000 tons in sailing vessels, and a gain of over 2500 tons of steam tonnage. Taking all the items together, we find that there is a gain in steam tonnage of about 14,000 tons, and a loss of over 17,000 tons in sailing vessels. In exact figures, we added 36,128 tons to our fleets, including those in the colonies, and we removed therefrom 40,202 tons. Thus, when the efficiency of the steam tonnage is borne in mind, it will be seen that the result of the month was an addition of effective tonnage. But a very large proportion of the tonnage added to the registers was in the shape of very small vessels—steamers for river and special uses. Out of the 32 iron and steel steamers, for instance, there were not fewer than 11 which were of less than 70 tons; and it is also noticeable that several of these were built a few years ago, so that the facts would point to the registration of fishing or other craft which had not been previously registered; and there are somewhat similar facts in relation to the wooden sailing vessels registered. Out of 23 added to the list, there are 19 under 100 tons in the colonies, and out of 24 in the United Kingdom, 23 were under 85 tons, and many of these are old vessels now registered. It may, then, be looked on as a fact that although there is a comparatively large addition to the fleet, part of it is in replacement of the vessels lost, and part of it is in the form of vessels for special purposes. For cargo-carrying vessels, it may be said that there is less building than needed to replace lost vessels, and that the work now turned out at our shipbuilding yards is generally large "liners" or vessels for river and allied uses.

WATER SUPPLY IN THE CITY.

The intention of the Commissioners of Sewers for the City to obtain water for some establishments in the City, and perhaps for a water supply for sale, has some reason on its side, although the ultimate gain or the permanent value of the scheme is not perhaps likely to be great. The fact that many thousands of houses in the City are increasing very much in value may not be any reason for an increase in the water-rate, though as a matter of business there is more than one side to this question; but the fact that these houses are using less and less water, if it be a fact, need not afford any reason for expectation that the water companies should reduce the water rate. The company has to bear the original cost, and cost of maintenance of apparatus and materials of supply, and it was on the expectation that the demand would grow that investors were originally found who would speculate in the works wherewith to supply the public with a commodity that they could only get with difficulty. If now the public find that their rents increase in value, they need not be very much surprised if they find that the water companies try to share in the great improvement. There is, however, obviously no reason for an increase in a water rate, when water supply costs the suppliers no more than hitherto, and hence the water company must admit that the Commissioners, a very wealthy body, have good grounds for their intention to do as much as possible without the company's supply, by boring wells into the chalk to get water for their own use. A fight on the subject would probably not tend to the advantage of the water companies.

LOCOMOTIVES FOR AUSTRALIA.

An order for forty-four locomotives for Australia is going begging on the Continent. The English agents applied to Austrian works to build them, because the freight from Trieste to Australia would be cheaper than from England, which sounds oddly, considering the frequent and rapid communication between England and Australia. The Austrian works, having nothing to do, would gladly have taken the order under different conditions, which were of the following exacting character:—The builders were to find two sureties domiciled in Melbourne for the proper fulfilment of the contract, were to establish workshops there wherein to erect the engines on the arrival of the parts, and were to guarantee that the locomotives made a faultless trial trip of 1000 miles before the last payment took place. Setting aside the conditions, here is another of those regretable cases where, if the negotiation had succeeded, English works would have been deprived of orders which undoubtedly should be given to them by all that is fair, considering whence the money to pay for these things originally comes, and now that the high colonial officials are assembled in London, it does seem a favourable opportunity for those specially interested in such like contracts to make an endeavour to get them put upon a more equitable and mutual basis.

LITERATURE.

Elements of Geodesy, by T. Howard Gore, B.S., Professor of Mathematics at the Columbian University; sometime Astronomer and Topographer V.S. Geological Survey; Acting Assistant U.S. Coast and Geodetic Survey; Associate des Preussischen Geodätischen Institutes. New York: John Wiley and Sons, Astor-place, 1886. London: Trübner and Co.

This book, as stated in the preface, is designed to be useful to beginners, who are expected to obtain a clear insight into the subject dealt with from its perusal, and to be grateful that the discoveries and writings of many have been so condensed or elaborated as to make the study of geodesy pleasant. In this object we think the author has to some extent failed. Like many who know the instruments and tools they describe thoroughly, he presupposes a knowledge in his readers which does not exist; and his descriptions, while being perfectly clear to himself, are to those less used to handling these instruments of precision, as would be the case with beginners, somewhat involved and wanting in clearness; and this difficulty is increased by the paucity of the diagrams and illustrations, and the fact that most of these, where they do occur, are entirely without letters of reference. The remarks on the adjustment of instruments are not very clear, nor is the description of the correction for runs put in its simplest form, and the formulæ cannot be so clearly followed in all cases as might easily have been the case. We do not pretend to have examined all the formulæ,—that would be a work of months—but this is the impression derived from the inspection of examples taken here and there through the book.

The historic sketch is most interesting, showing as it does the advance from measurement by time—that is, by a day's march, or by the steps of a camel—to the use of instruments, which in skilful and careful hands can be made to measure to ·22 of an inch in a mile, these instruments also advancing from wooden rods of more or less initial accuracy in length, to steel bands, metal rods, glass rods, and rods made of two metals and compensated. There are, again, the progressive improvements in the instruments of observation, from the sector of 5ft. or greater radius to the use of the telescope with the sector; the theodolite with 3ft. horizontal circle to the theodolite as at present used with 12in. to 18in. circle; and contemporaneously with these advances in the accuracy of the instruments used are the better understanding of the configuration of the earth and the corrections to be made to ensure accuracy.

The construction of the Ramsden theodolite with a 3ft. circle in 1783, and the fact that this same theodolite is still, not only in existence, but is said to be as good as new, speaks volumes both for the care with which it has been handled and for the value of the workmanship.

In page 19 it is stated that Schwerd concluded from his measurement of the Speyer base that a short line most carefully measured would give equally good results with a longer one; and in page 49 we find, "This error in a short line will be increased proportionally in the computed lengths of the long sides of the appended triangles . . . . from this it may be seen that all our errors are of an accumulative description." These remarks seem to contradict themselves, but such is not the intention of the author. There is no reason why a short base line should not be as accurate as a long one, and the errors in the long base line may reasonably be expected to be proportional to those in the short one, and the development from the short base to a large system of triangulation should also be simply proportional, and contain no greater errors per unit of length. Such developments may, however, from other causes connected with the lie of the country, offer serious difficulties. Otherwise the short base offers the advantage that it can be repeatedly measured and brought to the highest degree of accuracy in the same time which would be taken up in measuring the longer base once.

All that is said about the necessity for care and accuracy in every detail of such work as is here described is admirable, and cannot be too strongly emphasised. The descriptions of the laying of the rods, the apparatus employed, and the number of men found necessary for the work, are most useful, as are also the tables for finding the required elevations for stations, the dimensions of towers, and the formulæ and factors at the end of the book.

It would have been interesting to the insular mind if there had been found in the table of probable errors of measurements—page 61—some mention of the English and Irish surveys, so as to be able to compare them with the results tabulated, especially as it is stated on page 248 that the advantage of "the results from the combination of the American arcs is the preference it gives to Clarke's spheroid over that of Bessell."

The tables showing the manner in which the record of observations is kept are useful, and the whole book is of great interest; and it is a pity that, in our opinion, much of its usefulness is marred by the want of a sufficient number of diagrams and illustrations already referred to, and to the fact that it is, in many cases, written in a manner which is above the comprehension of those for whose use it is designed—namely, beginners; and we trust that in a future edition these blemishes may be removed.

Laxton's Builder's Price Book for 1887. Originally compiled by William Laxton. Seventieth edition. London: Kelly and Co. 1887.

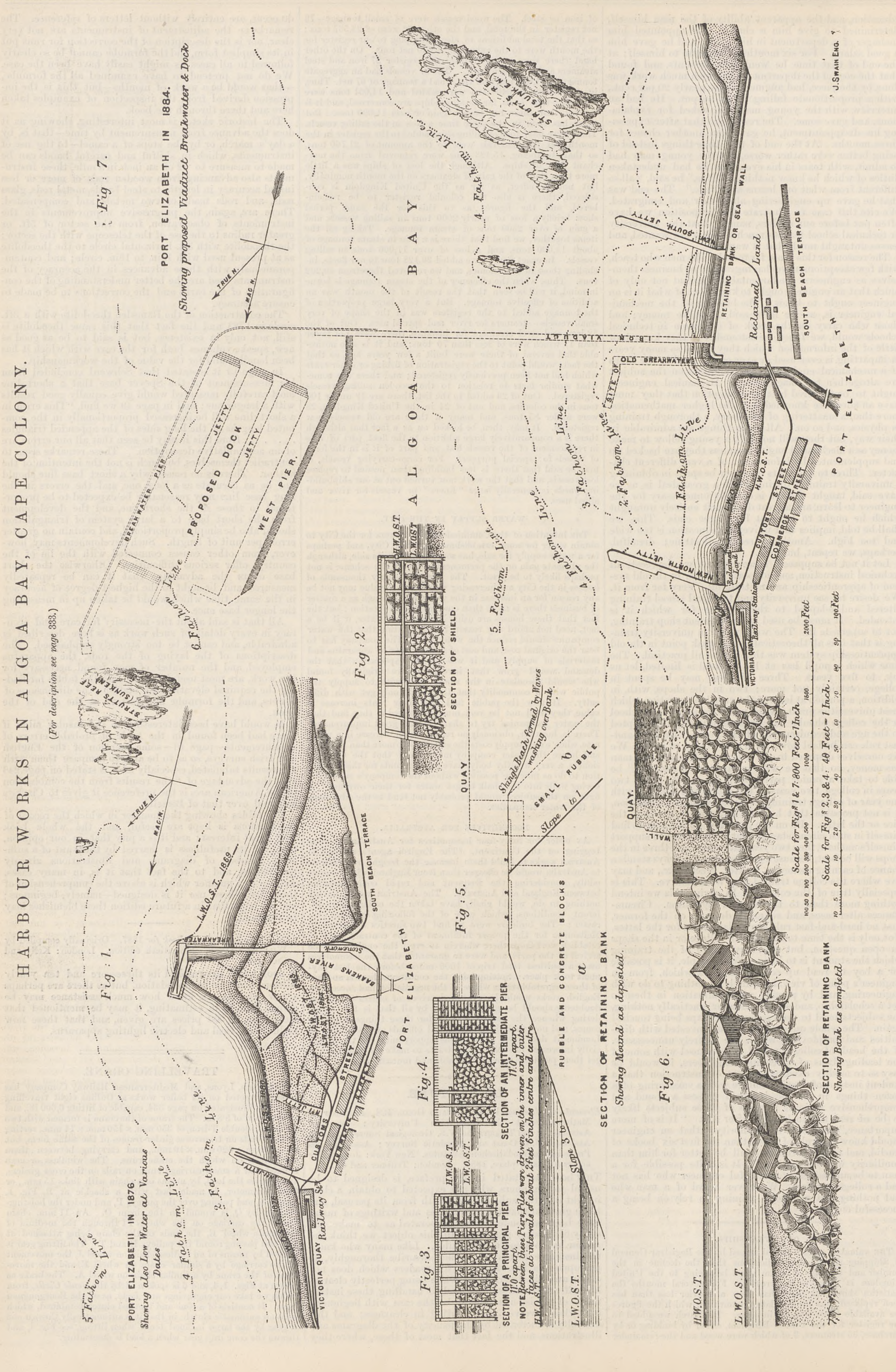
A book which has reached its threescore and ten yearly editions needs no commendation, but as there are perhaps a few who do not know how much assistance may be gained from it in estimating, it may be mentioned that more than 72,000 prices are given, and that these now include electrical and electric lighting apparatus.

TRAVELLING CRANE.

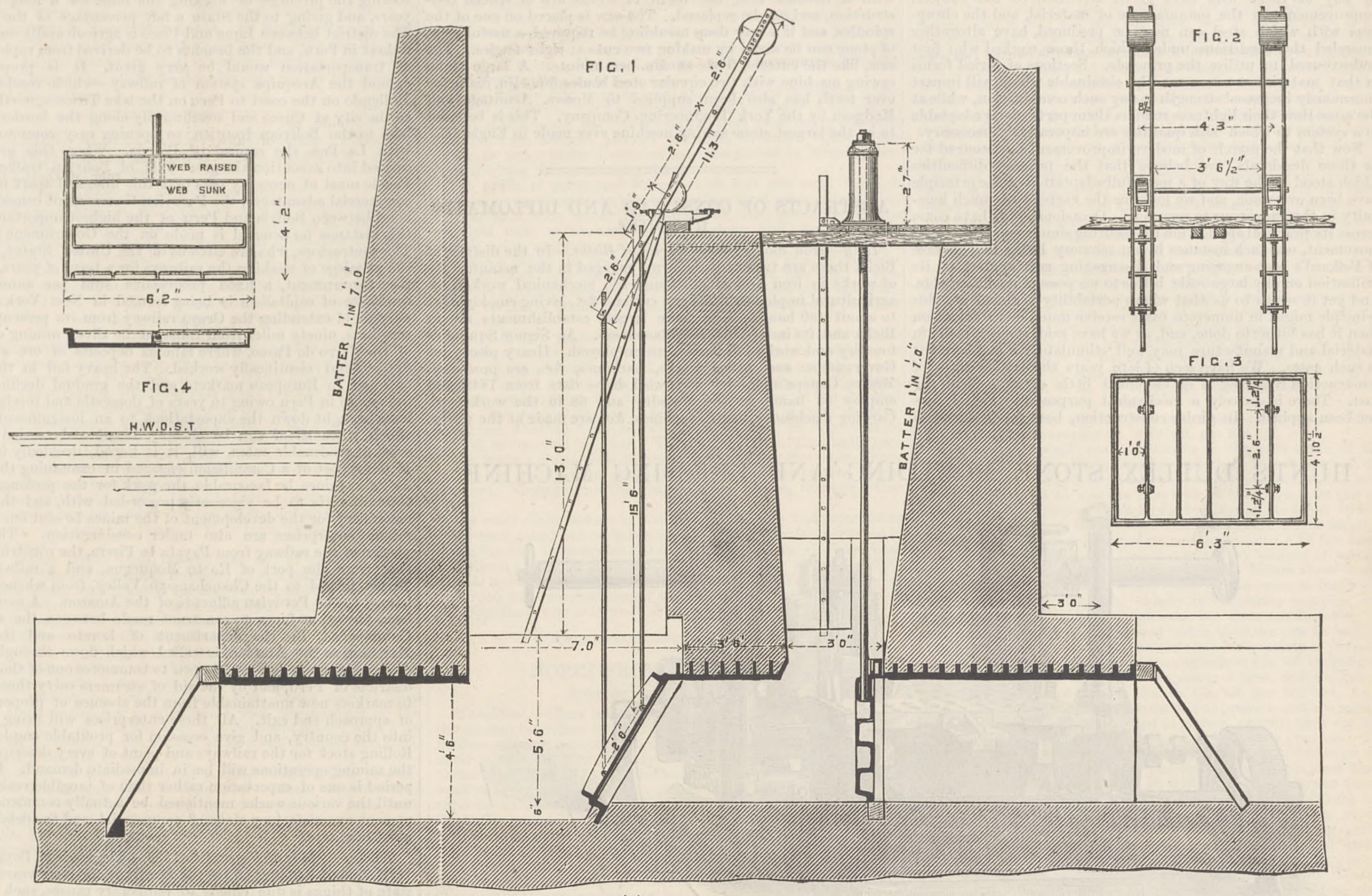
The Paris, Lyons, and Mediterranean Railway Company has recently erected on its boiler works at Oullins eight travelling cranes, as illustrated on page 334, capable of lifting 6,600 lb., and with a span of 8·8 m. The frame of the crane is formed with two girders of double T-iron, of 350 mm. × 150 mm. × 14 mm., resting at their ends on transverse girder-frames of the same form, but of 160 mm. × 120 mm. × 10 mm., and carrying between them the wheels on which the crane runs. The windlass or crab is fixed, and a small carriage runs on rails on the cross girders, and carries the load, by means of a chain with links 15 mm., or 0·6in. diameter, is made fast with a shackle at R, Fig. 1, page 334, and passing over the pulleys P, and under the hoisting-hook pulley Q, is wound on the drum O. An 11 mm. chain moves the carriage on the wheels I I through the medium of the chain-wheel E, the ends of the chain being attached at S S, and passing round the pulleys H and T. The lifting gear is worked by means of an endless chain on wheel J, the movement of the carriage by a similar chain on wheel E, and the movement of the crane by a similar chain on wheel A. The brake as shown at Figs. 1, 4, and 6 is spoken of by the *Genie Civile*, from which we take our engravings and facts, as of the Bourgougnon type. It consists of a cone and toothed clutch combined, which form an automatic clutch, in that it is automatically thrown out of gear by the large inclined teeth when lifting, see Fig. 4, and throws the cone into gear when a load is descending.

HARBOUR WORKS IN ALGOA BAY, CAPE COLONY.

(For description see page 333.)



STONEY'S SLUICES.—BALLYTEIGUE AND KILMORE RECLAMATION WORKS.



VERTICAL SECTION ON LINE A.A.

BALLYTEIGUE AND KILMORE RECLAMATION DRAINAGE WORKS, CO. WEXFORD, IRELAND.

THESE works, recently completed under the advice of Mr. W. N. Lewis as engineer, reclaim from the sea some 1700 acres of valuable slob lands, which receive the waters and alluvial deposit from a catchment area of about ten square miles. One of the leading features of these works is the cutting of a channel, mostly through rock, direct to the sea, avoiding a long and tortuous course to the natural outlet from the slob, which is here protected by a bank from the sea. By means of the shorter direct rock cutting, a better fall for drainage is secured, and the channel is of a permanent character, not likely to silt up.

Mr. Lewis wisely protected his outlet to deep water by a curved breakwater pier, and a tunnel has been left in a portion of the channel, so as to break up the waves from about half-tide and upwards. This, in conjunction with the breakwater, produces fairly calm water in the vicinity of the outlet sluices—a very necessary precaution, as this part of the coast is exposed to the full force of the storms from the south and east, and very rough seas roll in.

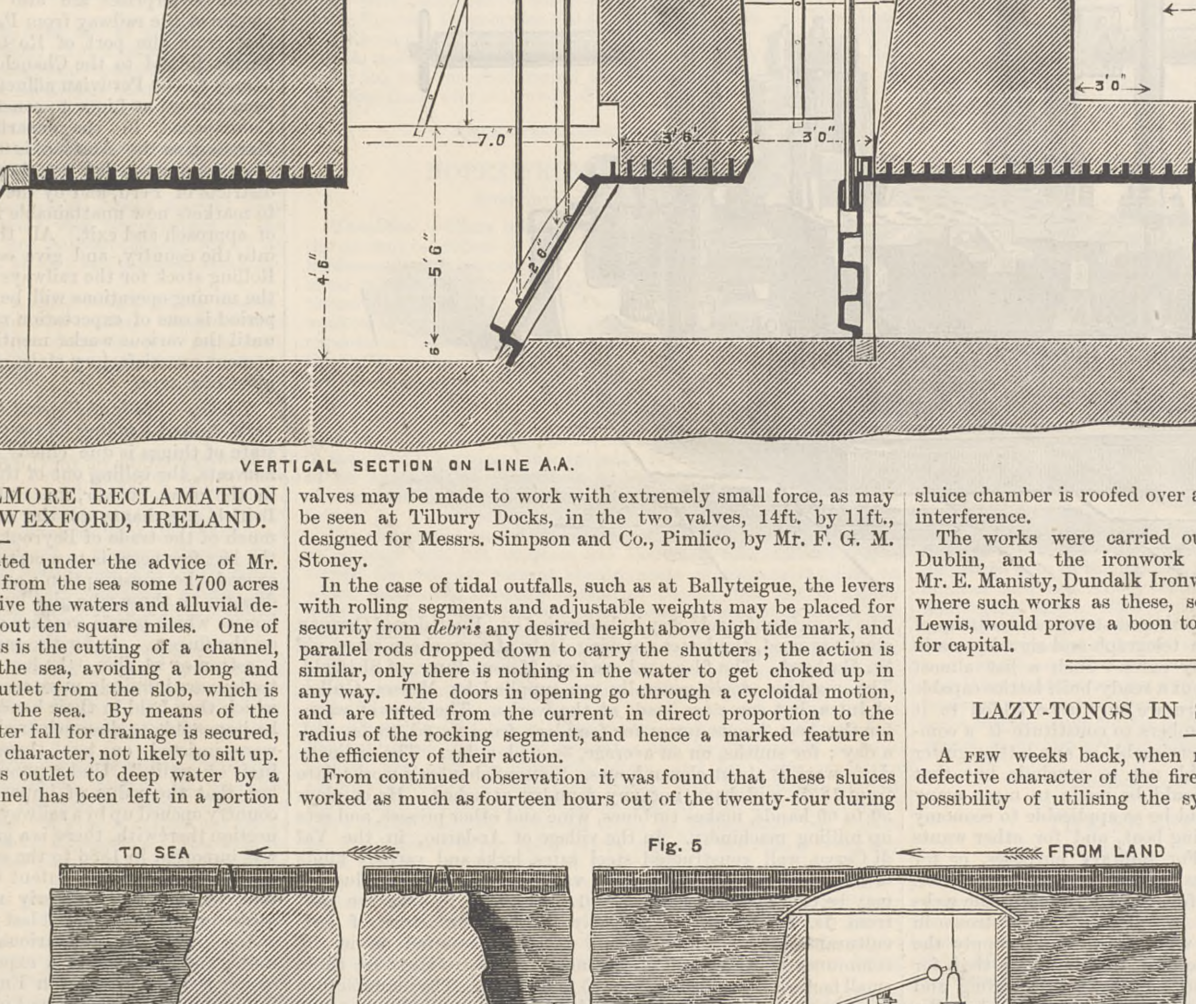
Another feature in these works is the peculiar arrangement of the outlet sluices, adopted by the Drainage Board on the advice of their engineer. These sluices, designed and patented by Mr. F. G. M. Stoney, M.I.C.E., Westminster, as automatic outfall sluices, are peculiar in their action, inasmuch as they are acted upon by very slight forces, and their range of action is different from that of ordinary flap valves, which take a considerable head of water to actuate them and which at best open only a few degrees, more or less. Uniformly marked and truly marked gauges are erected in the masonry chambers to landward and seaward of the automatic sluices, and from very careful observations it has been ascertained that these patent sluices commence to open when the tide is ¼in. to ⅜in. lower than the land water, and when the tide is a few inches below the land water the valves are full open. A few inches of the lower edge of the valves differing in the passing current is quite sufficient to maintain them open, and when the rising tide prevents this outward current, the valves just as promptly shut down. When it is understood that these valves are adjustably counterbalanced in all positions, and that they have not any fixed pivots subject to friction, the excellent results obtained will be easily understood. To describe their action simply, we will suppose a plain shutter carried on a pair of lever bars, having a counterbalance at one end and the shutter at the other. These bars, instead of being mounted on a fixed point or hinge, are carried on a segment of a circle, whose centre is situated in the centre of gravity of the moving mass. This segment rolls or rocks on a horizontal roller path, but is prevented from sliding by bights of chain suitably arranged which allow of rocking motion only. By this means very large flap valves may be made to work with extremely small force, as may be seen at Tilbury Docks, in the two valves, 14ft. by 11ft., designed for Messrs. Simpson and Co., Pimlico, by Mr. F. G. M. Stoney.

In the case of tidal outfalls, such as at Ballyteigue, the levers with rolling segments and adjustable weights may be placed for security from *debris* any desired height above high tide mark, and parallel rods dropped down to carry the shutters; the action is similar, only there is nothing in the water to get choked up in any way. The doors in opening go through a cycloidal motion, and are lifted from the current in direct proportion to the radius of the rocking segment, and hence a marked feature in the efficiency of their action.

From continued observation it was found that these sluices worked as much as fourteen hours out of the twenty-four during spring tides, and nine hours during neap tides; but the chief point of their efficiency is the extent to which they remain open while in action. As a proof of their success it may be mentioned that some reclaimed land was put into tillage a few months after the works were opened. The sluices were erected and started about the end of September, 1886, and the land was tilled in January.

Fig. 1 is a general section through the sluice chambers, showing the automatic flap valves shut and in a chamber landward of these ordinary penstocks, which, when occasion requires it, can be shut down to prevent the passage of water to or from the sea or land. Strong protecting iron gratings are provided to the chambers, both landward and seaward, and convenient platforms are constructed to enable the attendant to keep these gratings free from seaweed or land *débris*. Figs. 2 and 3 show front views of flap valves and levers. Fig. 4 shows the penstock doors made to stand pressure in two directions. There are three automatic valves and three penstocks. Fig. 5 is a smaller section of the sluice chamber, showing the automatic valve open as it works with the current outwards to the sea. Fig. 6 is a small sketch showing the masonry chamber in the rock cutting and a tunnel in a portion of the channel between it and the sea, the relative distances along the section being omitted. The sluice chamber is roofed over and the sluices are locked up from interference.

The works were carried out by Mr. J. Dixon contractor, Dublin, and the ironwork was supplied and erected by Mr. E. Manisty, Dundalk Ironworks. There are many situations where such works as these, so successfully carried out by Mr. Lewis, would prove a boon to the country and fair investment for capital.



SLUICE CHAMBER AND OUTLET TUNNEL, BALLYTEIGUE DRAINAGE WORKS.

LAZY-TONGS IN STRUCTURAL WORK.

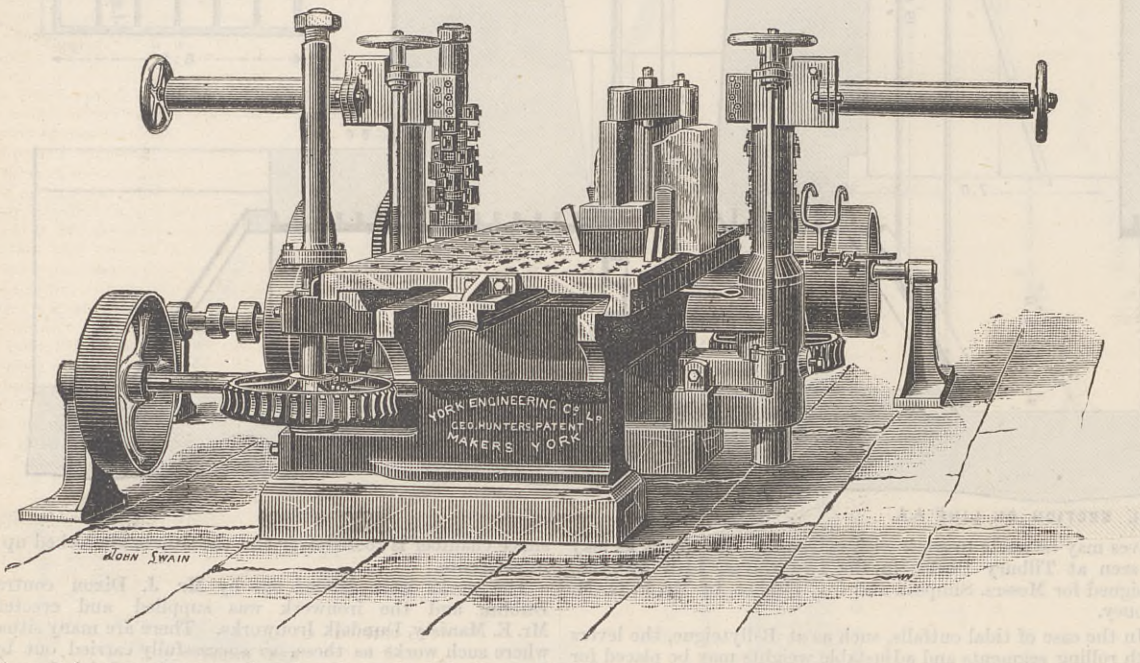
A FEW weeks back, when making some comments upon the defective character of the fire-escapes in use, we suggested the possibility of utilising the system of jointed lattices after the method popularly known as "lazy-tongs" for the improvement of our present means of rescue. Since then we have received from several correspondents communications which show that our suggestions could hardly be termed novel. Indeed we may say that the idea—though not scarcely as "old as the hills"—has at all events engaged the attention of inventors for a considerable number of years; while one gentleman writes us that he is at present perfecting such a combination of lattices as we suggested with the express object of its utilisation for the chief purpose to which we directed attention. Another correspondent has been obliging enough to take the trouble to send us a tracing made from an engraving which appeared in the *Illustrated London News* of October 11th, 1856, which represents an observer elevated "by a series of tiers of expanding laths, each 6ft. in length, worked by a wheel acting on a spindle . . . to a height of 50ft. or even 100ft." This machine appears to have been patented by Messrs. Stocqueler and Saunders as a "patent elevator and observator." Their attention appears to have been given to this device to meet the demand for some means of observing more closely than was possible by any other method the interior of Sebastopol and its fortifications during the siege of that place. The idea received the approval of the War Department, but it was not worked out in a practical manner until after Sebastopol fell, and the invention, it would seem, was not in any way availed of by our authorities, nor can we learn that it was ever applied to any of the many purposes to which it was undoubtedly applicable. Among the list of these claimed by the patent subsequently taken out by Messrs. Stocqueler and Saunders we do not find any mention made of fire-escapes. It is mainly for this latter purpose that our second correspondent informs us he is designing an elevator of somewhat similar character to that above referred to; and it seems that, should his machine when constructed realise all that he anticipates it will do, an exceedingly useful adjunct to our present means of life rescue at fires will be obtained. But the consideration we have given to the several communications we have received upon this subject has led us to conclude that this system of lazy-tongs is capable of far greater development and of more extended use than has hitherto been claimed for it by any of those who have given attention to the subject. Improvements in the manufacture of material, and the cheapness with which steel can now be produced, have altogether amended the conditions under which those worked who first endeavoured to utilise the principle. Sections of varied forms in that material are now readily obtainable which will impart enormously increased strength to any such combination, while at the same time their lightness renders them particularly adaptable to a system to which both qualities are imperatively necessary.

Now that the march of modern improvement has secured for us those desiderata, we believe that the primary difficulties which stood in the way of a more full adaptation of the principle have been overcome, and we look for the exercise of much ingenuity in the endeavour to secure it. Occasionally we have come across its practical application for securing simultaneous reversed movement, one such instance in our memory being in the case of Folkard's boat-engaging and disengaging gearing, but of its utilisation on any large scale hitherto we possess no knowledge. And yet it seems to us that where portability is aimed at, this principle might in numerous cases receive much more attention than it has hitherto done, and, as we have said, improvement in material and manufacture may well stimulate its employment in such cases. We have seen of late years the lattice form of construction receiving a development little dreamt of in the past. There is scarcely a mechanical purpose to which it has not been applied. In girder construction, both for bridges and buildings, it is everywhere employed, and standards built up of it have superseded the old wooden telegraph and signal posts in every direction. We could easily extend such a list almost *ad infinitum*. The lazy-tongs is but a ready-built lattice capable of extension or contraction; there are only to be added to it the compression and tensional members to constitute it a complete structure, as strong and as serviceable as any lattice girder rigidly rivetted up. It is impossible not to conclude but that we possess a facile means which could be made to meet many known wants. These means would be as applicable to economy in stowage as is the Berthon folding boat, and for other wants could be as usefully employed. For military purposes, or for others akin to them, it strikes us as presenting many capabilities. Thus, for instance, lattice girders for a bridge, of which the webs at least would be complete, could be extended over a stream in two or three minutes. A rove wire cable would supply the tension member, and some device for readily fitting that for compression would transform the lazy-tongs into strong and reliable girders fitted for the passage of heavy weights. We sketch out such an idea in extension of the suggestions we before offered, because, as we have above written, we think that the quality of the material now at command warrants the belief that the inventive faculty might well be applied to the utilisation of this well-known but little employed principle. Were we to go further into the matter, we are confident that it would be possible to add to the suggestions we have made to a very large extent; but we may well leave further applications to the ingenuity of those who may be disposed to take the matter up with thoroughness. We should be glad to have the opportunity of seeing and describing the fire-escape on this principle which one of our correspondents informs us he is now constructing. It will constitute an effort in a direction which we should desire to see followed up.

DUPLEX STONE DRESSING MACHINE.

THE accompanying illustration shows a duplex stone moulding and dressing machine lately constructed by the York Engineering Company for Messrs. Armitage and Hodgson, contractors for the New Town Hall, Portsmouth. Machines of this class—Hunter's patent—have been used on many large works, and are well known to engineers, builders, and contractors. The one illustrated embodies the latest improvements. The stones to be dressed or moulded are clamped down to a table, travelling at a speed varying according to the hardness of the stone. On each side of this table revolves a vertical steel spindle carrying tool holders. Flat steel tools are used for dressing, and trumpet-headed ones for moulding. The tool holders vary in length to enable the exact profile to be obtained. In the machine under notice the ends of the tools are made telescopic, which allows a very fine adjustment. The stones passing before the revolving roughing barrels are reduced approximately to the required moulding. Steel scraping plates, with the exact profile required, are then inserted into the vertical rocking shafts. These plates are moved horizontally or vertically, while the table moves to and fro at an accelerated speed in front of them; the plates thus meet the stone, and the desired profile is obtained. If the stones are not very large, one set can be worked by each side of the machine at the same time; the tools being arranged so that one scrapes on the forward movement and one on the return; the workman passing round to give the feed or regulate the tools. The machine described is set to feed at the rate of 5in. per minute, on Portland stone. This machine is also provided with a circular saw, the teeth of which are of special construction, and can be replaced. The saw is placed on one of the spindles, and if a very deep moulding be required, a useful piece of stone can be saved by making two cuts at right angles. The saw, like the cutters, feeds at 5in. per minute. A large stone sawing machine with two circular steel blades 8ft. 3½in. diameter over teeth has also been supplied to Messrs. Armitage and Hodgson by the York Engineering Company. This is believed to be the largest stone sawing machine ever made in England.

HUNT'S DUPLEX STONE MOULDING AND DRESSING MACHINE.



ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Italy—Iron and steel industries of Biella.—In the district of Biella there are twenty-three firms engaged in the manufacture of works in iron and steel—foundries, mechanical workshops, agricultural implement makers, cutlers, &c., giving employment to about 480 hands. The three largest establishments are in Biella and its immediate neighbourhood. At Signor Squindo's foundry and works 120 hands are employed. Heavy pieces for Government and other works, harbours, &c., are produced. Messrs. Canepa's foundry and workshops date from 1842, and employ 38 hands in the foundry and 68 in the workshops. Carding machinery, looms, turbines, &c., are made at the works. The repairing of machinery is also carried on. English and German steel are used, the latter entering Italy at very cheap rates, *viâ* St. Gothard. The files used are from Messrs. Bury, of Sheffield. The machine tools generally are supplied by Messrs. Guller, of Intra, but some are made at the works. The rates of wages for the best hands range for founders from 2s. 6d. to 3s. 2½d. a day; for smiths, on an average, 3s. 2½d. a day. The ordinary day's work is about eleven hours. Signor Scheuber's works date from 1857, and have not any foundry attached. He employs 50 to 60 hands, makes turbines, wine and other presses, and sets up milling machinery. In the village of Andarno, in the Val di Cervo, well constructed steel safes, locks and various kinds of iron work are produced. The value of the annual production may be calculated at from £2000 to £2400. Smiths are paid from 1s. 8d. to 2s. 5d. per day. The manufacture of agricultural and other implements is chiefly carried on in the communes of Netro and Mongrando. At Netro there are three small factories, employing from 35 to 40 hands. The manufacture consists of scythes and other implements for agriculture, as well as for different uses. The value of the annual production amounts to between £3000 and £3200. Steel and fine steeled iron are used in the manufacture of the goods, which are sold in Italy and exported to South America. There is another factory at Netro originally founded in 1816 as a bayonet and sabre factory. The average number of hands employed is about 50, and the value of the annual production about £6000. The articles now manufactured are implements used in agriculture, arts, and industries, including tools for arsenals, mechanical workshops, and railways. Cast steel and steeled iron are used. There is some export to Greece, South America, and Switzerland, but the principal market is in Italy. The average wages for good workmen in these factories is from 1s. 7½d. to 1s. 8d. per day. For articles of cutlery the small but well-known factory of Messrs. Sella at Masserano, founded in 1837, may be first mentioned. The articles produced are sold entirely in Italy, where they find a favourable market. The difficulties which Italian manufacturers have to meet, and which tend to minimise their profits, are—internal competition, the continuous and rapid transformation of the old methods of manufacture, the general state of depression which has of late years affected agriculture, commerce, and industry, the absolute limit of division of labour, the disparity and variety of the articles produced in each separate factory, dearness of fuel where the available water power is insufficient, or cessation of credit and onerous taxation. To meet some of these difficulties heavy protective duties have been established in favour of Italian industries—a proceeding very popular among manufacturers, but the permanent advantages of which may be open to doubt.

Peru—Progress in.—Up to the present time the more important of the propositions laid before Congress relating to commercial and provincial matters have not been disposed of. Plans of the highest importance are proposed. The port of Callao is promised a relief from the tax of 4s. a ton charged by the foreign company having the monopoly of discharging and loading vessels. According to the laws of Peru no exclusive privilege can be granted for a longer period than ten years. When the original concession of the company expired in 1884 the Government granted an extension of the same for fifty years longer, in return for a heavy money advance, and on this ground of illegality the concession will doubtless be set aside. European capital is offered to build a railway from Lima to the port of Pisco, 100 miles south of Callao, and from thence to construct a narrow gauge line to the city of Ayacucho and the quicksilver mine of Santa Barba, near Huancavelicu. No pecuniary aid is asked from the Government, the company seeking the privilege of working the mine for a long term of years, and giving to the State a fair percentage of the profits. The district between Lima and Pisco is agriculturally one of the richest in Peru, and the benefits to be derived from rapid means of transportation would be very great. It is proposed to extend the Arequipa system of railway—which reaches from Mollendo on the coast to Peru on the lake Titicaca, northwardly to the city of Cuzco and southwardly along the border of the lake to the Bolivian frontier, so opening easy communication with La Paz, the capital of Bolivia. When this project is carried into execution the great bulk of Bolivian traffic to the Pacific must of necessity pass over this line, and apart from the commercial advantages, the Peruvian Government considers this bond between Bolivia and Peru of the highest importance. In this instance no demand is made on the Government for aid. The contractors, who are citizens of the United States, require the privilege of working the railways for a term of years, paying the Government a fixed progressive sum per annum. A syndicate of capitalists is being formed in New York for the purpose of extending the Oroya railway from its present inland terminus, ninety miles from Lima, to the silver mining districts of the Cerro de Pasco, where famous deposits of ore are to be drained and scientifically worked. The heavy fall in the price of sugar in European markets, and the gradual decline of all industries in Peru owing to years of domestic and foreign wars, have brought down the exportations to an insignificant figure, which, when silver can be cheaply mined and carried to the coast at reasonable rates, will, it is hoped, decidedly increase. If the report of a Commission engaged in examining the Cerro de Pasco mines be favourable, the work for the prolongation of the railway is to be vigorously proceeded with, and the heavy machinery for the development of the mines be sent on. Other minor enterprises are also under consideration. The completion of the railway from Payata to Pirera, the construction of that from the port of Ilo to Moquegua, and a railway from Tarma inland to the Chanchamayo Valley, from whence access is easy to the Peruvian affluents of the Amazon. A society has been formed at Lima to construct roads between the town of Cuhuapanas, in the department of Loreto and the river Marañon, as the Amazon is called which flows through Peru. Such communication would open to commerce one of the richest districts of Peru, and by the aid of steamers carry these riches to markets now unattainable from the absence of proper means of approach and exit. All these enterprises will bring money into the country, and give occasion for profitable employment. Rolling stock for the railways and plant of every description for the mining operations will be in immediate demand. But the period is one of expectation rather than of tangible reality, and until the various works mentioned be actually commenced the present unsatisfactory state of commercial and financial affairs must continue.

Turkey—Trade of Beyrout in 1886.—The trade of Beyrout for 1886 showed a falling off for the first time for some years. This state of things is due chiefly to temporary causes, such as bad harvests, the calling out of the reserves, the general uneasiness in the news of war, &c. "I would here call the attention of British merchants to the excessively precarious condition of much of the trade of Beyrout. The increase in imports during the last few years is to a certain extent artificial, as the imports exceed the consumption; and a check of any kind will bring disaster on those who give long credit. There are some strong houses which would weather any storm, but they can be counted on the fingers. As for the rest, especially those dealing in stuffs—cotton or woollen—the less credit granted the better. German traders are infinitely more accommodating than British, owing to which they hold in their hands so much of the trade. It would be impossible to do much trade with Beyrout if cash payments were insisted on, but three months should be the outside limit of credit." Under present conditions it seems impossible but that the value of imports must diminish; but were the country opened up by a railway, and a port made at Beyrout in connection therewith, there is a great future before it. Cardiff coal was imported in 1886 to the same amount as in 1885. The consumption of coal and patent fuel—briquettes—averages 10,000 tons per annum. Formerly not more than 10 per cent of this quantity was English, but last year the quantity rose to 3000 tons, owing to the efforts of various firms to obtain a footing at Beyrout; and this year it is expected that more than half of the supply will be direct from England, and that next year French briquettes will be driven out of the market. The English article is better than the French, and can be delivered cheaper, in spite of the heavy difference in cost of transport. Merchants will not buy briquettes on speculation, but act only as commission agents. The demand for briquettes is not likely to increase, but in view of the formation of a gas company the import of coal will probably be quadrupled. British iron reaches the same figure as in 1885. In the hardware class nearly all articles come from Austria, France, and Germany. The trade in carpenters' tools is not very large, there being but few used in the interior of the country, and with the exception of frame-saws, which are fitted with French blades, and English—farriers' and smiths'—files, all tools are of Austrian and German manufacture, and very inferior. Other carpenters' hardware is German, and of the worst description. Cutlery is almost all German, and is mostly marked Paris or bears forged English marks. Horseshoes and nails are hand-made out of the best Swedish iron on the universal Eastern model, four costing 2s. 1d. They could be stamped out by machinery at a much lower price, and there is no reason why an attempt should not be made to supply the market with machine-made shoes. There is a considerable trade in lead pipe, which is likely to increase on account of the construction of the gas works—which are being commenced by a Paris company—but at present it is entirely imported from France. There are several agents of French pipe makers in Beyrout and not one English. The Waterworks Company obtained some English pipe of first-class quality, the price of which, inclusive of all expenses, was slightly less than that of the French. Locks come from Austria, they are expensive and of the worst quality, the commonest door lock costing 2s. 1d., and are sold on commission by German agents. English locks are not bought because English manufacturers will not cater for their customers. A lock which will double lock is indispensable in this country owing to the shrinkage of timber, and English made locks do not comply with this requirement. Picks are native-made, as English picks are too heavy and large. Best London made picks cost in Beyrout 3s. 0d., while a native pick of the same weight, though infinitely inferior, costs 2s. 6d. Shovels are common iron shovels, of French make, costing without handles 1s. 6d. each. The municipality has lately requested the Waterworks Company to supply it with English shovels, as they come cheaper in the end, though the prime cost is half as much again. The only agricultural implement is the universal heartshaped hoe set at less than a right angle to its short handle. It is native made, takes the place of fork, shovel, spade, &c., weighs about 3 lb., and costs 1s. 6d. Though the Beyrout market is not large, it would repay some attention on the part of Birmingham firms. Many French and German commercial travellers visit Beyrout, while an English one is hardly ever seen. For this there is a very good reason. The most important item of British imports is Manchester goods. In Manchester are many natives of Syria, who keep very close touch with the Beyrout market. In the hardware line, where we have been ousted by foreigners, something might be done by catering for the requirements of the natives.

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

(*From our own Correspondent.*)

THE iron exchanges in Wolverhampton and Birmingham this week met with the knowledge that there was to be no advance in ironworkers' wages. Thus any indecision in the matter of selling prices which might previously have interfered with the conduct of business was removed. Sir Thomas Martineau has awarded that the rate of wages fixed on January 1st, 1886, shall be continued without alteration. Puddlers' wages therefore remain at 6s. 9d. per ton. The award is to be subject to a month's notice on either side.

The surroundings of the position succinctly appear in the award, where it appears that the operatives claimed that puddlers' wages should be increased 5 per cent., alleging that it appeared from the Board of Trade returns and otherwise that a marked improvement in the iron trade had taken place during the past few months.

On the other hand, it was strongly urged by the representatives of the employers, amongst other things, that the improvement appearing on such returns applied mainly, if not entirely, to steel, and that no such improvement as had been alleged existed in the South Staffordshire iron trade.

To these considerations may be added the fact that the actual selling price of iron, as shown by the employers' books, is on the average 8s. 3d. per ton lower at date than at the time of the previous award.

Local orders rather than export ones are at present mainly keeping the finished ironworks running. Yet it cannot be reported that there is any vigour about buying, and specifications are this week somewhat difficult to get in, as always occurs towards the end of the month. Consumers desire to limit deliveries, but keep the month's accounts within easy limits.

Sheets, bars, and hoops and strips are the classes of iron chiefly selling, and the qualities run mainly upon the medium and common priced irons. Some buyers are placing fair orders for delivery over this quarter, but merchant orders on export account keep slow. An improvement is anticipated with the advance of the quarter. Prices of marked bars are without change at £7 to £7 12s. 6d.; medium sorts, £5 10s. to £6; and common about £5. Strips and hoops are £5 to £5 5s.

Prices of sheets mostly keep at a little within £6 for singles; £6 5s. for doubles; and £7 to £7 5s. for trebles. Steel sheets at £12 to £13 are in fair request by stampers and japanners. Inquiries for galvanised sheets are fairly numerous on account of Australia, New Zealand, South America, and India, but prices are unsatisfactory, and many bids have to be declined; £9 10s. to £10 per ton is now a common price for 24 gauge f.o.b., Liverpool; £10 7s. 6d. easy is quoted by some makers, delivered, London.

The "Woodford" brand of black sheets is quoted at date £7 for singles, £8 10s. for doubles, £10 for 26 b.g., and £10 10s. for 28 b.g. "Woodford crown" close annealed sheets are, £9 10s. for singles, £11 for doubles, £12 10s. for 26 gauge, and £13 for 28 gauge. For best qualities £1 10s. per ton additional is asked, and for double best £3 per ton additional. Siemens-Martin steel sheets are, £13 for singles, £14 10s. for doubles, £16 for 26 gauge, and £16 10s. for 28 gauge. "Woodford charcoal" sheets, £16 for 20 gauge, £17 10s. for 24 gauge, and £19 to £19 10s. respectively for the thinner gauges.

Thin sheets keep up fairly well. Messrs. Hatton, Sons, and Co., Bradley Iron and Tin-plate Works, Bilston, are just now meeting with a demand for such iron and for tin-plates. In sheets, steel is steadily encroaching upon iron for stamping and working-up purposes. American, colonial, and Continental orders are assisting to keep the works engaged.

The plant possessed at these works is very complete. Including the boiler plate mill, there are some six mills in all, and the annealing furnaces will anneal over 100 tons per week. They are heated by Wilson gas producers, and the sheets turned out are as soft almost as lead, and have a splendid appearance. The firm do not go in for the large sizes of boiler-plates, but rather cultivate high quality.

Thin iron sheets for working up purposes of single gauge are priced by Messrs. Hatton at £10 to £12 per ton; charcoal black sheets, £15 to £18 per ton; steel boiler plate are about £7 to £8 per ton; soft steel sheets, heavy singles, £9 to £10 for deep stamping purposes and tinning; and doubles 20s. to 30s. extra with a yet further 20s. to 30s. per ton for lattens. Steel blooms and billets the firm quote about £5 15s. to £6.

Pig iron buyers have been somewhat awkwardly caught in the matter of recent purchases entered into for delivery over the greater part of this year at the advanced rates recently ruling. These contracts are now being delivered, and consumers are found in the position of having to sell manufactured iron at almost the old unsatisfactory prices. The new business doing in pigs is very small just now, and prices are still falling. Northamptons are now quoted 37s. per ton delivered, but may be had in some cases at 36s. 6d. Derbyshires are an average of 38s. easy, and best sorts are 39s. Lincolnshires have got down to 40s. per ton. Native pigs remain at 52s. 6d. as the quotation for hot blast all mines, 40s. for part mines, and 30s. for common.

The coal trade is tame, and prices are very low. Steam coal, for forge purposes, is obtainable at 4s. 6d. at the pits. Ordinary forge is 5s. to 6s. Even the best thick coal of South Staffordshire is now getting very small prices. Earl Dudley's forge and furnace coal, for example, is now realising only 7s. to 7s. 6d. per ton, and his lordship's best slack is 5s. at the pits.

The consignment of mining machinery which, as already noticed in THE ENGINEER, Messrs. F. Silvester and Co., of Newcastle-under-Lyme, have recently shipped to Australia, consisting, it may be mentioned, mainly of a pair of high-class 50-horse power horizontal winding engines, with link reversing motion, and drum on first motion shaft, fitted complete. The engines were built to order, and were a repeat contract, a similar consignment last year having given much satisfaction.

The orders from India for both iron and manufactured goods and machinery are still unfavourably affected by the value of silver. Canada is steadily recovering from the recent failures, and is sending over some good spring orders, which are welcomed in numerous branches. A few Australian orders are a little more valuable; but as a whole, the Australian trade keeps but tame, and the reports of fierce competition are supported by the character of the indents. South America continues to bulk largely, and an encouraging demand for sawing machinery is amongst the most favourable features of the market. Certain native buyers are over from New Guinea, but the paper of the country is not easily negotiable, and business is thereby impeded. Natal is growing in favour, and in machinery and general metal goods more is being done with the colony than for a long time past. For this gold discoveries are largely responsible. The stirrings of early life are traceable in the trade with Burmah; and men whose experience is the widest express complete confidence in an early indication of vigour in the railway and machinery requirements of the East generally.

An important step has been taken in the wrought iron tube trade. For some time past prices in this industry have been going from bad to worse in consequence of the severe internal competition. Rates have got down to an almost profitless level, but an improved conditions of things is now apparent. Success has crowned the efforts which have recently been made to re-organise the association for regulating discounts on gas, water, and other tubes.

Most of the leading firms, not only in the Birmingham and South Staffordshire district, but in other parts of the kingdom, including Scotland, have been induced to consent to sell on one common standard. The best results are for the present following the re-organisation.

In one case a few days ago, in which a large merchant house solicited quotations for a contract of some hundreds of thousands of feet of iron tubes, the tenders sent in from some thirty different firms all, I am assured, showed the same advanced figure. The particular order under discussion has been placed in Birmingham, a tender from this town being the favourite.

The prices of galvanised tubes, which had also sunk through reckless competition to an unremunerative level, are now beginning to recover a little under the agreement lately made among the principal tube galvanisers of Birmingham and district. The revised prices represent a rise on tubes over 1¼in. of about 7s. per ton, which brings the price to £3, but on tubes of smaller diameter for gaswork the new list is lower by about 2s. 6d. per ton. These advances are much objected to by some of the iron tube manufacturers, certain of whom threaten to put down galvanising plants of their own.

The hardware trades are not very brisk at date, and makers complain of the leanness of prices. Orders are fairly divided over home and export markets, and in some branches, notably in galvanised hollow wares and other stamped goods, the European markets are buying well. The goods are, however, of the cheapest class. The colonial demand keeps much within makers' expectations, and whether from Melbourne or Sydney, no improvement can yet be reported in prices. The demand from East India runs mainly upon a cheap class of work, and many orders offered have still to be declined on account of the unremunerative prices attached. Orders from the Transvaal are coming forward rather better.

The small chain makers at Cradley Heath, who had returned to work, were called out on Saturday, the masters having persisted in their objection to recognise the 4s. list. With those who have been on strike for thirty-seven weeks, the number now at play is 2000. A mass meeting of the operatives was held on Wednesday, after which the men marched round the district with the intention of inducing those who continued at work to put down their tools.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is still no improvement to report, either in the present condition or in the outlook of trade in this district. Business all through continues dull and depressed, and there is little or no movement either one way or the other, except that the continued stagnation of the market naturally tends towards a further weakening of prices. Buyers either hold back altogether in the expectation that by waiting they will be enabled to do better, or they offer prices which makers as a rule do not care to entertain; and where there is any business to be done, merchants and speculators come in at excessively low cut prices. There is evidently a determined effort to "bear" the market down to the low prices that were ruling last year; so far the course of the market has been in favour of the underselling speculators, and there does not seem to be anything at present in prospect likely to bring about a strong healthy tone to trade which would give confidence in the future.

The attendance on the Manchester iron market on Tuesday was an average one, but business was extremely slow. There are, of course, the ordinary current requirements of consumers going on which necessitate a certain amount of buying, but this is mostly from hand to mouth, and where anything of weight is doing it is only at excessively low prices. Pig iron still meets with very little inquiry, some of the makers who do not care to compete at the low prices at which iron is being offered through second hands still hold on to about late rates, but they are quite out of the market and underselling goes on amongst merchants and speculators at prices considerably below those which makers are asking. For Lancashire pig iron quoted list rates are simply nominal, as local makers are open to entertain offers, and for large quantities extremely low prices have been taken. For Lincolnshire brands the average quoted prices are about 37s. to 38s., less 2½, for forge and foundry qualities delivered equal to Manchester, but buyers are not disposed to pay those prices, and they are able to cover any small pressing requirements at lower figures. In outside brands, such as Scotch and Middlesbrough, the tone is, if anything, easier; Scotch makers do not give way to any material extent, but their iron is offered freely in the market at considerably under the quoted rates, and good named brands of Middlesbrough foundry iron can be bought at about 6d. per ton under the figures which were being quoted a week or so back.

For hematites there is still but a very poor inquiry, and there is some excessively low cutting in prices; for No. 3 foundry delivered into the Manchester district, makers ask about 55s. 6d. to 56s. 6d., less 2½, but they are 2s. to 3s. above the prices that buyers offer, and above what merchants in some cases are willing to take.

There is still no improvement to report in manufactured iron, but if anything the tendency is rather in the opposite direction. One or two makers are busy, and very firm in their prices; but this is no indication of the general state of trade, which, taking it all through is very dull, with an absence of new orders of any weight coming forward. The average basis of quoted prices remains at about £5 per ton for good qualities of bars delivered into the Manchester district; but when prompt orders are to be got, there is an increasing disposition to come below this figure rather than allow them to pass, and in some instances 1s. 3d. to 2s. 6d. per ton less money is taken. Hoops average £5 5s. to £5 7s. 6d., and sheets, £6 5s. to £6 10s. per ton delivered into the Manchester district.

The condition of the engineering trades remains unsatisfactory; whilst it is true that works here and there are getting busier. Others report trade falling off, and depression as still the predominant characteristic of nearly all branches of industry.

At the meeting of the Manchester Association of Engineers, held on Saturday, a paper on "Indicator Diagrams," read at a previous meeting by Mr. James Hartley, and a summary of which was given in my "Notes," came up for discussion, in the course of which Mr. W. H. Booth pointed out how, with reference to gas-engine diagrams, errors sometimes arose by their being calculated as if they were steam engine diagrams, instead of counting the number of explosions per minute, and finding the power in that way. Mr. Mannock urged that if compound engines were not properly constructed and worked they had the fault of losing three times as much as a simple engine, and it was not unfrequent to find a compound engine making good diagrams but burning an unconscionable amount of coal. Too small a cylinder for the high pressure was frequently the cause of considerable loss, and the ratio of four to one, which was adopted by many makers, was not always the best. The indicator, he added, might be applied for a variety of purposes; and in fact, if properly used, might be made to tell them everything that was possible about an engine. Mr. Matthews remarked that it was an open question with many engineers as to the correct size they should make the engines for the power required. There had recently been a good deal of discussion with reference to triple and quadruple expansion engines. These, he had no doubt, were the engines of the future, but the question which did not at present appear to be satisfactorily settled was the exact point of pressure at which triple and quadruple expansion could be the most effectively introduced. In replying upon the discussion, Mr. Hartley urged that one of the greatest sources of loss in engines was initial condensation, and he knew firms who had 80 lb. pressure in the boiler and only got 27 lb. to 30 lb. pressure in the cylinder. If such people were to compound their engines and put on automatic expansion gear, they would effect a very great saving. Now that high pressure was so largely used, it was very essential that more attention should be paid to steam jacketting, as this was the point where economy must come in the future; and it was not only the sides, but it was equally, if not more important, that the ends of the cylinders should be jacketted also, and he would jacket both high and low-pressure cylinders.

A numerously attended meeting of delegates representing most of the trades' union societies in this district was held on Tuesday in Manchester, and it was resolved to form a Labour Electoral Association on the lines laid down at the Trades' Union Conference at Hull, with the object of raising a fund to enable industrial candidates to contest elections when vacancies occur, and to support them when returned to Parliament. An executive committee was formed of nine trades' union representatives, including two representatives of the Amalgamated Society of Engineers, one of the Metal Planers' Society, and one of the Steam Hammer-men's Society.

In the coal trade there is a fairly steady business still being done in all descriptions of fuel, and most of the pits are kept on about full time, but with the advance of the season there is the usual weakening in prices, and with the close of the month it is probable there will be a more or less general reduction of 3d. to 6d. per ton on present list rates, which in some instances may be accompanied by a reduction in wages. In the West Lancashire district the question of a reduction in wages has already been under consideration, but nothing definite has yet been decided upon. At the pit mouth prices average 8s. 6d. to 9s. for best coals; 7s. to 7s. 6d. for seconds, 5s. 6d. to 6s. common house coals, 5s. to 5s. 6d. steam and forge coal, 4s. 6d. to 4s. 9d. burgy, 3s. 6d. to 4s. best slack, and 2s. 6d. to 3s. for common sorts.

Shipping is rather quieter, with steam coal delivered at Liverpool or Garston averaging 7s. to 7s. 3d. per ton.

Barrow.—The weak tone noticeable in the iron trade of this hematite district is still noticeable, and there is not so much disposition on the part of large consumers to place orders for large forward deliveries as was the case a short time ago. On the one hand, large producers are independent of immediate sales; and on the other hand, large buyers have already secured deliveries of as much iron as they require for some months to come. In the meantime, the trade is more or less conducted by holders of second-hand stocks, who are disposed to clear them before there is any further reduction in prices, which some people seem to think probable. The trade doing is chiefly in Bessemer samples, and hematite qualities are in more general use than was formerly the case, as, owing to the low prices at which they can now be bought, they are more generally used than formerly for a variety of purposes where cheaper and inferior iron was employed; 42s. 6d. is the figure at which speculators have been disposing of iron, and makers, on the other hand, are asking 45s. to 47s. 6d. per ton net, f.o.b. Makers are not operating in the market at present, and are waiting until they are more nearly cleared of orders, or until they are in a position to secure fuller prices for the iron they produce. The stocks of iron on hand are comparatively large, but deliveries are larger than they have been, and throughout the season some heavy consignments of metal have to be shipped to America, the Continent, and the colonies, as well as to home consumers. There is a steady tone in the steel trade, although prices remain at the lower prices quoted last week, heavy sections of rails being quoted at £4 1s. 3d. per ton net at works, or f.o.b. local ports, and soft billets at £4 per ton. Blooms, billets, and bars are in good demand, but merchant steel is quiet in all brands. There is more inquiry for ship plates, angles, and other shipbuilding steel material, and shipbuilders are in a more hopeful position, having booked a few orders, while others are offering on the part of both home and foreign owners. Engineers, ironfounders, and boiler-makers are fairly but not briskly employed, but they are more hopeful of orders for the remainder of the year. There is no new feature to note in the finished iron trade, as orders are still few in number and are slowly offering, while prices remain at unremunerative rates. The trade in iron ore is steadily maintained, and the consumption at the furnaces is quite up to recent statistics. Prices are steady and firm at from 9s. to 10s. 6d. per ton net f.o.b. at mines. The coal and coke trades are steadily employed, and there is an improving demand for all classes of fuel. Prices, however, are undisturbed. The shipping trade is busy, and as large cargoes have to be despatched to foreign ports during the season, it is expected this trade will continue brisk.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

MESSRS. WM. JESSOP AND SONS, Brightside, have recently been pretty busy in a class of work which forms a speciality of their business—spur rims, wheels, and pinions cast in steel. Among late orders completed have been wheels of large dimensions for Messrs. Schneider, of Creusot, France, to be used in the new mills the firm have erected for the production of steel plates. Several thousands of Jessop's steel wheels and pinions are now at work in the Lancashire cotton mills. On Monday I saw a large steel casting of theirs—a spur rim casting—at the Manchester Exhibition; it weighed 14 tons, and was 18ft. in diameter. Too large to go by rail, the firm had to send it by road on a strong trolley pulled by a traction engine. Four miles past Stockbridge—a village near Sheffield—the engine broke down and delayed the journey a day. It then went straight away, and reached Manchester in safety. The journey was over the great Penistone range of moorland—one of the wildest districts of the north. The landlord of one of the inns in that bleak region gave the men in charge of the casting a somewhat rough experience. They intended to stay overnight at his place, but he would have nothing to do with people who dealt in such monstrous things, and turned them out of the house at ten o'clock at night. They had to sleep in a hay loft, minus the hay, and all caught cold. After the casting has been shown in the Exhibition, it will be used in a large rolling mill in Lancashire.

The Thorncliffe Iron Company—Messrs. Newton, Chambers, and Co.—have a reputation for cooking apparatus of all kinds. They have just manufactured an exceptional article in this line to the order of a London firm. It is intended for a railway dining car, which the metropolitan house are building for a royal family in Europe. The apparatus is made of cast and wrought iron, is 5ft. 6in. in length, 2ft. 8in. wide, and stands 2ft. 9in. high, and consists of cooking ovens, boilers, hot closets, and all the requisites of a first-class cooking stove. In the centre is the fire, covered over with a movable cast iron plate, which, in its turn, serves the purpose of a hot plate for heating water and boiling purposes. To the left of the cook is placed a wrought iron cooking oven, which can be made any size, and over this oven is a pan for making sauces, jellies, gravies, &c. On the right of the cook are two smaller ovens, one of which can be used as a hot closet, and adjoining these ovens is a large boiler for water, the latter being drawn off by a tap. A coating of a mixture of sand, &c., placed on the sides and back, serves as a non-conductor of heat, thus preventing damage to the external appearance of the stove and the car. On the top is fixed a plate rack heated by air. The fittings, racks, and other appointments are silver-plated, and the ironwork is finely finished. It is altogether an elaborate and ingenious arrangement, carried out in high-class style, befitting the place it is to occupy and the people for whose comfort it is constructed.

A Sheffield firm have just had an experience of how the prohibitory tariffs of foreign countries operate against English manufacturers. For nearly a century this firm has maintained an establishment in New York almost as large as that in Sheffield. Out of 57,000 dozens of files produced, America has taken over 30,000 dozens. Since the last revision of the American tariff, the

New York establishment has had to be closed, and the movable property has arrived in Sheffield.

Sheffield is fairly well represented at the Manchester Exhibition. At the private press view on Monday, I spent several hours in the machinery department, which is a noble display, such as perhaps Lancashire alone could show. Messrs. Thomas Firth and Sons, Norfolk Works, exhibit crucible and Siemens-Martin cast steel forgings for gun tubes, gun carriages, &c. Noticeable in their exhibit is a piston-rod forged in one piece from a crucible cast steel ingot, which weighs 3 tons 10 cwt., an inner tube for a 16 centimetre gun as supplied to the French marine, which has been forged from a solid steel crucible ingot, then turned, bored, tempered in oil, and finished; a tube for a 9-centimetre gun, also as supplied to the French marine, which has been subjected to an exceptionally severe powder test by Sir W. G. Armstrong, Mitchell, and Co., the result being attached to the gun tube. There are also shown the inner tube of a 100-ton gun—the fore or muzzle part—which has been rough turned with a ¾in. traverse in a lathe specially designed for this heavy class of work. In projectiles Messrs. Frith show one made for the "Woolwich infant"—the 81-ton gun—in the solid forged state, not having been machined. At the other side is the "Ferminy" shell, made on the process they have recently acquired. They also exhibit Vavasseur's patent centre pivot 6in. gun carriage, a large propeller blade, a runner cut off the blade to show the nature of the steel, and many other forgings.

Hadfield's Steel Foundry Company, Hecla Steel Casting Works, Sheffield, include in their exhibits of war material a steel shell for 9·2in. breech-loading gun, exhibited after it had done its work. It had penetrated 24¾in. of wrought iron, passing completely through a 16½in. Cammell wrought iron plate, 2ft. of wood, and 8½in. into a second wrought iron plate placed behind. The projectile was practically uninjured. This firm also showed a 6in. projectile which had passed through a 8in. wrought iron plate, and was so little injured that it could be put into the gun and fired again. Still more interesting were two 9·2in. common shells as now supplied to her Majesty's Government. Mr. Hadfield, the head of this well-known firm, has made steel projectiles a study for many years, with the result that he has invented a shell which, known as "Hadfield's patent," has exceeded expectations in severe trials. Among other cast steel castings for a great variety of purposes, are shown dredger buckets, now being used in dredging the Preston Canal, and similar to what will be used in dredging for the proposed Manchester Ship Canal, with a pair of steel wheels and axles, which, after falling down a shaft 1770ft. deep, are only slightly bent.

In the lighter industries very fine exhibits are made in cutlery by Messrs. Joseph Rodgers and Sons, and in sterling silver, electro-plate, and table cutlery by Messrs. Walker and Hall, Electro Works, Sheffield, who have excelled themselves in articles which take rank as art productions as well as for purposes of utility. This firm have a specially admirable display in tea and coffee services, silver and gilt dessert service, candelabra, claret jugs, and biscuit-boxes. They exhibit the portrait of Mr. George Walker, the founder of the firm and of electro-plating in Sheffield, together with the miniature vat and battery with which he experimented with Mr. Wright, the inventor of electro-plating.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUT little business was done in Cleveland pig iron last week, the sales effected having been for the most part by certain speculators who were unable to hold until prices improve. No. 3 g.m.b., which was quoted at 34s. per ton at the date of last report, gradually fell in value to 33s. 6d. At the market held at Middlesbrough on Tuesday last, however, a more cheerful tone prevailed than has been the case for some weeks, and the belief that prices were again about to advance was unduly entertained. There are no longer any eager sales. The excellent shipments and the decreasing stocks are circumstances which seem to be having a marked influence on the market, and the improvement reported from Glasgow has also added strength. When the market opened, some sales were made by merchants, for prompt delivery, at 33s. 6d. per ton; but towards the close sellers were asking 33s. 7½d., and even 33s. 9d. Forge iron is not easily obtained, as the bulk of it is in makers' hands. Last week the price asked was 33s. per ton, but on Tuesday only 32s. 6d. to 32s. 9d. was named.

Stevenson, Jaques, and Co.'s current quotations are:—"Acklam hematite," mixed Nos., 45s.; "Acklam Yorkshire"—Cleveland—No. 3, 36s.; "Acklam basic," 36s., refined iron, 48s. to 63s. per ton.

Holders of warrants are less ready to sell than they were a few days since. Last week the price fell as low as 33s. 2d. per ton, but on Tuesday an improvement set in, and some sales were made at 34s.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store is now steadily decreasing, the quantity held on Monday last being 329,396 tons, or 273 less than a week previously.

Shipments of pig iron are increasing. Germany, Russia, and the United States are taking much larger supplies than for some time past. The quantity shipped between the 1st and 25th of this month was 64,008 tons, or nearly 12,000 tons more than during the corresponding portion of March.

There is still no sign of improvement in the finished iron trade. Prices are the same as quoted last week, but the reduced rates have not as yet induced fresh business.

The fresh ballot which was arranged to be taken at the different collieries concerned in the Northumberland strike was brought to a conclusion on Saturday evening last. Three questions were submitted to the men, viz.:—(1) That a proposal be made to the owners to accept a reduction of ten per cent. on condition that men living in rented houses be allowed a rebate of 1s. per week; (2) that the newly elected Wages Committee should be empowered to settle with the owners on the best terms obtainable; and (3) that the strike be continued. For the first of these propositions, 1317 votes were recorded; for the second, 1382 votes; and for the third 3665 votes. At six collieries the men refused to vote at all. The strike will therefore be continued. Notwithstanding all this, it is generally believed that it cannot last much longer.

The accounts for March of the Tees Conservancy Commissioners, which have just been published, seem to encourage the belief in improved trade, thus:—Their revenue for the month was £4956 9s. 6d., or upwards of £1000 more than was received in March, 1886. During the five months ending March 31st, the total revenue was £23,758 10s. 11d., or £4831 6s. 10d. more than was received during the corresponding five months of 1885 and 1886.

Among the exhibits which have been admitted to the Exhibition at Newcastle-on-Tyne, free of charge, is that of Mr. E. C. Greenway Thomas, of London. The exhibit is a model of his floating breakwater, which consists of a series of triangular-shaped buoys with concave sides, and moored at a certain distance from each other. Each buoy draws 10ft. of water, and is secured to anchors ahead and astern. The principal prow is placed so as to face the approaching waves, and to gradually divide and divert them right and left. A line of such buoys moored outside the area which it is desired to protect have the effect of causing each wave-section to expend its force by colliding with another section. It seems highly desirable that this promising invention should have a fair trial somewhere where is merits would be practically tested. Off the coast of Northumberland and Durham are to be found many suitable places.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron trade was flat in the early part of the week, but the market improved afterwards in consequence of orders being received for Scotch pigs for the United States. These orders, which are for No. 1, are but of moderate size, but the market was so depressed, and prices had for so long been steadily declining, that their reception was sufficient to impart some strength to the market. The past week's shipments of pig iron amounted to 6969 tons, as compared with 7483 in the same week of last year. Fair shipments are taking place to Russia, but the Continental demand is easily met. Since last report one furnace has been put in blast at the Portland Ironworks of the Eglinton Iron Company, and there is now a total of eighty in operation, against ninety-seven twelve months ago. Considerable additions continue to be made to the stock of pig iron in Messrs. Connal and Co.'s Glasgow stores.

Business has been quiet in the warrant market. Prices were about 40s. 10d. cash early in the week, but an improvement subsequently took place, and business was done between 41s. and 41s. 3d., sellers not being particularly desirous of parting with their holdings at the current rates.

The market values of makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, No. 1, 48s., No. 3, 43s.; Coltness, 54s. and 44s. 6d.; Langloan, 50s. 6d. and 46s.; Summerlee, 52s. and 43s.; Calder, 50s. 6d. and 42s.; Carnbroe, 44s. and 40s. 6d.; Clyde, 47s. and 42s.; Monkland, 42s. 9d. and 39s.; Govan, at Broomielaw, 42s. 9d. and 39s.; Shotts, at Leith, 48s. 6d. and 45s. 6d.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 47s. 6d. and 41s.; Eglinton, 42s. 6d. and 38s. 6d.; Dalmellington, 44s. 6d. and 40s. 6d.

The steel trade is in a fairly active state generally, and several of the leading firms are quite busy. In the past week 405 tons of Glengarnock basic steel billets were shipped coastwise from Ardrossan.

At present the pipe founders are comparatively slack, and the orders in the market, which are for the most part of small extent, are keenly competed for. The contract for pipes for the extension of the waterworks of Wishaw, consisting of 5000 lineal yards of 9in., 7in., and 6in. pipes, was closely contested by seven Scotch firms—four of them in Glasgow—and between the highest and lowest offer—that of Messrs. D. Y. Stewart, of Glasgow, which has been accepted—there was a difference of only £100.

There are few shipbuilding orders being placed at present. The latest is one for six paddle steamers and twelve flats, which Messrs. William Denny and Brothers, of Dumbarton, are to build for the Irawaddy Flotilla Company.

The past week's shipments of iron and steel manufactured goods from Glasgow include locomotives and duplicates valued at £26,100 for Kurrachee, and for the same port eight steel cargo barges worth £3850; machinery £14,000, the greater part of which went to India; sewing machines, £2100, mostly to France; steel goods, £3000; and general iron manufactures, £27,000, including pipes and railway iron to the value of £14,500 for Kurrachee and Bombay.

The volume of the coal trade is extending with the influx of orders for the northern ports of Europe, the navigation of which has now been opened. Coalmakers are cautious as to entering upon contracts of long duration, because they fear a recurrence of labour disputes. The week's coal shipments were, at Glasgow, 22,913 tons; Greenock, 1103; Ayr, 7907; Irvine, 1767; Troon, 5431; Burntisland, 20,211; Leith, 2968; Grangemouth, 13,241; Bo'ness, 9547; Granton, 1953; Port of Glasgow, 900; and Dundee, 260; total, 88,001 tons, as compared with 82,191 in the coresponding week of 1886. For steam coals there is a brisk inquiry, and the prices are well maintained; but other qualities have an easier tendency.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

QUIETNESS is the order of the day in most of the Welsh industries, and low prices do not appear to have the attraction that I would think they should have. Here, for instance, is a collection of quotations at which some amount of business has been done. Blooms, by far the best trade, £4 5s.; steel rails, £4 2s. 6d., in a few cases, £4 5s.; bars, £4 15s.; pig, 46s.

The iron trade is certainly not brisk, but there is a little doing, and ironmasters are unrelaxed in getting in stocks of iron ore, foreign specially, as the price is low, about 10s. 6d. to 11s. Santander and Bilbao are sending in large quantities.

There has not been much exported of late. A cargo to Colombo was sent away this week. A contingent of Belgians are now engaged at Cyfarthfa in putting up the new range of Evance and Coppée coke ovens; these will be placed immediately in the rear of the Bessemer plant.

Ironmasters say that the expected revival of the iron and steel trade is still afar off, and in no department is there much to boast about. A party of Chinese officials visited Dowlais last week, and were taken over the works and hospitably entertained. It is said that business will probably result from the visit.

Colonial business wears a slightly better look, and it is reasonably inferred that the London meeting will have a favourable influence. The visits of the leading colonists to iron and steel works have not been, I infer, simply from curiosity.

The tin-plate trade last week was not so good. Swansea complained in particular, not so much for lack of orders, as for tonnage to take away stock. For instance, there was a remarkable occurrence in the fact of no consignment leaving for the United States. Liverpool had a few, and some plates left for France, Germany, and other places. In all, the exports only amounted to 32,915 boxes. Stocks now held by Swansea amount to 122,598 boxes. Make is now exceeding the demand, so it is not surprising that buyers are hanging back, hoping for lower figures. These remain at present very similar to those of last week.

Cokes are not in so much demand as Bessemers, and these can be had from 12s. 6d. Best brands are still close upon 13s. This is the figure asked, but in a few cases 1½d. or 3d. reduction is taken. Siemens command most attention of any plates, prices ruling according to quality from 13s. 3d. Very few touch 14s.; but on the other hand, still fewer can be had for 13s.

The make of the Newport district is beginning to tell upon the trade, yet makers are not despondent. There is a steady increase in the uses to which plates are applied. A movement is on foot for the federation of the workers at the Glamorgan and Monmouthshire works. On Saturday a meeting was held at Swansea, presided over by a Monmouthshire tin-plate worker, when the subject was discussed and carried.

Patent fuel has been in slight demand of late. Swansea did little last week; and I note that the Cardiff works have been far from busy.

Pitwood is very stagnant and prices falling; this is due to the slackness in the coal trade. Surveyed broadly, the coal trade is far from brisk. Some coal-owners are doing fairly well in respect of quantity. This week I noticed some fine cargoes for India, and various coal stations, such as Port Said. One cargo of 3500 tons, another of 2150 tons, and a third of 2500 tons, went to Singapore, one of 3200 to Bombay, another of 2000 to Colombo. But as I remarked last week, when one colliery can produce close upon 2000 tons in one day, these large cargoes have but little significance. Much more greater significance is to be attached to the rapid depletion of the coal field. The largest producer is now clearing away 1½ acres per week, and many are turning out an acre. Last week showed a lessened export at all the ports, and lessened prices are now prevailing. The ruling figures for best steam at port are 8s. to 8s. 3d. f.o.b. Cardiff. Monmouthshire coal, from 9d. to 1s. less; small steam, 4s. to 4s. 3d., and quiet at that; Rhondda No. 3, from 8s. 3d. to 8s. 6d. I have all along looked for an improvement in the Welsh coal trade when the Severn tunnel is in thorough developed order, and I see that a Western contemporary supports this, and adds that Welsh coal is now finding its way *viâ* the tunnel to Plymouth. Last week a train of 100 tons was taken *viâ* the tunnel to Exeter, and thence by South-Western to Plymouth. The question is, whether rail-borne rates can compete with those of steamers as at present arranged

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE present condition of the Rhenish-Westphalian iron market is not such as to enable a prophecy to be hazarded as to what turn it will take in the immediate future. Both buyers and sellers are passive for the moment; prices, however, with few exceptions, have been maintained. The reports from Silesia sound still very satisfactory. All the pig iron stocks have been cleared off the works, and buyers must now fall back on those in speculators' hands; and the smelters will only contract at advanced prices, which they will get, provided the forges and mills keep on as busily as is now the case. Forge pig is noted at M. 47·50; foundry, 50 to 54; merchant bars, 115 to 120; and coke plates, 150 to 160 p.t.

The Belgian iron market is satisfactory. It is true that it is just now experiencing a slight reactionary crisis, which usually follows an exceptionally brisk demand, and the building season has hardly fairly begun; but still the works, as a rule, have regular work in hand for two to three months to come. Pig iron is firm. Steel not quite so much so as a month or two back; still the works are moderately well employed. Girders are in full demand, and it is contemplated to raise the prices. In South and Middle Italy they are in great request, and for Rome and Naples the quantity required is estimated at 100,000 t. Here would, perhaps, be an outlet for Messrs. Dorman and Co.'s steel girders. The machine shops and foundries are pretty well engaged, and large orders arc in prospect. The coal trade is very satisfactory, and the export is lively at firm prices. Coke is not quite so favourably situated, and more than 11·50f. is not attainable. The great coal mine, Fremeries, is now burning, and a great catastrophe imminent.

The French iron trade is in some districts satisfactory, but at Paris quite the reverse. In the Haute-Marne the orders being worked off are being replaced by fresh ones, and on the whole the iron business seems to be improving, especially in the Nord Department, since the building season has commenced, where the works are busy. The ironfoundries are a little better off for work, but in most cases the prices are unremunerative. In Paris prices have fallen to those of a year ago, and merchants ask for girders 125f. and for merchant iron 127·50, but the rolling mills maintain their quotations steadfastly.

The demand for ores in Rhineland-Westphalia has shrunk considerably, and the foreign ore market also shows a weak front. At Bilbao, 6s. 10d. to 7s. 3d. is the price of best sorts. Those of the Siegerland are not materially changed. The total produce of Germany last year was 8,489,231 t., against 9,136,340 t. the year before. There is little change to note in pig iron. The demand for forge has remained stationary in Westphalia, whilst in the Siegerland it has gone back, with a prospect of lower prices. Spiegel is not in such good request for export as it was, and principally that high in Mn. is brisk of sale. Foundry pig is also weak, but Bessemer and basic are unchanged and satisfactory.

The best sorts of Spiegel cost up to M. 56 p.t.; best forge 46 to 47; and Rhenish, 48; foundry, 49 to 56 for the 3 Nos.; Bessemer, 51 to 52, and Luxemburg forge 37. The rolling mills in general have still enough work on hand, but the demand is not near so brisk as it was; and although the convention prices are not as high as they ought to be in proportion to those of crude iron, buyers are still keeping aloof. More strong firms have joined the wrought iron convention, so that it is now in a firmer position, and endeavours are being made to unite with that of Silesia, when it will be possible, perhaps, to secure better prices. The sectional rolling mills are beginning to be very busy as the building season advances, and the prices are being stiffened.

It is to be hoped that the strike of the building artisans, now going on, will not depress them again. The plate millowners are complaining of want of orders, but some are able to keep on full time. The prices are, however, being firmly adhered to at what they are, but they are far too low in comparison to the cost of the raw materials. Thin sheets are falling, both in price and sale, but special works keep full on with them. The condition of the wire rod branch shows little alteration. There is quite sufficient demand, so prices keep firm, and they are easily obtainable. In the small gauges the demand is much reduced, and the prices are unremunerative. In steel there is nothing new to report. On the 16th inst. 2822 t. of rails were awarded at Bromberg, half to Krupp, at M. 111, and half to Hoesch and Co., of Dortmund, at 112, as the lowest tenders, the other Rhenish-Westphalian works asking 120 to 122 p.t., all at works.

On the 12th inst. at Magdeburg 1100 sets of wheels and axles were awarded, 550 sets at M. 295 to the Bochum Steel Works, and 275 sets to each of the works Horde and Union of Dortmund at 296 p set. All the manufacturers, far and near, of steel spades and shovels have combined, and are about to raise the prices of these articles in accordance with those of the raw materials. The wagon works are a little better off for orders just now, as a good many tenders have been sent out by the State railway administrations, amongst them one for 300 iron coal trucks, 36 post and passenger coaches, and 50 covered railway vans, for which the Société Metallurgique of Brussels put in the lowest tender, much to the annoyance of the native works, though in all probability the latter will receive the order. There is still much to be desired as far as machine shops and foundries are concerned, only isolated works having pretty much work in hand. At Halle the railway station is to be rebuilt, and tenders for 220 tons of iron work have just been let for M. 52,600, other tenders having ranged M. 55,780, 55,989, and 67,611.

The iron prices are—merchant bars, base price, M. 110 and higher; angles, 112 to 115; hoops, 108 to 115; iron and steel billets, 112 to 125; and special, 130; boiler plates, 5½ mm. and thicker, 145; thin black sheets, 130 to 135; thick plates, 140 to 160 and higher; iron wire rods, 112; steel ditto, 110 to 112·50; drawn iron wire, 125 to 130; steel ditto, 125 to 130; steel rails, 125 to 130; iron sleepers, 120 to 125; wheels and axles complete, 300 to 325; and light steel rails, 108 to 112 p.t.

In Russia it is proposed to at once raise the duty 50 kopeks per pud on bar and hoop iron, and 75 kopeks on small sizes of rod iron, boiler-plates, and thin sheets. For the current year 10,000,000 puds of cast iron may be imported, but after that it is to be excluded altogether, as Russia will then be in a position to furnish all its own requirements. It is reported from Warsaw that the rolling mill plant of Silopp, Ran, and Loewenstein, has now been dismounted, and is about to be transported by sea from Danzic to the Caucasus, there to be again set to work. This is quite a new place for modern works of this kind. If petroleum could be made to answer, the speculation might succeed; at any rate it shows with the new works in Russia Proper, that Russian industry is all gravitating towards the south and south-east.

Trade returns just published show that Sweden imported last year from England, principally in iron and steel goods, for 89,148,000; and from Germany, under the same circumstances, for 89,041,000 crowns. But Sweden exports to England 112,055,000, while to Germany it only amounts to 18,146,000 crowns. Under these circumstances it is clear Sweden should, and undoubtedly would, willingly take much more from England if this field were cultivated by English manufacturers as carefully and as energetically as by their German rivals, and it would assuredly repay the efforts made. In order to command success, however, it would be necessary to send over there travellers armed with knowledge of continental habits and lingual acquirements, not forgetting that the usual price lists in the English language are, on the whole of the Continent, merely so much waste paper, in spite of the well executed illustrations. Buyers demand now-a-days every detail in the vernacular of the country wherever business is to be done. The traveller must also be able to give every information concerning freights, exchanges, and so forth from the shipping port to the door of the customer. If English manufacturers would only bestir themselves, modify their insular trade habits and education, and be true to themselves, they need not in reality ever or anywhere fear the legitimate rivalry of Germany.

NEW COMPANIES.

The following companies have just been registered:—

Dhu Heartach Steamship Company, Limited.

Registered on the 16th instant, with a capital of £2000, in £1 shares, to acquire the s.s. Dhu Heartach, now lying at Liverpool, and to employ the same in carrying fish at Dingle Bay and other places. The subscribers are:—

	Shares.
G. H. Parker, 12, Tithebarn-street, Liverpool, cotton broker	1
S. Lord, 1, Belgrave-road, Birkdale	1
Thos. Parker, Southport	1
W. H. Seville, Liscard, cotton broker	1
C. P. Higginbotham, 16, Manchester-street, Liverpool, cotton broker	1
A. Palethorp, 85, Gladstone-road, Liverpool, cotton broker	1
G. Charnley, 48, Beaumont-street, Liverpool, cotton broker	1

Registered without special articles.

Durham and Lord Byron Amalgamated Gold Mining Company, Limited.

This company proposes carrying on mining operations in Australia, and will enter into an agreement for the purchase of the Durham and Lord Byron mines. It was registered on the 19th inst., with a capital of £100,000, in £1 shares. The subscribers are:—

	Shares.
A. Channing Bicknell, H.I.M.E, 42, Pelham-street, S.W.	1
H. W. Pelham-Clinton, 98, Belgrave-road	1
G. Morris Barker, 64, Sutherland-gardens, Maida Vale	1
J. A. Thomson, 90, Cannon-street, contractor	1
C. Upward, Maybank-road, Woodford, clerk	1
J. P. Lythgoe, 33, Vesta-road, Brockley, accountant	1
R. D. Balfour, 4, Austinfriars, broker	1

The number of directors is not to be less than three, nor more than seven; qualification, 500 shares, or equivalent stock; the first are Messrs. A. Balfour, E. P. Barlow, A. C. Bicknell, and G. Augustus Thomson; remuneration, £1200 per annum.

"Fly" Cycle Company, Limited.

This company was registered on the 15th inst., with a capital of £5000, in £1 shares, to acquire the business of Alexander Spaul, of the Norfolk and Norwich Bicycle Works, Norwich, with the stock-in-trade and other effects, including the trade mark "Fly." The subscribers are:—

	Shares.
A. Spaul, Norwich	1
F. G. Emms, Norwich, solicitor	100
A. B. Taylor, Norwich, manufacturer's manager	20
E. T. Cooper, Norwich, manufacturer's manager	25
J. R. Pearson, Norwich, cutler	25
*W. Emms, Norwich, draper	50
*A. Smith, North Walsham, farmer	50

The number of directors is not to be less than three, nor more than seven; qualification, 50 shares; the first are the subscribers denoted by an asterisk, and Mr. Ernest Grimmer. The company in general meeting will determine remuneration.

Inventors' Agency, Limited.

This company was registered on the 15th inst., with a capital of £10,000, in £10 shares, to promote the invention and discovery of apparatus, instruments, and processes for commercial, scientific, and other purposes, and to carry on the business of patent agents. The subscribers are:—

	Shares.
A. G. Stewart, C.E., 3, George-yard, Lombard-street	1
W. L. Markill, C.E., 3, Tokenhouse-buildings	1
W. A. Dawson, C.E., Norfolk Cottage, Putney	1
A. Fyson, C.E., Fairfield, Richmond	1
J. L. Wanklyn, 8, West Chapel-street, Mayfair	1
C. R. Thursby, C.E., 14, Jermyn-street	1
J. Parker, 43, Scarsdale-villas, Kensington	1

The number of directors is not to be less than three, nor more than seven; qualification £100 in shares; the subscribers are to appoint the first. The company in general meeting will determine remuneration.

Machine Decorating Biscuit and Confectionery Company, Limited.

Registered on the 15th inst., with a capital of £75,000, in £1 shares, to manufacture all kinds of biscuits, bread, and confectionery, and to carry on business as refreshment contractors. The subscribers are:—

	Shares.
*E. Herisse, 84, St. Mark's-road, Dalston, engineer	1
J. J. Hone, 10, Finsbury-circus, surveyor	1
*T. F. Veasey, 76, Finsbury-pavement, engineer	1
A. W. Lynn, 43, Ashburton-grove, Holloway, clerk	1
H. J. Adkin, 10, Finsbury-square, solicitor	1
A. Odell, 13, Kempsfoot-road, Kennington, clerk	1
A. Herisse, 84, St. Mark's-square, Dalston, confectioner	1

The number of directors is not to be less than three, nor more than seven; qualification, 50 shares; the first are the subscribers denoted by an asterisk; remuneration, £50 per annum each, with an additional £50 per annum for the chairman. The board will also be entitled to one-tenth of all surplus profits after allowing for payment of 15 per cent. dividend.

Mineola Steamship Company, Limited.

Registered on the 13th inst., with a capital of £25,000, in £500 shares, to carry on the business of shipowners in all branches. The subscribers are:—

	Shares.
*T. Hogan, 123, Front-street, New York, stevedore	1
*J. Hogan, 123, Front-street, New York, stevedore	1
*C. W. Hogan, 123, Front-street, New York, stevedore	1
J. Benson McIve, New York, grain elevator	1
E. G. Burgess, New Jersey, grain elevator	1
C. F. Bank, 71, Broad-street, New York	1
J. McCaldin, 79, Broad-street, New York	1

The first three subscribers are appointed directors and managers.

Pant-y-Buarth Lead Mining Company, Limited.

This company proposes to acquire the assets and liabilities of the Coed-y-Fedw and Pant-y-Buarth Lead Mining Company, Limited, upon terms of an agreement dated 12th February, made with the liquidator of that company. It was registered on the 14th inst., with a capital of £25,000, in £1 shares. The subscribers are:—

	Shares.
W. Marlborough, 29, Bishopsgate-street, stock and share dealer	1
E. J. Bartlett, 70, Bishopsgate-street, stock and share dealer	1
S. Jackson, 5, Ivydene-road, Hackney, secretary to a company	1
G. E. Hooke, 3, Bishopsgate-street, mining share dealer	1
H. Chapman, 24, Lugard-road, Peckham, share dealer	1
B. C. Hooke, 18, Winslade-road, Brixton	1
J. H. Nobbs, 81, Bishopsgate-street, clerk	1

The number of directors is not to be less than two, nor more than five; qualification, £50 in shares or stock; maximum remuneration, £300 per annum.

Singapore, Straits Settlement, and Siam Electrical Company, Limited.

This company was registered on the 16th inst., with a capital of £60,600, in £5 shares, to carry on at Singapore, the Straits Settlements, Siam, and elsewhere in the far east, the business of an electric light company in all branches, and for such purpose to enter into an agreement with Mr. Edward John Wells. The subscribers are:—

	Shares.
*F. L. Rawson, 11, Queen Victoria-street, electrician	1
H. Foote, 11, Queen Victoria-street	1
J. H. Ward, 11, Queen Victoria-street, managing clerk	1
J. Shurmere, 4, Gilbert-road, S.E., clerk	1
A. Steven, 80, Fernhead-road, Paddington, clerk	1
W. S. Rawson, 68, Cornwall-gardens, S.W.	1
D. Potter, 112, Chetwynd-road, N.W., engineer	1

The number of directors is not to be less than two, nor more than seven; the first are Messrs. Harry Seymour, Foster, and F. L. Rawson; qualification, 20 shares, or £100 stock. The remuneration of the board will be at the rate of £100 per annum for each director, and 5 per cent. upon the annual net profits after £10 per cent. dividend has been paid. The remuneration of the committee is to be £150 per annum, and a share of the said percentage.

LAUNCHES AND TRIAL TRIPS.

The s.s. Paris, which has been built by Messrs. C. S. Swan and Hunter, of Wallsend-on-Tyne, was taken on trial on Friday, the 22nd, with very satisfactory results, the speed being nine knots loaded. The dimensions of the vessel are 162ft. by 25·2ft. by 9ft. 9in. The engines, which have been fitted on board by Messrs. Westgarth, English, and Co., of Middlesbrough-on-Tees, have cylinders 13½in., 22in., and 36in. diameter, by 24in. stroke; 150 lb. working pressure; indicated horse-power, 364. The Paris has been built to trade to Paris, and is fitted with lowering masts and funnel to pass under the bridges.

The vessel Fee Cheu was successfully launched on Saturday last from the yard of Messrs. Wm. Doxford and Sons, Sunderland. She is 220ft. by 32ft. by 20ft., with flush spar deck, and is fitted as an armed cruiser and cable vessel, and has engines with cylinders 19½in., 31½in., and 52in., with 36in. stroke, capable of driving her 13 knots. The armament consists of two 6in. Armstrong breech-loaders, and four small Armstrongs in the 'tween decks. She is entirely built of steel, and the whole shell plating is of ¾ steel plates. She is expected to sail shortly for the China station.

The s.s. Electrician, the fifth vessel built by Messrs. Raylton Dixon and Co. for Mesrrs. Thomas and James Harrison, of Liverpool, was launched on Monday afternoon from the yard of her builders. She is a spar deck steamer built of steel and intended for the Calcutta trade, of the following dimensions:—Length over all, 337ft.; breadth, 40ft.; depth moulded, 29ft. 2in.; and has a deadweight carrying capacity of about 4100 tons with Lloyd's freeboard. She has hood over steering gear aft, with long deckhouse, in which is very handsomely fitted saloon and accommodation for passengers, and is fitted throughout in every way as a first-class steamer for this special trade. She will be fitted with engines by Messrs. Blair and Co., of Stockton, on their triple expansion principle, having cylinders 24in, 40in., and 66in., with 45in. length of stroke.

Messrs. Joseph L. Thompson and Sons, Sunderland, launched on Monday, the 25th inst., a handsomely modelled steel screw steamer of the following dimensions, viz.:—Length, B.P., 284ft.; breadth, extreme, 38ft.; depth moulded, 20ft. 10in.; deadweight capacity, about 2950 tons, at 19ft. 2in. draught, with Lloyd's freeboard. Classed 100 A1 at Lloyd's. This vessel has been built to the order of Messrs. John H. Barry and Co., of Whitby, and is the eighth vessel built by this firm for the same owners; she is built on the web frame and longitudinal plate intercostal system, thereby dispensing with hold or orlop deck beams —has raised quarter deck, full poop, long bridge, 118ft., topgallant forecastle, iron decks, six iron bulkheads, five large hatchways, and is fitted with all the latest improvements, viz.:—Harfield's patent windlass, four large steam winches, by Lynn of Pallion, Copper's steam and hand steering gear combined, and also Hasties' patent screw steering apparatus on the poop. The engines, which are of the triple expansion type, are being built by Mr. John Dickinson, Palmers-hill Engine Works, Sunderland, of 180-horse power, cylinders 21½in., 35in., 58in., with a stroke of 39in. Two steel boilers, 150 lb. working pressure; will also be fitted with Dickinson's patent steel built crank shaft, and Blake's donkey boiler. This vessel is intended for the general carrying trade, and has been fitted up in every respect to meet the requirements of the Grain Cargoes Act of 1880.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

17,168. Flexible Couplings, D. M. Legat, London.—[Received April 20th, 1887. Antedated October 20th, 1886, under International Convention.]

19th April, 1887.

5651. Roadways, &c., E. Tuthill, London.
5652. Bicycles, T. A. Aston, Birmingham.
5653. Propelling Velocipedes, J. A. Stephan and R. Southerton, Birmingham.
5654. Hat Blocking Machines, G. Atherton.—(*R. Eickmeyer, United States.*)
5655. Softening and Purifying Water, G. E. Davis, 5656. Winding up Bandages, G. F. Williamson, J. Dawson, and H. W. Bean, Wellingborough.
5657. Multiple Expansion Steam-engines, J. Spear, Liverpool.
5658. Setting the Brims of Felt Hats, W. and J. Horsfield, Manchester.
5659. Button-hooks, J. T. B. Bennett, Birmingham.
5660. Sugar-cane Mills, J. Thomson and J. Black, Glasgow.
5661. Purifying Sewage, &c., G. E. Davis and G. B. Aitken, Manchester.
5662. Woven Fabrics, W. E. Gedge.—(*The Hunt Automatic Loom Company, United States.*)
5663. Rivets, M. Arnold, London.
5664. Link-plate for Locks on Leather Bags, H. and W. H. Sanders, Walsall.
5665. Gas Cock, A. Thomson, Lowfields.
5666. Carding Machines, W. Cunningham, Glasgow.
5667. Chimney Cowls, J. Drummond, Glasgow.
5668. Winding and Doubling Mechanism, C. Sipman, Nottingham.
5669. Sight Feed Lubricators, J. L. Grandison, Manchester.
5670. Fastenings for Gloves, &c., W. A. Critchlow, London.
5671. Joints of Drain Pipes, W. C. Roberts, London.
5672. Warp Lace Machines, J. Woolley, London.
5673. Brushes, J. Raper, M. Pearson, and F. Gill, London.
5674. Steam Motor Engines, G. W. Newall and J. F. Blyth, London.
5675. Indicating the Level of Liquids in Vessels, T. Anderson, London.
5676. A more Perfect Combustion of Fuel, J. Platt, Sheffield.
5677. Tables, &c., F. Wakefield, Liverpool.
5678. Raising the Tables of Circular Saw Benches, C. Redman, London.
5679. Preventing Accidents in Hoists, W. H. Noble, London.
5680. An Octochord, A. Allam, London.
5681. Die Holder for Making Bricks, R. S. Bluck, Peterborough.
5682. Securing Hooks, J. C. Hudson, London.
5683. Letter Blanks and Envelopes, A. J. Boult.—(*A. Cox, Canada.*)
5684. Branding Soap, &c., E. Boothroyd, London.
5685. Mercantile Material, A. J. Boult.—(*E. H. M. Caston, Canada.*)
5686. Worsted Yarns, W. P. Thompson.—(*D. E. Coe, United States.*)
5687. Armatures for Electric Generators, W. P. Thompson.—(*H. W. Spang, United States.*)
5688. Bicycles, W. P. Thompson.—(*L. B. Gaylor, United States.*)
5689. Mechanical Musical Instruments, W. P. Thompson.—(*C. A. Kuoter, United States.*)
5690. Air-tight Metal Cans, H. Rees, London.
5691. Pocket Protectors, A. M. Clark.—(*D. J. Scott, United States.*)
5692. Sewerage for Building, C. H. Shepherd, London.
5693. Automatically Exposing Sprays and Button-hole Flowers, A. Gray, London.
5694. Sound Producing Lock, &c., F. G. Griffith, London.
5695. Spring Wheel for Traction Engines, T. F. and J. H. Braime, London.
5696. Goloshes, A. H. Scaife, London.
5697. Pots for Tinning Plates, J. Abbott, London.
5698. Preparing Pottery to Receive Metal Pipes, S. H. Rowley, London.
5699. Handle and Socket Connection, J. Marston, London.
5700. Portable Lathe, A. F. Bergström, London.
5701. Rolled Glass, J. Armstrong, London.
5702. Glazing, J. Armstrong, London.
5703. Fire-kindlers, M. A. Haudecœur and L. E. P. Courtois, London.
5704. Binding Electrical Cut-out Fuses, G. C. Sillar, London.
5705. Generation of Steam, E. Edwards.—(*E. C. Sonnett and A. A. Leredde, France.*)
5706. Decorticating Machines, O. Imray.—(*B. Thoens, United States.*)
5707. Cut-outs for Electric Arc Lamps, E. F. H. H. Lauckert and H. W. Kingston, London.
5708. Heating Milk, J. F. O. Qvistgaard, London.
5709. Dynamo-electric Machines, A. I. Gravier, London.
5710. Saving Life at Sea, J. Johnson, London.
5711. Printing Machines, J. Kerr and J. N. Wilson, London.
5712. Steam Engines, D. Joy, London.
5713. Sounding Post for Violoncello, &c., W. H. Vingoe, London.
5714. Sulphuric Anhydride, W. S. Squire, London.
5715. Counterfoils, P. J. Donnelly, London.
5716. Keeping Cash Accounts, P. J. Donnelly, London.
5717. Electrical Signalling, H. H. Lake.—(*M. G. Farmer, United States.*)
5718. Lasting Boots and Shoes, H. H. Lake.—(*C. B. Lancaster, United States.*)
5719. Toilet Paper, H. H. Lake.—(*S. Wheeler. United States.*)
5720. Dynamo-electric Machines, C. Coerper, London.
5721. Hospital Bedsteads, C. Drake, London.
5722. Velocipedes, A. J. Boult.—(*F. Renz, Germany.*)
5723. Building Materials, S. Pitt.—(*G. Falconnier, Switzerland.*)
5724. Dust Guards for Car Axle-boxes, W. S. G. Baker, London.
5725. Combined Couch and Chair, A. Carter, London.
5726. Closing the Mouths of Bottles, R. H. Barrett, London.
5727. Compound Plates of Iron and Steel, A. Wilson, London.
5728. Earth Closets, J. C. Morrell, Ealing.

20th April, 1887.

5729. Preparation of γ-oxy-chineldine, W. R. Hodgkinson.—(*M. Conrad and L. Limpach, Bavaria.*)
5730. Feeding Steam Boilers, J. Metcalfe and E. Davies, London.
5731. Feeding Steam Boilers, E. Davies and J. Metcalfe, London.
5732. Pans and Seats of Water-closets, J. Martin, London.
5733. Retaining Carriage Windows at a Required Height, A. E. Bingemann, London.
5734. Lifting Apparatus, J. W. Buckley and A. T. Allen, Sheffield.
5735. Electric Apparatus for Baths, M. Humm, London.
5736. Sharpening the Teeth of Band Saws, T. Duncan and D. Mills, Manchester.
5737. Mechanism used for Looms, J. Ashworth, London.
5738. Circulating Water for Heating Railway Carriages, &c., J. King, Liverpool.
5739. Fenders, F. W. Kingdon, London.
5740. Rivetting Machines used for making Umbrella Frames, J. Morton, Aston.
5741. Manufacture of Artificial Leather, H. House, Leeds.
5742. Covering Rollers employed in Drawing, Spinning, &c., Machines, J. Smith, Halifax.
5743. Velocipedes, H. J. Lawson, Coventry.
5744. Stamping Bosses, J. Bloor, Manchester.
5745. Making and Driving Nails, W. Henshall, jun.—(*H. Weeks, United States.*)
5746. Meter for Registering Fluids, R. Gay, W. Walker, and W. Norris, Smethwick.
5747. Traction and Tramway Engines, F. J. Burrell, Thetford.
5748. Bolts for Doors, A. Payne, Nottingham.
5749. Removing Grease, &c., from the Feed-water of Marine Boilers, J. Turns, South Shields.
5750. Coal Boxes, J. L. Hanman, Birmingham.
5751. Ventilating Buildings, J. Horrocks, London.
5752. Saws, S. Taylor, London.
5753. Carbonate of Soda or Soda Ash, T. T. Mathieson and J. Hawliczek, Liverpool.
5754. Cutting Tobacco in Cakes, A. Paget, Radmoor.
5755. Scotia Method of Sewing, D. Young, Edinburgh.
5756. Boot Cutting Press, D. Young, Edinburgh.
5757. Caustic Ash, T. T. Mathieson and J. Hawliczek, Liverpool.
5758. Cleaning or Gutting Fishes, J. Clark, London.
5759. Malting Houses and Kilns, C. Last, London.
5760. Wooden Boot and Shoe Soles, H. Gebhardt, London.
5761. Hose Reels for Garden Purposes, J. Walker, London.
5762. Water-waste Preventers, T. Panario, London.
5763. Automatic Brake for Perambulators, C. C. Munro, London.
5764. Hames and Hame-chain Fastening, F. Read, London.
5765. Swivelling Sliding Doors or Partitions, G. Thornborough and E. Larmour, Manchester.
5766. Rapidly Lowering Water-tight Doors on Ships' Bulkheads, R. H. C. and G. J. C. Ball, London.
5767. Trimming Attachments for Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
5768. Meat Baster, L. Phillott, London.
5769. Fire-bricks, H. Hartland, London.
5770. Strainer for Fish Kettle, J. Marston and G. Cooch, London.
5771. Coal Boxes, J. Marston and W. Evans, London.
5772. Photographic Mounting Cards, L. Wolff, London.
5773. Heating and Filtering the Water of Swimming Baths, &c., C. H. Rosher, London.
5774. Exhibiting Views or Scenes, B. Hallett, London.
5775. Steam Engines, L. Soulerin, London.
5776. Stoppers for Bottles, H. S. Dean, London.
5777. Heating, Aerating, &c., Natural and Artificial Waters, C. Tollier, London.
5778. Calendar and Day-table, T. Wilkins, London.
5779. Stops for Double Gates, &c., M. Postlethwaite, London.
5780. Cutting and Dressing Stone, &c., R. C. Thompson and W. Spence, Surbiton.
5781. Producing an Unoxidisable Coating on Iron or Steel, C. Joseph, Viscount d'Hauterive, London.
5782. Cleaning the Bottom of Ships, J. Edwards, London.
5783. Prevention of Suffocation, &c., of Persons in Epileptic Fits, T. Nugent, Walthamstow.
5784. India-rubber Tires, J. Burbridge and T. Oakley, London.
5785. Purification of Crude Anthracene, A. A. Vale.—(*The Chemische Fabriks Actien Gesellschaft, Hamburg, Germany.*)
5786. Magazines for Fire-arms, R. Morris, London.
5787. Preparing Sea-weeds for Ornamental Purposes, J. R. Macdonald, Hastings.
5788. Automatic Delivery Magazine, W. H. Pearse, London.
5789. Franking Letters and Postal Orders, E. Oswald, London.
5790. Fastening for Permanent Way, H. J. Marshall, London.
5791. Compound or Varnish, F. Crane.—(*J. Hale, United States.*)
5792. Regulating Supply of Gas to Gas Stoves, C. Sparrow and J. Osgerby, London.

21st April, 1887.

5793. Roasting and Drying Farina, &c., J. King, Liverpool.
5794. Disc Pumps, J. Bowns, Manchester.
5795. Box or Counter Case, F. G. Heath, Redditch, Worcestershire.
5796. Automatic Discharge Valve, W. L. Holland, Preston.
5797. Portable Photographic Camera, W. J. Smith, Birmingham.
5798. Moulding the Impression of Blocks, &c., J. Caprini, Dublin.
5799. Blind Rollers, &c., J. Duggan, Liverpool.
5800. Furniture Nail, C. Crisp and W. Crisp, Halstead.
5801. Bolts, &c., D. Barnett and H. P. Barry, West Bromwich.
5802. Cord-holders for Window Blinds, J. Walker, Birmingham.
5803. Attaching Explosives to the Sides of Ships, F. P. Warren, London.
5804. Hat Adjuster, C. Hudson and J. W. Rockliffe, Newcastle-on-Tyne.
5805. Corrugated Paper, &c., P. M. Crane and F. Wilkinson, Manchester.
5806. Fastenings for Bags, &c., D. Graham and J. Y. Fulton, Glasgow.
5807. Registering Games, J. Brindle, Whitehaven.
5808. Tires, J. Wroe, Manchester.
5809. Oil Seed Press Bags, T. McDonald, Halifax.
5810. Nut-lock, J. Badger.—(*C. W. Clarke, United States.*)
5811. Terne and Tin-plates, G. Elias, London.
5812. Picture-holder, W. D. Wilkinson and F. Fowler, Birmingham.
5813. Room Carousal, M. Nobiling, Bradford.
5814. Drying "Slip" or "Slurry," T. H. Lodge, London.
5815. Portland Cement, T. H. Lodge, London.
5816. Utilisation of Hot Waste Gases, T. H. Lodge, London.
5817. Wrappers for Oil Seed Crushing, T. McDonald, Halifax.
5818. Drying Pile Fabrics, H. Lister, Halifax.
5819. Setting Angle Bars, N. Arthur, Glasgow.
5820. Differential Screws, H. H. Lake.—(*W. Junge, Germany.*)
5821. Adjustable Boards of Wringing and other Machines, J. Whittaker, H. Whittaker, and W. Whittaker, Halifax.
5822. Gas Valves, J. Breeden, London.
5823. Candlestick, B. Carr, London.
5824. Carbonic Acid, &c., J. W. Knights and W. D. Gall, London.
5825. Fire-proof Doors, J. Rowland, Liverpool.
5826. Delivering Articles, D. S. Dawson, Liverpool.
5827. Spirit Lamps, J. Hatfield, London.
5828. Window Sashes, J. Ward and W. Jones, Manchester.
5829. Icing Confectionery, W. F. Müller, London.
5830. Ribs for Umbrellas, &c., D. M. Redmond, London.
5831. Stopping Weaving Machines, W. B. Ball, London.
5832. Safety Pin, W. A. Kerr and T. Hurley.—(*P. Todd, United States.*)
5833. Combined Gas-motor Engine and Dynamo-electro Machine, F. W. Crossley, London.
5834. Extractor Mechanism for Small-arms, H. W. Holland and J. Robertson, London.
5835. Contact Makers, D. L. Selby-Bigge, London

5836. Administering Vapours for Medicinal Purposes, K. Schulze, London.
5837. Self-acting Spinning Machines, E. Edwards.—(*R. Schneider, Austria.*)
5838. Rack Pulleys, J. A. Schofield, London.
5839. Winding Yarns, W. T. Stubbs and J. Corrigan, Manchester.
5840. Projectiles, A. V. Newton.—(*A. Nobel, France.*)
5841. Condensers for Sea-water Distilling Apparatus, G. Graveley, London.
5842. Self-locking Mechanism, A. Illidge, London.
5843. Photographic Cameras, H. H. Cunynghame, London.
5844. Steam Traps, R. H. Low, London.
5845. Automatic Tracheotomy Tubes, F. B. Jones, Bristol.
15,804a. Wedges for Winning Coal, G. W. Elliott, Sheffield. 3rd Dec., 1887. [Received 14th April, 1887, and numbered at that time 5399, a.d. 1887, which number is now cancelled. This application having been originally included in No. 15,804, a.d. 1886, takes under Patents Rule 23, that date.]
2758a. Mechanical Device for Operating and Locking Movable Parts, P. M. Justice.—(*R. H. Isbell, United States.*) 22nd Feb., 1887. [Received 22nd April, 1887. This application having been originally included in No. 2758, a.d. 1887, takes under Patents Rule 23, that date.]

22nd April, 1887.

5846. Drying Linen, C. S. Crabtree, London.
5847. Chimney-pot, H. Hagon, London.
5848. Water Taps, J. Ditchfield, Denton.
5849. Filling Wash Boilers, J. Ditchfield, Lenton.
5850. Horse-collars, H. Frost and S. Salkeld, Manchester.
5851. Application of Steam Power to Knitting Machines, E. Shepherd, F. Rothwell, J. E. Hough, and T. Rothwell, Oldham.
5852. Valveless Insufflator, G. Holloway, Birmingham.
5853. Utilisation of Sulphate of Lime, &c., E. W. Parnell and J. Simpson, Liverpool.
5854. Production of Sulphide of Ammonium, E. W. Parnell and J. Simpson, Liverpool.
5855. Motion of Loom, J. Allan, Dundee.
5856. Gaslight Governors, H. N. Bickerton, Ashton-under-Lyne.
5857. Mechanism used for Carding Engines, J. H. Johnson.—(*La Société Alsacienne de Constructions Mécaniques, France.*)
5858. Reaping and Mowing Machines, A. McGregor, Manchester.
5859. Cleaning Boots, W. Carey, Bridgness.
5860. Stretching Leather on to Rollers, &c., J. Smith, Halifax.
5861. Velocipedes, H. J. Lawson and W. Phillips, Coventry.
5862. Driving Clocks by Magneto-electricity, W. Blenheim, Egham.
5863. Utilising Vapour of Volatile Liquids, &c., R. Harrison and W. Oliver, East Sunderland.
5864. Bale Band Fastenings, H. Lindon, London.
5865. Ornamental Step Ladders, A. Dormitser, London.
5866. China, J. Blair, London.
5867. Secondary Batteries, W. Kingsland, Gunnersbury.
5868. Dental Engines, W. Campbell, Dundee.
5869. Ships' Windlasses, W. H. Harfield, London.
5870. Bows for Landing Nets, J. E. Warner, Birmingham.
5871. Fastening Winches to Fishing Rods, J. E. Warner, Birmingham.
5872. Lamps, W. Cooper, London.
5873. Ventilating Railway Carriages, N. Evans, London.
5874. Cutting Cheese, &c., R. Whiteway, London.
5875. Manufacture of Hoops, J. B. Bradshaw, Sheffield.
5876. Window Fasteners, A. Barton and C. Arnold, London.
5877. Paint, A. Minter, London.
5878. Hair Pin, G. W. Young, London.
5879. Ends of Driving Belts, T. Brown, London.
5880. Self-collecting Apparatus, H. Knight, Isle of Wight.
5881. Meat Cutters, C. F. Leopold, London.
5882. Waistcoats, H. Lewis, London.
5883. Exploding Charges, F. W. Smith—(*Messrs. Klee and Koecher, Germany.*)
5884. Attaching Handles to Brooms, &c., P. G. Fletcher and J. Bradnock, London.
5885. Sewing Machines, A. F. Wileman, London.
5886. Tumbler Slip Hook for Horse Traces, &c., G. J. Hone, London.
5887. Wet Gas Meters, A. S. H. Brianthe, London.
5888. Furnaces, R. Marshall and W. Clark, London.
5889. Penholder and Blotter, G. W. Norton, London.
5890. High-pressure Tap, T. Firth, London.
5891. Cushions for Tresses, A. J. Boult.—(*H. B. Nielsen, Denmark.*)
5892. Connecting the Sides of Bedsteads to the Posts, E. Edwards.—(*C. J. Göttlich, Germany.*)
5893. Transferring Measurement, H. Hagemann, London.
5894. Cheques, &c., L. Simon, London.
5895. Bobbins, H. H. Lake.—(*H. Renard, United States.*)
5896. Sulpho-nitrosulpho and other Acids, A. Kern, London.
5897. Bridles, C. Dannhauer, London.
5898. Coverings for Cloth Samples, L. P. Leclercq, London.
5899. Explosives, P. M. E. Audouin, London.
5900. Measuring Rules, C. W. Price and R. Corsham, London.
5901. Earthenware Blocks and Tiles, J. D. Doulton, London.
5902. Photographic Lenses, T. R. Dallmeyer, London.
5903. Photographic Shutters, T. R. Dallmeyer and F. Beauchamp, London.
5904. Ball Valves, W. F. King, London.
5905. Driving Apparatus, A. Gray, London.

23rd April, 1887.

5906. Artificial Teeth, G. H. Jones, London.
5907. Tickets for Checking the Receipt of Fares, J. M. Black, London.
5908. Double Rivet Screw, P. A. Bolander, London.
5909. Forcing or Raising Beer, &c., J. and R. G. Rae, Glasgow.
5910. Teaching Music, M. Huddlestone, London.
5911. Pen-wiper and Ink-eraser Combined, H. C. Ussher, Bristol.
5912. Jacquard Multiplying Apparatus, F. Planchon, Manchester.
5913. Taking the Pitch of Screw Propellers, W. S. Cumming and D. Crawford, Glasgow.
5914. Coal Vases, E. L. Millar, Bishopston.
5915. Looms, W. H. Hacking, Manchester.
5916. Hammer Handles and Spoke Shafts, W. Cowley, Liverpool.
5917. Oil Cans, J. and G. Nickholds, London.
5918. Handles and Lids of Saucepans, &c., S. Snell, Birmingham.
5919. Decorticating, &c., Pepper Corns, F. Cross, Charlton.
5920. Perpetual Cutting Machines, F. Shaw and J. W. Senior, Halifax.
5921. Holding Wool, A. G. Klugh, London.
5922. Continual Heating Oven, &c., W. Sedgwick, Bootle.
5923. Controlling the Action of Photographic Shutters, G. S. Martin, London.
5924. Chained Wheels, L. Barlow, Manchester.
5925. Self-acting Brake, G. Kite and A. F. Williams, Cardiff.
5926. Brush for Dressing Silk, F. Fleming and J. Garside, Halifax.
5927. Preventing Smoke, J. K. Broadbent and A. Budenburg, Manchester.
5928. Piercing Holes in Walls, H. F. Richardson.—(*C. H. Bernhardt, Saxony.*)
5929. Looms for Weaving Gauzes of Doothies, J. Turner, Halifax.
5930. Portable Supports for Tarpaulins, H. Williams, Glasgow.
5931. Holding Billiard Chalk, H. Bonser, Birmingham.
5932. Working Flyer Frames, J. Heginbottom, Oldham.
5933. Oven Flues, H. Whiteside, London.
5934. Internally Stoppered Bottles, R. T. Gillibrand, London.
5935. Coke and other Forks, W. Bell, Sheffield.
5936. Adjusting Width of Fire, R. Rowbotham, London.
5937. Argand Burners, W. B. Wicken, London.
5938. Remedy for a Cough, C. Schuttyser, London.
5939. Lace Curtain and Window Blinds, J. F. Forth, London.
5940. Velocipedes, A. Easthope, London.
5941. Baster for use with Roasting Jack, H. E. Howard, London.
5942. Links, R. Coates and G. H. Thompson, Liverpool.
5543. Soles for Boots, A. J. Boult.—(*J. Wüst and A. Diamant, Austria.*)
5944. Chases, J. B. Ellis, London.
5945. Stoppering Jars, A. H. Storey, London.
5946. Stoppering Jars, A. H. Storey, London.
5947. Purses, T. Cambridge, London.
5948. Teapots, M. Law, London.
5949. Pillars, F. R. Fairbairns, London
5950. Guns, J. Platt, J., and J. Fielding, London.
5951. Motor Engines, W. D. and S. Priestman, London.
5952. Fishing Reels, W. J. Kerr, London.
5953. Acid, A. Kern, London.
5954. Projectiles, R. Low, London.
5955. Chains, G. E. Dorman, Stafford.
5956. Carriage Springs, W. James and S. Duffield, London.
5957. Colour Printing, J. Greth, London.
5958. Dynamo-electric Machines, A. M. Clark.—(*L. Maiche, France.*)
5959. Seatings for Bottles, W. B. Fitch, London.
5960. Extracting Oil, &c., from Greasy Waste, S. Schofield, Bradford.
5961. Fulling Machines, E. Kempe, London.
5962. Counter for Guns, H. W. Holland, London.
5963. Clutches or Grippers, J. Ramsay, London.
5964. Water Heaters, A. H. Crockford, London.
5965. Lubricators, R. T. Baines, London.
5966. Albums, H. A. M. Dittmar, London.
5967. Aerating Liquids, J. S. Fairfax, London.

25th April, 1887.

5968. Hats, J. H. Neave, Manchester.
5969. Braces, F. G. Hodges, Shrewsbury.
5970. Imparting Lateral Movement, to Bars in Warp Machines, J. Carver and J. Newton, Nottingham.
5971. Hot-water Apparatus, T. Heaps, Huddersfield.
5972. Attaching Telegraphic, &c., Insulators to Bolts, &c., A. Johnston, Dundee.
5973. Fish-plates, W. Farquhar, Norfolk.
5974. Printing, &c., W. R. Oswald, London.
5975. Collecting Furnace Ashes, R. Howarth, Wolverhampton.
5976. Dibbling Potatoes, J. G. Halls, Woodford.
5977. Rocking Saddle, H. Morton, Manchester.
5978. Holder for Carrying Parcels, H. A. Done, Sutton Coldfield.
5979. Pipe Cleaner and Match-box, G. W. Mohrstadt, Harborne, near Birmingham.
5980. Repeater Action for Alarm Locks, J. Cadbury and J. G. Rollason, Birmingham.
5981. Gas Motors, E. Korting, London.
5982. Filter Presses, L. A. Enzinger, London.
5983. Plough Beams, J. S. Collitt, Boston.
5984. Composition for Cleaning Textile Fabrics, E. J. Bates, Liverpool.
5985. Spinning Machinery, J. Wallace, jun., Belfast.
5986. Fuel, G. Beal, Liverpool.
5987. Matches, M. A. Whitley, Bradford.
5988. Signalling, Messrs. Dinnes and Middleton and J. Henry, Aberdeen.
5989. Propellers, O. E. Pohl, Liverpool.
5990. Furnaces, H. Cotton and R. Moon, Liverpool.
5991. Indicator, A. C. E. Howe, P. Foord, and W. Barber, London.
5992. Stoppered Bottles, D. Rylands and G. Bedford, Barnsley.
5993. Fastenings, J. Ruscoe, Cheshire.
5994. Buckles, C. C. Ellis, London.
5995. Pens, J. Blair, London.
5996. Riding Galleries, J. H. Small, London.
5997. Scissor Sharpener, F. Perrins, Birminghom.
5998. Gun, B. W. Stevens, Birmingham.
5999. Pantograph, —. Sielaf, M. Sielaf, M. Holcker, and S. Cohn, Surrey.
6000. Candle Machines, H. A. Biertumpfel London.
6001. Safety Whip Socket, W. Wright and C. T. W. Piper, Devonport.
6002. Damping Dust in Collieries, &c., H. W. Martin and J. Turnbull, London.
6003. Preserving Animal and Vegetable Substances for the Food of Man, R. Jones, London.
6004. Friction Clutch, R Heywood and D. Bridge, Manchester.
6005. Leather Lace and Strip Cutting Machine, H. E. Newstead and W. Hartley, Otley.
6006. Potato Planting Appliances, E. Buckle, Prestwich, near Manchester.
6007. Condensing Steam, &c., J. and G. Weir, Glasgow.
6008. Candle and Lamp Holders, W. B. Challice, London.
6009. Female Attire, J. Onions and J. Cooper, London.
6010. Rotary Hair Brush, F. A. Richardson, London.
6011. Watch Swivel, W. W. Philp, London.
6012. Levelling Billiard and other Tables, E. W. Perry, London.
6013. Governors for Regulating the Speed of Steam Engines, &c., J. H. Street and Tangyes, London.
6014. Automatic Measure Funnel, H. O Dahms, London.
6015. Paper Bags, S. Cropper, London.
6016. Display and Retail Devices for Fancy Paper, &c., A. J. Boult.—(*D. J. O'Sullivan, United States.*)
6017. Recording Number of Passengers, R. Foulkes and W. Hutchinson, Liverpool.
6018. Purifying Hydrocarbon Oil, A. J. Boult.—(*D. M. Kennedy, Canada.*)
6019. Rests for Billiard Cues, A. J. Eli and F. Hughes, London.
6020. Spinning, &c., Machines, C. W. Lancaster and E. Thormann, London.
6021. Drainage of Houses, A. Le Marquand, London.
6022. Explosives, J. H. Johnson.—(*F. Engel, Germany.*)
6023. Pressing, &c., Woollen and other Fabrics, T. Holroyd, London.
6024. Pressing Woollen, &c., Fabrics, T. Holroyd, London.
6025. Withering, &c., Tea, W. H. Gilruth, London.
6026. Fixing Pictures, Frames, &c., W. S. Simpson, London.
6027. Window Fastener, A. E. Rhodes, London.
6028. Miners' Safety Lamps, A. Schanschieff, Gipsy Hill.
6029. Metallic Sulphates, W. N. Hartley and W. E. B. Blenkinsop, London.
6030. Sleeper, G. F. Redfern.—(*F. Coblyn, Belgium.*)
6031. Stoppers, &c., for Bottles, H. L. Phillips, London.
6032. Preserving, &c., Sensitive Plates, E. Edwards.—(*Messrs. Koppe and Moh, Germany.*)
6033. Printing in Colours, H. C. A. Ffrost, London.
6034. Preparation of Aerated Waters, L. Keck, London
6035. Terne-plates, C. Morris and G. Birkbeck, London.
6036. Leather Roller Covers, W. Kaulhausen, London.

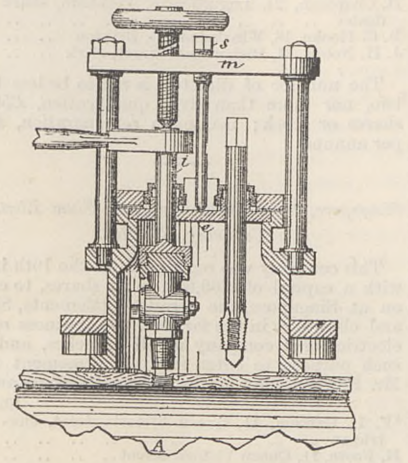
SELECTED AMERICAN PATENTS.

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

358,445. Machine for Tapping Mains, *O. B. Hall, Malden, Mass.—Filed December 11th, 1886.*

Claim.—(1) The combination, with a pipe tapping machine arranged to operate substantially as described, of a stud arranged to be forced downward upon the centre of the rotary tool carrying plate, substantially as specified. (2) In a pipe tapping machine, the com-

358,445

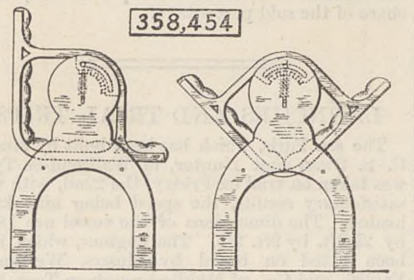


bination with body A, bar *m*, supported above and by said body, rotary plate *e*, carrying the drill-tap and carrier *i*, and means for depressing said tools, of stud *s*, arranged to be forced against the centre of said plate and to resist the upward pressure thereon, substantially as specified.

358,454. Car Seat, *C. W. Johnson, Philadelphia, Pa.—Filed November 25th, 1885.*

Claim.—In a car seat, the combination, with a vertical end piece which forms a support and consists of a frame designed and adapted to be fixed in position, and having a circular groove on its upper edge, and a movable frame which forms the end piece of a swinging or reversible seat and the connecting medium for the back and seat portions, said movable frame having

358,454

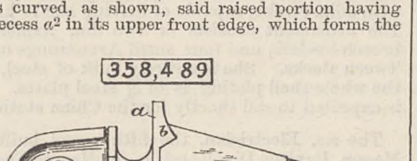


a notched quadrant which enters the groove in the vertical support and having also a curved slot, of a connecting bolt which passes through an opening in the vertical support and through said curved slot in the movable frame, and a spring bolt having its bearings on the said fixed support and engaging with said notched quadrant substantially as shown and described.

358,488. Guard Finger, *W. H. Sharood, South Toledo.—Filed February 11th, 1886.*

Claim.—The combination, with the finger having the raised portion in front of its shank projected laterally, forming the horns *a a*, which have their forward edges curved, as shown, said raised portion having the recess a^2 in its upper front edge, which forms the

358,489

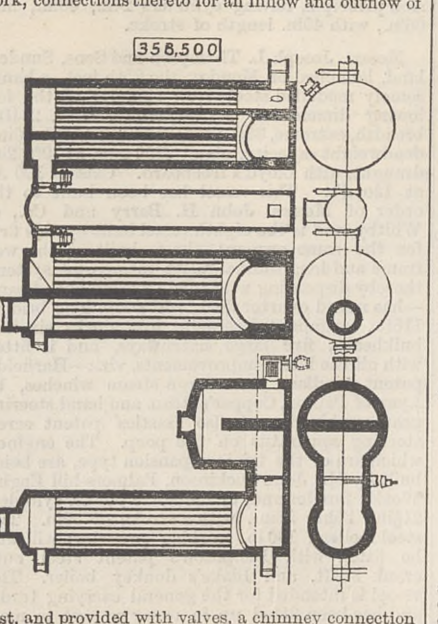


ridge *a'*, of the ledger plate having the shank B' seated in the recess, fitted snugly against the ridge, and provided with the wings *b*, which are curved on their rear edges, overlap, and fit closely against the curved forward edges of the horns, as and for the purpose set forth.

358,500. Hot-blast Stove, *V. O. Strobel, Philadelphia, Pa.—Filed May 15th, 1886.*

Claim.—(1) A hot-blast stove containing regenerative work, connections thereto for an inflow and outflow of

358,500

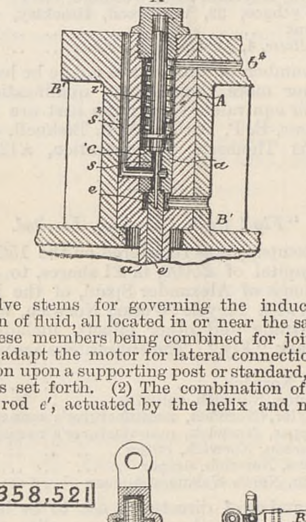


blast, and provided with valves, a chimney connection thereto provided with a valve, a combustion chamber exterior to the stove, a gas inlet to the combustion chamber, a connection leading from the combustion chamber to the stove, and a valve in said last-mentioned connection, combined substantially as and for the purpose set forth. (2) A hot-blast stove containing regenerative work, connections thereto for the inflow and outflow of blast, and provided with valves, a chimney connection thereto provided with a valve, a combustion chamber exterior to the stove, a valve in the last-mentioned connection, a gas inlet at the base of the combustion chamber, and a partion wall rising from the base of the combustion chamber toward the roof thereof, between the gas inlet and the gas connection to the stove, combined substantially as and for the purpose set forth. (3) A hot-blast stove containing regenerative work, connections thereto for the inflow and outflow of blast, and provided with valves, a chimney connection thereto provided with a valve, a combustion chamber exterior to the stove, a connection leading from the combustion chamber to the stove, a valve in said last-mentioned connection, a gas inlet to the combustion chamber, and a gas burner disposed exterior to the combustion chamber at said gas inlet and connecting with a source of gas and air supply, combined substantially as and for the purpose set forth. (4) Two or more hot-blast stoves containing regenerative work, connections thereto for the inflow and outflow of blast, and provided with valves, chimney connections thereto provided with valves, a combustion chamber, a gas inlet to the combustion chamber, connections leading from the combustion chamber to the stoves, and valves in said last-mentioned connections, combined substantially as and for the purpose set forth.

358,521. Electrically Actuated Fluid Pressure Motor, *G. Westinghouse, Jr., Pittsburgh, Pa.—Filed August 30th, 1886.*

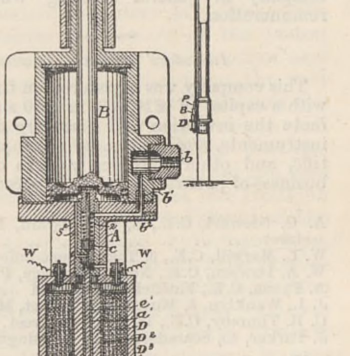
Claim.—(1) In an electrically actuated fluid pressure motor, the combination of a helix or coil, an armature, a valve moving rod actuated thereby, a cylinder, a main piston and stem working therein, and valves

358,521



and valve stems for governing the induction and eduction of fluid, all located in or near the same axial line, these members being combined for joint operation to adapt the motor for lateral connection to and operation upon a supporting post or standard, substantially as set forth. (2) The combination of helix or coil D', rod *c'*, actuated by the helix and moving in

358,521

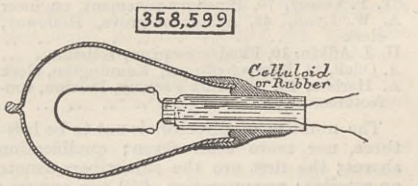


or nearly in the axial line of such helix, valve stems *e z'*, valves *c c'*, spring z^2, and suitable arrangement of fluid pressure ports from the supply port to the main cylinder and from such cylinder to the open air, substantially as set forth. (3) The bushing A, closed at one end by plug A', in combination with valve block *a*, valves *c c'*, and ports *s*, *s'*, s^2, and s^3, and electrically actuated valve moving rod *c'*, substantially as set forth.

358,599. Incandescent Electric Lamp, *T. A. Edison, Menlo Park, N.J.—Filed November 28th, 1881.*

Claim.—In an incandescent electric lamp, the combination, with the open mouthed glass globe and the

358,599

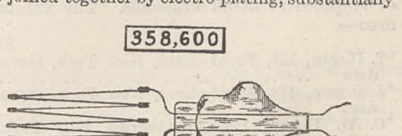


glass wire support entering centrally the mouth of said globe, of a hardened plastic material applied to the outside both of the wire support and of the globe, forming an air-tight joint between them, substantially as set forth.

358,600. Incandescent Electric Lamp, *T. A. Edison, Menlo Park, N.J.—Filed August 7th, 1882.*

Claim.—(1) An incandescent conductor for an electric lamp, composed of two or more carbon filaments joined together by electro-plating, substantially

358,600



as set forth. (2) The combination in an electric amp of two or more carbon filaments joined together by electro-plating, and leading in wires connected with such carbon filaments by electro-plated joints, substantially as set forth.