PROPOSITIONS ON THE DIRECT MOTION OF STEAM VESSELS.

By ROBERT MANSEL, Glasgow.

A STEAM vessel propelled at the observed speed V nautical miles per hour, by direct-acting compound engines, making N revolutions per minute, and developing power at the rate of E indicated horses; the diameter and stroke of the high-pressure cylinder being denoted by d and s, the ratio of the areas of the two pistons by r, and the mean diagram pressures upon the unit—one square inch—of these pistons by P and p (for the high and low-pressure pistons), respectively, we have the relation:

$$E = \frac{d^2 s}{21{,}010} N (P + r p). \quad . \quad . \quad . \quad (a).$$

For the obvious reason:
Power developed in high-pressure cylinder =

$$\frac{\pi d^2}{4} \times \frac{2 s N \times P}{33{,}000}.$$

Power developed in low-pressure cylinder =

$$\frac{\pi r d^2}{4} \times \frac{2 s N \times p}{33{,}000}.$$

Consequently, sum $E = \frac{d^2 s}{21{,}010} N (P + rp)$.

Hence, in any case, when we have given E, N, d and s, we obtain the unit piston pressures corresponding to the power, referred to the high-pressure cylinder alone, by the obvious formula—

$$(P + rp) = \frac{21{,}010\ E}{d^2 s N} \quad . \quad . \quad . \quad . \quad (b)$$

In the next place, so long as the movement takes place under precisely the same conditions, other than differences in the amount of developed power, at different trial speeds, the following set of conditions, expressed in six propositions, are satisfied:—

Proposition (I.).—The logarithms of the sum of the unit piston pressures increase from the value log. f at the origin, by the product of a small constant quantity of the form $(a - n)$, by the speed. Or in symbols—

$$\text{Log.}\ (P + r p) = \text{Log.}\ f + (a - n)\ V. \quad . \quad (I.)$$

Proposition (II.).—The logarithms of the number of revolutions for each mile of speed increase from the value log. m at the origin, by the product of a small number n, by the speed. Or, in symbols—

$$\text{Log.}\ \frac{N}{V} = \text{Log.}\ m + n\ V. \quad . \quad . \quad (II.)$$

Proposition (III.).—The logarithms of the gross indicated horse-power for each mile of speed increase from the value log. b at the origin, by the product of a small number a, by the speed. Or, in symbols—

$$\text{Log.}\ \frac{E}{V} = \text{Log.}\ b + a\ V. \quad . \quad . \quad (III.)$$

Proposition (IV.).—The logarithms of the effective unit piston pressures for each mile of speed increase from the value log. l at the origin, by the product of a small number of the form $(a + g)$, by the speed. Or, in symbols—

$$\text{Log.}\ \frac{P + r p - f}{V} = \text{Log.}\ l + (a + g)\ V \quad (IV.)$$

Proposition (V.).—The constant deduction from the unit piston pressures, to give the effective piston pressures (denoted by the symbol f in Propositions (I.) and (IV.); known in mechanics as *Morin's constant*). Has, for each trial speed, the value of its logarithm, equal to the differences of the logarithms of the power and revolutions for those speeds. After these, respectively, have been diminished by the sum of the constant quantity, Log. $\frac{d^2 s}{21{,}010}$, added to the values of the quantities $(a - n)$ V, for those speeds, as per Proposition (I.). Or, in symbols—

$$\text{Log.}\ f = \text{Log.}\ E - \text{Log.}\ N - \left\{ \text{Log.}\ \frac{d^2 s}{21{,}010} + (a - n) V \right\} \ (V.)$$

Proposition (VI.).—The logarithms of the gross indicated powers required for given speeds of a vessel are equal to the logarithms of the power absorbed in overcoming the constant pressure (determined by the preceding proposition) upon the pistons, at the rate of travel, increased, for each speed, by the product $(a - n)$ V, as determined by Proposition (I.). Or, in symbols—

$$\text{Log.}\ E = \text{Log.}\ \frac{d^2 s}{21{,}010} N f + (a - n) V \quad (VI.)$$

These six propositions, collected and written in the ordinary algebraic notation, are as follows:—

$$(P + rp) = f\ \text{Log.}^{-1}\ (a - n)\ V \quad . \quad . \quad . \quad . \quad . \quad . \quad (I.)$$
$$N = m\ V\ \text{Log.}^{-1}\ n\ V \quad . \quad . \quad . \quad . \quad . \quad . \quad (II.)$$
$$E = b\ V\ \text{Log.}^{-1}\ a\ V \quad . \quad . \quad . \quad . \quad . \quad . \quad (III.)$$
$$(P + rp - f) = l\ V\ \text{Log.}^{-1}\ (a + g)\ V \quad . \quad . \quad . \quad . \quad (IV.)$$
$$f = \frac{21{,}010}{d^2 s} \frac{E}{N} \frac{1}{(a - n)\ V} \quad . \quad . \quad . \quad . \quad (V.)$$
$$E = \frac{d^2 s}{21{,}010} N f\ \text{Log.}^{-1} \left\{ (a - n)\ V \right\} \ (VI.)$$

It is, of course, to be understood: the various quantities, denoted by the small letters, have their special values in different vessels; and not only so, but in the same vessel, these quantities, although they may remain constant through a considerable range of speeds, may be found to change to other values through another range of speeds. Fine, full-powered vessels, such as torpedo boats, usually present three sets of values. Again, from the simplicity of these formulas, it is at once apparent, when in the logarithmic form, the first members of the four first propositions represent points in a straight line defined, according to the principles of co-ordinate geometry, by two necessary data—the ordinate at the origin, and the angle of its inclination to the axis. The initial constant of the second member is the first of these, and the natural tangent of the angle of inclination is the factor of V in the inverse logarithmic functions $\text{Log.}^{-1}\ (a - n)$ V, $\text{Log.}^{-1} a$ V, &c. In this graphical treatment the speeds are taken, as abscissas *in natural numbers*, and at points in this axis corresponding to the trial speeds, we set up as ordinates, not the natural numbers, but the *common logarithms* of the ordinates. The upper ends of these will then be found to range in the inclined straight lines we have described; and slight aberrations from such lines will have to be studied in order to condescend upon the most probable values of the observation data. We must bear in mind: the element of so much importance—the true speed through the water—is not capable of direct observation. In almost every case, from the occurrence of tidal or wind drift, the observed speeds may differ very considerably from the true speeds; and the usual methods of correcting these, by taking means of the averages of different runs, with and against the drift, does not wholly remove errors arising from variations in the rate of drift during the time occupied by the trials. In Proposition (V.) out of the variable elements presented by the problem of steamship propulsion, *one* has been evolved which is, or ought to be, constant! If not so, the discrepancy can be traced to a faulty method or mere error of observation; and where well-defined and continuous differences are apparent, can then be shown to be due to changed conditions, due to hitherto undefined and not understood causes. I shall now proceed to partially illustrate the application of these propositions to a few examples; and if some of them may have already been referred to in my letters, the importance of the subject will, I think, justify the sacrifice of some space to their restatement. I would here remark, the various propositions are not independent of each other; they mutually are involved in, and justify each other; also, from its nature, Proposition (V.) is but slightly affected by one very fertile source of error, viz., incorrect noting of the revolutions. Therefore, its application better enables us to deal with and localise errors in the observation of speeds and diagram pressures. From the "Admiralty Tables" of Trial Data, let us now consider a simple case—say, one of the trials of her Majesty's steamship Constance.

EXAMPLE NO. I.—*H.M.S.S. Constance.*

Trial speeds. V	Revolutions. N	Indicated powers. E	Values Log. $\frac{E}{N}$.
9·94	74·8	800	1·0292
12·07	92·0	1538	1·2232
13·72	106·8	2522	1·3731

Also, Log. $\frac{d^2 s}{21{,}010} = -1{\cdot}5109$.

Now divide the difference of the first and last of the values of Log. $\frac{E}{N}$, by the difference of their corresponding speeds. We obtain—Proposition V.—

$$a - n = \frac{1{\cdot}3731 - 1{\cdot}0292}{13{\cdot}72 - 9{\cdot}94} = \frac{{\cdot}3439}{3{\cdot}78} = {\cdot}091.$$

Hence the following calculation:—

H.M.S.S. Constance.

Trial speeds ..	=	9·94	12·07	13·72	
Product ·091 V ..	=	·9045	1·0984	1·2485	
Log. $\frac{d^2 s}{21{,}010}$ ..	=	−1·5109	−1·5109	−1·5109	
Sum	=	·4154	·6093	·7594	
Subtract from Log. $\frac{E}{N}$	=	1·0292	1·2232	1·3731	
Leaves Log. f ..	=	·6138	·6139	·6137	A practical justification of the *constancy* of this quantity.

Hence, mean value Log. f = ·6138, and f = 4·11 lb. Next, determine values Log. E, by Proposition VI.

Since Log. $\frac{d^2 s}{21{,}010}$	=	−1·5109	−1·5109	−1·5109	
Log. f as above ..	=	·6138	·6138	·6138	
Log. N	=	1·8739	1·9638	2·0286	
Sum	=	1·9986	2·0885	2·1533	= Logs. of work done on the constant resistance f = 4·11 lb.
Add ·091 V	=	·9045	1·0984	1·2485	= Log. of factor giving gross work done on all resistances.
By Proposition VI. Log. E	=	2·9031	3·1869	3·4018	
By trial diagrams, Log. E	=	2·9031	3·1870	3·4017	Practically, in perfect agreement.

EXAMPLE NO. II.—*H.M.S.S. Iris.* (*Fifth Set of Trials.*)

Trial speeds.	Revolutions.	Indicated power.	Values, Log. $\frac{E}{N}$.
12·63	63·33	2278	1·5560
16·16?	82·41	4930	1·7768
17·98	94·41	7333	1·8903

Also, Log. $\frac{d^2 s}{21{,}010} = -1{\cdot}6813$

By Proposition V., $a - n = \frac{1{\cdot}8903 - 1{\cdot}5560}{17{\cdot}98 - 12{\cdot}63} = {\cdot}0625.$

Again, as in the preceding case—

Trial speeds ..	=	12·63	16·16	17·98	
Product ·0625 V	=	·7894	1·0100	1·1238	
Log. $\frac{d^2 s}{21{,}010}$ ..	=	−1·6813	−1·6813	−1·6813	
Sum	=	·4707	·6913	·8051	
Subtract from Log. $\frac{E}{N}$	=	1·5560	1·7768	1·8903	
Leaves Log. f ..	=	1·0853	1·0855	1·0852	A practically constant quantity.

Hence, mean value log. f = 1·0853, and f = 12·17. Next determine values Log. E as follows:—

Since Log. $\frac{d^2 s}{21{,}010}$	=	−1·6813	−1·6813	−1·6813	
And Log. f	=	1·0853	1·0853	1·0853	
Also Log. N	=	1·8016	1·9160	1·9750	
Sum	=	2·5682	2·6826	2·7416	= Logs. of work done on the constant resistance f = 12·17.
Add ·0625 V	=	·7894	1·0100	1·1238	= Logs. of factor giving gross work on all resistances.
By Proposition V., Sum, Log. E ..	=	3·3576	3·6926	3·8654	
By trial diagrams, Log. E	=	3·3576	3·6928	3·8658	Practically, in perfect agreement.

In this last example I would explain: The second speed has been taken at 16·16 knots, instead of 16·07 knots, the reported speed by the Admiralty table. As explained, the insufficient method of eliminating tidal drift variations leaves residual errors which may either increase or diminish the deduced speed; and it will readily be seen the value 16·07 would neither render the quantity Log. f constant nor give the true value of Log. E, whereas both are satisfied by the value V = 16·16. In the same way, in the following example, the speed for trial (3), given as 12·43 knots, ought to be 12·49 knots, very nearly, as follows:—

EXAMPLE NO. III.—*H.M.S.S. Heroine.*

Trial speeds.	Revolutions.	Indicated power.	Values, logs. $\frac{E}{N}$.
9·16	76·2	471	·7910
11·47	97·1	922	·9777
12·49	108·1	1243	1·0607
13·12	113·2	1466	1·1123

Also, log. $\frac{d^2 s}{21{,}010} = -1{\cdot}1881$

Thus, by Proposition V., we have

$$(a - n) = \frac{1{\cdot}1123 - {\cdot}7910}{13{\cdot}12 - 9{\cdot}16} = \frac{{\cdot}3213}{3{\cdot}96} = {\cdot}081$$

Again, Trial speeds	=	9·16	11·47	12·49	13·12	
Products ·081 V	=	·7420	·9291	1·0117	1·0627	
Add Log. $\frac{d^2 s}{21{,}010}$	=	−1·1881	−1·1881	−1·1881	−1·1881	
Sums, from	=	−1·9301	·1172	·1998	·2508	
Logs. $\frac{E}{N}$	=	·7910	·9777	1·0607	1·1123	
Leaves Log. f	=	·8609	·8605	·8609	·8615	Practically, a constant quantity.

Mean value Log. f = ·8610, and f = 7·261 lb. Next, determine values Log. E, by Proposition VI.

Since, Log. $\frac{d^2 s}{21{,}010}$	=	−1·1881	−1·1881	−1·1881	−1·1881	
And, Log. f ..	=	·8610	·8610	·8610	·8610	
Also, Log. N ..	=	1·8820	1·9872	2·0338	2·0538	
Sum	=	1·9311	2·0363	2·0829	2·1029	= Logs. of work done on the constant resistance, f = 7·261 lb.
Add ·081 V	=	·7420	·9291	1·0117	1·0627	= Logs. of factor giving gross work on all resistances.
By Proposition VI. sum, Log. E ..	=	2·6731	2·9654	3·0946	3·1656	
By Trial diagrams, Log. E	=	2·6730	2·9647	3·0945	3·1661	Practically, in agreement.

Example, No. IV.—A merchant single-screw steam vessel, built by Messrs. Denny, Dumbarton; and in this, and, indeed, in nearly every case, a slight drift correction is necessary. The speed for the second trial, given at 9·20 knots, ought to be only 9·10 knots, as will appear from the following calculations:—

EXAMPLE NO. IV.—*S.S. Merkara,—Messrs. Denny Brothers, Dumbarton.*

Trial Speeds.	Revolutions.	Indicated power.	Values Log. $\frac{E}{N}$.
6·20	31·15	299	·9815
9·10	44·75	718	1·1989
11·09	54·35	1225	1·3525
12·91	63·23	1948	1·4889

Also Log. $\frac{d^2 s}{21{,}010} = -1{\cdot}6238$

By Proposition V.—

$$(a - n) = \frac{1{\cdot}4889 - {\cdot}9815}{12{\cdot}91 - 6{\cdot}20} = \frac{{\cdot}5074}{6{\cdot}71} = {\cdot}0756.$$

Again—

Trial speeds	=	6·20	9·10	11·09	12·91	
Products ·0756 V	=	·4687	·6880	·8384	·9760	
Add Log. $\frac{d^2 s}{21{,}010}$	=	−1·6238	−1·6238	−1·6238	−1·6238	
Sums, from ..	=	·0925	·3118	·4622	·5998	
Logs. $\frac{E}{N}$ ..	=	·9815	1·1989	1·3525	1·4889	
Leaves Log. f	=	·8890	·8871	·8903	·8891	Practically, a constant quantity.

Mean value Log. f = ·8888, and f = 7·74 lb. Next, determine Logs. E by Proposition VI.—

Since Log. $\frac{d^2 s}{21{,}010}$	=	−1·6238	−1·6238	−1·6238	−1·6238	
And Log. f ..	=	·8888	·8888	·8888	·8888	
Also Log. N ..	=	1·4942	1·6572	1·7356	1·8007	
Sum	=	2·0068	2·1698	2·2482	2·3133	= Logths. of work done on the constant resistance f = 7·74 lb.
Add ·0756 V ..	=	·4687	·6880	·8384	·9760	= Logs. of factor to give gross work done on all the resistances.
By Proposition VI. Log. E ..	=	2·4755	2·8578	3·0866	3·2893	
By trial diagrams	=	2·4757	2·8561	3·0881	3·2896	—Obviously, a very close agreement.

Example No. V.—The merchant paddle steam vessel Prins Hendrik, built by Messrs. Elder and Co. In this trial data three speeds are given, but that of the second given as 14·19 knots, the true drift correction would have raised to 14·25 knots, as will appear from the following calculation:—

P.S. Prins Hendrik.—Messrs. Elder and Co., Glasgow, 1880.

Trial Speeds.	Revolutions.	Indicated power.	Values of Logs. $\frac{E}{N}$.
12·18	21·87	1259	1·7602
14·25	25·50	2032	1·9014
16·72	31·30	3678	2·0701

Also Log. $\frac{d^2 s}{21{,}010} = {\cdot}0791$

By Proposition V.—

$$a - n = \frac{2{\cdot}0701 - 1{\cdot}7602}{16{\cdot}72 - 12{\cdot}18} = \frac{{\cdot}3099}{4{\cdot}54} = {\cdot}06826.$$

Trial speeds	=	12·18	14·25	16·72	
Products ·06826 V	=	·8314	·9727	1·1413	
Add log. $\frac{d^2 s}{21{,}010}$ ..	=	·0791	·0791	·0791	
Sum, taken from	=	·9105	1·0518	1·2204	
Logs. $\frac{E}{N}$	=	1·7602	1·9014	2·0701	
Leaves Log f ..	=	·8497	·8496	·8497	A constant quantity, ∴ f = 7·074 lb.

And we next determine the values of Log. E for these speeds by Proposition VI.

Thus, Log. $\frac{d^2\,s}{21{,}010}$	=	·0791	·0791	·0791	
And Log. f	=	·8497	·8497	·8497	
Also Log. N.. ..	=	1·3398	1·4065	1·4955	
Sum	=	2·2686	2·3353	2·4243 =	Logs. of work done on the constant resistance.
Add ·06826 V ..	=	·8314	·9727	1·1413 =	Logs. of factor giving corresponding gross work done on all the resistances.
Hence Log. E ..	=	3·1000	3·3080	3·5656	
By trial diagrams	=	3·1000	3·3079	3·5656	The agreement in this case is perfect.

Example No. VI.—I shall conclude these examples, for the present, by the progression speed trials of H.M. s.s. Shah, a vessel having a single screw, with the ordinary equal cylinder engines. This vessel I have often referred to, and it is interesting, from the fact that at the highest trial speed, the change of conditions and constants I have written so much about is just taking place, and its effect upon the highest speed may be made obvious.

EXAMPLE No. VI.—*H.M.S.S. Shah.*

Trials.	Trial speeds.	Revolutions.	Indicated power.	Value Log. $\frac{E}{N}$.
(1) ..	5·32 ..	20·11 ..	318 ..	1·1990
(2) ..	8·01 ..	29·71 ..	772 ..	1·4147
(3) ..	12·13 ..	45·43 ..	2506 ..	1·7417
(4) ..	16·45 ..	65·35 ..	7477 ..	2·0585

Also, Log. $\frac{d^2\,s}{21{,}010}$ = ·4161

In this case, we apply Proposition V. to the differences of trials (3) and (1), which yield:

$$(a-n) = \frac{1{\cdot}7417 - 1{\cdot}1990}{12{\cdot}13 - 5{\cdot}32} = \frac{{\cdot}5427}{6{\cdot}81} = {\cdot}0797.$$

And, as previously—

Trial speeds	=	5·32	8·01	12·13	16·45
Product ·0797 V ..	=	·4240	·6390	·9668	1·3111
Add Log. $\frac{d^2\,s}{21{,}010}$ ..	=	·4161	·4161	·4161	·4161
Sum, taken from	=	·8401	1·0551	1·3829	1·7272
Log. $\frac{E}{N}$	=	1·1990	1·4147	1·7417	2·0585
Leaves Log f ..	=	·3589	·3596	·3588	·3313

Here the value of f is very small, and an average of the three lowest speeds would give f = 2·286 lb. An intelligent examination of the data will show; that, at the highest speed, the engines have began to race, and an abnormal and changed condition of circumstances is being established, and directly indicated by the reduced value, f = 2·144, of the constant. Now apply Proposition VI. We obtain:—

Log. $\frac{d^2\,s}{21{,}010}$	=	·4161	·4161	·4161	·4161	
Log. f ..	=	·3590	·3590	·3590	·3313	Note, in (4), f changes from 2·286 to 2·144 lb.
Log. N ..	=	1·3034	1·4729	1·6573	1·8152	
Sum.. ..	=	2·0785	2·2480	2·4324	2·5626	= Logs. of work done on the constant resistance.
Add ·0797 V	=	·4240	·6390	·9668	1·3111	= Logs. of factor, giving the corresponding gross work on all resistances.
Hence Log. E	=	2 5025	2·8870	3·3992	3·8737	
By trial Diagrams	=	2·5024	2·8876	3·3990	3·8737	Also a practically perfect agreement.

There should be little difficulty in following out the *rationale* of deducing the gross power by multiplying the power expended on "Morin's constant" by the transcendental factor, $\text{Log.}^{-1}\,(a-n)\,\text{V}$.

The fundamental, axiomatic equation,

$$E = \frac{d^2\,s}{21{,}010}\,N\,(P + r\,p)$$

has only to be modified by writing in it, for $P + r\,p$, the equivalent value, by Proposition I., $f\ \text{Log.}^{-1}\,(a-n)\,\text{V}$, and we then have,

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

Now, the first part of this, $\frac{d^2\,s}{21{,}010}\,N\,f$, is simply the amount of power corresponding to the pressure f acting upon the given engines at the rate of N revolutions per minute, which, when multiplied by the number whose common logarithm is the quantity $(a-n)\,\text{V}$, will necessarily give the gross power E, which is expressed by the factor, as usually written, $\text{Log.}^{-1}\,(a-n)\,\text{V}$.

WAGES IN GREAT BRITAIN.

No. XII.

Tunstall.—The chief industry of this district is the manufacture of china, earthenware, and all descriptions and grades of pottery, except the very lowest kind, such as common stoneware. In the various kinds of employment pertaining to this industry are engaged about one-fourth of the population of the district. There are in North Staffordshire extensive coal and ironstone mines, blast furnaces, works for the manufacture of iron, machinery, &c. The feeling between employer and employed may be described as friendly, but not cordial. Labour is well organised; and, on the other hand, there are associations of capitalists, such as the Coal and Ironmasters' Association, and the Pottery Masters' Association, which deal with all matters relating to their respective trades. Together with the North Staffordshire Chamber of Commerce, they look after, suggest, and try to promote legislation respecting the staple trades of the district, make recommendations and suggestions in the matter of negotiations, commercial treaties, collect information as to foreign tariffs, &c. Strikes are not particularly frequent, but do occur from time to time, such as the potters' strike in 1881, and the colliers' strike in 1882. The potters' strike was directly connected with the arbitration system, the men being dissatisfied with the awards, and refusing to be bound by the system any longer. On the whole, arbitration between employers and employed in this district has had only a doubtful success. Of all the co-operative societies in this district only one or two have been successful. The movement has not been sufficiently strong to have any appreciable effect on the trade of the district, but their failure has had the effect in some instances of reconciling the men to the methods of the employers, and teaching them that capital as well as labour has its misfortunes and troubles. The habits of the working classes will in this district compare favourably with those of any large bodies of operatives in similar grades of employment and earning similar wages.

Average Wages Paid per Week in the District of Tunstall.

	s.	d.
General trades:—		
Bricklayers	31	11
Carpenters	31	11
Masons	31	11
Blacksmiths	28	5
Strikers	20	3
Brassfounders	31	11
Horseshoers	20	3
Iron moulders—Bilston	29	11
,, Butterley	29	11
,, Dudley	29	11
,, Hanley	31	9
,, Stourbridge	31 / 29	9 / 11
Millwrights	28	5
Nailmakers (hand)	16	3
Labourers	18	5

Wages Paid to Members of Trades' Unions.

		s.	d.
Bricklayers—Dudley	per hour	0	7
,, Ironbridge	per week	25	0
,, Shrewsbury	per hour 6½d. and		7
Carpenters—Shifnal	per hour		6
Ironfounders—Stourbridge	per week	30	0

Wages Paid per Week in the Manufacture, Rolling, Smelting, &c., of Iron in North Staffordshire.

	s.	d.
Blast furnaces:—		
Chargers	30	3
Coke fillers	30	0
Enginemen	31	9
Keepers	*39	0
Lime fillers	30	0
Mine fillers	29	6
Slaggers	30	0
Weighmen	21	3
Labourers	17	6
Puddling:—		
Ash wheelers	17	9
Bar drawers	*27	0
Cinder burners	18	9
Coal unloaders	15	9
Hammer drivers	14	8
Helpers	16	9
Metal breakers	26	3
,, wheelers	26	0
Puddlers	*32	0
Rollers	*33	6
Roll turners	30	6
Shinglers	*33	4
Stock takers	*28	9
Weighers	*30	6
Labourers	14	9
Bar rolling:—		
Ash wheelers	17	8
Bloomers	*39	6
Bogiemen	17	9
Bolter down or rougher	24	0
Catchers	14	9
Chargers	13	6
Coal wheelers	15	9
Cutters down	19	0
Furnacemen	*33	6
Rollers	*39	6
Roll turners	30	9
Sawmen	21	9
Straighteners	21	6
Labourers	14	9
Plate and sheet rolling:—		
Bloomers	*51	9
Bolter down or rougher	28	9
Chargers	13	6
Cutters down	*42	3
Furnacemen	47	0
Heavers over or hookers	25	0
Helpers	25	0
Pilers	27	0
Plate loaders	20	0
Rollers	*52	0
Roll turners	30	9
Shearers	*42	6
Stock takers	20	0
Weighers	20	0
Wheelers	27	0

* Piecework.

Wages Paid per Week in connection with the Manufacture, Rolling, Smelting, &c., of Iron in North Staffordshire to:—

	s.	d.
Boilermen	27	0
Enginemen	23	0
Fitters	28	9
Smiths	24	0

Wages Paid per Week in Ironfoundries, Machine Shops, &c., in North Staffordshire.

	Lowest. s.	d.	Highest. s.	d.
Air furnace men	25	0	30	9
Blacksmiths	26	9	34	6
Strikers	15	0	21	0
Boilermakers	26	9	36	6
Borers	21	0	27	0
Drillers	20	0	27	0
Engineers	32	6	40	6
Enginemen	23	0	28	9
Fitters	28	6	34	6
Holders up	23	0	27	0
Millwrights	32	6	40	6
Moulders	—		32	9
Pattern makers	32	6	34	6
Assistants	19	0	23	0
Planers	23	0	27	0
Platers	34	6	38	6
Rivetters	27	0	32	6
Rivet heaters' boys	7	6	9	6
Screwers	20	0	27	0
Slotters	21	0	27	0
Turners	28	6	32	6
Labourers	17	0	21	0

Wages Paid per Week to Railway Employés in the District of Tunstall.

	Lowest. s.	d.	Highest. s.	d.
Engine department:				
Examiners	—		27	10
Fitters	—		35	6
Foremen	40	7	60	8
Under	–		40	7
Inspectors	—		40	7
Road department:				
Foremen	—		30	5
Inspectors	—		40	7
Platelayers	—		20	3
Station department:				
Brakesmen	—		30	5
Foremen	—		30	5
Inspectors	40	7	60	10
Shunters	—		28	5
Signalmen	—		27	10
Labourers	—		20	3

Wages Paid per Week to Corporation Employés in the Town of Burslem.

	s.	d.
Drainers	21	3
Enginemen	35	6
Highway foremen	35	6
Paviors	30	5
Labourers	20	0

Wages Paid per Week in Ironstone Mining in North Staffordshire.

	Hours.	Lowest. s.	d.	Highest. s.	d.
Banksmen	54	19	0	23	0
Colliers	54	—		23	0
Enginemen	84	—		26	0
Firemen	54	—		26	0
Furnacemen	84	—		16	9
Horsekeepers	54	—		23	6
Loaders	54	—		18	6
Overmen	54	—		39	0
Ruckers	54	—		20	9
Shaftmen	54	20	6	23	6
Smiths	58	—		23	6
Stokers	84	—		20	8
Timberers	54	20	6	26	0
Tunnellers	54	21	0	27	0
Wagonwrights	58	—		26	6
Weighmen	54	—		24	0

Wages Paid per Week in Coal Mining in North Staffordshire.

	Hours.	s.	d.
Banksmen	54	20	0
Cartmen	54	18	6
Enginemen	58	26	0
Firemen	58	18	9
Furnacemen	84	17	0
Helpers-up	54	19	0
Hewers	54	23	0
Inspectors on the heap	54	28	3
Lamp keepers	54	23	0
Onsetters	54	26	0
Overmen	54	39	0
Deputy	54	28	9
Platelayers	54	19	0
Rolley-way men	54	18	9
Screenmen	54	19	0
Shifters' master	54	31	9
,,	54	23	0
Smiths	58	24	9
Foremen	58	39	0
Switch keepers	54	14	6
Tunnellers	54	23	0
Wagonwrights	58	26	0
Wastemen master	54	26	0
Weighmen	54	23	0
Labourers—bank	54	19	0

Wages Paid per Week in Salt Mines in the Neighbourhood of Worcester.

	Hours.	s. d.
Boatmen	54	24 0
Engine drivers	72	25 6
Loaders	54	23 6
Salt makers	60	18 0—30 0
Smiths	63	26 0

Rents of houses occupied by the working classes in Tunstall range from 2s. 1d. to 4s. 7d. a week, according to condition, location, and size of the premises. The greater number of these houses let at from 3s. 2d. to 3s. 7d. per week, and are of a uniform appearance, containing two rooms on the ground floor, each 11ft. square, and two rooms above of the same size; there is usually also a back kitchen 9ft. by 6ft., and a yard which must be paved and of not less area than 156 square feet. There are a number of dwellings occupied by the poorer class of workmen at rents of from 2s. 1d. to 2s. 6d. per week. Coal is 15s. 3d. per ton and gas 3s. 2d. per 1000 cubic feet.

Examples of Cost of Living per Week in Tunstall.

	Number in family.					
	5		6		7	
	s.	d.	s.	d.	s.	d.
Bread and flour	4	8	3	7	5	1
Butter, cheese, coffee, milk sugar, tea, &c.	5	7	2	6	6	0
Meat	4	3	3	7	5	9
Vegetables	0	8	1	0	1	3
Fuel and light	2	3	2	0	2	5
Clothing	2	0	1	7	6	1
Rent	3	4	3	1	4	7
Total	22	9	17	4	31	2
Income	25	0	19	3	39	3

THE PANAMA CANAL.—According to our New York contemporary, the *World*, the latest information that comes from Panama is—and the *Financial News* says so—that in bisecting the backbone of the Western Hemisphere the canal diggers have taken the underpinning out of the Rocky Mountain portion of it, and that in consequence the whole range has begun to slide into the excavation at the rate of a foot a year. The inference is that the canal cannot be finished until the Rockies have all slid in and been carted away. It remains to be seen what effect this cheerful news will have on the company. Its hardihood in contemplating the amount of capital consumed in the progress of the work, its growing interest account, and the limited distance so far completed would seem to render it equal to almost anything; but this last revelation is enough to damp even the great De Lesseps' exuberance for the moment.

a minimum depth of 9ft. throughout. In the enlargement of the Worcester and Birmingham Canal it is desirable, as before stated, to adopt the Droitwich route as the outlet into the Severn, as being the least costly, and giving the greatest accommodation to the salt district; but this involves lengthening the Bevere lock—in the river Severn—from 80ft. to 110ft. or 210ft. It also necessitates some alteration in the Worcester Bridge over the river Severn, the arches of which when the river is flooded would be too low to allow vessels of 200 tons to pass.

On the third section—the Gloucester and Berkeley Ship Canal—it is proposed to straighten the sharp bends, strengthen the embankments, and thoroughly dredge the canal to its original section, so that long vessels of a draught of 16ft. may come up the canal to the Gloucester Docks; also to provide increased quay accommodation and shedding for their accommodation there.

The present outlet into the river Severn at Sharpness being so far up the estuary is limited in depth of water at neap tides, the lowest neap tide being about 15ft. only on the entrance sill. Large vessels in consequence can only approach Sharpness on spring tides, and therefore are subject to detention of some days at Kingroad. To overcome this difficulty it is proposed to construct a new entrance and tidal basin 5½ miles lower down the river at a place called Sheperdine, where 8ft. more water can be obtained, and where large vessels and ocean liners can enter every tide. It is intended to connect this new entrance and tidal basin with the Sharpness Docks by a lock and ship canal 25ft. in depth, and of sufficient dimensions to admit the largest liners trading in the Bristol Channel. The Sharpness Dock will be enlarged in area and quay berths. The estimated cost of these works is approximately:—

	£
Quay accommodation, Gloucester Docks	10,000
Straightening bends, dredging canal, &c.	24,000
Strengthening embankments	6000
New entrance, Sheperdine, tidal basin, lock and ship canal	300,000
	340,000

The fourth section is the estuary of the river Severn, and affords communication on every tide from Sharpness for coasters to and from all the ports in the Bristol Channel. From particulars already mentioned it will be seen that the engineering aspect of the scheme presents no features of special difficulty, and that to enable vessels of 200 tons to reach Birmingham only necessitates the alteration of 30 miles of canal at a cost of £600,000, and that to provide an efficient port at Sharpness which shall at the same time restore the prosperity of Gloucester, involves the outlay of a further sum of £340,000. But in addition we have, in considering the formation of a new undertaking, to include the Sharpness New Docks and Gloucester and Birmingham Navigation Company, which it is estimated may be taken over for £950,000.

These various canals with the connecting link of the Severn navigation between Gloucester and Worcester already form a chain of water communication between Birmingham and the sea, as before described. This chain of water communication has been very useful in the past, but it has not been sufficient for the needs of the great industrial district of which Birmingham is the centre, which has consequently had to rely in a disadvantageous degree on the railway. But if insufficient for the needs of the past, it is still more so for those of the present, and when it is considered in conjunction with modern capabilities it will be found to be very inadequate indeed. But notwithstanding its admitted shortcomings, it constituted a very valuable property but a few years ago. It still produces a large income, and is susceptible of very considerable development. Its average net earnings after payment of all working expenses for the ten years ending September, 1886, was about £41,000 per annum. That of the last two years has been £38,300. Much of this reduction in its receipts can be traced directly to the change in modern shipping. This is now frequently of a size and character unsuitable for Sharpness, and still more unsuitable for Gloucester. The time and cost incident to the carriage of goods to and from the interior with the present water arrangements fully accounts for the remainder. The obvious remedy for this loss of revenue is therefore to improve the connection with the sea, making it thoroughly efficient for modern requirements, which can be satisfactorily accomplished by carrying the ship canal down to Sheperdine; to improve the canal up to Gloucester so as to admit a larger class of vessels to bring their cargoes up to Gloucester, and to make such enlargement of the Worcester and Birmingham Canal as will make it navigable for barges and small steam vessels into the very heart of Birmingham.

The total cost of the whole project is estimated at £1,890,000, made up as follows:—

	£
Purchase of the entire undertaking of the Sharpness New Docks and Gloucester and Birmingham Navigation Company	950,000
Enlargement of the Worcester and Birmingham Canal, as proposed	600,000
Making new entrance to the Gloucester and Berkeley Canal at Sheperdine, 5 miles below Sharpness, with deep-water ship canal to Sharpness	300,000
Widening, deepening, and improving the canal between Sharpness and Gloucester	40,000
	1,890,000
Total capital, say	2,000,000

LETTERS TO THE EDITOR.

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

DOMESTIC DRAINAGE.

SIR,—I am sorry to say, on seeing a letter in the last week's ENGINEER respecting domestic drainage, I notice there made some statements which are very incorrect. It is made to appear that the one firm mentioned—the North British Plumbing Company—had introduced iron drainage entirely, and this only. Having had no small share in the introduction of this system, I take the liberty of correcting some very misleading statements in the letter of your correspondent, Mr. W. Silver Hall. He there claims that the sanitary details of the houses on the Kensington Court Estate, designed by Mr. J. J. Stevenson, were, to use his own words, "schemed and executed in accordance with the principles so ably enunciated in your leading article of April 15th," and also that the work was carried out by the above-named firm, for whom he acts as consulting engineer. So far from these being the facts, the work was not done by the firm he mentions, but by Mr. Henry Lovatt, the contractor for the buildings, and supervised by Mr. Wm. Yuill, C.E.

From what I have seen of the arrangements as carried out on the estate, I am sure it would be difficult to find a house in a better sanitary condition than one there, but although an iron drain pipe is laid under each house, the disconnecting traps and gullies are of glazed stoneware, the soil pipes being of lead. It is, however, the case—and this may to some extent explain his statements—that at one house, which was erected outside of the general contractor on the estate, the drains and internal plumbing were carried out by the North British Plumbing Company. It is, however, also the case that in this instance only a portion of the drain is of iron; a considerable part of the branch drains, the disconnecting traps and gullies, and the half-channel pipes, all being of glazed stoneware; while the manholes were simply built of—brick.

In spite of this, I consider an excellent result has been attained, all the drains being outside the building, and wonder if your correspondent is now prepared to condemn as "pot and patchwork" a special job of the firm for whom he acts, and which was believed to be at the time it was done one of the best it was possible to make. WM. DODDS, R.P.

4, Upper Baker-street, N.W., June 3rd.

WAGES IN THE ROYAL DOCKYARDS.

SIR,—In "Colburn's United Service Magazine" for the present month is an account of a visit of King George the Third to Portsmouth in June, 1773. The following list of wages therefrom of the dockyard artificers, compared with those given in THE ENGINEER of 29th May last, shows the great increase that has taken place in the last century:—

	Per day. s.	d.
Bricklayers	1	7½
Carpenters (house)	1	9½
Joiners	1	11½
Masons	2	3½
Braziers	2	6
Caulkers	1	11
Locksmiths	2	6
Sawyers	1	6
Shipwrights	2	0
Smiths..	1	8
Wheelwrights	1	10
Labourers	1	2

Westminster, S.W., June 6th. C.

THE EDUCATION OF ENGINEERS.

SIR,—The interesting articles and letters which have appeared on this subject led me to hope that I should find more about the matter in your pages. I fancy that most engineers are of one opinion—namely, that too much is taught in colleges that is not of the right sort—but there is nothing definite stated.

I venture to think that a great deal of good would be done if your readers would express their opinions in your columns as to what a mechanical engineer ought to know and need not know. As my contribution to the subject, I would say that nothing is more essential than that the engineer should know how to make intelligent use of text-books. Why, for example, should not a pupil be given Molesworth's pocket-book and told to use it in preparing designs for, say, a bridge or a turbine? Much that is taught now is intended to enable the student to dispense with the use of books which are carried as a matter of course by every mechanical engineer in practice, and to be able to use such books is an essential part of his training.

One professor, himself an engineer, had the courage some years ago to introduce the system of testing the powers of his students in a Midland college in reading and using books of reference. They were permitted, for instance, to take Molesworth or D. K. Clark into the examination room. The results, I have heard, were admirable all round; but if I am rightly informed, the practice has been regarded by the authorities as immoral, novel, and consequently bad, and has been stopped.

I am sure an expression of opinion by engineers would prove useful and valuable. J. W. DAVIS.

Manchester, June 16th.

STEADY TRAINS.

SIR,—In your valuable paper for June 10th, 1887, I see an article on "Steady Trains." In this letter I am only going to treat of the question of springs. Every goods wagon repairing yard can show stacks of broken springs. What is the cause? Simply this: from experience, I know that various companies put men to make and repair springs who do not know how to temper the spring steel that is placed in their hands; the consequence is that there is a lot of bad work turned out, and the reason for that is they get the men cheap, and it is a great mistake on their part; whereas, if they got practical springmakers who understand the various tempers of spring steel, they would be able to turn out good springs that would make steady running trains. It is bad springs that cause broken axles, tires, and axle-boxes, which throw either engine, carriages, or wagons off the track. What is wanted in railway companies' shops are practical springmakers who understand the steel they are going to make and repair springs with; and if they would get them they would have a far less bill to pay for soft and broken springs—in fact, far less repairs to rolling stock generally. Then there is another question with defective springs; they cause the rolling stock to thump on the track when running, and then there is the breaking of axles or tires and a breaking down of the whole train, and all this has to be accounted for in the traffic department; whereas, if the springs were properly tempered to withstand the load they have to carry, it would be a vast saving in the yearly accounts of railway companies. WILLIAM JAS. MARTIN.

40, Eastfield-place, Low-road, Practical Springmaker.

Springburn, Glasgow, June 13th.

TORPEDO BOAT CASUALTIES.

SIR,—I have followed with especial interest the recent articles in the technical papers upon the late torpedo boat manœuvres, and more particularly the portion of the subject which deals with the boiler calamity, from which important lessons may be learnt. As a practical boilermaker of lengthened experience, permit me to make a few brief observations upon Mr. Donaldson's letter in your last issue, which, I hope he will excuse me for saying, does not improve matters for his firm, for which firm I have the greatest respect.

I will pass by Mr. Donaldson's remarks in which he details the causes of his engines coming to grief, as it is a subject upon which I have only a superficial knowledge, and do not consider myself capable of offering an opinion. The grave question is one of boiler construction.

Now, taking locomotive practice in this country as a guide, I am in a position to state that it is an invariable rule in supporting the fire-box crown to adopt stays with either solid heads or nuts. I am confident no locomotive superintendent would for a moment sanction the simple rivetting over of the stays, and that which is deemed essential to safety in a locomotive is clearly still more so in a torpedo boat boiler, which is subject to even greater and more sudden fluctuations of temperature, coupled with the risk of the top of the box being occasionally uncovered, owing to the variations in the incline of the boat when at sea.

The practical difficulty in making sound work in rivetting over a long stay is due to the fact that the blow in striking the stay end is nearly all taken up by the thread next to this end, because, although you may hold up at the other extremity of the stay, owing to its length and consequent elasticity, only a very small portion of the blow is conveyed to the other end; therefore the actual result is, the strain has to be taken by the thread, which may be, and doubtless is, seriously crippled by the process of rivetting, and the head itself, which is hammered down cold, is clearly uncertain and of doubtful value. The actual strength of the fastening of the stay into the plate must be forever unknown, and probably not even the workman himself who makes the boiler is aware of the quality of the job or how much reliance can be placed on it. No internal or external examination can furnish any evidence of its strength.

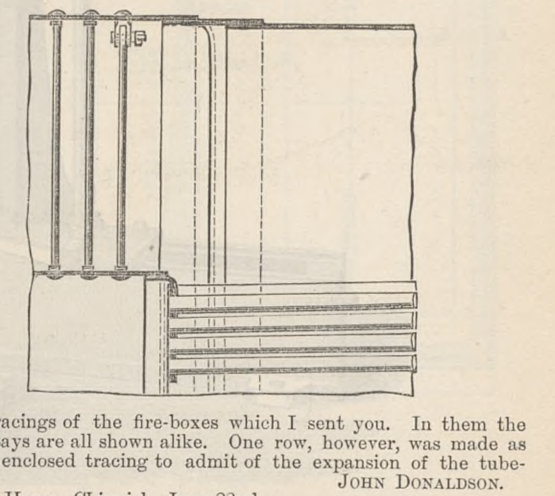
For my own part, and I think every practical boilermaker will agree with me, I hold that this system of rivetting long stays is undoubtedly very dangerous, because it is of uncertain value, and it is no proof to the contrary that a number of boilers have been made in this way, but rather that the owners of them should be on the look-out for accidents similar to those which befel Nos. 47 and 57, the risk of which increases as the boilers get old, the tops of the boxes covered with scale or grease, and the rivetted heads get burnt away.

One may argue that the boilers stood the hydraulic test and were perfectly tight. I am afraid that too much reliance is placed on the hydraulic test in these days of high-pressures, while important matters of practical detail are lost sight of.

As to the fusible plug doctrine, I do not think that the recent accidents on No. 47 and 57 can be accepted as a proof in favour of the system, because one can scarcely imagine that Mr. Donaldson would seriously approve of putting 216 fusible plugs into the crown plate, which is the number of stays shown in the sketch.

Manchester, June 20th. ERNEST SMYTHE.

SIR,—It may be as you think, that the portions of my letter of the 14th inst., which you were good enough to publish in your last week's issue, do not call for any comment at your hands. They will, however, enable your readers to form their own opinions as to the character and value of your article of May 27th, the appearance of which in the pages of THE ENGINEER demands, to my thinking, at least, an expression of regret. I hasten to correct a slight error



in the tracings of the fire-boxes which I sent you. In them the crown stays are all shown alike. One row, however, was made as per the enclosed tracing to admit of the expansion of the tube-plate. JOHN DONALDSON.

Tower House, Chiswick, June 22nd.

[The portions of Mr. Donaldson's letter which we did not publish are vague charges of unfairness and partiality on our part. We suppressed them in Mr. Donaldson's own interest, and we still venture to think that had he seen them in print he would be the first to regret the circumstance.—ED. E.]

SIR,—Mr. Donaldson has brought very serious charges against the crews of Admiralty torpedo boats—so serious that I think he is bound to supply some evidence that these crews are the incompetent, ignorant men he asserts them to be. I must ask him, therefore, to say why the boilers of 47 and 57 ran short of water. He is entirely silent concerning their feed pump arrangements, but it is a suggestive fact that, on his own showing, one fire had to be drawn because the feed pipe joint gave way. Did the pumps or injectors work throughout perfectly in 47 and 57?

In Mr. Donaldson's sketches I can find no fusible plug shown. Are we to understand that no fusible plug was fitted? If so, why was this precaution omitted? The charge brought by Mr. Donaldson against the men who have lost their lives is that they suffered the boiler to get short of water. Up to the present moment no one has stated this as a fact but Mr. Donaldson, who is an interested witness. Before bringing such charges of incompetence forward he ought to have waited for the conclusion of the coroner's inquest. We should then have known how far the want of water was due to incompetence and ignorance on the part of the men in charge, how far to the failure of feed pumps; or to priming, which at once empties the boiler and shows a full glass.

Mr. Donaldson's letter is good and instructive as far as it goes, but it does not go far enough. ONE OF A TORPEDO CREW.

Portsmouth, June 20th.

SIR,—Mr. Donaldson has written a letter which is brimful of interest on a most important question. No man can supply more information than he can, and long as his letter is, I for one wish it was longer. The builders of torpedo boats are naturally reticent, and what they say when they do appear in print is certain to be read with avidity. Will Mr. Donaldson supply information on two important points—1st. Does he know of any other builder of locomotive type boilers who uses the Thornycroft system of crown stays? 2nd. Will the failure of the boilers in No. 47 and 57 lead to a change of practice in this respect by Messrs. Thornycroft—that is, will they in future use nuts or heads on their stay bolts?

Bayswater, June 22nd. P. W. D.

ELECTRIC LIGHT ILLUMINATIONS.

SIR,—In connection with the Jubilee celebrations, attention should be drawn to the fact that the electric light illuminations were uniformly successful, and were not in any way affected by the high wind which at times detracted from the effectiveness of the devices illuminated by oil and gas.

The method adopted of placing electric incandescent lamps upon a white background was strikingly effective, and as a very successful installation of this kind may be mentioned that carried out by the Anglo-American Brush Electric Light Corporation on the front of the premises of the Institution of Civil Engineers in Great George-street, Westminster.

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION.
(E. GARCKE, per H. B., Secretary.)

Belvedere-road, Lambeth, London, June 22nd.

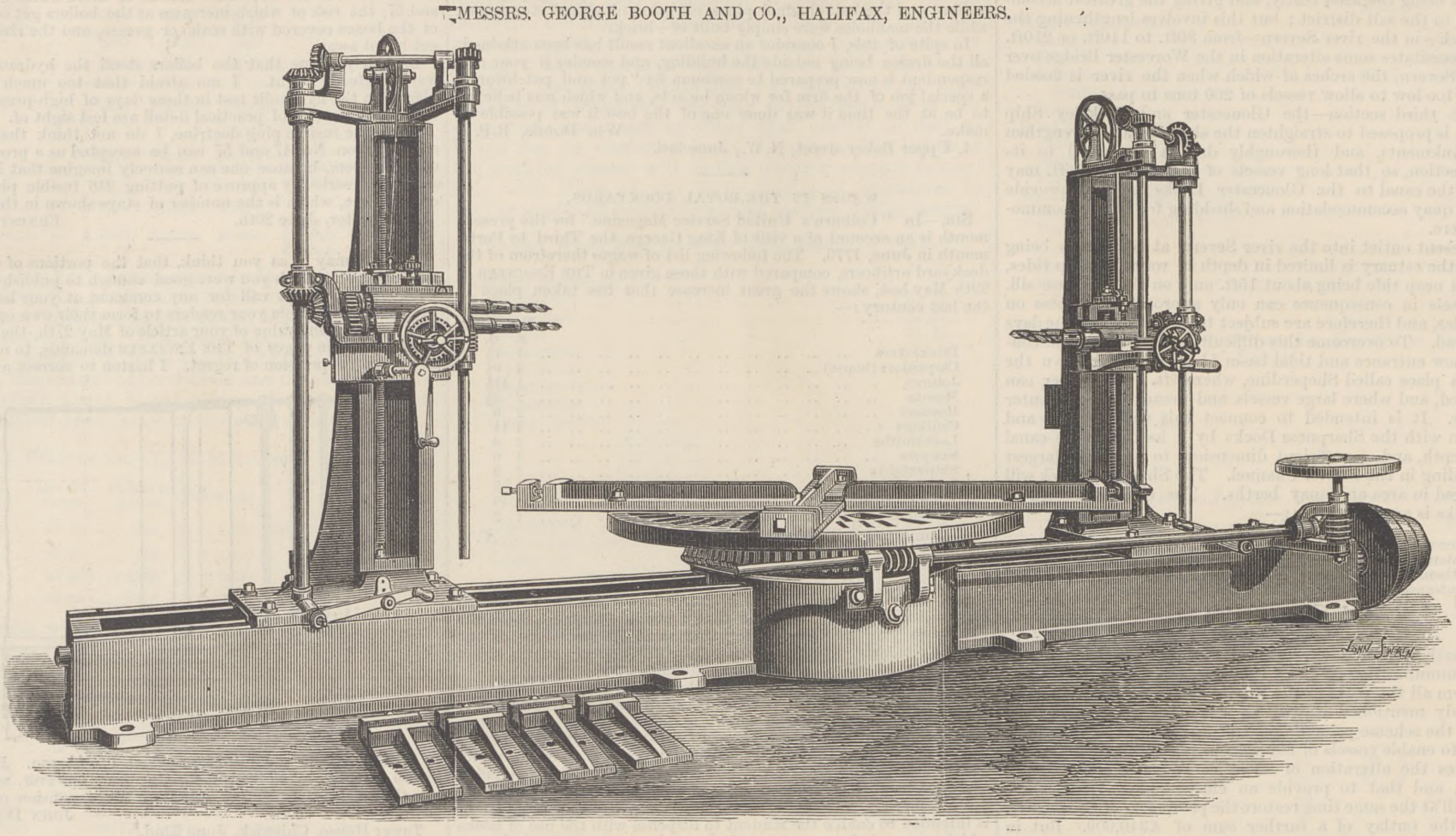
THEORETIC DIAGRAMS.

SIR,—I am exceedingly sorry that I have misrepresented Mr. Mudd's method of combining diagrams, and I can quite sympathise with his annoyance. The fact is that when I wrote the paper I was very much pressed for time, and unfortunately in this case I trusted to my memory and the impression I had received when first reading the account of the discussion on the late Mr. Wyllie's paper in the engineering prints, and it is only quite recently that I found, on reading the full account in the Proceedings of the Institution of Mechanical Engineers, that so far as the relative placing of the separate cards goes, Mr. Mudd uses the same method as Mr. Schönheyder. Had Mr. Mudd not already written to the secretary of the Liverpool Engineering Society, I fully intended to draw attention to my mistake when next we met, and to mention it in any correspondence that might arise from the publication of my paper in your pages. With regard to the correct standard area for comparison with the actual figures, and the correct expansion curves to compare with the indicator curves, I should like to say a little more; but having been from home, I have been unable either to look more fully into Mr. Mudd's letter or to write one myself, but I hope to have the pleasure of writing further next week. I trust that Mr. Mudd will accept my apology as frankly as I make it. J. JENNINGS CAMPBELL.

Liverpool, June 22nd.

LARGE BOILER SHELL DRILLING MACHINE.

MESSRS. GEORGE BOOTH AND CO., HALIFAX, ENGINEERS.



BOILER SHELL DRILLING MACHINE

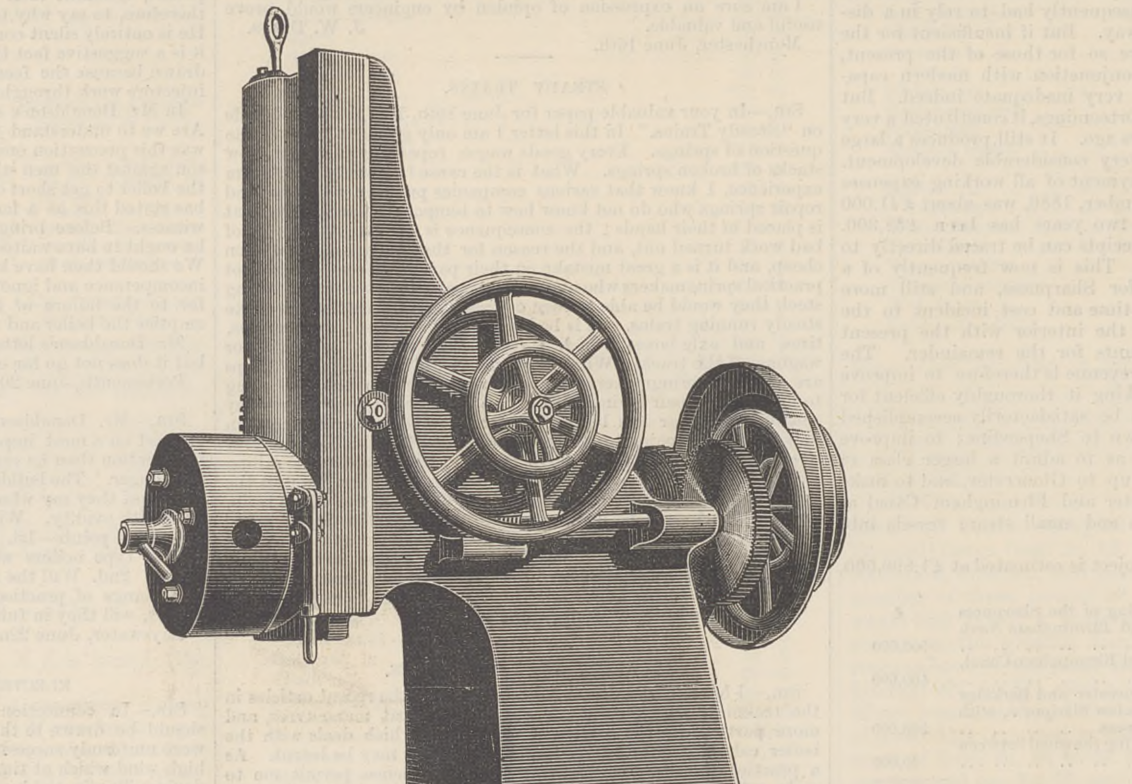
We illustrate above a boiler shell drilling machine, of novel construction, drilling boilers from 4ft. to 12ft. 6in. diameter. The machine consists of a massive bed, planed on the top with T slots, for securing the drilling standards. In the centre of this bed is fitted a circular table 7ft. diameter, and fitted with four portable cramp plates for securing boiler shells from 12ft. 6in. down to 9ft. diameter, whilst being drilled; the smaller set shown at the foot of machine being used for the same purpose for boilers from 9ft. down to 4ft. diameter. The circular table is revolved by hand by means of a worm and large hand wheel placed on the base of the right-hand drilling standard.

The drilling standards are arranged to move in or out upon the bed by hand by means of rack pinion capstan and lever to suit various diameters of boilers to be operated upon. The saddles are arranged to be raised and lowered upon the drilling standard by hand by screw, bevel gear, and handles, balance weights being used for equalising the weight. Each standard carries a saddle, and upon each saddle are fitted two spindle carriages, with vertical and transverse adjustment, so that two holes can be drilled in a boiler shell by either saddle, horizontally, vertically, or at any required angle, and from 2in. pitch upwards. The feed motion is arranged so that the drills on the vertical slides on the saddle can be stopped or regulated to compensate for the various lengths of drills, &c. The spindles are carried in long cast iron sockets, the spindle noses running against hardened steel washers at one end, and at the other end are arranged lock nuts for adjustment, when wear has taken place. The spindles are thereby supported in their whole traverse, so that they can not be strained while working, which is an important feature, as the work is very often liable to spring. The feed motion is in position, and is driven from vertical driving shafts by bevel and worm gearing connected and disconnected by friction clutch on the saddle. Each pair of drills is arranged so that it can be stopped, started, or reversed independently of the other pair by means of the lever placed at the foot of standard. By that means either pair of drills can be made to tap holes in fire-boxes, boiler backs, or any other work of the same kind.

The machine is driven by a large three-speed cone and spur gearing placed at the right-hand end of bed, so that it can be run at a speed suitable for the size of drill used. The machine was constructed for Messrs. Alex. Shanks and Sons, Arbroath. The makers have another in progress for Messrs. T. and H. Danks, Crown Boilerworks, Netherton, near Dudley. The machine is of special interest now that so many large cylindrical marine boilers of thick plates are being made which must have drilled holes. It may be mentioned that it is the subject of a patent.

UPRIGHT TURRET PULLEY AND WHEEL-BORING MACHINE.

MESSRS. JOHN BERTRAM AND SONS, DUNDAS, ONTARIO, ENGINEERS



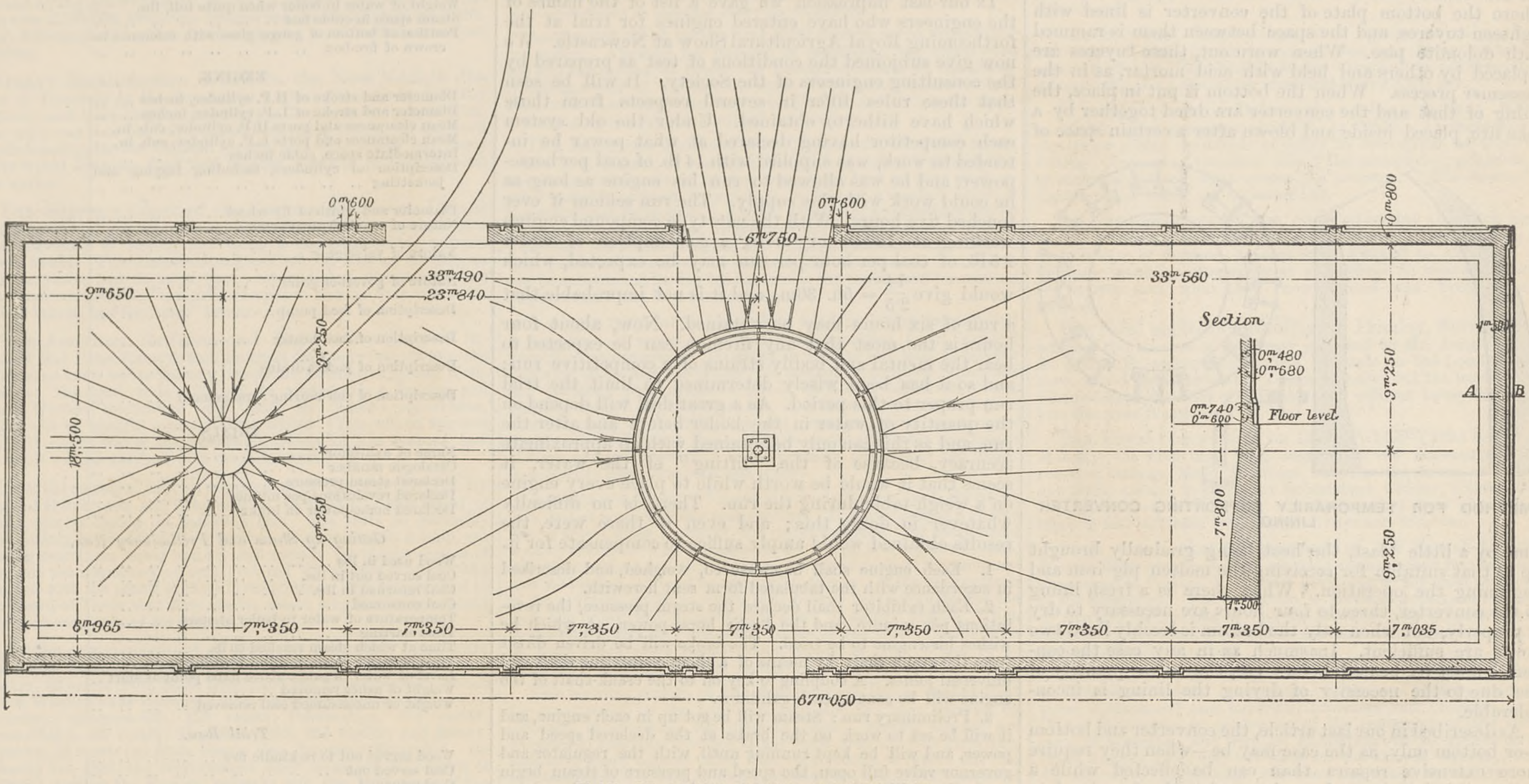
UPRIGHT TURRET PULLEY AND WHEEL-BORING MACHINE.

The accompanying engraving represents a 36in. upright turret pulley and wheel-boring machine, with four changes for bars. It takes in 36in. diameter and 24in. in depth. It consists of a heavy frame with hollow or cored section. The cone has five changes, a large diameter, and wide face. The turret takes in 2¼in. in bars, which are locked with wedges and screws keeping all true. The ram has large bearing surfaces, and has three changes of feed; by releasing the main friction it can be raised and lowered rapidly while the back friction allows it to be operated slowly by hand. The table revolves in a large bronze bearing and steel bottom step. This machine can bore pulleys, gear, couplings, and a great variety of machine work. The fast and loose pulleys are 24in. in diameter and 5in. in face, and should make 100 revolutions per minute. Weight, 5000 lb.

PARIS EXHIBITION, 1889—ROOF OF MACHINERY HALL.

In our impression of the 10th inst., page 469, we published engravings showing the principals of the great roof of 375ft. span designed for the proposed machinery hall in the projected Exhibition. We now publish on page 506 some of the details of the roof, all of which are accompanied with their dimensions, and require very little explanation. Fig. 1, page 469, is a half-section of the roof with the side bays. and showing the pivotted apex, the pivotted foot of the principals being shown at Fig. 5. Fig. 2 is a view partly in section showing the arrangement of rafters between the principals, and the mode of carrying the intermediate space covering. Fig. 4 is a portion of one of the rafters intermediate between the principals, and showing the connections of the purlines thereto, the purlines being vertical instead of normal to the main lines of the principals. On page 506, Fig. 9, shows the part making up the connection between the ends of the purline and the verticals at K, Fig. 1, page 469. Details of this are shown at Figs. 15 to 18, and of the purlines at Figs. 14, 19, 24, and 26. The apex and foot pivots are shown in detail at Figs. 27 to 31, and the connections are shown in Figs. 20, 21 22, 23, 25, and 34.

IRON AND STEEL WORKS, ATHUS, BELGIUM.—BASIC LINING REPAIR DEPARTMENT.

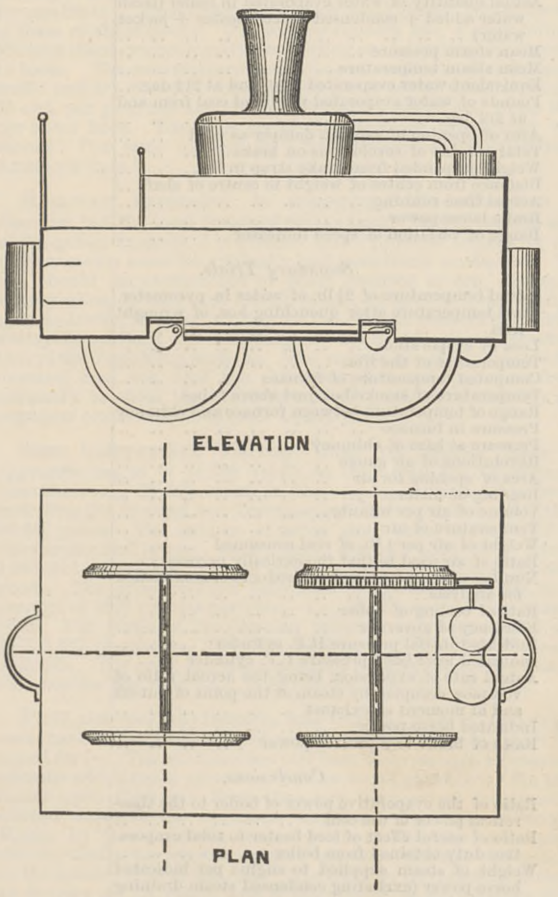


PLAN OF LINING REPAIR DEPARTMENT.

ATHUS IRON AND STEEL WORKS.*

No. V.

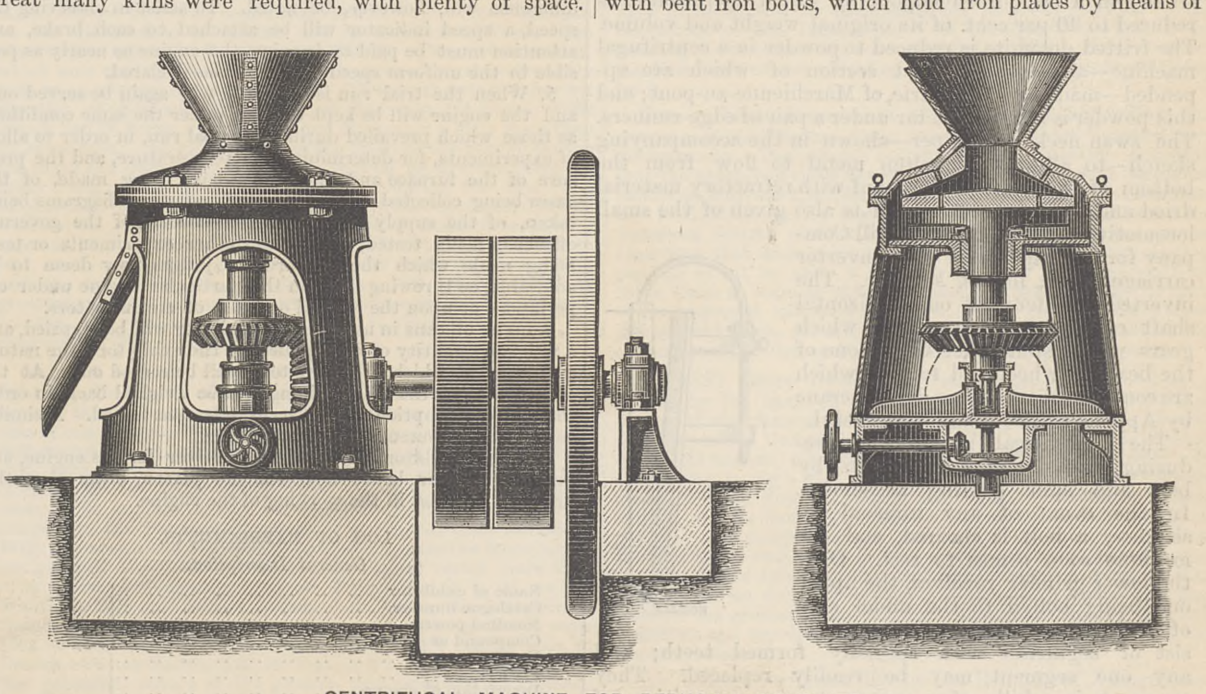
Lining repair department.—Not long before his regretted decease, Holley remarked to the Philadelphia engineers that there were in Europe many steel works where the essential operations were properly performed; but the comparatively minor details, such as repairs to the converter lining, transport inside the works, &c., were quite neglected in getting out the general plan, being in reality performed clumsily or inconveniently many times a day. Holley considered that it was absolutely necessary to place in a separate department all repairs to the lining of converters and their bottoms, as well as that of the ladles, because this work cannot be done round the casting-pit with-



LOCOMOTIVE BY THE COCKERILL CO.

out seriously interfering with the casting of the steel and the removal of the ingots and ingot moulds. There is, indeed, every advantage in arranging the repair department so as to be separate from the casting-pit—as at Athus—because the converter may remain on its carriage while the lining is being repaired; and it is a fortunate circumstance that those parts—viz., the mouth and the bottom—which are most liable to wear, are precisely those which, under this arrangement, are most accessible to the workmen. While it is considered fair work if the bottoms and tuyeres do not require renewal before the fifteenth blow, the basic lining of the converter will frequently stand over sixty blows before requiring repairs of any consequence. At Athus the average duration of the bottoms is eighteen blows, and of the converter lining eighty blows. Such repairs cannot well be effected without cooling down the converter, when the hollows eaten away may be filled up with basic bricks or mortar, an operation which generally requires twenty-four hours.

When the Thomas-Gilchrist process was first introduced on the Continent, dolomite was recognised as the most economically suitable substance for lining the converters in which the phosphoriferous pig was treated. This magnesian limestone was ground and moulded into bricks, which were burnt in kilns at a very high temperature. Besides entailing a high consumption of fuel, however, this practice possesses several disadvantages. On account of the considerable contraction—about 10 per cent.—caused by the evolution of the carbonic acid, it was difficult to charge the kilns methodically; and the bricks often fell and were broken so as to become unfit for lining the converters. Besides, the process of burning was a slow one; and a great many kilns were required, with plenty of space.



CENTRIFUGAL MACHINE FOR REDUCING DOLOMITE.

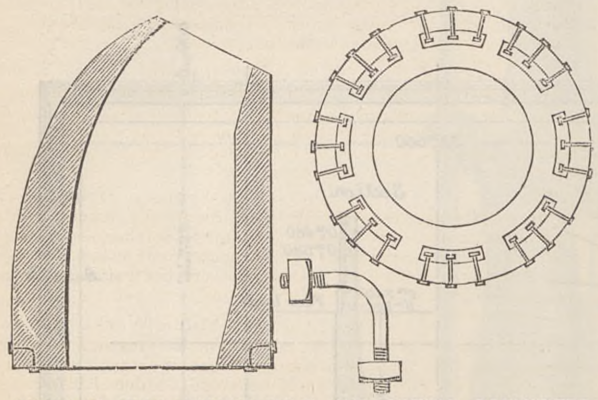
It was afterwards found preferable to first calcine the dolomite in pieces, then grind it, and afterwards to form it into a "pise" or mortar with tar, for lining the converters and their bottoms. The bottoms are generally lined as just described; but in some works, for lining the converters, the dolomite pise is rammed into iron moulds, formed to correspond with the internal contour of the converter. The bricks thus formed are afterwards dried in kilns; and, to effect repairs, these bricks are simply put in place without any cement or mortar whatever, as they become united, owing to the tar, when the converter is heated before being brought into use. This system is adopted when, on account of an insufficient plant, it is necessary to repair the lining of the converters as quickly as possible. As regards the lasting of the converter lining, however, this practice is generally found not so good as that of ramming the pise inside the converter.

At the Athus Steel Works the converters are lined with dolomite pise carefully rammed between the iron plate and a wooden mould, of a shape corresponding with that of the interior of the converter. The mouth only is lined with acid fire-bricks to a depth of 60 centimetres = 2ft. Holley arranged for the converters and their bottoms being dried in the repair department by a jet of air and gas acting like a blowpipe, the hot gases passing through temporary tuyeres in the converter, and making their exit by a chimney contrived in the bottom of the wagon and in that of the ladle. But, as this method of drying had never been applied to the basic process, and would have entailed considerable expense, it was decided at Athus to begin by drying the converters and their bottoms in the casting house. The converter, lined as above described, is brought mouth downwards on its wagon into the casting house and inserted in one of the belts, where it is turned on its trunnions so as to bring the mouth upwards. In this position the lining—which is but slightly consistent, and, not being kept up by the bottom, is unsupported below—would be exposed to fall out before there was time to put in place the bottom which sustains it. To obviate this difficulty, the converter is provided inside with bent iron bolts, which hold iron plates by means of nuts; and the lining has never been known to fall during the time necessary to replace the bottom, which is brought as quickly as possible, raised by the hydraulic press, and securely keyed. On the segment of the bottom which corresponds with the thickness of the converter lining is placed a sufficiently soft pise of tar and dolomite about 3 or 4 centimetres = 1in. to 1½in. thick, making a simple and satisfactory joint between the lining and the bottom of the converter ring. This arrangement is shown by plan and section of converter in the next page.

On the Continent there are two principal methods of making the lining for the bottoms. At many works, especially in Germany, the bottoms are rammed in cast iron moulds, the underside being provided with wrought iron pins, which, withdrawn when the ramming is done, leave the holes necessary for the passage of the blast. These bottoms are dried gradually for twelve to eighteen days in the moulds, which are put into long stoves. Each bottom is placed on a separate wagon; and the wagons, coupled together, are pushed farther into the stove each time that one is withdrawn for use. In this way the desiccation is regulated with the greatest nicety, and a better result is obtained than by drying

* Continued from p. 35 of vol. lxii.

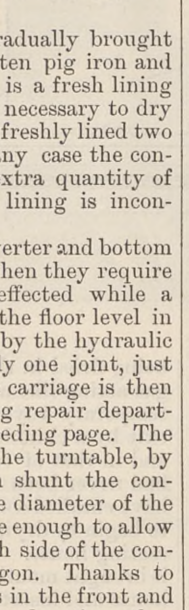
the bottom while remaining attached to the converter. At other works acid tuyeres are used to lead the blast to the converters; and this is the method adopted at Athus, where the bottom plate of the converter is lined with eighteen tuyeres, and the space between them is rammed with dolomite pise. When worn out, these tuyeres are replaced by others and held with acid mortar, as in the Bessemer process. When the bottom is put in place, the lining of that and the converter are dried together by a coke fire, placed inside and blown after a certain space of



METHOD FOR TEMPORARILY SUPPORTING CONVERTER LINING.

time by a little blast, the heat being gradually brought up to that suitable for receiving the molten pig iron and beginning the operation. When there is a fresh lining to the converter, three to four hours are necessary to dry it properly, but when only the bottom is freshly lined two hours are sufficient. Inasmuch as in any case the converter must be heated before use, the extra quantity of fuel due to the necessity of drying the lining is inconsiderable.

As described in our last article, the converter and bottom —or bottom only, as the case may be—when they require more extensive repairs than can be effected while a bottom is being changed, are lowered to the floor level in their carriage, from the stationary belt, by the hydraulic press. This requires the breaking of only one joint, just the same as for changing a bottom. The carriage is then run along by the locomotive to the lining repair department, a plan of which is shown on the preceding page. The principal feature of this department is the turntable, by means of which a single locomotive can shunt the converters, bottoms, ladles and slag tubs, the diameter of the turntable—11 metres = 36ft.—being large enough to allow sufficient space for the locomotive on each side of the converter placed in the middle of its wagon. Thanks to this arrangement, the engine—sometimes in the front and sometimes in the rear—suffices for all the shunting, thus dispensing with points and crossings. Moreover, all the necessary movements are effected while the various parts remain fixed on their own wagons, so that there is no need of any crane in this department. The dolomite for the basic lining, obtained from the banks of the Meuse, is fritted in a basic-lined cupola, by which operation it is reduced to 40 per cent. of its original weight and volume. The fritted dolomite is reduced to powder in a centrifugal machine—an elevation and section of which are appended—made by J. L. Marie, of Marchienne-au-pont; and this powder is mixed with tar under a pair of edge-runners. The swan neck or stopper—shown in the accompanying sketch—to allow the molten metal to flow from the bottom of the ladle is re-coated with refractory material dried and replaced. A sketch is also given of the small locomotive made by the Cockerill Company for hauling about the converter carriage, ladle, ingots, slag, &c. The inverted cylinders act on a horizontal shaft carrying a spur pinion which gears with a spur wheel inside one of the bearing wheels, all four of which are coupled. A travelling derrick crane by Appleby is also found very useful.



The centrifugal machine for reducing the dolomite is driven by belt and spur gearing as shown. In the event of any unusual resistance, a bolt is sheared, and the machine soon comes to rest. Only the lower grinder revolves, the upper one being bolted to the under side of the cover. Both grinders consist of segments with specially formed teeth; and any one segment may be readily replaced. They are cast in chills of a very strong composition of iron, the hardness of which exceeds that of hardened steel. The hand wheel serves to regulate the distance between the grinders, and therefore the fineness to which the dolomite is reduced. The dolomite is charged into the hopper in pieces of about 3in. diameter; but the quantity charged in makes no difference to the working of the machine, which feeds itself at a uniform rate, and therefore cannot choke. The larger size, which weighs 4 tons, requires from 15-h.p. to 25-h.p., and grinds from 10 to 40 tons per day. This machine is used by the Cockerill and Angleur Companies, by the Lilleshall Company, and by the Staffordshire Steel and Ingot Iron Company.

The machine is driven by a 40-h.p. horizontal engine, made by the Maschinenbau-Anstalt Humboldt. The cylinder is 0·26 m. = 10¼in. in diameter; and the stroke, 0·52 m. = 1ft. 8½in. The main feature of this engine is the Rider valve gear, which has already been illustrated in our pages.

THE new Hammersmith Bridge was opened on Saturday by Prince Albert Victor, who afterwards laid a memorial stone of rough-cut granite block on one of the abutments of the new Battersea Bridge. Both these bridges have recently been fully illustrated in our pages.

STEAM ENGINE TESTS AT NEWCASTLE-ON-TYNE.

IN our last impression we gave a list of the names of the engineers who have entered engines for trial at the forthcoming Royal Agricultural Show at Newcastle. We now give subjoined the conditions of test as prepared by the consulting engineers of the Society. It will be seen that these rules differ in several respects from those which have hitherto obtained. Under the old system each competitor having declared at what power he intended to work, was supplied with 14 lb. of coal per horse-power, and he was allowed to run his engine as long as he could work with this supply. The run seldom if ever touched five hours. With the new type compound engines working at 120 lb. or more, a consumption of under 2·5 lb. of coal per hour per run may be expected, which would give $\frac{14}{2 \cdot 5}$ = 5h. 36m., and it is not improbable that a run of six hours may be obtained. Now, about four hours is the most that any fireman can be expected to bear the mental and bodily strains of a competitive run; and so it has been wisely determined to limit the trial run proper to this period. As a great deal will depend on the quantity of water in the boiler before and after the run, and as this can only be obtained with an approximate accuracy, because of the "lifting" of the water, it seems that it would be worth while to place every engine on a weigh-table during the run. There is no difficulty whatever in doing this; and even if there were, the results obtained would amply suffice to compensate for it.

1. Each engine shall be measured, weighed, and described in accordance with the tabulated form sent herewith.

2. Each exhibitor shall declare the steam pressure, the revolutions per minute, and the brake horse-power, at which he wishes his engine to be tried. The brake will be driven direct from the crank-shaft by means of a short connecting shaft and universal joints. A coupling to key on to the crank-shaft of the engine will be sent to each exhibitor.

3. Preliminary run: Steam will be got up in each engine, and it will be set to work on the brake at the declared speed and power, and will be kept running until, with the regulator and governor valve full open, the speed and pressure of steam begin to decline. The time occupied in raising steam and in getting ready for the trial run, together with the revolutions made, the fuel (including 8 lb. of wood) and the stores consumed, will be noted.

4. As soon as the speed has shown a tendency to fall, the engine will be stopped, any coal remaining on the bars and the ashes will be raked out, 1 lb. of wood will be served out to re-kindle the fire, and a weighed supply of coal will be issued, after which the trial run will begin. The duration of each trial will be four hours, or as near thereto as can be arranged. During the trial run there will be noted the steam pressure, the temperature, and the quantity of the feed water, and that of the water discharged by pet cocks and jacket drains, and the level of the water in the boiler before starting and shortly after starting. At the end of four hours the supply of fuel will be stopped, the unused supply will be weighed back, and the trial will be continued till, the regulator and the throttle-valve being full open, the speed shows a tendency to decline. The height of the water in the boiler throughout the trial must be kept as constant as possible, and at the termination should be left at the level at which it was when the trial commenced; any slight, unavoidable difference will, however, be noted. To assist in observing the speed, a speed indicator will be attached to each brake, and attention must be paid to keeping the engine as nearly as possible to the uniform speed of revolutions declared.

5. When the trial run is over, coal will again be served out, and the engine will be kept working under the same conditions as those which prevailed during the trial run, in order to allow of experiments, for determining the temperature, and the pressure of the furnace and the smoke-box, being made, of the gases being collected for analysis, of indicator diagrams being taken, of the supply of air being measured, of the governor efficiency being tested, and of any other experiments or tests being made which the stewards or judges may deem to be advisable, as throwing light on the particular engine under experiment, or upon the general question of steam motors.

6. The oil cans in use by each exhibitor will be emptied, and a weighed quantity of oil supplied by the exhibitor—the nature and price of which will be noted—will be served out. At the end of the run the oil remaining will be weighed back, in order that the consumption may be accurately ascertained. A similar course will be pursued with the tallow.

7. Each exhibitor is to provide a driver for his engine, and during the four hours' trial run, no person, other than this driver, is to assist in the working of the engine.

LOG OF EXPERIMENTS.

General Description.

Name of exhibitor ..
Catalogue number ..
Nominal power ..
Compound or simple ..
Weight, empty ..
Price ..
Description of engine ..

BOILER.

General Description of Boiler.

Maximum declared working pressure ..
Description of safety valves ..

Fire-box and grate—
Size of ordinary grate in inches ..
Area of ordinary grate in square feet ..
Width of bars in inches ..
Width of air spaces in inches ..
Area of air spaces in square feet ..
Area of grate used at trial in square feet ..
Area of air spaces at trial in square feet ..
Height of fire-box crown above bars in inches ..
Length from out to out of tube plates in inches ..
Number of tubes ..
Material of tubes ..
Outside diameter of tubes in inches ..
Inside diameter of tubes in inches ..
Heating surface—
Heating surface of fire-box in square feet ..
Heating surface of tubes in square feet ..
Heating surface of smoke-box in square feet ..
Total water-heating surface in square feet ..
Square feet of water-heating surface per nominal horse-power of engine ..
Superheating surface ..
Area through tubes, square feet ..
Ratio of area through tubes to normal grate area, square feet ..
Area of chimney, square feet ..
Arrangement and area of blast nozzle ..
Arrangement of ash-pan damper ..

Ratio of heating surface to normal grate area ..
Weight of water in boiler at normal level, lbs. ..
Weight of water in boiler when quite full, lbs. ..
Steam space in cubic feet ..
Position of bottom of gauge glass with reference to crown of fire-box ..

ENGINE.

Diameter and stroke of H.P. cylinder, inches ..
Diameter and stroke of L.P. cylinder, inches ..
Mean clearances and ports H.P. cylinder, cub. in. ..
Mean clearances and ports L.P. cylinder, cub. in. ..
Intermediate space, cubic inches ..
Description of cylinders, including lagging and jacketting ..

Diameter and width of fly-wheel ..
Nature of crank arrangement ..

Nature of valve gear ..

Nature of governor gears ..

Description of feed pump ..

Description of feed-heater ..

Description of jacket drains ..

Description of self-moving arrangement ..

TRIALS.

Name of exhibitor ..
Catalogue number ..
Declared steam pressure ..
Declared revolutions per minute ..
Declared horse-power on brake ..

Getting up Steam and Preliminary Run.

Wood used in lbs ..
Coal served out in lbs. ..
Coal returned in lbs. ..
Coal consumed ..
Temperature of water in boiler at start ..
Time starting ..
Time at which steam reached 60 lb. ..
Time at which steam reached working pressure ..
Level of water in gauge above fixed point at start ..
Weight of ashes removed ..
Weight of unconsumed coal removed ..

Trial Run.

Wood served out to re-kindle fire ..
Coal served out ..
Coal returned ..
Coal used ..
Oil served out ..
Oil returned ..
Oil used ..
Tallow served out ..
Tallow returned ..
Tallow used ..
Time of starting run ..
Time of finishing run ..
Level of water above fixed point just before starting
Level of water above fixed point directly after starting ..
Level of water above fixed point at finish ..
Weight of water due to difference of level ..
Mean temperature of water used ..
Mean temperature of water entering boiler ..
Total water supplied to engine in lbs. ..
Water returned to feed tank from condensation in feed-heater ..
Temperature of water condensed in feed-heater ..
Water condensed in steam jackets ..
Temperature of water condensed in steam jackets ..
Actual quantity of water evaporated in boiler (fresh water added + condensed in feed-heater + jacket water) ..
Mean steam pressure ..
Mean steam temperature ..
Equivalent water evaporated from and at 212 deg. ..
Pounds of water evaporated per lb. of coal from and at 212 deg. ..
Area of opening of ash-pan damper as used ..
Total number of revolutions on brake ..
Weight suspended from brake strap in lbs. ..
Distance from centre of weight to centre of shaft ..
Actual time running ..
Brake horse-power ..
Range of variation of speed indicator ..

Secondary Trials.

Initial temperature of 2¼ lb. of water in pyrometer.
Final temperature after quenching 5 oz. of wrought iron ..
Loss by evaporation ..
Temperature of the iron ..
Computed temperature of furnace ..
Temperature of smoke-box just above tubes ..
Range of temperature between furnace and chimney
Pressure in furnace ..
Pressure at base of chimney ..
Revolutions of air gauge ..
Area of opening for air ..
Reading of meter ..
Volume of air per minute ..
Temperature of air ..
Weight of air per 1 lb. of coal consumed ..
Ratio of air used to that theoretically necessary ..
Number of samples taken of products of combustion for analysis ..
Rate of cooling of boiler ..
Efficiency of governor ..
Indicated initial pressure H.P. cylinder ..
Indicated least back pressure L.P. cylinder ..
Actual rate of expansion, being the actual ratio of volumes occupied by steam at the point of cut-off and at moment of exhaust ..
Indicated horse-power ..
Ratio of brake to indicated power ..

Conclusions.

Ratio of the evaporative power of boiler to the theoretical power of the coal ..
Ratio of useful effect of feed heater to total evaporative duty obtained from boiler ..
Weight of steam supplied to engine per indicated horse-power (excluding condensed steam draining from jackets) ..
Weight of steam supplied per brake horse-power (excluding condensed steam draining from jackets).

Order of Merit, according to

Efficiency of boiler ..
Efficiency of engine ..
Economy of fuel per brake horse-power ..
Economy of water per brake horse-power ..
Efficiency of governor ..

NOTE.—The tables given in J. H. Cotterill's work on the steam engine will be used in making the computations.

THE Technical Bureau of the Semaine Industrielle, of Liege, is urging the necessity for co-operation and participation in the following enterprises:—Gas lighting in Spain and Portugal; tramway construction and working in Spain and Servia; the working of sulphur and lignite mines in various parts of Europe; the development of a Belgian concession of a highly plastic fireclay, containing by analysis, water, 0·33; organic matter—coal—4·35; silica, 77·6; alumina, 15·05; lime, 2·1; magnesia 0·32; not taken 0·25.

RAILWAY MATTERS.

A NEW station at the Manors, Newcastle-on-Tyne, was opened by the North-Eastern Railway Company last week. It has cost over £100,000, including bridges and an island platform 200ft. long, furnished with offices, and replaces a small and inconvenient station.

GREAT dissatisfaction is felt in the New Norfolk district of Tasmania at the stoppage of works in the Derwent Valley Railway, and a deputation waited on the Government on April 27th. The reply was that the Government believed in having all the work constructed under the contract system, and that it was not likely there would be more than two months' delay in proceeding with the works.

THE Supreme Court of the German Empire at Leipsic has approved of the sentence of three months' imprisonment of a man convicted of buying and using a non-transferable railroad return ticket. This was a test-case, as Prof. Dr. Rud vs. Jhering, an eminent jurist, had declared that a return-ticket, notwithstanding that "not transferable" was printed upon it, was not only meant for "the" bearer, but for "any" bearer.

THE American *Railroad and Engineering News* is informed that "the Pennsylvania Railroad Company intends to make exhaustive trials on its line of a compound locomotive on the Webb system. The trial, it is said, will be made with a London and North-Western locomotive built under Mr. Webb's supervision, which will be brought over for the purpose. This will be the first really thorough test of the compound system in this country, and its result will be watched with much interest.

THE three days' official inspection of the Tay Bridge by General Hutchinson and Colonel Rich, on behalf of the Board of Trade, was concluded on Saturday last. The tests on Saturday were mainly to ascertain the vibrations of girders while a train was passing over them slowly and at high speed. On the conclusion of the tests the inspecting officers declared themselves in every way satisfied with the result of their investigations, and telegraphed to the Board of Trade that they saw no reason why the bridge should not be at once opened for general traffic.

AT the commencement of 1887 the following lines were opened in Russia:—Romny-Krementschug, 198 versts; Ssedlez-Malkin, 62 versts (both State lines); and the Noworossisskij branch of the Wladikawkas Railway. The following lines are under construction:—Ssamara-Ufa, 455 versts; Pskow-Riga, 354 versts; Brest-Cholm, 107 versts; Homel-Brjansk, 257 versts; and Rshew-Wjasma, 15 versts (all State lines); also Jarosslaw-Kostroma. On January 1st, 1887, the Government itself managed 3410 versts of railways, besides the Finland railways and the 1005 versts of the Transcaspian line, which is under the control of the War Department, but is shortly to be transferred to the Ministry of Communication.

WHAT next? The varying requirements of modern travel and the enterprise displayed in meeting them are evinced by the announcement, the *Colonies and India* says, that Messrs. Cook and Sons, the tourists' agents, besides "personally conducting" the mining engineers to Utah and Montana for their summer meeting, "have arranged to conduct the Mahommedan pilgrims of India to Arabia, issuing first, second, and third-class tickets from Bombay to Jeddah and return for 90, 60, and 45 rupees. A Mohammedan doctor accompanies the pilgrims, and special arrangements will be made for ladies. Pilgrims' valuables can be deposited at Bombay and drawn at Jeddah. Price of return ticket paid to heirs in case of demise *en route*."

OUR Birmingham correspondent says:—"The engineering works engaged on heavy railway rolling stock accessories, are making a large turnover on account of South America, and other foreign States. Excellent reports reach me of the activity at certain of these establishments. One district concern has, I am informed, 500 tons of heavy wheels and axles waiting on the railway for dispatch to India. The manufactures are all open work intended for goods traffic and are of steel; some of the goods are of unusual weight, 25 cwt. per pair, and are intended to take a gauge 9in. wider than our home lines. The axles are of 5in., and are throughout very strong. The same concern is, I understand, busy also for South American lines."

RAILWAY extension is engaging the attention of Jamaica, but the local *Standard* thinks that, "in the present state of the public finances, it is evident that a prudent scheme of railway extension must be gradually and tentatively conducted. The line should be constructed in short sections of ten, fifteen, or twenty miles, so that each section might, as soon as completed, be open to traffic, thereby helping at the earliest possible moment to defray its own cost and conducing to the more economic construction of the remaining sections. The narrow gauge is advocated, as Jamaica does not need the extensive plant and appliances found necessary to meet the requirements of productive districts and populous centres in the Mother Country."

THE independent railway lines of Russia have an aggregate length of 21,098 versts, so that with the Government lines there are 24,508 versts in the country. The total network, including the Finland and Transcaspian Railways, has a length of 26,642 versts. The returns of seven state lines, exclusive of the Jekaterinburg-Tjumen, show that during 1886 they carried 1,861,912 passengers, 174,197 soldiers, and 176,382,076 pouds of goods. The gross receipts amounted to 12,143,715 roubles, or an average of 4201 roubles per verst—*i.e.*, 10·34 per cent. less than in 1885. The whole of the Russian railways together carried only 34,233,685 passengers, 2,506,096 soldiers, and 2,550,847,013 pouds of goods. The gross receipts amounted to 220,454,956 roubles, or 9211 roubles per verst—*i.e.*, 5·84 per cent. less than in 1885.

PHOLADS and phylloxera, and teredo-navalis, and white ants have usually not helped much, but the following might be hoped for:—"The existence has just been discovered of a detestable microbe which feeds upon iron with as much gluttony as the phylloxera upon the vine. Some time ago the greatest consternation existed amongst the engineers employed upon the railway at Hagen by the accidents occurring always at the same place, proving that some terrible defect must exist either in the material or the construction of the rails. The German Government directed an inquiry to be made, and a commission of surveillance to be formed for the purpose of maintaining constant watch at the spot where the accidents—one of them attended with loss of life—had occurred. It was not, however, until after six months had elapsed that the discovery was made. One of the employés had observed that the surface of the rails appeared to be corroded, as, if by acid, to the extent of 100 yards. The rail was taken up and broken, and it was perceived that it was literally hollowed out by a thin grey worm, to which the qualification of "railoverous" was assigned, and by which name it is to be classed in natural history. The worm is said to be about two centimetres in length, and of the size of the prong of a silver fork in circumference. It is of a light grey colour, and on the head carries two little glands filled with a corrosive secretion, which is ejected every ten minutes upon the iron. This liquid renders the iron soft and spongy, and of the colour of rust, and it is then greedily devoured by the insect. "There is no exaggeration," says the official report of the calamity, "in the assertion that this creature, for its size, is one of the most voracious kind, for it has devoured 36 kilogrammes of rail in a fortnight!" The *Ironmonger* says the foregoing comes from a German source, but until it sees a specimen of this extraordinary worm, and witnesses its destructiveness, it prefers to doubt the existence of so "railoverous" a creature.

NOTES AND MEMORANDA.

FOR mounting albumen prints without wrinkle, upon any kind of paper, a thick solution of bleached shellac in alcohol is recommended as meeting every requirement.

LAST week 2513 births and 1390 deaths were registered in London. Allowing for increase of population, the births were 358 and the deaths 43 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 19, 17·9, and 17·5 in the three preceding weeks, further declined last week to 17·2.

THE American *Railroad and Engineering Journal* says:—Mr. F. J. Clamer, of the Ajax Metal Company of Philadelphia, has discovered a method of depositing pure lead on iron, steel, or other metallic surfaces by which, it is claimed, a perfect union of the metals can be secured. A great number of applications can be suggested for this process, as the lead will protect the iron or steel from rust, the action of acids, &c. Bridge rods and bolts can be thus protected, wires can be covered, and lead-coated iron sheets can be substituted for the lead sheets in the tanks used for making sulphuric acid and for other purposes.

A SUBSTITUTE for red or white lead is being introduced in America. It seems to be a German invention, for it is called graphite "smear-grease," intended to replace red lead in making joints for steam and gas fitting. It is made of properly pulverised and perfectly pure graphite, mixed with best boiled oil. The graphite being a natural lubricant, it is claimed that it enables a fitter to make a much tighter and consequently a much more perfect joint. Further, that a joint so made can remain any length of time, and will then yield to the ordinary pressure of the tongs. It is equally useful for bolts and screws.

ALUMINIUM-BRONZE forges similarly to the best Swedish iron, but at a much lower temperature. It works best at a cherry red; if this is much exceeded, the metal becomes "red short," and is easily crushed. The temperature for rolling is a bright red heat, and it is a curious fact that if the metal were forged at the temperature it is rolled, it would be smashed to pieces. If the temperature in the ordinary muffle in which it is heated be allowed to rise too high, the bronze will frequently fall apart by its own weight. When in the rolls it acts very much like yellow Muntz metal. As it loses its heat much more rapidly than copper or iron, it has to be annealed frequently between rollings.

THE annual report of the Astronomer Royal states that the construction of the new 28in. refractor has been delayed by difficulty in obtaining the discs of glass. Messrs. Chance are engaged in removing a bunch of fine veins from the flint glass disc, and have every hope of being able very shortly to report the disc practically perfect; and M. Feil's successor has successfully moulded a crown disc from which he believes that he has removed all defects. The details of the special tube and other mechanical parts have been settled with Mr. Grubb, and he has made considerable progress with its construction, so that when the object glass is completed it will be mounted without delay.

DURING the past month, despite the prejudicial influence of the stormy weather on the state of the river sources, the general character of the water supplied to the metropolis has been eminently satisfactory. The proportion of organic matter present in the water—not at any period of the year excessive—has, with the advance of the season, undergone an appreciable diminution. Thus, in the case of the Thames-derived supply, the maximum proportion of organic carbon in any one sample was ·152 part in 100,000 parts of the water; while the mean proportion for the month was ·134 part, as against a mean of ·162 part for the preceding month, and a mean of ·167 part for the previous four months of the year. The condition of the East London Company's Lea-derived water, in respect to its degree of freedom from organic matter, was, however, unexceptional, the mean proportion of organic carbon present being only ·108 part, with a maximum of but ·131 part in 100,000 parts of the water.

THE February number of the *Annuaire de la Société Météorologique de France* contains an article by M. Hervé-Mangon on the distribution of rainfall and its duration in Paris, from observations taken during the years 1860-70. These observations, which were made with Hervé-Mangon's pluvioscope, show that rain falls on an average 19 hours a month. The month with the shortest duration of rain was August, which had only 12½ hours, while March had 26 hours, and October and November a little more than 22 hours each. An examination of the hours of the rainfall during the night and during the day shows that on an average there are fewer hours of rain during the night than during the day. The longest interval without rain was 26 days, from September 11th to October 6th, 1865. The greatest nnmber of consecutive days of rain was 18, from October 3rd to 20th, 1867. The month of March had, on an average, the greatest number of rainy days, viz., 21·2, and the month of June the least, viz., 13·1. The months of greatest and least amount of rainfall do not correspond with these months, the maximum being 2·21in. in September, and the minimum 1·00in. in February.

FROM a recent report by Dr. Hellman on statistics of lightning damage in Schleswig-Holstein, Baden, and Hesse, it appears that the danger from lightning in these parts—unlike the case of other parts of Germany—has been decreasing of late years. Soft-roofed houses are fired about seven times oftener than those with hard roofs. Windmills are struck 52 times, and church and clock towers 39 times, oftener than ordinary houses with hard roofs. The marshy regions in Schleswig-Holstein are the most dangerous, and the land about inlets of the east coast the safest. With like conditions, the relative danger decreases the more houses are grouped together. In Baden the danger varies more than in any part of Germany. About Heidelberg it is 24, and in Waldshut 265 per million houses. In Hesse, the low plain of the middle Rhine is the most dangerous part. In the fifteen years 1869-83 there were killed by lightning for every million men, in Prussia, 4·4; in Baden, 3·8; in France, 3·1; and in Sweden, 3·0. The geological nature of the ground, and especially its capacity for water, has important influence. Thus, calling the danger on lime 1, that for sand is 9, while for loam it is 22. This, says *Nature*, is partly why most of South Germany and Austria is less dangerous than North Germany.

AT the last meeting of the Meteorological Society, a paper was read on the "Amount and Distribution of Monsoon Rainfall in Ceylon generally, with Remarks upon the Rainfall in Dimbula," by Mr. F. J. Waring, M. Inst. C.E. The principal feature in Ceylon, as determining both the amount and distribution of rainfall, is a group of mountains situate in the south central portion of the island, equidistant from its east, west, and southern shores. The south-west and north-east monsoons in Ceylon may be said respectively to blow steadily from May to August inclusive, and from November to February inclusive. In March and April, and in September and October, the weather is more or less unsettled, and no regular monsoon or direction of the air current is usually experienced. After giving details of the rainfall at twenty-five stations, the author concludes by remarking upon:—(1) The effect of the mountain zone in determining the amount and distribution of the rainfall. (2) The apparent gradual veering of the rain-bearing currents of air as each monsoon progresses. (3) The relative insignificance of the south-west monsoon as compared with the north-east monsoon in inducing rainfall. (4) The cause of the large general rainfall of the north-east monsoon throughout the island generally as compared with that of the south-west monsoon. (5) The influence of the gaps in the external ring of the mountain zone, and of the central as well as the other ridges in it, in determining the amount of rainfall within the zone and in the neighbouring districts outside it.

MISCELLANEA.

A TELEGRAM from Askabad states that the work of making a highway between that place and Kutchan, in Persia, has commenced.

THE Sheffield Corporation, at a special meeting held last week decided, by thirty-nine to five, four being neutral, to make an offer to the Sheffield Water Company to purchase their undertaking at a price which is estimated at £2,121,597.

IN several places in Dakota the artesian wells of 900ft. to 1050ft. show pressures of 250 lb. to 325 lb. As there are no elevations within hundreds of miles to correspond to this, the Chicago *Journal of Commerce* asks "the geologists, gasologists, or seismologists to tell what causes the pressure." The *Journal of Commerce* had better ask an easier one.

AT Newcastle-upon-Tyne, on Wednesday the 15th inst., Sir W. Armstrong laid the foundation stone of a new building for the College of Science, to cost from £20,000 to £25,000. Sir William, speaking afterwards at a luncheon in connection with the event, said what they now wanted was bread-winning science.

THE rural sanitary authority of Frimley, Surrey, have adopted the scheme of sewerage prepared by Mr. James Lemon, M. Inst. C.E., and application will be made to the Local Government Board for sanction for a loan to carry out the works. The scheme adopted is that of filtration, the effluent being discharged into the river Blackwater.

THE Royal Commission on Irish Public Works has since Monday, the 13th inst., been engaged in the inspection of the coasts of Galway, Mayo, and Sligo, between the towns of Galway and Sligo, visiting in particular Roundstone, Clifden, Killary, Clew Bay, Belmullet, and Killala. On Friday they held a sitting in Sligo to take evidence respecting railways and fisheries.

IT is stated that the prospects of the French Railway Jubilee Exhibition have been seriously compromised by the failure announced in Paris of M. Gabriel Levy, one of the chief promoters of the enterprise. The exhibition is nominally open, and a series of *fêtes* had been arranged, but the *Railway News* says the want of support by the French companies and the scandal now created are serious difficulties to meet.

IT has been decided by the Government of the Colony of Victoria to hold an International Exhibition of arts, manufactures, agricultural and industrial processes and products, in the City of Melbourne, in celebration of the centenary of the settlement of Australia; and that the Exhibition will be opened on the 1st of August, 1888, and will close on the 31st of January, 1889. An executive commission has been appointed by the Governor under the Seal of the Colony to conduct the Exhibition; and its London Committee, who have control of all questions concerning the exhibitors of the United Kingdom, have offices at 8, Victoria-chambers, Westminster.

THE Society of Arts offer prizes to art-workmen in the following eight classes for the present year, as follows:—(1) Painted glass, £25, £15, £10. (2) Glass blowing in the Venetian style, £10, £5, £3. (3) Enamelled jewellers' work, £25, £15, £10. (4) Inlays in wood, with ivory, metal or other material, with or without engraving, £25, £15, £10. (5) Lacquer, applied to the decoration of furniture or small objects, £25, £15, £10. (6) Decorative painting on wood, copper, or other material, applied to furniture and internal decoration, £25, £15, £10. (7) Hand tooled bookbinding, £25, £15, £10. (8) Repoussé and chased work in any metal, £25, £15, £10.

LAST year the New York Legislature directed that certain officers of the New York and Brooklyn City governments should investigate and report this year upon the practicability of a new connection between the cities by bridge or tunnel at or near Grand-street, New York. The report has been made, and is to the effect that either a bridge over or a tunnel under the East river, at the point named, would be practicable, although more room would have to be allowed for the approaches than was specified in the resolutions of the Legislature. On the question whether the building of the connection was needed there was a sharp division, the New York officers all voting against, and the Brooklyn officials for it.

THE published accounts and estimates regarding the progress of the Panama Canal continue to show extraordinary discrepancies. The official bulletin of the company announces that the number of cubic metres of rock and soil removed during the month of May was 1,167,000. Cable advices from New York state that a M. Boulange, an engineer on the canal, has addressed the American Society of Civil Engineers, in almost hopeless phrases regarding that undertaking. If the completion of the canal is possible at all, he said, it can only be done by an expenditure three times as large as that now being incurred. Sixty per cent. of the coloured labourers die, and 80 per cent. of the whites. The present funds, he said, may last for four months, when the abandonment of the work is probable, at least for some years.

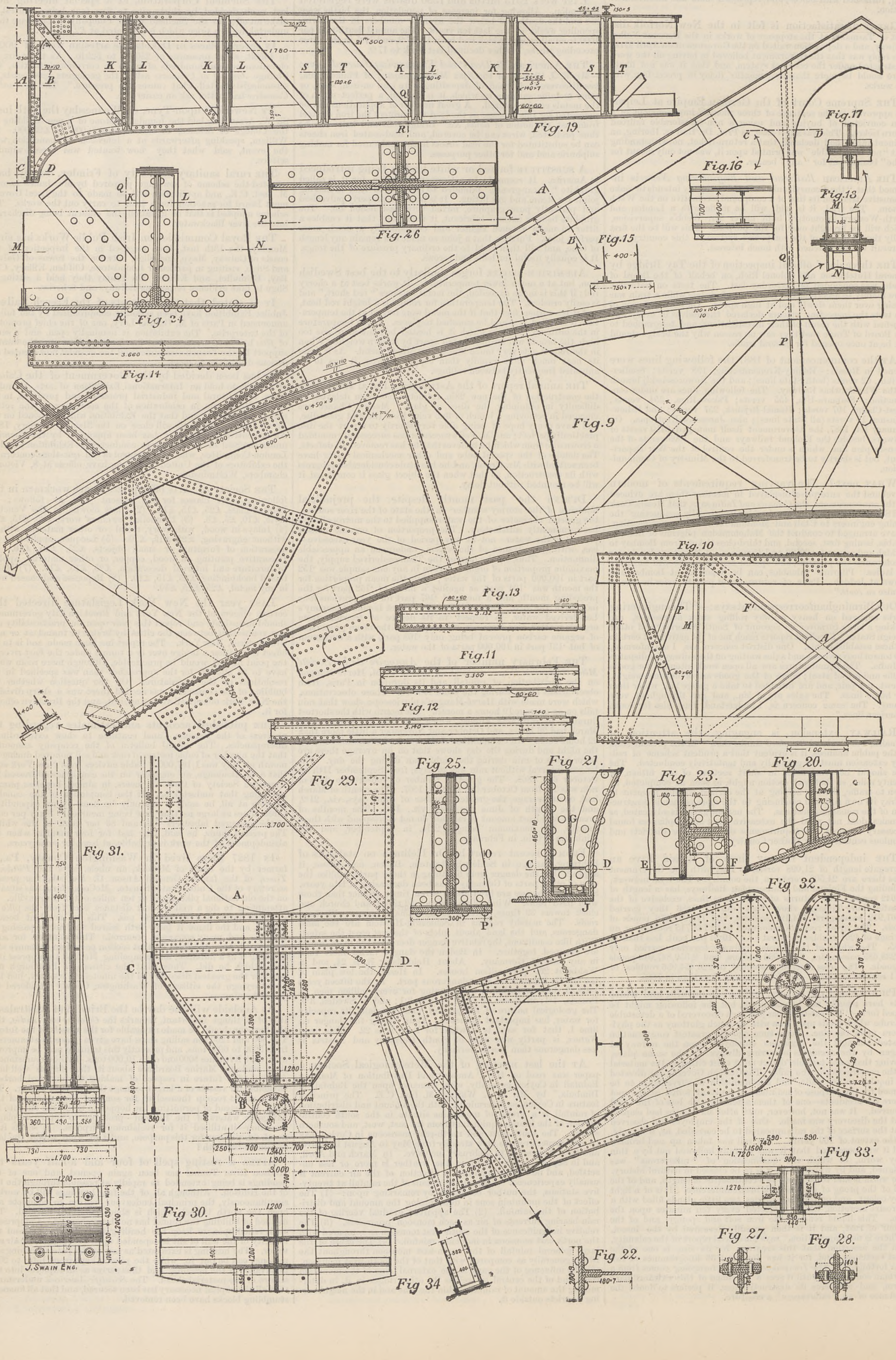
IN 1827 there lived in Washington County, Pa., a farmer by the name of McCook, an uncle, says the *Pittsburgh Times*, of the famous General Anson G. McCook, the present secretary of the United States Senate. McCook's farm was situated on the old national pike, eight or ten miles out of Brownville. In attempting to dig a well a short distance back from the pike he struck a large flow of natural gas. This by accident became ignited, and the flame it gave forth scared the horses passing on the pike, and many runaways occurred. This went on for some time, until the authorities in that section passed an ordnance stigmatising it as a nuisance, and compelling McCook to suppress it as such, which he did. Thus what the citizens of Pittsburgh now consider the greatest discovery of the nineteenth century, just half a century ago the citizens of Washington County considered the greatest nuisance.

As Adelaide will one day be the Brindisi of Australasia, it is of all things important, remarks the *Colonies and India*, that the harbour should be made navigable for the vessels of the future. The 800 and 1200 ton sailing ships have given place to steamers of from 5000 to 6000 tons, and presently this tonnage may be improved upon until it reaches 8000 and even 10,000 tons. In the circumstances, then, while the Marine Board are about it, they may as well have an eye to the future in respect of making the outward harbour navigable for vessels of a larger tonnage than those of to-day. The Board might recoup themselves for some of the expense of this work, if, instead of permitting the hopper to throw the silt into the navigable waters of the harbour—probably to return to plague invention—it utilised it for reclaiming purposes. It seems it is worth 6d. per ton for this purpose, and if so, what would the land reclaimed be worth?

AFTER a resting spell of four and a-half years the Hudson River Tunnel has been again opened, and one of the headings is being extended as rapidly as possible through the bed of the Hudson. Although all of the four headings will be worked simultaneously, the principal endeavour will be to complete and open the north tunnel, which is about one-third finished. The method of building the tunnel has not been changed. Compressed air is relied upon to keep the heading free from water, and the tenacity of the wall of silt is depended upon to separate the air and water. The heading is excavated as fast as the pate sheathing and masonry can be put in, while the pilot is kept from 15ft. to 20ft. in advance of the heading, and thus serves as an explorer into the nature of the material ahead. The *Scientific American* understands that all the capital necessary has been secured, and that all financial stumbling blocks have been removed.

THE PARIS EXHIBITION, 1889.—ROOF OF THE MACHINERY HALL, 375FT. SPAN.

(*For description see page 502.*)



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THE ENGINEER, June 24th, 1887.

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CHILLED CASTINGS.

(To the Editor of The Engineer.)

SIR,—Will any of your readers tell me how the makers of stone breakers get a chill an inch thick in thin metal, the rest remaining soft enough for machinery?

F. F.

Preston, June 21st.

ELECTRO-MAGNETS.

(To the Editor of The Engineer.)

SIR,—I shall be much obliged to any reader who will tell me how to get the maximum effect in pull-out of a given weight of wire to form a coil and iron to form a core, and how to make a bobbin. The total weight available is 5 lb.; the stroke of the core, 1in.; the current, 6 ampères; the potential, 60 volts. I can find nothing in books which will help me.

ELECTRO-MOTOR.

London, June 22nd.

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

MEETINGS NEXT WEEK.

GEOLOGISTS' ASSOCIATION.—Friday, July 1st, at University College, Gower-street, W.C. Papers to be read:—"On the Geology of Cornwall, with special reference to the Long Excursion," by J. H. Collins, F.G.S., &c. "On the Deposition of the London Clay," by J. Starkie Gardner, F.G.S., &c.

DEATHS.

On the 16th May, at East London, South Africa, of heart complaint, ALFRED WRIGHT, C.E., aged thirty-eight, third son of the late John Wright, of Rochester, M. Inst. C.E.

On the 18th June, at 11, Upper Phillimore-gardens, COSMO INNES, M. Inst. C.E., aged forty-five, secretary of the London Sanitary Protection Association, youngest son of the late Cosmo Innes, of Edinburgh.

THE ENGINEER.

JUNE 24, 1887.

JUBILEE.

FOR once the United Kingdom has held high holiday in the fullest possible sense of the word. It is easy to talk or write of the United Kingdom. To realise what the words mean is beyond belief difficult. They do not apply alone to the little group of islands of which London is the heart, the soul, and the brain. The true United Kingdom consists of regions which all but encompass the earth; and it speaks well for British loyalty that our colonies and territories have manifested just as keen a desire to honour our Queen-Empress as the men and women of England itself. Geologically speaking, fifty years is an infinitesimal period of time. Historically, it may or may not possess immense importance. Progressively, it has sufficed for the bringing about of vast changes. The fifty years which have passed since the young Princess Victoria was called in the early summer morning to ascend the throne of a mighty dominion are more remarkable for the advances made by mankind than any similar period concerning which a record exists. From comparative barbarism whole nations have rushed into civilisation. In this country the change wrought has been marvellous. In what is it apparent? To what is it due? The answer to the first question is supplied by a thousand memories. The answer to the last has yet to be given. It scarcely suggests itself with universal clearness. Each man knowing a little or more, but not all, will supply his own answer, and supplying it, will feel that it is not self-contenting. It will leave a mist of doubt between the truth and his mental vision. Is it in politics that we have advanced? Alas! no. Is it in morals? In mental philosophy? Perhaps. The only thing certain is that in the vast domain coming under the head of civilisation enormous progress has been made. But reflection shows that the settlement of this proposition as a fact has advanced matters but a little way. To whom is the advance in civilisation due? We are egotistical enough to answer, to the engineer. The engineer is the great pioneer of civilisation. It is impossible to note any real advance in civilisation which has been made since the earliest epochs of history to which the engineer has not contributed, if he has not originated and carried it through from first to last. This may be termed an audacious proposition. Let us see if it can be supported, sustained, justified.

In what does civilisation consist? The complete answer would fill a volume. Within limits, we may say that it consists in the special power of utilising natural phenomena for the support of life and the augmentation of happiness. Pushing a little farther, we find that civilisation depends in a very curious way on facilities for intercommunication of thought, body, and what the political economist calls "commodities." Furthermore, it may be said that man being essentially imitative, facilities for intercommunication are essential to the uplifting of those who stand, mentally, low in the scale of humanity. In all ages and under all circumstances advances in civilisation have been due, not to the many, but to the few, and the greater the facilities for intercommunication the greater has been the influence of those who have played the part of leaven to the great mass of mankind. Now the engineer has, above and beyond all others, promoted the art of intercommunication. We use the word "engineer" in a comparatively broad sense; we mean to convey by it the idea of a man who, by the aid of his hands taught by his brain, can produce and carry nearer and nearer to perfection devices for utilising natural forces or phenomena in aid of man. It has been said, and said with truth, that the printing press was a great civiliser. But after all, the invention of movable types, their construction, and that of the screw press, by which they were utilised, were each and all due to that peculiar constructive faculty which divides the engineer from other men. It forms no part of our purpose to supply a catalogue of the engineering events of her Majesty's reign. It is our object to endeavour to make plain what has been the nature of the influence exerted by the engineer; and this, we repeat, has been and is mainly displayed in providing means by which men can with the greatest possible facility exchange thought and place. Can it for a moment be doubted that railways have enormously promoted and extended civilisation? There can be but one answer. But when the fact is admitted we have only covered a part of the ground. Civilisation has not been promoted by the railway, but by the work which it has enabled men to do.

A very noteworthy feature of the work done in science, —and under the head of science we include engineering— during the fifty years terminated last Tuesday has been the combination in an unusual degree of natural laws to secure a given end. Many of the phenomena of nature which we now utilise freely, are while isolated quite useless to man. Their existence has been recognised for years or centuries, but no good has come of the recognition until within very recent periods. To no class of men is the world more indebted than to engineers for this work of combination. Engineers have made very few discoveries. The carrying out of original research is not their duty. They leave that to the philosopher; but the philosopher, having discovered here a fact and there a fact, the engineer combines them and produces results which astound even the philosophers. The discoveries of Faraday and Ampère in electro-magnetism were useless until men like Wheatstone gave us the telegraph, and like Holmes, Gramme, Siemens, and Ericsson supplied the dynamo-electric machine and the electric light. The construction and laying of the Atlantic cable was one of the grandest of all the achievements of the engineer. The philosopher had very little to do with it. He had found that a magnetic current would deflect a magnetised needle. From this apparently small discovery was drawn an enormous deduction, and the result has been of stupendous importance. All that has been done in mechanical science during the history of the world sinks into complete insignificance compared to the fact that men can now communicate with men almost as though they were face to face across the ocean and the prairie, the mountain and the forest. Fifty years ago, nay, thirty years ago, the man who would dare to assert that, being in London we could ask a question in New York and get an answer in an hour, would be laughed at. He who ventures to assert that this is really a very wonderful and beautiful performance now risks ridicule for another reason. We have in the Atlantic cable a typical instance of the results of combination. By the aid of the steam engine was produced the cable; by the aid of the steam engine were rolled the plates of which the Great Eastern was built; by the same agency was the huge ship propelled across the Atlantic. Electricity by itself could not effect the required result, nor could steam; combined they have placed New York and San Francisco within speaking distance of London.

To the labours of the engineer during the last fifty years is due the cheapening of food to an incredible extent. The political economist hastens to assure the world that bread is cheap in this country only because wheat and flour are admitted duty free. The assertion is absurd. Wheat and flour are cheap in England only because of the railway and the cargo steamer. The repeal of the Corn Laws in February, 1849, was followed by dear corn, just as cheap corn had preceded that repeal. In 1835 the average price of wheat in England was £1 19s. 4d. a quarter; in 1837 it was £2 15s. 10d.; in 1847 it was £3 9s. 9d., but that was famine year in Ireland; in 1849 it was £2 4s. 3d.; but in 1855, in spite of the repeal of the Corn Laws, it rose again to a point above that reached in 1847, being no less than £3 14s. 9d. These figures show that the operation of the tariff had an insignificant effect compared to that of other influences. The cargo steamer may be said to have first come into prominent existence about 1863 or 1864, and from that date to this wheat has almost persistently fallen in price, because the supply has overtaken and even outstripped the demand. The engineer, in a word, exerted a far more powerful influence than the statesman. Furthermore, let it not be forgotten that the English engineer has taken the lead of his professional brethren all over the world. The British civil engineer existed and made his influence felt when he was yet unknown in Europe. Fifty years ago all Europe sought for Englishmen to carry out the work which Englishmen had first taught them was indispensable; and so it is even now, and so it will be to the end. We do not share the gloomy vaticinations of those who assert that foreign culture is beating English brains and hands. We do not know what it is to be beaten; and we know that the difficulties and tribulations which may deter and repel weaker minds, only serve to temper and harden the genuine metal of the British engineer.

Turn in what direction we may, we find that the material progress which has been effected during the last fifty years has been not only mainly, but entirely due to the labours of the engineer. Drainage, water supply, sanitation as a whole, have been conferred on the world by the labours of the profession which we represent. Not only has the engineer done so much to make life happy, to him is the world indebted for the fact that he has made life possible, at least in this country. To his aid, the supply of food, clothing, water, houses, is directly due. We in no sense or way undervalue the labours of the great men of science, who have lived, and moved, and worked since Queen Victoria came to the throne. But as we have endeavoured to show, the labours of the laboratory must have been barren of results without the consummate power of adapting and combining means to an end which have been manifested by the engineer. Without the engineer, the man of science, the seeker after nature's secrets, could have done little or nothing. But the engineer has never been in this position. Unaided by research he has revolutionised the world. Before railways came roads and canals. To whom is England indebted for her roads? Who first taught people what a road was? Was it the capitalist, or the public, or the Government, or the man of science? Not at all. These men rested content to flounder through mud and mire. They grumbled, but they went on floundering. The man who taught England how to make roads was a born engineer, a blind man, Thomas Metcalf, who began operations in Yorkshire in 1765. After him came an incomparably greater engineer, Telford. What shall we say of Rennie, and Stephenson, and Brunel? How shall we speak of Alan Stevenson, the lighthouse engineer *par excellence*, and of his great predecessor Smeaton? Turn in what direction we please, we always encounter the same fact. To the engineer is due, beyond and above all other men, the social and material progress which have marked out and distinguished the fifty years of Queen Victoria's reign as the most remarkable for achievements of mind over matter in the history of the world. The engineer has been all-powerful. He has altered the face of countries. He has removed mountains. He has annihilated space and time. He has fed millions. For him the impossible has had no existence. He has heaped up national riches until its amount is incalculable. He has converted primeval forests into plains laughing with corn. He has ascended almost to the heavens; he has plunged into the bowels of the earth. He has bridged the ocean; and who is foolhardy enough to say that he has reached the limit of his power? Who dare assert that the seeker after nature's truths has fathomed them all, or that no discoveries will yet be born tiny as a babe, which shall grow to the stature of mighty giants in the hands of him to whom the words "it is impossible" seem but an empty phrase? We dare not, even if we would, assert that the work of the next half-century shall be less mighty, less important, or less far-reaching than that of the last. We may shrink in awe from the contemplation of the possibilities of that future which begins to-day. But be that future what it may, we rest steadfast, confident, ever sure that the engineer will play a mighty part in it; and that the men who are coming will be worthy of those who have departed, and who are veiled from our gaze in a mighty golden cloud of glory and renown.

DEPRESSION IN THE MILLING TRADE.

It has been estimated by Mr. H. Kains Jackson, a trustworthy authority on grain and milling statistics, that the annual consumption of flour in the British Isles is about 250 lb. per head of the population. Up to 1865 nearly the whole of the flour necessary to meet the wants of the country was made by the home millers; but a year or two later rapid inroads were made by foreigners; and in 1871 about two million sacks of 280 lb. each were imported. A decade later—that is, in 1881—the imports of foreign manufactured flour had risen to five and a-half million sacks. During that period the increase in the imports of flour were much larger *pro râta* than in wheat, the proportions having been—flour, 250 per cent. increase; wheat, 70 per cent. This startling augmentation in the imports of foreign-made flour was held to be the unanswerable argument for the general adoption of the roller system in Great Britain and Ireland. British milling had become anything but a jolly business. The millers had without doubt got behindhand, and the superior American and Hungarian-made flours were preferred by the British public. The millers, however, aided by willing experts, decided to improve their fighting tools, to obviate the surrender of their industry to the foreigners. How thoroughly that feeling spread was pointed out in an article in The Engineer on April 22nd, where it was shown that about £9,000,000 were expended within the last six years in the equipping of British and Irish mills with the new system.

From the report which we printed in The Engineer of June 17th on the "Depression in the Milling Trade," it appears that all this vast outlay of capital has been ineffectual in stemming the flow of foreign-made flour, and that the annual imports continue to increase by leaps and bounds, threatening to entirely swamp the British milling industry. The report of the Committee appointed to investigate the depression in milling is not pleasant reading, but it appeared almost cheery after the more desponding speeches by the millers, which the reading of it gave rise to. One after another the millers who attended the convention at the Crystal Palace rose and stated that they believed the milling trade was, to a large extent, doomed to go to the wall unless a duty was put on the imports of foreign-made flour. Whether that remedy is within reach or no it is not for us to say; and the millers themselves did not believe they were likely to obtain any immediate encouragement in that direction. It cannot, however, be matter for doubt that the country mills of the United Kingdom may be looked on already as things of the past. The flour of the future, it is clear to us, will be manufactured in large mills situated at the docks of our large shipping ports. The report directs attention to the fact that while the population in 1851 was nearly 18,000,000, the number of persons engaged in milling was 36,000; whereas, with a population of 26,000,000 in 1881, the number of persons employed in milling was only 23,000. This decrease, we would point out, is not due, as the millers think, to the imports of foreign flour, as the imports in 1881 were not as serious as at present, but is almost altogether owing to the high state of efficiency attained in self-regulating milling. In the old mills the products from each machine were caught in sacks and carried by men to the next stage in the process; in the modern roller mill the material is not handled from the time it is lifted by the elevator from the ship in the uncleaned state until it appears as finished flour at the warehouse. There appears to us to be something loose in the figures of the report. It was stated that the figures relating to the number of men employed in milling had been furnished by the Government officials, and that those relating to the number of mills were supplied by Mr. J. H. Chatterton, the obliging secretary of the National Association of British and Irish Millers. Admitting that there are 8700 flour mills and 23,000 men employed in them, if we deduct the 8700 owners, this leaves less than two men to operate each mill, which cannot be correct. Again, admitting that there are 8700 mills, and that the wants of the country are only 36,000,000 sacks per annum, this gives the average capacity of the mills at one sack per hour, which we know cannot be the case. After presenting these figures, the report proceeds to deal with an article which appeared in The Engineer of April 22nd relative to the capital laid out within the last six years in converting the British mills from the "sudden death" to the "gradual reduction" system. As stated above, we put the expenditure at £9,000,000, but the report gives a total of £5,000,000. This amount puts the actual sum as much under the actual figure as the number of flour mills is exaggerated. The amount, we understand, was arrived at by consulting with a number of the gentlemen who have had the largest share in putting in the new machinery, and the method adopted is responsible for some of the principal items of cost being overlooked. In the first place, the turnover of work done by a few of the leading firms is no criterion of what was done by local millwrights, and that item, we are aware, was a large one. Another item very much under-estimated is the cost of the labour of erecting the new machinery inside the mills. It is not generally known that the custom largely adopted was for the miller himself to undertake the cost of the labour of erecting the mill, and there are few millers but will bear us out when we state that the totals were disappointingly and often seriously large, in some cases amounting to over £3000. This considerable sum does not appear in the contract prices of the engineers, and of itself would account for a large part of the discrepancy between The Engineer and this special report by a Committee of millers. Again, it is overlooked that large sums were spent in altering the old buildings to suit the new machinery; the report only refers to new buildings; and, further, The Engineer's estimate did not omit the large item for additional motive-power in the form of new engines, boilers, turbines, &c. &c., a class of work generally undertaken by engineers outside the milling engineers proper, and it is not surprising if the Committee overlooked these items, which account for the difference between our own and the Committee's estimate.

As understood by the milling trade, the special Committee was appointed to inquire into the causes of the severe depression and suggest remedies. Those who expected any tangible hints must be disappointed, as the report deals largely in vague generalities. The speeches of the millers who criticised the report did not mince matters, as they clearly made it known that in their opinion a duty on wheat and grain was the only possible remedy. Two north-country millers thought that the trade might regain its lost ground, but their remarks were coldly received. If the imports of foreign-made flour increase at the same rate during the next two decades as they have done during the past one, the art of milling in England must become extinct. To a large extent the country mills are already silenced, and instead of there being 8700 mills, as stated in the report, we are safe in stating that there are not 1600 mills in the United Kingdom actually making flour. While the state of the milling trade is depressed in the extreme, yet we have no doubt that the largest portion, if not all the trade will be regained and retained by the home millers, but the entire flour will be made in even less than 1600 mills. This fact is gradually dawning on the whole milling trade, as it is now generally known that the larger the mill the cheaper the cost of production. Already there are over twenty mills in England, with a capacity of 5000 sacks per week; while Mr. Seth Taylor, of London, has recently put in the "Simon" system to produce over 10,000 sacks per week, and the North Shore Mills at Liverpool, on the same system, are equally large; while Messrs. Greenwood, at Blackburn, and Mr. Arthur McDougall, of the City Mills, Manchester, have adopted the "Carter" system on a similar scale. Under one hundred mills of the capacity of the above mentioned are quite enough to manufacture the 36,000,000 sacks necessary for the annual wants of the population of the United Kingdom. We have before us some returns relating to the respective cost of running large and small mills, and the figures are very much in favour of the former. In a small mill the cost of production and general expenses are as high as 4s. per sack of the output, while large mills can be managed under 2s. per sack. That being so, the future of British milling is clearly in the direction of large mills; and it is the surplus flour of the huge American mills, which are cheaply worked, that has flooded the British markets. With or without a duty on foreign-made flour, the large British mills properly managed in the best centres, where the wheat can be elevated from the ship into the mill, will be more than able to cope with their foreign competitors. With the illimitable wheat supplies of India, which are specially suitable for the roller process of milling, there is no reason why we should receive our principal food supply —either in the raw or manufactured state—from America.

THE SEWAGE PLANS OF THE METROPOLITAN BOARD.

Some of the recent proceedings of the Metropolitan Board with reference to the sewage question are rather perplexing. It was thought that the Board had a well devised chemical process in hand for the treatment of the London sewage. A solution of lime combined with protosulphate of iron was to furnish an effluent sufficiently innocuous to enter the river at the outfalls during the cooler months of the year, while a further application of manganate of soda and sulphuric acid was to render the effluent perfectly safe during the heat of summer. All this was understood to be the fruit of research and practical experiment carried on by the engineer and the chemist, Sir J. Bazalgette and Mr. Dibdin, aided by no less an authority than Dr. Dupré, the investigation commencing as far back as February, 1884. At a subsequent period the process was reported upon and approved by Sir F. Abel, Dr. Odling, Dr. A. W. Williamson, and Dr. Dupré. The experimental stage was developed until it went so far as to include the treatment of nine million gallons of sewage per day. On the basis of these experiments a contract has been entered into for the erection of sewage works at the southern outfall, at a cost of £400,000, and a sludge ship has just been completed, costing £16,000. Works at the southern outfall are being designed, so that until lately it seemed as if the Board knew exactly what it was about, and had clearly resolved what to do. Suddenly there is a change of front, and that at a very untoward time. The public have seen, by the published reports of the meetings of the Metropolitan Board, that Sir Henry Roscoe has been called in to advise as to whether some cheaper or better mode of treating the sewage on its way to the outfalls might be devised, in preference to the use of manganate of soda. Sir Henry Roscoe reported that bleaching powder and sulphurous acid would be cheaper, and probably as efficacious as the manganate. This has so pleased the majority of the Board, that Sir H. Roscoe has since been called upon to report upon the deodorisation of the sewage at the outfalls as well as in the sewers. We cannot but view this wavering policy on the part of the Board as possessing an element of danger. There is too much reason to fear that the chemical operations at the outfalls have been partly paralysed by this indecision. If it should prove that the river has been allowed to lapse into a state bordering on putrescence, the consequences can hardly be less than serious. It is much easier to hold impurity in check than to grapple with it and overcome it when once it has made headway. A continuance of sultry weather may have such an effect that in a few hours the Thames may undergo a terrible change for the worst. Sir H. Roscoe may then try his best, and so may Mr. Dibdin, but the odds will be fearfully against them; and, if they fail, the Board may have reason to rue the day. The plan which answered fairly well last summer, if adopted early this year, might be confidently expected to accomplish even better things than before, though nothing can be done quite *secundem artem* until the new works are finished and brought into operation. The process adopted last year may be costly; but if the plans which are now in favour should fail, economy will not be accepted by the public as a valid excuse. At any cost within the limits assigned by the Royal Commission—if, indeed, those limits should be deemed sacred—the river must be kept from putrefying. If the Board fails to fulfil this, its primary duty, a storm may arise such as will not be easily laid.

THE RAILWAY HALF-YEAR.

We are now sufficiently near the end of the half-year of the chief English railways to allow of the formation of an estimate of the general results of the working. It may be remembered that there were for many of the chief companies very poor dividends for the past half-year, the earnings having fallen off. In the half-year which is now running its course there is another and a better testimony to the state of the great trades served by the railways. All the great companies will have enlarged their earnings during the first half of 1887. The returns of the traffic receipts made up to the present time include the Whitsuntide traffic for this year, but not for the past, so that the extent of the gain cannot be exactly stated; but there are indications that two at least of the chief companies, the Lancashire and Yorkshire and the London and North-Western, will have receipts above those of a year ago, the increase in each case being fairly stated as about £100,000 at least. Two or three others, the North-Eastern, the Great Western, and the Manchester, Sheffield, and Lincolnshire, have each very substantial receipts, the increase of the former being probably fully £70,000 when the half-year's accounts are made up; and in nearly every case there is for the half-year an increase, though in one or two lines the addition is not large. But the fact remains that the takings of the companies are larger this half-year than they were a year ago, and that to an extent which is appreciable on the chief lines. This is the first result, and it can certainly be relied on. Whether the working expenses will take up a large part of this sum remains to be seen, but there is the advantage of very cheap coal and iron, so that two of the main departments of expenditure will find considerable relief. Last year, too, there was a prolonged snowstorm in the middle months of the first period, and this greatly increased the expenses of many of the companies. On the other hand, the capital of nearly every company is more than it was, and the claims of the additional interest alone would swallow up all the increase in the receipts on some of the railways; and the lower charges for goods and minerals on some of the railways must have caused the transport to be much larger to bring up the revenue to the point it has, so that there may be some increase of working charges in consequence. Against the fact of increased receipts we have to set the doubt whether the expenses may not have advanced, but there seems ground for the belief that on the whole the half-year will be better than its corresponding predecessor. What further economies the boards of the companies may have been able to carry out remains to be seen, but these have been possible; and the conclusion would seem to be that the result in dividends will be better. Some of the companies have increases of revenue so large that some addition to the dividend—an addition in one case to the extent of nearly one per cent. per annum—would seem to be probable. In all cases the dividend might be expected to be maintained, but in most some slight increase would appear to be the most probable result of the working of the half-year.

STEAMSHIPS AND THEIR LOSS

The official return of the registrar for the past month shows that the serious loss of shipping property continues. There were no fewer than 23 steamships, iron built, removed from the register for the United Kingdom in the month. The net tonnage of these was 10,711, and nine of them were under 100 tons each. Of the vessels above that tonnage there were two stranded, both being large cargo-carrying steamers; five were sold foreign—to France, Russia, Austria, Turkey, and Guatemala; two were wrecked; one lost; and one was missing. Of steamers built of wood five were removed from the registry by collision, foundering, and other loss, none being sold; and if we take the totals for the whole of our fleets at home and in the colonies, wood and iron, steam and sailing, we shall find that there were last year removed from the registry 166 vessels in the month, the net tonnage being 44,307. In the same time the additions to the fleets were as many as 113 vessels, but the total tonnage was only 21,353, so that the loss was more than double that of the additions for the month. It is true that there was a portion of the tonnage removed sold to foreigners, but that portion is small, and after it is allowed for there is still a very large loss in the carrying capacity of our fleets. This will in the future affect the freight market, and eventually it will benefit the shipbuilder by making shipowning more profitable, and thus causing more orders; but the national loss is serious. It is noticeable that in the official return there is only given the names and ports as well as the tonnage and power and mode of removal of vessels lost; but there should be either in that or in some other way some statement to lead to sound conclusions as to the causes of the loss, and as to the modes by which recurrence can be prevented. It should be possible to state succinctly, for example, the class of vessel lost and the trade she had been engaged in. At present there is far too little discrimination by the great assuring clubs between the risks run by vessels in different trades and of varying types. There is at times a sligh additional premium on certain kinds of voyages, or voyages in certain times, but there is no systematic attempt to discriminate as to risk, and thus the good vessels pay for the bad ones, the good types for those inferior, and the careful owner for, let us say, the less careful. It is a question which will soon have to be raised, and that seriously, for the drain in the past month was at the rate of about 500,000 tons yearly, an enormous loss, which must afflict the insurers heavily, even when all allowances are made for the old vessels which are broken up. It would be the first step to the improvement of matters in this direction if there were an exhaustive analysis, from period to period, of the loss of vessels and the method of loss as well as the accompanying circumstances.

The Electric Illumination at the Institution of Civil Engineers.—A novel application of electric light for the purpose of public illumination was effected by the Anglo-American Brush Company for the Institution of Civil Engineers. Five hundred incandescent lamps, arranged two in series, each of 10-candle power, and aggregating 18,550 watts, were employed in forming the following legend:—"1837—1887, her Most Gracious Majesty the Queen;" and in surrounding the panel at the top of the building containing the name of the institution. The current was provided by a Victoria dynamo driven by a 20-horse power portable engine.

LITERATURE.

Les Machines Marines: Cours Professé à l'Ecole d'Application du Genie Maritime. Par A. BIENAYME. Ouvrage Couronné par l'Academie des Sciences. Paris: E. Bernard et Cie. 1887. 4to., 527 pp. Plates.

THE first four chapters of this book are devoted to the history of the invention, design, and development down to recent times of the steam engine, and a marine engine after it had commenced to be that; the system of propulsion receiving notice with the change from paddle engines to screw engines, and geared engines to direct coupled engines for screw propulsion. Respecting the modern marine compound engine the author remarks that the British claim for John Elder the credit of its production, while in France it is claimed for Benjamin Normand, and he says that whilst the question of priority is not settled, it is certain that Normand took out a patent in France for this type of engine in 1856, and that in 1861 he fitted the Furet, and later the Eclair and the Albert with his compound engines in place of Penn's oscillating engines. He also says that from the small cylinder of Normand's engines "the steam passed into an intermediate receiver, where it was dried and at the same time slightly superheated to prevent, as much as possible, condensation during the second part of its work." This seems to be identical with Mr. Cowper's "hot pot."

Speaking of the recent types of engines and of three and four cylinder triple and quadruple expansion compound engines, Benjamin Normand again receives the credit of being first in a patent in 1871, and with engines fitted in the Montezuma in 1872. John Elder is credited with making the first English triple expansion engines in the Propontis in 1874, this being, the author says, followed by the Anthracite and the Aberdeen, the latter being from plans by Mr. Kirk. Thus some of our readers may once more think they learn new things of themselves by going to a foreign book. The sixth chapter deals with the power of engines, and after explaining the *rationale* of the estimation of the power of an engine, gives the rules which have successively been more or less commonly used in practice, commencing with those of Watt, and concluding with three tables giving the leading particulars of a large number of engines and their fuel consumption. The second part of the work commences with the thermodynamic questions connected with the use of steam in engine cylinders; the laws relating to temperature pressure and volume, and to Carnot's cycle, Regnault's work, expansion, theoretic efficiency, losses affecting practical efficiency, incomplete expansion, and clearance and port spaces. The tenth chapter takes up the consideration of engines of successive expansion or compound engines of the two, three, or four-fold expansion. He argues that steam in passing from a high-pressure cylinder into a receiver, which is large enough to maintain a tolerably equable pressure, is superheated in its passage, by expansion without work, and that this super-heating increases the volume, though not the pressure, and thus the "triangular" loss between the two diagrams of the high and low cylinders is apparent, but not real, inasmuch as the area of the low pressure is greater than it otherwise would be. In the eleventh chapter he discusses Hirn's experiments, and Zeuner's criticisms on them, and conjectures as to indicator inaccuracies, and the advantages of superheating, the use of a jacket (*chemise*), and of separate expansions. Indicators and indicator diagrams are treated in the next chapter, and this is followed by critical and analytical description of the various parts of the engines, with discussion of the questions involved, and of the formulæ which have been theoretically deduced; these including sizes of cylinder ports, range of expansion, size of air pumps, condenser and condenser water, and pumps, feed pumps, injectors, and so on. The influences of inertia and equilibrium of engines are next treated. In the twenty-fourth chapter paddle-wheels are dealt with, and many forms illustrated, and screw propellers are taken in the next; and after examining the experimental results of trials by various experimenters, he concludes that large diameters are advantageous; efficiency generally decreasing with increase of speed, except with very fine lines; that four blades are generally preferable, and that sharp pitches are not advantageous. The fifth part deals with boilers, commencing with a description of the principal types, from the time of Watt to the introduction of what the author calls the actual marine types. The early and recent types are all fully illustrated, and strength and dimensions discussed; chiefly with reference to French practice, though our own is not omitted, our formulæ for strength of flues, amongst other things, being given in English as well as metric units. The publisher's work does justice to that of the author, which is of a high character, though the text is after the French fashion, in paper cover and plates in loose sheets. The English names are, it may be remarked, correctly given, although in one place Trevithick appears with a "w" instead of a "v," and Glasgow appears once as Glascow, though, like Trevithick's name, the error is evidently typographic.

Practical Electric Lighting. By A. BROMLEY HOLMES, Assoc. M. Inst. C.E. Third edition. London: E. and F. N. Spon. 1887.

THIS is the third edition of a very useful little book. It is not what the initiated and the more or less completely trained would acknowledge to be a necessary book, but it is nevertheless one which will be found of service to all, but especially to those who wish to gather preliminary practical notions upon things electrical, things that they cannot afford the time, and have not the patience to hunt for or boil down out of the higher order of electrical books. The reader of this can quickly obtain notions of electrical terms, measurements and measures, and instruments, apparatus, machines, and methods. When he has gone through this book he will have an idea of what he wants from more scientific works and how to obtain it.

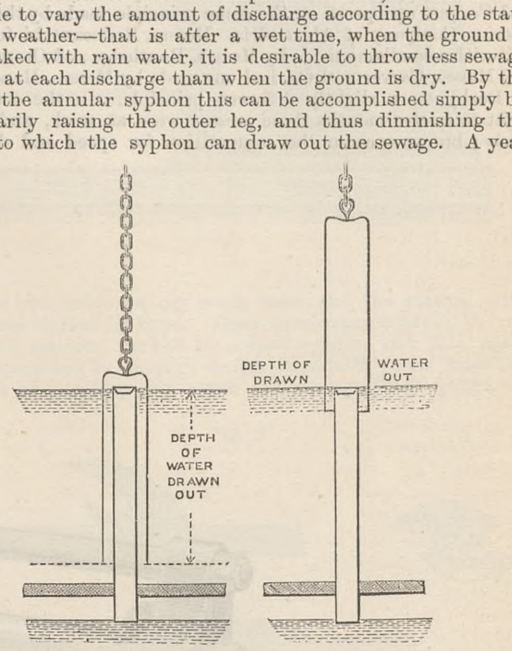
A NEW METHOD OF PRODUCING SODIUM.

A NEW method of reducing sodium from its oxide, which promises to be of important practical value, has lately been perfected by the inventor, Mr. H. Y. Castner, of New York, who has erected a full-size plant in Lambeth, where we have recently examined the furnace in operation. Although some considerable demand for sodium as a reducing agent has been developed during the last thirty years, consequent upon the researches of the late M. H. St. Claire Deville and others upon the metallurgy of aluminium and the allied light metals, there has not been any substantial improvement in the method of obtaining it upon that introduced by Brunner in 1808, namely, the heating of carbonate of soda with an excess of charcoal; lime being added to prevent fusion and the consequent separation of the lighter carbon from the soda. The operation must be performed in wrought iron retorts, as the temperature required—about 1400 deg. C.—is too near the melting point of cast iron to allow the latter to be used with safety; and although the reduction of sodium oxide requires a temperature not much exceeding that required for the production of zinc, it is necessary to give a heat nearly approaching to the melting point of wrought iron to obtain one-third of the metal contained in the charge, as soda in the presence of lime combines with the latter oxide, forming compounds which require a very high temperature for their decomposition. Another inconvenience is in the excessive production of carbonic oxide, which by reacting upon the sodium vapour, and reproducing a mixture of soda and finely-divided carbon in the neck of the condenser, may not only cause considerable loss, but may give rise to dangerous explosions. For these and other reasons the manufacture of sodium has hitherto been tedious and costly, so that although the materials used are comparatively low-priced, the cost of production has been about 4s. per lb., the greater part of which is chargeable to the waste of the iron retorts. In Mr. Castner's method the material chosen for reduction is caustic soda of the highest attainable strength, the reducing agent being a so-called carbide or ferruginous coke, which is prepared by mixing finely-divided iron (reduced from ferric oxide by hydrogen or carbonic oxide) with pitch, coking the mixture, and grinding the coke so obtained. This product, containing iron and carbon in the proportion of 7 to 3, is so dense that it remains diffused through melted caustic soda, and thus, by insuring contact between the latter and the carbon—the active reducing agent allows the reduction to be effected at a much lower temperature—about 850 deg. Cent., or a moderate red heat—than is required when lime is used. The operation is performed in cast steel crucibles. Those at present in use have a capacity of about 20 lb. of mixture—15 lb. of caustic soda, and $5\frac{1}{4}$ lb. of carbide—but it is proposed to increase the size so as to take 40 lb. charges. These latter are about equivalent to the largest sized crucible used in silver or bronze melting. The crucible bottom has a socket or plug at the bottom, by which it is attached to the top of a ram in a hydraulic cylinder, so that it can be introduced into or removed from the reducing chamber by raising or lowering the hydraulic piston. The cover of the crucible is dome-shaped, with an inclined delivery tube at one side leading to the condenser. It is fixed by a projecting plug at the top into the arch of the furnace, and has the lower edge made convex, in order to fit into a corresponding concavity in the rim of the crucible. This rim is filled with lime, which when the crucible and cover are brought into contact by the hydraulic pressure it forms a sufficiently gas-tight joint. The crucible when charged with the mixture of caustic alkali and carbide, receives a low preliminary heating for about half-an-hour in a small furnace, when the mass melts, and boils violently, but ultimately subsides to a condition of tranquil fusion. When the latter condition has been attained it is removed to the reducing furnace, and lifted into position by the hydraulic apparatus. The condenser is a narrow cast iron box containing naphtha, with a tube for the escape of gas at the top, and is adapted to the delivery tube by an iron stirrup and screw clamp. A rod with a spiral blade passing through a packed joint in the front of the condenser is used to keep the delivery tube clear. The reducing furnace is heated by gas from a Wilson producer which enters the chamber by a port near the bottom, and is burnt by air which receives a preliminary heating by passing through a cast iron pipe stove placed in the course of the spent flame. When the condenser is adapted the gas escaping at the top is lighted, giving a yellow flame of varying intensity according to the state of the operation. This gas varies from nearly pure hydrogen at the commencement to a mixture of 95 per cent. of hydrogen and 5 per cent. of carbonic oxide towards the end of the operation, which lasts about an hour and a-half. About one-third of the soda in the charge is reduced, the remainder being converted into carbonate, which may be crystallised for sale, or reconverted into caustic soda. The iron, together with a small proportion of carbon, forms an insoluble residue, and is utilised to form a fresh carbide. The production of carbonic oxide may be regulated by the proportion of carbide used, and if the latter be reduced below the amount necessary to effect complete reduction this gas is not evolved. This is a point of importance in the reduction of potassium, where the black compound resulting from the reducing action of the vapour upon carbonic oxide is of an excessively explosive character.

The experimental furnace now at work contains three reducing chambers, and is capable of treating 45 lb. of caustic soda, yielding $7\frac{1}{2}$ lb. of sodium, and 39 lb. of carbonate at one time, or a total of 120 lb. of the former, and 624 lb. of the latter per day. The fuel consumed is about 1 cwt. per hour for the reduction, and $\frac{1}{2}$ cwt. for the preliminary heating. Owing to the very moderate heat in the furnace the wear of the crucible is only trifling, and it is considered that it may be used about 200 times before it is worn out. According to Mr. Castner's estimates, the cost of sodium made in this furnace need not exceed $8\frac{3}{4}$d. per lb. so that it might be sold at about 1s. per lb., or one-fourth of the present ruling price. These estimates have been carefully gone into by Dr. Gore, F.R.S.; Mr. James Mactear, and Sir H. Roscoe, M.P., F.R.S., who see no reason to doubt their probability. Such a reduction would mean, among other results, a notable cheapening of aluminium and magnesium, which metals have hitherto received only restricted industrial use on account of their high price, and it is therefore to be hoped that the process will soon be adopted on the large scale. The details of the process have been most carefully worked out by the inventor, and the furnace, which we hope to illustrate in an early number, is remarkable as a piece of good and careful construction.

A NOVEL METHOD OF UTILISING THE ANNULAR SYPHON.

MR. RUDOLPH HERING calls attention in the *American Sanitary Engineer* to an adaptation of Field's annular syphon. The intermittent discharge of sewage, particularly when the area of land upon which it is to be disposed is small, often makes it desirable to vary the amount of discharge according to the state of the weather—that is after a wet time, when the ground is well soaked with rain water, it is desirable to throw less sewage upon it at each discharge than when the ground is dry. By the use of the annular syphon this can be accomplished simply by temporarily raising the outer leg, and thus diminishing the depth to which the syphon can draw out the sewage. A year



ago, in building sewage disposal works for the Sagamore Hotel, Lake George, he arranged the syphon in this way, suspending the outer leg by a pulley, and raising it or lowering it to suit the conditions. He found that it could be raised over four feet, so that its lower edge came to within a few inches of the top of the inner leg without disturbing in the least a proper starting of the syphon action. In this extreme case, then, the water in the tank was lowered only a few inches at a time, though at more frequent intervals, instead of having its entire contents discharged all at once.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—F. W. Highton, assistant-engineer, to the Malabar; William Snell, assistant-engineer, to the Impérieuse; G. J. Ross, acting chief engineer, to the Gannet, to date June 1st.

AMERICAN ARMOUR-PLATES.—Mr. John Illingworth, the head of the Newark—N.J.—Steel Works, has just patented and—according to the U.S. *Army and Navy Register*, had successfully tested a new steel armour-plate for war vessels. Heretofore no armour has been found that would resist a projectile from the Hotchkiss gun fired at a distance of 60ft. The trouble was that the first shot generally shattered the steel, and the next exposed the unprotected hull by knocking off the broken pieces. By Mr. Illingworth's process the plate is composed of four thicknesses of steel of different tempers, the hardest being that on the surface. The plate was tested at Annapolis recently, and was found to be satisfactory. Four shots were fired at it from a 6-pounder rapid-firing Hotchkiss gun at a distance of 60ft. Although the plate was crushed by the three shots planted in the same place, it remained intact, and the projectiles were all broken by the resistance. The plate used in this experiment was composed of two thicknesses, measuring 3in. through, and the projectile was thrown against it with a striking velocity of 1850ft. a second.

BEAMS WITH FIXED ENDS.—At the last meeting of the Physical Society a paper was read, entitled, "Note on Beams Fixed at the Ends," by Professors Ayrton and Perry. This paper contains a simple method of solving problems relating to horizontal beams with vertical loads, and fixed at both ends. The curve of bending moment for the given distribution of load is first plotted, supposing the beam "supported" at the ends, and the constant c by which the ordinates of this curve exceed those of the true curve, is determined from the condition that the angle between the end sections must be nought. If M is the bending moment at a section, I the moment of inertia of the section about its neutral line, and E Young's modulus of elasticity for the material, then $\frac{M}{E\,I}$ is the curvature of the beam at that section. If $o\,o^1$ is a short length of the beam, the angle between the originally parallel sections at o and o^1 is $\frac{M}{E\,I} \cdot o\,o^1$. Hence, if the beam be divided into a great number of parts, and the values of M and I determined at the middle of each then

$$\Sigma \frac{M}{I} \cdot o\,o^1 = o \quad . \; . \; . \; . \; . \quad \text{(I.)}$$

since E is supposed constant. But $M = m - c$, where m is the bending moment at the same section, supposing the ends "supported."

$$\therefore \Sigma \frac{m - c}{I} = o; \text{ or } \Sigma \frac{m}{I} = E \frac{c}{I}$$

$$\therefore c = \frac{\Sigma \frac{m}{I}}{\Sigma \frac{1}{I}} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad \text{(II.)}$$

The following rule results:—Knowing m and I at every point, divide the beam into any number n of equal parts, find $\frac{m}{I}$ at the middle of each part, and take their sum; this gives the numerator of (II.) Find $\frac{1}{I}$ at the middle of each part; their sum gives the denominator of (II.) From this c is determined. Diminish all the ordinates of the m diagram by c, and we have the diagram of bending moment for a beam fixed at both ends, with any assumed distribution of load and variation of cross-section. Particular cases are worked out in full. Numerous drawings made by students of Finsbury Technical College were exhibited, showing applications of the method to different distributions of loading.

TWENTY YEARS COTTON PRESSING IN EGYPT.

(*Continued from page* 491.)

AFTER this came a totally different system of cotton pressing, viz., the Armstrong accumulator press. The first press on this principle was made by the Engineering Company of Alexandria for Messrs. Tod, Rathbone, and Co., the hydraulic cylinders and rams being made by Messrs. George Forrester and Co., of Liverpool. This press was proportioned and arranged to be driven by the original 14-horse power horizontal engine worked by a 16-horse power boiler, that had before driven the McCombe press. The speed was estimated at 15 bales per hour, 6 cwt. each, pressed to a density of 30 lb. to the cubic foot. Every condition was fulfilled to the satisfaction of both makers and owners; but the march of progress cannot be stopped, and now the demand for heavy and denser pressed bales became so great that the machinery in use was inadequate to turn out the quantity of bales required for shipment to England and elsewhere; besides the cotton crop was vastly increasing, the old hand-presses were going out of use, and a considerable rise in freight took place. What was the consequence? Messrs. Peel and Co. put up a press on the same principle made by the Engineering Company of Alexandria. Messrs. Rodocanachi followed suit with a small one made by Messrs. Routledge and Ommanney, and Messrs. Carver and Co. had one made by Messrs. Handyside, of Derby, on a slightly different principle. In the course of eight to twelve months these presses were at work, and doing fairly; but now came the competition for speed and density, with alarming results for the poor presses. Greater engine and boiler power was applied, the number of pumps was increased, and larger piping, with a different arrangement of valves, was substituted for the old.

The results were 25 bales per hour instead of fifteen, 6¾ cwt. each bale instead of 6 cwt., and 20 cubic feet measurement instead of 22, cracking of hydraulic cylinders and pumps, smashing of press bottoms and tops and columns, splitting of valve-boxes and breaking of hoops. However, nothing daunted the press owners or their engineers; new pieces, stronger and of better metal, were obtained, steel cylinders instead of cast iron, 9in. rams instead of 8in., and Whitworth's compressed steel pumps instead of gun-metal. Messrs. Tod, Rathbone, and Co. also ordered a spare press complete, which was erected alongside the other, and so arranged that the two could be worked together or each separately by the same engine and pumps with very satisfactory results, the two making twenty bales per hour each with nearly the same consumption of coal. The construction of these presses as they are at the present time, and the mode of working them, is as follows:—The accumulator presses belonging to Messrs. Tod, Müller, and Co.—late Tod, Rathbone, and Co.—are worked by a pair of 12-horse power nominal horizontal engines, driven by a 25-horse power double-flue Cornish boiler, made by Mr. Wm. Turner—late Ommanney and Tatham—of Manchester. These engines are connected to the pumps direct from the engine crank shaft by a pinion and spur wheel on the counter shaft, running in bearings on the top of the pump frame. This shaft makes one revolution to four of the engine's, running at 105 revolutions per minute. The pumps, of which there are eight, viz., four 1ft. 6in. stroke, 3½in. diameter, worked from disc cranks outside the pump frame, and the other four 12in. stroke, 2in. diameter, worked by excentrics inside the pump frame, the spur wheel being in the centre. The four large pumps force the water, which is taken from a tank on the top of the engine-room, through a main cast iron pipe 5in. diameter, direct to the accumulator. The four small pumps force their water direct into the presses for finishing the bale. The accumulator is a wooden box containing twenty-five tons of sand, supported by a 9in. hydraulic ram, 9ft. stroke, working in an ordinary cast iron cylinder. The presses are each supplied with three 9in. Whitworth's compressed steel cylinders and cast iron rams, 11ft. rise, the boxes being on the revolving system, and three in number. The spare press was made by Mr. Wm. Turner, of Manchester, the boxes being all of wrought iron. The arrangement of valves and piping are the same on both presses. There are five screw-down valves to each press, one in direct communication from the accumulator to the centre cylinder, with a back-pressure valve, through which the water passes, and is self-acting, closing immediately the pressure becomes greater in the press than the accumulator pressure on that ram, another valve, also in direct communication with the accumulator and the two outside cylinders of the press. The third valve is in direct communication with the four small pumps and the three hydraulic cylinders. The other two are the let-off and syphoning valves. The piping from the accumulator and small pumps is 1in. bore, and the piping for the let-off and syphoning is 2in. bore, and in immediate connection with the tank on roof, the water returning to the tank on completion of each bale. The follower is firmly fixed on the top of the rams, and on rising with the centre ram, takes the other two rams with it, the vacuum caused thereby being immediately filled with water through the syphoning valves. The press is worked in the following manner: The two screw-down valves leading from the main accumulator pipe are closed, all the others are open. The accumulator is at its highest point. The valve in connection with the centre cylinder is opened, and when the ram has risen till the pressure on the cotton is equal to the accumulator pressure on that ram, the syphon valves are closed and the valve from accumulator to outside cylinders opened, when the three rams will rise still further till they also become in equilibrium, showing at this point 840 lb. per square inch on ram surface; these valves being shut, the small pumps force direct into the press till the bale is finished—pressure two tons per square inch. To let down, the two syphon valves are open, when the water returns to the tank. In working the two presses together, the valves leading from the small pumps are never opened at the same time, but alternately, the accumulator working on one press while the small pumps are finishing the bale on the other.

The differential accumulator press or intensifier was introduced in 1869. Two of these presses complete, one for Messrs. Carver and Co., and one for Messrs. Choremi, Müller, and Co., with their engines, pumps, and boilers, were supplied by Messrs. Handyside, of Derby, from drawings made here by Mr. Norman Wylie, for Mr. George Ashcroft the contractor. The special object of the differential accumulator was to do away with the small pumps forcing direct into the press for finishing, and so reducing the risk of breakage, in case of carelessness on the part of the valve-man, or by the sudden jerks unavoidably given by the small pumps. The engine and pumps were all on the bed plate, the engine set diagonally in the centre of the frame, and the four pumps fixed on the side of it horizontally, and worked by gearing. The press and boxes were on the same revolving principle as in the previous presses. The low-pressure accumulator was the same as on the ordinary accumulator presses, but instead of working direct on the press rams, its pressure was actuated on a watertight piston 16in. diameter, the piston-rod, 6in. diameter, of which formed the plunger of the differential cylinder, from which the water was forced into the press cylinders. This system gave a steady, equal, and certain pressure on the bale, which was limited to whatever pressure was required by weighting the larger accumulator accordingly, to make a bale of a certain weight or density. The only drawback was that should too much cotton be put into the box, then the table could not rise the required height to fasten the bands, in which case the pressure had to be relieved and some of the cotton taken out. This did not often happen, for it is astonishing how nearly the Arabs guess the quantity of cotton they have in the box by its resistance against their feet when tramping it in. I have known in a lot of 100 bales the difference to be less than 5 lb. either way, unless it should be in the first or last bale of the parcel, and many would turn out exactly the same weight.

A further description of this principle of press than this it is unnecessary for me to give, so I will now try and explain the last and, I consider, the most perfect of the accumulator presses. Of this kind there are two in Cairo, a small one in the establishment of Messrs. George Andres and Co., the other rather larger, in Messrs. Peel and Co.'s factory. The difference between the two is that Messrs. Andres' is worked by one accumulator and small pumps for finishing, and Messrs. Peel's by the differential accumulator. It is only necessary for me to point out the difference in the arrangement of the presses themselves, the motive power being the same as already described, viz., in one case finishing with small pumps direct, and in the other by means of the differential accumulator. The real difference lies in the arrangement of the boxes, there being a fixed box outside the large columns, round which the double upper portion of the box turns. There are two of these top pieces with their doors, &c., complete; but fixed on the bottom edge of their sides are four self-acting catches for holding the loose follower-plate in position, after it has pushed up the loose cotton, clear of the fixed box. When this is accomplished, the full top part being partially pressed and turned round under the finishing press, the empty top portion of the box takes its place, at the same time automatically relieving the loose follower-plate, which then descends with the fixed follower and ram, belonging to the fixed box. The finishing part of the press is furnished with three 9in. hydraulic cylinders and rams in Andres' press, and five 10in. in Peel's, the strokes being about 3ft. The great advantage in these presses consists in the unlimited length that can be obtained in the fixed box—so doing away with tramping—and the great power that can be attained by the short and numerous cylinders in the finishing part, also the readiness in which any of the short high-pressure cylinders can be changed in case of accident, and their comparative cheapness, as against cylinders of 13ft. or 14ft. stroke. The ram in the fixed box is 7in. diameter and about 14ft. stroke. The hooping or grooved plate is made of steel, and turns round the large column, so that it can be moved out of the way whilst the fixed box is being filled. There are two of these: one being under the finishing press head while the bale is being finished, and the other under the girders forming the head of the fixed box. These presses originally of the old type, have been altered to this system here; and credit should be given to the engineers of the various pressing establishments for the energy with which they worked in developing their ideas, and which, in the course of eighteen years, has produced machines not excelled by those in any other part of the world. Reference should also be made to the way in which they have been met by their several proprietors.

In the year 1869 the engineer of Messrs. Carver's factory, Mr. B. Stock, conceived the idea of constructing a set of double-acting horizontal steam and hydraulic forcing pumps, so arranged that they could work their existing compound steam and hydraulic press with greater speed and less consumption of fuel. As before stated, the great defect in the old arrangement was the loss of steam and time in having to lift the four plungers so often to obtain the desired result by their down strokes. The arrangement of this system was as follows:—The steam cylinder was placed horizontally in the centre of a strong cast iron bed-plate, with its piston-rod working through each end of the cylinder, and connected to two wrought iron crossheads supported by cast iron slide bars. To each of these crossheads was attached—see Fig. 2—two forcing plungers working in cast iron barrels fixed to the bed-plate outside the steam cylinder. By a simple arrangement of valves and pipes the water was forced by the whole four pumps, at each forward or return stroke of the piston, into the centre cylinder of the press, and then into the three, the two outside cylinders syphoning in the usual way. Then the large pumps were knocked off in pairs, the small ones finishing the bale. The steam piston was actuated by an ordinary slide worked by hand, and the press valves arranged the knocking-off process of the pumps, thus taking two men to work the whole plant. A bell telegraphic arrangement was made between the two, the men being out of sight of each other; this system worked very well, it being sometimes necessary to telegraph an extra half stroke of the small pumps to fetch the bale up to the desired height to fasten the hoops in case of an extra heavy bale or one of very dry cotton. The drawing of the general plan was made by Mr. Norman Wylie, for Messrs. Carver and Co., and submitted by them to Messrs. Ommanney and Tatham, but for some time was not proceeded with. In 1871 Mr. Davison—Messrs. Choremi, Müller and Co.'s engineer—proposed the same plan, but with modifications, and under his direction this system was adopted and carried out by myself, who had then succeeded to the business of the late firm of Ommanney and Tatham The

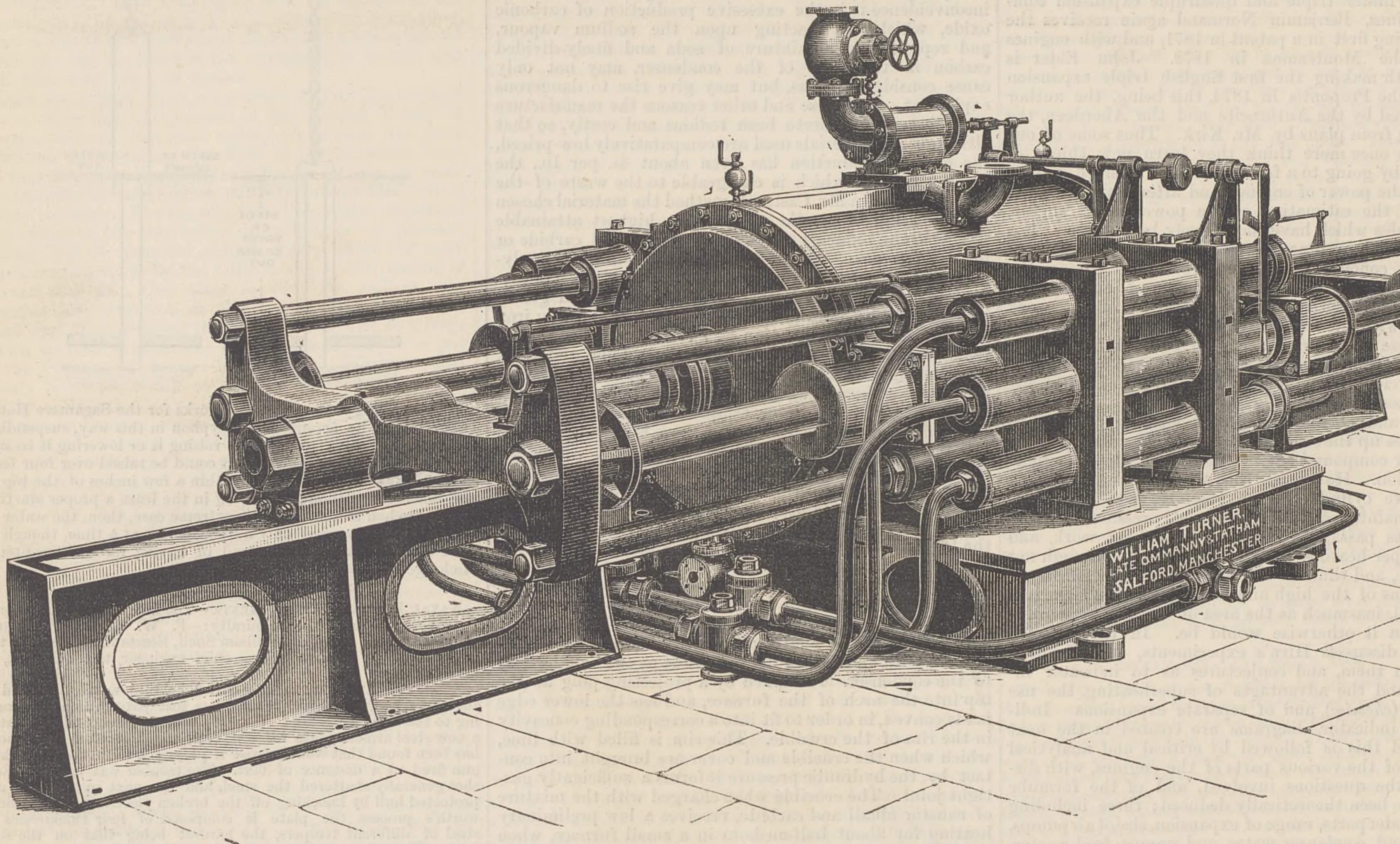


Fig. 2.—HORIZONTAL DIRECT-ACTING HYDRAULIC POWER PUMPS

number of pumps was increased from eight to twelve, larger in diameter and longer stroke; the steam cylinder was also increased in proportion. When the machinery was erected and attached to one of their old presses the result was most satisfactory. Since then they have had two others made of greater power, Whitworth's compressed steel cylinder taking the place of the old cast iron, but the general arrangement is much the same as the original plan designed for Messrs. Carver and Co. These machines can easily make fifty bales per hour of 7 cwt. each compressed into 20 cubic feet. Messrs. Choremi's establishment, better known as the Alexandria Cotton Pressing Company, was burnt down on September 1st, 1883, and thoroughly gutted from end to end. The damage to the machinery was very great, but these machines suffered the least, partly owing to their position in the works, but principally to their strength and the compact way in which they were put together. One of their presses was of the vertical compound steam and hydraulic type, and the upper portion, viz., presshead, steam cylinder, piston-rod, pumps, plungers, &c., being totally destroyed, all the gun-metal valve boxes and connections, pumps, glands, &c., being completely fused or otherwise injured. Mr. W. Turner has replaced all the destroyed parts of machinery appertaining to the presses, and the building was recently completed, and four of the presses at work. This establishment is the largest in Alexandria, and the most complete in all its details, and probably ranks second to none in the cotton-pressing world. Their fifth and most powerful press will soon be at work; it will be one on the vertical system. Its capabilities we have yet to learn, but in my own opinion the horizontal is the best, safest, and most economical yet invented, where there is space enough in which to erect the machinery; but on these points I am not entirely supported by others, some engineers being persuaded that the compound system, when rightly proportioned, must be the most economical, as its first force is from the steam direct, and on the down stroke the actual weights lifted are again given back by gravity in the down strokes.

As these remarks are on the progress of cotton pressing and the machinery connected therewith, it will be as well now to draw my readers' attention to the old systems of tying the bales, and the various fasteners for connecting the iron bands—where iron bands were used—as well as the machines then in use for punching the bands and cleaning the cotton, in comparison with those that were now adopted to keep time with the increased speed, density, &c. The bales, formerly being so loosely packed, were in many cases simply tied with rope made from the fibre of the date palm, each band being fastened with a running knot drawn tight by means of a wooden lever, and then double tied to prevent slipping; these bands numbered from ten to twelve. Others were bound with soft iron wire, No. 6, b.w.g., the ends being looped back through each other and twisted each round its own end. In these cases there was a considerable amount of slip on the expansion of the bale. Iron bands were fastened by the arrow tie, a piece of wrought-iron plate in this form, Fig. 3:—

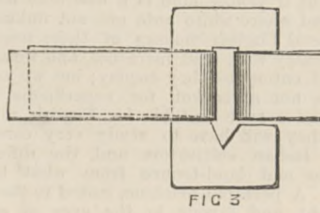
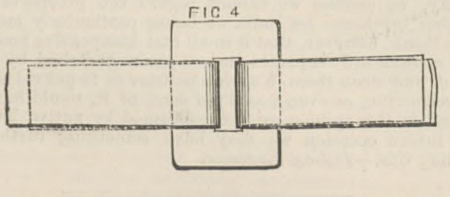


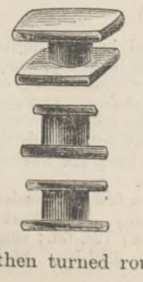
FIG 3

FIG 4



The hoops were bent, the tie slipped on one end of the hoop, and then the other end slipped on to the tie, the overlapping ends of the hoop being next the bale. Another kind, Fig. 4, was a plate with a slit the width of the hoop punched in it, through which the two ends of the hoop were passed and then drawn as tight as possible; the hoops used with these systems were 1in. wide by 19 or 20 b.w.g. As the bales become heavier and denser, hoops $1\frac{1}{8}$in. wide to $1\frac{1}{4}$in. by 17 to 15 b.w.g., punched for two studs and fastened with various kinds, all of which were more or less on the same principle, viz., a round shank with a square or round head on one end and an oblong end on the other. These are some of the forms (Fig. 5). The holes in the hoops were punched oval, the oblong end of the stud passed through and then turned round. These studs held well, but they had their disadvantages—first, it was necessary to put the hand behind the hoop while the stud was being turned round with the first finger and thumb, causing more slack of hoop than is now necessary; secondly, the drag on the stud being outwards, there was more likelihood of its being torn out of the hoop; thirdly, this outward drag made the outside end of the hoop gape, thus causing much difficulty in packing the bales on board ship.

Fig. 5



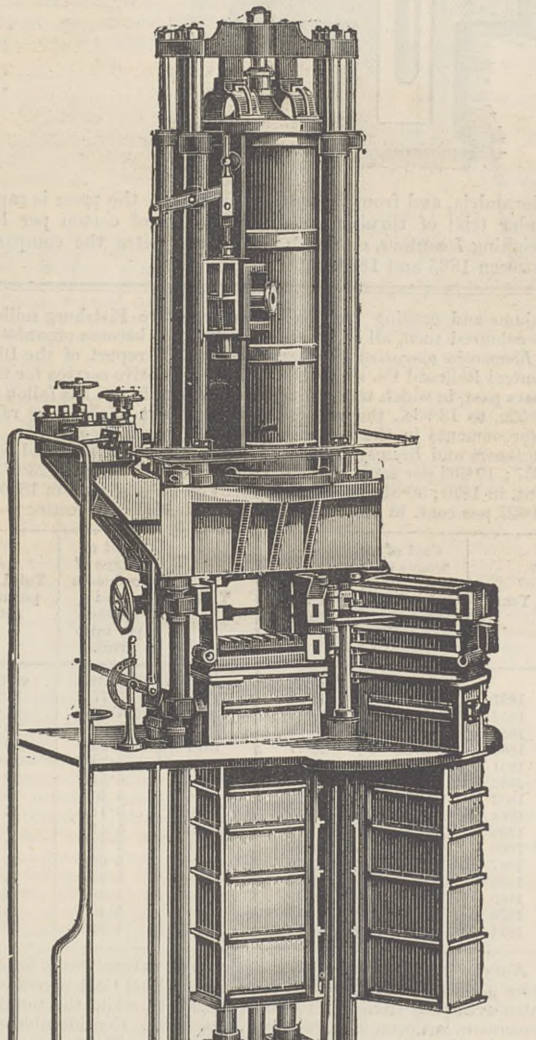
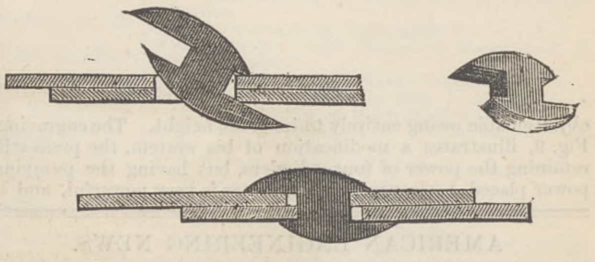


Fig. 8

All these difficulties have been got over in the invention of the Patent Excelsior Stud in 1875, which is put direct into a rectangular hole, does not require turning round, and under pressure draws the ends of the hoop together, the friction caused thereby adding considerably to its holding power. These studs have now entirely superseded the old kinds here (Fig. 6).

The first punching machines were of two kinds—one, the lever and plate machine, same as now used in Manchester for punching the iron bands on dry goods bales, and the vertical screw machines worked by hand. These were superseded by the cam and slot machine worked by a foot treadle; and this, again, was superseded by Turner's double adjustable power machines, capable of punching any length of hoop exactly to gauge, and keeping a press going all day making fifty bales per hour (see Fig. 7).

Fig. 6



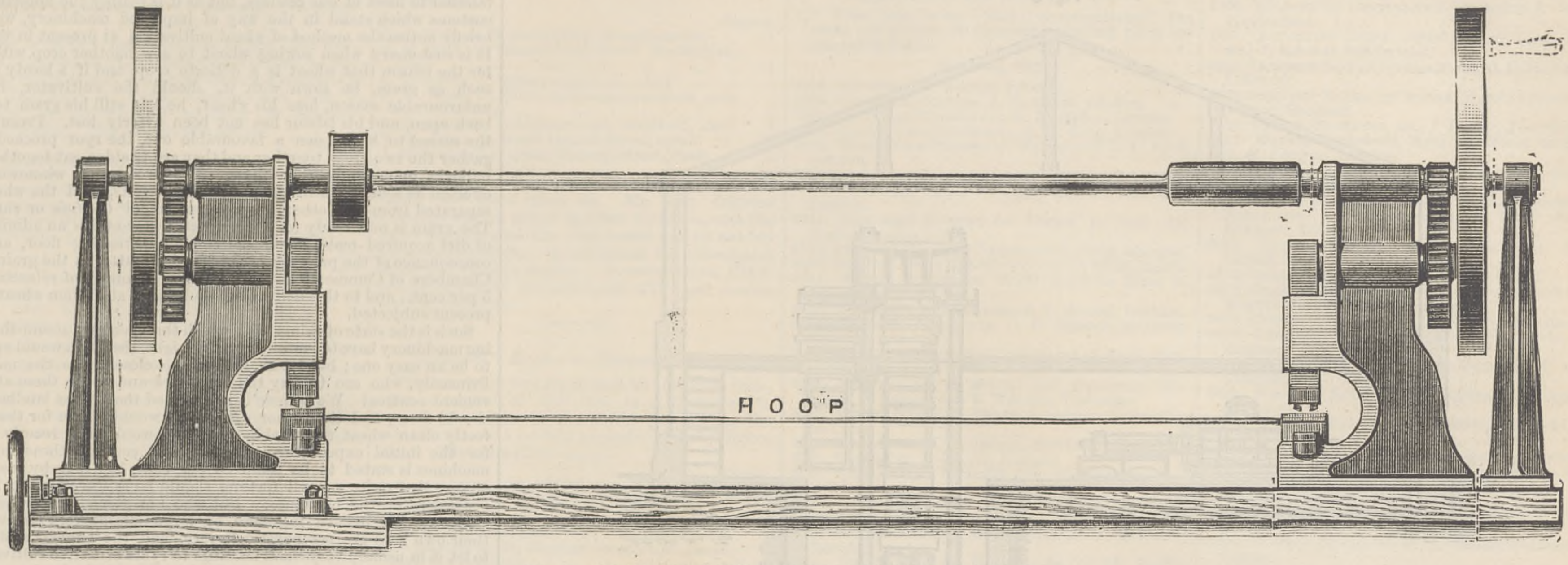


Fig. 7.—IMPROVED BALING HOOP PUNCHING MACHINE.

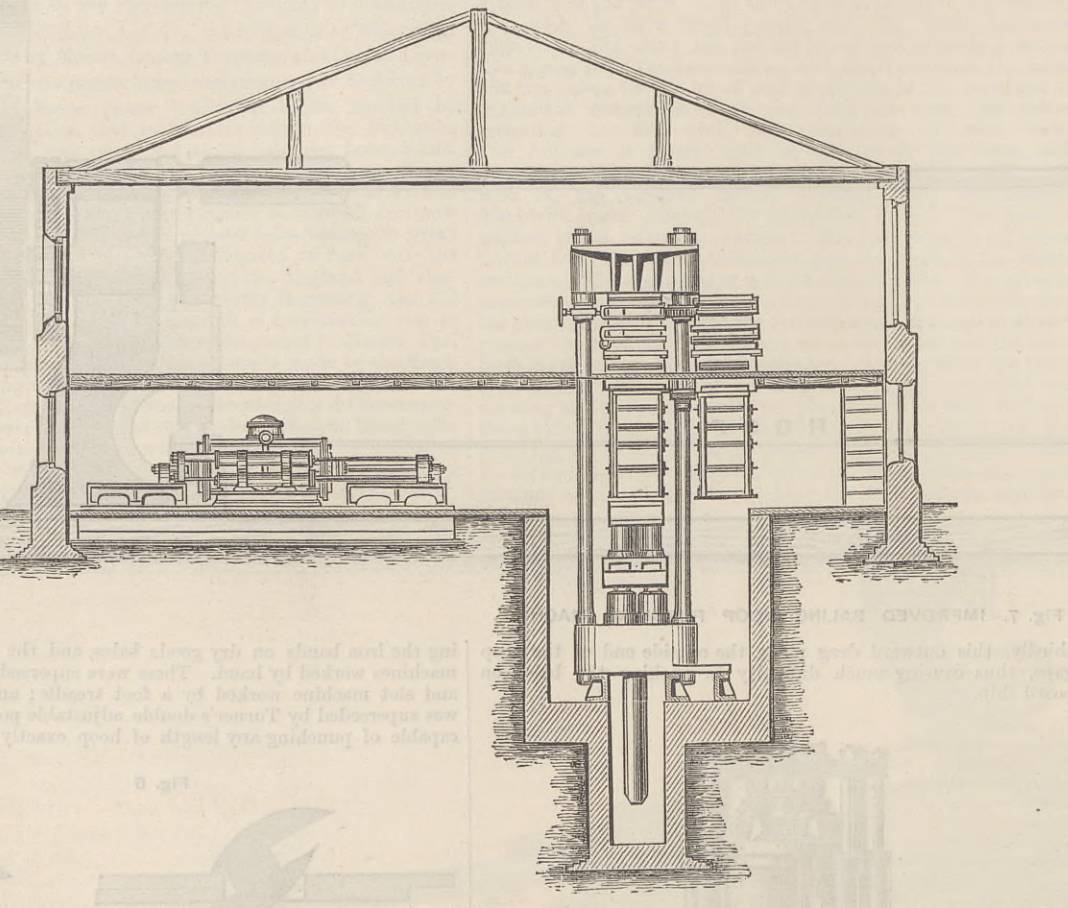
Turning now to the clearing machinery—without which no pressing establishment is complete—in 1865 a pressing factory, turning out 120 bales per day of from 7 cwt. to 8 cwt. each, required twenty-five cleaning machines of the old willow type. Each machine was worked by two men, with one extra to put in the cotton. This seemed to be a dreadful waste of time, labour, and money; and Messrs. Tod, Rathbone, and Co.'s engineer, Mr. Benwell, received permission to make them a machine to be driven from the fly-wheel of their existing engine. When the machine was put to work it was found that it turned out more cotton than the whole twenty-five, and did it better and for one-fourth the cost. These machines are now used in every cotton-pressing establishment in Alexandria, with an addition by Messrs. Choremi's engineer, Mr. Davison, viz., a cotton race, which carries the cotton from the machines to the presses. It is difficult to give a description of the cleaner without designs, but it consists of an endless band-carrier about 4ft. wide formed of leather straps, with light cross strips of wood fastened by copper bolts, which travels slowly and carries the clean cotton direct to the presses. On each side of this carrier are the cleaners, which are rectangular boxes, each containing in their length four revolving beaters, running occasionally 700 revolutions per minute. The cotton is placed by hand into the upper hopper, and is gradually carried forward and beaten, until finally delivered upon the endless carrier to the various presses.

The large press, which is illustrated in Fig. 1, was especially designed, with the assistance of their engineer, for Messrs. Carver and Co., of Alexandria, and the advantage gained by the increased power of this press over all previous presses has led to the design of a still more powerful press, which is illustrated in Fig. 8—Messrs. Turner and Lewis's patent. The absolute pressure to complete an Alexandrian bale of cotton may be accomplished by two hydraulic cylinders, the rams of which in the compound system can pass up into the box, but when this pressure has to be increased to ensure greater density, the rams become so large that they will not enter the box. To overcome this difficulty, and to render this system of pressing suitable for any market, especially for India, where a much greater density is required, the press shown in Fig. 8 was specially designed. It will be seen that the bottom crosshead, which in the original design is placed on the hydraulic rams, is now placed below, and lifts the follower by means of an air cylinder carrying also with it, the two false rams or props. As these are lifted sufficiently high two strong shutters drop automatically beneath them, and thus connect the steel crosshead with four short-stroke hydraulic cylinders. This operation is completed by the up-stroke of the steam cylinder, and when the down-stroke is made the pumps on each side of the steam cylinder come into action, and force up the four hydraulic rams to complete the bale. It is necessary so to proportion the sizes of the six or eight pumps as to complete the bale in two strokes. As this action is direct, there is a minimum of friction as compared to a great number of small pumps connected to an engine, and constantly running. It is contended from experience that these presses give the least possibility of breakdown, and are the most economical in the market, because the first pressure from the steam is direct, and also because all the dead weight lifted in the up stroke is returned by gravity in the down stroke. The return of the follower is exceedingly quick, as it can be adjusted to almost any velocity by regulating the air cylinder. The shutters also withdraw themselves automatically, so that it is possible for two men only to work this powerful press. When jute is pressed it is necessary to lay it in the boxes; a simple contrivance is arranged for gradually lowering the rope rack. Mr. Turner's firm originated the revolving system of boxes necessary when great speed is required. He has applied it to small fodder presses, oil presses, &c., and in every case where time in pressing is an object.

Although Mr. Turner prefers the direct-up lift of the steam cylinder or compound system, there are occasions when this is arrayed with 50in. steam cylinder, with 6ft. or 7ft. stroke, and with eight or twelve ram pumps of steel, all double-acting.

Since the above was written, Mr. Turner has completed and set to work a large press for Messrs. Davies, Benachi, and Co., of

Fig. 9



objectionable owing entirely to its great height. The engraving, Fig. 9, illustrates a modification of his system, the press still retaining the power of four cylinders, but having the pumping power placed horizontally. The latter is very powerful, and is Alexandria, and from the engineer's report the press is capable under trial of turning out seventy bales of cotton per hour, weighing 7 cantors, or 700 lb. This completes the comparison between 1865 and 1884.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

New York and Boston Rapid Transit Railroad Company.—The project for a direct line from New York to Boston has been pushed forward from time to time for a good many years, but lately a definite scheme has been formulated. A company has been incorporated, plans filed, and surveys and estimates made. The line is to be 193 miles long, double track, well laid out and substantially built, with 81 lb. steel rails on stone ballast; there will be no grade crossings, and only two drawbridges. Express trains are to make the run in three and a-half hours. The shortest existing line is 234 miles, and the run averages six hours. The line will be built in four sections; from New York to the Connecticut State line, by the New York, Connecticut, and Eastern Railroad Co.; thence to New Haven, Conn., by the New York and Connecticut Air Line Railroad Co.; thence to the Massachusetts State line, by the New York and Boston Railroad Co.; and thence to Boston, by the New York and Boston Inland Railroad Co. All these corporations are controlled by the Rapid Transit Co., which has a capital stock of 750,000 dols.; president, Wm. T. Black. The total cost for putting the road in condition for operation is estimated at 22,946,579 dols., as follows: construction, 19,556,234 dols.; equipment, 1,830,500 dols.; interest during construction, 1,200,000 dols.; engineering during construction, 315,000 dols. The time for construction is put at two years. D. C. Lindsley is chief engineer for the company, and the route of the line has been gone over by J. N. Greene and William J. McAlpine, civil engineers, of New York.

Street railroad franchises.—The law of 1884 requires that street car companies shall pay 3 per cent. of the gross receipts into the city treasury for the first five years, and 5 per cent. thereafter. When competitive bids are made for franchises they offer a bonus above this legal percentage. Two street railroad franchises were recently sold in New York; both were for cross town lines, between the east and north rivers, one on Twenty-eighth and Twenty-ninth streets, the other on Fulton-street. Two companies bid for the first franchise, and the bidding opened at 2 per cent. of the gross receipts and closed at 26½; three companies bid for the second, which was awarded at 35 per cent. of the gross receipts per annum. These high bids attracted considerable attention, and it is generally understood that the successful companies, which are both controlled by men of large experience, will conceal their actual receipts by cooking the returns, as they could not afford to pay the city from a third to a half of all the money received from passengers. If both the roads are successful, and the returns and payments are fairly made, they will pay the city more than is now received from all the other street car companies combined. The Fulton-street line, connecting the most important ferries on both rivers, and passing through the Wall-street district and a dense business centre, will probably prove very successful. It is to be operated by electricity on the Bentley-Knight system; the conductor conduit is very shallow, and the slot for the contact maker is ⅝in. wide. One truck on each car has a motor on a driving shaft, with connecting rods to the wheels.

Mica mining in New Hampshire.—One of the finest mica mines in the States is situated near Groton, N.H., on Fletcher Mountain; there are two shafts 35ft. deep, and the work is carried on in openings from the bottom and on the sides of the shafts; one man holds the drill while another does the striking, and the holes are used for blasting. The mica is in veins from 1ft. to 5ft. thick, and pieces weighing from 20 lb. to 40 lb. are frequently met with. In the cutting shop the material is cut to required shape by long steel shears, hardwood patterns being used. In the finishing shop the layers are split and cleared; the refuse is ground up, mixed with oil, and used as a lubricant. The mica is used chiefly for the doors of stoves and ranges, and also for electric light shades. All the marketable product of this mine is sent to Utica, N.Y., where it is sold to consumers.

Iron and steel workers.—The Amalgamated Association of Iron and Steel Workers, at the convention at Pittsburg, Pa., on June 8th, adopted a resolution providing for the appointment of a committee to regulate the output in the different mills and to secure a uniformity in the various classes of work in the different mills. A meeting is to be held by manufacturers and the wage committee to endeavour to settle the demand of the former for a reduction in the guide mill and sheet mill rates. The men want 5·50 dols. per ton for puddling on a 2 c. card rate. A clause is to be introduced in the constitution admitting coloured skilled workmen to membership; this is to prevent their joining the Knights of Labour and causing trouble. There are two Pittsburg mills run by coloured men, all of whom are anxious to become organised.

Locomotive operating expenses.—The annual report of the Illinois Central Railroad Co. shows the cost of locomotive service for thirty years past, in which time the total cost per mile run has fallen from 26·52c. to 13·93c., the reduction having been effected by various improvements in the machinery and design of the engines. The engineers and firemen received 17·201 per cent. of the total cost in 1857; 19·633 per cent. in 1860; 15·691 per cent. in 1865; 23·677 per cent. in 1870; 30·812 per cent. in 1875; 36·187 per cent. in 1880, and 39·627 per cent. in 1886. The following table is interesting:—

Year.	Cost of wages of engineers and firemen per mile run.	Total cost per mile run.	Year.	Cost of wages of engineers and firemen per mile run.	Total cost per mile run.
	cents.	cents.		cents.	cents.
1857	4·51	26·22	1872	5·77	21·76
1858	3·97	19·81	1873	5·84	21·10
1859	3·81	20 78	1874	6·02	19·57
1860	3·96	20·17	1875	6·03	19·57
1861	3·84	18 92	1876	5·79	18·81
1862	3·85	17·42	1877	5·54	17·21
1863	3·93	22·28	1878	5·46	15·29
1864	5·56	33·52	1879	5·41	14·15
1865	5·65	37·14	1880	5·41	14·95
1866	5·78	32·67	1881	5·54	16·58
1867	6·18	29·62	1882	5·09	15·82
1868	6·11	27 57	1883	5·35	15·57
1869	5·88	25·49	1884	5·28	14·45
1870	5·95	25·15	1885	5·49	15·02
1871	5·72	21·50	1886	5·52	13·93

Natural gas in Buffalo, N. Y.—The use of natural gas is becoming more popular, and the Buffalo Natural Gas Fuel Co. has reduced its rates gradually from 75c. to 20c. per 1000ft., while the number of consumers has been increased in inverse ratio. Considerable extensions of the pipe system are to be carried out. The fuel is used for house furnaces, kitchen ranges, cooking stoves and grates, and is not only economical, but saves considerably in wear and tear, dust, and trouble. A careful record kept by one consumer showed 78·90 dols. per annum for the gas, as against 94·50 dols. per annum for coal.

Railroad notes.—The St. Louis, Arkansas, and Texas Railroad is under contract, and work is progressing on construction. Contracts for grading 100 miles of the extension to Fort Worth, Tex., have been let; and also for the spikes and bolts for twenty-five miles of tract. An order for fifteen Mogul engines, to be delivered in September, has been placed with the Rhode Island Locomotive Works, Providence, R.I. The Baltimore and Ohio Railroad is again looking up an independent line from Philadelphia to New York, and has surveying corps in the field. At present the company has a running arrangement over the Philadelphia and Reading Railroad, and the Central Railroad of New Jersey to New York, but although a good business is possible, very little traffic is sent this way. The contract for the big Arthur Kill Bridge to Staten Island is awarded, but no particulars are afforded by the company. On the new western trunk lines active work is in progress, and there is a great demand for experienced engineers.

Private ironclads.—Captain A. Snow, of the Board of Trade and Transportation, New York, recently submitted a proposition for New York and Brooklyn to build ironclad rams for harbour defence; the cities to offer them to the Government, and if not accepted to hold them in reserve. A resolution to this effect was adopted.

STEAM-THRASHED WHEAT IN INDIA.

On a former occasion we devoted some considerable attention to the question of the introduction of steam agricultural machinery into India, and from the glowing report of some experiments in steam thrashing at the Government Farm, Bhadgaum, an account of which we gave at the same time, it appeared that manifold advantages awaited the adoption of Western appliances in supercession of the time-honoured and primitive methods pursued by Indian ryots.

Having recently witnessed some steam thrashing trials—*sic*—at Dumraom, we hasten to amend the opinion formerly expressed after a perusal of the favourable reports above alluded to, by briefly detailing the facts of the case as they presented themselves to us, and we think our readers will have no difficulty in coming to a correct conclusion in the matter.

The manner in which land is cultivated in India is, no doubt, familiar to most of our readers, but as it is mainly the immemorial customs which stand in the way of improved machinery, we will briefly notice the method of wheat cultivation at present in vogue. It is customary when sowing wheat to sow another crop with it for the reason that wheat is a delicate crop, and if a hardy crop, such as gram, be sown with it, should the cultivator, in an unfavourable season, lose his wheat, he has still his gram to fall back upon, and his labour has not been utterly lost. Presuming the season to have been a favourable one, the ryot proceeds to gather the two crops together and they are trodden out together by bullocks upon an earthen floor. The process of winnowing is effected as soon as a favourable wind permits, and the wheat is separated from the other grain by means of *Chalnis* or riddles. The grain is now ready for the market, but contains an admixture of dirt acquired mainly from the earthen thrashing floor, and in consequence of the presence of this foreign matter in the grain, the Chambers of Commerce have adopted a standard of refraction of 5 per cent., and to this deduction, we believe, all Indian wheat is at present subjected.

Such is the state of things with which the makers of steam-thrashing machinery have to contend. At first sight, their task would appear to be an easy one; but let us look a little closely into the matter. Primarily, who are to buy the machines and erect them at convenient centres? We believe it is intended that large landholders should do so, and the higher price they would obtain for the perfectly clean wheat the machines produce would fully recoup them for the initial expenditure. Again, the cost of thrashing by machines is stated to be some 80 per cent. less than by treading out, so that quite a small fortune should be in store for the lucky possessors of the machines. But who are going to use the machines? We believe instances of large landholders cultivating their own land are comparatively rare, and the general custom is to let it in usually very small holdings to ryots or native cultivators. The ryots therefore are the actual cultivators of the land, and the duty of supporting the expensive machines would fall upon their shoulders.

If we glance for an instant at the case from the ryots' point of view, we shall plainly see the amount of support the machines would be likely to receive from that quarter. At present each ryot has his own thrashing floor and his own bullocks, and as labour costs next to nothing, he is able to thrash his wheat and prepare it for the market with the minimum of labour and expense. Presuming a steam thrashing machine has been erected at a convenient centre, and that he has been instructed to make use of it, his course of action would be somewhat different. In the first place, he would have to transport his mixed crop from his farm to the machine a greater or less distance according to circumstances; but those who have experience of country carts travelling over country roads will easily understand that a very short journey might result in considerable loss of grain, the wheat being shaken out of the ears by excessive jolting. Arrived at the machine, he has to wait until his crop is thrashed, for he requires to take the straw back with him, as it constitutes his cattle's fodder. Here we would remark that we have not yet seen the thrashing machine that will separate wheat from gram or from linseed in a satisfactory manner, but, as this is now done by hand with *Chalnis*, it could, no doubt, be managed by the machines with a proper arrangement of riddles and screens.

One of the chief difficulties in the way of machines is the question of their location, and it will be evident to all that unless a large number of them are established, the majority of farms would be at considerable distances from them, and we leave it to our readers to decide whether, under such circumstances, the ryot would be likely to make use of the machine when he can do the work himself without expending a *pice* in a little longer time than it would take him to get to the machine, wait for his grain to be thrashed, and return with the straw; besides, for the use of the machine, he would, of course, have to pay a fair price. In reply to the difficulty of conveniently locating the machine, the makers would, no doubt, retort that the machine and the engine which drives it are portable—and so they are as far as being mounted on wheels is concerned—but what degree of actual portability can unwieldy machines weighing four or five tons claim to possess in an up-country district, where some of the roads are the merest cart tracks across fields in which the light native carts sink many inches.

Makers of steam-thrashing machines in England have been experimenting in this field for some time now, and should be fully alive to the disadvantages their machines labour under at present; but they still try to introduce the English type of machine, fitted with an arrangement for bruising the straw, which they recognise as a necessary adjunct to a machine for Indian use. It is to be regretted that they do not take cognisance of other points quite as necessary in an Indian machine as straw bruising. For instance, the machines fail to separate various grains satisfactorily, and until they do so, they cannot expect Indian cultivators to buy or use them.

We do not know if the makers have considered the special wants the machines would have to supply in India; but if they have, we cannot congratulate them upon the result. The materials of which the machine is composed are, in our opinion, hardly suited to this climate, and we doubt if yellow pine is a desirable material for continued use in a land where white ants are not unknown. We understand that several English makers of these machines are about to visit this country with trial machines, and we are glad to recognise the spirit of enterprise they display; but we would warn them that India is not a market for superfluous stocks of thrashing machines of a type suitable for English work to be foisted upon, and they will have to study very carefully the different wants of Indian cultivators and the different conditions of agriculture and land-tenure from what holds customary in England. A portable machine, suited to the wants we have indicated, might find favour in the eyes of some large landholders who farm their own lands; but as these are in the minority, we confess we cannot regard the prospects of steam thrashing machines for India as being particularly encouraging. We do think, however, that a small and inexpensive machine that would satisfactorily separate various grains thrashed by the native method, and clean them in such a manner as to get rid of the 5 per cent. refraction, or even 2 or 3 per cent. of it, would have a large sale, and in this opinion we are confirmed by native landholders. On a future occasion we may have something further to say regarding this.—*Indian Engineer.*

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

(*From our own Correspondent.*)

On 'Change in Wolverhampton yesterday, and in Birmingham to-day—Thursday—business was tame. This result was produced not only by the Jubilee holidays, but also by the approaching end of the quarter, when buyers usually withhold purchases. Sufficient orders were in hand to resume operations at the mills and forges on Wednesday night, but it is anticipated that future business until the end of the month will be inadequate to keep the works at anything like full time.

Some of the marked bar firms are in receipt of a few more orders, but the works are by no means in regular employ. The Earl of Dudley's prices stand at:—Bars, lowest quality, £7 12s. 6d.; single best, £9; double best, £9 10s.; and treble best, £12 10s. Stri

NEW COMPANIES.

THE following companies have just been registered:—

Continental Metropolitan Tramways Company, Limited.

This company was registered on the 10th inst., with a capital of £1,000,000, in £5 shares, to purchase the shares of the Compagnie d'Exploitation des Tramways de Paris, Reseau Sud, and to acquire any continental tramway or omnibus undertaking. The subscribers are:—

	Shares.
*George Richardson, 3, Lombard-court, E.C., merchant	100
*Lieutenant-Colonel C. M. Davidson, 11, St. George's-square, S.W.	100
*J. Marshall Gillies, 86, St. James-street	100
J. Goddard, jun., 81, Gracechurch-street, merchant	100
J. W. Grey, 51, Broadhurst-gardens, merchant	100
G. J. Toy, Athole House, Tynemouth-road, Tottenham, clerk	1
E. S. Grey, 38, Elmore-road, N., chartered accountant	1

The number of directors is not to be less than three, nor more than seven; the first being the subscribers denoted by an asterisk, and M. le Comte de Louvencourt and M. A. Vlasto; qualification, 100 shares; remuneration, £450 per annum each, with an additional £250 per annum for the chairman.

Holden and Brooke.

This is the conversion to a company of the business of mechanical engineers, carried on by the above-named firm at St. Simon's Works, Salford. It was registered on the 14th inst., with a capital of £12,000, in £10 shares, with the following as first subscribers:—

	Shares.
*G. F. G. Hooper, Fallowfield, Manchester, engineer	200
G. Thomas, 28, Deansgate, Manchester, engineer	10
*R. G. Brooke, Crumpsall, Manchester, engineer	1
H. A. G. Brooke, 189, High-street, Manchester, surgeon	50
E. Franke, 10, Aytoun-street, Manchester, merchant	50
M. E. Robmow, 10, Aytoun-street, Manchester, merchant	50
*H. Holden, Lymm, Chester, engineer	1
G. E. Lund, 491, Oxford-street, Manchester, solicitor	20

The subscribers denoted by an asterisk are the first directors; qualification, 10 shares. The company in general meeting will determine remuneration. Messrs. R. G. Brooke and G. F. Hooper are appointed managing directors, at salaries of £200 per annum, and will be entitled to such further sums as the company in general meeting may determine.

Lake Copais Company, Limited.

On the 11th inst. this company was registered, with a capital of £1,000,000, in £10 shares, to acquire the concessions and enactments relating to the drainage of Lake Copais, Greece, the reclamation and utilisation of lands in Greece, and the development of agricultural, urban, riparian, or seaport property, and ancillary matters. The subscribers are:—

	Shares.
S. Sechiaz, 4, Bishopsgate-street, merchant	1
S. Allgelasto, 19, Great Winchester-street	1
L. G. Grimold, 19, Great Winchester-street	1
N. Grew, C.E., Dashwood House	1
J. B. Goldey, 8, Alma-road, Canonbury	1
W. T. Soussaint, 25, Dalston-lane, E.	1
S. C. Cheston, 12, Cornwall-terrace, Regent's Park	1

The number of directors is not to be less than five, nor more than seven; the subscribers are to appoint the first, one of whom must be an expert in lands of recognised standing and ability; remuneration, £1650 per annum, or such larger sum as the company in general meeting may determine. The directors may purchase the Lake Copais Concession for a lump sum of £655,000, in fully-paid shares, to be issued to Mr. John Cockburn Francis Lee, who has arranged for the acquisition thereof from the French company, known as La Compagnie Française pour le Desséchment et l'Exploitation du lac Copais, upon the terms of paying to the French company £500,000 in fully-paid shares. Mr. Lee is also to guarantee to this company the subscription of not less than £200,000 cash, on mortgage debenture bonds or other security, bearing 6 per cent. per annum interest, to be issued at a discount of not more than 11 per cent. The directors are also empowered to pay not more than £20,000 in fully-paid shares, by way of bonus, to any person willing to enter into an effectual guarantee for the execution, at the price of £130,000, of the works designed to complete the drainage and reclamation of Lake Copais.

Los Andes Oil and Ozokerit Company, Limited.

On the 14th inst. this company was registered, with a capital of £150,000, in £10 shares, to acquire upon terms of an agreement of the 9th inst. (unregistered), made with Mr. James Britten, certain tracts of land in Venezuela, now belonging to the Constancia Dacovitch Company, together with the petroleum oil sources, wells, mines, springs, and deposits of ozokerit, and other property, including a refinery established in the city of Caracas. The subscribers are:—

	Shares.
D. Raikes de Chair, 11, Brewster-gardens, Kensington	1
H. W. Paul, 32, Craven-terrace, Lancaster-gate, insurance broker	1
W. H. Irwin, 117, Leadenhall-street, merchant	1
J. Eddowes, Leadenhall House, shipbroker	1
R. A. Hudson, 117, Leadenhall-street, secretary to a company	1
L. B. Harvey, F.S.A., St. Margaret's, Herts, accountant	1
R. W. Papineau, C.E., Urswick-road, Homerton	1

The number of directors is not to exceed seven; the subscribers are to appoint the first, and act *ad interim*. The company in general meeting will determine the remuneration.

Paper Bottle Company, Limited.

This company proposes to manufacture bottles, boxes, and packages made under certain patents referred to in two unregistered agreements entered into with Mr. Herbert Tulk and Mr. James Bromley Rowley respectively. It was registered on the 11th inst., with a capital of £120,000, in £1 shares, with the following as first subscribers:—

	Shares.
J. A. Kirk, 44, Woburn-place, Russell-square	1
A. H. Bach, 46, Bassett-road, North Kensington, clerk	1
C. Tuckfield, 8, Gibson-square, N., clerk	1
N. W. Russ, 27, Corn Exchange-chambers, corn and flour factor	1
J. H. Bate, 25, Ellingham-road, Stratford, clerk	1
W. H. Allen, 59, Great Russell-street, agent	1
J. Milsted, 128,a, Queen Victoria-street, clerk	1

The number of directors is not to be less than three, nor more than six. Mr. Wm. Righter Comings will be one of the first directors, and the other members of the first board will be elected by the subscribers. Qualification for subsequent directors, £250 in shares. Remuneration, £1500 per annum, with an additional £100 per annum for the chairman.

"Roburite" Explosives Company, Limited.

This company was registered on the 11th inst., with a capital of £250,000, in £10 shares, to acquire the right to the secret process for the manufacture of a certain explosive called "Roburite." The subscribers are:—

	Shares.
Colonel C. C. Minchin, Eastbourne	1
G. H. Smith, C.E., 16, The Vale, Blackheath	1
C. J. Rushor, C.E., Aston, Birmingham	1
H. A. Krohn, Ariol-road, West Kensington	1
J. F. Sandeman, 31, Chesham-street, S.W., secretary to a company	1
R. Cunningham, Ware-road, Hertford	1
A. B. Cunningham, 19, Burlington-chambers, Birmingham	1

The number of directors is not to be less than three, nor more than nine; the subscribers are to appoint the first, and act *ad interim;* remuneration, £2500 per annum, inclusive of £500 per annum to the chairman; qualification, 25 shares.

London Mercantile Gas Company, Limited.

This company was registered on the 10th inst., with a capital of £30,000, in £5 shares, to manufacture gas and gas products. The subscribers are:—

	Shares.
H. F. Highton, Evelyn Lodge, Putney	1
B. D. Thompson, 17, Clarendon-gardens, W.	1
B. M. Clarke, jun., 52, Rye-hill Park, S.E.	1
P. H. Le Sueur, 35, Rectory-road, N., clerk	1
E. A. Highton, Evelyn Lodge, Putney, clerk	1
E. McCarthy, 3, Brunton-place, E., clerk	1
W. Bartholomew, 23, Mildmay-grove, N.	1

The number of directors is not to be less than five; the subscribers are to nominate the first; remuneration, £100 per annum, and 5 per cent. upon the net profits in excess of sufficient for the payment of £10 per cent. per annum dividend.

CONCRETE DOCK WORKS: ALARMING DISCOVERY AT ABERDEEN.—A matter of the highest possible importance and interest to all connected with the construction and management of harbours has been brought to light at Aberdeen. Two years since the Aberdeen Harbour Commissioners opened a graving dock. The dock was formed of Portland cement concrete, the steps being lined with granite ashlar. A few months ago it was noticed that the concrete entrance walls, which are not lined with granite, had become swollen, and that the surface had begun to show cracks. Investigation as to the cause was at once made, and Mr. W. Smith, the harbour engineer, suspecting that chemical action was inducing the mischief, conferred with Professor Brazier, of Aberdeen University, who analysed briquettes of the Portland cement used in the construction of the graving dock, and also samples of the concrete taken from the entrance walls of the dock. From the analysis made it appeared that the action of the sea-water on the Portland cement itself, as well as on the cement in the concrete, caused an expansion and softening of the cement in consequence of the deposit of magnesia from the sea-water, and also led to the formation of carbonate of lime by the union of the carbonic acid contained in the sea-water with the lime in the cement. This somewhat startling discovery must necessarily receive great attention. Within the past quarter of a century a great number of sea works have been formed of Portland cement concrete. At Aberdeen itself there is a breakwater of nearly a thousand feet entirely formed of concrete. In various ways it has required patching since its construction fifteen years ago, but the idea that its defects were due to chemical action did not occur to the harbour engineer till last year. He then mentioned the matter in a paper communicated to the Institute of Civil Engineers, the paper being printed in the first part of the Transactions of the Institute for 1886-87. The remarkable point in regard to the Graving Dock at Aberdeen is the rapidity of the chemical action of the sea-water upon it as compared with the length of time that similar action has had opportunity of taking effect on sea works. We understand the greater effect is ascribed to the fact that the pressure of the water in the dock is much heavier than is the pressure of the water on the sea works. In the former case the pressure is from five to eleven pounds per square inch; in the latter it must be very light, except when the waves drive heavily against the works. Till the present time there does not appear to have been any investigation as to the chemical action of sea-water upon concrete. Now that science has been called in, and has made the discovery that concrete must give way before the sea, it will be the task of chemists to look out for some countervailing substance which shall prevent the decay that seems to be inevitable. It is something that science has shown the danger that is being run; it will redound more to the honour of scientific men if they can indicate the means by which the impending calamity can be avoided. The subject came before the Harbour Board of Aberdeen yesterday, and they resolved to hold a meeting of the whole Board in committee to consider the matter.—*Dundee Advertiser.*

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.

14th June, 1887.

8505. STOCKINGS, J. Holmes, London.
8506. CLEANSING FILTERS, J. W. Hyatt, London.
8507. SECTIONAL MONUMENTS, A. H. Miller, London.
8508. BLANKET and OVERCOAT, A. H. King, London.
8509. WOOD-BLOCK FLOORS, C. Evans and C. J. Ford, London.
8510. PRODUCING LITHO GRAINAGE on ZINC for PRINTING PURPOSES, R. H. W. Biggs and W. Duxbury, London.
8511. TREADING MOTIONS for LOOMS, R. Hall.—(*E. Grube, Germany.*)
8512. SHAPING WOOD, R. Cooper and J. Craig, Glasgow.
8513. SHUTTLE PEGS, J. Atkinson and D. Hirst, Leeds.
8514. SCREW THREAD on GLASS SPINNING RING, E. Leak, Stockport.
8515. AUTOMATIC LUBRICATORS, J. L. Garsed, Halifax.
8516. STRINGING RACQUETS, C. D. Heaton, Stoke-on-Trent.
8517. AUTOMATIC WEIGHING APPARATUS, J. Heys, Manchester.
8518. SELF-FEEDING PUNCHING and EYELETING MACHINE, A. Garrett and G. Webster, Towcester.
8519. LIFE-SAVING BUOY BOATS, J. Sample, Newcastle-on-Tyne.
8520. TRANSPORT, H. Stockman, North Sunderland.
8521. VALVE TAP, C. Wayte, London.
8522. GAS LAMPS, S. Chandler, sen., S. Chandler, jun., and J. Chandler, London.
8523. CIGAR WRAPPING MACHINE, J. E. Schmalz, London.
8524. SEWING MACHINE ACCESSORIES, A. F. Wileman, Ealing.
8525. DRYING WOVEN FABRICS, &c., J. H. Smith, Glasgow.
8526. STEAM SHIP PROPULSION, J. Bosch, London.
8527. BOOTS and SHOES, E. Moore, London.
8528. ABSORBING MOISTURE, D. McGregor and J. McArthur, jun., Glasgow.
8529. CURING SCALDS from WATER, &c., C. Schuttyser, London.
8530. PENCILS, R. Edwards, London.
8531. RAILWAY CARRIAGES, &c., A. J. Boult.—(*W. J. Brashears, United States.*)
8532. LOOPER MECHANISM for SEWING MACHINES, J. A. House, London.
8533. DRIVING and PROPELLING STEAMERS, O. E. Pohl, Liverpool.
8534. PACKING for STUFFING BOXES, J. Morrin, Liverpool.
8535. ORGANZINE or SILK WARP, J. E. Tynan, London.
8536. OPERATING, &c., TORPEDOES, A. H. Simpson, London.
8537. OXYGENISED WATER, A. Scott, London.
8538. PORTABLE FORGES, J. Wilson, London.
8539. PACKETS of MATCHES, A. Berkeley, London.
8540. SOLDERING, F. Wright, London.
8541. MOTOR for DRIVING SEWING MACHINES, D. Jones and C. E. Quilter, London.
8542. LOCKS for CANALS, &c., T. Villard, London.
8543. ADVERTISING, E. and A. Howell and J. Hines, Glasgow.
8544. SPRING CLASPS, L. N. Loeb.—(*C. Loeb, United States.*)
8545. STEELYARDS, H. Pooley and J. Chater, London.
8546. HAT PAD, E. L. White, London.
8547. KEY and CHAIR for RAILWAYS, J. W. Stansfield, London.
8548. WINDMILL BLADES, J. W. Stansfield, London.
8549. ABDOMINAL SUPPORTERS, D. L. Snediker, London.
8550. CRANES, W. Shapton, London.
8551. HATS, H. Brown and A. B. Langmore, London.
8552. LAMPS, A. H. Hearington, London.
8553. HYDRAULIC MACHINES, J. Armer, London.
8554. PRINTING, H. E. Newton.—(*R. Hoe and Co., United States.*)
8555. VALVES, W. C. Hood, London.
8556. WIRE-STITCHING, H. Brehmer, London.
8557. KNIVES, T. Vogel, London.
8558. SEWING MACHINES, H. H. Lake.—(*A. M. Stickney, United States.*)
8559. WINDOWS, H. H. Lake.—(*R. Schenck, United States.*)
8560. CARDING COTTON, C. Weber, London.
8561. SPINNING COTTON, H. H. Lake.—(*J. Shaw, United States.*)
8562. WARP MACHINES, H. H. Lake.—(*J. A. Wiedersheim, United States.*)
8563. FLOOR CRAMP, W. E. Bradley, W. B. Cochran, and A. A. Bennett, London.
8564. COUPLINGS, A. G. W. Foster and J. H. Shelnutt, London.
8565. MECHANICAL ALARM, J. P. O'Donnell.—(*A. Buisset, jun., France.*)
8566. LAMPS, E. L. Bill, London.
8567. VELOCIPEDES, J. S. Fairfax, London.
8568. MOVING PERSONS by GRAVITATION, J. W. Stansfield, London.
8569. RACK and PINION MECHANISM, F. Rinecker and R. Abt, London.
8570. MEASURING MECHANICAL FORCE TRANSMITTED, C. Dihlmann, London.
8571. The METALLIC CURB BOX, &c., G. W. Wright, London.
8572. METALLIC DUPLEX STREET CHANNEL, G. W. Wright, London.
8573. MORTICE JOINT for LARGE TUBES, G. W. Wright, London.
8574. SHEET METAL CANS, H. H. Lake.—(*E. Norton, United States.*)

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8575. CARBONISING WOOL, H. H. Lake.—(*C. Schrebler, United States.*)
8576. MACHINES for CUTTING CIGAR WRAPPERS, J. E. Schmaly, London.
8577. CARRIER for PHOTOGRAPHIC FILMS, W. L. Sargeant, London.
8578. ROTARY ENGINES or PUMPS, J. Landells, Tynemouth.
8579. REGULATING HORSESHOE KNIVES, J. Searby, Rotherham.
8580. BOOTS, T. Davies, London.
8581. METALLIC TOPS, &c., for BOTTLES, J. F. Smyth, Belfast.
8582. ROTARY EXPANSION STEAM ENGINE, H. Postans, Hadleigh.
8583. TOAST STAND, Messrs. Forrest and Son, Manchester.
8584. BEEHIVES, W. H. Jenkins, Swansea.
8585. VENTILATORS, H. T. Johnson and T. S. Wilson, Manchester.
8586. VENTILATING COWL, H. T. Johnson and T. S. Wilson, Manchester.
8587. FINGERS of MOWING MACHINES, C. J. Foster, Fordington.
8588. HINGE, R. Cliff, Birmingham.
8589. WATCH KEYS, F. R. Baker, Birmingham.
8590. PROJECTING WATER, W. T. Hardy and J. Hart, Middlesbrough.
8591. STRAINING PULP, R. Wood, Glasgow.
8592. LOOMS, E. Hollingworth, Halifax.
8593. WEIGHING MACHINE, J. Bradbury, Manchester.
8594. CARDS, W. Cunliffe, Kent.
8595. FASTENING RODS, T. Dineen, Leeds.
8596. SELF-FEEDING CLIP, W. G. Hanna, Manchester.
8597. SCREENING COALS, E. Kochs, Manchester.
8598. CUTTING STONE, J. W. Maloy, London.
8599. ZINC ORES, E. Walsh, jun., London.
8600. VANES, J. Gordon, jun , London.
8601. WINDING MACHINES, W. T. Stubbs, Manchester.
8602. TAPS, H. Harrison, Leeds.
8603. APPETISING TONIC MIXTURE, A. Savigear, London.
8604. CARDING ENGINE BEARINGS, G. and E. Ashworth, Manchester.
8605. PROTECTING SEA-BEACHES from DRIFTING SANDS, E. Lightowler, Southport.
8606. HOLDING-UP GENTLEMEN'S DRAWERS, J. Wynn, Cheltenham.
8607. BATTENING DOWN SHIPS' HATCH TARPAULINS, &c., J. Manson, Sunderland.
8608. TRIMMERS for SEWING MACHINES, C. H. Buchanan, Leicester.
8609. DRIVING BOATS by LEVER HINGE PADDLES, D. Ashton, Sheffield.
8610. SHEETS, BLANKETS, &c., J. Pinker, Liverpool.
8611. MAKING COMPOSITE METALLIC PIPES or RODS, G. H. Denison, London.
8612. MEASURING WOVEN FABRICS, &c., J. L. Garsed, Halifax.
8613. IMPARTING a HEAVING and ROLLING MOTION to BOATS used in ROUNDABOUTS, R. Steel and G. Hodgson, Leeds.
8614. TIMEKEEPERS and TIME INDICATORS, J. L. Garsed, Halifax.
8615. STEAMERS, &c , J. G. Scott, Manchester.
8616. GUIDING WOVEN FABRICS into DRYING and other MACHINES, T. A. Crook, Manchester.
8617. GLOVES, H. C. Roth and F. Geiler, Manchester.
8618. LIGHTING, &c., GASES, MacN. C. Bowie, Kilbarchan.
8619. PAPER BOXES for HOLDING JAMS, &c., P. Cook, Glasgow.
8620. STOPPING LOCOMOTIVE ENGINES, J. Wilkinson, Blackpool.
8621. FLUSHING CISTERN, J. Kretschmann and J. P. Goulson, London.
8622. OBTAINING AMMONIA, &c., L. Mond, Liverpool.
8623. SEPARATING COAL, W. P. Thompson.—(*R. A. C. von Schlieben, Berlin.*)
8624. BUTTONS, A. Dinklage, London.
8625. SUBMARINE WHEELS for STEAMSHIPS, J. Bosch, London.
8626. SAFETY LAMPS, W. F. B. Massey-Mainwaring, London.
8627. WATER JOINT APPARATUS, T. W. Vaughan and J. Brown, London.
8628. BUTTON-HOLES, H. E. Newton.—(*The National Machine Company, United States.*)
8629. RINGS, HOOPS, &c., of PULLEYS, J. Robertson Glasgow.
8630. FURNACES, W. Muirhead, Glasgow.
8631. FILLER and GAUGE, H. C. Braun and A. F. Lloyd, London.
8632. MEASURING, &c., WATER, O Brown, London.
8633. POINTS for TRAMWAYS, W. E. Kenway, London.
8634. LAMP-HOLDER, J. Taylor and G. E. Tucker London.
8635. LOCK NUT, G. H. Wells, London.
8636. FASTENING KNIFE BLADES to HANDLES, G. H Wells, London.
8637. PAPER BOXES, J. T. Craw, London.
8638. RECEIVING, &c., NIGHT SOIL, A. M. Clark.—(*La Compagnie Générale de Salubrité, France.*)
8639. SHOT for ORDNANCE, W. S. Simpson and C. E. Groves, London.
8640. BUTTON or STOP for OARS, &c., E. J. Ayling, London.
8641. ELECTRIC LIGHTING, H. Edmunds, London.
8642. MUSICAL BOXES, P. Lochmann, London.
8643. OIL LAMPS, M. Sievert, London.
8644. DISINFECTING, &c., ROOMS, H. Bouttell, London.
8645. GRINDING and POLISHING METALLIC ROLLERS, &c , I. Gallowitsch and W. Seel, London.
8646. STOVES or HEATING APPARATUS, E. A. Wiman, London.
8647. SEWING MACHINES, W. W. Horn.—(*J. Vannett and G. S. Yingling, United States.*)
8648. FIREPROOF COLUMN, &c., A. W. Rammage, London.

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8649. CIGARETTES, L. Rosinsky, Birmingham.
8650. CANDLESTICKS or HOLDERS, J. L. Garsed, Halifax.
8651. CONVERTIBLE FURNITURE, J. Coley, London.
8652. REDUCING CORK, J. S. Farmer, Manchester.
8653. SHEDDING MOTION of LOOMS for WEAVING, J. and E. Horrocks, Bradford.
8654. STANDARDS for WIRE FENCING, &c., W. P. C. Bain, Glasgow.
8655. CHECKING COINS inserted in WEIGHING MACHINES, &c., J. Slaytor, Sheffield.
8656. ORNAMENTATION of METALLIC BEDSTEADS, W. H., S., and C. Sproston, Birmingham.
8657. PLANING WOOD, J. M. Wilson, Manchester.
8658. INTERNAL FURNACES for STEAM BOILERS, W. H. Mirfin, Manchester.
8659. MARINE and other ENGINES, H. P. Fenby, Farnley, near Leeds.
8660. ATTACHING AIR SPRINGS to DOORS, &c., E. Verity, J. M. Verity, and B. Banks, Leeds.
8661. BOAT, M. Goldstein and Z. Levy, London.
8662. PNEUMATIC ACTIONS for ORGANS, G. T. Beilby, Midlothian.
8663. BURNERS or STOVES, D. Cowan, Glasgow.
8664. PRESERVING EGGS in the SHELL, H. H. Doty, London.
8665. CHECK TILL, C. G. Woodcock, London.
8666. TREATING ALKALI WASTE, A. M. Chance and J. F. Chance, Liverpool
8667. HAND DRIVING GEAR, J. Gouick, Dundee.
8668. DYEING WOOL, C. T. Clegg, Manchester, H. A. Clegg, Montford, and F. Lee, Didsbury.
8669. CANVAS COVERINGS for SHIPS' BOATS, J. Clayton, Seacombe.
8670. CENTRIFUGAL PUMPS, W. I. Ellis, Manchester.
8671. DISINTEGRATORS, J. A. Yeadon and R. Middleton, Leeds.
8672. ENVELOPES, J. Hertz, London.
8673. STOPPERING BOTTLES, &c., S. M. Lancaster, London.
8674. BOOTS and SHOES, J. F. Gilmour, Glasgow.
8675. GAS DIP PIPES, T. Hailes, London.
8676. HOLDING NECKTIES and SCARFS, F. H. Maberly, Birmingham.
8677. BEARINGS of WASHING, &c., MACHINES, T. T. Mercer and T. Woolfall, London.
8678. HEAT DIFFUSERS, &c., A. Caldow and J. Burnett, London.
8679. GAS, A. G. Meeze, Redhill.
8680. RACING TOYS, A. J. Boult.—(*F. Blazicek, Austria.*)
8681. MONEY TILLS, J. Barker and E. Ramsbottom, Liverpool.
8682. GAS REGULATORS, J. L. and I. Braithwaite, Liverpool.
8683. DOOR HANDLES, J. W. Kershaw and S. Bennett, Liverpool.
8684. CASTORS, A. C. Henderson.—(*J. L. P. Dossaris, France.*)
8685. STOPPERING BOTTLES, G. H. Aylett, London.
8686. CABLE TRAMWAYS, W. N. Colam, London.
8687. CABLE TRAMWAYS, W. N. Colam, London.
8688. CABLE TRAMWAYS, W. N. Colam, London.
8689. SPANNER, G. Townsend.—(*E. Meuke, Germany.*)
8690. LAWN TENNIS POLES, J. W. Bennett, London.
8691. PEN-HOLDERS, T. Hooper and S. G. Moore, London.
8692. REGULATING ATMOSPHERIC GAS-BURNERS, J. Osgerby, London.
8693. CHECKING the RECEIPT of FARES, J. M. Black, London.
8694. BOOK MARKER, W. Cross, London.
8695. SUPPLY CLIP for FEEDING BOTTLES, S. J. Pocock, London.
8696. SAFETY LAMP-BURNER, W. Nottley, London.
8697. GENERATING LIGHT and HEAT, H. H. Doty London.
8698. HOT BLAST VALVES, E. A. Cowper, London.
8699. JOINTING, &c., of RAILWAY SLEEPERS, &c., J Robertson, Glasgow.
8700. VACCINATION SHIELDS, J. Turner, Glasgow.
8701. ELECTRIC ENERGY, J. Ross, Glasgow.
8702. ROTARY ENGINES, E. Wortmann, London.

8703. Spinning Wool, &c., J. J. Delmar, F. E. Tucker, and F. How, London.
8704. Catching and Removing Soot from Chimneys, F. A. Fichtner, London.
8705 Screening Coal, H. Lawrence, London.
8706. Gaiters, E. Edwards.—(*A. Hazel, France.*)
8707. Water-heating Apparatus, H. Darby, London.
8708. Fixing Telegraph Posts, J. Oppenheimer, Manchester.
8709. Wire Rope or Chain Haulage, T. Evens, London.
8710. Electrical Apparatus, T. Nordenfelt, London.
8711. Regulating Exposures in the use of Photographic Shutters, T. R. Dallmeyer and F. Beauchamp, London.
8712. Colouring Iron and Steel Surfaces, J. Y. Johnson.—(*A. de Meritens, France.*)
8713. Mill for Rolling, &c., Tea Leaves, W. H. Gilruth, London.
8714. Mariners' Liquid Compasses, W. J. Reynolds, London.
8715. Pipes, &c., for Smoking, J. Glover, London.

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8716. Tablets, H. C. Capel, London.
8717. Acid, O. Schulz, London.
8718. Elevated Railways, W. B. Mack, London.
8719. Railways, E. L. Taylor, London.
8720. Washing Plates, G. W. B. Crees, London.
8721. Washing Wool, &c., W. Ambler and W. O. Blackburn, London.
8722. Surgical Appliance called a Sling, E. Potts, Liverpool.
8723. Engine and similar Packings, D. G. Creswell, Manchester.
8724. Cycles, F. W. Gerhard, Wolverhampton.
8725. Feeding Wool to Carding Machines, E. Wilkinson, Huddersfield.
8726. Raising the Healds in Looms for Weaving, C. Bedford, Halifax.
8727. Oil Feeders, R. Ramsey and B. Wright, Durham.
8728. Spinning Caps, J. Rushforth and W. Tate, Bradford.
8729. Engine Cleaning Waste Machines, J. D. Tomlinson, Rochdale.
8730. Shears, F. W. E. H. Cooper and O. F. E. Keil, Sheffield.
8731. Joint for Brackets, J. and H. S. Fordred, Birmingham.
8733. Handles, C. Law, Sheffield.
8734. Refining Cotton Seed Oil, R. Hunt, Liverpool.
8735. Obtaining Oil Feeding Cake, R. Hunt, Liverpool.
8736. Metallic Wheels, W. Cooper and J. Holdsworth, Hull.
8737. Motor, J. W. Willans and J. B. McCulloch, Leeds.
8738. Warming Apartments, S. Reeve, London.
8739. Movable Rein Support, C. J. J. G. Petrzywalski, London.
8740. Cranes for Shipping Coal, W. Cooper and J. Holdsworth, Hull.
8741. Conveying Passengers, J. J. Butcher, Newcastle-upon-Tyne.
8742. Cuff Fasteners, J. Carter, London.
8743. Soles of Boots, E. Hale, Liverpool.
8744. Lubricators, W. James and G. Crowe, Liverpool.
8745. Measuring Angles of Inclination, T. Myers, Liverpool.
8746. Bands for Transmission of Work, F. H. Maberly, Birmingham.
8747. Animal Trap, W. Irvin, London.
8748. Bags, W. T. Crooke, London.
8749. Batching Jute, E. Heumann, London.
8750. Watch Stands, T. White, London.
8751. Twist Lace Machines, B. Hallatt, London.
8752. Staining Glass, E. Edwards, Staffordshire.
753. Cork Stopper, W. F. Anderson and H. Davidson, London.
8754. Indicating Time, A. J. Ready, London.
8755. Trapping Overflows to Water-closets, E. Emanuel, London.
8756. Cocks, J. T. Harris, London.
8757. Barbed Wire Fencing, C. Shaw and W. Hayward, London.
8758. Coupling Railway Rolling Stock, G. S. Spencer, London.
8759. Refrigerator, H. Pückert.—(*I. Schwarz, Saxony.*)
8760. Ball Castor, C. Copus and H. D. Booth, London.
8761. Locks and Keys, S. C. Munro, London.
8762. Lock for Railway Carriage Doors, E. Taylor, London.
8763. Dumb Waiters, G. W. Cannon and E. Storm, London.
8764. Studs, S. Smirke, London.
8765. Darning Machines, A. Helwig, London.
8766. Attaching Railway Rails to Metal Sleepers, C. G. Stuart and F. H. Gill, London.
8767. Cutting the Teeth of Wheels, S. Robinson and A. Keats, London.
8768. Promoting Combustion, W. Oliphant, London.
8769. Measuring Distances, E. Krauss, London.
8770. Feathering Blade Wheels, A. H. Carpenter, London.
8771. Pulsometers, J. Reid, London.
8772. Carpets, &c., H. Fawcett, London.
8773. Opening Packing Cases and Boxes, C. Schneider, London.
8774. Extracting Air from under Railway Vehicles, W. H. Gilruth, London.

18th June, 1887.

8775. Yarn and Cloth Finish, N. O. McIlhagga, Belfast.
8776. Imperial Bar Frame Bee-hive, W. J. Green, Sudbury.
8777. Feeding Rollers, D. B. Briggs and W. Eastwood, Bradford.
8778. Chimney Tops, S. H. Jefferys, Halifax.
8779. Tomb Tablets, A. Hunt, Southport.
8780. Shafts or Spindles, W. Butterworth and P. Shawcross, Rochdale.
8781. Gas-burners, H. J. Burgess, Brighton.
8782. Straining Paper Pulp, &c., J. and R. Wood, Glasgow.
8783. Belt Pulleys, G. Richards and G. Napier, Broadheath.
8784. Fixing Slabs of Glass on Tables, R. Thompson, Wigan.
8785. Surface of Pulley Wheels, H. M. Townsend, Peterborough.
8786. Imitating the Grain of Woods, J. Watson, York.
8787. Union Socket, S. G. Mason and H. Hodkinson, Birmingham.
8788. Spring Clip for Brooches, A. Lovekin, Birmingham.
8789. Mercantile Forms, W. H. McDougall, Bonnyrigg, Midlothian.
8790. Regenerative Hydrocarbon Lamps, L. Chandor and C. H. Nölting, London.
8791. Bottling Beer, W. P. Thompson.—(*J. Vindis, Prague.*)
8792. Oil Tanks, J. Rea, Liverpool.
8793. Tricycles, &c., W. S. Boult, London.
8794. Time Indicator, J. Thropp, Birmingham.
8795. Galvanometers, W. E. Ayrton and J. Perry, London.
8796. Gas, &c., Pipes, N. C. Cookson, Newcastle-upon-Tyne.
8797. Handles of Cricket Bats, G. Wells, Brighton.
8798. Reversible Hand Brush, J. Leigh, London.
8799. Conveying Boats over Weirs, &c., A. H. Williams and E. L. White, London.
8800. Treatment of Sewage, F. W. Lacey, Brentford.
8801. Condensers, R. G. Brooke and T. White, London.
8802. Velocipedes, K. Schmitt, London.
8803. Dyeing and Scouring Yarns, C. L. Klauder, London.
8804. Stethoscopes, W. R. Pike, London.
8805. Paring, &c., Fruit, T. Bletcher and E. E. Streat, London.
8806. Spring Corkscrew, H. Walrath, London.
8807. Indicators for Telephone Exchanges, &c., W. Moseley, London.
8808. Safety Valve E. Hafner, London.
8809. Sharpening Scissors, &c., W. S. Simpson, London.
8810. Flooring, W. L. Wise.—(*P. M. Petersen, Denmark.*)
8811. Ornamenting Metallic Bedsteads, F. R. Baker, Birmingham.
8812. Piercing Contrivance, F. R. Baker, Birmingham.
8813. Sleeve and Cuff Links, T. W. Jones, London.
8814. Extinguishing Lamps, J. C. C. Read, London.
8815. Bark, H. J. Simpson, G. de M. MacKirdy, and A. Taylor, Liverpool
8816. Tannins, &c., H J. Simpson, G. de M. Mac Kirdy, and H. Taylor, Liverpool.
8817. Celluose, H. J. Simpson, G. de M. MacKirdy, and A. Taylor, Liverpool.
8818. Gas Motor Engines, C. G Beechey, London.
8819. Lamp Extinguisher, A. Martin, London.
8820. Producing, &c., Liquid Chlorine, C. T. J. Vautin, London.
8821. Pumps, J. Hemington, London.
8822. Filling Bottles, &c., with Liquid, L. A. Enzinger, London.
8823. Extractors for Breech-loading Break-down Fire-arms, A. Mackie, London.
8824. Medals, &c., A. Martin, London.
8825. Refining of Oils and Fats, R. Oxland, Plymouth.
8826. Cartridges for Breech-loading Fire-arms, H. J. Carpenter, Durham.

20th June, 1887.

8827. Light and Portable Music or Reading Stand, E. W. Dixon, Bath.
8828. Boots, Shoes, &c., M. Yoxon, Leicester.
8829. Buckles for Braces, &c., D. Cutler, Birmingham.
8830. Driving Chain, W. Morgan, Birmingham.
8831. Automatic Extinguishers for Paraffine and such Lamps, J. Duggan, Liverpool.
8832. Stop Motions for Doubling and Twisting Frames, A. H. Dixon and W. J. Gradwell, Manchester.
8833. Measuring the Amount or Intensity of Light, E. Pickard, Mansfield.
8834. Taps, &c., for facilitating Repairs while under Pressure, A Butler, Leeds.
8835. Decorating Clayware, L. A. Fry, London.
8836. Lawn Tennis Net Holder, R. C. Hope, Scarborough.
8837. Metallic Pedestals, S. L. Dore and T. B. Leech, London.
8838. Roving Boxes, A. Binns, Bradford.
8839. Flying Trapeze Frames, J. H. Draycott, Birmingham.
8840. Armour Plating, J. J. Arnold, Southampton.
8841. Breech-loading Fire-arms, W. Ford, Sutton Coldfield.
8842. Feeding Bottle Protector, &c., F. W. Laurie, London.
8843. Chronograph Mechanism, E. de Pass.—(*Henchoz frères, Switzerland.*)
8844. Shipping Coal without Breakage, A. A. Rickaby, London.
8845. Metallic Plate for Heels of Boots, J. Waugh, London.
8846. Railway Milk Churns, R. M. Hyde and S. Stone, Essex.
8847. Mineral Water Vans, C. Turner.
8848. Fastening the Heads of Brushes, D. Jackson and J. Tate, London.
8849. Door Cramp, S. Bastow, London.
8850. Mantlets, W. E. Heath, London.
8851. Shirts, C. C. Blackburn, London.
8852. Lead Pencil Point Cutter, W. Bracewell, Brinscall.
8853. Binding Newspapers, J. C. Mewburn.—(*O. Dietrich, Germany.*)
8854. Dyeing Cotton, J. Grunhut, London.
8855. Electric Piles, E. Julien, Liverpool.
8856. Measuring Electric Currents, H. Aron, Liverpool.
8857. Carding Wool, H. Duesberg-Bosson and D. Grosjean, London.
8858. Tools, H. Thomas, London.
8859. Targets, C. Chandler, London.
8860. Elevator Chain, O. W. Gauhe, London.
8861. Paper Making, G. H. Mallary, London.
8862. Paper Making, G. H. Mallary, London.
8863. Guns, G. A. Farini, London.
8864. Fastening the Lids of Baskets, D. R. Noble, Peterborough.
8865. Textile Fibres, E. Edwards.—(*F. J. Maizier and F. J. W. Reetz, Belgium.*)
8866. Aluminium, W. Cross, London.
8867. Printed Fabrics for Multicolour Yarns, A. Just, London.
8868. Cabinet Bed and Bedstead, M. Jacob, London.
8869. Softening the Sound of Pianos, J. E. Mennesson, London.
8870. Freezing Machines, —. Comte and —. Mabut, London.
8871. Elastic Spirals, I. F. Clasen, London.
8872. Safety Screw Fastenings for Studs, &c., I. F. Clasen, London.

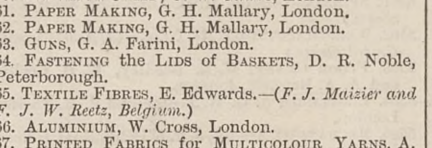
SELECTED AMERICAN PATENTS.

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

360,863. Fastening for Leather and other Flexible Materials, *L. O. Dion, Natick, Mass.—Filed June 15th*, 1886.

Claim.—A fastening for securing pieces of material, consisting of a tack having the shank excentric to its head, the latter provided on its under side with a

360,863

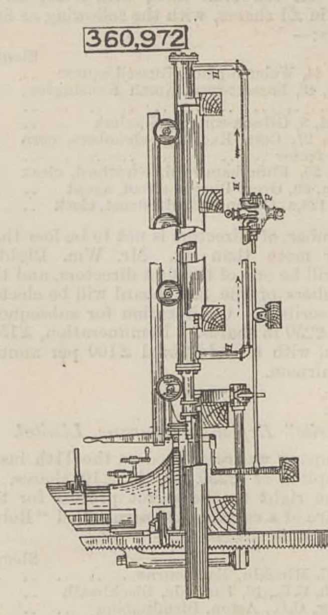


clinching die or surface and adapted to be applied in pairs from opposite sides of the material, and the points of the tacks upset in the recess or die, in the manner and for the purpose set forth.

360,972. Steam Feed for Sawmills, *De W. C. Prescott, Marinette, Wis.—Filed August 2nd*, 1886.

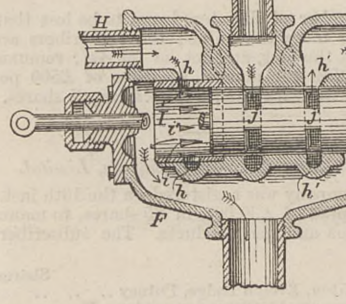
Claim.—(1) In a sawmill, a band saw, in combination with the log carriage, a steam feed device connected to the carriage, and a graduating device, whereby steam is admitted to the cylinder gradually for the forward movement of the carriage, substantially as and for the purposes set forth. (2) In a sawmill, a band saw, in combination with the log carriage, a steam feed device connected to said carriage, a valve for admitting steam alternately to the feed pipes leading to the front and rear of the steam cylinder, and a device covering the port opening to the former of said pipes, and provided with graduated openings, whereby steam is supplied in small quantity at first and gradually increased, substantially as and for the purposes set forth. (3) The saw carriage, in combination with the steam cylinder, piston arranged therein, feed pipes opening into the cylinder in front and rear of said piston, steam chests provided with ports h h^1, reciprocating valve J, and sleeve I, provided with openings gradually constricted

360,972



as they extend inward, substantially as and for the purposes set forth. (4) The saw carriage, in combination with the steam cylinder and piston, the

360,972



bination with the steam cylinder and piston, the feed pipes H H^1, the valve chest F, provided with ports h h^1, the reciprocating valve J, provided with openings j j^1, and the sleeve I, provided with tapering openings i i^1, the latter shorter than the former, substantially as and for the purposes set forth.

360,891. Wire Rope Clutch, *L. Knaak, Oakdale, Pa.—Filed June 1st*, 1886.

Claim.—(1) As a new article of manufacture, a swivel clutch consisting of the parts A and B, and provided with the latch c and spring e, constructed substantially as shown. (2) In a swivel clutch, the combination of

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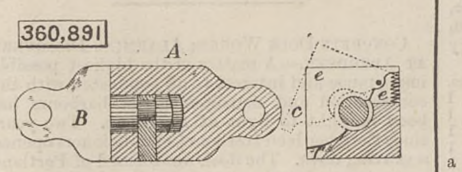


the latch c with the part A and the grooved part B, constructed so that when the clutch is locked either part may freely rotate, as described.

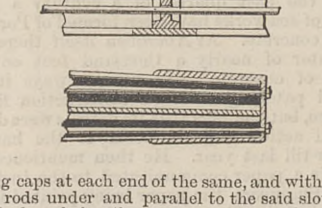
361,049. Yard for Ships, &c., *D. Campbell, Fort Cauley, Auckland, New Zealand.—Filed July 1st*, 1886.

Claim.—(1) The improved hollow metallic yard having slots or longitudinal openings provided with

361,049

uniting caps at each end of the same, and with interior metal rods under and parallel to the said slots, all as described and for the purposes set forth. (2) The hollow metal yard provided with longitudinal slots and uniting caps and interior rods, and with a hori-

361,049

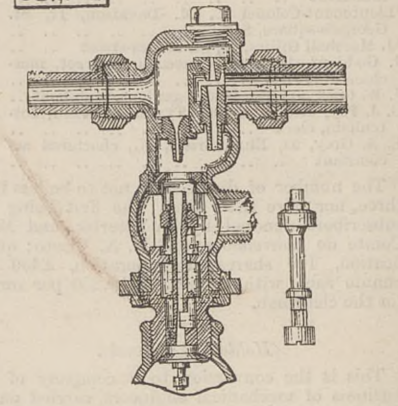


zontal central plate extending longitudinally from end to end of the yard, as and for the purpose set forth. (3) The hollow metal yard provided with longitudinal slots and uniting caps and interior rods, and with a longitudinal metal plate and a central disc, substantially as and for the purposes set forth. (4) In combination with the said hollow metal yard having an upper and lower slotted surface, the rods supported within the yard, the double metal rings or hanks formed of the two rings, and the connecting cylindrical metal neck or bar, as and for the purposes set forth.

360,148. Injector, *A. S. Ebermann, Baltimore, Md.—Filed May 14th*, 1886.

Claim.—(1) In an injector, the combination, with a combining and discharge tube and a valve adapted to close the secondary overflow, of a bearing adapted to receive pressure of steam and water from the combining and discharging tube, said bearing being attached to the said valve and located on the side of the relief opening in the tube opposite that on which the said

361,148

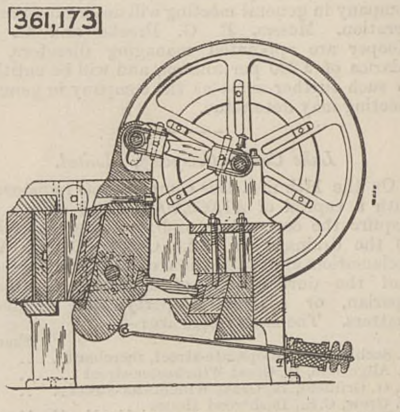


valve is located, substantially as set forth. (2) In an injector, the combination, with a casing having a movable combining and discharge tube located therein and overflow ports extending through it, of valves secured to the tube adapted to open and close the initial and secondary overflows, the secondary overflow valve being adapted to make a full opening before the initial valve opens, substantially as set forth.

361,173. Stone and Ore Breaker, *S. L. Marsden, New Haven, Conn.—Filed May 4th*, 1886.

Claim.—(1) The combination, with a centrally pivotted movable jaw, of a pitman attached to the upper part thereof, and a tension rod attached to the lower part of said jaw, substantially as described. (2) The combination, with the movable jaw centrally pivotted on a horizontal sliding pivot, of said pivot, a tension rod attached to the lower part of said jaw, and

361,173

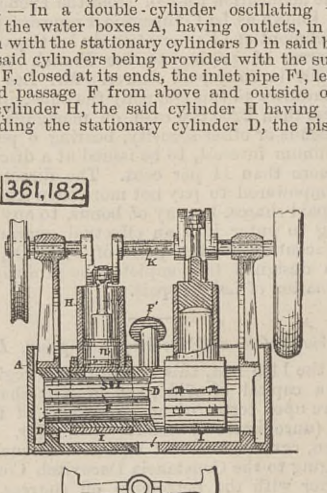


a vertically adjustable pitman connected with the upper end of said jaw, substantially as and for the purpose specified. (3) The combination, with the movable jaw centrally pivotted on a sliding pivot and formed near its upper end with vertical slot d and recess g, of said pivot, the pitman, and the pitman wrist pin passed through said slot and provided with nuts, substantially as and for the purpose specified. (4) The combination of the centrally pivotted movable jaw, a pitman attached to the upper part thereof, a tension rod attached to the lower part of said jaw, and a toggle connected with said jaw between said pitman and tension rod, substantially as described.

361,182. Water Engine, *G. T. Pilling, Baltimore, Md.—Filed July 13th*, 1886.

Claim.—In a double-cylinder oscillating water engine, the water boxes A, having outlets, in combination with the stationary cylinders D in said boxes, each of said cylinders being provided with the supply-passage F, closed at its ends, the inlet pipe F^1, leading into said passage F from above and outside of the piston cylinder H, the said cylinder H having collar surrounding the stationary cylinder D, the piston n

361,182



and connections, the shaft K, the collar I, attached to said cylinder H and having the upper portion I^1, the latter having ports r, s, and s, the said cylinder having ports s^1 s^1, adapted to register with the ports s s on the downstroke of the piston, whereby the exhaust water from the cylinder H flows into the cylinder D, and the supply passage F, having port r^1, adapted to register with the port r, whereby the water flows from the passage F into the cylinder H, so as to make the upstroke of the piston n, the said pistons being connected to the said crank-shaft K, so as to have rising and falling motion alternately, all substantially as shown and described.

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