ON VELOCITY IN BELT AND ROPE GEARING.

The advantage of high speeds in the transmission of power by belt and rope gearing is now everywhere admitted and understood. Not so well, however, is it apprehended that a sharply defined limit exists, beyond which a farther increase of speed is not only without advantage, but actually injurious. This limit is one imposed by the inertia of the band, and determines that linear velocity at which the power transmitted is greatest, being quite distinct from the question of the efficiency of the band as a transmitter of power, which is determined by other circumstances—such as its stiffness and elasticity, the resistance of the air, and axle friction.

The band in running around with the pulleys is subject to a tension, due to centrifugal force, in precisely the same manner as are the rims of the pulleys themselves; a portion of its strength is taken up in resisting this pull, the remaining portion only being available for the transmission of force. This action was probably first pointed out in The Engineer by the late Professor Rankine. In the issue of March 5th, 1869, appeared an article by him, "On the Centrifugal Force of Bands in Machinery," from which the following paragraphs are taken:—

"(2) *Centrifugal tension of an endless band.*—The general principle of the tension produced in an endless band by centrifugal force is closely analogous to that which forms the foundation of the 'hypothesis of molecular vortices,' a hypothesis proposed in 1849 as a means of deducing the dynamical theory of heat from the general laws of dynamics, viz., that a vortex or endless circulating stream produces an outward pressure against the inside of any vessel within which it may be contained, of an amount proportional to the weight of matter contained in an unit length of that stream and to the square of its velocity, and independent of the figure of the stream; for it can be proved from the elementary laws of dynamics that if an endless band of any figure whatsoever runs at a given speed, the centrifugal force produces an uniform tension at each cross section of the band equal to the weight of a piece of the band, whose length is twice the height from which a heavy body must fall in order to acquire the velocity of the band.

"In symbols let w be the weight of an unit of length of band; v the speed at which it runs, and g the velocity produced by gravity in a second (=32·2ft. or 9·81 metres); then the *centrifugal tension*, as it may be called, has the following value:—

$$\frac{w\,v^2}{g} \quad \ldots\ldots\ldots\ldots \quad (1)$$

There are different ways of demonstrating that proposition, the simplest being as follows:—Consider any pair of cross sections of the band at which the motions of the particles are parallel and contrary. Call those cross sections A and B. The weight of band which passes any given cross section in a second is wv; the particles at A are moving with the velocity $+v$, and the particles at B with the equal and contrary velocity $-v$; hence, in each second a mass of matter of the weight wv undergoes a change of velocity amounting to $2v$; and according to the second law of motion, the force in units of weight required to produce that change is $\frac{wv \times 2v}{g} = \frac{2wv^2}{g}$. One-half of that force is supplied by the tension at A, and the other half by the tension at B; therefore the tension at each of those points is $\frac{wv^2}{g}$; and the same demonstration may be applied to every pair of points in the band at which the motions are contrary.

"(3) *Effect on the band when in motion.*—The effect on the band when in motion is that at any given point the tension which produces pressures and friction on the pulley, or available tension, as it may be called, is less than the total tension by an amount equal to the centrifugal tension; for this amount is employed in compelling the particles of the band to circulate in a closed or endless path. It is, of course, to the total tension that the strength of the band is to be adapted; therefore the transverse dimensions of a band for transmitting a given force must be greater for a high than for a low speed."

The problem which it is now purposed to solve is this. The tension requisite for the transmission of a given power, diminishing directly as the speed with which it is transmitted is increased, and the available strength of the band also diminishing, but at a different rate, to find for a band of a given working strength and weight per running foot the velocity at which the greatest power may be transmitted.

Let H = power to be transmitted, then $\frac{H}{v} = R =$ force to be transmitted by the band. A band when strained over two pulleys with a certain initial tension will transmit a force depending, among other things, upon such tension. When the band is in motion this initial tension is replaced by an increased tension on the driving span and a diminished tension on the trailing span. The band must of course be designed to suit the increased tension, the value of which can be obtained from the expression

$$P\left(1 - \frac{1}{2{\cdot}718^{\frac{ul}{r}}}\right) = R$$

where P = tension on driving span due to force transmitted;
u = coefficient of friction between band and pulley;
l = length of pulley circumference embraced by the belt;
r = radius of pulley;
l and r being always taken in terms of the smaller pulley.

But in any given gear the value of $1 - \frac{1}{2{\cdot}718^{\frac{ul}{r}}}$ is a constant and independent of the velocity, let it be called a, then

$$P\,a = R = \frac{H}{v}$$

$$P = \frac{H}{a\,v}$$

The centrifugal force of the band is $f = \frac{w v^2}{g r}$, giving, as already stated, a tension on the belt of $F = \frac{v^2 w}{g}$.

Let the working strength of the band be called S; it is taken up in resisting P and F, and when the whole of the assigned strength is utilised,

$$S = P + F$$

$$S = \frac{H}{a\,v} + \frac{v^2 w}{g}.$$

Finding now the value of v, at which H is a maximum,

$$H = S\,a\,v - \frac{a\,v^3 w}{g}.$$

differentiating we get $\frac{d\,H}{a\,v} = S\,a - \frac{3\,v^2\,w\,a}{g}$.

and setting this equal to zero we obtain

$$v = \sqrt{10{\cdot}7\frac{S}{w}}.$$

Leather belting is commonly assumed to possess a working strength of 330 lb. per square inch. It weighs 62 lb. per cubic foot, or, say, 0·43 lb. per foot run, per square inch of section.

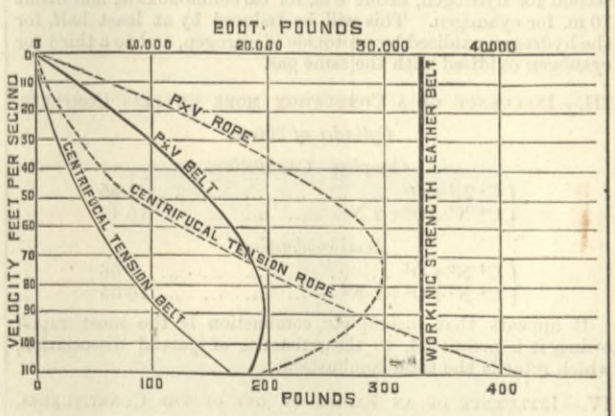
Then— $$\frac{S}{w} = \frac{330}{0{\cdot}43} = 770$$

and v = 90·7ft. per second, or say 5500ft. per minute.

In the case of ropes we get a somewhat lower limit. Take a 2in. cotton rope, it weighs 1·12 lb. per foot run, and has a working strength—as taken from cases in everyday practice—of, say, 600 lb. This is higher than the value generally assigned, because it takes into account the increased tension on the driving side, as well as the centrifugal tension. Then $\frac{S}{w} = 535$, giving the velocity at which the maximum power may be transmitted as 4560, or, say, 4500ft. per minute.

The expression $V^1 = 200\sqrt{\frac{S}{w}}$ gives an approximate but rather high value of the velocity expressed in feet per minute. Of course the calculations may be very easily worked out for any other proportions of $\frac{S}{w}$.

That the speed thus obtained is really that at which the maximum power may be transmitted can be readily proved in a very simple manner. Taking in the case of a leather belt, the three velocities 80ft., 90ft., and 100ft. per second, and deducting in each case the proportion of the strength of the band taken up in resisting centrifugal tension $= \frac{wv^2}{g}$, we get as the available strength of the band 243·6, 217·65, and 195·0 lb. per square inch in the three cases respectively. If now the available strength so obtained be multiplied by the corresponding velocity, the numbers 19,488·0, 19,588·5, and 19,500·0 are obtained as the relative values of the power transmitted. It will be seen that the power corresponding to the velocity of 90ft. per second is greater than that corresponding to either 80 or 100, but that that corresponding to 100 is somewhat greater than that of 80, indicating that the maximum value is somewhat over 90; the calculated result was 90·7ft. per second.



The same course might be followed in regard to the rope, but it is superfluous, as a series of the values so obtained are plotted on the diagram, both for a 2in. rope and a square inch of leather belt. It may be remarked here that these dimensions have been assumed throughout merely for the sake of convenience. The diagram requires little explanation, the continuous rise in the curve of centrifugal tension is quite apparent, as is also the rise in the power curve up to a certain point and its subsequent fall. It will be seen that little or nothing is gained by running either ropes or belts at a speed higher than 70ft. per second or 4200ft. per minute—that is to say, under the assumed proportions of strength to weight. If we choose to assume a higher or lower working strength the figures will be correspondingly altered.

That such a discussion as the foregoing is required there can be little doubt when it is known that ropes are now, or have been until recently, running at as high a speed as 7000ft. per minute, at the cost, too, of a very special construction of the drums. A glance at the diagram, which goes up to 6600ft. per minute, shows that at that speed a rope would only transmit two-thirds of its maximum power at the same total strain; or that it would at the lower velocity we have obtained as the most desirable, transmit the same power with a correspondingly diminished total tension.

R. J.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—John McCarthy, engineer, to the Sylvia; William Pearson, engineer, to the Sultan; Richard W. Toman, assistant engineer, to the Sylvia; Andrew Watt, chief engineer to the Pembroke, additional; and Robert C. Widdecombe, chief engineer, to the Indus, for the Prince Albert.

RAILWAY BRIDGES IN NEW SOUTH WALES.

A pretty dispute between the heads of two important departments of the Government Railways in New South Wales, resulted, some eighteen months since, in the appointment of a Royal Commission to inquire into the subject of the disagreement, viz., the stability of certain iron bridges, and of a timber viaduct approaching the Murrumbidgee Bridge. A glance at this report will afford some instruction to our readers.

Mr. Cowdery, the engineer for existing lines, whose duty, it appears, consisted largely in the proper maintenance of all works when once completed and handed over to his charge, in the conduct of his work seems to have thought it desirable to execute certain repairs to bridges under his supervision, varying from about one year to twenty years old. These repairs consisted largely in re-rivetting. To assist him in this, he applied to Mr. Whitton, the engineer-in-chief for railways, for drawings of the bridges under treatment, which Mr. Whitton refused to supply; who being made aware of some adverse comments in the public press on the security of these bridges, wrote a minute to the Minister of Works, recommending that this re-rivetting should be discontinued, as he considered it not only unnecessary, but injurious. Mr. Cowdery, in his turn, communicated with the Commissioner of Railways, alleging that the bridges were very defective. The Commissioner then desired Mr. Cowdery to make a formal report to him upon the matter. The engineer-in-chief being afterwards put in possession of this communication, sent a counter report to the Minister, insisting that the bridges were in good condition, and "that no better bridges with regard to material and workmanship were ever built." After some squabbling between the principals in this affair, the Minister with such a pleasing variety of opinion, feeling himself unable to determine the technical questions raised, thought it prudent in the public interest, to have the matter referred to a body of experts; and this view being finally accepted by the Executive Council, a Commission was appointed in October, 1883, which being soon afterwards disbanded, was replaced by a number of gentlemen forming the Commission, whose report was laid upon the table of the Legislative Assembly in the beginning of September of this year.

The Commission seem to have entered upon their duties with a desire to sift the matter to the bottom; taking evidence, as far as practicable, from all persons who had been engaged upon the design, construction, erection, or maintenance of the bridges, with a view to treat each side of the dispute with fairness, and to arrive at a just conclusion as to the stability of the works considered. Their inquiry embraced a personal examination of the designs, and of the bridges as they stand, with suitable tests carefully conducted, and incidentally some experiments upon the strengths of colonial timbers, needed with reference to the timber viaduct. In estimating the section of metal required to bear the stresses imposed upon the various parts of the structures, they adopted the British Board of Trade units for railway bridges in wrought iron, viz., 5 tons per square inch in tension, and 4 tons in compression. The live load was assumed to vary from 1·5 tons per running foot for each line in the case of 60ft. spans, to 1·25 tons for the 198ft. spans, which appears to be fairly in accordance with the usual practice. The tests for deflection were made with locomotives standing on the bridges in various positions, when running full speed across, and running full speed with brakes applied coming on to the bridge. The live load taken in the calculations was never exceeded in the tests. The Commissioners narrate the results of their investigations, from which it appears that of the bridges they considered, about fifteen in number, but one or two were quite free from defect, nearly all had some loose rivets, with such faults as want of contact between plates or bars, inaccessibility of cells in compression booms, want of drainage in some parts, or defective expansion arrangements. About one-half of the number were either equal to the requirements laid down as to section of booms, &c., or in excess, whilst one-third of the bridges were deficient in this respect. The Solitary Creek Bridge girders were found wanting in the section of both booms, there being in tension and in compression about 76 per cent. only of the area required. The Penrith Bridge, in like manner, was discovered to be weak, having but 86 per cent. of the section needed in both upper and lower flanges of the 198ft. spans. The Wollondilly Bridge, 60ft. girders, were deficient in the flanges also, with 73 per cent. of the section proper to both members; but in the 130ft. spans of the same bridge the top booms alone were defective, there being in this case but 80 per cent. of the needed metal.

It is worthy of note, that the want of sufficient sectional area in the principal members, as found by the Commissioners, is a fault only existing in the earlier bridges examined by them, all those built before 1870 being too light either in the top or bottom booms, or both, and all those after this date, with one exception—the Solitary Creek Bridge, built in 1872—coming up to, or exceeding their requirements. In the Penrith Bridge, in addition to the want of sufficient strength in the booms, there appears to have been a considerable lack of rivet section, the shearing stress reaching as much as 9·3 tons per square inch in the web rivets over the piers. The Commissioners, after stating categorically the defects, or freedom from defects, in each case, say, that they do not find the bridges in such a condition as Mr. Cowdery's representations had led them to expect; and then proceed to make recommendations with reference to the iron bridges, which consist principally, in advising that rivets where "positively" loose shall be replaced; certain decayed timber in the floors renewed; modifications introduced to facilitate inspection, drainage, and ventilation; in one case the replacing of angle iron covers deemed defective; and the substitution in the Penrith Bridge of 1in. rivets for $\frac{7}{8}$in., for a considerable length of the girders near the piers; with the addition of a longitudinal runner under the cross-girders, to distribute the weight of the driving wheels of locomotives over a number of cross-girders, which are pre-

sumably weak. The Commissioners are of opinion that, considering the duties of the engineer for existing lines, he should be provided with drawings of all bridges under his charge, and should, previous to renewing loose rivets in any joint, ascertain the precise stresses to which it may be subject, to learn if this is immediately necessary, which Mr. Cowdery appears not to have done in those bridges he had already treated.

The Wagga Wagga timber viaduct being also carefully considered, it was found that a large number of the piles were decayed, which is attributed chiefly to the fact that the timber was felled when the sap was up; and it is further noted that under the conditions imposed for its construction, there was not sufficient time to obtain properly seasoned material. The piles showed signs of decay soon after being put down, dry-rot having quickly made its appearance. Mr. Cowdery stated that in the three years after the line was opened, the viaduct cost £1546 for repairs. Amongst other precautions he had thought it desirable to place props under some of the timber girders, which, as Mr. Whitton complained, "produced an impression that the viaduct was unsafe," and desiring their removal. The Commissioners deem the viaduct now trustworthy, extensive repairs having been carried out, though they express the opinion that the whole of the timber piers will probably have to be replaced within twenty years. In commenting generally upon the design and construction of the bridges, the Commissioners state that though some of the earlier of these are defective, they are all good specimens of design and workmanship for the periods at which they were built. Attention is called to the dissimilarity amongst the bridges of the method of designing the joints of the top booms. In the Tamworth and Macdonald bridges they are deficient in rivet section; though the Commissioners remark, that in this case, fortunately, the butting of the plates is remarkably close, which is not so with some other joints where the rivetting is ample. But it appears to us, that as in these two examples close butting may possibly be due to the yielding of the joints, allowed by deficient rivetting, rather than to precise workmanship, it is not of necessity to be regarded with satisfaction. Though the re-rivetting is on the whole commended, this practice is deprecated unless accompanied by "positive" looseness. What does this mean? If a rivet does not fill the hole in which it has been placed, and can be said in any sense to be "loose," surely it is not doing the duty required, as it can hardly be taking stress, and in our opinion, the sooner it is replaced the better.

The Commissioners enlarge upon the fact, that in ordinary practice, it is not expected that material and work should be perfect, and add, that if it were so, scantlings might be reduced to the extent of 30 or 40 per cent. This statement is probably open to question; but granting that it is in part true, still we are convinced that it is desirable to remedy all defects in such structures as they become apparent. There is always a possibility that faults may exist, even of a serious nature, which are not to be ascertained by ordinary and practicable methods of inspection. Indeeed, the Commissioners by their own recommendations, do, to all intents and purposes, support this view, as they propose extensive repairs, some apparently beyond the scope even of Mr. Cowdery's procedure. It is suggested finally that all bridges should be periodically tested by the engineer-in-chief, that his responsibilities should not cease with the construction of the work, and on the other hand, that the engineer for existing lines should not be held solely responsible, nor should he undertake structural alterations without the sanction of the chief engineer. The Commissioners advise that the duties of these two officers should be clearly defined, and that the advice of the engineer-in-chief should be taken upon the matter; so it will be perceived, that whilst Mr. Cowdery's proceedings have been substantially approved, and Mr. Whitton's opinions negatived, Mr. Whitton has had his horn exalted, and Mr. Cowdery has been snubbed.

City and Guilds of London Institute for the Advancement of Technical Education.—Alderman Sir R. N. Fowler, Bart., M.P., has consented to present the Institute's scholarships, prizes, and certificates at a meeting to be held on Wednesday evening, December 9th, at the Salters' Hall, St. Swithin's-lane, E.C. The Right Hon. the Lord Mayor will preside.

Liverpool Engineering Society. — The usual fortnightly meeting of this Society was held on Wednesday, the 28th inst., at the Royal Institution, Colquitt-street, Mr. W. E. Mills, president, in the chair. A paper by Professor Hele-Shaw—University College, Liverpool—entitled "Recent Researches on the Nature of Friction and the Action of Lubricants," was read by the author. The author, in the first place, briefly reviewed the steps which had been made in the progress of our knowledge of friction, and pointed out that General Morin's results and conclusions, both on the sliding and rolling contact of surfaces, published between 1830 and 1834, had until recent years been regarded as final. During the last ten years, however, many scientific men had worked at the subject, and much light had been thrown, not only on the sliding and rolling friction of solids, but on the friction of liquids and gases. The author, in the present paper, confined his remarks entirely to the sliding contact of dry and lubricated surfaces of solids. Commencing with the friction of dry surfaces, it has for some time been admitted that the so-called laws of friction usually given in text-books are probably never exactly true under ordinary pressures and velocities, while they lead to very erroneous conclusions if applied beyond moderate limits, and the experiments of Ball, Douglas, Galton and Westinghouse, Fleming Jenkin and Ewing, Poirée, and others were alluded to in proof of this. In discussing the actual nature of friction of dry surfaces the author believed that more careful and elaborate observations of temperature at extreme velocities and pressures was needed. Coming to the subject of the contact of lubricated surfaces, a far greater advance had been made. The work of Thurston and the experiments made by the committee of the Institution of Mechanical Engineers were of great value, and the main results were brought forward. A striking feature in the progress of the subject was the increasing use of testing machines, and those of Thurston, Stapper, and Bailey, were exhibited and described. In conclusion, the author stated that the question of lubricants was of immense importance in marine engineering, and, while large sums of money were being annually saved in railways by scientific lubricant tests, the mode of judging the efficiency of lubricants used for marine engines remained of the most crude nature, and this alone, in a place like Liverpool, was, he trusted, a sufficient reason for bringing forward the present paper.

THE PROPERTIES OF GASEOUS EXPLOSIVE MIXTURES.

Abstracted and Translated by B. H. Thwaite.

No. II.

Preliminary Observations.

In the course of the experiments, the duration of time required for the pressure to develope its maximum effect was carefully noted. This maximum pressure never attained the degree it would otherwise have done had there been no loss due to wasteful radiation through the sides of the cylinder, and this wasteful radiation increased in proportion as the rate or speed of combustion diminished. The loss of heat increases, of course, in proportion as the capacity of the exploding cylinder is less.

Three experimental cylinders—bombes—were used, having respectively a capacity of 300 cc., 1500 cc., and 4 lits. The mechanical registration arrangements were very ingenious, and calculated to give accurate results. The following tables give the duration of time—expressed in one-thousandths of a second—which elapsed between the moment of inflammation and that of the production of the maximum pressure:—

I.—Influence of the Size of the Vessel or Cylinder.

Nature of explosive mixtures.	Cylinder of 300 cc.	1500 cc.	4000 cc.
H^2+O^2	1·04	—	2·14
$H^2+O^2+H^2$	1·67	—	4·22
$H^2+O^2+N^2$	2·67	—	6·87
$C^2\,O^2+O^2$	12·86	—	15·51
$C^4\,H^4+O^{12}$	2·86	—	2·23
$C^4\,N^2+O^8$	1·55	4·50	—
$C^4\,N^2+O^4+\frac{3}{2}\,N$	3·20	2·74	—
$C^4\,N^2+O^4+2\,N^2$	10·35	15·12	—

It will be seen that generally, the duration of time required for the pressure to attain its maximum increases with the increase of the capacity of the cylinder.

II.—Influence of the Composition of the Mixture.

Simple Mixtures with Complete Combustion.

Cylinder of 300 *cc.*

H^2+O^2	1·04
$C^2\,O^2+O^2$	12·86
$C^4\,N^2+O^8$	1·55
$H^2+N^2\,O^2$	2·06
$C^2\,O^2+N^2\,O^2$	15·39
$C^4\,N^2+4\,N^2\,O^2$	4·53
$C^4\,H^2+O^{10}$	1·94
$C^4\,H^4+O^{12}$	2·86
$C^4\,H^6+O^{14}$	0·83
$2\,C^2\,H^4+O^{16}$	1·24

Carbonmonoxide (C O) is not so rapid as hydrogen—this confirms the present knowledge of these gases—the relation of the time (12·3) being intermediate between the *regime* of explosion (2·6) and the *régime* of ordinary combustion (34). The employment of nitrogen protoxide in place of oxygen, retards the action. With cyanogen and hydro-carbons, very hydrogenated—*carbures très hydrogénés*—the speed or velocity varies very little from that with hydrogen—further conforming to the velocity ratios already deduced from explosive waves—cyanogen, ratio = 1·3 in place of 1·5; formene, 1·23 in place of 1·2; methyl, 1·2 in place of 0·8. There was a difficulty in estimating the absolute velocity with the experimental apparatus available, but to obtain some idea of the relative velocity, we may admit that the flame reaches the piston at the moment of the maximum. The velocity would then be about 100 metres per second for hydrogen, about 8 m. for carbonmonoxide, and about 70 m. for cyanogen. This will be reduced by at least half, for the hydrogen oxidised by protoxide of nitrogen, and to a third for cyanogen oxidised with the same gas.

III.—Influence of a Combustion more or less Complete.

Cylinder of 300 *cc.*

Complete Combustion.

$C^4\,N^2+O^8$	1·55
$C^4\,N^2+O^8+2\,N^2$	15·4

Semi-combustion.

$C^4\,N^2+O^4$	1·06
$C^4\,N^2+O^4+2\,N^2$	10·35

It appears that incomplete combustion is the most rapid, owing, it is presumed, to the existence of partial dissociation, which retards the total combustion.

IV.—Influence of an Excess of one of the Constituents.

Cylinder of 4 lits.

H^2+O^2	2·14

Excess of Hydrogen.

$H^2+O^2+\frac{1}{10}\,H^2$	2·27
$H^2+O^2+\frac{1}{5}\,H^2$	2·53
$H^2+O^2+\frac{1}{3}\,H^2$	2·41
$H^2+O^2+\frac{1}{2}\,H^2$	2·82
$H^2+O^2+H^2$	4·22
$H^2+O^2+2\,H^2$	5·95
$H^2+O^2+3\,H^2$	9·67

Excess of Oxygen.

$H^2+O^2+O^4$	8·16
$H^2+O^2+3\,O^4$	16·04

The combustion is retarded owing to the excess of the unoxidised gas. The retarding influence of the total oxygen being nearly half that of hydrogen, with equal volumes, this corresponds with the greater translation velocity of the molecules of oxygen.

V.—Influence of the Products of Combustion.

Cylinder of 300 *cc.*

Carbonmonoxide.

$C^2\,O^2+O^2$	12·86
$C^2\,O^2+O^2+\frac{1}{2}\,C^2\,O^4$	27·18
$C^2\,O^2+O^2+C^2\,O^4$	35·8

Cyanogen.

$C^4\,N^2+O^4$	1·06
$C^4\,N^2+O^4+\frac{3}{4}\,C^2\,O^2$	3·64
$C^4\,N^2+O^4+2\,C^2\,O^2$	6·44

It will be seen that the action of combustion becomes still more retarded—three-fold, for an equal volume of carbonmonoxide ($C_2\,O_4$), in one instance, and six-fold for an equal volume of carbonmonoxide ($C_2\,O_2$) in the other case. We thus perceive how in the condition of ordinary combustion the propagation of the combustion is retarded by the mixture of the products of combustion.

VI.—Influence of an Excess of Inert Gas.

Cylinder of 4 lits.

H^2+O^2	2·14
$H^2+O^2+\frac{1}{2}\,N^2$	2·86
$H^2+O^2+\frac{1}{4}\,N^2$	3·55
H^2+O^2+N	6·87
$H^2+O^2+2\,N^2$	11·98
$H^2+O^2+3\,N^2$	24·45
$H^2+O^2+4\,N^2$	36·35

Cylinder of 300 *cc.*

Carbonmonoxide $C_2\,O_2$.

$C^2\,O^2+O^2$	12·86
$C^2\,O^2+O^2+\frac{1}{2}\,N^2$	17·78
$C^2\,O^2+O^2+N^2$	26·49

Cyanogen—Complete Combustion.

$C^4\,N^2+O^8$	1·55
$C^4\,N^2+O^8+N^2$	6·09
$C^4\,N^2+O^8+2\,N^2$	15·4

Cyanogen—Semi-combustion.

$C^4\,N^2+O^4$	1·05
$C^4\,N^2+O^4+\frac{3}{4}\,N^2$	3·20
$C^4\,N^2+O^4+2\,N^2$	10·35
$C^4\,N^2+O^4+3\,N^2$	23·63
$C^4\,N^2+O^4+4\,N^2$	29·78

Nitrogen retards the combustion of hydrogen and that of carbonmonoxide $C_2\,O_2$, the first in a greater proportion than the latter. This shows that the phenomenon is not simply the result of a decrease in the temperature, which is nearly the same in both cases; but it is the result also, of the greater inequality of the velocities of translation of the gaseous molecules. The influence of the inert gas effects at the same time a diminution in the temperature of combustion, which reduces the translation velocity of the molecules, and diminishes the number of effective collisions between molecules susceptible of a reciprocal action. Thus, the notable excess of nitrogen retards the action of combustion in a greater degree than the two components of the combustible mixture. In fact, at triple volume in the oxyhydrogen mixture, the reduction of time of the action of combustion is proportional to—

10 for hydrogen
16 for oxygen
24 for nitrogen

The presence of an excess of one of the products retards the action still more—thus, carbondioxide ($C_2\,O_4$) retards more than nitrogen the combustion of the carbonmonoxide ($C_2\,O_2$). In all these instances the inequality of the specific heat (for $C_2\,O_4$) also intervenes, and the variation of dissociation which can introduce the presence of the components and their products.

VII.—Isomerical Systems.

Cylinder of 300 *cc.*

$H^2+N^2+O^2$	2·67
$H^2+N^2\,O^2$	2·06
$C^2\,O^2+N^2+O^2$	26·5
$C^2\,O^2+N^2\,O^2$	15·4
$C^4\,N^2+O^8$	1·55
$2\,C^2\,O^2+N^2+O^4$	1·78
$C^4\,H^6+O^{14}$	0·83
$C^4\,H^4+H^2+O^{14}$	1·37

Combustion is slower in the systems the least condensed, which are at the same time those which disengage the least heat, both effects diminishing the translation velocity, and the probability of effective molecular collisions.

VIII.—Mixture of two Combustible Gases.

Cylinder of 300 *cc.*

Hydrogen and Carbonmonoxide.

H^2+O^2	1·04
$C^2\,O^2+O^2$	1·29
$H^2+\frac{1}{3}\,C^2\,O^2+O^3$	2·57
$H^2+\frac{3}{3}\,C^2\,O^2+O^3\frac{1}{3}$	1·39
$H^2+C^2\,O^2+O^4$	3·88
$H^2+2\,C^2\,O^2+O^6$	4·14

Hydrogen and Ethylene.

$C^4\,H^4+O^{12}$	2·86
$C^4\,H^4+H^2+O^{14}$	1·37

The velocity of combustion is not in any case the mean of that of the mixed constituents; but the two gases have a tendency to burn separately each with its own velocity, the result is that the maximum observed pressure does not respond to an uniform state of combination of the system; consequently it is produced with certain irregularities, and is inferior to what it should be. Thus the carbonmonoxide and hydrogen burnt separately by means of oxygen give sensibly the same pressure; 10·1 atmospheres for the one and 9·9 atmospheres for the other. The velocity of combustion appears to indicate that hydrogen, in the case of ethylene mixed with hydrogen, is oxidised first.

IX.—Hydrocarbons—Combustible Elements Combined.

Cylinder of 300 *cc.*

$C^4\,H^2+O^{10}$	Acetylene	1·94
$C^4\,H^4+O^{12}$	Ethylene	2·86
$C^4\,H^6+O^{14}$	Methyl	0·83
$C^2\,H^4+O^8$	Formene	1·24
$C^4\,H^6\,O^2+O^{12}$	Methylic Ether	1·42
$C^8\,H^{10}\,O^2+O^{24}$	Ether Vapour	2·89

The velocity of combustion of gases which are highly hydrogenated is very near to that of hydrogen; from this it appears to indicate that the hydrogen is oxidised before the carbon even in complete combustion. These effects intervene in the momentary equilibria resulting from an incomplete combination, such as the re-apportionment of the oxygen between two combustible mixtures, such as, for example, carbon and hydrogen; or, better still, between the carbon and hydrogen associated in the form of a carbide, or in the re-apportionment of the hydrogen between two comburants, such as chlorine and oxygen. This re-apportionment in the initial moments, depends upon the relative velocities of the combinations, and it can be very different from the definite equilibrium which will be established in the same system maintained at a constant temperature during a convenient time. A system quickly cooled, such as that which is obtained after explosion, does not furnish real measurements of the affinities, because it can produce a quite different re-apportionment of its elements—a circumstance which has hitherto not been sufficiently taken into account.

WEDLAKE'S ORGAN.

We have been requested by several of our readers to give a description of the most noteworthy features of the numerous organs exhibited during the recent International Inventions Exhibition, and although we cannot do all in this direction that appears to our correspondents desirable, we have selected two organs which seem to be specially worthy of attention for illustration and description. The instruments in question have been constructed by Mr. Wedlake, of Berkley-road, Regent's Park, and by Messrs. Mitchell and Thyne. The latter stood in the music room, the former—which we illustrate and describe this week, is a much smaller instrument—stood in an out-of-the-way corner at the end of the long music gallery, and its proportions were dwarfed by the splendid organ exhibited by Messrs. Walker. Mr. Wedlake's organ, however, contains much that is extremely interesting, not only to the organist, but to every lover of mechanism; and it is perhaps hardly too much to say that Mr. Wedlake has succeeded in doing a nearly impossible thing, to wit, he has invented a new valve.

In order to make what follows intelligible we must premise that in all modern organs of any pretensions to excellence what are known as pneumatic levers are fitted to reduce the labour of playing. When a key is pressed down by the organist's finger a little "pallet," or flap valve, is pulled open, against a pressure of air tending to keep it shut. When couplers are used the organist, in putting down one key with his finger, pulls down one or more other keys with which the first is for the time coupled, and the resistance is proportionately augmented. The labour of playing was well known to the last generation of organists. The pneumatic lever serves the purpose of what electricians call a "relay." The organist opens a very small valve, which admits air under pressure to a little bellows, one of the boards of which, being movable, is connected with the pallet before referred to. Thus it will be understood that the little bellows, or pneumatic lever, does all the heavy work, and the keys of a huge organ offer no more resistance to the player's fingers than the keys of a piano do. This great gain has not been obtained without some loss. So long as an organist opened a pallet direct by the muscular effort of his fingers, he was in touch, so to speak, with his instrument, and although it is practically impossible for the best organist to get anything equivalent to the marvellous effect of touch manifested in pianoforte playing, yet it was possible to put forth *some* expression, but the pneumatic lever killed all that. With it a pallet is open or shut—there is no medium—and the organist does not know whether it is open or shut save by hearing. He cannot feel. Now Mr. Wedlake's improvements in organs have resulted in restoring the connection between the organ and the instrument, while retaining all the advantages of the pneumatic lever. On this point we reproduce information supplied to us by Dr. C. W. Pearce, Fellow and Member of the Council of the College of Organists, who, writing to us on the subject, says:—"Situated in one of the most out-of-the-way, unnoticeable nooks in the Exhibition, at the end of the long Central Gallery, is an organ which for beauty of tone and perfection of mechanism will compare most favourably with the other organs in the building, even with instruments of double its size. One only needs to sit down and play upon it for five minutes to discover the real artistic pleasure it is capable of giving the performer. A sensation of real grip, such as no other pneumatic action has ever given, at once establishes a sympathetic bond of union between artist and mechanism—*direct contact*, in fact, with the sound-producing apparatus—as direct as that which has hitherto been almost exclusively enjoyed by pianists and violinists. Moreover, the action is perfectly noiseless, there being not the least suspicion even of a click or a thud to disturb the musical rhythm. This is especially the case in rapid repetitions of a single note, such as are to be met with in Mr. W. T. Best's arrangement of Mozart's 'Zauberflöte' overture, an arrangement which organists well know is perfectly impracticable upon an organ with the ordinary pneumatic action, but which can be played with facility upon this instrument."

This is valuable testimony from a high musical authority. He puts this in other words in a testimonial which he has given to Mr. Wedlake:—"After," he says, "giving three recitals on the organ in the Inventions Exhibition, built by Mr. Henry Wedlake, I have much pleasure in stating that the new patent pneumatic action applied to that instrument leaves little to be desired as far as touch is concerned. My previous experience of pneumatic action may be thus summarised: I have found it costly, complex, noisy, and unsympathetic. All sensation of grip was entirely removed, and an unseen medium seemed interposed between the player and his instrument, which, to a large extent, nullified that feeling of direct contact with the sound-producing apparatus which is as dear to the organist as to the violinist or pianist. I have no hesitation in saying that Mr. Wedlake has given the organist a touch which is as sympathetic as it is noiseless; and which being produced by simple means is therefore inexpensive. His pneumatic touch enables the performer to realise that he is playing upon the very organ itself, and not upon a dumb keyboard, which however quickly and effectively it acts upon the organ mechanism, nevertheless does its duty in such a cold-blooded manner as to reduce his enthusiasm to its minimum." We have now to see how the end in question is attained.

In the pneumatic levers hitherto in use, wind under a pressure of 5in. or 6in. of water is admitted from the air-receivers of the organ into the collapsed bellows, and distends it. In the Wedlake pneumatic system the arrangements are reversed. The bellows are placed in a box, or chest, kept full of wind under pressure. The valve being open, the wind is thus in the bellows as well as surrounding it. On raising the valve to the flexible seat the compressed air now in the bellows is allowed to escape, and the pressure being only external the bellows collapses and opens the sound-board valve. Thus, the same pressure of wind that closes the bellows opens it again on the valve dropping from the flexible seat and closing the exhaust aperture. By this system one-third more power is gained from the fact that the wind is pressing on the ribs, or yielding portion of bellows, at the time when there is most suction on the sound-board valve. Whereas in the original method, the wind does not take effect on the ribs until the bellows are partially opened, the suction having been overcome and the pallet opened.

On page 373 we give a front view and a transverse section through the organ, which is a three-manual instrument, CC to G, fifty-six notes, and pedal organ, CCC to F, thirty notes, and contains the following stops, couplers, &c. It will be noticed by organists that there is no "mixture" stop in the entire organ, and those who have not heard the instrument may be inclined to regard the omission of these harmonic stops as a serious defect; but the general brightness of tone fully compensates what would ordinarily be considered a loss of brilliancy in the full organ *ensemble*.

In the section of the organ, A shows the new patent pneumatic levers located in a chest filled with wind of the same pressure as that supplied by the "feeders," or bellows, below. B is the pedal "sound board," that is, the perforated board on which the pedal pipes stand at the back of the organ; C is a tremulant to the swell organ, D are the light touch valves of this organ, E and F are the same for the great and choir organ, H is the connection from the pneumatic levers to the swell organ, back-falls, and octave couplers. Above we give sections of the pneumatic chambers and bellows. The bellows is now open, and the pallet, not shown, is closed. The organist presses down a key, and by so doing pulls down the tracker G. This causes the valve M to rise from its lower seat and close the upper orifice. The result is that the air no longer confined in the bellows is squeezed out by the pressure in the pneumatic chamber—shown in solid black—the lower board is raised and the wire fixed to it operates to open the pallet and cause the pipe or pipes proper to the particular key touched to speak The valve M and its seat is a very curious and ingenious arrangement of mechanism. The valve itself is a little disc of wood covered smoothly with leather; the seat K is of soft leather glued all round the hole in the centre to the top board of the little bellows; on top of K lies a ring of cardboard, which serves, oddly enough, to support the leather seat. A pneumatic lever, such as we have illustrated, was shown in a glass box by Mr. Wedlake, and its action was well worth careful study. As the valve M was raised, the seat K was drawn down to meet it, the cardboard modifying the form of the curve taken by the leather. In the same way, when the valve was falling away, K followed it down for a certain distance, and then came away with a jerk, leaving a large opening available for filling the bellows, and so closing the pallet and silencing the note in a hurry. It is to this peculiar correspondence between the valve and its seat that the special touch of this organ, named by Dr. Pearce, is due. The valve can always be felt, so to speak, as it rests on its elastic seat. The valve M is kept in its place by a spring of thin wire S, hooked into the top of a wire gallows or bridge shown in front view above. R is a long strip of thin cane, or other elastic wood, which prevents M from slipping sideways. The other end of this carries a valve N, which, normally closed, is raised by the pin P as soon as the lower board has gone high enough, thus admitting air, and preventing the bottom board from clapping noisily against the top board, which it would otherwise be certain to do when a rapid passage was being played.

It will be seen that the space occupied vertically is extremely small; and for this reason all the pneumatic levers for a large organ can be stowed into a comparatively shallow box—which is often a matter of great importance where height is lacking.

We append the specification of the organ:—

Great Organ.

1. Open Diapason	Metal	8ft.	56	pipes.
2. Stopped Diapason and Clarabel	Wood	8ft.	56	,,
3. Horn Diapason	Metal	8ft.	56	,,
4. Principal	Metal	4ft.	56	,,
5. Harmonic Flute	Metal	4ft.	56	,,
6. Fifteenth	Metal	2ft.	56	,,
7. Trumpet	Metal	8ft.	56	,,
Total			392	pipes.

Swell Organ.

8. Double Diapason	Wood	16ft. tone	68	pipes.
9. Open Diapason	Metal	8ft.	68	,,
10. Rohr Flute	Wood	8ft.	68	,,
11. Echo Dulciana	Metal	8ft.	68	,,
12. Voix Celeste	Metal	8ft.	68	,,
13. Principal	Metal	4ft.	68	,,
14. Fifteenth	Metal	2ft.	68	,,
15. Cornopean	Metal	8ft.	68	,,
16. Oboe	Metal	8ft.	68	,,
Total			612	pipes.

Choir Organ.

17. Dulciana	Metal	8ft.	56	pipes.
18. Lieblich Gedackt	Wood	8ft.	56	,,
19. Suabe Flute	Wood	4ft.	56	,,
20. Piccolo	Metal	2ft.	56	,,
21. Clarionet	Metal	8ft.	56	,,
Total			280	pipes.

Pedal Organ.

22. Open Bass	Wood	16ft.	30	pipes.
23. Sub-Bass	Wood	16ft. tone	30	,,
Total			60	pipes.

Couplers.

24. Swell to great.
25. Octave swell.
26. Sub-octave swell.
27. Swell to choir.
28. Swell to pedal.
29. Great to pedal treble side.
30. Bass side.
31. Choir to pedal.
32. Octave pedal.

Composition Pedals.

Three to great organ. | Three to swell organ.

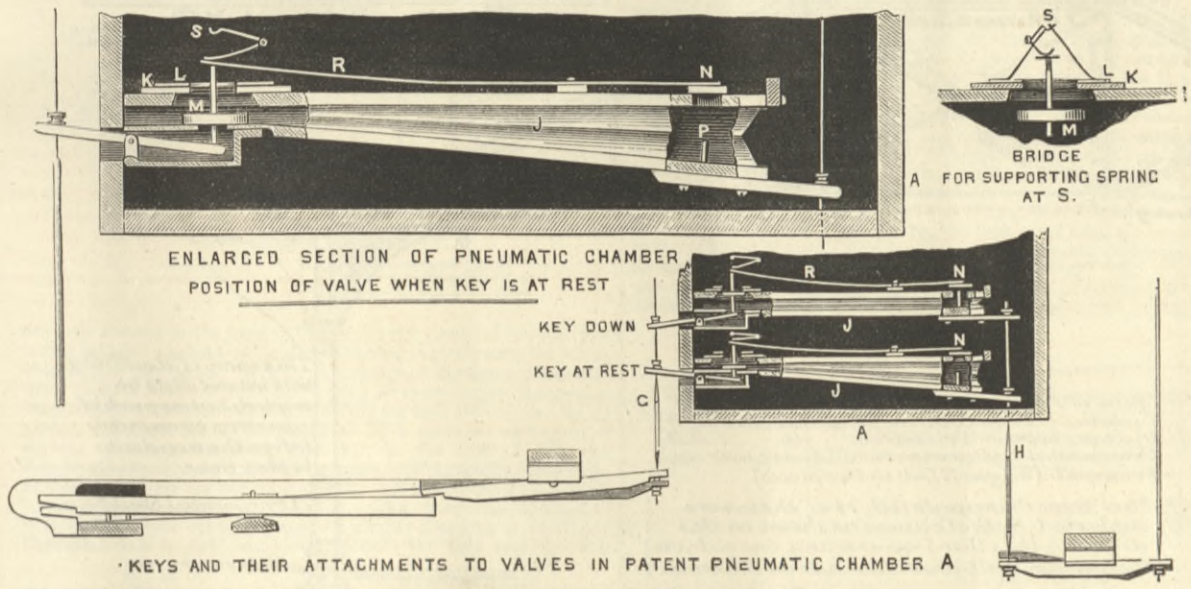
Tremulant to swell organ by pedal.

We feel that in describing this most ingenious mechanical arrangement we have quite failed to convey an adequate idea of its peculiarities. Indeed, these can only be realised by those who have seen it in action, and noticed the wonderful sensitiveness of the flexible seat, and the manner in which it is apparently attracted towards the valve.

So far we have spoken of the valves in the pneumatic levers alone, but there are other valves in an organ. The pedal organ is fitted with tubular pneumatics. If our readers will turn to the section on page 373 they will see at B a section of one used for the great pedal pipe above it, an "open base" 16ft. long. It is a double-beat valve, T T, and therefore balanced. Enlarged sections are given above. The pedal when put down permits air to escape from the little bellows, which then pulls down the valve or pallet. Then air escapes from the trunk, and flows round to the foot of the pipe, as shown clearly enough in cross section. Now, it is no news to engineers that double-beat valves are not always quite tight, because it is not easy to seat two rigid valves rigidly connected on two rigid seats rigidly connected, and difficult as this may be in engine work, it is still more difficult in organ work, which is necessarily much less accurate. Mr. Wedlake solves the whole difficulty by making one of his valve seats K^1 elastic, and we believe that the same thing might be done with very considerable advantage with steam valves. It will exercise the ingenuity of some of our readers, perhaps, to find how this can be effected. Mr. Wedlake secures elasticity by making the aperture controlled by one of the valves larger than the valve, and securing leather round its edges. Thus, when the valve is opened the discs are drawn away from their seats. That which has a rigid seat at once opens, but the seat follows the other valve a certain distance, and aids the valve to open still further, and when the valve is being closed one meets its elastic seat before the other meets its rigid seat, and shock is entirely prevented. A modification of the same valve is also shown in Fig. 3, which explains itself. There are several other points about the organ which deserve notice, but for which we have not space. Mr. Wedlake also exhibited a most ingenious arrangement for fitting organ pedals to pianos, about which we shall have more to say at another time.

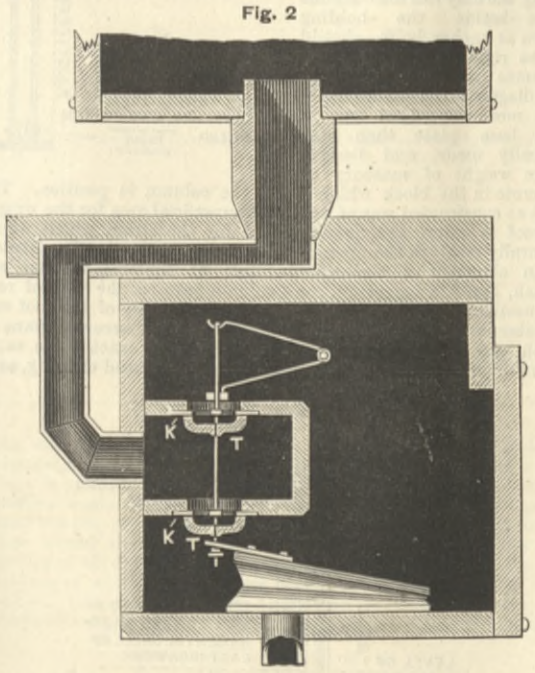
In conclusion, we may add that Dr. C. W. Pearce speaks in th highest terms of this instrument from a musical point of view that is to say, as regards quality and bril ncy of tone.

Fig. 1



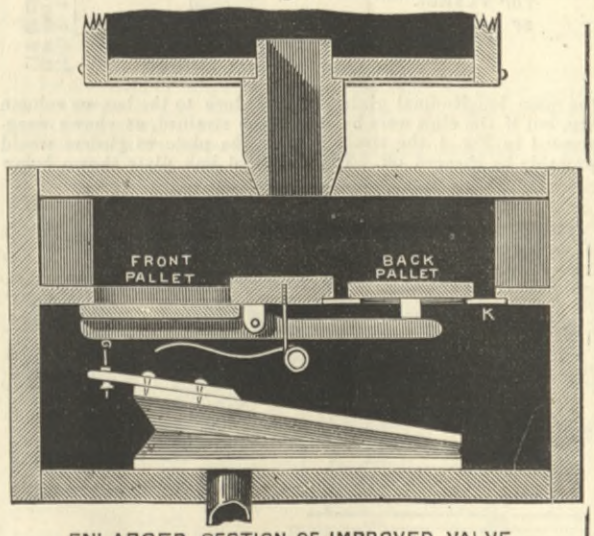
KEYS AND THEIR ATTACHMENTS TO VALVES IN PATENT PNEUMATIC CHAMBER A

Fig. 2



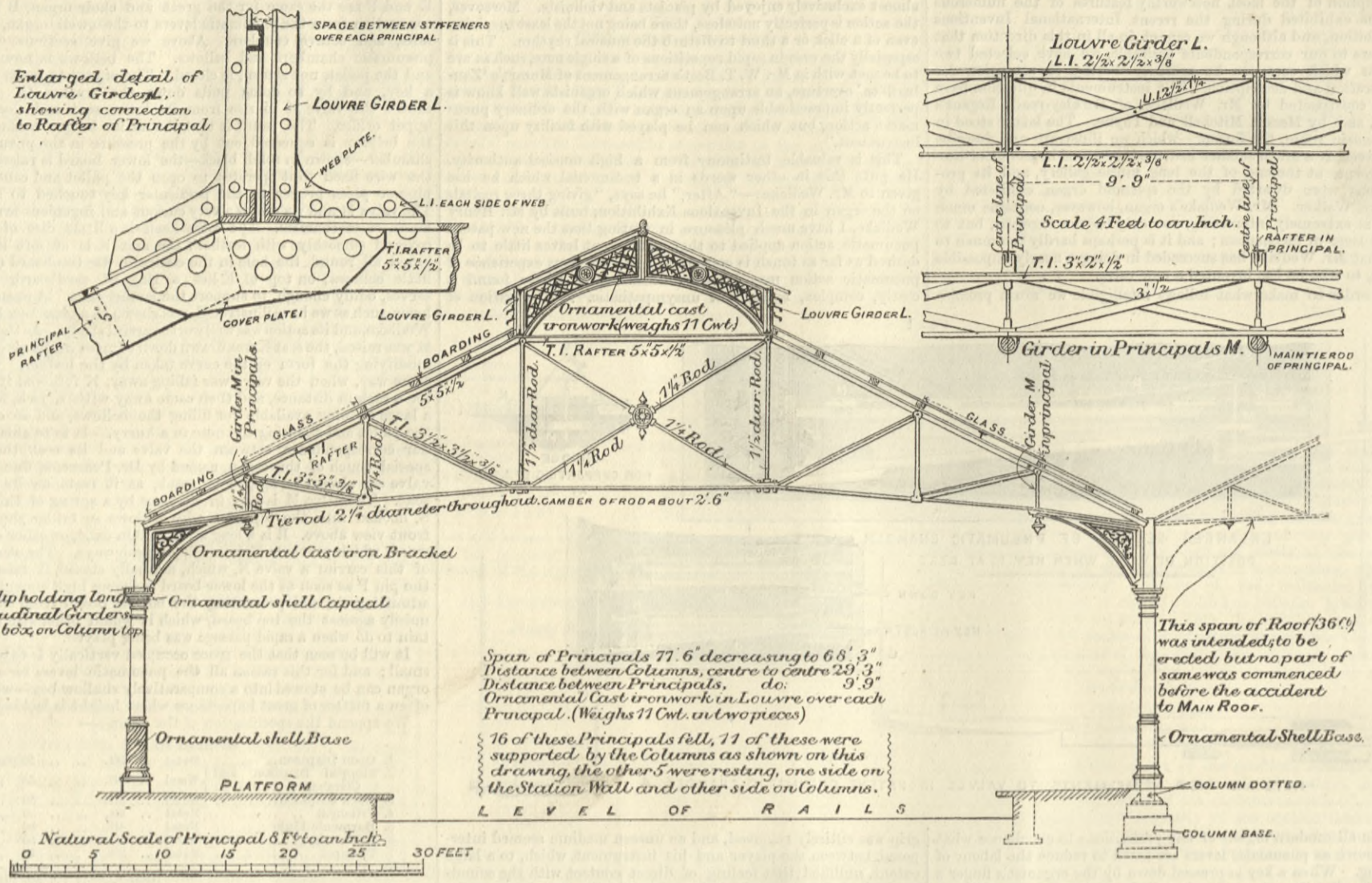
ENLARGED SECTION OF IMPROVED VALVE FOR PEDAL SOUNDBOARD AT B

Fig. 3



ENLARGED SECTION OF IMPROVED VALVE FOR PEDAL SOUNDBOARD AT B

THE FALL OF THE HUDDERSFIELD STATION ROOF.



HUDDERSFIELD STATION ROOF.

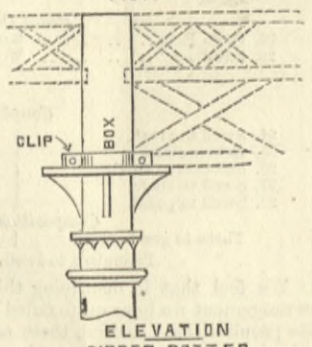
THE following is a report by Mr. W. J. S. McCleary, of Sunderland, on the construction and fall of the new roof during erection at Huddersfield station, 10th August, 1885 :—

All the ironwork of sixteen principals was erected complete, and the carpenters were busy fitting sash bars, &c., when the roof fell without much warning, killing four men and injuring several others. Having been engaged by one of the parties concerned to act on his behalf as professional adviser, I had the opportunity of examining all the details of the *débris* which were lying upon the site about a week after the accident. I also attended the coroner's inquiry. The following is a report which I prepared, and which I thought might be of some little interest to those in the profession :

The strains of the principals have been checked by a proficient man at this particular work.

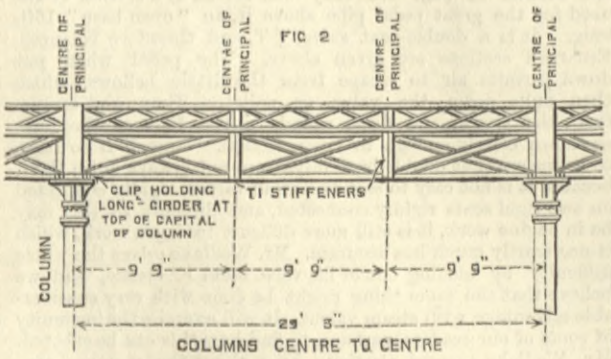
The columns were 29ft. 3in. apart centre to centre, 22ft. long, 13in. diameter at the base, and 11in. diameter at the capital. There was a square box or post above the capital 11in. diameter, which the longitudinal girders butted against. A considerable length of the lower portion of column was reduced in diameter to allow for the connection of an ornamental shell base. The base of column was secured to the foundation by means of four anchor or holding down bolts 1in. diameter—see sketch of column. The columns were held together with longitudinal girders constructed of light lattice ironwork; these girders butted against the box or column top, see Fig. 1. The box is a part, and cast in one piece with, the column. The longitudinal girder is constructed as a double lattice girder as seen in Fig. 2, not a design for strength, but more for ornament than

FIG. 1



ELEVATION
GIRDER DOTTED

FIG 2

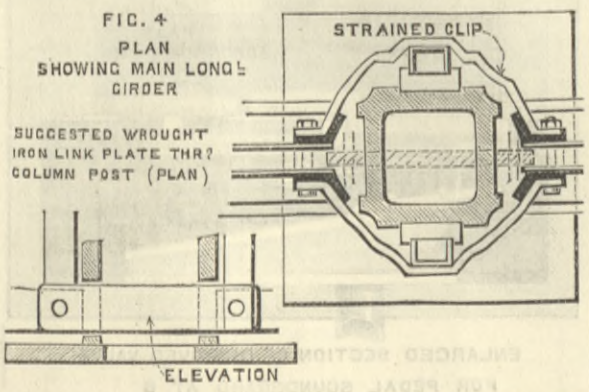


COLUMNS CENTRE TO CENTRE

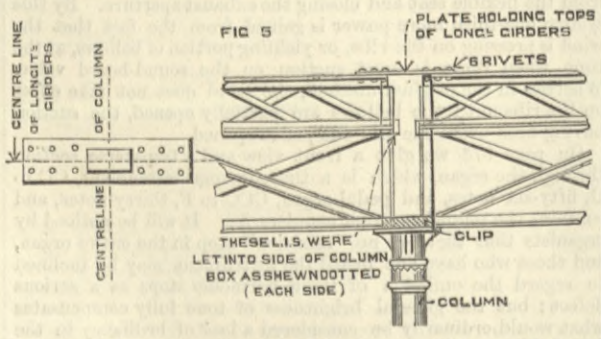
ELEVATION OF MAIN LONGITUDINAL GIRDER

use. This longitudinal girder holds the columns in position, and also takes the weight of the roof principals, there being two intermediate principals on the girder and also a principal over each column. This girder is connected to the column box by means of wrought iron clips on each side of the bottom of girder and at the top of the column capital. These clips are bolted together by means of two ⅞in. diameter bolts, and are forged to fit and suit the mouldings on the box at column top, Fig. 3; they are also shaped to take the bottoms of cast iron ornamental bracket, which is connected to main tie-rod of principals at each column. This form of clip, having so many angles, if stretched out would, of course, make a much longer strap than would be necessary to connect girder to girder around the box at the column top. This makes a connection of this form faulty, as there is no doubt there would be a tendency in a heavy storm to drag these clips out of shape, as shown exaggerated in Fig. 4. The safest plan to avoid this liability would have been a link plate right through the box and bolted each side with the bolts taking the clip, as shown in Fig. 4. There was a plate upon the top flange of longitudinal girders which had a hole in the centre taking the top of box on column top, and rivetted by six rivets through each end of top of girder, as in Fig. 5. The plates would, of course, serve to hold

the main longitudinal girders at their tops to the box on column top, but if the clips were by any chance strained, as shown exaggerated in Fig. 4, the rivets holding the plate to girders would probably be sheared off. The suggested link plate shown below



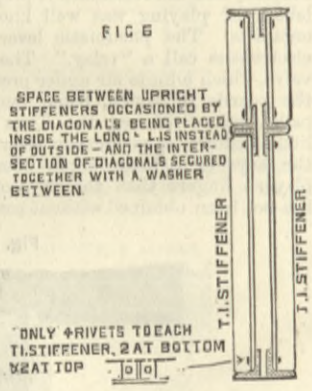
would prevent any chance of the clips being strained. The main longitudinal girders are not very substantially constructed considering the rigidness required to support two roof principals, as well as being the only ties of columns. The upright stiffeners



of these girders are composed of tee-irons, which would have added to the stiffness of the structure if they had been placed back to back and rivetted together instead of being some distance apart without even any packing plates to fill the space, which would have served as well as if they had been back to back. This section, Fig. 5, shows the space left between the stiffeners through the diagonals being placed inside the longitudinal angle irons instead of outside. The intersection of the diagonals could have been secured by means of a suitable thick washer equal to the thickness of the L.I. flanges.

This construction would have also brought the upright stiffeners closer together, and a plate the same thickness as the washer for diagonals could be inserted as packing, and the whole rivetted together, thereby forming a substantial stiffener, which is absolutely required for a girder of this description. These girders being the only ties the columns have—beside the holding down or anchor bolts—should be as rigid as possible. The columns having no longitudinal diagonal ties, should have had more superficial area in the base plate than was actually made, and besides more weight of masonry or concrete in the block which holds the column in position. The base as constructed was of sufficient superficial area for the weight of roof to carry, but not sufficient for the strain which would naturally result in the pressure from a heavy storm. Fig. 7 below is an elevation of the column base as constructed, and the sketch, Fig, 8, a suggestion for a column base for the style of roof in question. Another great defect in the stability of the roof was the absence of extra provisional strength of the screen columns at north end of roof. These end columns were exactly the same strength and design as intermediate columns, instead of being, as is

FIG 6



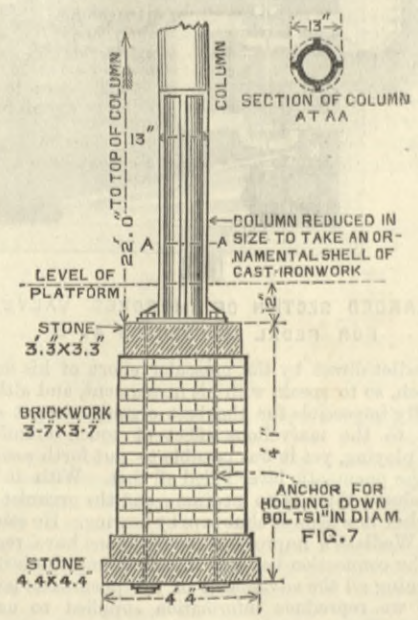
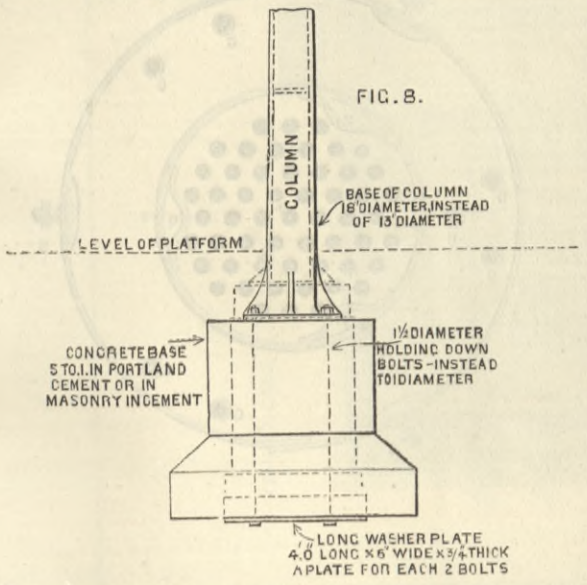


FIG. 7

usual for all large roofs, enlarged to at least double the strength of the others. At the coroner's inquiry the fact was mentioned in evidence that these end columns only supported half the weight of the intermediate columns, which is, of course, perfectly true as far as weight goes, but they not only have weight to take but are also the main abutment of the whole structure, and should therefore be of sufficient strength to withstand a strong sweeping wind along the whole length of roof. The end columns as constructed were not strong enough for the purpose, and should have been double as strong, or what would have served as well would have been a group of columns firmly braced together. One of these

columns was found to be defective after the fall of the roof; but this was not the cause of the accident, as an able witness—who was standing close to this column at the time—proved that he saw the roof collapse before the column was snapped. The defect found in the column was that the casting was "cold shut" nearly half-way around and for the whole thickness of the metal. This is a fault very liable to occur in the casting of columns so slender as those in question. The brackets or corbels which supported the ends of principals are not a very strong feature, although a most prominent one regarding the safety of the roof. These corbel brackets

FIG. 8.



are only secured to the longitudinal girder by means of two ¾in. diameter bolts of a considerable length having to go through the whole thickness of the corbel. Where the valley of the two roofs should meet there is not such a one-sided drag as there is upon the outside longitudinal girder, there being a corbel on each side of the valley girder, and these are linked together by a plate on each side of corbel, as shown dotted in Fig. 9. In the case of the outside longitudinal girders, the corbels are on the principal side only, and as the girders are not substantially stiffened there is a tendency to drag the girder over from the top. The connection of shoe of principal to top of corbel is made by simply dropping a small pin through a hole in both shoe and corbel; the hole receiving this

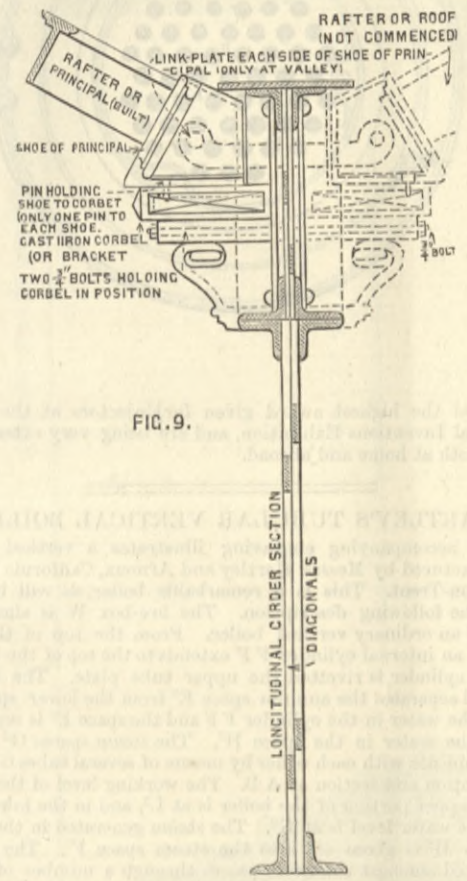
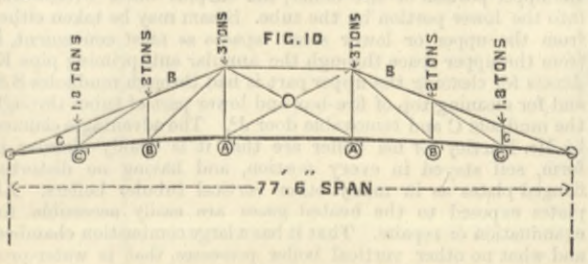


FIG. 9.

pin was not slotted, and there is no other allowance made for expansion or contraction of the principals, which in a design of this class is at times something considerable and under the circumstances would drag the columns very much, and probably when in time the pin got displaced from constant straining the principal shoe would slide off the corbels altogether. One of the most serious of all defects in the construction of the roof is the total absence of wind-ties or counter bracing, and also having no longitudinal tie-rods connecting the principal tie-rods together. If longitudinal tie-rods had been used nearly all oscillation would be

FIG. 10



prevented, and in my opinion the accident would not have happened, at least until such time as the weak principals began to rot and rust with age. In the evidence it was mentioned that had the boarding of roof been completed the principals would have been well held together; but I think it is understood by engineers that an iron roof should stand sufficiently strong in itself without, what I might call, the temporary help of timber and nails. At any rate it would be outrageous to leave a roof of this magnitude trusting to the boards to do the work of substantial iron straps. Even if the roof was entirely boarded over this would not be excusable, as timber rots sooner than metal, and has often to be renewed; besides this the roof had not much boarding, as a considerable area was to be glazed.

Strains of principals.—Span of roof, 77ft. 6in; centre to centre of principals, 9ft. 9in.; (assumed for convenience of calculation), 10ft.; weight per square foot of roof surface, 40 lb. This weight of 40 lb. per square foot is the usually assumed load for a roof of this description, and includes the weight of construction, possible load of snow, and resultant force from wind striking the surface of the roof at an angle of 10 deg. with a horizontal line. The different weights at the points of support amount to 3 tons at A^1, 2 tons at B^1, and 1·8 tons at C^1 respectively, as in Fig. 10. The reaction at each support arising from these weights amounts to 3 tons + 2 tons + 1·8 tons = 6·8 tons. The compressive strain in the portion B C of the main rafter of principal is 21 tons, and this part of the rafter being 10ft. long to its nearest point of support it would be advisable not to take more than 1½ tons per square inch for compression, therefore the area required becomes $\frac{21}{1\frac{1}{2}} = 14$ square inches, whilst the actual area of the T.I. rafter of roof as constructed was only (T.I. 5in. × 5in. × ½in.) = 4¾ square inches. This main rafter ought to have been constructed in one of the forms at Fig. 11. A stout channel iron would also have served as well as a built up rafter. The tensile strain of the tie-rod of principal A C for the re-action as above is 19 tons, requirin $\frac{19}{5} =$ 3·8 square inches; actual area of this tie-rod as built (2¾in. diameter rod) = 3·97 square inches. Therefore, this tie-rod would have been strong enough assuming that all pins, links, &c., at points of connection were in proper proportions.

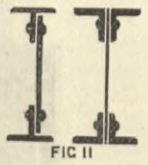
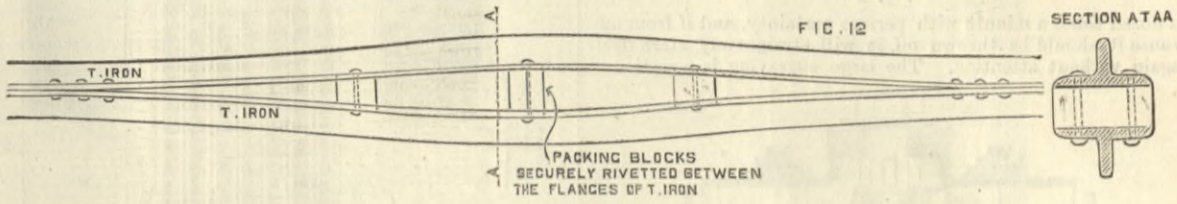


FIG 11

The portions of rod at A F, and more so at A J, Fig. 14, might have been less in diameter than 2¾in. in proportion to somewhat reduced strains in those parts. The strain in strut F G is 3¼ tons, and being so long—13ft.—and both ends hinged, it would be advisable not to put more than ½ ton per square inch, therefore requiring = 6½ square inches. The actual area of this strut T.I. 3½in. × 3½in. × ⅜in. was only 2·44 square inches. These struts are sometimes made of wrought iron solid drawn tubing, which is made in various diameter thicknesses, some of them are made of considerable thickness, and used for high pressure steam boilers. This section of strut is, of course, the best—and very far superior to the tee-iron as commonly used—it offers the same resistance for an application of forces in any possible direction. The strut in question—for so great a length—might with advantage, if preferred architecturally, have been constructed by two tee-irons, Fig. 12.

FIG. 12



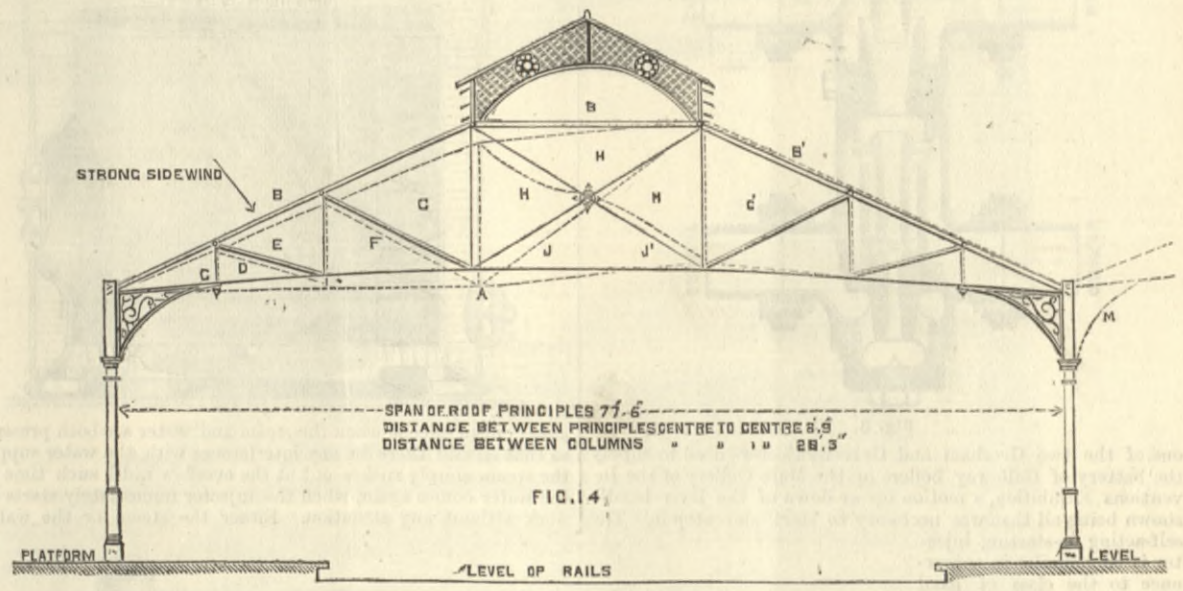


FIG. 14.

Similar and proportionate deductions apply to strut D E, the strain in which is = 2¾ tons.

Ties.—The strains in ties C D, E F, and G H, Fig. 14, are ¼ tons, 1¼ tons, and 2 tons respectively, requiring 0·05, 0·22, and 0·4 square inches respectively. The actual areas are 1·22, 1·22, 1·26 square inches respectively.

Rafter.—The compression in the part B E of the main rafter is 18 tons, and similar results as for part B C. Therefore, the action of rafter required for B C would, of course, also refer to part B E. The remaining part of the main rafter is compressed in B G and B^1 G^1 with = 16 tons, and in B H with = 10¼ tons. The length of these parts of main rafters B G 13ft. and B H 18½ft., and the strength that was provided in same was thoroughly out of proportion to the actual requirements, more so than even in the comparatively shorter piece B C, and the depth of the T.I., viz., only 5in., bears an excessively unfavourable proportion of the length 18½ft. of the strut. The before described suitable section for a rafter of this description ought to have been run over this part of the roof, and also strengthened with plates on top and bottom flanges, as in Fig. 13. The correctness of the strain of tons found by diagram in part B H can be proved by taking moments of all forces round the centre of the truss, viz., 6·8 tons × 38½ft. − (1·8 ton × 30ft. + 2 tons × 21ft. + 3 tons × 9½ft. = 137·28 foot-tons) .·. strain at centre = $\frac{137{\cdot}28}{12\text{ft. depth}}$ = 11·44 tons. This difference of about 1 ton arises from the small scale—4ft. to an inch—in which the diagram is drawn, which, as the result is arrived at by a step-to-step way, must necessarily bring an accumulation of inaccuracies. Everything stated above is based on the supposition that the roof is loaded in a perfectly uniform way—taken at 40 lb. on the square foot—that for the three loads of 3, 2, and 1·8 tons on the left side of the roof exactly corresponding loads occur on the right side of the roof, and in this state of perfect equilibrium the two diagonal rods in centre bay of principal, have, of course, no strain to take. The sketch diagram, Fig. 14, shows in an exaggerated degree by dotted lines the approximate effect that a strong wind from the left-hand side would tend to produce in the various parts of principal, and at a glance one can conclude what an excessively ill adapted design this principal is for resisting any strong side wind. Another roof was intended to be erected on side M, but no part of this was commenced at the time of fall of main roof. Under such altered conditions of loading the tie-rod H J—or the tie-rods H^1 J^1, when the wind is from the opposite direction—will be strained to a very considerable degree, which would help to greatly increase the tension in the parts A F, A D, and A C of the main tie-rod, and also throw increased compressive strain on strut F G and through tie E F on strut D E. A most serious weakening of the upper part of the main rafters B G B H B^1 G^1 would follow, as these parts, besides the increased compressive strain, would also have to bear—as there is always some amount of slackness in so many joints together—some part of bending strain; therefore to provide against strong winds from any direction, all parts of a principal built on this system should be considerably increased in area over the safe strains worked out. About 15 per cent. should be added to the safe areas to allow for all emergencies, including bad workmanship, &c. And it would be a safe plan to keep the louvre as low as possible—of course allowing for ample ventilation—so as to offer as little vertical surface for strong side winds to play upon. In the usual construction of roof principals, both rafters meet at the apex and form with the tie-rod a triangle, which is, of course, much stronger in itself than a collar-beam roof similar to the faulty design in question.

FIG 13

THE QUANTITY OF AIR REQUIRED IN THE VENTILATION OF BUILDINGS.*

By R. F. HARTFORD, Member of the Western Society of Engineers.

THE following is submitted as addendum to the interesting paper on "Ventilation of Stables," recently presented by Mr. A. W. Wright, member of this society.

The authorities consulted have been Pettenkofer, De Chaumont, Parkes, and others. From these we learn that a man at rest exhales for each pound of his weight 0·00424 cubic feet of CO_2 per hour. Under the same conditions he exhales 0·1189 cubic feet of air.

If n = number of miles a man may walk in one hour—or its equivalent in other work—then

CO_2 per pound of weight per hour
$$= 0{\cdot}000424 + 0{\cdot}00211\,n, \qquad (1)$$
and air exhaled per pound of weight per hour
$$= 0{\cdot}1189 + 0\,0591\,n. \qquad (2)$$

In the paper by Mr. Wright it is stated, on the authority of the Boston *Journal of Chemistry*, that "a horse or cow is said to have six times the breathing capacity of a man." This is the allowance commonly made in the ventilation of mines in Europe, where the animals used are about six times the weight of the average miner. If this allowance be a correct one, and experience indicates that it is, we may assume that the larger domestic animals have the same breathing capacity as a man per pound of weight.

Now let

V = cubic feet of air required in a given time,
T = time in hours,
W = weight of man or animal in pounds,
x = allowable excess of CO_2 above that in normal atmosphere

Then
$$V = \frac{(0{\cdot}00424 + 0{\cdot}00211\,n)\,W\,T}{x}. \qquad (3)$$

The best authorities have agreed that 6 parts of CO_2 in 1000 parts of air should be the maximum limit with good ventilation. The normal condition is about 4 parts of CO_2 in 10,000 parts of atmosphere, making for all practical purposes
$$x = 0{\cdot}0002. \qquad (4)$$

The average weight of a car-horse may be taken at 1100 pounds = W.

If it be assumed that in a stable a horse does work equivalent to $n = \frac{1}{4}$, the formula for stable ventilation becomes
$$V = 26235\,T, \text{ or} \qquad (5)$$
V = 437·25 cubic feet of air per minute.

If the horse be regarded as at rest, $n = 0$ and
V = 388·7 cubic feet of air per minute.

Formula (3) is of general applicability.

I am aware that my results look large, but I believe they are no larger than good ventilation requires, if the ventilating apparatus alone is relied upon to furnish the fresh air. That unknown quantity which may pass through cracks, &c., is not considered. Of course, the results change with the choice of a different value of x. Some authorities say the limit of CO_2, in good respirable air, may be 10 parts in 10,000 parts, making $x = 0{\cdot}0006$, and V = 7773 cubic feet of air per hour as necessary for one horse—about 26 cubic feet per minute more than Mr. Wright gives. But if the experiments of Drs. Angus Smith, Parkes, Pettenkofer, and De Chaumont have any value, this is much too low for good ventilation-

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Nov. 7th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,818; mercantile marine, Indian section, and other collections, 3264. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1262; mercantile marine, Indian section, and other collections, 204. Total, 16,548. Average of corresponding week in former years, 14,145. Total from the opening of the Museum, 24,423,323.

GAS ENGINE PATENTS.—We understand that the actions brought by Dr. Otto, for infringement of his English patent for the well-known Otto gas engine, may be expected to come on for hearing in the course of a few days. The first of these two actions, Otto *v.* Steel, is set down for hearing next Tuesday, and as soon as it is disposed of, Otto *v.* Sterne and Co., Limited, will, it is said, be taken. Both of these cases will probably excite considerable attention. We understand that the plaintiff has secured the services of the Attorney-General, Mr. Aston, Q.C., Mr. Horace Davy, Q.C., and Mr. Hemming, Q.C.; while for the defendants in both cases Mr. Moulton, Q.C., has been retained. Among the expert witnesses to be examined on behalf of the plaintiff's claims may be mentioned Sir Fred. Bramwell, F.R.S., Professor Dewar, F.R.S., Mr. Imray, and Mr. T. B. Lightfoot; and on behalf of the defendants. Sir William Thomson, F.R.S., Dr. Hopkinson, F.R.S., Mr. E. A. Cowper, M.I.C.E., and Professor Perry.

* From the "Journal" of the Association of Engineering Societies.

GRESHAM AND CRAVEN'S SELF-ACTING RE-STARTING INJECTOR.

THE injector has undergone many improvements since its invention, none more valuable than those intended to render its action certain. The injector which we illustrate carries this qualification to perfection, because it can be started and stopped

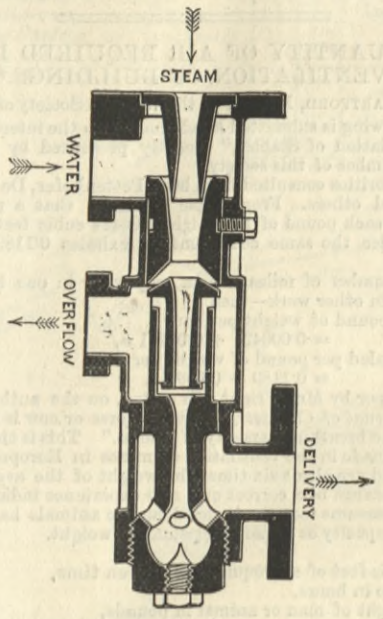


Fig. 2

a dozen times a minute with perfect certainty, and if from any cause it should be thrown off, it will straightway start itself again without attention. The large engraving is a section of

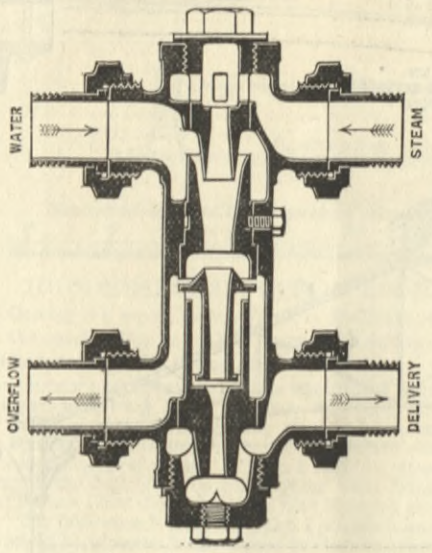


Fig. 3

one of the two Gresham and Craven injectors used to supply the battery of Galloway boilers in the Main Gallery of the Inventions Exhibition, a motion up or down of the lever handle shown being all that was necessary to start and stop it. The self-acting re-starting injector is very similar in appearance to the class of fixed nozzle injectors made by Messrs. Gresham and Craven for many years, consisting of —(1), a steam cone; (2), a water or combining comb; (3), a delivery cone. The only difference between these injectors and the one we are about to describe and illustrate is the dividing of the water cone into halves at about the centre of its length, leaving the smaller end of this cone free to slide to and from its larger end, which is fixed into the outer casing of the injector by means of a set screw. Its action may be described as follows: Steam is turned on and rushes down the steam cone and through the large end of the water cone and out at the point where this cone is divided, creating a vacuum in the water chamber; the water then rushes up into the chamber and surrounds and condenses the steam, which, in the form of partially condensed steam and water, leaps across the opening between the larger and smaller ends of the water cone; this jet creates a vacuum in the overflow chamber, when the pressure of the atmosphere at once forces the smaller end of the water cone—which is free to slide—up to the larger end, thus closing the space between the two halves of the water cone and making a continuous water and combining cone as in the ordinary injector. The combined jet of steam and water then passes out at the ordinary overflow, until the velocity is sufficiently great for it to enter the delivery cone and pass forward into the boiler. The automatic action of this injector consists of the opening and closing of the space between the two halves of the water or combined cone, this space being always open except when the steam and water are both present, so that should there be any interference with the water supply the steam simply rushes out at the overflow until such time as the water comes again, when the injector immediately starts to work without any attention. Either the steam or the water may be turned on first in starting this injector. Fig. 2 shows the standard pattern of new injector, with flanges. Fig. 3 shows the standard pattern of new injector, with screwed unions. The cones can be easily taken out and cleaned without breaking any pipe joints. These self-acting re-starting injectors have received the highest award given for injectors at the International Inventions Exhibition, and are being very extensively used both at home and abroad.

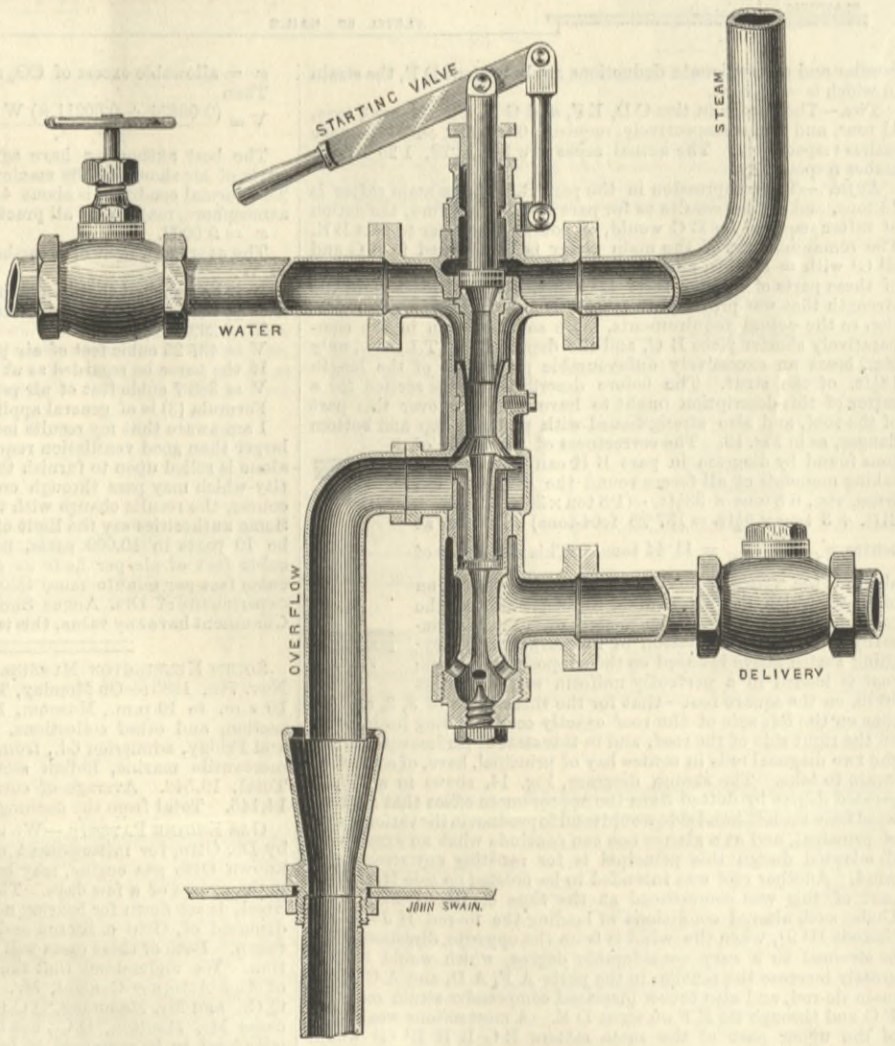
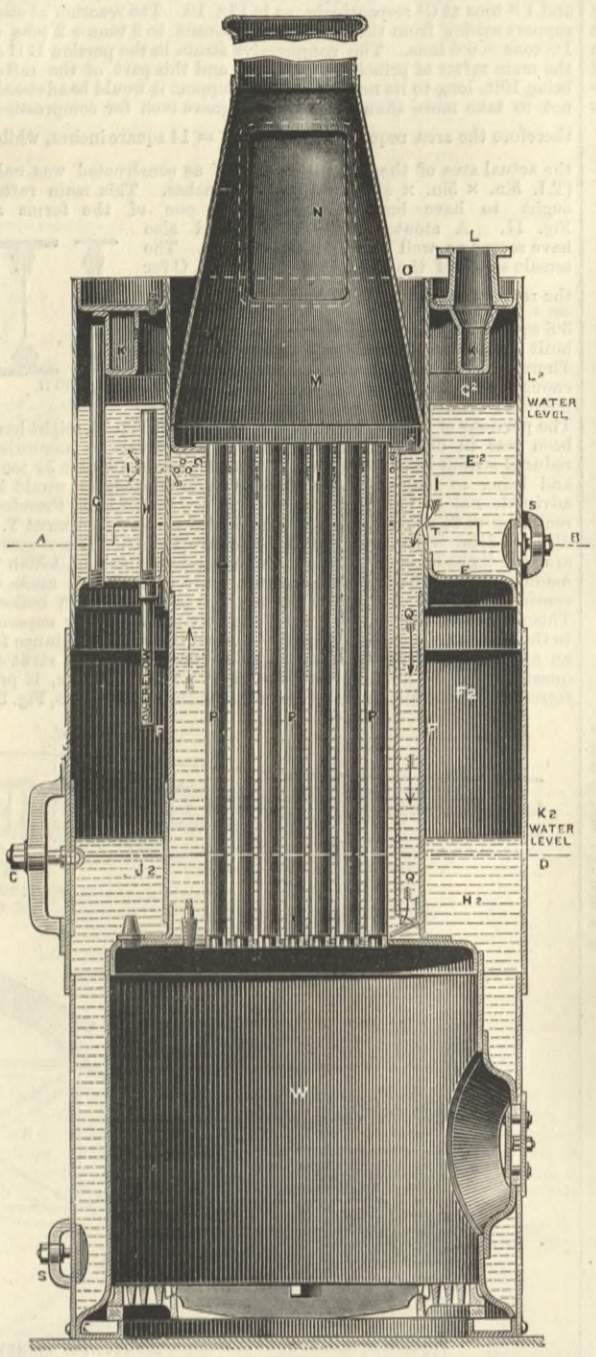
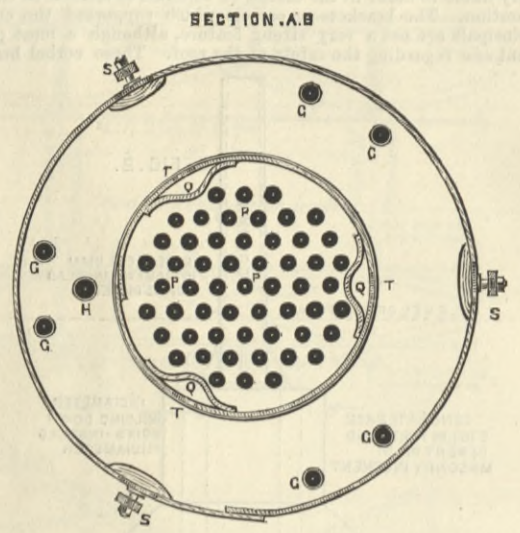
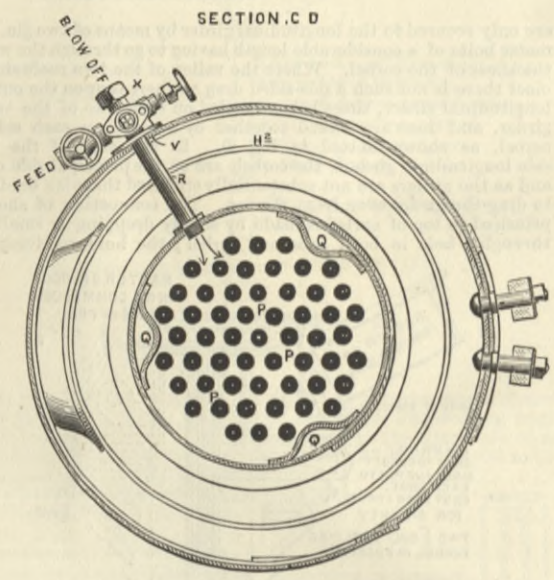


Fig. 1—SELF-STARTING INJECTOR.

HARTLEY'S TUBULAR VERTICAL BOILER.





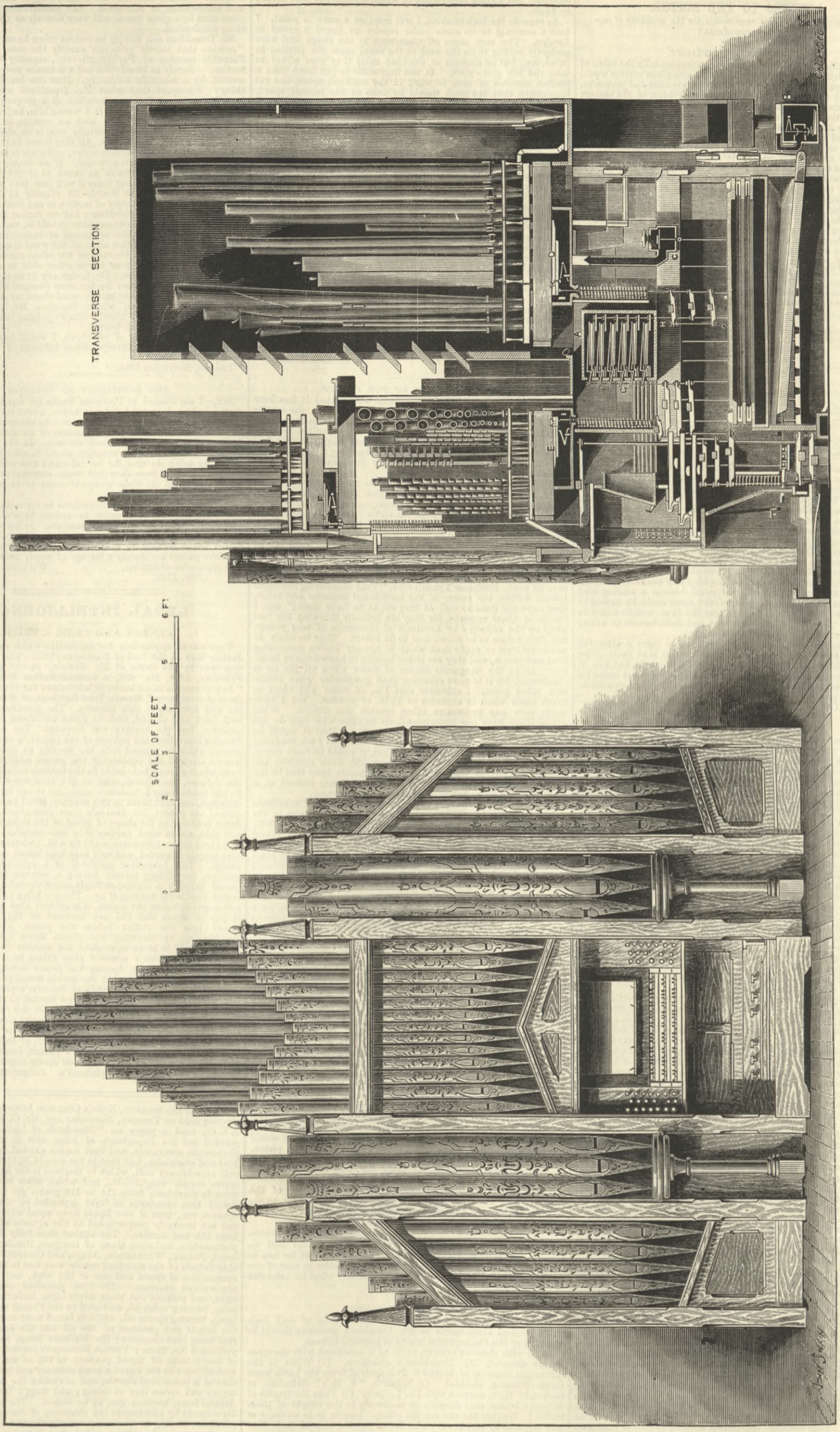


HARTLEY'S TUBULAR VERTICAL BOILER.

THE accompanying engraving illustrates a vertical boiler manufactured by Messrs. Hartley and Arnoux, California Works, Stoke-on-Trent. This is a remarkable boiler, as will be seen from the following description. The fire-box W is similar to that of an ordinary vertical boiler. From the top of the fire-box W an internal cylinder F F extends to the top of the boiler; in this cylinder is rivetted the upper tube plate. The flanged plate E separates the annular space E^2 from the lower space F^2. Thus the water in the cylinder F F and the space E^2 is separated from the water in the space H^2. The steam spaces G^2 and F^2 communicate with each other by means of several tubes G shown in elevation and section at A B. The working level of the water in the upper portion of the boiler is at L^2, and in the lower portion the water level is at K^2. The steam generated in the lower portion H^2 is given off into the steam space F^2. The steam generated amongst the tubes passes through a number of small holes I I I into the water at E^2 whence, it rises into the steam space G^2. The water returns from the water space E^2 to the top of the fire-box through holes T into passages formed by channel plates Q Q Q, whence it returns in the direction indicated by the arrow to the top of the fire-box. Feed water is forced in the inner cylinder through the tube R or into the space H^2 at V, the tube R serving also as a blow off pipe. An overflow pipe H communicating between the two steam spaces may be used, whereby a constant feed may be maintained into the upper portion of the boiler, the surplus water overflowing into the lower portion by the tube. Steam may be taken either from the upper or lower steam spaces as most convenient, if from the upper space through the annular anti-priming pipe K. Access for cleaning the upper part is had through mudholes S S, and for cleaning top of fire-box and lower part of tubes through the mudhole C and removable door J^2. The advantages claimed by Mr. Hartley for his boiler are that it is wholly circular in form, self stayed in every portion, and having no distorted flanged plates as in many other vertical tubular boilers. All plates exposed to the heated gases are easily accessible for examination or repairs. That it has a large combustion chamber, and what no other vertical boiler possesses, that is water-protected vertical tubes of sufficient length to abstract all useful heat from the gases, and, having also large steam spaces, it must be economical. That it has an absolutely ensured circulation, the currents of flow and return being each entirely separated and independent of the other. That there must be less priming than in other vertical boilers, because there is nearly eighty per cent. more area of water surface for delivering steam than in any other boiler of equal diameter, also because in the upper portion the steam is discharged horizontally below the level of the water, and being distributed rises easily to the surface without excessive ebullition. That being accessible and vertical the tubes may be of small diameter, hence great heating surface may be obtained in small space. That the chimney is central, thus obviating the inconvenience of outside chimneys used in many other multitubular vertical boilers. We understand that this boiler has undergone a severe test, extending over nine months, with most satisfactory results.

WEDLAKE'S ORGAN, INVENTIONS EXHIBITION.

(For description see page 369.)



LETTERS TO THE EDITOR.

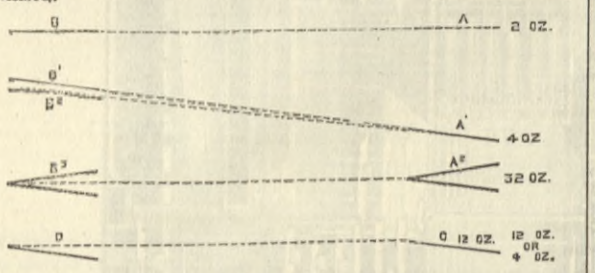
[We do not hold ourselves responsible for the opinions of our correspondents.]

THE PROBLEM OF FLIGHT.

SIR,—While attempting to determine experimentally the value of the purely frictional resistance which a smooth plane surface would meet in its passage through air at different velocities and pressures, I discovered a method of presenting the problem of the soaring flight of birds which is here given.

Suppose the forces to act with the same velocity in a horizontal plane in the different cases, that the surface a lies in the plane of the force and is of the same weight as the air it displaces, and that a force of 2 oz. will carry it to b. Suppose, also, that the motion is uniform, acceleration having terminated. If the same force were applied in the plane of a', then a' would go to b'; but as a' is inclined, it will pass to b''. From a' to b' there is skin friction only, but from a' to b'' there is slight condensation and other disturbances requiring more pushing force. We will employ double the amount, using 4 oz. from a' to b''.

It is evident that no amount of horizontal force would carry a' level, but by putting a similar plane above it we have a'', and a horizontal force will carry the two level. We will suppose this double plane to meet four times as much resistance on each side as from a' to b'', when a push of 32 oz. would be needed to carry it to b''. The 32 oz. of force flows to the rear in the disturbed air, but under no circumstances could a'' make a soaring bird. If all the force were collected and applied in the rear expansion, it could do no more than conserve the initial impulse, and all cannot be utilised.



We will now take $\frac{1}{2}\ a''$, and introduce another force acting at right angles to the horizontal one, by adding 12 oz. of weight to the plane. It is evident that when c, weighted with 12 oz., is driven to d, there is the same force passing to the rear as in $\frac{1}{2}\ a''$. The same work is done on the air, the condensations are the same, and all the air disturbances are the same.

The question now arises, Does c require a 16 oz. push or a 4 oz. push? It seems that the 12 oz. is put in the place of the neutralised pressure of the two planes, and that a 16 oz. push is demanded by the conditions of the case. If it be demanded, c could never become a soaring bird; for, like a'', it would need all the rear force. If, however, the moment the 12 oz. is added to c the rear push falls from 16 oz. to 4 oz., then the latter could become a soaring bird with ease, as more than one-half of the force could be wasted in obtaining the level factor. In such case the 12 oz. weight added to c would be putting the condensations and disturbances in excess of a' to b'' into the air, and not the rear push.

I freely admit that, if 16 oz. be required to carry c after the addition of the 12 oz., my explanation of soaring is at fault. The birds are still in the air waiting analysis. If, however, but 4 oz. is needed, c is a falling body doing work on the air without losing its energy of position, and the atmospheric spaces all about us contain mechanical possibilities hitherto undreamed of.

Chicago, October 27th. I. LANCASTER.

TRADE UNIONS AND PIECE-WORK.

SIR,—You will confer a benefit on engineer employers in London if you will open your columns to a thorough discussion of the rules of the various Trades Unions relating to piece-work. These rules are prepared and revised from time to time without reference to the masters, who, in my opinion, should be consulted in matters that affect their interests equally with the men, for the benefit of the trade of the country. Masters in London are more affected by the Trade Union rules than in any other part of the country. Very few really skilled workmen for the various engineering trades can be obtained at short notice in London who do not belong to their respective Unions. I can remember the time when the Unions did not raise any objection to piece-work. What is the state of the case now? I have before me the Book of Rules of the Amalgamated Society of Engineers for 1885, revised at Nottingham, May 25th, 1885. I find it stated at page 105, that "the Society considers piece-work one of the greatest evils it has to contend with, and it therefore becomes the duty of every member to permanently dispense with piece-work whenever an opportunity presents itself, and certainly to prevent its introduction into any shop or district where it does not exist." The penalty for the first offence is a fine of 20s., and for the second exclusion from the club. I am not one of those who object to Trades Unions because they are Trades Unions; on the contrary, I consider they do great service to both masters and men, as long as they confine themselves to legitimate objects.

The first point to be considered is, if the power of getting work done "piece-work" is an advantage to the masters. Speaking for myself only, I have no hesitation in saying "yes" to this question. I find on an average that work costs 10 per cent. less if done piece-work than by day-work. Moreover, you save indirectly in many ways. Is piece-work an advantage to the men? This question is more difficult to answer. I have never yet come across a first-class workman who was unwilling to take piece-work. If he would not do so, it was solely on account of the Club rules. He can earn more money, and is more his own master—can rest when he feels tired, without the fear of getting into trouble with the foreman or master for so doing. Nothing is so absurd as to expect a man engaged in severe physical labour never to require a rest from morn to eve; and yet, if you find a man sitting down and doing nothing, you naturally blame the man or the foreman for not looking after him. Piece-work enables masters to tender with more certainty and closer cut, and must therefore bring work to the district where it is allowed. I have asked scores of intelligent men to explain to me on what grounds they or the Unions can object to piece-work. The only answer I can get is, that it is thought that piece-work employs fewer men, and therefore prevents those who are in want of work from getting it.

The rules of these Trade Unions are not all alike. The Society of Amalgamated Engineers includes smiths, fitters, turners, pattern makers, millwrights, planers, borers, slotters, mechanical draughtsmen, brass finishers, and coppersmiths. Of these trades the smiths are probably the only body who work piece-work to any extent in London. The moulders, boilermakers, and shipwrights have each their separate society, whose rules vary somewhat. The moulders are not allowed to take piece-work, unless it has been in use in the shop where they work before these rules were introduced. The members of the Boilermakers' Society take work by the piece for new work, but not for repairs. With the shipwrights in London piece-work is almost universal; but as a set-off against this virtue they have some very arbitrary customs. For instance, if men working on the outside of a ship have to leave off work through bad weather, then those inside, who may be under cover, must leave off work also. Shipwrights ordered to leave one ship, and go to work on another boat, must first be discharged by the firm who employs them before they can do so. They must not work overtime if others of their trade are out of work, and wish to be employed. They consider themselves entitled to choose their own leading hands, and not those their masters may wish, perhaps, to place in that position. I do not say that these rules are always enforced, but I know many cases in which trouble has been caused by them.

As regards the boilermakers, I will mention a case in point. I took a contract to do some boiler repairs on board a vessel in London. The men came off piece-work in the shops and were perfectly willing to do the work at the usual rates for putting in tubes, &c., but on account of the Club rules they were afraid to take the job piece-work. It was impossible to put more than a limited number of men to work in the confined space, and yet imperative that the work should be done at the utmost speed. The only alternative was to put the men on time and a half, and trust to their honour to work as if they were on contract. I am happy to say that the work was done for less than the rates offered. But does not this seem a humiliating position for both masters and men to be placed in? In some cases of piece-work the Club does good, by compelling men to return to work and complete contracts which they have left without due cause. I fancy this is done entirely with a selfish motive, to prevent the men coming on the funds when out of work, and not through any philanthropy or sense of justice towards the master. The law, in fact, would do as much, only with more trouble and expense. I will conclude by asking if it is legal for these so-called friendly societies to fine and expel members—who probably join for the sake of the legitimate purposes of the society—who exercise an Englishman's right of freedom of contract. If this practice is within the law, then let public opinion assert itself, and insist that it will not allow trade to be lost to us by such suicidal and senseless folly. At ordinary day work the British workman does not as a rule earn his excess wages over the Belgian or German, but at piece-work he can beat all the world, except the American, in the amount of work done in a given time, and consequently the profit to his employer and advantage to himself of freedom of contract is obvious. If necessary, employers must get a Bill introduced into Parliament making any interference with freedom of contract illegal. Might not the Royal Commission on Trade take this matter up with advantage to

A LONDON MASTER.

November 6th.

THE LOCOMOTIVE OF THE FUTURE.

SIR,—The history of the steam engine shows that it has been improved by men who have thought and reasoned on the matter giving their ideas publicity, and then others have been induced to turn their attention to the subject, and good has resulted from it. I will follow in their footsteps as a practical workman who has had forty years' experience, and I trust something to say that will lead to a new departure that will make the steam engine more safe and economical.

My experience tells me that steam can be used continuously over again, and between seven and eight million foot-pounds of useful work got out of each pound of coal consumed. I have studied the nature of heat, water, and steam in all its forms, and am prepared to discuss the matter fully and clearly. I have also to say that the present engines could be made to do more work with at least 50 per cent. less fuel—for instance, I am sure I could make one of Ramsbottom's engines, which only weigh about 27 tons, take a train of coaches weighing 150 tons fifty miles an hour with 15 lb. of coal per mile, or less than one-half what they are doing at the present time. Professor Tyndall says, "That considering the information within the power of the mechanical engineer and artist, they have not done so well as they ought to have done;" and I concur in those remarks, for they are literally throwing the fuel away on the railways by hundreds of thousands of tons yearly, and they refuse to be shown how to do better. They certainly do not know how to apply that which is already known concerning heat and steam, and they are either lacking in knowledge or indifferent as to the dangerous nature of water when all the air is eliminated, for it is more explosive than gunpowder when ebullition takes place. I calculate that 1 lb. of water will exert as much force when it explodes as 1½ lb. of powder. Yet I have never seen any precaution taken against this danger. What explanation have our superintendents to offer why they do not apply a remedy? The above leads me to think that it would be more safe to have more air in our boilers—and this I am confident of, whether it would be more safe or not, it would be more economical; for by using air I would do away with both injectors and pumps, and put the water into the boilers hotter than that in the boiler, by heating the water with the exhaust steam instead of it going into the air or before it went into the condenser.

In locomotives I would take the blast pipe away and substitute a jet from the exhaust steam after it had heated the water in the holder, which would have to be strong enough to bear 300 lb. pressure. I would also make the pistons into a brake to retard the train, and thus get about one-half the force of the train for useful work. To wit, force the water into the boiler and start the train with; also to clear the rails instead of sand, for sand causes a deal of friction, and in stormy weather the wind blows it off the rails or blows it away before it gets to them; but a jet of hot air would go right to the mark at once, and so clear the rails that the wheels would not slip, and this would cost nothing on a locomotive. If the air was compressed on the top of the water it would require less heat to boil it, and when heat was applied the dirt and other matter it contains would drop to the bottom of the holder, and this would prevent scaleing in the boiler. This is what I recommend with the present engines, without altering them only just to suit the purposes that I have suggested.

Then I have to offer a few remarks on firing up the locomotive. Instead of dropping the fires when they have done their work, I would utilise the heat by putting it into an engine that was going out. I would then fire the engines up with a Bunsen flame about one hour before going out time, and thus save 4 cwt. of coal a day for each and every engine. I have not fired all my shot yet, I have a little left for another day.

What I conceive to be the best plan of a steam engine is to have the cylinders as long as possible and small in diameter as could be got to do the work. I would surround them with a hot medium, then put an exhaler to be worked by the exhaust steam, turn the steam through some water, and when it rises above the water send it through some hot tubes, and so impart a sufficient amount of heat to do the work. I would work the steam full force the whole length of the stroke, and thus obtain as much power as possible out of the engine. The steam extractor would act like a condenser by causing a dilated space behind the piston. An engine on the above principle would do more work than two of the ordinary engines of the same size, and exert a force of 4-horse power for each pound of coal consumed.

The above is a good description of the steam engine of the future. If I am encouraged I will in future show how to do without smoke, and the best form of steam raiser.

34, Chetwode-street, Crewe, BENJAMIN BAGSHAW,
November 6th. Railway Engine Driver.

[We make no comment on the foregoing letter, except that we think it advisable to let the "working man" say what he has to say. We can all learn something from such a letter as that of our correspondent, although it may not be precisely what he intended to teach.—ED. E.]

DR. LODGE'S MECHANICS.

SIR,—It is greatly to be regretted that a man of such high mathematical attainments as Mr. Donaldson possesses should be ignorant of the fundamental truths of physical science,

I will with pleasure answer, as far as is consistent with the space at my disposal, Mr. Donaldson's questions. (1) What is the derivative meaning of inertia? It is derived from the Latin word *iners*—inactive, slothful. (2) What is "Φ. Π.'s" definition of motion? He is content with Dr. Lodge's. (3) Does the inertia of different bodies vary directly or indirectly as the weight of these bodies? Neither the one nor the other. Inertia is in no sense or way affected by *weight;* it varies directly as the *mass* of the bodies. (4) Does the acceleration produced in different bodies by a given moving force in a given time vary directly or indirectly as their weights? Neither one nor the other; weight has nothing to do with acceleration in this sense. The acceleration produced in a given time by a given cause will vary directly as the *mass* of the thing accelerated.

Mr. Donaldson can hardly be serious when he says that he is of "opinion that inertia possesses exactly the same property as a Parnelite member of Parliament—viz., capacity for obstructing motion." Surely so loosely-worded a sentence never was seriously written by a scientific authority. How can inertia possess anything? I suspect that what Mr. Donaldson means is that he regards inertia as the manifestation of a property possessed by matter for resisting motion. If I wrong him, he has only his own loose English to thank. But such an opinion is opposed to all physical truth. Matter is entirely unable to obstruct or resist motion of any kind in any way. All that it can do is absorb it, so to speak, just as a sponge absorbs water, and gives it out again just as the sponge does when it is squeezed. If we double the size of our sponge it will hold just twice as much as it did before. In the same way, if we double our mass it will just take twice as long or twice as much force to double its velocity as it did before. Momentum is the "quantity of motion in any body." All authorities are agreed on this definition; but we cannot have quantity of anything *in* a body without capacity to hold it, and therefore I say that inertia is simply the reciprocal of momentum, and means "capacity for motion;" this sense of the word is a good one, for it entirely does away with the notion too often conveyed by inertia, viz., that matter is in some way or other able to resist being put in motion, which it is not. Dr. Lodge saw fit to think my suggestion a good one. Whether he has since changed his mind or not I cannot tell, but he has not said a word about my definition in his "Elementary Mechanics," which, therefore, Mr. Donaldson may read with safety and, I should think—judging from his letter of the 3rd inst.—with much benefit.

For a full expression of my views, I would beg to refer your correspondent to the correspondence columns of THE ENGINEER for April 3rd, 1885.

London, November 10th. Φ. Π.

THE EFFICIENCY OF TURBINES.

SIR,—I am obliged to Professor Smith for repeating the information, which I regret I did not notice, about the letter m—viz., that it is a numerical fraction or ratio. In the second paragraph, however, he states that it is a fraction of an area; but surely a fraction of an area must be itself an area. In the final paragraph he further states that the equation would in some respects be simplified by using A_i and A_o for inlet and exit water sections. If the word section here does not mean sectional area, what can it mean? Are A_i A_o then sectional areas to be substituted for m_i m_o ratios?

Professor Smith raises no objections to my criticisms, and does not either answer, or promise to answer by-and-bye, the other questions relating to his final equations. Is his silence, then, to be taken for an answer in the affirmative? If this be so, Professor Smith ought frankly to acknowledge that the whole contents of his three papers are simply a farrago of wordy nonsense.

Westminster-chambers, WILLIAM DONALDSON.
Nov. 11th.

LEGAL INTELLIGENCE.

JENSEN AND TRIER *v.* SMITH.

THIS was an application for injunction which came before Mr. Justice Kay on the 2nd of November, 1885. The patent in question was in the name of Mr. Jensen, patent agent, dated 1st February, 1878, No. 427, a communication from Stauffer for "Improvements in oil-boxes or lubricators for revolving and other parts of machinery," Messrs. Trier Brothers, of Westminster, being the sole licensees in this country. The invention is largely used both here and abroad, and its great usefulness was proved and admitted, but the novelty was disputed. The now well-known Stauffer lubricator, the subject of the patent, is used for semi-solid grease, which is pressed into the bearing by gradually screwing home a screwed cap containing the grease against a flat surface, from which a small hole leads to the bearing to be lubricated. For the defence, one witness, who at the time was a boy, stated that he had made many lubricators according to one form shown in the drawings, and sold them in this country, about twenty years before date of the patent, but the sale soon discontinued; nor was evidence tendered in the shape of proof of the thing itself thus made and sold, nor to what parties they were supplied. Evidence was also given that a lubricator made by a M. Delettrez, of Paris, had been largely imported and sold here long before date of plaintiff's patent. This lubricator consisted of a cylinder fitted with a shallow, easy-fitting piston, having a screwed piston-rod, which passed through a correspondingly screw-threaded lid, and had a crutch handle for turning it by. The cap being unscrewed and the grease put in below the piston, it is evident that when the piston is put in again and the cap screwed on the grease may be forced into the outlet below the piston, and thence into the bearing, by screwing the piston down upon the grease. This was held to be an equivalent for another form of plaintiff's lubricators, in which a screwed plug fitting in a screwed grease container was used for forcing the grease down. On the other hand, it was contended that the grease would go past Delettrez's piston, while the screw threads of Stauffer's plug rendered this impossible, partly because each screw thread, as it were, formed a lute for the next one, and partly because the resistance against leakage past it of a fine screw thread is many times greater than that afforded by a piston, unless the latter is very deep or is packed. Collinge's hinge, patent No. 4617, of 1821, was also held to anticipate this part of plaintiff's patent, because a screw plug intended as a mere stopper for an oil cavity might to some extent be used in the same way as plaintiff's. Judgment for defendant, with costs.

ENGINEERING SOCIETY, KING'S COLLEGE, LONDON.—At a general meeting held on Tuesday, November 3rd, Mr. C. H. Wordingham, A.K.C., read a paper on "Standards of Light." The author pointed out the importance of being able to measure physical phenomena accurately, and that means existed for doing this in heat and electricity, but that in the case of light there was as yet only an arbitrary unit, which in England is the light afforded by a sperm candle weight ⅛ lb., and which after burning for fifteen minutes must burn from 114 to 116 grains per hour. He mentioned that standards of light depended on the law of inverse squares, viz., that if two lights have equal effects, their intensities are inversely proportional to the squares of their distances from the test surface. The author then fully described various photometers, including those of Bougner, Rumford, Vernon Harcourt, Bunsen, Wheatstone, Arago, and Gorham, and pointed out that defects of the standard candle were due to the variety of the composition of sperm and size of the wick, and the variation of atmospheric pressure. He then described other standards of light, and pointed out their advantages, including:—The Carcel lamp, burning colza oil, and used as the French standard; Keates' lamp, burning sperm oil, which is found more constant than colza, the height and pressure of the oil and the composition of the fuel being kept constant; the Methven lamp, an Argand burner yielding a 3in. flame; Vernon Harcourt's pentane flame, consisting of one volume of liquid pentane to 600 of air, burning with a conical flame at the top of a brass chimney and giving a light equal that of a theoretical candle, and obviating the necessity of a gas supply and errors due to wicks; and Sugg's 10-candle lamp, an Argand lamp, burning gas, to be tested. The author concluded his remarks by alluding to the discovery of the action of light on selenium, tending to decrease its electrical resistance, and described experiments made with a selenium cell under varying circumstances.

RAILWAY MATTERS.

THE Wolverhampton Town Council has this week sanctioned the use of steam power on the lines in the borough of the Dudley, Sedgley, and Wolverhampton Tramways Company for a period of six months from the 15th December.

THE Minnesota and North-Western road has completed its bridge across the Mississippi River at St. Paul. Work was commenced the 1st of last December, the piers being, the *Railway News* says, sunk through the ice; and it has been finished in the remarkably short time of ten months. The bridge is of iron, 1825ft. long, and the draw span, 412ft. long, is the largest and heaviest in the world.

AN English engineer, well known in railway circles, says that American bridge builders are, for bridges of all ordinary sizes, completely cutting the English builders out of the market for Canada and other colonies, and this is chiefly due to the baneful effects of Board of Trade rules, which, instead of improving, have caused the depreciation of our bridges, by the use of the common material which will stand the four and five tons tensile and compressive strains.

THE prolonged arbitration case between the Great Western Railway Company and the London and North-Western Railway Company respecting the boating of traffic on the Worcestershire side of the South Staffordshire district, has resulted in a decision in favour of the London and North-Western Railway Company. The case involved a large sum of money, as the Great Western Railway Company sought to require the London and North-Western Railway Company to boat certain goods traffic to several stations, but the traffic will be continued as formerly.

THE *Gleaner*, speaking of Jamaica, says:—"On general principles, we heartily support an extension of railway facilities as far as practicable, because, apart from being a vast benefit to the island, they will afford employment for the labouring classes, and prevent the bone and sinew of the country leaving for Colon, where labourers speedily become moral and physical wrecks, and return to their homes with broken constitutions to live by preying on society. As pointed out by us some time since, the extension from Porus to Montego Bay can be built in sections by Jamaican contractors."

THE following telegram, dated November 8th, has been received from Mr. Sandford Fleming, C.E., C.M.G., late Engineer-in-Chief of Dominion Government Railways, by the president of the Canadian Pacific Railway:—"First through train from Montreal arrived at Vancouver. Most successful journey. Average speed, including ordinary stoppages, twenty-four miles per hour. Before long quite possible to travel from Liverpool to Pacific by Canadian National Line in ten days. Physical difficulties have been overcome by gigantic works skilfully executed with marvellous rapidity." It is, however, said that a good deal of work has been done in a temporary way so as to get trains into work.

A SYNDICATE has been formed for the purpose of raising funds to build a line of railway which is to connect the wealthy mineral districts of the north of Western Australia, which lie in the vicinity of Champion Bay, with Perth the capital, and Fremantle, the chief port of the colony. It is to commence at Guildford, a station on the existing Government line—the Eastern Railway, distant from Perth about eight miles and from Fremantle about twenty miles, and proceed *vid* Gingin, Victoria Plains, Upper Irwin, and Dongarra to a junction at or near Walkaway (Greenhough Flats) with the proposed southern terminus of the Government line—the Northern Railway—thus tapping the Swan, Gingin, Chittering, and other important localities. Mr. R. Price-Williams, M.I.C.E., has been appointed by the syndicate to proceed to Western Australia to make an exhaustive report upon the nature of the land to be acquired and upon the scheme generally.

EVERYBODY in New York is watching with great interest the tests of the Daft motor on the Ninth Avenue Elevated road. The *Electrical World* says:—We have the pleasure of reporting, from personal observation, that on Wednesday night, in spite of the rustiness of the track and other troubles incidental to a start of the kind, Mr. Daft's motor, Benjamin Franklin, showed its power, moving freely up and down the track. As we have already travelled behind a Daft motor at other places at the rate of several miles an hour we think we can now promise our fellow New Yorkers an early ride on the Elevated by electricity. Meantime the electric tramway which was equipped with the Daft motors at Baltimore is in regular operation. It has now been running for over two weeks, and nothing has yet occurred to make the undertaking anything but a decided success. Indeed the tramway company is so well pleased that it has ordered two more motors, which will be put upon the line as soon as possible. The ascent of the heavy grades on this line is a remarkable feature, one grade being of 350ft. to the mile; yet no difficulty is experienced in overcoming it. The success of this undertaking marks another decided advance in the application of electricity in this country, and it will not fail to strengthen the confidence of the advocates of electric railways.

THE Mersey Railway Tunnel, being very nearly completed, is on the eve of opening for traffic, and by the end of the quarter it is expected that trains will be running regularly and frequently between Liverpool and Birkenhead. As the time tables and the fare tariff are undergoing final revision, advantage has been taken of some unavoidable delay in completing the ventilating apparatus to arrange the junction for the lines authorised in the last session of Parliament for connecting the tunnel with the rails along the line of docks. The ventilation is secured by means of powerful fans, which in the air shafts produce a current of air of the force of thirty miles an hour. Access to the tunnel for passengers would be obtained by a stairway, an inclined way, and an immense lift capable of carrying 100 persons. The line will form a connecting link between the Great Northern, Midland, and Sheffield Companies on the Liverpool side, and the Great Western and North-Western on the Birkenhead side of the Mersey, and will give, for the first time, the Great Western Company a direct access to Liverpool. There are various works to be carried out before the system is complete, and in order to finish these the directors now offer for subscription £600,000 Five per Cent. Preference Stock at par, which, after the payment of the debenture interest, will be a first charge on the profits of the railway, and will take priority over the remaining £1,430,000 of share capital.

THE project to connect the upper and lower parts of the town of Biella has received the sanction of the Minister of Public Works. The line, which will consist of a double track, will be 180 metres —590ft.—in length, with a difference of level between the two extremities of 60 metres—196ft. 8in.—corresponding to a gradient of 1 in 33⅓. The gauge proposed is one metre, and the rails, which are to be of steel and of the Vignoles pattern. will weigh 36 kilogrammes per metre—72 lb. per yard—they will be fixed on strong oak longitudinal sleepers, connected at distances of 4 metres apart —13ft.—by iron tie rods, and the whole permanent way will be supported by brick pillars. The carriages—one for each line—will be capable of holding twelve passengers, and will be attached to the ends of a wire rope, passing over a horizontal pulley at the top end of the line, so that one car descends while the other ascends. Below the floor of the carriage will be a tank, divided into three compartments, two of which being of the capacity of 1 cubic metre, whilst the other will hold 1½ cubic metres of water, or in all 3½ tons in weight. The tank of the car being filled with water at the top of the line it descends by gravity, hauling up the other, the tank of which is empty. The speed will be regulated by a friction brake connected with the horizontal pulley passes, but the carriages will also be provided with powerful brakes, sufficient to bring them to a standstill on the incline in case the rope should brake. The rope will be of steel, consisting of six strands of eight wires each, its diameter 23 millimetres—⅞in.

NOTES AND MEMORANDA.

IN Greater London last week 3440 births and 1884 deaths were registered, corresponding to annual rates of 34·5 and 18·9 per 1000 of the population.

THE aggregate amount of rainfall last week at Greenwich was 0·47in. The duration of registered bright sunshine in the week was 7·1 hours, against 13 hours at Glynde Place, Lewes.

PROFESSOR STOKES has been nominated as Professor Huxley's successor in the presidential chair of the Royal Society. This makes Professor Stokes the successor of Newton as to repeated presidentship.

THE rapid progress of population in New South Wales is shown by the fact that, with an area of 310,700 square miles, it contains a larger number of inhabitants than South Australia, Queensland, Western Australia, and Tasmania, with a combined area of 2,658,402 square miles.

THE deaths registered during the week ending November 7th in 28 great towns of England and Wales corresponded to an annual rate of 19·9 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The five healthiest places were Halifax, Brighton, Sunderland, Leicester, and Hull.

AT the Royal Observatory, Greenwich, the mean reading of the barometer last week was 29·86in.; the lowest reading was 29·24in. at the beginning of the week, and the highest 30·17in. at the end of the week. The mean temperature of the air was 44·6, and 1·4 below the average in the corresponding week of the twenty years ending 1868.

BEFORE the Paris Academy of Sciences a note on a new process for making hydrogen gas was recently read by MM. Felix Hembert and Henry. They described a simple and economic process by which hydrogen gas available for numerous combinations applicable to the arts and industries may be, they said, produced at the rate of 0·015 franc the cubic metre.

IN London last week 2695 births and 1483 deaths were registered. The annual death-rate per 1000 from all causes, which had been 18·6 and 17·5 in the two preceding weeks, rose last week to 18·9. During the first five weeks of the current quarter the death-rate averaged 17·8, and was 2·0 below the mean rate in the corresponding periods of the nine years 1876-84.

WRITING on the durability of slate when exposed, Mr. A. C. Kimber says: "In the Granary Burying Ground, in Boston, there is a stone of slate erected to the memory of Captain William Condy, who died August the 25th, 1685. The style of lettering, position, &c., all indicate that it was put there soon after the burial. Yet every letter is clear and sharp, even the guiding lines scratched with the chisel being perfectly distinct. In fact, the stone seems to have suffered no change whatever. There are many others near it in the same condition, and of nearly equal age."

THE meldometer—$\mu\epsilon\lambda\delta\omega$, to melt—is the name given by Professor Joly to an apparatus which consists of an adjunct to the mineralogical microscope, whereby the melting points of minerals may be compared or approximately determined and their behaviour watched at high temperatures, either alone or in the presence of reagents. It consists of a narrow ribbon of platinum, 2 mm. wide, arranged to traverse the field of the microscope. The ribbon, clamped so as to be readily renewable, passes bridgewise over a little scooped-out hollow in a disc of ebony. The clamps also take wires from a battery, and an adjustable resistance being placed in circuit the strip can be thus raised in temperature up to the melting point of platinum. The disc being placed on the stage of the microscope, the platinum strip is brought into the field of a 1in. objective, protected by a glass slip from the radiant heat. The observer is sheltered from the intense light at high temperatures by a wedge of tinted glass, which further can be used in photometrically estimating the temperature by using it to obtain extinction of the field.

ACCORDING to a paper on the "Electrical Resistance of Alcohol," by G. Foussereau—*Compt. Rend.* ci., 243-45—the specific resistance of different samples of commercial absolute alcohol varied from 2·47 to 3·68 megohms. When alcohol is mixed with water, the resistance of the liquid diminishes, and attains a minimum differing very little from that of water when the mixture contains only 3 per cent. of alcohol, but increases to that of water with more dilute solutions. In every case a considerable alteration in the composition of the mixture is necessary to produce any notable change in the resistance. The differences observed with commercial alcohol are not due to the presence of varying quantities of water but to small quantities of dissolved saline matter. The presence of 1 part sodium chloride in 2,600,000 parts of alcohol lowers the resistance in the ratio of 1 to 0·527, and the addition of potash produces a similar result. When alcohol is kept in glass vessels, its resistance rapidly diminishes; but if kept in porcelain vessels, the resistance is not affected to anything like the same extent. The highest resistance observed with carefully purified alcohol, collected in porcelain vessels, was 7·031 megohms. The resistance diminishes by 0·0145 of its value for each rise of temperature of 1 deg. at ordinary temperatures.

A BORE-HOLE made about two years ago to a depth of 52 metres into the older Devonian strata near Burgbrohl, on the Rhine, yields a large and steady supply of carbonic acid gas, with water, which is variously utilised. In a recent paper to the Niederrheinische Gesellschaft in Bonn, Herr Heusler says the normal quantity of gas amounts to about 2160 cubic metres in twenty-four hours The supply having proved constant, a compressing apparatus was set up last autumn, the gas being taken directly over the bore-hole. The present system produces per minute from 500 litres of gaseous CO_2, 1 litre of liquid, weighing 1 kilogramme. As the liquefaction depends on the external air temperature, and is impossible at a temperature over 30·9 C.—the critical point—it is necessary in high temperatures to cool the apparatus; and the water of the spring—which keeps at 12 deg.—serves for this. The pressure employed ranges from about 50 to 70 atmospheres. The wrought iron vessels for despatch of the liquid contained about 8 litres, and are tested to about 250 atmospheres; they very rarely explode. The enormous expansion of carbonic acid with rise of temperature yields a pressure which—*Nature* says—is utilised for compression of steel and other casts, and Messrs. Krupp, at Essen, have thus got, *e.g.*, a pressure of 1200 atmospheres for a temperature rise of 200 deg. C. Among other uses are preservation of beer, impregnation of natural water, apparatus for fire extinction, and motor force for torpedoes.

THE following figures relating to the mean monthly rainfall at Greenwich Observatory have been compiled by Mr. G. A. Biddell, M.I.C.E., from the returns of thirty-nine years ending with 1879: —The mean monthly fall is 2·06in. = 202 tons, or say 45,000 gallons per acre, just over one gallon per square foot. The mean yearly fall is 24⅔in., about 2500 tons per acre, rather more than 10 cwt. per square yard, or nearly 13 gallons per square foot. The dryest year was 1864, 16·38in. The wettest year was 1852, 34·01in. The seven dryest years—each below 20in.—were 1847, 1850, 1854, 1858, 1864, 1870, and 1874. The seven wettest years—each above 30in.—were 1841, 1848, 1852, 1860, 1866, 1872, and 1879. The six winter and spring months, viz., December, January, February, March, April, and May give a fall equal to 10½in., each quarter about 5¼in. The six summer and autumn months, viz., June, July, August, September, October, and November equal 14¼in., each quarter nearly half this quantity. The following are the mean monthly averages given in the order of their rainfalls:—March, 1·42; February, 1·54; April, 1·66; December, 1·76; June, 2·05; January, 2·05; May, 2·07; November, 2·23; September, 2·25; July, 2·40; August, 2·49; October, 2·82. In these one day is taken from January and one from March and added to February, thus making them each equal to 30 days. If March is taken as 31 days the fall is 1·47in., and if February is taken as 28 days the fall is 1·44in.

MISCELLANEA.

ON Saturday the North-East Coast Institution of Engineers gave a farewell banquet to Mr. W. H. White, who is leaving Newcastle to take up his position as Chief Naval Constructor to the Admiralty.

STEEL revolving shutters for closing dock shedding are now being extensively used. At the new docks at Tilbury, now in course of construction by the East and West India Dock Company, no less than 120,000 superficial feet of shutters will be used, Messrs. Clark, Bunnett, and Co., of Rathbone-place, being the contractors for their erection.

THE fine new flour mills machinery, on the roller system, in the Phœnix Mills of Messrs. John Davidson and Sons, Newcastle-on-Tyne, was inaugurated yesterday. The new roller mill plant, by Mr. J. H. Carter, of Mark-lane, makes this one of the largest and most elaborately complete mills in Europe, and as there are many new and special points in the mill we shall refer to them at length on another occasion.

OWING to the want of harbour accommodation for vessels and fishing smacks in the districts between Beachey Head and Bexhill, a proposal is being considered for constructing a harbour between Eastbourne and Pevensey Bay, with a steam tramway skirting the sea eastward of the redoubt for about four miles. The scheme includes a tidal harbour for vessels, an extensive fish-curing station, and a yacht station two miles from Eastbourne.

IN view of the threatened outbreak of hostilities, and the announcement that a fortified post is being constructed at Prome, to afford a place of refuge for the residents in the district, it will be interesting to those who have friends there to know that the district has an ample water supply, the Government having within the past two years constructed waterworks at Prome, fitted up with pumping machinery by Messrs. Merryweather and Sons.

MESSRS. ROBERT STEPHENSON AND CO., of Newcastle-on-Tyne, have made arrangements to take over the shipyard and works of Messrs. McIntyre and Co. at Hebburn-on-Tyne. The principal shareholders in McIntyre and Co. will retain a substantial interest in the business, which will consist of shipbuilding, marine, locomotive, and general engineering works. This will probably necessitate the removal of all Messrs. Stephenson and Co.'s marine work to Hebburn, and the construction of large docks there.

IN connection with the annual meeting of the British Association next year in Birmingham, it has been decided to hold an Exhibition of Industry and Natural History in Bingley Hall to remain open for one month preceding October 8th. The area from which manufactures will be admitted is a radius of fifteen miles from Birmingham, and wherever practicable processes, as well as products, will be illustrated. Numbers of the leading manufacturers have already shown themselves willing to co-operate. To make the hall more attractive, streets of old Birmingham workshops will be formed.

THE engineers of the French service are establishing a telephonic communication between Paris and Rheims, 160 kilometres from Paris. The Paris terminus of this line will be the Exchange. A sum of one franc for each five minutes will be chaged for conversation. As soon as this line is finished the work will begin of connecting Rouen with Paris—126 kilometres. Rouen has been already connected with Havre, 78 kilometres distant, by a telephonic line. Conversation between these two cities is very easily held. It is the success of this system which led to further extension on larger distances.

THE impression gathered from the address before the Chemical Section of the British Association by Professor Armstrong, one of those who supports the demand for State aid to research, has thus been epitomised by the *Chemist and Druggist*: "Professor Armstrong is not an inspiriting orator, and his address was almost monotonously lugubrious. The neglect of chemical research in this country is a dire evil. Examiners are incompetent, students fail to recognise the 'holiness of work' and the 'sacredness of accuracy,' teachers are expected to teach and professors are expected to lecture, and so they have no time for original work, though they are, it would appear, the faithful few who are the salt of our nation."

DR. FRANKLAND reports to the Registrar-General that the Thames water sent out by the Grand Junction and Lambeth Companies last month exhibited no material difference in character from that of the previous month's samples; a marked increase in the amount of organic matter was, however, noticeable in the case of the Southwark, Chelsea, and West Middlesex Companies' waters, but the actual proportion present was small for this season of the year. All the samples were clear and bright. The water drawn from the Lea and distributed by the New River Company contained only a very small proportion of organic matter, the supply being second, in this respect, only to the best of the deep-well waters. The water of the East London Company ranked with the best samples of the Thames waters. Both waters were clear and bright on delivery.

A COMMITTEE of the Royal Meteorological Society has been appointed to take into consideration the question of the supposed diminution of water supply and the suggested increase of floods. The committee is desirous of obtaining as much information as possible, and will therefore be very glad to receive any data bearing upon the subject, and showing the past and present state of the water supply either from gaugings of wells or springs; the height of flood marks in rivers, streams and lakes; the records of low water periods; or any historic data which may be collected relating to the subject. Information relating to the period between 1825 and 1835 would be extremely valuable, in order to enable the committee to fill up a gap in the diagram accompanying the report in the *Quarterly Journal* for July, 1885. All communications should be addressed to the assistant secretary, Mr. W. Marriott, 30, Great George-street, Westminster.

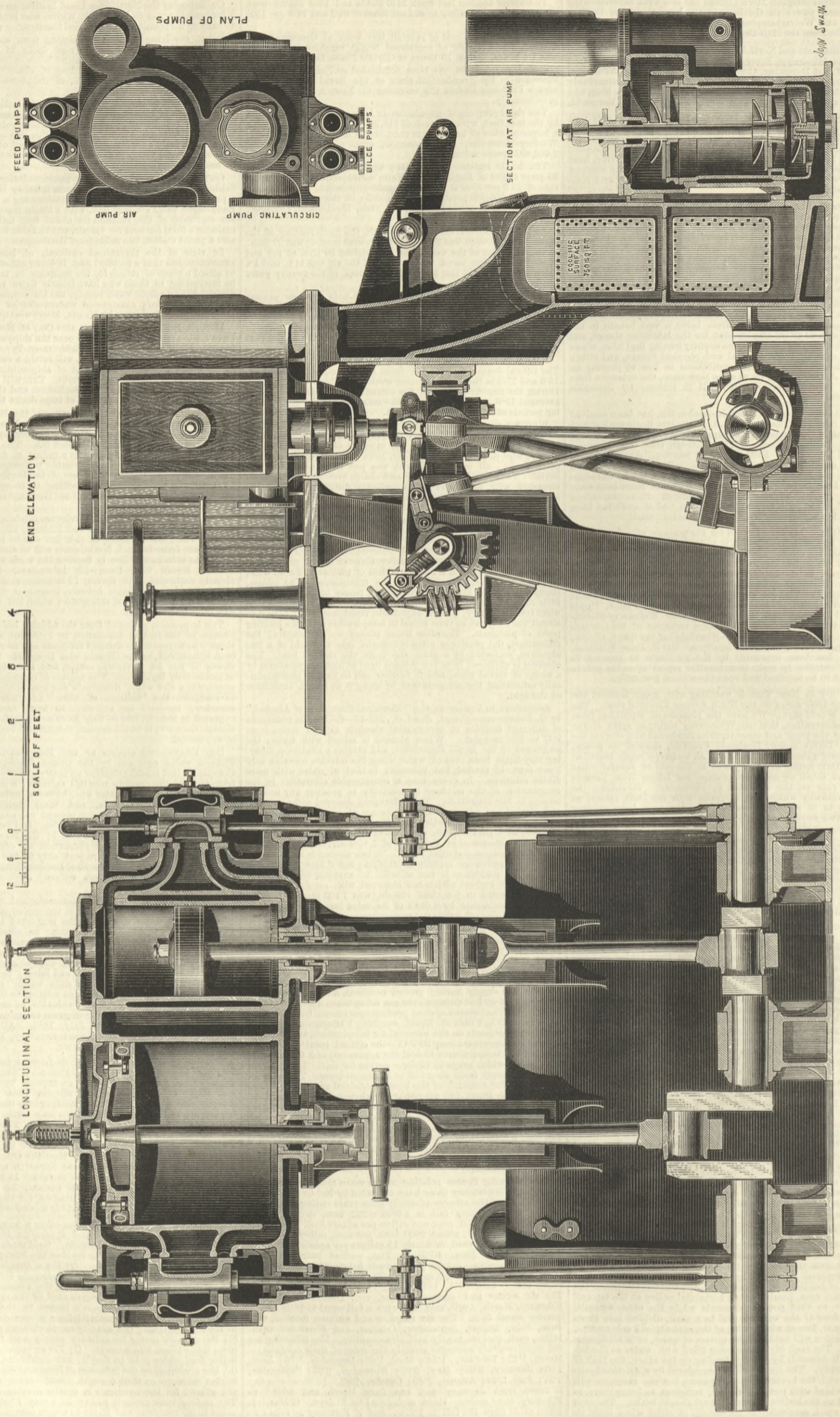
IN alluding to the request of M. de Lesseps for more money to continue the construction of the Panama Canal, the *New York Times* of the 9th inst. advocates an inquiry by Congress into the real status of that undertaking, alleging that it is of national interest, and a proper topic for consideration, because the possible bankruptcy of the private corporation may result in the enterprise being taken over by the French Government. The *Tribune* declares that the truth in regard to the canal has been concealed, and that a corrupt press has lied to the full extent of its subsidy. It considers that investors should know that the enterprise is regarded here as a gigantic failure, which was begun in ignorance, fostered in enthusiasm, and will terminate in ruin. It declares that if M. de Lesseps desires to preserve his honour, he should place his private property in the hands of trustees, for the benefit of those who will be ruined by reliance upon his assurances.

THE *Société Industrielle d'Amiens* offers a number of medals for new or improved machines and apparatus for session 1885-6. Foreigners are permitted to compete. Gold medals are offered for: —(1) A brake dynamometer to replace the Prony, and to be more simple in design and working. (2) For a simple and inexpensive transmission dynamometer with arrangements for reading off work done direct. (3) For a disposition of the vacuum brakes so as to suppress the noise made by them as used by the railway companies. (4) For a project for workmen's houses in the Ville d'Amiens. (5) For an apparatus for maintaining a proper degree of moisture in the air of spinning and weaving rooms without causing draughts. (6) For a water meter for ordinary supply and for boiler supply, price being taken into account. (7) For an apparatus for purifying boiler feed-water; to be simple, not cumbrous, and not costly. (8) For a memoir on the influence of form and dimensions of steam engine chimneys on their draught. Besides these, numerous medals are offered for improvements in textile machines and their parts. The society thus expends money in a way likely to be of direct value to its members and likely to secure commercial advantages. We have no society offering similar prizes in England.

COMPOUND ENGINES OF THE DREDGER, "MELBOURNE."

MESSRS. W. SIMONS AND CO., RENFREW, ENGINEERS.

(*For description see page 379.*)



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

J. A. M. (St. Paul's-churchyard)—*Your letter is controversial, but it contains no statement of definite fact admitting of being proved by you, and, as a result, we cannot insert it.*

T. W.—*The shaft of the greatest diameter will have the greatest friction. The shape of the bearing will not have much effect unless the surfaces are so small that they cut. The bored out bearing is the best, because it can be most effectively lubricated.*

UTILISING THE WASTE HEAT OF CUPOLAS.

(To the Editor of The Engineer.)

Sir,—Can any of your numerous readers tell me if any attempts have been made to utilise the waste heat from a foundry cupola, and, if so, with what results?

Foundry Manager.

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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.

The Institution of Civil Engineers, 25, Great George-street, Westminster, S.W.—Tuesday, Nov. 17th, at 8 p.m.: Ordinary meeting. Papers to be further discussed, "On the Theory of the Indicator, and on the Errors in Indicator Diagrams," by Professor Osborne Reynolds, F.R.S., M. Inst. C.E. "Experiments on the Steam Engine Indicator," by Mr. A. W. Brightmore, B.Sc., Stud. Inst. C.E. Friday, Nov. 20th, at 7.30 p.m.: Students' meeting. Paper to be read and discussed, "Recent Researches in Friction," by Mr. John Goodman, Wh.Sc., Stud. Inst. C.E. Sir Frederick J. Bramwell, F.R.S., President, in the chair.

King's College Engineering Society.—A general meeting will be held on Tuesday, Nov. 17th, at 4 p.m., when Mr. A. Collins will read a paper "On Well Sinking."

The Cleveland Institution of Engineers.—The first meeting of the session will be held in the hall of the Literary and Philosophical Society, Corporation-road, Middlesbrough, on Monday evening, Nov. 16, at 8 precisely. (1) List of elections since last meeting. (2) Annual report. (3) Auditor's report. (4) President's address. (5) Paper "On Modern Practice in Slide Valves," by Mr. Tom Westgarth, Middlesbrough.

Royal Meteorological Society, 25, Great George-street, Westminster.—On Wednesday, the 18th inst., at 7 p.m., the following papers will be read:—"The Helm Wind of August 19th, 1885," by Mr. William Marriott, F.R. Met. Soc. "The Typhoon Origin of the Weather over the British Isles during the 2nd of October, 1882," by Mr. Henry Harries. "Note on the Principle and Working of Jordan's Improved Sunshine Recorder," by Messrs. J. B. Jordan and F. Gaster F.R. Met. Soc.

Society of Arts.—The hundred and thirty-second session of the Society of Arts will commence on Wednesday, the 18th inst., when the opening address will be delivered by Sir Frederick Abel, C.B., D.C.L., LL.D., F.R.S., chairman of the Council.

THE ENGINEER.

NOVEMBER 13, 1885.

THE FUTURE OF THE AUXILIARY FLEET.

A circumstance which may be found, one way or the other, to have an important bearing upon the maritime strength of this country, has hitherto escaped public recognition. A Committee has been formed at the Admiralty, consisting of the Parliamentary Secretary, Mr. C. T. Ritchie; the Controller of the Navy, the Director of Transports, and the Director of Naval Construction, Mr. W. H. White, who are to advise on the best means of utilising the mercantile marine as auxiliary to the Navy in time of war. It might have been thought that this question was settled, and that the plans so admirably worked out by Sir Nathaniel Barnaby were such as placed a powerful auxiliary fleet at the service of the Government whenever required. But excellent as these plans undoubtedly were, they contained one defect, of which it cannot be doubted the ex-Director of Naval Construction was fully conscious, and for which he was in no sense responsible. A powerful force was organised, but the connecting link between that force and the British Government was left singularly weak, and so remains to this hour. When in the spring of the present year there was danger of hostilities with Russia, an alarm was raised that the emissaries of that Power were in treaty for the purchase of some of the fast ocean steamers which had been built in accordance with the requirements of the British Admiralty. Forthwith our own Government proceeded to charter these ships, not only for the sake of employing them as armed cruisers for the defence of our commerce, but for the additional reason that, if not employed under the British flag, they might be found under the Russian. A large expenditure was incurred for a purely precautionary purpose. The scare passed away, and the merchant steamers, some fifteen in number, which had been hired for half a year, have now reverted to their original use. For the money spent—in all a very considerable sum—there is now nothing to show, except it be that the promptitude with which the Government acted has promoted the peace which we now enjoy. There is also the experience gained in so far carrying out the auxiliary scheme. The school may have been a dear one, but the lesson learned is none the less true; and we may assume that the appointment of the Committee to which we have referred has been brought about by circumstances arising out of the recent call for the services of the Auxiliary Fleet. We would rather suppose this than entertain the idea that the departure of Sir N. Barnaby from Whitehall is taken as a signal for subverting one of his most cherished undertakings. His successor is too strong a man to seek distinction by upsetting all that was special to the man who went before him, and we look for something that shall develope rather than cripple or destroy what has been so well begun. We have the less fear for the future of the Auxiliary Fleet seeing that its inception was due to the sagacity of a Conservative First Lord of the Admiralty, the late Mr. Ward Hunt. The task assigned to the Committee is itself of such a nature as to imply that there is a desire to remedy defects in the existing scheme, and not to get rid of it by means of an adverse report. It would not be difficult to bring about a collapse, so that the Auxiliary Fleet should vanish from among the naval resources of the country. Cold neglect would be sufficient for this purpose, and unfortunately there has been a tendency in that direction, so far as any encouragement from the Transport Department is concerned. As the head of that department is on the Committee, we hope some improvement will come to pass in respect to this matter.

To practical minds an essential defect of the present system for securing a powerful mercantile fleet as auxiliary to the Royal Navy consists in the absence of that golden tie—a subsidy. A bait has been held out to the shipowners, but it has simply served to tantalise their expectations. They were led to hope that if they provided watertight compartments, constructed according to the Admiralty regulations, and conformed in other respects to what was required, they would have the preference when ships were wanted for the transport service. There was every reason to expect this, for if the ships were to be thus rendered safer than the ordinary class, it seemed inevitable that they would be chosen for the conveyance of troops and stores, in preference to vessels having a liability to founder with their precious freight. But the very bulkheads which were to recommend the ships to the favourable notice of the Director of Transports, have produced the opposite effect. Cutting up the vessels into these sections has exhibited the disadvantage of bad stowage, and this has been a fatal barrier to their employment in the Government service in time of peace. Where cargo has to be carried, it may seem that there is some ground for the objection urged against such ships. But where the conveyance of troops is concerned, it might have been thought that the difficulty of stowage would be got over, and there would be the powerful inducement of security for the men's lives. The result, however, is not so, and ships laden with troops go to sea with the unquestionable risk that, if by collision or otherwise they receive a serious rift, the vessel must go down. A catastrophe of this kind, if ever it were to happen, accompanied by an extensive loss of life, would raise a tremendous outcry, should it be clearly seen that proper compartments would have kept the ship afloat, so that none need have perished. The risk has been run, and is still incurred. The pitcher goes often to the well, but perhaps it gets broken at last. The lives of British soldiers are precious, and ought never to be placed in peril if it can possibly be avoided. But the point we have now in view is this—that except for the recent six months' hiring of sundry steamships to serve as armed cruisers, there is no compensation forthcoming in aid of the shipowner who has put himself to the trouble and expense of making his ship suitable for war purposes when wanted. Should the deliberations of the Committee lead to a change of plans, what shape can it assume? There are more than 400 vessels on the Admiralty list. To subsidise all these would be impracticable. At least, we should apprehend so. We must rather calculate on a system of selection, though this must needs be followed by a large amount of grumbling among those who would be left out in the cold. If there is to be a subsidy, it is extremely likely that we shall see the large and fast steamships retained on the list, and the remainder practically struck off, though perhaps nominally retained. Another point which we should look for is, that the Admiralty will endeavour to bring about the building of steamships not only having water-tight compartments of a special kind, and complying with the other conditions already laid down, but characterised by further recommendations. If able to offer an immediate and direct reward, the Admiralty might be able to bring about the construction of ships with twin-screws and with underwater steering gear. A limited number of swift and powerful ships would be preferable to a crowd of vessels too numerous to be subsidised, and likely in some cases to pass into the hands of the enemy just as a crisis is approaching. The soundness of this view may be inferred from the fact that when the Government wished to secure merchant steamers to serve as armed cruisers, they simply selected a few ships of the highest class.

It would be, indeed, a deplorable circumstance if there should be an absolute reversal of the policy which prescribed that England should use her unrivalled fleet of ocean steamships as an arm of war when engaged with a naval Power. The utility of the merchant fleet as auxiliary to the Royal Navy must consist in the protection afforded to our commerce. The mercantile fleet of this country has utterly outgrown the old convoy system. It will be liable to attack from light-armed cruisers of high speed; and the mischief that may be done in this way is indicated by the ravages of the Alabama when preying on the commerce of the Northern States. A single ship, with a daring commander, may be said to have paralysed the entire commerce of America. We cannot hope to cope with this form of attack, if ever the evil day should come, except by the employment of a numerous fleet, such as we may readily obtain from the merchant service. The Declaration of Paris does not lessen the necessity for this precaution. The privileges of the neutral flag are limited by the circumstance that anything needful to the maintenance of a struggle with a hostile Power may be declared contraband of war. When there is war we must fight for what we want. We cannot rely upon the neutral flag to bring us the food supplies which will be required if ever we are in conflict with a nation possessing the means of harassing our commerce. But it will not be a regular navy that will stop the supplies. It will be a swarm of predatory cruisers, half-piratical in their character, which can only be met by a well formed Auxiliary Fleet. Privateering is happily at an end, and our commerce may now be made, in a certain sense, to protect itself. That is to say, it can furnish from its own resources a certain number of armed steamers which shall enable the remainder, or a sufficient portion, to carry on the needful communication with other countries. The Royal Navy is insufficient for the performance of the twofold task involved in carrying on a war and at the same time protecting our commerce. An extravagant addition to the Navy might meet the case, but it would be much more economical to subsidise the merchant service, and to perfect our present arrangements for making that service helpful when war actually breaks out.

One thing we must need say, that whatever changes are effected, the Admiralty must not let go the Auxiliary Fleet. It is an arm which needs to be strengthened and developed, aided as it must be by due arrangements for manning it, arming it, and so forth, when the time for action arrives. Men, guns, and stores must be available, not only in the home ports, but on foreign stations, so that at the sound of war there shall spring up, all over the seas, a flying force ready to meet the birds of prey which will assuredly seek to attack the unarmed vessels of our mercantile marine. It is true that the Declaration of Paris is substantially favourable to the interests of this country. But there is an awkward exception as to the contraband of war. We want a supplement to this Declaration, which shall strictly limit the aforesaid "contraband," so that it may not include bread stuffs and animal food. It has been well laid down that under the new system the duty of the Navy will be principally confined to keeping open the great ocean highways, and to preserving freedom of access to the coaling stations. "For the protection of commerce," it is said, "we must rely on our mercantile auxiliaries."

THE VALUE OF INCANDESCENT LAMPS.

The value of incandescent lamps may be expressed in terms of their photometric energy, their durability, and their first cost. The first again must be considered in connection with the amount of power expended in producing a given amount of light. It will be remembered that the Franklin Institute recently carried out a series of comparative trials of incandescent lamps. The report produced by the committee we published in our impression for September 18th. It is to be regretted that the investigation was carried out under conditions which have deprived it of value. That, at least, is the opinion of all competent electricians in this country. The subject was discussed by the Dynamicables at their last meeting, and there was no dissentient voice raised. As the Dynamicables constitute a private society we have no intention of reporting a discussion not intended for the ears of the general public; but the gentlemen who took part in it are so eminent, both as theoretical and practical electricians, that no one will, we think, be disposed to dispute the soundness of any verdict they may unanimously pronounce on electrical matters, and we may be excused for citing their opinion above in support of our own.

In dealing with this question of the value of incandescent lamps it is above all things necessary to be quite clear and precise in the use of terms. There is now a very considerable number of incandescent lamps of various constructions in the market; and the inventors of each system maintain that it is better than any other. If asked how better, the reply is that it gives more light and is longer lived than any of its rivals, the power expended being the same. Now, a great deal of vague talk circulates concerning the lighting power and the longevity of incandescent lamps; and the general public may rest certain that they do not hear quite the worst. Putting this on one side, however, we may go on to point out that no one really knows except by chance how much light an incandescent lamp gives with any accuracy. Thus, for example, if we buy a 20-candle lamp, we shall find it labelled with the volts and ampères it requires to run it to the best advantage. Thus, we may find 80 volts ·9 ampères. Such a lamp will require $\frac{80 \times \cdot 9}{735} = \frac{72}{735}$ horse-power, or about ten lamps to the horse-power. These would be rated at 25 candles each. We have taken here fancy figures, because we do not wish our calculations to be identified with any special make of lamp. The purchaser pays under the impression that he is getting lamps which will, when burned according to instructions, give him 25 candles each. But the average consumer, whether of gas light, lamp light, or electric light, has not the most remote idea what 25 candles mean; and he is quite incapable of saying whether he gets more or less than he bargained for. Light cannot be measured or weighed like milk or beef, and the consumer is compelled to trust to the good faith

of the electrician to get what he bargained for. In the case of gas it is different. The gas is tested by examiners, and when the consumer is told that he is supplied with 16-candle gas he knows that he has a Government guarantee that he gets gas of a definite quality—that, in a word, he has what the company sold to him. The testing of incandescent lamps is a far more difficult matter than the testing of gas, and the work has not yet been brought to anything like perfection. To begin with, there is no such thing as a standard sperm candle. This has long been known to gas examiners, who no longer use it, employing instead Vernon Harcourt's standard flame, which is produced by a mixture of seven volumes of gaseous pentane with twenty of air, burned from an aperture $\frac{1}{4}$in. diameter, with a flame 2$\frac{1}{2}$in. high, but the Franklin Institute lamp tests were all made with "standard" candles. The standard candles are defined in the Metropolitan Gas Act of 1860, namely—sperm candles six to the pound, burning at the rate of 120 grains per hour. Few people are aware how entirely untrustworthy the standard candle is. It can by careful snuffing be made to vary over 20 per cent. in the amount of light given out. No two candles are alike, save by chance. It is only necessary to put one at one side and another at the opposite side of a photometer screen to prove this. Thus, then, it appears at the very outset that the tests to which so much importance has been attached were made with instruments—for the standard candle is simply a light-measuring instrument—notoriously untrustworthy, but in this respect the American trials are no worse than any others. Furthermore, there is a very great difference in the amount of light given out by an incandescent lamp in various planes vertical and horizontal. Do the makers always measure them in the worst or the best position? Who will say?

Leaving the question of amount of light developed by a given power on one side, let us turn to the question of longevity. On this point again very vague ideas prevail. We hear of lamps lasting tremendous numbers of hours; and we know that very curious tricks are played with statistics of lamps—such as estimating the average duration of two or three hundred lamps from the life of half a dozen, and so on. By the consumer the duration of a lamp is usually determined by its age at the time when either the filament or the globe is broken. Curiously enough, the condition of the lamp at any given epoch is overlooked. But incandescent lamps are, like human beings, liable to decrepitude in old age; and, just as the most decrepit men and women seem to possess charmed lives, so it is with the aged incandescent lamp. The feeble old man of ninety takes care of himself; he runs no risks. The incandescent lamp of two or three thousand hours follows this good example; it takes care of itself. In other words, a 20-candle incandescent lamp will, by degrees, lose the power of giving light until it falls down to 8 or even 7 candles; and it takes *nearly* as much power in the latter stages of its existence as it did at first. We say nearly with emphasis, because in its old age less energy by a small amount is expended in the lamp than was used when it was young; and this reduction is the main cause of its longevity. It may be the worst possible economy to use long-lived lamps. Indeed, so far as is known, there seems to be a particular period in the lives of some incandescent lamps which, once reached, they ought to be superannuated; but no one yet knows what is the precise period.

In conclusion, we may point out that there is no such thing as a good volt or ampère meter to be had in the open market. What we mean is that the volt meters and ampère meters sold are, as a rule, not in accord with standard instruments, and this is the legitimate outcome of the circumstance that there is no place where makers can send their instruments to be officially tested. A mathematical instrument maker can send his thermometers or barometers to Kew and get them tested for a small charge. The watchmaker can do the same thing by his chronometers and watches. The pound weight and the yard measure can be verified by Government standards; but there is nothing of the kind available in a general way to electricians, and it is quite time that there was. At present, as far as incandescent lamps are concerned, at all events, there is no trustworthy evidence to be had as to what their powers really are. Electricians are in the position of the earlier inhabitants of this island, who, lacking foot-rules, measured lengths in terms of grains of corn.

CHESTER AS A SEAPORT.

Simultaneously with the initial proceedings for making the Manchester Ship Canal, the city of Chester is taking steps to recover something of her old position as a port. A few generations ago, when Liverpool had little more than existence to boast of, ancient Cestria was a busy and important port on the west coast, but in time her shipping departed from her, and went to help to make Liverpool what she now is. The Dee began to silt up, and Chester as a mercantile city rapidly declined. Now, however, after a long period of stagnation, the citizens have wakened up and resolved at least to try to regain their old position. Works have accordingly been undertaken to restore the navigability of the Dee up to Chester, under the direction of Mr. Leader Williams, C.E., the engineer of the Ship Canal, and Mr. C. E. Taylor, the engineer to the Corporation of Chester. With this work considerable progress has already been made, and it will probably be completed within a few months. It is proposed to provide a navigable channel with a depth of 15ft. or 17ft. from the sea up to the city, and with this view a continuous training wall is being constructed on the Flintshire shore of the Dee, while an existing training wall is to be raised opposite Connah's Quay. Extensive dredging is being carried out, and by these means it is hoped that vessels of perhaps 1000 tons burthen will in future be enabled to sail up to Chester with cargoes for that district, instead of, as at present, going up the Mersey and sending their freights thence by railway. The channel of the river has already resumed its original course to some extent, and some portion of land likely to be of value has been reclaimed by the influence of the training walls.

SHIPPING LEGISLATION.

The recent attempt at legislation against what is believed to be the shipping interest has forced that interest into the number of those who are taking steps to protect themselves by using parliamentary influence. There has been sent out from several of the north-eastern ports a very remarkable series of questions to be put by owners of shares in steamships to the candidates in their localities. The latter are asked to state their views as to the "proposal to prevent investors in shipping from insuring their interest for such sums as may be agreed between insurer and insured;" the question of employers' liability; of the competition between foreign and British vessels; of light dues; of the Wreck Commissioners' Court, and of several other similar matters. It is certain that the influence of the shipowners will be felt in this way in many parts where it had not been expected. One of the consequences of the new method of shipowning—that of the wide dispersion of the ownership—is to spread that ownership far inland, and thus to enable the shipping interest to impress itself on the parliamentary candidates at many places other than the seaports. This influence is now being attempted to be wielded; and it would seem to be a fair attempt, if we are to allow the desirability of such efforts to impress themselves on candidates by distinct organisations. It is one of the consequences of what has been called the attack on shipping in the last session. The general election allows the shipowners—using the word in its widest application—the opportunity of testing their friends and their foes; and this they will do, and they will gain knowledge and exercise an influence which will be useful to them and their cause whenever the shipping laws are to be dealt with in the future. The attack showed one of the weaknesses of the shipowners; but it also showed one of the sources of strength, and that strength is being utilised now in a way that could not have been anticipated.

THE LIVERPOOL WATER WORKS.

The squabble in the Liverpool Town Council respecting the Vyrnwy Water Works and the two engineers entrusted with that undertaking—Mr. Hawksley and Mr. Deacon—is still dragging on, and at a recent meeting of the Council another rather unseemly scene took place. It being apparently impossible to arrange matters as between Mr. Hawksley, Mr. Deacon, and the Corporation, Mr. Bateman has been requested to investigate the present state of the works, and draw up an independent report thereon in association with Mr. Lyster, the Liverpool engineer. At the same time Mr. Deacon was instructed to report on the stability of the embankment at Vyrnwy, and the manner in which the works had been carried out—under his own direction. At a recent meeting some members of the Town Council took objection to Mr. Deacon being asked to report on his own work, suggesting that, if that course was pursued, Mr. Bateman would possibly be unfairly influenced when making his examination. Upon this there followed accusations and retorts, and a very unworthy passage of arms occurred before the decision was arrived at to abide by what had been done. This important work promises not only to be a long time in arriving at completion, but to spoil the temper and manners of eminent Liverpool men, and at the same time involve the reputation of more than one eminent engineer.

SHIP CANALS AT HOME AND ABROAD.

The idea of resorting to ship canals as an aid to commerce is spreading on the other side of the Atlantic as well as in this country. The latest instance of this is a gigantic ship canal to be constructed between the States of Delaware and Maryland, from the mouth of the river Sassafrazin, Chesapeake Bay, to a point in Delaware Bay. The scheme is not quite new over there, for it has been on the way for several years, but the necessary capital of a million and a half has now been subscribed, a contract for the work has been made, and operations have begun. This waterway will have the advantage of possessing no locks—not requiring them—and when completed will, among other benefits, reduce the distance between New York and Baltimore by more than 200 miles. On a smaller scale similar projects are being worked out here. It is seriously proposed to enlarge the Birmingham and Worcester Canal, that small vessels and steam barges may travel direct between the sea at Cardiff and Birmingham; and a scheme is being examined and considered for connecting Sheffield with the sea at Goole by means of a canal.

FIFTY MILES OF LOADED COAL WAGONS.

Our miners who are still talking—through their leaders—of striking for a 15 per cent. advance in wages, might be invited to consider the present condition of the coal market. A large Sheffield Company, which does a great business with the metropolis, was advised by its London agents that on Monday 3400 loaded wagons were standing at the London depôt of the Midland Railway Company, and that all the other railway companies had similar quantities. It was added that there was nothing doing in the market. North-country coal went down twice last week—one shilling each time. Our Sheffield correspondent, who has put himself to some trouble to ascertain the facts, states that the various railway companies loading to London have no fewer than 15,000 wagons standing full of coal. Each wagon measures 16ft. If placed in one continuous line, the loaded wagons would extend a distance of between forty and fifty miles. Giving only six tons to a wagon, the quantity of coal blocked up on the rails is equal to 90,000 tons, and it is being constantly increased.

LITERATURE.

Minutes of Proceedings of the Institution of Civil Engineers, with other Selected and Abstracted Papers. Vols. lxxix. to lxxxiii. Session 1884-5 Edited by James Forrest, Assoc. Inst. C.E., Secretary. London: The Institution. 1884-5.

These four volumes comprise the tangible work of the representative institution of English engineers during the working session 1884-5, and they contain a vast quantity of information communicated by members, supplemented by abstracts giving the essential parts of papers in foreign Transactions and periodicals published all over the world. There is no subject which has been treated in such a way as to bring out new information or to throw new light upon it by foreign authors that is not dealt with in these pages; and there is no question upon which an engineer does not feel bound to turn to these volumes for reference as soon as he commences to search for anything. The Institution still attracts the best papers written, although only a few of those received are read and discussed. The four volumes contain over fifteen hundred pages, fourteen papers which have been read and discussed, thirty-nine papers which have not been read, and 278 abstracts of foreign papers and articles. As this represents the published work of the Institution, the whole of which passes through the hands of the iron secretary, Mr. Forrest, and shows nothing, except the annual report, of the work of administration, some idea may be gathered of the extensive character of the business conducted by the secretary, and carried through by him and his staff.

The subjects treated in papers read include "Electric Lighting in Ships;" "Working Tramways by Steam;" "Comparison of British and Metric Measure;" "The Construction of Steam Boilers;" "The Metropolitan and Metropolitan District Railways and the Inner Circle Completion Lines;" "Construction of Locomotive Engines;" "Electrical Regulation of Steam Engines;" "Rivers Flowing into Tideless Seas;" "Mechanical Integrators;" "Signalling of the North-Western Railway," and the "Theory of the Indicator." In some cases the value of a paper does not consist so much in the amount of facts it contains as in the information which it elicits in discussion; and although discussions often prove very wordy means of conveying a small amount of information, they afford the means of obtaining the most recent thought and fact on a subject, and of correcting false impressions. The discussions as printed in these volumes are very much condensed, but they do not, apparently, lose anything by this. While, however, the value of discussion must be admitted, and those of the Institution are certainly more adequate than those of any other with which we are acquainted, the necessity for maintaining the high character of papers to be read for the two purposes of really giving information and of eliciting it must not be lost sight of. Most of the papers which were read last session certainly do combine both, but we are led to the foregoing remarks by the incompleteness in this respect of two or three; they are, however, the exceptions, and serve only to emphasise the fact that the character of the papers is generally high. Vol. lxxxi. is notable as containing several excellent papers, including those on the "Metropolitan District and Inner Circle Lines," by Mr. B. Baker, and by Mr. J. W. Barry, the "Construction of Locomotive Engines," with the results of the working of those on the Brighton Railway, by Mr. W. Stroudley, on "The Electrical Regulation of the Speed of Steam Engines," by Mr. P. W. Willans. Vol. lxxxii. also contains good papers on "Rivers Flowing into Tideless Seas," as illustrated by the River Tiber, by Mr. W. Shelford; on "Mechanical Integrators," by Professor Hele Shaw; and "On the Signalling of the London and North-Western Railway." The paper on "Electric Lighting of Steamships" was satisfactory only in the discussion it raised. It was the first paper on its subject, and contained but little of that detailed information which might have been expected from anyone who took the subject in hand, considering how very extensively the electric lighting of ships had, at the date of the paper, been carried out under various systems. The paper on "The Working of Tramways by Steam" discusses at some length the Board of Trade regulations and the financial aspects of the subject, but a leading feature of the paper is the Kitson tramway engine, which is only partially described, the author appearing to be very much afraid of giving dimensions of either boiler or engine, or of the surface air condenser, or sectional illustrations. The paper, however, succeeds in what was probably its chief purpose, namely, to show that in all cases steam may be more profitably employed by tramway companies than horses, and it makes a good many suggestions concerning the working of tramways which will no doubt be carried out as time overcomes sentimental and temporary objections by the education of experience. This paper was by the Hon. R. C. Parsons; and one was read at the same time and discussed by Mr. W. Shellshear on "The Sydney Steam Tramways." It gave the results of experience with Baldwin, Kitson, and Merryweather engines, spoke most highly of the American engines, and amongst other things mentioned that the trains on these street railways often ran considerably over ten miles per hour, but stoppages were only made at stated places as on railways, with which they had much in common.

Amongst the selected papers, or papers not read but printed, in this volume, are some of high value. The first given is by Mr. J. W. Wyatt, on the "Art of Making Paper by the Machine, as exemplified in the Manufacture of High-class Writings and Printings." Another is by Mr. J. Kraft, on "Compressed Air and Machinery for Utilising it;" and an important one is by Mr. J. G. Mair, on "The Results of some Independent Engine Tests." This is supplementary to a paper much referred to by those interested in steam engine thermo-dynamics, and published in vol. lxx. This paper deals with the somewhat perplexing uncertainties as to the amount of water in cylinders and its effect. The author is disposed to differ from Zeuner in some of the conclusions at which he has arrived, although Dr. Zeuner's formulæ for the exchange of heat between the cylinder walls and the working steam are similar to those he himself gave in his earlier paper. In answering one objection made by Zeuner to the results of certain experimental tests, namely, "that owing to the violent eddying motion of the steam during admission, and at the point of cut-off, the indicator diagram does not give the pressures with sufficient accuracy during these periods." Mr. Mair says:—"It is evident that if the steam ports of an engine be quickly closed, the whole mass of the steam in the cylinder which has been flowing in with great velocity will be suddenly stopped, and therefore owing to the eddying motions then set up the pressure will not be uniform throughout the mass, and a certain period of time must elapse before the kinetic energy of motion is transformed into heat and the pressure in the cylinder is correctly shown by an indicator; and if the engine is running very fast it may even be presumed that the piston reaches the end of its stroke before a state of thermal equilibrium is arrived at in the cylinder. But the errors made by accepting an indicator diagram as not only giving the correct pressures, but also—with saturated steam—the temperature due to the pressure cannot be of sufficient magnitude to in any way nullify the general principles of engine testing, and the measurement of the heat exchanges. With steam much wiredrawn—that is, where the pressure in the cylinder is much

lower than the pressure in the boiler or steam pipe—allowance should, perhaps, be made, but any neglect in taking this correction into consideration cannot seriously influence the action of the sides of cylinders." In this most engineers will agree with Mr. Mair, and if eddying had any material effect on the registration of pressure by an indicator it would certainly be shown to some extent on the admission line, and the true line obtained from good engines would be impossible. The author gives the results of experiments with single-cylinder engines, with a Bull engine, and with Woolf engines.

Vol. lxxx. commences with Sir Frederick Bramwell's interesting address, followed by the paper on metric measures, which revives an old discussion on questions which will probably long remain a matter of opinion. The scientific derivation of the metric system is put forward in its behalf, but inasmuch as this derivation is as arbitrary and as little absolute as any other system, the claims on this score are very small indeed. The metre is undoubtedly an awkward length for ordinary measuring operations, and the small divisions are equally inconvenient. The chief gain by the system is the decimal facility, more especially as concerns cubic measures of water. The foot and inch, divided into tenths, would be equally advantageous for measures of length, and the cubic measures, or measures of volume, are very little less simple in application under our own than under the metric system. The discussion on the paper showed that the general opinion held by engineers is strongly in favour of our own system, and none of the speakers favoured the rejection of our well-tried English system for that of a foreigner not a bit more scientific than our own. We have undoubtedly a large number of systems of weights and measures which are not wanted—such as those used for precious metals, for different liquids, and different materials. Our English foot is the same as that of many countries; it is infinitely more convenient than the metre, and our necessities are only that the one system of weights should be used. There is not for any reason—except that we should use the same measures as France and those countries which followed—the slightest necessity for our adopting the French metric system, for even if we wanted to make our measures of volume directly referable to volume and weight of water, we need only make a small alteration in our very handy foot length. A reduction in the length of the foot by slightly over one-tenth of an inch would reduce the cubic foot so that a cubic foot of water would weigh 60 lb. and contain 6 gallons; but inasmuch as this would only be true for fresh water at 60 deg., it would not be true for sea water or for water at any other temperature, or for any other liquid. The advantage of the decimal system is very great, but we can use this just as much as we like now. For a few purposes the English foot is now divided into tenths, and for very many the inch is divided into tenths. There is no reason why the whole practical world should be made to bow to the wishes of a comparatively small number of enthusiasts who would reduce our measures to the awkward style of the metric system, the failure of which is shown by the way in which the "demi-kilo" is used instead of the 50 centigramme, and even the "quart d'un demi-kilo" and many others, all showing that the most natural system, the binary, will enforce itself. It is a comment in itself that one, the last, of the illustrations by Sir F. Bramwell, who favours the English measures of easy conversions, that the misplacement of a decimal point makes the equivalent of 16 mm. appear ten times too high, namely, 6·5in. instead of 0·65.

The paper on "Steam Boilers" led to a useful discussion, but it was most remarkably devoid of novelty or completeness. A paper on "The Maximum Flood Discharge from Catchment Areas, especially those of India," is a paper of interest to engineers engaged in water supply, irrigation, and inland navigation. The author, Mr. James Craig, objects to the use of Dickens' formula for discharge, and after investigation gives a new and much more comprehensive expression of his own, one objection to Dickens' being that the area might be a strip infinitely long but almost infinitely narrow. Professor Unwin gives the results of a series of experiments on the friction of discs in water.

Mr. Chas. James gives a paper on "Removing Rocks Under Water at Port Colborne," and Mr. J. A. Longridge gives a long paper on "Guns as Thermo-dynamic Machines," dealing especially with initial and recoil velocities. There are three students' papers in the volume, the first being by Mr. F. Geere Howard, on "Secondary Batteries," a paper which might now be supplemented by one giving new results of experiments. It is announced that Mr. Howard will read a paper on the use of accumulators in tramway cars. A students' paper on "Trigonometrical Surveying," by Mr. Dalrymple-Hay, is followed by one on "Gauging Flowing Water," by Mr. H. T. Turner.

The papers on the "London Underground Railways" are not only descriptive of the works of these costly lines, but they show the changes that have taken place in the practice as to construction and proportion of retaining walls since the first of the lines was built, a notable feature being the use of invert concrete struts from the foot of one wall to the other, thus entirely preventing their movement in this direction. In constructing the last part of this railway the engineers and the contractors were undoubtedly much helped by the experience gained in the previously built lines, but the last part involved some of the heaviest and most difficult work of its kind ever carried out.

The paper on "Locomotives on the Brighton Railway" is remarkably complete, and will long form a valuable contribution to the literature of locomotive engine design, construction, and performance. Our readers have been fully informed by engravings and description as to the design of Mr. Stroudley's engines, and to a considerable extent of their successful performance. The paper, however, supplies valuable information relating to the working of the locomotives as steam engines and steam boilers, and upon the cost of hauling different trains at various speeds on a railway with a good track, but with many and heavy gradients. For this information we must refer readers to the paper, but as to the performance of the boilers it must be remarked that the reader is inclined to doubt the accuracy of records which give from 11 lb. to 13·1 lb. of water per pound of coal as the evaporative power of the boilers. Taking calorimetric values and the heat of combustion of materials as a guide, 13·1 lb. is impossible. Are we to doubt the calorimetric determinations, or Mr. Stroudley's figures? Is it possible that combustion at very high temperatures, as in the locomotive fire-box, obtains a higher efficiency from the combustible than has been obtained in the laboratory? This is a view which has received some support in other directions, but it cannot be at present accepted as other than a possibility. Mr. Stroudley makes a considerable gain in his coal consumption by heating his feed-water, by means of exhaust steam, to a temperature which reaches sometimes 190 deg. As much as 3 lb. of coal per mile is thus earned, and other locomotive superintendents are turning their attention again to this matter—which is worth it, and would save much more that has yet been saved by compounding. On the Great Eastern Railway one of Kirkaldy's heaters, by which the feed will be raised to at least 250 deg., is being tested. The discussion on Mr. Stroudley's paper occupied three evenings, and elicited information of importance from locomotive engineers from all parts of the kingdom.

The paper on "Electrical Regulation of the Speed of Steam Engines," by Mr. P. W. Willans, is a description of the requirements in such a regulator, and of the regulator made by the author, designed especially for controlling the speed of the engine so that it is in direct proportion to the work the dynamo it is driving is called upon to perform. Compound winding of dynamos was at one time supposed to make such governors unnecessary, and during the discussion it was shown to be unwise to assume that laboratory or lecture-room experiments and calculations could always exceed, or indeed often approach, in value the information obtained by the practical electrical engineer. A few of the teachers are inclined to assume that the walls of a technical institute are the fountains of knowledge, but this idea gets very rude shakes sometimes, when they come before the men who really do make the new knowledge. Mr. Willans' paper is not only valuable as a description of electrical governors, but for its original information on the dimensions, winding, and power of solenoids.

The first paper in vol. lxxxii. is by Mr. Shelford, upon "Rivers Flowing into Tideless Seas," as illustrated by the river Tiber, a paper which deals with differences between the *régime* of rivers running into tidal seas and of those which run into seas such as the Mediterranean, the first having no deltas, and the second never being without deltas, which affect their flow in several ways. The principle upon which English engineers act in improving our rivers, namely, carrying low water as far inland as possible, is not, in Mr. Shelford's opinion, applicable to rivers running into tideless seas, and he points out the difficulties that obtain with the embankment of portions of such rivers liable to floods. General rectification of the channels of these rivers seems to be the only conclusion to be drawn from the paper, but rectification which must be guided by special local study, and not by any general principle. The paper is suggestive of points for consideration with reference to the parts of our main rivers above tidal effect, and will be read by river engineers with much interest. "Mechanical Integrators" is the subject of the paper following this. It is by Professor Hele Shaw, and is probably the most complete paper on its subject, both descriptive and analytic, that has yet appeared in English. His own investigations on this subject have been extensive, afford much new information, and many suggestions.

The paper on "Railway Signals," by Mr. A. M. Thompson, was discussed at great length, but we can only refer to it, and also to the last paper read last session, which was by Professor Osborne Reynolds, and by Mr. A. W. Brightmore, on "The Indicator, and Errors in Indicator Diagrams." These papers are only given in abstract, as they were not discussed, but will appear in full in the next volume, together with the discussion, which began on Tuesday. The subject is one of great interest, but the tendency of the papers is to exaggerate the errors as taken with existing instruments. Whatever Professor Reynolds does, he does well as far as his own work is concerned, but in this paper he has so far ignored the work of others during the past few years, that his paper has little value except for the discussion which it will elicit.

Amongst the papers not read but printed in this volume is one by Mr. T. Andrews on "The Corrosion of Metals in Sea Water," and deals specially with the relative corrosion of iron and steel, the results of numerous and continued experiments, being a confirmation of the extensive experiments carried out by Mallet many years ago, with all the originality and elaborate completeness which marked his experimental investigations.

We cannot and need not follow the contents of these volumes any further. We have said sufficient to show the comprehensive character of the "Proceedings" of the Institution and of the work carried out under Mr. Forrest. These four volumes contain stores of information of which we have not been able to say one word, and it is all presented in a way that places these "Proceedings" in the first rank, both as to character, completeness, finish, and facility of reference. A separate volume containing the set of lectures delivered last session on hydraulics, has also reached us, and contains the opinions of the acknowledged authorities on the various branches of the subject.

The Panama Canal: Its History, its Political Aspects, and Financial Difficulties. By J. C. Rodrigues, LL.B. London: Sampson Low and Co. 1885.

A little over a century and a-half had gone by between the time that France was wildly subscribing in the eighteenth century to the great Mississippi bubble of John Law the English people to the similar South Sea bubble, and the time that France almost as enthusiastically subscribed to the Panama Canal scheme of their countryman, M. Ferdinand de Lesseps. We do not say that there is any very exact likeness between the two things in which the French were called upon to invest, but if Mr. Rodrigues' book is to be credited throughout, the financial difficulties of the Panama Canal Company are likely to cause a very disagreeable stir before long in Paris.

The author is perhaps strongly imbued with American ideas on this subject, but this need not affect the statistics he quotes of the finances of the Panama Company, whatever it may do in affecting his opinions as to the amount of work to be done in making the canal. He tells us that in December, 1879, he accepted a special commission from the editor of the *New York World* to go to Panama, there to meet M. Lesseps, and to write his impressions of the canal scheme in its different bearings. Since that time he has followed the subject very closely, and his impressions of 1880 have grown into conviction.

It is unnecessary to follow the author through his pages, but we may say that they lead him to the conclusion that M. de Lesseps has "allowed himself to be used as a tool in the hands of ambitious people who, in plain words, bought his name, in order that they might enrich themselves out of the savings of the artless and enthusiastic mass of his own countrymen." He maintains that M. de Lesseps never made a serious study of the scheme until it was found that the people did not support the company, then he went to Panama with an "International Technical Commission," organised by himself, and although this commission found that the eighteen days' survey which previously had provided all the information for building up estimates, was incorrect, and that the estimated amount of excavation would be about seventy-five millions instead of forty-six million cubic metres, M. de Lesseps reduced the estimated cost before he got back to Paris by about one-fourth, bringing it down to £33,720,000 instead of £42,000,000 as fixed by the Congress, and then also further reduced it by eight millions sterling, finally bringing the estimate down to £26,320,000. On his return he assured the public that the Americans were favourable to his scheme, compared the work to that of the Suez Canal, appealed again for money, and received as result of first call nearly six million sterling, of which £1,800,000 went straight to the pockets of promoters and concessionaires. Mr. Rodrigues tells his readers a great deal about enormous sums spent for locomotives and machinery never used, because unsuitable; tells more about difficulties not expected; that the percentage for contingencies was reduced to 10 per cent., although in the Suez Canal they reached 128 per cent., and gives what he holds to be too ample evidence that the present company must become bankrupt.

The author spares none of those who have taken part in what he styles gigantic frauds in connection with the finances of this scheme, and Americans come in for a pretty piece of hard hitting. He says, "As to the American syndicate, it is one of the most shameful corruption funds ever recorded in the history of financial enterprises. Imagine this expenditure of £480,000, so that a few men in New York might *represent* the company in America and co-operate with it when requested," and "so that here in Europe M. de Lesseps might say that America was all right."

Those in any way interested in the history or finances of the Panama Company should read this book.

THE DREDGER "MELBOURNE."

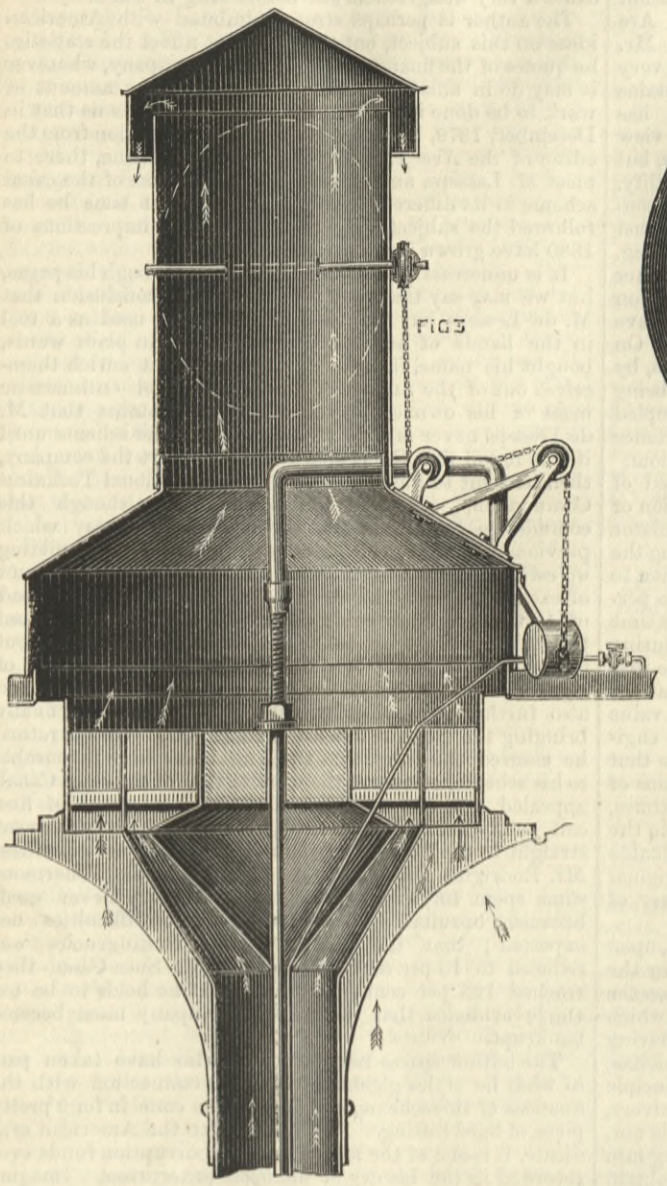
On page 376 we give illustrations of the compound engines of this big dredger. The supplementary engravings of the machinery, which we shall give in another impression, will be accompanied by a description of the whole.

Baron Sadoine.—On the occasion of the Antwerp Exhibition, M. E. Sadoine, general manager of the Société John Cockerill, Seraing, was made a Baron of the kingdom of Belgium.

Referring to the Hudson's Bay Trade Route, we recently mentioned that a party of engineers set out from Wennipeg on October 12th in order to survey the route of the projected line of railway between that place and Hudson's Bay. The object of this line, the first section of which extends about 300 miles, is no less than to open up a new trade route between Great Britain and the great North-West of Canada. It is satisfactory to be able to state, amidst all the American competition on the other side of the Atlantic, that this line has been secured by English engineers, and is now being surveyed under the direction of Mr. W. Shelford, of Great George-street, Westminster, who has himself just returned from a personal inspection of the country.

Death of Dr. W. B. Carpenter.—Dr. W. B. Carpenter, C.B., F.R.S., died at three o'clock on Tuesday morning, at his residence, 56, Regent's-park-road, from the effects of burns caused by the accidental upsetting of a lamp whilst he was taking a vapour bath on Monday. The deceased, who was in his 73rd year, was a native of Bristol, where he was born in 1813. He was the son of Dr. Lant Carpenter, of Bristol, and was educated in Bristol, at University College, London, and at the University of Edinburgh, where he graduated M.D. in 1839. He commenced practice at Bristol, but resolving to devote himself exclusively to scientific and literary pursuits, he removed to London in 1843. Soon afterwards he was appointed Examiner in Physiology and Comparative Anatomy in the University of London, and Professor of Medical Jurisprudence in University College, which offices he held until 1856, when he was appointed to the registrarship of the University of London. He was the author of "Principles of General and Comparative Physiology," "Principles of Human Physiology," "A Manual of Physiology," "Principles of Mental Physiology," "The Microscope and its Revelations," an "Introduction to the Study of the Foraminifera," some able papers in the "Cyclopædia of Anatomy and Physiology," in the reports of the British Association, in the *Quarterly Geological Journal*, and in the "Philosophical Transations." In 1861 the Royal Medal was awarded to Dr. Carpenter by the Council of the Royal Society for his contributions to physiological science. In 1868 and two following years he took a principal part in promoting the expeditions fitted out for deep sea exploration, which have yielded results of great importance to physical and biological science, and it was at his and Sir Wyville Thompson's instance that the Challenger was afterwards despatched. His reports of those expeditions are contained in the "Proceedings" of the Royal Society, and in the "Journal" of the Royal Geographical Society. The honorary degree of LL.D. was conferred upon the deceased by the University of Edinburgh in August, 1871; in 1872 he presided over the British Association at its meeting at Brighton; and in 1873 he was elected a corresponding member of the Institute of France. His last public appearance was at the recent meeting of the British Association, when he moved a vote of thanks to Mr. John Murray, of the Challenger expedition.

COUNCIL HOUSE VENTILATOR, BRISTOL.



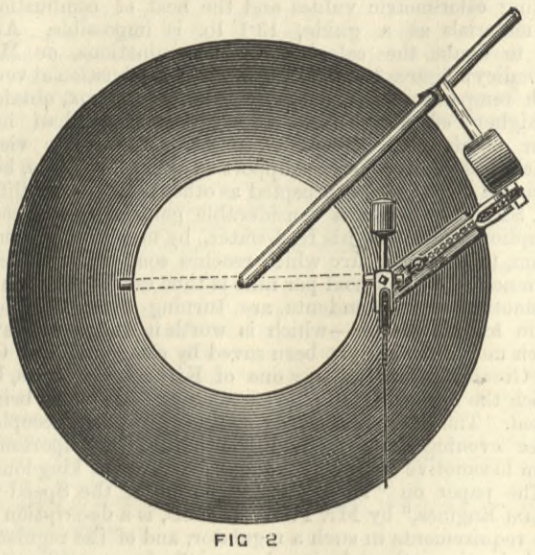


FIG 2

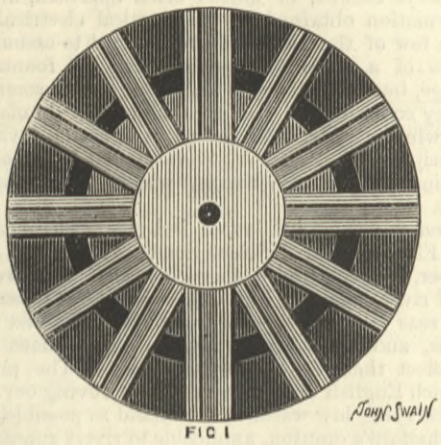


FIG 1

THE VENTILATION AND LIGHTING OF THE BRISTOL COUNCIL HALL.

By Professor Hele Shaw.

The author, who has from time to time had the honour of advising the city authorities of Bristol, was recently consulted by them with reference to the ventilation of the large room in the Council House, in which the general meetings are held. This is a handsome room 38ft. by 22ft. and 21ft. high, lighted entirely from above through a circular opening 17ft. in diameter, surmounted by a top, or lantern light in the form of a twelve-sided structure 12ft. high, having a flat lead roof, the sides being fitted with plate glass. The artificial lighting was obtained from a large and massive brass chandelier hanging from the centre of the top light, and carrying twelve argand gas lamps. No special provision has been hitherto made for ventilation, the requirements of which were supposed to be met by the windows in the top light, by two fireplace openings, and the one entrance-door, the latter, however, opening only to a lobby connected with passages in the building. Thus it is not surprising that at meetings of the Town Council, lasting several hours, with sometimes as many as sixty people present, the atmosphere became almost unbearably close. The only remedy for this was to open the windows in the top light formed by the large sides of glass, the frames of which are simply hinged at the top. This, however, led to a down-rush of cold air, which proved a more serious evil than even the vitiated air.

The author obtained full permission to carry out all necessary alterations, and at first only proposed to place three inlet ventilators of suitable design, one at one end of the hall and two on the side walls, at a height of 12ft. from the ground, and to cause these to work in conjunction with an extracting ventilator placed above the central opening. The wall ventilators were made and fixed, and even by themselves effected a marked change in the air of the hall, when, at the suggestion of the Mayor, Mr. Wathen, it was determined to remove the brass chandelier, and light the hall by a ventilating sunlight in its place. The wisdom of the step is obvious when it is considered that, besides being a great obstructionist in the matter of daylight, the chandelier was a source of deleterious influences, not only on the assembly below, but on the very valuable pictures for which the City Hall is noted, one, for instance, being a Vandyck of Charles I. On investigation it was found that the roof of the top light was constructed in the old cart-wheel style, with a central block of cast iron 12in. diameter and 6in. thick, with radiating arms 3in. wide, as shown in Fig. 1. This rendered it impossible to employ any ordinary pattern of sunlight, and a special design was made by the author's brother, Mr. Edward Shaw, in conjunction with Mr. A. M. Hunt, to meet all the requirements of the case, which Messrs. Strode, of London, the patentees of the sunlight, proceeded to construct. This sunlight—which is shown in Fig. 3—has forty-two burners, and extracts the vitiated air in three ways: (1) By heating the outer cone inside the perforated pendant, thus warming the air on its passage towards the ventilating shaft; (2) by drawing the air with it as it issues into the chamber above the level of the roof; (3) by the draught in the flue above.

In order to fix the sun-burner a hole was cut in the centre of the ceiling 3ft. in diameter, and the space round the hole between the plaster and the roof protected by sheet iron backed with plaster. This space, which was partly blocked by the cast iron centre and radiating arms, had to be divided into outer and inner concentric spaces, as shown in Fig. 1, the former for the escaping air from the room, the latter for the heated products of combustion from the burners. Every precaution has been adopted to prevent the flow of gases being checked, thus wedge-shaped casings have been fitted to the radiating arms and a cone to the cast iron centre. Arrangement has been made to enable the attendant to regulate the throttle ventilating valve, shown in dotted lines, Fig. 3, which acts to prevent a down flow of cold air when the burners are not lit, and this arrangement is as follows:—Outside the door of the hall is fixed a box in such a position that a person standing by it can see the sunburner. A handle inside the box can be pulled down and secured at any one of a series of holes arranged vertically in a plate fixed to the back of the box. This handle is connected by means of a wire rope and chains to the gas tap lever, which is heavily weighted, so that when the handle is released the weight falls and shuts off the gas. On its way from the handle to the gas tap lever the chain passes over a series of pulleys, one of which is fixed to the balanced arm carrying the large ventilating valve in the 18in. pipe. When the handle is at the top of the box this valve is shut, but on being pulled down the small balance weight is overcome and the throttle valve opened to an extent indicated by the top series of numbers in the box. When the ventilator is fully opened the further pulling of the handle turns the gas on by an amount shown by a second series of numbers. The arrangement is such that the gas cannot possibly be turned on until the ventilator is fully open, thus entirely preventing the gas from collecting in the flue or top light, and so causing an explosion, and should the wire or chain give way the weights cause both the ventilator and gas tap to immediately close. A thorough test has been made since the alterations, and both lighting and ventilation have given entire satisfaction. H. S.

University College, Liverpool.

TENDERS.

For the erection of filter presses, and other machinery in connection therewith, for the Brentford Local Board. Mr. F. W. Lacey, A.M.I.C.E., engineer.

	£	s.	d.
Messrs. Manlove, Alliott, Fryer and Co., Nottingham—accepted	1320	0	0
Messrs. S. H. Johnson and Co., Stratford, E.	1200	0	0

For making up Albany-road and Bangor-road for the Brentford Local Board. Mr. F. W. Lacey, A.M.I.C.E., surveyor.

	£	s.	d.
Albany-road.			
Nowell and Rolson, Kensington	292	0	0
S. Atkins, Twickenham	280	0	0
H. R. Trehearne and Co., Battersea	252	0	0
J. Mowlem and Co., Westminster	251	0	0
T. Brunsden and Co., Brentford	229	0	0
H. Spicer, Brentford—accepted	215	0	0
Bangor-road.			
Nowell and Rolson, Twickenham	233	10	0
H. R. Trehearne and Co., Battersea	220	0	0
T. Brunsden and Co., Brentford	218	0	0
H. Spicer, Brentford	203	0	0
J. Mowlem and Co., Westminster	197	0	0
S. Atkins, Twickenham—accepted	190	0	0

THE GRAMME ARC LAMP.

From the moment when Gramme had invented his dynamo, he turned his attention to the production of a good arc lamp, and he has worked in this direction for several years. His labours have resulted at last in the production of the lamp which we illustrate, and which is in successful operation in the Antwerp Exhibition. The accompanying section will make its construction quite clear.

The whole of the "regulator" is contained in a case, through the bottom of which the upper carbon holder passes. The mechanism consists of two parts, independent of each other. The one feeds the lamp, the other strikes the arc. A powerful electro-magnet A A commands this latter portion of the mechanism. The two side rods carry the lower carbon. They are connected to an armature by two stout springs R R. The magnet is fixed to the frame or case of the lamp by a kind of bridge, on which it stands as shown. The springs R R continually tend to lift the lower carbon up. When a current passes through the magnet, the armature C is drawn down, the resistance of the springs overcome, and the lower carbon is lowered and the arc struck.

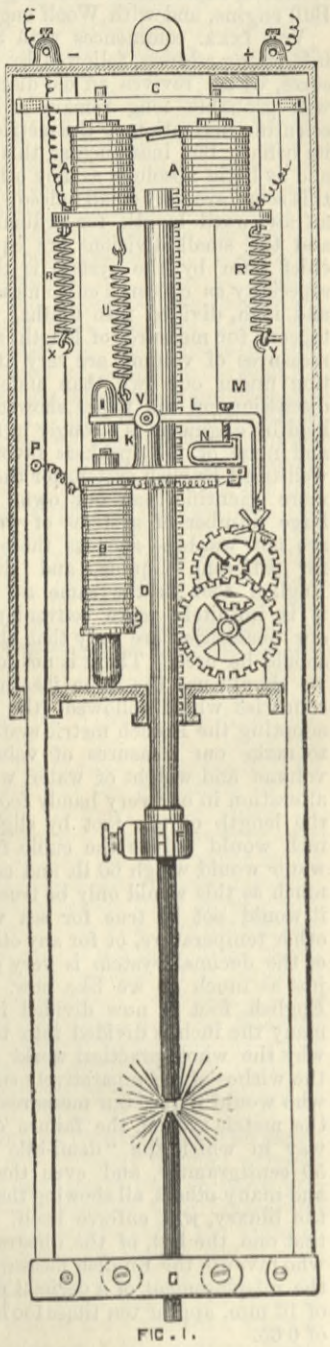


FIG. 1.

Let us turn now to the feed mechanism, in which we see that, as in most arc lamps with gearing, a train of wheels is put in motion by the weight of the upper carbon holder, fitted with a rack, taking into one of the wheels of the train. The last pinion carries a five-armed fly. The motion of this is checked by a reheotome detent S, controlled by an electro-magnet B. This is the most important part of the lamp, as its action is such that the light does not jump, the feed being very steady. The mode of action will be readily understood. I is the armature of the electro-magnet B; the detent S is secured to the lever L, in which is a regulating screw M, resting on the bent spring N. The lever moves on a centre V carried on the bridge piece R. The screw M makes contact with N; the coiled spring U opposes the pul of the magnet B.

The current enters the lamp at X, which is not insulated, so that the whole regulator is in circuit. The shunt magnet B is, however, only in circuit while M rests on N. So long as the principal current possesses sufficient intensity, the detent S prevents the revolution of the fly with which it engages. If the main current becomes weakened by the lengthening arc, more current passes through the shunt magnet B, which then draws down the armature I, and raising S leaves the fly free to revolve, but the moment S is raised, the current is cut off from B, and S is suffered to fall again. The operation is immediately repeated if the carbon has not descended sufficiently. If the parts I L were made light, we should have nothing but a rapid make-and-break action, which would not permit a tooth to escape at all, or at least without certainty; but being heavy, the action is deliberate, and the fly being fitted with a fan, a very pretty step-by-step motion is ensured. We watched the action of one of these lamps for some time in the Antwerp Exhibition, and found that it generally fed one tooth of the fly at a time, sometimes two teeth, and very rarely three teeth. In one sense the feed was nearly continuous, taking place two or three times a minute. The lamp worked very well indeed. It is to be remembered, however, that the current was very steady, and the carbons very good; but we have no reason to doubt that the lamp would perform well even under more unfavourable conditions. M. Gramme says of his lamp:—"In all the regulators yet constructed, the advance of the upper carbon is determined by an electro-magnet and a spring pulling against each other. When the influence of the electro-magnet makes itself felt sufficiently to overcome the spring—that is to say, when the armature is attracted—the distance between the armature and the poles being reduced the equilibrium between the spring and the magnet is interrupted for a time, and the carbons run down further than is necessary." This is a defect which has often been commented on. M. Gramme has got over the difficulty very satisfactorily, but there are other expedients for gaining the same end. The most prominent defect we can find in the lamp is that sparking will take place between M and N. This is not in itself serious, but sparking leads to bad contacts, and a train of minor evils which always ensue. However, we have here a very simple and excellent lamp, the performance of which leaves little to be desired. Its external characteristics are, however, not all that could be desired, and it will be seen that no cut out is provided.

Shipbuilding in Italy.—An iron steamer of 300 tons burden will shortly be launched at Genoa, from the shipbuilding yard of Messrs. E. Cravero, marine engineers at La Foce. She has been built for a Genoese shipowner, Mr. A. Nain, who, since 1878, has established a regular packet service between Genoa and Rome. This vessel will be the largest that has hitherto ascended the Tiber as far as Ripa Grande. A contract has been given by the Italian Government to the same firm for building four sea-going torpedo boats. They are to be 40 metres—131·1ft.—in length, and are to be delivered in eighteen months. The total cost will exceed £40,000.

the wealth the canal works will bring them. The land has already gone up in value some hundreds per cent., and, greater increase being anticipated, those who now own the acres are keeping a tight hold upon them. It is expected that through the agency of this canal and its lateral branches the land will be converted from wheat fields into orchards and vineyards, the soil and climate being suitable for that purpose, and the present proposal is to split up the country as far as possible into homesteads of moderate dimensions.

HYDRAULIC BOILER TESTS.

THE substance of the report of the committee of the United States Master Mechanics' Association appointed to report on this subject is given herewith. After reprinting the circular and explaining that realising the fact that it is the general practice to combine other tests with hydraulic, they had ventured so far to exceed their instructions as to solicit information on other tests in connection therewith; and after putting in the complaint that only thirteen answers had been received from 240 circulars sent to as many members, the committee say :—

Of the thirteen replying to the circular, three are entirely opposed to hydraulic tests, one saying he thinks it an injury to a boiler; and another says he has seen a boiler tested to 120 lb. by hydraulic pressure, that leaked at every joint, but was perfectly tight under an equal pressure of steam. Of the ten members reporting who favour hydraulic tests, all give decided preference to hot over cold water as giving proper expansion to the parts, and favour the introduction of hot water in preference to firing the boiler filled with cold water, as the want of circulation by this plan is likely to produce unusual expansion; and while some favour frequent tests and others think them only necessary after general repairs to boilers, they all recommend careful inspection to detect pitting and grooving, and hammer tests to detect defective stays and braces. The excess of tests over working pressure recommended by different members varies from 25 lb. to 40 lb., and while they do not consider the test at rest conclusive as to its perfect safety under all conditions of service, yet they consider it as conclusive as any test under such condition.

Mr. Lawson, of the Lawson Non-explosive Boiler Company, to whom a circular was sent, replies :—"I think hydraulic tests desirable with pressure sufficient to discover leaks and weak parts which might escape the eye, and as often as there is reason to think that parts of the boiler may have become weak from corrosion or other causes, I think a pressure not exceeding one-fifth of the tensile strength of the boiler can do no harm to the seams." Mr. Johann, of the Wabash, St. Louis, and Pacific Railway, says he is decidedly opposed to the excessive cold hydraulic test, as he considers it liable to create a defect where none previously existed; but uses the hot hydraulic pressure, applying it with the Rue boiler test—with which most of you are doubtless familiar—and connecting to a system of steam pipes running to the pits.

Mr. Barnett, of the Grand Trunk, favours careful measurements of the boiler both under pressure and after pressure is removed, to determine if any alteration of shape occurs or permanent set after pressure is removed.

Your committee, after a somewhat extended experience in testing both new and old boilers, added to what information they had gathered from other sources, would respectfully recommend that all boilers intended to carry ordinary pressure in service should be tested when new to 180 lb. hydraulic pressure by introducing hot water; and after the boiler shall have become warm, so as to produce uniform expansion, the pressure to be applied, and a careful examination made to determine if any change of shape is produced in any of the parts that would indicate weakness in design or material; and an examination after pressure is removed of stays and braces, to see if any weakness is developed or undue strain thrown upon individual members; for we are thoroughly of the opinion that a new boiler that will not stand a hot water pressure of 180 lb. without movement of its parts or overstraining is not absolutely safe to stand the strain of service through its ordinary life.

For all subsequent tests, preceded by a careful inspection, as specially of stay bolts by hammer tests, we would recommend a hydraulic pressure by hot water of not less than 25 lb. above working pressure. We consider a pressure test the only perfect one for a boiler, inasmuch as it reaches every point and exposes every defect possible to reach at rest. Defects that, through inadvertence or position, might escape other methods, will not escape this. We also believe hot water to be sufficiently elastic to thoroughly equalise the pressure, and as it will expose a leak more readily than steam, and can be much more economically applied, and is also much more cleanly in its application, we most heartily recommend it as the most proper test available. And now, in conclusion, we approach the question of the frequency of tests with some trepidation, but inasmuch as the efficiency of any method depends upon its systematic application, we are constrained to recommend a periodical inspection and test every twelve months for the first two years of the life of a boiler, and thereafter every six months of all boilers in service.

The committee, which consisted of W. N. Sprague, W. L. Hoffecker, and D. O. Shaver, also submitted the following boiler-test rules of the Pennsylvania Railroad as a part of their report, as in their opinion among the best extant:—

"*Boilers of locomotives.*—The boilers of new locomotives must be subjected to an hydraulic pressure of 25 lb. per square inch above their rated working pressure before going into service. This test must be made once a year for the first two years, and thereafter every six months. When boilers are being tested, the foreman of the machine shop having under his charge the repairs of locomotives must attend personally, remaining outside, while an assistant examines the fire-box from the inside. A record of all tests must be made, giving dates, and anything worthy of mention, which must be signed by the foreman and the person assisting. The boiler must be heated to near the boiling point of water before the test is commenced. Special examination of the stay bolts of locomotives in service must be made not less frequently than once every week. An inspector especially trained for the service must tap each stay-bolt from the fire-box side, and judge from the sound which of them are broken. When these examinations are made there must be not less than 30 lb. of steam pressure upon the boiler, which will produce sufficient strain upon the stay-bolts to cause the separation of the parts of broken ones. Should the boiler not be fired up, the examination can be made after drawing all the water from the boiler, in which case the vibration of the sheet after striking the bolt will indicate any unsoundness. The latter test is preferable when it can be made without inconvenience. He must keep an accurate record of the location of each imperfect bolt, and report the same to the master mechanic, who will decide, from the position of the bolts and the construction of the boiler, whether the locomotive must be withdrawn from the service. No locomotive must be allowed to remain in service when there are one or more stay-bolts broken in the top row. The dates of all tests of boilers and examinations of stay-bolts must be given by the road foremen of engines on their monthly reports to this office.

"*Stationary boilers.*—Stationary boilers carrying 100 lb. pressure per square inch must be tested in accordance with the instructions given for locomotive boilers, including the examination of stay-bolts. Stationary boilers carrying less than 100 lb. pressure per square inch must be subjected to a hydraulic pressure of 50 per cent. in excess of their rated pressures once in every six months, and a special examination made of the stay-bolts both before and after the pressure has been applied, in the manner described for the examination of the stay-bolts of locomotives. Stationary boilers of odd types, such as those used over heating furnaces, must be tested the same as other stationary boilers, so far as the pressure and dates of test are concerned, and must be examined with reference to the particular construction of each boiler. It must be understood that the foregoing rules apply to all boilers, whether located at the shops or at outlying points, and that they are in the direct charge of the master mechanic in whose district they may be placed. The dates of all tests and examinations must be promptly reported to this office, giving also the general condition of the boilers, and noting any stay-bolts or braces found to be broken.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, October 31st.

MANUFACTURERS of railway material of all kinds are exceptionally busy. The railmakers have closed large contracts within a few days, and the brokers here are now in negotiation for heavy sales, which, if placed, will probably fill the rail mills with orders to April 1st. Bridge builders and structural iron makers are full of orders, and inquiries are received which indicate that prices will continue firm. Locomotive works are suffering from a serious depression, as railway companies are repairing old engines and making them answer. Car works are running to about one-half capacity, although in some cases two to three months' work is secured. The iron and steel works throughout the country are barely securing as much business as is executed, and in some directions prices are weakening. The manufacturers of machines, blocks, lathes, and tools of all kinds are quite busy with orders that will keep their works busy up to the end of the year.

The new steel cruisers for which contracts were by the late Administration with Mr. John Roach will be completed. The last Congress appointed a Commission to report upon the policy to be adopted by the Government to secure a supply of ordnance and armour-plates. The Commission has investigated the facilities of a good many manufacturers, and have sent out circulars asking for specific information, and will meet in New York on November 17th to consider the answers, and to give hearings to any parties desiring to be heard.

The improvement in manufacturing and trade circles is indicated by the decline in the surplus reserve since July 15th from 65,000,000 dols. to 30,000,000 dols. A large amount of capital is being called out of the vaults, though the rate of interest is very low, and will likely continue low, because of the abundance of money.

Quite a number of new enterprises, requiring a large amount of capital, are under consideration; and unless something unusually depressing shall intervene, a large amount of important engineering and railway enterprises will be undertaken on the opening of spring.

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

(*From our own Correspondent.*)

THE iron market is disarranged by the notice for a reduction of wages which has been given by the ironmasters. Buyers anticipate that the reduction will lead to lower prices. Ironmasters explain that there is no room for further ease, but consumers are preferring to delay the distribution of orders until after the arbitration, which, it is expected, will occur early next month. Meantime, the works keep fairly active, although specifications are not so brisk as could be wished. Sheets still lead the market, and makers have a good deal of work in hand. Prices are very varied, and range from £6 15s. for galvanising doubles up to £7 17s. 6d. and £8 for lattens.

Black sheets of the Woodford brand delivered to out-ports are quoted £8 for 20 gauge, £9 10s. for 24 gauge, £11 for 26 gauge, and £11 10s. for 28 gauge. Woodford crown close annealed sheets are £9 10s. for 20 gauge, £11 for 24 gauge, £12 10s. for 26 gauge, and £13 for 28 gauge. For best qualities 30s. per ton more is demanded on each gauge, and for double best a yet further 30s. per ton. Siemens-Martin steel sheets stand at £13 for 20 gauge, £14 10s. for 24 gauge, £16 for 26 gauge, and £16 10s. for 28 gauge. Charcoal sheets of the Woodford make are £16, £17 10s., £19, and £19 10s., according to gauge.

In tin-plates there is a good business doing, and makers speak confidently of prospects. Prices keep firm, and Crowther Brothers and Co. quote best charcoal plates, 22s. per box; ordinary charcoal, 20s.; best coke, 18s. 6d.; common coke, 16s. The extras for each X are 5s. 6d. per box on best charcoals, 5s. on second quality, 5s. on best cokes, and 4s. 6d. on common cokes. In lead and terne coated sheets, of which Crowther Brothers and Co. make a speciality for the use of hardware manufacturers, the firm are fairly well occupied, and quote No. 3 lead singles, £13; B lead, cold rolled and close annealed, £17; B terne, £18; charcoal terne, £20; C C lead, hard singles for cotton can manufacture, £12 10s.; doubles, £13; and lattens, £14 10s. Annealed tin sheets the firm quote: Best coke, £24; best charcoal and best soft steel, £26; and extra best charcoal, £28.

Marked bars remain steady at the standard quotation of £7 10s., whilst for the common sorts £5 is about the minimum. Second-class sorts are £6 10s. down to £6.

Shoe and tie bars are realising fair sales, though export demands in the last-named branch have not much increased. Angles and tees are in moderate demand at £5 10s. to £5 12s. 6d. for common sorts. Inquiries for good lots have come to hand in those sections, but without much augmentation in sales so far.

Hoops are pretty well inquired after for the colonies, and there is a moderate business doing in girder iron and plates for home use. Common hoops are abundant at £5 10s. at works; gas tube strip, £5 2s. 6d. to £5 5s. Tank plates, £6 15s. to £7 and on; boiler plates, £7 10s. to £8 and £8 10s.

Steelmasters are not finding that amount of custom from makers of ordinary merchant and galvanising sheets which they had hoped for. Sheet makers state that it pays them better to continue to use puddled iron. The introduction of steel blooms and billets into the sheet mills means, they declare, a reduction in the output at once of something like one half. The outlook for the puddling process is, therefore, better than it had at one time been imagined was likely. Neither is steel making rapid progress among constructive engineers here. Engineers, indeed, reiterate their former expressions of opinion, that for structural purposes iron will continue to hold its own for a long time. The increased oxidation of steel is held to be no light disadvantage. But a more serious drawback is the want of reliability which is declared to be still a characteristic of much of the steel put upon the market.

Sales of pigs are slow. Prices for the better classes show a little more firmness than those for mixed and cinder pig, of which there are still, here and there, heavy stocks on hand. A good many buyers have completed contracts which will last them until after Christmas.

All-mine pigs are still 55s. to 57s. 6d.; part-mines, 42s. to 45s.; and cinder pigs, 32s. 6d. to 35s. Hematites are mostly quoted 53s. to 54s. The Tredegar brand is quoted 54s. for No. 3, and 43s. for second quality. Northampton pigs are 38s.; and Derbyshires, 39s. to 40s.

There are now thirty-five furnaces in blast in South Staffordshire, an increase of three upon last year, and the average make per furnace has also increased.

A good attempt will be made by certain of the constructive ironwork manufacturers here to obtain a contract which the City of Liverpool is intending to give out for the wrought iron girders and other ironwork necessary for carrying New Pall Mall over the Waterloo tunnel of the London and North-Western Railway.

The standard quotation for iron roof work is regarded at the present time as £12 per ton and upwards on trucks in Staffordshire, and for iron rivetted girders £10 per ton and upwards. Galvanised shedding for agricultural purposes is priced on the basis of £35 for 40ft. length.

Railway wagon builders in Birmingham speak of a much better demand for iron underframes and wagon ironwork generally than for complete carriages and wagons. Some concerns are very well off in the ironwork department, while in the body-building shops they are very quiet.

Railway fastenings are in slow demand. The Patent Nut and Bolt Company, Smethwick, however, on account of the unique position which it has established, keeps a favourable exception, and is still able to command a good deal of work of one sort or another. The increasing extent to which our home trunk lines are manufacturing their own railway fastenings is regarded by makers as accounting for not a little of the present quietude, and at the same time the competition of the German, Belgian, and French makers is increasing in neutral markets. A revival in foreign railway construction would be heartily welcomed by the Staffordshire makers.

Cast iron pipe manufacturers are mostly well engaged, but the work has to be accepted at a fine figure.

The wrought iron tube trade is not as active as it usually is at this season, even in the gas branch. The competition of German firms is still formidable on the Continent; but in this country and the colonies English makers have now got prices at a level which defies competition. Large rivetted tubes for waterworks are in brisk demand for colonial and other markets.

Some interesting experiments with a new fire extinguisher patented by Mr. Reuss, of Manchester, have been conducted in the presence of the Birmingham Watch Committee. The apparatus is specially designed for household use, and consists only of a cylinder no larger than a big wine bottle, fitted on to a small hose pipe, which may be attached to a water tap. The cylinder contains a chemical preparation, which being dissolved as the jet of water shoots through it, generates carbonic acid gas.

In the school recently started in Birmingham by Mr. George Dixon, chairman of the School Board, a valuable engine of technical education has been put into the hands of the operative classes, which should do a great deal towards placing Birmingham artisans on a level with those of foreign countries in this respect. The school already contains 200 boys, and in its first year earned nearly £600 in Government grants.

The Birmingham Trades Council have just discussed the question of fair *versus* free trade, and have given an adhesion to the continuance of our present commercial policy. The Council also resolved: "That they viewed with regret the answers given by the local Chamber of Commerce to the Royal Commission, that trades unions and the laws affecting the hours of labour have been some of the causes of the present depression."

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business throughout all branches of the iron trade in this district still drags on in a dull, depressed manner, as it will probably continue to do for the remainder of the year, and the tendency of prices is downwards. Makers do not openly quote reduced list rates, but these are only really adhered to in a few instances where they have still a considerable weight of iron to deliver against old contracts, and are content for the time being to remain out of the market. Where orders are wanted there is a disposition, in face of the present discouraging outlook of the market, to accept very low figures rather than allow business to pass, and in some instances prices are taken that are almost, if not quite, as low as those ruling prior to the recent rise in the market.

There was a tolerably large attendance on the Manchester Iron Exchange on Tuesday, but there was again very little business done. The Lancashire pig iron quoted rates remain at about 38s. 6d. to 39s., less 2½ per cent., delivered equal to Manchester, and local makers show little or no disposition to come below these figures, although they are considerably above what buyers are prepared to give, and also above the prices at which some of the Lincolnshire brands are being offered. For district brands quotations range from 38s. to 38s. 6d. and 39s. to 39s. 6d., less 2½, delivered here; but even the minimum figures do not bring forward any buying. North-country iron is being offered in this district at almost as low prices as ever, and best named brands of Middlesbrough foundry are to be got at under 41s. net cash, delivered equal to Manchester, whilst Scotch iron is offered freely at under makers' prices.

Hematites continue in very poor demand and low in price, good foundry qualities being obtainable at about 51s. 6d. per ton, less 2½, delivered into this district.

In manufactured iron there is still only a very slow trade doing, and with works getting short of orders there is a growing weakness in prices. The average basis of quoted rates remains at £5 5s. per ton for bars delivered into the Manchester district, and some of the leading makers still hold to this figure as their minimum price, but for prompt specifications there are makers of both Lancashire and North Staffordshire bars who are prepared to come as low as £5 2s. 6d. per ton, with hoops to be bought at £5 12s. 6d. per ton.

The condition of the engineering trades continues without improvement from the general slackness previously reported. In exceptional cases there is activity on special work, and as illustrations of this, I may mention that Messrs. Hulse, of Salford, who have large orders in hand for special tools, are under the necessity of again extending their works by the building of an additional erecting shop, which will cover in what was previously their open yard. Messrs. Goodfellow and Matthew, of Hyde, are also busy, and amongst other orders have in hand a pair of special engines of 600-horse power for Woolwich, two pairs of Corliss engines, 350-horse power, for Indian mills, together with the requisite gearing; also a pair of 400-horse power engines and mill gearing for a local firm, two travelling cranes, one for Liverpool and the other for the Admiralty, together with a number of small high-pressure engines, and a high-pressure condensing engine of 70-horse power for the South of England. Other similar instances might also be mentioned, such as Messrs. Hetherington and Co., of Manchester, who have a very large order for cranes in hand; but these are exceptional cases, and do not at all represent the general condition of trade.

When so much stress is being laid, as at the present time, on the importance of a more practical training in our schools, especially in connection with mechanics and engineering, it will be of interest to note a visit last Friday by a number of pupils under Mr. Thos. Jones, teacher of engineering and engineering drawing at the Central Board Schools, Manchester, to Messrs. Wm. Barningham and Co.'s Ironworks, Pendleton, Salford. The visit was for the express purpose of seeing the process of iron manufacture in actual operation, and the pupils saw the pig iron puddled, hammered under the steam hammer, and then rolled out into puddled bars; afterwards cut up into short pieces, re-heated and rolled out into rails, angle iron, and round bars. Great interest was manifested in watching the various processes and in listening to the explanations which were given by the managing director, Mr. I. Bowes, and the foreman of the works. To the pupils an opportunity was thus afforded of acquiring really practical knowledge, which would render much more intelligent their school studies of the subject, and if similar visits to works, where available, could become a systematic portion of ordinary school instruction, it would probably help forward considerably the practical and scientific training, the importance of which in connection with our various branches of industry has been so much urged of late.

The practicability of working coal at much greater depths than hitherto has been generally thought possible was strongly urged in the course of a paper on "The Long Wall System," by Mr. W. E. Garforth, a mining engineer of Normanton, before the members of the Manchester Geological Society on Tuesday. The two main difficulties to contend with were, he said, (1) The pressure due to the weight of the superincumbent strata; and (2) the increase of temperature owing to the greater depth from the

surface. With regard to the first difficulty, it had been shown that a proper system of working allowed the subsidence of the overlying strata to be regular, and by the weight being thrown on the goaf, a large portion of the pressure was taken from the face, and the coal was saved from being crushed. A further advantage might be obtained by holeing in the dirt above and below the coal, which tended to lessen the resistance. By packing the goaf close up to the roof and ripping above the same, the height of the roadways could, at a reasonable cost, be maintained sufficiently long for the coal to be won, and roadways made in the goaf, which gave off no inflammable gas, when consolidated, were preferable for ventilation to those driven in pillars of crushed coal. The area of the roadways could be maintained, and sudden outbursts of gas avoided, either in a system of working which caused frequent breaks, by bore holes, or by driving return air ways in the overlying seam. There were other matters connected with the working of deep mines which should also be considered, for instance—that the subsidence of the surface, owing to the increased thickness of the strata, and the number of laminations was more regular than in shallow workings; that the average yield per foot per acre would prove to be more in many mines in the future than in the past; that if the sectional area of the roadways could be maintained, as he believed they could, large volumes of fresh air could be circulated through the mine, and by increased splitting could be changed more quickly; that men were now working at upwards of 1000 yards deep without experiencing the difficulties that were at one time feared. There were also the natural advantages connected with deep mining, such as less water than in shallow mines; probably the cost of pumping water in the past had been greater than the extra outlay for keeping the roadways in the future; that inflammable gas was not met with in greater quantities at 1000 yards than at one-third that depth; and that the temperature had not increased at the same rate as anticipated. After many inspections of the deepest mines now being worked—and in the case of the Ashton Moss Colliery, near Manchester, the depth was over 1000 yards—he had come to the conclusion that coal would continue to be worked as deep as it was proved to exist. The last generation of colliery managers had expressed doubts about winning coal at 500 yards, and their fears were probably of equal value with the doubts expressed by some people of to-day.

The coal trade is without material change; the colliery proprietors in the Manchester district maintain the advance in prices put on at the commencement of the month, but in other districts there has been no appreciable upward movement. House coals move off pretty freely, but other sorts for ironmaking, steam, and general trade requirements continue bad to sell, and plentiful in the market.

Shipping has been rather more active, with slightly better prices being got in some instances at Liverpool and Garston.

Following the 10 per cent. advance in wages that has been given to the men in the Manchester district, the miners' conference at Manchester last week decided that notice should be given generally for a similar advance. So far as the colliery proprietors in south-west Lancashire are concerned, they are very resolute about not entertaining any advance of wages in the present state of trade.

Barrow.—Commercial business here is very much handicapped at the present moment by political considerations, which are exercising the minds of all classes. But trade is so dull in all its branches that if any new orders of moment were offering they would readily be picked up by scores of makers who are in want of work, and whose establishments, speaking generally, are very indifferently supplied with contracts. The requirements of consumers of hematite pig iron are very limited, and the markets, which at one time were open to local producers of this class of metal, are now in many instances closed either actually or practically. For instance, very little is being done with America, and only a limited trade is being done with continental users, who are now able to supply themselves very readily by means either of imported Spanish ore or by the adoption of the basic process, which in many cases has taken place on a fairly large scale. On colonial account the business doing is comparatively small, and the enquiries with a view to further orders are not only few in number, but are accompanied with a total absence of either spirit or enterprise. Many people are entertaining the belief that the trade of the country, so far as iron is concerned, has not reached its lowest point; but it is difficult to conceive how it can be possible to reduce matters to a lower point except means are found for getting cheaper raw material on the one hand and cheaper labour on the other. Working men are now paid very low wages, and it is equally difficult to see how they can take less wages unless they can get cheaper food, cheaper rents, &c., and of this there is not much prospect. Steel makers and shipbuilders are alike very indifferently employed. Iron ore and coal are in limited consumption at late values. The engineering trades are fairly employed in the marine department, but are doing very little in general orders.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Earl Fitzwilliam has promptly corroborated what I mentioned some time ago as to the Milton and Elsecar Ironworks. Admiral Douglas, his agent, noticing the statement that three distinct offers had been made from persons desirous of taking and carrying on the works, writes to the *Sheffield Telegraph* to say that at the time of Mr. Dawes' lease expiring in 1879, every endeavour was made to re-let the works, and amongst others Messrs. Newton, Chambers, and Co. were invited to take to them; but after inspection and due consideration they declined, stating that they could not be worked to advantage. Admiral Douglas adds:—"No distinct offer was ever made to either Earl Fitzwilliam or myself, and no terms were ever suggested or discussed." This ought to settle the controversy.

Mr. George Wilson, chairman of the Cyclops Steel and Ironworks—Messrs. Charles Cammell and Co.—has returned from St. Petersburg, where he has been on business connected with the Kolpino Works near that city. The company some time ago came to an arrangement with the Russian Government, whereby armour plates could be produced there under English superintendence.

The coal trade continues very dull, in spite of the raw November weather, and there are no indications whatever of any improvement.

The Board of Trade returns for October again show a serious decrease, as compared with the corresponding month of 1884, in the different productions which interest the Sheffield district. In hardware and cutlery the total value exported was £261,313, as compared with £284,856 and £328,141 in the corresponding month of 1884 and 1883. The decreasing markets are: Russia, from £5068 to £4684; Germany, from £18,413 to £12,678; Holland, from £8777 to £7264; Spain and Canaries, from £6437 to £3881; United States, from £25,958 to £24,758; Brazil, from £12,351 to £11,223; Argentine Republic, from £10,412 to £9336; British Possessions in South Africa, from £5955 to £4877; British East Indies, from £27,379 to £27,014. The increasing markets are: France, from £11,416 to £14,417; foreign West Indies, from £5011 to £5999; Australasia, from £57,487 to £58,566.

In steel rails the values for October of 1883-4-5 are respectively £329,635, £230,392, and £168,591. No business was done during last October with Russia, Germany, Egypt, Mexico, or Italy; Spain and Canaries has fallen from £9193 in October, 1884, to £1809 last month; the United States from £2141 to £692. In October, 1883, the value sent to the States was £30,388. Brazil decreased from £16,751 to £9661; Argentine Republic, from £20,096 to £12,055; Peru, from £2749 to £83; British North America, from £54,019 to £7463; Australasia, from £60,839 to £27,111. The chief increasing markets are: British Possessions in South Africa, from £2816 to £6856; British East Indies, from £31,067 to £74,688. Railroad of all sorts shows a heavy decrease, the values for October of 1883-4-5 being respectively £448,698, £345,539, £313,123. Spain and Canaries has decreased from £12,601 to £1809; United States, from £2141 to £692; Brazil, from 18,799 to £12,124; Argentine Republic, from £48,447 to £43,479; Chili, from £2455 to £82; Peru, from £3152 to £190; British North America, from £61,182 to £8273; Australasia, from £73,004 to £37,655. British East Indies shows a very decided increase from £83,630 to £157,985. To British Possessions in South Africa the value of £35,417 was sent in October of 1883; in October, 1884, the value dropped to £3185, and last month it had risen to £8158.

Unwrought steel shows slight improvement, the value last month being £99,272, as compared with £97,414 for October, 1884. France fell from £9089 to £6906, and the United States from £25,176 to £21,263; but the trade done with other countries has advanced from £63,149 to £71,103. In October of 1883 the value exported was £120,261.

Pig iron was exported last month to the value of £200,590, against £282,910 and £385,192 for October of 1884 and 1883 respectively. The chief decreasing markets are Russia, Germany, Holland, Belgium, France, Italy, United States, and all other countries except British North America, which has increased from £17,323 to £18,979. Hoops, sheets, and plates are also lower, though not to the same extent, the values exported last October being £325,476, against £333,450 for the corresponding period of 1884.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland pig iron trade continues in an extremely dull and almost stagnant condition, there being few inquiries and fewer sales. Very little was done at the market held at Middlesbrough on Tuesday last, and prices remained without appreciable alteration. Merchants' price for No. 3 g.m.b. was 31s. 9d. per ton, which is about the same as they asked a week previously. What little business passes is for prompt delivery only. Merchants occasionally offer to book forward at 32s. to 32s. 3d. per ton, but with the present dismal outlook consumers are in no hurry to commit themselves. Most of the makers keep out of the market altogether, but there are two or three firms who are ready to accept 32s. for No. 3, provided delivery be promptly taken. Forge iron is steadily maintained at 30s. 9d. per ton.

Warrants are to be had at 32s. 6d. per ton, but there are few inquiries for them.

Messrs. Connal and Co.'s Middlesbrough stock of pig iron increased 1125 tons during last week, the quantity held on Monday last being 114,586 tons. On the same day their Glasgow stock was 635,298 tons, being an increase of 2533 tons during the week.

The shipments of pig iron from the Tees continue very unsatisfactory. Up to Monday last only 15,832 tons had been shipped since the 1st inst., as against 25,179 tons during the corresponding portion of last month.

The Cleveland ironmasters' returns for October, published on the 3rd inst., have turned out decidedly unfavourable, showing as they do an increase in stocks of pig iron of 14,182 tons for the month. Of the 154 blast furnaces in the district, only ninety-five are now at work. The output of pig iron of all kinds was 204,391 tons, that being an increase of 2239 tons as compared with the output during September. The stocks in the entire district at the end of October amounted to 443,609 tons, representing an increase of about 155,000 tons during the last twelve months.

In the finished iron trade the prospects do not improve. The demand is poor, and at prices now obtainable makers are not eager to book orders. Many of them have in fact decided to suspend operations altogether, as they cannot work except at a loss. Prices are as follows:—Ship-plates, £4 10s. to £4 12s. 6d. per ton; angles, £4 5s. to £4 7s. 6d.; common bars, £4 15s. to £4 17s. 6d.; steel plates, ship quality, £6 12s. 6d.; and steel angles, £6 5s.—all f.o.t. at makers' works, less 2½ per cent.

The West Marsh and Britannia Ironworks, belonging to Messrs. Dorman, Long, and Co., are still idle, but it is rumoured that arrangements are being made to start again shortly, the men being willing to accept greatly reduced wages rather than remain idle for an indefinite length of time.

Messrs. Jones Brothers, Middlesbrough, have decided to close their works entirely for a time. Their plate-mill has been standing for several weeks, but hitherto they have had two sheet mills in operation. The ever-increasing difficulties of carrying on the iron manufacture, together with the absence of any margin of profit, have now compelled them to suspend operations altogether and wait for better times. At the moment there are no finished ironworks of any kind in operation at Middlesbrough, and the ironworkers are walking about the streets.

Messrs. Bolckow, Vaughan, and Co., have had a serious breakdown in one of their large steel mills at Eston. The repairs are progressing rapidly, however, and by next week they expect to be again at work.

The Cleveland blast furnace men have expressed their willingness to submit to a 2½ per cent. reduction of wages, but positively refuse to have anything to do with the sliding scale. Indeed, sliding scales seem unpopular with the workmen in almost every branch of the Northern iron trade.

Great attention is now being paid to the reduction of cost of production of iron and steel products of all kinds. If the elements of cost of a ton of bar iron be carefully analysed, it will be found that when royalties and railway carriage on all raw materials used are paid for there is only sufficient left to provide for the labour of various kinds necessary to produce the bars at current rates. In other words, there is now no margin at all for interest on the capital of the coalowners, mineowners, smelters, or manufacturers, nor anything for profit. This is rather a serious state of things, and cannot last indefinitely. It is on such grounds that strong appeals are likely to be made to railway companies and royalty owners to lower their rates, and so help to save the trade from the unprecedented difficulties which now surround it.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been a good deal of speculative business in the warrant market, but the legitimate inquiry for pigs shows no improvement. The shipments are small, amounting for the week to 7617 tons against 7818 in the preceding week and 6783 in the corresponding week of 1884. A very considerable quantity has been sent to Russia and a large shipment to Italy, but the other countries are buying sparingly, and the trade with Germany and France has become much contracted. Since last report one furnace has been relighted at Coltness, but another has been put out of blast at Calder, so that the total number in operation remains at 91 against 96 at this date last year. There is a considerable reduction in the imports from Cleveland, but large stocks of this iron are held in Glasgow. The deliveries of pigs into Messrs. Connal and Co.'s Glasgow stores are larger than usual, the addition in the past week amounting to between 2000 and 3000 tons.

Business was done in the warrant market on Friday at 41s. 6d. cash. Monday's market was active, with transactions at 41s. 6d. to 41s. 8½d., closing at 41s. 7½d. cash. The quotations on Tuesday forenoon were 41s. 7d. to 41s. 8½d., and again 41s. 7½d. cash, and in the afternoon 41s. 7½d. to 41s. 8d. cash. Business was done on Wednesday at 41s. 7d. to 41s. 9½d. cash. To-day—Thursday—transactions took place from 41s. 10½d. up to 42s. 6d. cash, the advance being due to some coalmasters promising advanced wages.

The market values of makers' pig iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 45s. 6d.; No. 3, 43s.; Coltness, 48s. and 44s.; Langloan, 47s. and 44s.; Summerlee, 47s. 6d. and 43s.; Calder, 51s. 6d. and 43s.; Carnbroe, 45s. and 42s. 6d.; Clyde, 45s. 9d. and 41s. 9d.; Monkland, 42s. and 39s. 6d.; Quarter, 41s. 6d. and 39s. 6d.; Govan, at Broomielaw, 42s. and 39s. 6d.; Shotts, at Leith, 47s. and 46s.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 43s. 6d. and 43s.; Glengarnock, at Ardrossan, 45s. and 41s. 6d.; Eglinton, 41s. 6d. and 38s. 6d.; Dalmellington, 42s. 6d. and 40s.

The total shipments for the year to date are now 391,186 tons, against 479,275 in the same time last year.

The past week's shipments of iron and steel manufactured goods from Glasgow embrace machinery to the value of £7070; sewing machines, £5126; steel goods, £3750; and general iron manufactures, £33,000. The latter, including £12,450 worth of iron pipes for Yokohama, £5780 pipes and tubes for Constantinople and Japan, and £3880 pipes, sheets, and roofing for New South Wales.

In the coal trade there is a good business doing. Shipping coals are still in request, and the inquiry for household sorts is improving. The week's shipments included 25,332 tons despatched from Glasgow, 159 tons from Greenock, 1750 from Port-Glasgow, 1812 from Irvine, 6062 from Troon, 7816 from Ayr, 3425 from Leith, and 17,320 from Grangemouth. In Fifeshire the business is active both in shipping and inland orders, and the coals are for the most part cleared away as they are brought to the bank. A large proportion of the coal shipments on the east coast are for northern European ports, and it is anticipated that the inquiry for this trade will slacken at an early date. There is a scarcity of shipping tonnage, and freights are moving slightly upward. The increase in the price of coals intimated two weeks ago in the Glasgow district is not likely to become at all general. No advance has been obtained either for main or steam coals, and it is only the very finest qualities of household upon which a rise can be obtained, and even as regards these the full amount of the 1s. advance is not regularly paid.

Encouraged by the result of the Midland Counties ballot, the miners of Lanarkshire are again agitating for an increase of pay. The men talk of a strike at their meetings now to enforce the advance. As the rise in the price of coals affects only a very few of the masters, it is difficult to see how they can raise wages at present, and the general belief among coalmasters on 'Change in Glasgow this week is that the colliers will make no serious move on this side of the Christmas holidays.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

If exports fairly represent the condition of the coal trade, I should say that business was again beginning to look up; but they are not the surest gauge, as one week steamers come in plentifully and clear off the sidings, while coalowners' books do not show any alteration for the better. Yet, so far as Cardiff is concerned, a better tone is beginning to be shown, and coalowners of position have openly acknowledged their impression that "we have reached the lowest depth, and are now about to ascend." In best steam and small steam there is more animation, though not yet sufficiently marked to tell much at the collieries.

Newport does not show quite so well as it did, house coal having again drooped. At Caerphilly there are rumours of a sale of the Black Vein Llantwit Colliery, which have disturbed the neighbourhood, as now a re-start will not be likely for some months again. Other colliery speculations, principally in house coal, are hanging fire. This is to be regretted, as now would be the best time for sale, and money is abundant. A small start in house coal has begun at Walnut Tree, which will be a boon to the district, as the Works Colliery at the Drift is stopped.

I am informed that No. 3 seam has been struck at the new colliery at Ynyscadidng, proving 2ft. 6in.; and that the 9ft. is now safe at Ynysybwl. This latter colliery having now all the seams in splendid form, promises to be one of the finest in the district. Tylor's coal company, Penderyss Rhondda, is being floated as a limited company, capital £200,000 in £10 shares. The iron companies appear to be fortunate in securing coal contracts. Dowlais holds several, Cyfarthfa and Ebbw Vale are also fortunate, and last week the Tredegar Company secured one for the Waterford and Limerick Railway.

I have no general improvement to record in connection with any branch of the iron and steel trade. In fact, things appear to be getting worse, and the lower classes of labourers on the works, principally Irish, are suffering considerably. Rhymney is very quiet of late; Cyfarthfa shows little signs of stagnation, but the accumulations of stock are immense. The Messrs. Crawshay are carrying out the traditions of the family, making freely in the most depressed times, and I hope will be repaid for their courage.

The lament amongst ironmasters is that the life of a steel rail is so long that unless we can get Burmah, China, or some other country opened out for railways there is not sufficient demand to keep all going in this country. It has been suggested that a maxim of Mr. Menelaus should be carried out—"If there is no demand for steel rails, make what there is a demand for." The query is, to what purpose can steel be applied, and one "Constant Reader of The Engineer" says, get a good malleable article as a substitute for pitwood. We import a great proportion of the pitwood used, and to use malleable steel would be a double benefit. I give the idea place for what it is worth. In many places—on the face, for instance—it might be used in coal-working with or without a wooden shoe.

It is reported that the scheme to transfer one of the iron industries of the North to Newport, Mon.—that of the Messrs. Nettlefold—has been abandoned.

There is to be a resumption of work at Tondu, both at the forges and furnaces, next week. The stoppage has lasted nearly seven months, and the men will now resume work at a reduction of 5 per cent.

Speaking to a tin-plate manager a few days ago, he expressed himself as dissatisfied with the tone of things. He admitted that in the past few years there had been a great increase in demand; "Yet," he said, "do what we will, stocks increase." "The fact is," he added, "there are too many in the trade, and great as is the use of tin-plate, increasing, one might say, daily, make increases too. The stop week has told well, but when the men work they dash away, and soon make up for lost time." There is, emphatically, too much capital embarked in the trade.

Prices have slightly drooped since my last, and ordinary cokes have been sold as low as 14s. to 14s. 6d. This, however, does not represent market quotations. Siemens' and Bessemer's have declined from 3d. to 6d.

At a meeting held in Swansea last Saturday, it was agreed to pay the legal expenses of all workmen who defend themselves from paying money to employers that is not due. The attention of workmen was also called to the mode of payment at Morriston.

I am glad to note hopeful progress at Swansea. The Harbour Trust is going in for powers in the next Parliament to carry out important extensions, &c., of the Prince of Wales Docks. The Rhondda and Swansea Bay line has been further opened to Cymmer, and is generally progressing.

Launch of the Palamed.—On November 6th the s.s. Palamed built by Messrs. Andrew Leslie and Co. for the Ocean Steamship Company of Liverpool, was taken on her trial trip. The dimensions of the vessel are as follows:—Length, 320ft.; breadth, 36ft.; and depth, 27ft. 9in. Her engines, constructed by Messrs. Robert Stephenson and Co., are of the Holt's tandem design, having cylinders 27in. and 58in. diameter, with a stroke of 5ft., and indicating 1500-horse power. Steam is supplied from one large double-ended steel boiler, fitted with Fox's patent corrugated furnaces, weighing 75 tons. The engines worked smoothly and well on the trip, and, we are informed, gave the highest satisfaction. Immediately on the adjustment of her compasses the vessel proceeded to Middlesbrough to take in a cargo of iron for Liverpool. This is the first of four similar vessels now being built and engined by the same firm.

NEW COMPANIES.

THE following companies have just been registered:—

A. Tylor and Co., Limited.

This company proposes to take over the business of A. Tylor and Co., of the Pendyrys Colliery, situate at Tylorstown, Glamorgan. It was registered on the 30th ult. with a capital of £200,000, in £10 shares. The purchase consideration is £120,000 in fully-paid shares, and the payment and discharge of the debts and liabilities of the vendors in connection with the business and property. The subscribers are:—

	Shares.
Isabella Tylor, Mayfield, Sussex, widow	1
*A. E. Tylor, 117, Leadenhall street, colliery agent	1
*W. L. Bright, 117, Leadenhall-street, merchant	1
*L. Tylor, Cardiff, colliery agent	1
*W. H. Tylor, 2, Newgate-street, colliery proprietor	1
Ernest Cooper, 14, George-street, Mansion House, chartered accountant	1
*J. J. Tylor, 2, Newgate-street, engineer	1

The number of directors is not to be less than five; qualification, 200 shares; the first are the subscribers denoted by an asterisk, and Herbert Kirkhouse and John Albert Bright. The company in general meeting will determine the remuneration of the board.

Anglo-Canadian Asbestos Company, Limited.

This company proposes to purchase from Messrs. Irwin, Hopper, and Co., of Montreal, upon terms of a contract of the 26th ult., certain lands known as the Eureka and Emelie, situate in Quebec, for the raising of asbestos and other minerals. It was registered on the 2nd inst. with a capital of £50,000, in £2 shares. The subscribers are:—

	Shares.
Henry Bayliss Worrell, 14, Linden-grove, Nunhead, solicitor	1
E. T. Collis, 70, Cloudesley-road, N., clerk	1
C. W. Jones, 124, Cassland-road, Hackney, clerk	1
J. Pearce Rull, 1, Bassien Park-road, Shepherd's-bush, house agent	1
J. B. Fryer, C.E., 14, Ranelagh-road, Harlesden	1
R. Hawker Jones, 4, Annette-road, N., accountant	1
C. P. Simpson, 35, Effra-road, Brixton, accountant	1

The number of directors is not to be less than three nor more than six; qualification, 50 shares; the subscribers are to appoint the first. Remuneration, £200 per annum to the chairman, £200 per annum to any resident director, and £100 per annum to each other director.

Beaumont Machine Tunnelling Company, Limited.

This company was registered on the 3rd inst. with a capital of £10,000, in £10 shares, to purchase the plant and business of tunnel driving carried on by Colonel Beaumont and Thomas John Bewick at the river Mersey and elsewhere, and to extend such business. An unregistered agreement of the 28th ult. regulates the purchase.

	Shares.
F. E. Blockett Beaumont, 26, Kensington-gardens-terrace, engineer	1
Wm. Potts, 33, Duncombe-road, Hornsey-rise, accountant	1
T. J. Bewick, C.E., Haydon Bridge, Northumberland	1
Henry O'Niell, 83, Philip-road, Peckham, accountant	1
E. Brooke, Grove Cottage, Twickenham, clerk	1
A. A. Cubitt, 59, Mercers-road, Holloway, clerk	1
E. A. L. Elvins, 89, Appach-road, Brixton, clerk	1

The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, shares or stock of the nominal value of £200; remuneration, £800 per annum, and a further £100 for each 1 per cent. dividend on the preference and ordinary shares over £7 per cent. per annum.

Bilton Portland Cement, Blue Lias Lime, and Brickworks Company, Limited.

This company proposes to purchase the business of Portland cement, hydraulic lime, and brick manufacturers, carried on by Mr. J. Dumbleton Pinfold, at New Bilton, near Rugby. It was registered on the 31st ult. with a capital of £40,000, in £10 shares. The subscribers are:—

	Shares.
FitzGerald A. Arbuthnot, 34, Fenchurch-street, merchant	1
J. J. Lockhart, 34, Fenchurch-street, merchant	1
J. W. Pinfold, Rugby, engineer	1
W. A. Porter, 7, Mincing-lane, clerk	1
W. S. Lockhart, C.E., 7, Fenchurch-street	1
A. B. Rodyk, 7, Mincing-lane, solicitor	1
J. D. Pinfold, Rugby, engineer	1

Registered without special articles.

George Richards and Co., Limited.

This company proposes to purchase the letters patent, dated 13th January, 1884, No. 169, granted to George Richards for certain improvements in machinery for planing and smoothing wood by revolving and fixed cutters; and also to take over the business of George Richards and Benjamin Chew Tilghman, trading as George Richards and Co., at Broadheath, Cheshire, and elsewhere. It was registered on the 29th ult. with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
*J. E. Mathewson, Upperthorpe, Sheffield, engineer	1
*B. C. Tilghman, Bellefield Works, Sheffield, engineer	1
*A. Simpson, Bowdon, iron merchant	1
*George Richards, Altrincham, engineer	1
*John Richards, Altrincham, engineer	1
T. Ashton, Moss Side, Manchester, cashier	1
R. Johnstone, Hulme, Manchester, bookkeeper	1

The number of directors is not to be less than three nor more than eight; the first are the subscribers denoted by an asterisk; qualification, one share; the company in general meeting will determine remuneration. The purchase consideration is 2400 fully-paid shares.

J. B. Orr and Co., Limited.

Upon terms of an agreement of the 16th ult., this company proposes to acquire the business of manufacturers of, and dealers in, silicate paint and other articles, carried on at Charlton, Kent, by the Silicate Paint Company. It was registered on the 4th inst. with a capital of £50,000, in £1 shares. The consideration is £32,000, payable £7000 in debentures, and the balance in fully-paid shares. The subscribers are:—

	Shares.
*J. B. Orr, 46, Cannon-street, chemist	12,496
*Major-General W. P. Barwell, Rochester	12,496
E. Read, 5, Austin Friars	1
T. H. Weeks, 51, Bread-street, solicitor	1
W. J. Nevill, jun.., Carlton Club	1
C. Winch, 4, Lancaster-place, Strand, solicitor	1
T. Jukes, Old Charlton, bookkeeper	1
J. Bryson, jun., Westcome Park, S.E., clerk	1
W. A. Willoughby, 4, Lancaster-place, solicitor	1

The two first subscribers are appointed directors so long as they may each hold 1000 ordinary shares; qualification for other directors, 50 shares. The company in general meeting will determine remuneration.

Linde British Refrigeration Company, Limited.

Upon terms of an agreement of the 28th ult., this company proposes to acquire and work the British Letters Patent, No. 1458, dated 5th April, 1876, for improvements in refrigerating and freezing apparatus, and Provisional Letters Patent, No. 9612, dated 12th August, 1885, for improvement in the manufacture of ice, granted to Carl Linde, of Wiesbaden, Prussia. It was registered on the 31st ult. with a capital of £100,000, in £10 shares, with the following as first subscribers:—

	Shares.
Carl Linde, Wiesbaden, and Royal Hotel, Blackfriars, engineer	1
G. Herbert Lloyd, Springhill, Birmingham, manufacturer	1
W. Feltman, Royal Hotel, Blackfriars, and Rotterdam, brewer	1
W. Heilgers, 22, Great St. Helen's, East India merchant	1
*Ewing Matheson, 32, Walbrook, engineer	1
Carl van Lang-Puchoff, Royal Hotel, Blackfriars, and Frankfort	1
*W. Statham, St. Mary's, Bedford	1

The number of directors is not to be less than four nor more than eight; qualification, 50 shares; the first are the subscribers denoted by an asterisk, and five others to be appointed by the above signatories. The company in general meeting will determine remuneration.

Metallurgical Association, Limited.

This company was registered on the 29th ult. with a capital of £300,000, in £1 shares, to acquire and work patents, and to act as patent agents and brokers. The subscribers are:—

	Shares.
Wm. Adams, 85, Gracechurch-street, public accountant	1
G. Lomer, 115, Palace-chambers, Westminster, merchant	1
C. H. Hoare, 5, Dundinald-road, Wimbledon, clerk	1
H. G. Barlow Alexander, 125, Hampton-road, Forest-gate, merchant	1
J. Rohr, 24, Barrington-road, Brixton, merchant	1
P. Thaine, 51, St. John's Park, Blackheath, accountant	1
Lieut.-Col. R. P. Hare, 12, Queen's Mansions, Victoria-street	1

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

Railway Sleeper and Steel Company, Limited.

Upon terms of an agreement of the 22nd ult., this company proposes to purchase certain inventions of Mr. Samuel Rideal, of Wards-buildings, Deansgate, Manchester, and patents in connection therewith, for improvements in the manufacture of bolts, nuts, spikes, screws, rivets, and similar articles used as permanent way fastenings; for improvements in wheel tires, and for improvements in the manufacture of metal sleepers and chairs combined, for railway purposes. Upon terms of an agreement of the 23rd ult. the company further proposes to purchase from Mr. James Hartley Procter certain lands, buildings, machinery, and effects, at Droylsden, Lancaster. It was registered on the 31st ult. with a capital of £10,000, in £5 shares, to carry on the business of manufacturing engineers and workers in metal. The consideration for the inventions, &c., is £500 cash and 700 fully-paid shares. For the property referred to in the second agreement, the consideration is a perpetual yearly rent charge of £73 15s., the payment of £1500, and the allotment of 60 fully-paid shares. The subscribers are:—

	Shares.
J. Hartley Procter, Bolton, architect, &c.	1
S. Rideal, C.E., Deansgate, Manchester	1
W. Jukes, West Gorton, ironfounder	1
R. Procter, 22, Booth-street, Manchester, solicitor	1
J. Ashworth, Haslingden, cashier	1
T. Humphreys, Sale, Cheshire, skip and hamper manufacturer	1
J. Morris, Salford, engineer	1

Most of the regulations of Table A are adopted. Directors' qualification, £100 in shares or stock.

Parker's Electric Wire Corporation, Limited.

Upon the terms of an agreement of the 23rd September, this company proposes to acquire the Letters Patent, No. 4781, A.D. 1883, granted to Mr. J. G. Parker, for improvements in conductors of electricity. The company was registered on the 2nd inst. with a capital of £100,000, in £5 shares. The purchase consideration is 7500 fully-paid shares. The subscribers are:—

	Shares.
Edward Easton, C.E., 11, Delahay-street, Westminster	1
E. R. Robson, 9, Bridge-street, Westminster, architect	1
E. Andrew, 9, Bridge-street, Westminster, Parliamentary agent	1
J. S. Green, 1, Gresham-buildings, Basinghall-street, merchant	1
W. E. Blenkinsop, 15, Earlsfield-road, Wandsworth-common, manufacturing chemist	1
Herbert Morris Winch, 43, Horsleydown-lane, Southwark, clerk	1
J. G. Parker, C.E., 11, Queen Victoria-street	1

Registered without special articles.

PRODUCTION OF ALUMINUM IN THE UNITED STATES.—The amount made in 1884 was 1800 troy ounces, an increase of 800 ounces over the production in 1883. At 75c. per ounce, the total value was 1350 dols.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

3rd November, 1885.

13,223. ROUNDABOUTS, J. Parker, Hull.
13,224. IRON and STEEL, E. Young, Dulwich.
13,225. WASHING APPARATUS, M. F. D. C. Dannmeyer, London.
13,226. WIRE ROPES, H. Cheesman, Hartlepool.
13,227. SOCKETS for HANDLES of SPADES, A. E. Stayner, Sheffield.
13,228. APPARATUS for COPYING MUSIC, A. W. H. Wood, Ullesthorpe.
13,229. WIRE MATTRESSES, W. Brookes, Manchester.
13,230. MAKING TEA and COFFEE, T. L. Reeve, Birmingham.
13,231. NUT LOCKS, F. G. Stark, London.
13,232. FIRE ALARM APPARATUS, J. C. Wilson and M. Martin, Paris.
13,233. STONE CUTTERS' TOOLS, T. Woods, London.
13,234. AUTOMATIC SELF-ADJUSTING ELECTRIC INDICATORS, P. Jolin and T. Ballard, Bristol.
13,235. SMOKERS' COMPANIONS, W. Singleton and E. Priestman, Sheffield.
13,236. SEWING NEEDLES, R. Chidley, Middlesex.
13,237. PREVENTING WASTE in TAPPING CASKS, H. W. Robinson and C. J. Smith, Northampton.
13,238. APPARATUS for INDICATING TEMPERATURE, J. Murrie, Glasgow.
13,239. LOCKING NUTS, J. Roberts, E. G. Pickering, and J. Brindle, Harrington.
13,240. COUPLER for RAILWAY WAGONS, G. F. Martin, Eastleigh.
13,241. TINNING and FINISHING TIN-PLATES, T. H. Johns, London.
13,242. AUTOMATIC EXTINCTION of FIRE, J. Hickisson, London.
13,243. ADVERTISING, E. J. Hayball, London.
13,244. HORIZONTAL WIND ENGINES, R. Biddle, London.
13,245. REVERSIBLE LID and RING-SCREW FASTENING, C. L. L. Lloyd-Jones, London.
13,246. ELECTRIC LAMPS for PHOTOGRAPHIC PURPOSES, E. G. Craven, London.
13,247. SMOKE-PREVENTING CHIMNEY POT, H. W. Headland, Leyton.
13,248. SUPPLY VALVES for CISTERNS, W. Carr, London.
13,249. COMPOUND ENGINES for STEAM, W. Jarvis, Banbury.
13,250. PUMPS for LIQUIDS, W. Jarvis, Banbury.
13,251. CASH TRAYS for CASH BOXES, &c, W. Jarvis, Banbury.
13,252. HAND PARCEL CARRIER, E. G. Brewer.—(*A. H. Beaufery, France.*)
13,253. CABS, T. D. Gilbert, London.
13,254. CABLE COUPLINGS, H. Gale, London.
13,255. CAR BRAKES, H. J. Haddan.—(*J. F. Mallinckrodt, United States.*)
13,256. PLANING MACHINES, P. Jahn, London.
13,257. RESERVOIR or FOUNTAIN PENS, C. W. Robinson, London.
13,258. RESERVOIR or FOUNTAIN PENS, C. W. Robinson, London.
13,259. TANNING SKINS, &c., G. L. Fèvre and C. Tissier, London.
13,260. FURNACES for SMELTING ZINC ORES, L. Kleeman, London.
13,261. ROLL HOLDERS for PHOTOGRAPHIC CAMERAS, A. M. Clark.—(*E. and H. T. Anthony and Co., United States.*)
13,262. CASE for PHOTOGRAPHIC SENSITIZED PAPERS, A. M. Clark.—(*E. and H. T. Anthony and Co., United States.*)
13,263. DYEING APPARATUS, A. M. Clark.—(*L. Pfaff, United States.*)
13,264. PASSENGER INDICATOR for VEHICLES, E. Bellis, London.
13,265. VELOCIPEDES, L. A. Groth.—(*O. Ludewigs and H. Wolter, Germany.*)
13,266. DYNAMO-ELECTRIC MACHINE, L. A. Groth.—(*R. Vogler, Germany.*)
12,267. LONGITUDINAL CELLULAR DOUBLE BOTTOMS for WATER BALLAST, H. Withy and G. W. Sivewright, London.
13,268. WORKING FANS, &c., J. Y. Johnson.—(*G. E. E. Bozérian, France.*)
13,269. TELEPHONIC TRANSMITTERS, G. L. Anders, London.
13,270. OIL LAMPS, A. Kiesow, London.
13,271. TILE GRATE FRONTS, &c., S. B. Sutcliffe, London.
13,272. ECONOMISING FUEL and CONSUMING SMOKE, J. W. Holden, London.
13,273. CORN and BUNION PROTECTORS, E. Ellenband, London.
13,274. COLLECTING, COMPRESSING, &c., AIR POWER, &c., E. M. Whipp, London.
13,275. FURNACES, APPARATUS, &c., W. Deighton, Sheffield.
13,276. GARDEN HAND LIGHTS, E. Horley, London.
13,277. SHAFTS of WHEELED VEHICLES, E. Edwards.—(*L. Sanier, France.*)
13,278. BOILER FURNACES, C. B. Davison, London.
13,279. INSULATORS for TELEGRAPH WIRES, &c., W. P. Thompson.—(*E. A. Müller, Germany.*)
13,280. TREATING SUBSTANCES CONTAINING ALUMINA or IRON, W. H. Watson, Liverpool.
13,281. TREATING LIQUID REFUSE, W. H. Watson, Liverpool.
13,282. OIL STOVES, C. O. Schwartz and Brand Stove Company, London.
13,283. NUT LOCKS, A. S. Goodrich and O. F. Shaw, London.
13,284. DIVIDED CAR AXLES, H. Thielsen and H. W. Dilg, London.
13,285. EYE-BARS, C. L. Strobel, London.
13,286. SAFETY LAMPS, J. Urwin and J. F. Barlow, London.
13,287. PRODUCING DESIGNS on GLASS, S. T. Gough, London.
13,288. DRYING and BRUSHING IRON SHEETS, J. Lysaght, London.
13,289. FIXING LOOSE CUFFS in COAT SLEEVES, C. A. Whall, London.
13,290. STEAM ENGINES, P. W. Willans, London.
13,291. GRAVITY SWITCH BACK RAILWAYS, La M. A. Thompson, London.
13,292. WINDOW FASTENER, H. H. Denne, London.
13,293. GRINDING MILLS, L. Gathmann, London.
13,294. PRESERVING WOOD, H. H. Lake.—(*J. H. Young, United States.*)
13,295. BOILERS, P. Reilly, London.
13,296. MEASURING HIDES, &c., W. R. Lake.—(*The Sawyer Leather Machinery Company, U.S.*)
13,297 TRAPS and FLYING TARGETS, W. R. Lake.—(*J. L. Raub, London.*)
13,298. CALCULATING and ADDING MACHINES, E. Halsey, London.

4th November, 1885.

13,299. HEATING MILK, J. Brown, Manchester.
13,300. INVALIDS' ELECTRIC CALL BELL, T. G. Usher, Sunderland.
13,301. TREATING COTTON, &c., E. H. Hargraves, Manchester.
13,302. SKIRTS, J. Walker, Manchester.
13,303. OXIDISING LINSEED OIL, T. J. Flynn, Manchester.
13,304. BLAST PIPES, R. J. Billinton and R. M. Deeley, jun., Derby.
13,305. PROTECTING the KNEES of OMNIBUS PASSENGERS from RAIN, G. R. Smith, Birmingham.
13,306. HAIR-CUTTING MACHINE, A. N. Watts, Sharnbrook.
13,307. STEERING TRICYCLES, &c., H. J. Brookes and W. R. Kettle, Smethwick.
13,308. PAVING STREETS, J. Donald, London.
13,309. ROTARY AIR and GAS MOTOR ENGINES, J. H. R Dinsmore, London.
13,310. PACKING for STUFFING BOXES, A. Beldam, Liverpool.
13,311. RAILWAY BUFFERS, D. N. Arnold, Sheffield.
13,312. FISH-BACK RAILS, A. Whowell, London.
13,313. WEIGHING APPARATUS for VEHICLES, D. France, Manchester.
13,314. OVEN HASTENER and TRIVET COMBINED, W. W. Griffin, Liverpool.
13,315. WASHING UTENSILS, R. J. Watkinson, Birmingham.
13,316. METAL WHEELS and TOOTHED RACKS, &c., E. Prince, Preston.
13,317. SAFETY BICYCLE, W. E. Crowther, Manchester.
13,318. DRIVING FUNKAHS, J. L. Watson, London.
13,319. DYNAMO MACHINES, M. Immisch, London.
13,320. STEREOSCOPIC PICTORIAL EFFECTS, W. E. Crowther, Manchester.
13,321. WINDOW FASTENINGS, J. Simmons, London.
13,322. FINGERING KEYED INSTRUMENTS, T. A. Wright and S. Marsden, Leeds.
13,323. PIANOFORTES, A. Eason, London.
13,324. INDESTRUCTIBLE WICKS for OIL LAMPS, A. E. Webb, London.
13,325. SOCKET JOINT, H. Davidson and H. Hart, London.
13,326. KILNS for BURNING and DRYING BRICKS, W. Whitwell, J. E. Swindell, and W. B. Corliss, Stourbridge.
13,327. DRY CLOSETS and COMMODES, J. Green, London.
13,328. MAKING CEMENTS, T. Smith, London.
13,329. SHIPS' WATER-CLOSETS, J. Beresford and W Restall, London.
13,330. CLEANSING and DYEING OLD FELT HATS, A. Savage, London.
13,331. TARGETS for RIFLE PRACTICE, T. B. Ralston, Glasgow.
13,332. VENTILATING APPARATUS, C. Lawrence, London.
13,333. INCANDESCENT LAMP HOLDER, J. Lee, London.
13,334. SHIPS' COURSE RECORDER, C. F. E. Berg, Berlin.
13,335. BALL VALVES, E. C. Urry, London.
13,336. VENTILATING TUNNELS, H. J. Haddan.—(*C. Raventos, Spain.*)
13,337. PERMANENT WAY of RAILWAYS, T. von Baggesen, London.
13,338. JOINTLESS METAL BAND FOLDER SPECTABLES, L. Courlander, Croydon.
13,339. PISTONS, S. Butler, London.
13,340. COMBINING MATTRESSES with BEDSTEADS, G. H. Slack, London.
13,341. SUPPORT for TREES, &c., J. Makin and J. Southern, London.
13,342. ILLUMINATING SUBSTANCE, C. A. von Welsbach, London.
13,343. DYNAMO-ELECTRIC MACHINES, S. P. Thompson, London.
13,344. BALL CASTORS for FURNITURE, &c., W. H. Secar, London.
13,345. PIPES, &c., for SMOKING, J. E. Park and S. J. Blane, Bart., London.
13,346. DOOR LOCKS, W. R. Lake.—(*C. A. Andersson, Sweden.*)
13,347. HARVESTER BINDERS, A. J. Boult.—(*J. and T. Noxon, Canada.*)
13,348. COPYING MACHINES, A. J. Boult.—(*W. F. McKay, Canada.*)
13,349. FIREMAN'S DRESS, A. J. Boult.—(*J. W. Elliot, Canada.*)
13,350. HORSE COLLARS, A. J. Boult.—(*T. G. Gillespie and M. S. Cassan, Canada.*)
13,351. IMPRINTING on STEEL, &c., A. J. Boult.—(*G. J. B. Rodwell, Canada.*)
13,352. CHIMNEY TOP or VENTILATOR, E. Aldous, London.
13,353. HOT-AIR STOVES, E. Aldous, London.
13,354. WATER-CLOSETS, BATHS, &c., E. Aldous, London.
13,355. ALARM APPARATUS, A. Barrett, London.
13,356. WASHING ORES, MINERALS, &c., C. Sheppard, London.
13,357. BRADAWLS, CHISELS, and like TOOLS, W. H. Aish, London.
13,358. GAS and OIL STOVES, S. Drewett and S. P. Howard, London.
13,359. PATTERN or DRESS CHARTS, P. M. Justice.—(*E. G. McIntire, U.S.*)
13,360. ASCENSION PIPES, C. Hunt, London.
13,361. REFINING VEGETABLE OILS, A. T. Hall, London.
13,362. MECHANICAL TELEPHONE, L. N. Loeb.—(*C. Loeb, U.S.*)
13,363. MECHANICAL TELEPHONE, L. N. Loeb.—(*C. Loeb, U.S.*)
13,364. SUBMARINE BOATS, A. P. J. Stourton, London.
13,365. HAT BODIES, &c., A. M. Clark.—(*A. J. Kornreich, France.*)
13,366. DELIVERING GOODS, J. and S. W. Lewis, London.
13,367. BRACE and STRAP ATTACHMENT, D. L. Brain, London.
13,368. TURNING INGOTS of STEEL, &c., T. Davage, jun., London.

5th November, 1885.

13,369. BOTTLING MACHINES, J. F. Smyth, Belfast.
13,370. SLIDE VALVES, C. Stout, Liverpool.
13,371. SUPPORTING of SLIDING WINDOW SASHES, J. and W. Smith, Liverpool.
13,372. LINEN BUTTONS, J. Cadbury and F. W. Lambert, Birmingham.
13,373. BALL TOPS, W. and H. Sutcliffe, Halifax.
13,374. ROTARY MOTORS and PUMPS, J. H. R. Dinsmore, Liverpool.
13,375. DISTANCE INDICATOR for CABS, &c., G. B Smith, Birmingham.
13,376. ENGINES, W. Schmidt, London.
13,377. STIFFENERS and HEELS of BOOTS, J. Richardson and J. I. Hemmingway, Sheffield.
13,378. DRYING WHEAT, &c., J. Dyson, Halifax.
13,379. BOBBINS, J. Percival, Manchester.
13,380. TREATING COTTON, &c., F. Sutcliffe, Manchester.
13,381. TWINERS, T. and J. T. Tetlow, Manchester.
13,382. LINING for CANDIED PEEL PACKAGES, H. Faulder, Manchester.
13,383. GUMMING, &c., PAPER and LABELS, J. J. Allen, Halifax.
13,384. REGULATING WEIR SLUICES, W. Barrington, Limerick.
13,385. SUSPENDERS for FIXING GAS PENDANTS, G. Maskell and F. Denby, Bradford.
13,386. TRICYCLES, R. Scott, Newcastle-on-Tyne.
13,387. PIPES for SMOKING, J. Carter, Glasgow.
13,388. SPINNING FISHING REELS, R. Heaton, Birmingham.
13,389. BUTTON FASTENERS, W. Frost, Worcester.
13,390. EXCENTRICS for HAY PRESSES, J. Bradbury, Manchester.
13,391. COMPOUND STEAM ENGINES, H. J. H. King, Newmarket.
13,392. MECHANICAL RACE GAME, I. Greenbury, Edinburgh.
13,393. INJECTORS, C. S. Madan, Manchester.
13,394. DRYING CHINA CLAY, &c., J. Rogers, Truro.
13,395. FLUID METERS, H. H. Sporton, London.
13,396. PAINT for COATING SHIPS' BOTTOMS, E. Jackson, Liverpool.
13,397. REMOVING SCUM from STEAM BOILERS, J. L. Cantelo.—(*J. White, United States.*)
13,398. APPARATUS for REDUCTION of SPINAL CURVATURE, J. W. Symington, London.
13,399. ENLARGING PHOTOGRAPHS by DAYLIGHT, G. H. Dollery and L. S. Zachariasen, London.
13,400. SEPARATING FOREIGN SUBSTANCES from BEANS, &c., C. A. Baxter, London.
13,401. HANGING GRIDIRONS, E. Burrows, London.
13,402. TRAVELLING TRUNKS, G. H. Sellman and T. H. Hill, London.
13,403. DIRECTING the WATER-SHED of UMBRELLAS, J. Pigott, London.
13,404. LOOMS for WEAVING, J. M. Collins, Glasgow.
13,405. TOOTH BRUSHES, J. Parry, London.
13,406. SLIDING GASALIERS, W. Richards, London.

13,407. Centrifugal Bolting Machines, R. Ufer, London.
13,408. Colouring Matters, the Leipziger Anilinfabrik Beyer and Kegel, London.
13,409. Signalling Apparatus, G. S. Buchanan, Glasgow.
13,410. Copper Tubes, T. B. Sharp, London.
13,411. Hair-curling Irons, W. L. B. Hinde, London.
13,412. Transmitting Orders on Board Vessels, J. I. Thornycroft, London.
13,413. Petroleum Burners, J. Roots, London.
13,414. Rollers for Wet Spinning Frames, J. Erskine and F. W. Finlay, London.
13,415. Rubber Tires for Wheels, J. Burbridge, London.
13,416. Automatic Switches, L. Clerc, London.
13,417. Candles, G. A. Sweetser, D. W. Bell, and W. Bohm, London.
13,418. Ribs of Umbrellas, M. Desaxe, London.
13,419. Iron, &c., Pipes, D. J. R. Duncan, London.
13,420. Optical Lantern, J. H. Hamilton, London.
13,421. Removal of Earth, W. R. Lake.—(*J. Allard, France.*)
13,422. Electric Generators, W. A. Barlow.—(*M. Sappey, France.*)

6th November, 1885.

13,423. Earthenware Pipes, A. Patrick, Glasgow.
13,424. Twisting and Winding Strands, P. Fraser, Glasgow.
12,425. Cartridge Cases, F. W. Ticehurst and J. S. Edge, jun., Birmingham.
13,426. Propelling Mechanism for Bicycles, &c., W. Clift and J. Vale, Birmingham.
13,427. Shaft Bearings, W. Hornsby and R. Edwards, Grantham.
13 428. Coupling Ladders, G. A. Kennedy, Manchester.
13,429. Packing Cases, J. G. Watkins and W. H. Tyther, Birmingham.
13,430. Cog-wheels and Pinions, J. Johnson, Spennymoor.
13,431. Wet Spinning Frames, J. B. Pirrie, Carrickfergus.
13,432. Asphalted and Bituminous Felt, G. Rogers, Belfast.
13,433. Bunsen and other Gas-burners, T. Fletcher, Manchester.
13,434. Screw-gill Boxes, G. W. Douglas and J. Shaw, Bradford.
13,435. Locking Bolt, J. Fagg and F. Stanley, Margate.
13,436. Aerated Bleaching Liquor, J. Apsley and E. Lumb, London.
13,437. Bleaching Cotton, &c., J. Apsley and E. Lumb, London.
13,438. Washing Machinery, J. Apsley and E. Lumb, London.
13,439. Steam Turbines, C. Blagburn, London.
13,440. Preparing, &c., Cotton, H. Stevenson, J. Webb, and S. Hallam, Manchester.
13,441. Boots and Shoes, A. Hannibal, London, and G. Hurdle, Southampton.
13,442. Simplex Mechanical Horse, S. H. Oram, London
12,443. Button-hole Attachment, H. W. Pollock, Glasgow.
13,444. Telescopic Sights, &c., D. Fraser, Edinburgh.
13,445. Ejectors, M. W. Household and G. F. Janes, London.
13,446. Clothes-peg, S. J. Pocock and F. H. Freeth, London.
13,447. Driving Gear, A. C. Nagel, R. H. Kaemp, and A. W. F. G. Linnenbrügge, London.
13,448. Actuating the Tables of Planing Machines, R. C. and J. C. Mollon, London.
13,449. Boots and Shoes, G. F. Hutchings and F. H. Inman, London.
13,450. Stoppering Bottles, F. T. Marwood, London.
13,451. Neutralising the Residual Magnetism in Electro Magnets, E. G. Colton.—(*F. and O. Haenichen and O. Seebass, United States.*)
13,452. Men's Hats and Ladies' Hats and Bonnets, H. Pittman, London.
13,453. Electric Clocks, E. G. Colton.—(*F. and C. Haenichen and O. Seebass, United States.*)
13,454. Bookbinding, W. J. Hopkins, Worcester.
13,455. Wire Spoked Wheels for Perambulators, &c., W. H. Dunkley, London.
13,456. Cabs, &c., T. D. Gilbert, London.
13,457. Steam Cranes, G. Anderson, Glasgow.
13,458. Buckles, W. A. F. Blakeney, Glasgow.
13,459. Decorticating Corn, &c., G. Macaulay-Cruikshank.—(*G. A. Buchholz, Germany.*)
13,460. Semolina and Flour, G. Macaulay-Cruikshank.—(*G. A. Buchholz, Germany.*)
13,461. Advertising, Caillet-Cashmere and E. A. Jahncke, London.
13,462. Sulphide of Zinc, J. B. Spence, London.
13,463. Coating Plates for Photography, A. Coventry, Manchester.
13,464. Latches for Doors, &c., H. T. Johnson, Manchester.
13,465. Lighting the Interior of Ovens, J., J. A., and W. K. Baker, London.
13,466. Producing, &c., Extreme Temperatures, E. Solvay, Liverpool.
13,467. Children's Cradles, F. Pearson, jun., and E. D. Payne, London.
13,468. Carbon, G. A. Moore and C. de Cardi, London.
13,469. Collar Studs, R. Willoughby, Liverpool.
13,470. Omnibuses, &c., G. F. Redfern.—(*F. Audiger, France.*)
13,471. Moulds for Casting Type, &c., W. Rayment, London.
13,472. Treating Copal, A. and M. Mackay, London.
13,473. Boots and Shoes, W. R. Lake.—(*G. W. Copeland, U.S.*)
13,474. Repeating Guns and Rifles, F. Bisson and M. Runkel, London.
13,475. Sewing Needles, A. T. Boon, London.
13,476. Barbed Wire, F. B. W. Malet, London.
13,477. Washstands, W. B. Swire, London.
13,478. Electrical Switch Boards, R. A. Scott, W. T. Goolden, and A. P. Trotter, London.
13,479. Blacking, E. Edwards.—(*M. Schauenberg, Belgium.*)
13,480. Hoisting, &c., Apparatus, J. T. Parlour, London.
13,481. Bottling Beer, &c., G. Barker and A. E. Daniel, London.
13,482. Propelling Steamships, &c., H. St. G. Wilkinson, London.

7th November, 1885.

13,483. Churn Bungs or Stoppers, J. Wooldridge, Lye Cross.
13,484. Ploughs and Shares, J. Mealor, Ness.
13,485. Incandescent Lamps, W. Maxwell and T. V. Hughes, London.
13,486. Metal Fastenings, C. Peters, Birmingham.
13,487. Self-rocking Cradle Bassinette and Cot, E. Jacobs, Aston.
13,488. Gas Lighting and Heating, T. G. Marsh, Failsworth.
13,489. Elevators, T. Hunt, Birmingham.
13,490. Portable Tooth Brush, H. W. Graham, Birmingham.
13,491. Utilising Waste Flue Dust, C. H. Aston, Birmingham.
13,492. Window Blinds, J. A. Macmeikan, London.
13,493. Combined Bedstead and Mattress, J. B. Rowcliffe, Manchester.
13,494. Curtains and Dress Flounces, J. Edelston, Manchester.
13,495. Ornamenting Velvets, H. Heywood, Manchester.
13,496. Bumper for Power Looms, H. Marsden, Manchester.
13,497. Fixing Window Sashes, R. Hunter, Skelmorlie-by-Greenock.
13,498. Compressing into Shape Packets of Hackle Gills, W. Worrall, Dundee.
13,499. Lamp Burners, J. Lind, Liverpool.
13,500. Saddles for Bicycles, &c., H. Grunwell, Farsley.
13,501. Stay Busks, &c., Fasteners, R. H. Wall, London.
13,502. Clips or Holders for Filing Papers, &c., J. S. Downing, Birmingham.
13,503. Hats, W. H. Akester and R. R. Kelly, London.
13,504. Floorcloth, &c., W. H. Akester and R. R. Kelly, London.
13,505. Substitute for Cork, W. H. Akester and R. R. Kelly, London.
13,506. Treating Paper, &c., with Dissolved Nitro Cellulose, W. H. Akester and R. R. Kelly, London.
13,507. Dry Gas Governors, W. Lyon, London.
13,508. Metal Rims for Earthenware, J. W. Johnson and M. W. White, London.
13,509. Automatic Fire Extinguisher, J. and C. E. Buell, London.
13,510. Sand Blast, B. C. Tilghman, London.
13,511. Wire Fencing, P. Henwood, London.
13,512. Rotary Pumps and Engines, W. Wadsworth, London.
13,513. Controlling the Supply of Gas, D. Orme, Manchester.
13,514. Boardings for Surfaces to be Plastered, W. Heinrichs and K. Wildhagen, Halifax.
13,515. Indicating Mechanism, &c., H. W. Rhoads, Halifax.
13,516. Distributing Steam for Heating Purposes, G. G. M. Hardingham.—(*P. J. Grouvelle, France.*)
13 517. Sizes of Lasts, A. Hannibal, London.
13,518. Measurement for Boots, A. Hannibal, London.
13,519. Soldering Sheet Metal Cans, E. Edwards.—(*B. Norton and J. G. Hodgson, U.S.*)
13,520. Ornamental Jewellery, E. Edwards.—(*E. Anthony, Belgium.*)
13,521. Ring-spinning, P. Eadie, R. Eadie, and J. Eadie, Manchester.
13,522. Mechanical Motor, J. J. Defalque, Belgium, and J. Oppenheim, London.
13,523. Boots and Shoes, W. F. Griffith, London.
13,524. Heating Railway Carriages, &c., W. Foulis, Glasgow.
13,525. Chairs, J. Wardrop, Glasgow.
13,526. Fire Grates, W. H. Barker and G. Barker, London.
13,527. Cleansing Bottles, G. Burges, London.
13,528. Stoppering Bottles, G. J. Chambers, London.
13,529. Gas Governor, T. A. Greene and C. M. Walker, London.
13,530. Regenerative Gas Lamps, T. A. Greene and C. M. Walker, London.
13,531. Waterproofing Woollen, &c., Fabrics, H. J. Haddan.—(*Löwinger and Knöpflmacher, Austria.*)
13,532. Adjustably Fastening Rails to Sleepers, J. R. Steiger, London.
13,533. Textile Fabrics, C. D. Abel.—(*F. C. Glaser, Germany.*)
13,534. Perambulators, F. Beauchamp, London.
13,535. Artificial Bait, A. M. Clark.—(*J. J. Eskil, United States.*)
13,536. Irrigating Attachment for Bottles, A. B. Tutton, London.
13,537. Pickers for Looms, D. Roebuck, London.
13,538. Lamps, W. A. Barlow.—(*H. Kock, Germany.*)
13,539. Tipping Billiard Cues, &c., W. Bown and G. Capewell, London.
13,540. Return Tube Boilers, E. P. Plenty, London.
13,541. Filtering or Purifying Water, T. Archer, jun., London.
13,542. Slide Weighing Machines, &c., C. Williams, London.
13,543. Applying the Electric Search Light to Guns, I. K. Rogers, London.
13,544. Marine Engines, J. T. Bucknill, London.
13,545. Umbrellas, Parasols, &c., I. K. Rogers, London.
13,546. Looms, F. B. Fischer, London.
13,547. Lubricators, J. McL. McMurtrie, Glasgow.
13,548. Axle, G. H. Needham, London.
13,549. Braces or Suspenders, W. A. Barlow.—(*C. Peters, Germany.*)
13,550. Opening or Closing Windows, W. R. Lake.—(*N. Couland, France.*)
13,551. Transporting Cash, &c., W. R. Lake.—(*The Kenney Electrical Cash Carrier Company, U.S.*)

9th November, 1885.

13,552. Internal Fire-box and Cross Tube, T. Staples, Birmingham.
13,553. Internal Flues of Boilers, T. Staples, Birmingham.
13,554. Railway Chair Vibration Key-holdfast, R. Barker, Whitehaven.
13,555. Dupe Heald-making Machine, W., J., T., J., and B. Milner, Bradford.
13,556. Simplex Ruler, W. H. Foster, Birmingham.
13,557. Tramcar Rail Points and Reverser, P. Redford, Manchester.
13,558. Drawing off, &c., Liquids, R. Stanley, Birmingham.
13,559. Protecting Ships' Ventilators, R. Yarrow, London.
13,560. Consuming Oil as Fuel, R. Walker, Sunderland.
13,561. Tricycles, C. J. B. Ward, Rochester.
13,562. Double Chain Continuous Elevators, W. H. Steel, London.
13,563. Toilet Glasses, A. C. Henderson.—(*J. Bay, France.*)
13,564. China, &c., F. D. Bradley and H. Snow, Longton.
13,565. Pencil-holding, &c., S. Hall, Leeds.
13,566. Bottling Machines, S. Bunting, Dublin.
13,567. Distribution of Gas, G. Anderson, Durham.
13,568. Mixing Tea, E. Burke, Dublin.
13,569. Spring Motors, L. A. Parrock, Birmingham.
13,570. Propeller Apertures of Ships, M. H. Taylor and L. Benjamin, Birkenhead.
13,571. Mercurial Air Pumps, W. Maxwell and T. V. Hughes, London.
13,572. Hand Fire Extinguishers, A. W. Porter, New York.
13,573. Preserving Meat, M. Closset, Paris.
13,574. Rolling Plates, &c., J. Guest, Smethwick.
13,575. Conveying Articulate Speech by Electricity, H. J. Allison.—(*A. M. A. Beale, U.S.*)
13,576. Wringing Machines, O. R. Nitsch, London.
13,577. Fastening the Ends of Tapes in Spinning Machinery, J. Briggs, Halifax.
13,578. Tennis Balls, W. Sykes and F. Fowkes, Wakefield.
13,579. Separating, &c., Middlings, F. Bosshardt.—(*C. C. Huth, Germany.*)
13,580. Lifeboats, H. G. Tipping, Liverpool.
13,581. Gunpowder, B. H. Remmers and J. Williamson, Glasgow.
13,582. Gunpowder, B. H. Remmers and J. Williamson, Glasgow.
13,583. Heating, &c., Apparatus, B. H. Remmers and J. Williamson, Glasgow.
13,584. Co-acting Apparatus for Signals, J. Cockburn, London.
13,585. Motors with one or more Cylinders, E. Kaselowsky, London.
13,586. Non-explosive Mineral Oil Lamp, E. Sundborg, London.
13,587. Disposal of Sewage, A. A. Common, London.
13,588. Polo Stick, F. B. W. Malet, London.
15,589. Arranging the Main and Mizen Sheet Blocks of Fishing Smacks, &c., W. Sissons and P. P. White, London.
13,590. Socket for Picks, &c., J. Urwin and J. F. Barlow, London.
13,591. Preventing the Entrance of Wind, &c., J. Sutherland, London.
13,592. Glassware, L. J. Murray, London.
13,593. Guards for Protecting the Legs, F. H. Ayres, London.
13,594. Presses for Rackets or Bats, F. H. Ayres, London.
13,595. Artificial Stones, A. G. Brookes.—(*R. A. Meyn and J. F. O. Armack, Germany.*)
13,596. Boiler Furnaces, A. Mackie, London.
13,597. Grease Proof Cases, T. Rouet, London.
13,598. Discharging Water from Flushing Tanks, P. Winn, London.
13,599. Beaters, W. Richardson, Manchester.
13,600. Syringes, P. A. Newton.—(*T. J. Moore and E. A. Warren, United States.*)
13,601. Hand Typographic Apparatus, E. de Pass, London.
13,602. Mixing Tea, A. E. Jarvis, H. Smith, and E. H. Francis, London.
13,603. Applying Gas Lamps to Pianos, F. J. Harris, London.
13,604. Hand Mincer, M. Simmen, Glasgow.
13,605. Bottle Stoppers, E. W. Rippin, London.
13,606. Steering of Carriages, F. L. Smidth, London.
13,607. Telephonic Receivers, &c., C. A. Gisborne.—(*F. N. Gisborne and D. H. Keeley, Canada.*)
13,608. Pocket Knives, J. Thurnauer, London.
13,609. Producing Copies for Lithography from Photographs, M. Walker, G. E. Walker, and J. B. Germeuil-Bonnaud, London.
13,610. Connecting Electric Currents, F. B. O. Hawes, London.
13,611. Media for Photographic Development, O. Imray.—(*E. Jacobsen, Germany.*)
13,612. Arc Lamps, E. A. Ashcroft, London.
13,613. Facilitating the Use of Printing Plates, M. Jaffé, London.
13,614. Rotary Motive-power Engines, J. Y. Johnson.—(*V. G. Bell, Jamaica.*)
13,615. Looms for Weaving, A. Wright and E. Firth, Bradford.
13,616. Treatment of Jerusalem Artichoke, A. Z. Champy, A. N. Champy, and L. P. Champy, London.
13,617. Mowing and Reaping Machines, E. Pratt, London.
13,618. Shower Baths, E. J. C. Baird, London.
13,619. Measuring Water, &c., E. Craddock, London.
13,620. Frames of Tricycles, A. E. Briant, London.

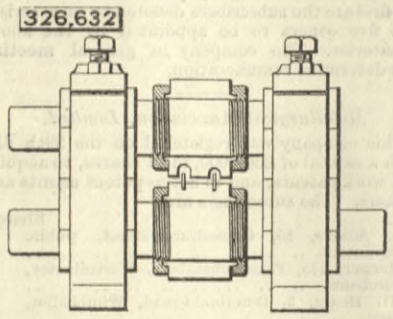
SELECTED AMERICAN PATENTS.

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

326,632. Machines for Making Claw Ends of Hammers, *J. Dodge, Newark, N.J.—Filed October 25th*, 1884.

Claim.—The formation of the matrices in the face of the roll, or, by preference, the dies thereon, for the

326,632

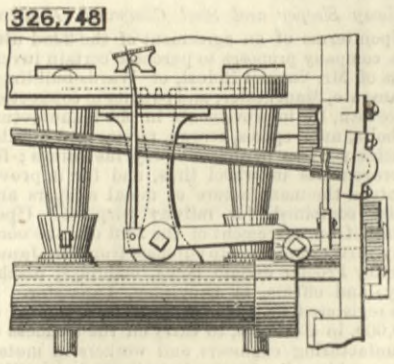


purpose of forming the claw ends of hammers, and the knives for splitting and dividing the same, substantially as described and shown.

326,748. Grain Drill, *John F. Keller, Shepherdstown, W. Va.—Filed June 15th*, 1885.

Claim.—(1) The combination, with a fertiliser-distributing hopper, of a regulating slide for controlling the discharge openings, an elbow lever which engages with the regulating slide, an adjusting screw which engages with the elbow lever to adjust the slide, and a lever which engages the elbow lever, and operates independently of the slide adjusting mechanism

326,748

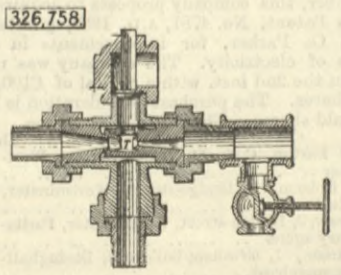


either to increase the area of the discharge openings or to restore them to the dimensions to which they had originally been adjusted. (2) In a grain drill and fertiliser distributor, the combination, with a discharging mechanism, under the ordinary operation of which the outflow is continuous and uniform, of a means, substantially as described, whereby the outflow may be instantly increased in volume, and then with equal facility and celerity may be restored to its former regulated rate of discharge.

326,758. Injector, *John Loftus, Albany, N.Y.—Filed June 17th*, 1885.

Claim.—In an injector, the combination of the injector-body having the four diametrically opposite branches, the overflow chamber fitting upon the upper branch, the overflow valve playing upon the upper end of the upper branch, within the overflow chamber, the suction pipe fitting upon the lower branch, the steam plug fitting in one horizontal branch, having a flange at its outer end bearing against the outer end of the said branch, and having a tapering steam nozzle at its inner end, a feed pipe entering the boiler and secured

326,758



to the other horizontal branch, and provided with a T branch having a cock or globe-valve, a discharge plug fitting in the discharge branch, and having a flange bearing against the end of the said branch, a reduced portion formed with an upwardly pointing overflow suction nozzle, and a discharge tube opening in the interior of the said reduced portion, and a combining tube or plug fitting in the end of the reduced portion of the discharge plug, and having a nozzle pointing into the said portion, as and for the purpose shown and set forth.

326,768. Shears, *Benj. F. McCarty, Rolling Prairie, Ind.—Filed July 10th*, 1885.

Claim.—(1) The combination of the frame C, the disc D, the connections F F, the shear arm E, the cutters G G^1 and H and H^1, the adjustable bar M, provided with the arm N, and the lever K, substantially as shown and described. (2) The frame C, the cutters H and H^1, the adjustable bar M, provided with arm N, in combination with the disc D, provided with the offset J, the arm J^1, the lever K, the connections F F, the pivotted shear arm E, and the cutters G and G^1, substantially as shown and described. (3) The frame C, having an aperture C^1, the disc D, the lugs D^1, the

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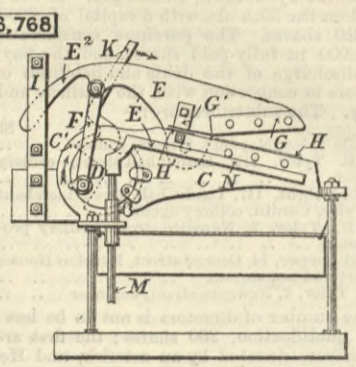
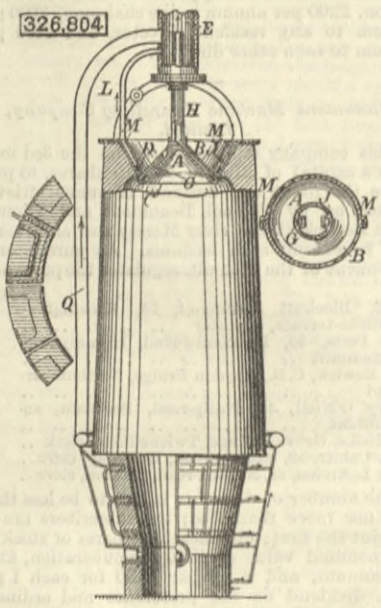


offset J, the arm J^1, and the lever K, in combination with the connections F F and the shear arm E, substantially as shown and described. (4) The frame C, having an aperture C^1, the disc D, the lugs D^1, the offset J, the arm J^1, the lever K, and the guide I, in combination with the connections F and the shear arm E, provided with the extension E^2, substantially as shown and described.

326,804. Blast-furnace, *Victor O. Strobel, Philadelphia, Pa.—Filed April 15th*, 1885.

Claim.—(1) In a blast-furnace, the combination of hopper B, having integrally formed therewith the conduit D in its extreme lower edge and passages M within the wall of the hopper and leading from said conduit to the rim of the hopper, the chimney E, and the pipe L, connecting one of said passages M with the chimney, substantially as and for the purpose set forth. (2) In a blast-furnace, the combination of the bell A, having integrally formed with it the conduit C, in its lower edge, and the passage G, formed within the wall of the bell and leading from said conduit upward to an outlet near the apex of the bell, and the passage J, formed within the wall of the bell and leading from said conduit to the apex of the bell, and the pipe H, secured to the apex of the bell in communication with the passage J, substantially as and for the purpose set

326,804

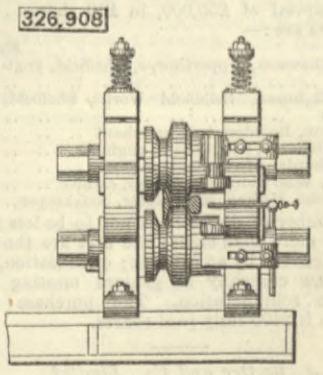


forth. (3) In a blast-furnace the combination of the bell A, with its conduit and passages, the chimney E, surmounting the furnace, and the central pipe H, secured to the bell in communication with the passage J and fitted to slide vertically within the chimney, substantially as and for the purpose set forth. (4) In a blast-furnace, the combination of a circular series of flat segmental plates disposed horizontally within the brickwork of the furnace-bosh and provided with cavities having each two openings for the passage of air, and a pipe leading from one of said openings in each cavity to a device adapted to produce a circulation of air, substantially as and for the purpose set forth. (5) In a blast-furnace, the combination of several series of flat segmental plates disposed horizontally within the brickwork of the bosh and provided with cavities, each cavity having two openings for the passage of air, pipes connecting a plate of one ring with plates of the other rings, and a pipe connecting one of such connected plates with a device for producing a circulating of air through the plates and connected pipes, substantially as and for the purpose set forth. (6) In a blast furnace, the combination of a pipe Q, several circular series of flat segmental plates disposed horizontally within the brick walls of the bosh, and pipes connecting the several circular series of bosh-plates with the pipe Q, substantially as and for the purpose set forth.

326,908. Art of Making Rails, *William R. Jones, Braddock, Pa.—Filed July 20th*, 1885.

Claim.—(1) An improvement in the art of making rails, which consists in heating the rail and then cooling the head more rapidly than the remaining parts thereof, substantially as and for the purpose described.

326,908



(2) An improvement in the art of making rails, which consists in partially cooling the head of the heated rail as it comes from the finishing rolls by contact with a cooling liquid substantially as and for the purpose described.