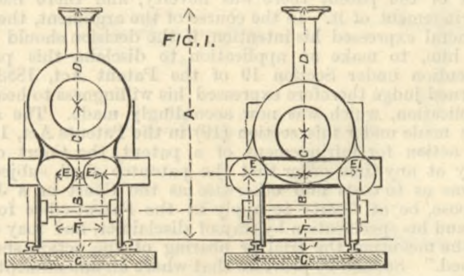
HIGH AND LOW LOCOMOTIVES.

By PROFESSOR A. G. GREENHILL.

AN article in THE ENGINEER of September 17th, 1886, with the above title has stated very clearly the practical reasons why a high locomotive will run, contrary to the common preconceived opinion, with greater safety and steadiness under ordinary circumstances than a low locomotive. The low locomotive is typified by Crampton's express engine in the Exhibition of 1851, and the high locomotive by McConnel's engine in the Exhibition of 1862 (Fig. 1).

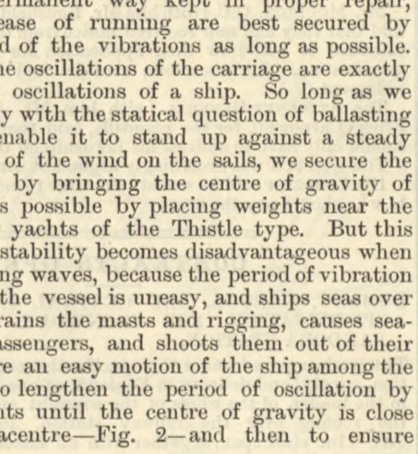


The broad gauge fallacy, as it may be termed, was the idea in the minds of its projectors that the extra width would allow the boilers of the engines and the bodies of the carriages to be brought down between the wheels, and that the consequent lowering of the centre of gravity would conduce to greater security and steadiness of running. We find, however, that what remains of broad-gauge rolling stock is carried above the wheels, exactly as on the narrow gauge, so that the fallacy must speedily have been exploded from practical experience.

In a rude age, with very bad roads, it was no doubt necessary to keep the centre of gravity low to prevent a capsize, and no springs could have stood the shocks and jolting. With a view of having to serve principally in such uncivilised regions, our military carriages are still constructed without springs, in order to be prepared for the worst; but when Telford and Macadam had improved our coach roads, and later the railway had taken the chief place as a means of locomotion, it was found that the danger of a capsize might almost be disregarded, and springs for carriages came into general use.

1. Considering, then, a wheeled carriage with springs travelling on permanent way kept in proper repair, steadiness and ease of running are best secured by making the period of the vibrations as long as possible. In this respect the oscillations of the carriage are exactly analogous to the oscillations of a ship. So long as we are concerned only with the statical question of ballasting a ship so as to enable it to stand up against a steady uniform pressure of the wind on the sails, we secure the requisite stiffness by bringing the centre of gravity of the ship as low as possible by placing weights near the keel, as in racing yachts of the Thistle type. But this excess of statical stability becomes disadvantageous when the ship gets among waves, because the period of vibration being shortened, the vessel is uneasy, and ships seas over the bulwarks, strains the masts and rigging, causes sea-sickness in the passengers, and shoots them out of their berths. To secure an easy motion of the ship among the waves, we seek to lengthen the period of oscillation by raising the weights until the centre of gravity is close below the metacentre—Fig. 2—and then to ensure

FIG. 2



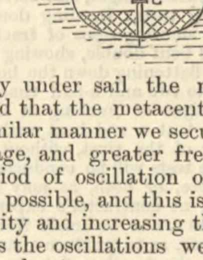
stability under sail the metacentric curve must be so adjusted that the metacentre rises as the ship heels; and in a similar manner we secure greater ease of travelling in a carriage, and greater freedom from shock, by making the period of oscillation of the body of the carriage as long as possible, and this is secured by raising the centre of gravity and increasing the flexibility of the springs.

2. As the oscillations we shall consider are small oscillations about a mean position of equilibrium, we can compare them with the small oscillations of a pendulum, and use the length of the simple equivalent pendulum as a measure of the character of the oscillation; the period T of oscillation being connected with l, the length of the simple equivalent pendulum, by the well-known formula

$$T = \pi \sqrt{\frac{l}{g}}$$

For consider the equation of oscillation of an ordinary pendulum, supposed a rigid body of given shape—Fig. 3—about a smooth horizontal axis O; then if k denotes the

FIG. 3



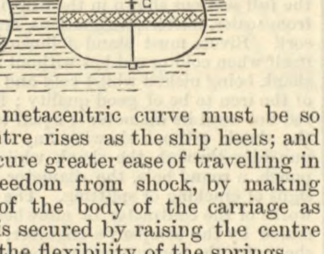


FIG. 5

radius of gyration of the pendulum about a parallel axis through G, the centre of gravity, h the distance between these axes through O and G, and W the weight of the pendulum in pounds; then $W(h^2 + k^2)$ is the moment of inertia of the pendulum about the axis through O; and taking moments about this axis when the inclination of G O to the vertical expressed in circular measure is θ, we obtain the equation for motion

$$\frac{W}{g}(h^2 + k^2)\frac{d^2\theta}{dt^2} = -Wh\sin\theta,$$

or

$$\left(h + \frac{k^2}{h}\right)\frac{d^2\theta}{dt^2} = -g\sin\theta. \quad . \quad . \ (1).$$

Making O L = l, where $l = h + \frac{k^2}{h}$, we see that the pendulum oscillates in exactly the same manner as a particle at L, suspended by a fine thread from O.

L is then called the centre of oscillation, and l the length of the simple equivalent pendulum.

There are two ways of increasing l; either by increasing or diminishing h; that is, by taking the axis of suspension O either a long way from, or close to, the centre of gravity G; the second method is practically preferable, being analogous to the system of raising the weights in a ship to increase the time of oscillation, and, consequently, the length of the simple equivalent pendulum.

Equation (1) written in the form

$$l\frac{d^2\theta}{dt^2} = -g\sin\theta \quad . \ . \ . \ . \ . \ . \ . \ (1)$$

has the first integral

$$\tfrac{1}{2}\,l\left(\frac{d\theta}{dt}\right)^2 = g(\cos\theta - \cos\alpha)$$

2α denoting the angle of oscillation, but cannot be integrated further except by elliptic functions.

Supposing, however, the oscillation is so small that $\sin\theta$ may be replaced by its circular measure θ, then

$$l\frac{d^2\theta}{dt^2} = -g\theta \quad . \ . \ . \ . \ . \ . \ . \ . \ . \ (2)$$

the differential equations for harmonic vibrations, the integral of which is

$$\theta = \alpha\cos\sqrt{\frac{g}{l}}\,t, \text{ or } \alpha\sin\sqrt{\frac{g}{l}}\,t;$$

and therefore the time of oscillation from rest to rest is given by

$$T = \pi\sqrt{\frac{l}{g}}.$$

3. Take, then, an ordinary railway carriage, and consider first the simple vertical oscillations.

On the usual hypothesis that the resilience of a spring is proportional to the displacement, we shall find that the length of the simple equivalent pendulum for vertical oscillations is equal to the permanent average set of the springs due to the weight of the body of the carriage.

For if W denotes the weight of the carriage in pounds, and E s the total resilience in pounds of the springs for a uniform vertical displacement s, then if c denotes the permanent average set of the springs due to the weight of the body of the carriage,

$$W = Ec;$$

and if the springs all receive the same additional vertical displacement x, the equation of vertical oscillation is

$$\frac{W}{g}\frac{d^2x}{dt^2} = W - E(c + x) = -Ex,$$

or,

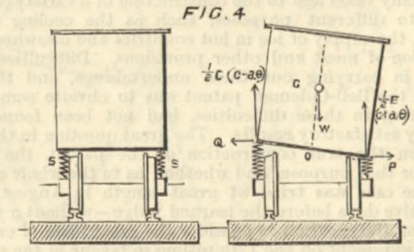
$$c\frac{d^2x}{dt^2} = -gx,$$

so that c is the length of the equivalent pendulum of the oscillations, as stated above from equation (2).

If we consider the analogous case of the vertical "scending" and "heaving" oscillations of a ship, we shall find that the length of the equivalent pendulum is V ÷ A, V denoting the average displacement of water in cubic feet, and A the area in square feet of the horizontal section of the ship at the water line; the weight of the ship being w V pounds, and the resilience of the water for small vertical oscillations acting like a spring, in which E = w A, w denoting the weight in pounds of a cubic foot of water.

4. Secondly, let us consider the rolling oscillations of the railway carriage and the analogous rolling oscillations of a ship. Supposing that the springs of the carriage permit only of vertical oscillation without any side or end play, the rolling motion must be supposed to take place

FIG. 4



about a longitudinal axis O—Fig. 4—in the horizontal plane passing through the top of the springs; and we may for simplicity take this axis of oscillation to be midway between the opposite pairs of wheels, any motion about a parallel axis in this horizontal plane bringing vertical oscillations of the centre of gravity of the body of the carriage into play, oscillation which we have already analysed.

Let h denote the height of the centre of gravity of the body above the horizontal plane through the top of the springs; $2a$ the distance between a pair of springs on the same axle; and now let the body of the carriage receive a small angular displacement, whose circular measure is θ, about the longitudinal axis of the carriage midway between the top of the opposite pairs of springs. In consequence of this angular displacement the resistance of the springs on one side will become $\frac{1}{2}E(c + a\delta)$, and on the other side will become $\frac{1}{2}E(c - a\delta)$; and the moment of the resistance of the springs about a parallel longitudinal axis through the centre of gravity of the body of the carriage, tending to restore the equilibrium, will be

$$\tfrac{1}{2}E(c + a\theta)(a - h\theta) - \tfrac{1}{2}E(c - a\theta)(h + a\theta) = E(a^2 - ch)\theta,$$

neglecting θ^2.

We notice, in consequence, that the springs will not hold the body upright if h is greater than $a^2 \div c$, and the body will have a permanent list to one side or the other, exactly as a ship without proper ballasting.

Returning to the question of the rolling oscillation of the body, the centre of gravity of the body will have a horizontal acceleration $h\frac{d^2\theta}{dt^2}$; and consequently, if P and Q denote the outward horizontal components of reaction of the springs on the body,

$$\frac{W}{g}h\frac{d^2\theta}{dt^2} = P - Q.$$

But the moment of P and Q about the longitudinal axis, through the centre of gravity of the body, tending to restore upright equilibrium, is

$$P(h - a\theta) - Q(h + a\theta)$$
$$= (P - Q)h - (P + Q)a\theta,$$

of which $(P + Q)a\theta$ may be neglected, since P and Q are small, of the same order of magnitude as θ.

Finally, the equation of rolling oscillation will be, taking moments about the longitudinal axis through the centre of gravity, of which the radius of gyration is k,

$$\frac{W}{g}k^2\frac{d^2\theta}{dt^2} = -E(a^2 - ch)\theta - (P - Q)h$$

$$= -E(a^2 - ch)\theta - \frac{W}{g}h^2\frac{d^2\theta}{dt^2},$$

$$\text{or } (h^2 + k^2)\frac{d^2\theta}{dt^2} = -\frac{gE}{W}(a^2 - ch)\theta,$$

$$= -\frac{g}{c}(a^2 - ch)\theta,$$

and comparing with the equation of small oscillation (2),

$$l\frac{d^2\theta}{dt^2} = -g\theta,$$

of the simple equivalent pendulum of length l, we have

$$l = c\frac{h^2 + k^2}{a^2 - ch},$$

for the rolling oscillations of the body of the carriage.

In the analogous case of the rolling oscillations of a ship—Fig. 5—we must suppose the motion to take place about a longitudinal axis through the centre of gravity of the ship, as the pressure of the water, being always vertical, cannot generate horizontal oscillation in the centre of gravity G.

Then for the oscillations, M denoting the metacentre,

$$\frac{W}{g}k^2\frac{d^2\theta}{dt^2} = -W\,.\,GM\sin\theta,$$

so that

$$l = \frac{k^2}{GM},$$

the length of the simple equivalent pendulum k, denoting the radius of gyration of the ship about the longitudinal axis through the centre of gravity.

5. A similar investigation will show that the length of the equivalent pendulum for pitching oscillations of a four-wheeled railway carriage—Fig. 6—is given by

$$l' = c\frac{h^2 + k'^2}{b^2 - ch}$$

$2b$ denoting the distance between the axles of the two pairs of wheels, and k' the radius of gyration of the body of the carriage about a transverse horizontal axis through the centre of gravity.

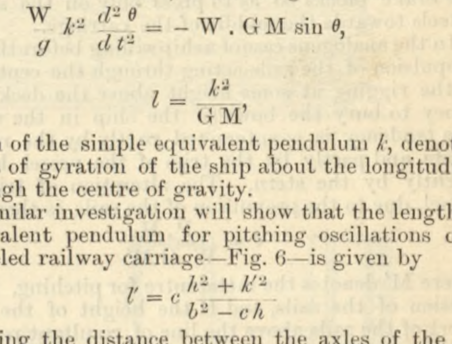
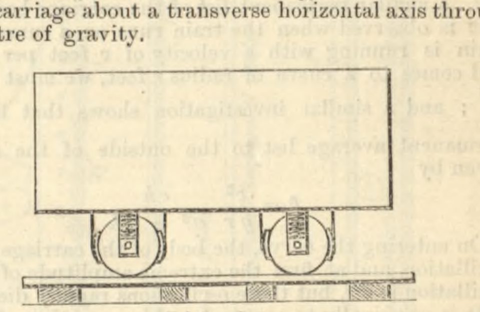


FIG. 6



In a six-wheeled carriage the middle pair of springs will be unaffected by the pitching oscillations, so that we must increase the above value of l' by half its value; and thus

$$l' = \frac{3}{2}c\frac{h^2 + k'^2}{b^2 - ch}$$

Similarly for the pitching oscillations of a ship,

$$l' = \frac{k'^2}{GM'},$$

M′ denoting the metacentre for pitching oscillations, and k' the radius of gyration of the ship about a transverse horizontal axis through the centre of gravity.

The most general oscillation of the carriage and of the ship may now be considered as a combination of the three kinds of simple oscillations—vertical or "scending," rolling, and pitching—which we have just analysed. These may be studied practically on the top of an omnibus or on the deck of a ship.

6. The investigation of the pitching oscillations of a railway carriage just given will be useful in explaining the sudden jerk now felt in trains fitted with continuous brakes, the moment after stoppage at a platform.

While the train is being retarded by the brake, the body of the carriage compresses the front pair of springs and partly releases the hind pair, and thus the floor slopes downward in a forward direction; but the moment the train has stopped the retardation ceases, and the body swings back with a pitching oscillation to the horizontal position, thus causing the jerk.

Supposing, then, a four-wheeled railway carriage—Fig. 6—under retardation f, and let θ denote the small slope of the floor in circular measure; then the backward horizontal reactions on the body in each pair of springs may be taken to be $\frac{1}{2} W \frac{f}{g}$ pounds, while the vertical resilience of the forward and after pair of springs will be respectively

$$\tfrac{1}{2} E (c + b\,\theta) \text{ and } \tfrac{1}{2} E (c - b\,\theta);$$

so that taking moments about the centre of gravity,

$$\tfrac{1}{2} W \frac{f}{g} (h + b\,\theta) + \tfrac{1}{2} W \frac{f}{g} (h - b\,\theta)$$
$$- \tfrac{1}{2} E (c + b\,\theta) (b - h\,\theta) + \tfrac{1}{2} E (c - b\,\theta) (h + b\,\theta) = 0;$$

or, since $W = E\,c$,

$$\frac{f}{g} c\,h - (b^2 - c\,h)\,\theta = 0,$$
$$\theta = \frac{f}{g} \frac{c\,h}{b^2 - c\,h},$$

giving θ the slope of the floor, a gradient of one in $\frac{1}{\theta}$.

Here the carriage is supposed retarded by the buffers or couplings of the adjacent carriages; but if the carriage is retarded by its own brakes, each wheel being provided with a pair of brakes, pressing at opposite ends of a horizontal diameter, then the slope θ will be still further increased in consequence of the frictional couple of the wheels.

If r denotes the radius of a wheel, this frictional couple on a pair of wheels will be $\frac{1}{2} W \frac{f}{g} r$, neglecting the inertia of the wheels; so that now

$$W \frac{f}{g} (h + r) - E (b^2 - c\,h)\,\theta = 0,$$

or

$$\theta = \frac{f}{g} c \frac{h + r}{b^2 - c\,h}.$$

Taking a brake power of 448 pounds per ton, then $\frac{f}{g} = \frac{778}{2270} = \frac{1}{5}$; suppose also $c = .2$, $b = 8$, $h = 5$, $r = 2$, then $\theta = \frac{1}{180}$, so that in a carriage about 30ft. long the ends will each rise or fall an inch when the train stops.

A way to neutralise this unpleasant motion is to place the brake blocks so as to press only on the side of the wheels towards the middle of the carriage.

In the analogous case of a ship sailing before the wind, the propulsion of the sails acting through the centre of effort in the rigging at some height above the deck has a tendency to bury the bows of the ship in the water, and this tendency is counteracted partly by the rake of the masts, and partly by the trim of the vessel being made slightly by the stern. The alteration of trim θ of the vessel, due to the propulsion of the sails, is then given by

$$\theta = \frac{P.\,H}{W.\,G\,M'}$$

where M′ denotes the metacentre for pitching, P the propulsion of the sails, and H the height of the centre of effort of the sails above the line of resultant resistance P, of the water.

7. A similar permanent list of the carriage body to one side is observed when the train runs on a curve; if the train is running with a velocity of v feet per second, and comes to a curve of radius r feet, we must put $f = \frac{v^2}{r}$; and a similar investigation shows that then the permanent average list to the outside of the curve is given by

$$\theta = \frac{v^2}{g\,r} \frac{c\,h}{a^2 - c\,h}.$$

On entering the curve, the body of the carriage is set in oscillation, and at first the extreme amplitude of angular oscillation is $2\,\theta$, but those oscillations rapidly die out.

It is principally to counteract this sensation of rolling list in the carriage, and not from fear of a bodily capsize, that the super-elevation of the outer rail of a curve is given.

For if H denotes the height of the centre of gravity of the whole carriage above the rails, and d the distance between the tread of an opposite pair of wheels, then, when running with velocity v round a curve of radius r, the weight of the carriage is shared between the inner and outer rail in the ratio of

$$\tfrac{1}{2}\left(1 - \frac{v^2}{g\,r}\frac{H}{d}\right) \text{ to } \tfrac{1}{2}\left(1 + \frac{v^2}{g\,r}\frac{H}{d}\right);$$

as is seen immediately by taking the moments of the forces about each rail in succession (Fig. 4). Consequently, when $\frac{v^2}{g\,r} = \frac{d}{H}$, the carriage is on the point of capsizing.

Now we may suppose $d = 5$, and $H = 10$ at the greatest; so that $v^2 = \frac{1}{2} g\,r$, or taking $g = 32$, $v = 4\sqrt{r}$; for instance, if the velocity is 60 miles an hour, then $v = 88$, and $r = 484$, a curve of 160 yards radius; thus showing that the risk of a capsize under ordinary practical conditions need not be considered.

If a super-elevation of the outer rail is given by inclining the sleepers at an angle to the horizon, then the weight of the carriage is shared between the inner and the outer rail in two pressures perpendicular to the sleepers in the ratio of

$$\tfrac{1}{2}\left(\cos\alpha + \frac{v^2}{g\,r}\sin\alpha\right) + \tfrac{1}{2}\left(\sin\alpha - \frac{v^2}{g\,r}\cos\alpha\right)\frac{H}{d}$$
$$\text{to } \tfrac{1}{2}\left(\cos\alpha + \frac{v^2}{g\,r}\sin\alpha\right) - \tfrac{1}{2}\left(\sin\alpha - \frac{v^2}{g\,r}\cos\alpha\right)\frac{H}{d}:$$

and these are equal if $\tan\alpha = \frac{v^2}{g\,r}$.

Meanwhile the body of the carriage, in consequence of the elasticity of the springs, takes up a mean position more nearly horizontal and level than the sleepers, so that the deflecting effect of the curve is neutralised.

In an analogous manner the turning of the screw propeller will heel a steamer through a small angle θ, given by $\sin\theta = 33{,}000\ I \div 2240\ W\,\pi\,n.\ G\,M$, where I denotes the I.H.P., and n the revolutions per minute.

8. Taking the expression for l, the length of the equivalent pendulum for rolling (or pitching) oscillations

$$l = c\frac{h^2 + k^2}{a^2 - c\,h},$$

we see that there are three ways of increasing l, and thus making the motion easier—

(I.) By increasing the flexibility, and consequently the permanent average vertical set c of the springs.

(II.) By diminishing a the distance between the springs, by placing the springs inside the wheels.

(III.) By increasing h, the height of the centre of gravity. (Compare "Der Maschinenbau," Band III., von F. Redtenbacher, 1865.)

The Crampton engine, with its low centre of gravity and outside springs, is thus a contrast to the McConnel engines with high centre of gravity and inside springs—Fig. 1—which would have the long, gentle, easy swing of the old, high, narrow, mail coaches, with piles of luggage on the roof, and inside springs, coming slowly into oscillation and slowly coming to rest again.

Coming to recent times, the latest engines of Beyer and Peacock for the Dutch railways have been made with boilers raised higher than in previous designs, and they are found to run steadier, and also to have the working parts more accessible for inspection and repair.

9. For the purpose, however, of investigating the character of the motion of a body like a large ironclad performing slow oscillations, Sir W. Thomson has pointed out that it is advisable to employ pendulums with as short a period of oscillation as possible, in order that these oscillations should die out quickly and the pendulum assume the general direction of the resultant of gravity and the reversed acceleration at any point. For this purpose Sir W. Thomson employs plummets with very short cords of suspension, or we might employ small open vessels of water or mercury, the mean level of which at any instant would be perpendicular to the resultant force.

The practical importance of this investigation has been shown by Mr. Philip Jenkins in his paper on "The Shifting of Cargoes," read before the Institution of Naval Architects in June, 1887; for if the change in direction of the plummet or of the surface of the mercury at any point is greater than the angle of repose of the cargo—grain or coal—then shifting will take place. Mr. Jenkins shows that shifting of cargo is most likely to happen at the extreme inclination of each roll of the ship; and then it can easily be demonstrated by his methods that if we make—Fig. 5—$G\,L = l = k^2 \div G\,M$, and draw L C at right angles to G L to meet the horizontal through G in C, then a plummet suspended by a short cord at P will take up a position at right angles to P C, or the surface of mercury in a vessel at P would take the direction P C; consequently, if P C makes an angle with the deck greater than the angle of repose, the cargo will shift.

A complete mathematical investigation of the lines of force in a rolling ship shows that they are equiangular spirals, varying at every instant: and the determination of the position of the ship where this variation is least would be of practical interest in its bearing on the prevention of sea-sickness.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE.—QUEEN'S BENCH DIVISION.

Before Mr. Justice Stephen.

HASLAM *v.* HALL.

This was the great patent case—described by the learned judge as the most interesting he had known—as to the validity of the Bell-Coleman patent for "refrigerative processes and apparatus for preserving food" that is in transport from our colonies or foreign countries. It was known at and long before 1877—the date of the patent—that air is heated by compression and that it may be cooled by re-expansion, especially if, as it expands, it is let to do work, thereby re-converting its heat into pressure. And the general idea of employing this property of air for the purpose of providing large quantities of cold air where it was required was applied many years ago to the construction of a variety of machines adapted to different purposes, such as the cooling of heated chambers, the supply of ice in hot countries and elsewhere, and the preservation of meat and other provisions. Difficulties, however, occurred in carrying out these undertakings, and the general object of the Bell-Coleman patent was to obviate some of those which, owing to these difficulties, had not been found to yield completely satisfactory results. The great question in the case was what, upon the true construction of the patent, the patentees claimed for that purpose, and whether, as to the whole of it, it was new. The case was tried at great length in August, the trial taking twelve days before the learned judge—without a jury—and, after taking the vacation to consider the great mass of evidence, he delivered judgment on the 12th ultimo in favour of the plaintiffs—the present holders of the patent—as to the greater part of the patent, but against them as to a part. The last question which the learned judge had to consider, he said, was as to the validity of claim 2 in the Bell-Coleman specification. The claim is in these words—"The arranging or combining together of steam engine, air compressing, and air expansion apparatus in the improved manner described." The only question, he said, was as to the construction of this claim. On one construction of it, it was admitted by the witnesses for the plaintiffs to be bad for want of novelty; but if another construction was adopted it was contended to be good. The claim related to a connection which was established between the steam engine and the refrigerating part of the machine in the Bell-Coleman patent. It was an admitted fact that a machine known as the Bathgate machine had been used years before the Bell-Coleman specification, and to the knowledge of the plaintiffs, which differed from the apparatus in question only from the circumstance that one pair of pistons was employed instead of two. The advantages of the arrangement were very similar, though, of course, the advantage of continuous working after a partial breakdown was not included in them. The question, therefore, was whether an apparatus which consisted simply in the duplification of an apparatus previously known could be said to contain novelty. If it could the claim was good; if not it was bad. Some remarkable evidence was given upon this point. It clearly appeared that both Sir F. Bramwell and Dr. Hopkinson considered at first that the true interpretation of the specification was to claim a working with two cylinders as well as the working with four, and, therefore, that the claim in question was bad. It was, however, admitted that it was a question of law for the learned judge, and he proceeded to deal with it. Did the specification, he said, claim the arrangement of two cylinders as well as that of four, or was the claim confined to the juxtaposition of four? The question, he said, was one of considerable difficulty. When worked by two cylinders only it was obvious that the machine in question would be simply the Bathgate machine, and this, no doubt, would be a complete anticipation. The advantages claimed would follow mainly, if not entirely, from the employment, or, at any rate, from the presence, of four cylinders. The question, therefore, came to this: Did the claim include the use of two, or was it confined to the use of four, parallel cylinders? He thought that the claim, if good, would have been infringed by the use of half the machine. *Primâ facie*, the effect of his decision on this point was to invalidate the patent, and to entitle the defendant to judgment, though in the rest of the patent there was novelty, and there had been an infringement of it. In the course of the argument, the Attorney-General expressed his intention, if the decision should be adverse to him, to make an application to disclaim this part of the invention under Section 19 of the Patent Act, 1883, and the learned judge therefore expressed his willingness to hear any such application, which was now accordingly made. The application was made under this section (19) in the Patents Act, 1883:—"In an action for infringement of a patent, the Court or a Judge may at any time order that the patentee shall, subject to such terms as to costs and otherwise as the Court or a Judge may impose, be at liberty to apply at the Patent-office for leave to amend his specification by way of disclaimer, and may direct that in the meantime the trial or hearing of the action shall be postponed." Section 20 provides that where an amendment by way of disclaimer, correction, or explanation has been allowed under the Act, no damages shall be given in any action in respect of the use of the invention before the disclaimer, unless the patentee establishes that his original claim was framed in good faith and with reasonable skill and knowledge.

Mr. Aston, Q.C. (with the Attorney-General and Mr. Carpmael), appeared for the plaintiffs in support of their application, pointing out that his Lordship had not yet given judgment (except upon the issues of fact), having reserved his judgment, and that the application might be made at any time before judgment, and that it was subject to his discretion as to terms.

Sir H. James (with Mr. Moulton, Q.C., and Mr. Bousfield) appeared for the defendants, in opposition to the application, contending that it was too late, and that the enactment itself (as to postponement of trial) implied that the application was to be before the trial, and certainly not after trial.

Mr. Aston, in reply, again pointed out that judgment had not yet been given.

Mr. Justice Stephen: That is so, undoubtedly. I have only decided the issues of fact, reserving this question. The whole object of the Act was to give the Court power to accede to such an application in the course of or after trial.

The learned Judge said the case was important, and the question was novel. Therefore he would take time to consider his judgment.

On November 29th this case came again before Mr. Justice Stephens.

Mr. Moulton, Q.C. (with him Mr. Bousfield), for the defendants, said that they had now received notice from the plaintiffs that they intended to withdraw their application for leave to amend the specification. All, therefore, that he had to do was to ask for judgment.

The Attorney-General (with him Mr. Aston, Q.C., and Mr. Ernest Carpmael), for the plaintiffs, said that this was so, and he should only have to address his Lordship on the question of costs.

This question was accordingly argued at some length.

His Lordship said he would take time to consider his decision as to who should pay the costs.

CONTRACTS OPEN.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY—SPECIFICATION FOR IRONWORK FOR ROOFING—BANDORA STATION.

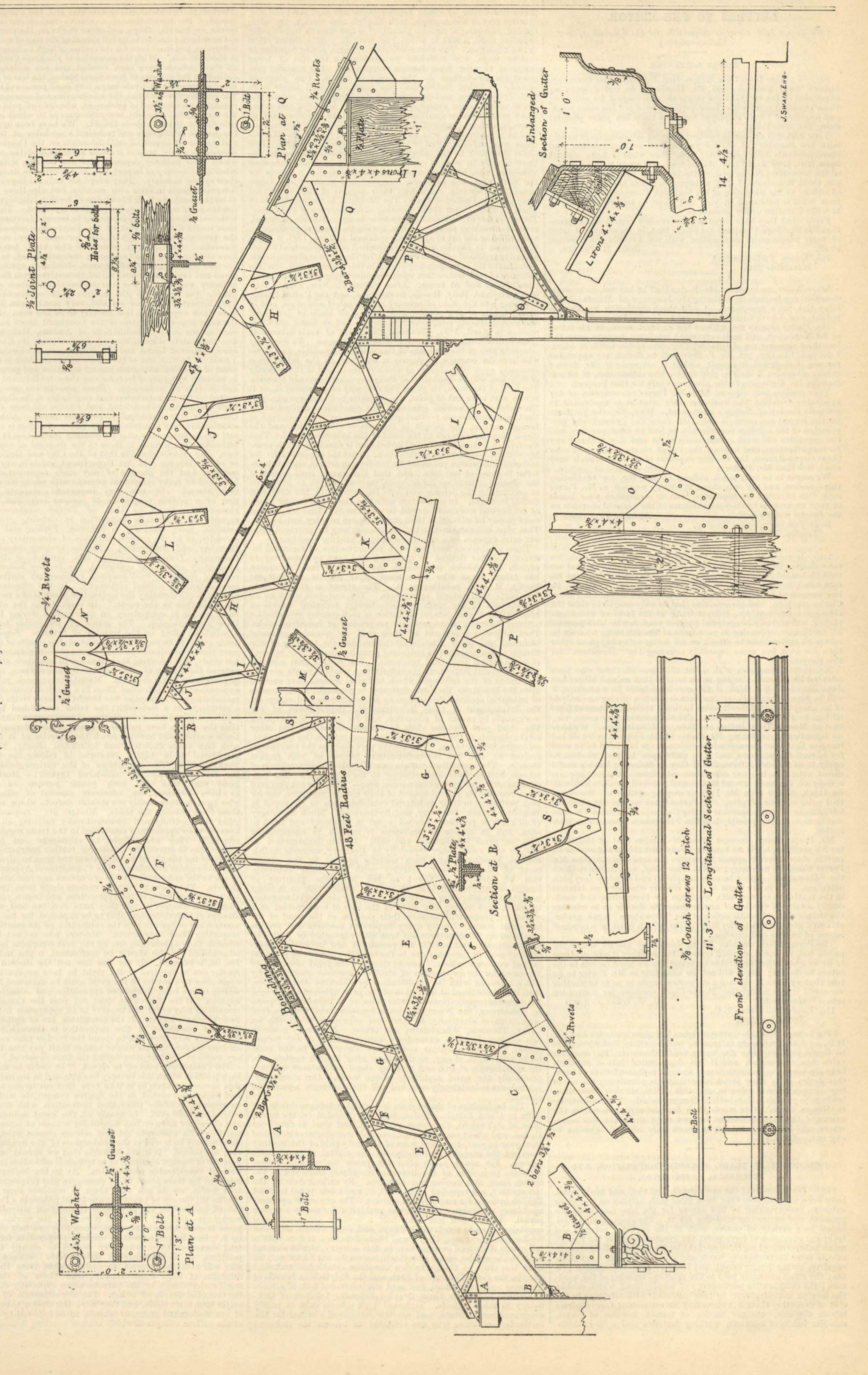
The work required under this specification consists of the construction, supply, and delivery in England, at one or more ports named in the tender, of the whole of the wrought and cast ironwork for the roofing over the railway station, 164ft. 6in. long by 62ft. 11in. clear span, together with all fastening, all galvanised, corrugated iron for ventilators, cast iron ornamental brackets, wrought iron ornamental finials, gutters, down pipes, and everything necessary for the completion of the work in India; with an addition of 50 per cent. to the net quantity of rivets, and 10 per cent. to the net quantity of bolts required, for waste. The ironwork is shown on page 447.

Materials.—The wrought iron is to be well and clearly rolled to the full sections shown in the drawing or in specification, and free from scales, blisters, laminations, cracked edges, and defects of any sort. Rivets must stand following tests: Bending double upon itself when cold or red hot without showing signs of fracture; the shank being nicked whilst cold and bent double, showing the fibre of the iron to be of good quality; flattening down the head whilst red hot until its diameter is equal to two and a-half times that of the shank without showing any signs of cracking at the edge; punching through the shank whilst at a red heat with a taper punch, a round hole, the diameter of the rivet, without showing signs of cracking or splitting. The tests will be conducted at the works of the contractor or elsewhere, or both, as may be determined by the company's engineer, at contractor's expense. The sheets for the corrugated ventilators are to be made from such a quality of iron, and in such a manner, as to produce a surface free from cracks, dirt, or scale. The sheets when flat are to weigh 1·96 lb. per square foot before being galvanised; the additional weight after galvanising must in no case be less than $2\frac{1}{2}$ oz. per square foot. No material falling short of these tests is to be used, and no iron of foreign manufacture is to be used throughout this contract. It is expressly to be understood that the greatest accuracy is to be observed in every part of the work, the object of the design being to facilitate as much as possible the erection of the roofing in India by perfection of workmanship in this country, and all corresponding parts must be made exactly similar and interchangeable. All plates and bars are to be holed up to full dimension, although the word "rivets" may be used on the drawings; the rivet holes are to be made of the sizes figured. All rivetting is to be done by hydraulic or steam machines of approved construction, and in no case must the diameter of the rivet under the head be more than $\frac{1}{32}$in. less than the diameter of the hole it is intended to fill. All loose rivets and rivets with any defect or deficient heads must be cut out and replaced by others. Rivets must be cut out when required for the examination of the work. All rivets are to be cup headed at each end, and the heads are to contain not less than $1\frac{1}{4}$ diameter of the rivets. The cover plates and gussets must be shaped to the full sizes shown on the drawing, and any plates in which the holes are made nearer to the edge than shown in the drawing will be rejected. All resting plates are to be perfectly flat. All holes may be either punched or drilled, but will be rejected if holes are not accurately placed. The whole of the trusses are to be put together in position with bolts and nuts and the purlins bolted to them to test the accuracy of the work. The bolts are to be heated to the temperature of melted lead and then dipped in boiling linseed oil.

Tenders are to be made upon forms bound up in the specification, which must be sent in without being detached. No allowance shall be claimed by contractor whose tender may be accepted for any error discovered after being sent in, and in any such case payment on the actual quantity supplied will be made only in proportion to the total lump sum as tended. Tenders are to be sent in not later than twelve o'clock at noon on the 13th December, 1887.

CONTRACTS OPEN.—ROOF OF BANDORA STATION.

(For description see page 446.)



LETTERS TO THE EDITOR.

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

WATER SOFTENING.

SIR,—I gather from their letters that the Stanhope Company, Messrs. Gray and Co., and Mr. Howatson do not dispute my exposition of the fact that the means they all employ for obtaining those chemical results they have written you of are the same means and appliances I have employed any time these ten years past for doing the same thing.

Your editorial articles in relation to water softening dealt mainly with the chemistry of Clark's process, and in that relation your correspondents addressed you; but, after what I have written upon that, they would now like to lead you away to the question of the separation of the precipitate from the softened water. If you think it desirable I shall be happy to follow them, at the risk of adding to the education of the Stanhope Company, who appear, from what is published in your last issue, to be sadly in a fog as to what filtration under pressure is.

From what they have written your readers would not suppose that the Stanhope Company are aware that, in those cases I cited of their unsuccessful competition with me, I employ no filtration at all. JOHN H. PORTER.

165, Queen Victoria-street, November 29th.

SIR,—Allow me to assure Mr. Porter that he has not, as he says, wounded my feelings in disclosing the language of Messrs. J. W. Gray and Son's prospectus. I sold these gentlemen my English patent, and I have nothing whatever to do with the working of it.

Mr. Porter attacks me, without the slightest cause, in his letter of 1st November, and he is surprised I retaliate; he even goes the length of accusing me of appropriating some of his brilliant ideas. I did not, like him, get Sir F. Bramwell to design my apparatus for me, I designed it myself, and it is original; if Mr. Porter thinks otherwise, I shall be glad to give him satisfaction, if he will transfer the discussion to the place set apart for that purpose.

Your readers may suppose, after Mr. Porter's description of my apparatus—sending the workmen aloft—that it is equivalent to going to the top of Nelson's monument. Why, Sir, the platform for the largest apparatus is only 11ft. from the ground, the preparation of the solution occupies almost half an hour per day, and the apparatus will work continuously night and day without any further attention, and without the aid of steam power. Under these circumstances, the working expenses of my apparatus is very much less than Mr. Porter's.

We ought to be very much obliged to you, Sir, for ventilating this question, and my only object in writing was not, as Mr. Porter says, "to advertise my apparatus," but to strengthen your hands in your arguments against the evidence of the eminent chemists on the Bristol water supply. ANDREW HOWATSON.

Belle Vue-road, Upper Tooting, London, November 28th.

SIR,—In reply to Mr. J. H. Porter's letter of the 16th inst., we must decline to allow him to assert without contradiction that we wrote a heated letter, and we fear that this is only a reflex of his own mind, so that instead of lifting a veil from our prospectus, he has unmasked his design of endeavouring to advertise the Porter-Clarke machine; and his assertion that he only sought to show the chemical conditions, &c., independently of the form of vessel employed, will scarcely be accepted by your readers who have perused his first letter, appearing in your issue of the 4th inst., wherein he makes an indiscriminate attack on all water-softening plant other than his own, but more especially selecting the "Howatson" for this purpose.

Mr. Porter concludes with a list of names of those who have adopted his process, alleging as an excuse that we and others had done likewise. We think, if the correspondence be examined, it will be found that only on one occasion, when giving an analysis of an exceptionally difficult water having a varied hardness of from 60 deg. to 90 deg. all permanent, did we mention any name, viz., that of Messrs. Thos. Bolton and Sons, of Birmingham. We have no intention of imitating Mr. Porter in this respect, as we do not imagine that your correspondence columns are intended to be used for advertising purposes, and it is quite open to your readers to apply to us for such information if they so desire it; but we would direct attention to your advertisement columns, wherein appears a copy of the most recent testimonial received by us, which will, we think, silence even Mr. Porter's carping criticism. We regret that prior to their adopting the Porter-Clark we did not place the advantages of our apparatus before the respective firms whom he mentions as having possibly had the "Howatson" pressed on their notice.

Mr. Porter claims amongst other advantages that of simplicity for his machine, while we venture to say that this is not one of its merits, since it would appear to require the care and attention Mr. Porter thinks so necessary; on the other hand, we venture to think the "Howatson" cannot be more simplified and requires very little attention. We invite those of your readers who have an interest in the matter to inspect both machines for themselves, and confidently await the verdict of any engineer to decide as to whether the simple and automatic action of the "Howatson" is not preferable to a process which uses filter cloths, which must be a constant source of trouble and expense.

The Porter-Clark machine having been first placed before the public has, no doubt, secured orders; but whether it will continue to do so when other apparatus be better known must be left to the future to decide; but it will not be consoling to Mr. Porter to be told that we have lately had a suggestion made to us as to whether we could utilise an existing Porter-Clark machine for conversion into a "Howatson." J. W. GRAY AND SON

115, Leadenhall-street, E.C., November 29th.

[We believe that this correspondence has gone quite far enough. It is, no doubt, intensely interesting to the writers, but we venture to doubt that any one else cares much about it. Its scientific value has evaporated, and it has degenerated into a squabble between inventors, manufacturers, and the representatives of both. Our desire is to show strict impartiality in permitting the use of our correspondence columns, and this desire, we fear, sometimes leads us to publish letters better left unpublished. There is nothing in Messrs. Grays' letter worse than has already appeared in the course of the correspondence, but we must draw the line somewhere, and believe that it can be drawn here without injustice to any one.—ED. E.]

DEPRESSION OF TRADE, FOREIGN COMPETITION, AND TECHNICAL INSTRUCTION.

SIR,—The columns of the newspapers, technical and trade press, have for a considerable time been filled with articles on the above subjects, endeavouring to find causes for the long continued depression, and suggesting remedies for it. The stagnation is attributed to a variety of causes, such as the superior primary and technical education of foreigners; the greater energy of the foreign manufacturer in seeking fresh markets, his pliancy in exhibiting readiness to meet his customers' wants and give him the exact article he requires, giving longer credit, and being content with smaller profits; the strict attention paid to the practical training of the workmen; the comparative permanency of employment, which enables the foreign manufacturer to take contracts with safety as to the cost of executing them not exceeding his estimates; freedom from labour disputes, cheaper modes of transit, lowness of wages, steadier habits of workmen working factories and mills in shifts protective duties by which English goods are shut out; the disgraceful way in which goods, both English and foreign, are adulterated, and inferior articles passed off as first class by fraudulently branding them, a fact to which you have in your columns often drawn attention. The above-mentioned causes, acting together in various ways, are sufficient to account for the loss of trade supposed to arise from foreign competition. The remedies proposed are as various as the assigned causes. One proposed remedy—technical instruction—has been advocated much more than all the others, and described by its champions in season and out of season, more especially the latter, in language and terms which would require qualification if applied to the discovery of steam, invention of locomotives, and other aids to industrial progress. Technical instruction was to be the panacea for all the ills our trade was suffering, and would work a moral revolution. One slight drawback to the adoption of this blessing was that no one knew exactly in what it consisted, not even its most persistent advocates, who, when questioned and desired to give a reason for the faith that was in them, retreated into shadowy and vague generalities, forcibly reminding their hearers of that celebrated reply given in Oxford-street by The Mulligan to the inquiry about where he lived, "over there, pointing in the direction of Uxbridge." The advocates of technical instruction being not easily rebuffed, capable of making plenty of noise, having the merit of persistency, and skilled in the art of agitating, obtained in June, 1881, a Royal Commission to inquire into the instruction of the industrial classes abroad in technical and other subjects, for the purpose of comparison with that of the corresponding classes in this country, and also the influence of such instruction upon manufacturing and other industries abroad and at home. After visiting Belgium, France, Germany, Holland, Italy, Russia, Switzerland, and the United States, inquiring into the state of primary and technical education, cost of living, habits of the people, and visiting all kinds of industrial and manufacturing establishments abroad and at home, the Commission in April, 1884, presented the result of their labours in three octavo volumes, containing about 2000 pages. To give any adequate idea of the contents of this work is impossible, but those who have the courage to peruse it will find all the information necessary upon the subjects of which it treats, and in the majority of instances will be disabused of many prevalent ideas and theories. The bulk of the work, its price, the difficulty of procuring it, as it is now said to be out of print, are obstacles to the proper study of the question. Speaking generally, the conclusions arrived at by the Commissioners are:—That great as has been the progress of foreign nations, our people in the arts of construction and the staple manufactures are at the head of the industrial world. That the foreign system of technical instruction is unsuited to this country without considerable modification. That the opportunities for technical instruction possessed by the foreign artisan are much inferior to those of our own; and that the former have lamented the absence of facilities for technical instruction such as are given in evenings by the Science and Arts Department or the City and Guilds Institute. In connection with this the much longer hours of continental workmen should be considered. That we expend more money on education than any European country but France. That what technical instruction we require may be provided without extra expense by a re-arrangement of existing machinery.

These conclusions were not what the advocates of technical instruction either desired or expected, and may go some way to explain the oblivion into which the report of the Commission has fallen, those who were most eager for its appointment hardly, if ever, mentioning it. The report is divided into four parts, with several appendices. The first part gives us an introduction to the main subject—foreign technical schools—a brief outline of the general education in each country available for artisans, foremen, managers, and proprietors of industrial works. Then follows an account of visits paid to special continental technical and trade schools established for the training of the various classes engaged in industrial pursuits, also a brief account of some typical industrial museums. The second part contains visits to several important manufacturing establishments abroad, and treats of the influence which technical schools have exerted upon the industries they are designed to promote; also accounts of industrial societies established by manufacturers and others for the development of their industries, the improvement of the workpeople by means of education, and for various local objects. The third part contains visits to various educational and other establishments in the United Kingdom, and information on technical instruction at home. The fourth part contains the conclusions arrived at, and the recommendations arrived at with respect thereto. The appendices contain general statistics, programmes of schools, written statements relating to the inquiry, &c. The conclusions arrived at by the Commission are:—"We were not prepared for so remarkable a development of their natural resources, nor for such perfection in their industrial establishments as we found in Belgium, France, Germany, and Switzerland. Much machinery of all kinds is produced abroad equal in efficiency and finish to ours, and in numerous instances is applied to manufacture with as great intelligence and skill. In the construction of bridges and roofs, more especially in Germany, accurate mathematical knowledge has been usefully applied to the attainment of the necessary stability with the least consumption of materials. Great as has been the progress of foreign countries, and keen as is their rivalry with us in many important branches, our conviction, shared by continental manufacturers, is, that taking the state of the arts of construction as a whole, our people still maintain their position at the head of the industrial world. Nearly every important machine and process employed in manufactures has been either invented or perfected in this country, and most of the prominent new industrial departures of modern times are due to the inventive power and practical skill of our countrymen. Among these are the great invention of Bessemer for the production of steel in enormous quantities, by which alone, or with its modification by Gilchrist and Thomas, steel is new obtained at one-tenth of the price of twenty years ago, the numerous applications of water pressure to industrial purposes by Armstrong, the Nasmyth steam hammer, and the practical application of electricity to land and submarine telegraphy by Cooke, Thomson, Wheatstone, and others. Machinery made in this country is more extensively exported than at any former period; the best machines constructed abroad are in the main made with slight, if any, modifications after English models. In the manufacture of iron and steel we stand pre-eminent, and are practically the naval architects of the world. Our mechanical journals are industriously searched and their contents assimilated abroad."

"The beginnings of the modern industrial system are due in the main to Great Britain. Before factories, founded on the inventions of Arkwright, Crompton, and Watt, had time to take root abroad, and whilst our own commerce and manufactures increased from year to year, the great wars of the early part of this century absorbed the energies and dissipated the capital of Continental Europe. For many years after the peace we retained almost exclusive possession of the improved machinery employed in the cotton, linen, and woollen manufactures. By various Acts of the last century, not repealed until 1845, it was made penal to enlist English artisans for employment abroad. The export of spinning machinery to foreign countries was prohibited for nearly a similar period. Thus, when less than half a century ago continental countries began to construct railways and erect modern mills and mechanical workshops, they found themselves face to face with a full-grown industrial organisation in this country, almost a sealed book to those who could not obtain access to our factories. To meet this state of things foreign countries established technical schools, the Ecole Centrale of Paris and the Polytechnic Schools of Germany and Switzerland, and sent engineers and men of science to England to prepare themselves for becoming teachers of technology in these schools. Technical high schools exist in nearly every continental State, and are the recognised channel for the instruction of those who are intended to become the technical directors of industrial establishments; and the success which has attended the foundation of extensive manufacturing establishments, engineering shops, and other works on the Continent could not have been achieved to its full extent in the face of many retarding influences, had it not been for the system of high technical instruction in these schools. With the exception of the Ecole Centrale at Paris all these schools have been created and are maintained almost entirely at the expense of the several States, the fees of the students being so low as to constitute only a very small portion of their income. The buildings are palatial, the laboratories and museums costly and extensive, and the staff of professors, who are well paid according to the continential standard, is so numerous as to admit of the utmost sub-division of the subjects taught. We have been impressed with the general intelligence and technical knowledge of the managers and masters of industrial establishments on the Continent. These persons, as a rule, possess a sound knowledge of the sciences upon which their industry depends, and are familiar with every new scientific discovery of importance, and appreciate its application to their special industry. They adopt not only the improvements and inventions made in their own country, but also those of the world at large, thanks to their knowledge of foreign languages and of the conditions of manufacture prevalent everywhere. The creation of technical schools for boys intending to become foremen is of much more recent date than that of the Polytechnic Schools, and up to the present time, though a few foremen have received some theoretical instruction in schools of this kind, foreign foremen have not generally been technically instructed, but, as in England, are men who by dint of intelligence, steadiness, aptitude for command and organisation have raised themselves from the position of ordinary workmen. For the technical education of workmen outside the workshop the resources of continental countries have hitherto been, and are still, very much more limited than have been supposed in this country to be the case. In several of the more important centres of the Continent there exist societies, such as the Sociétés Industrielle of Amiens, Mulhouse, Rheims, &c., the Société d'Enseignement Professionnel du Rhone, with its headquarters at Lyons, and the Niederoesterreichischer Gewerbe-Verein of Austria, one of the chief objects of which is the development of technical education among workmen and persons engaged in industry by means of lectures and the establishment of museums and schools of technology. These associations are mainly supported by the manufacturers and merchants of the district to which their operations are restricted, and receive aid from Chambers of Commerce, the municipality, and the State. Although these societies are very numerous, their sphere of action is very limited, and the facilities they offer for evening instruction in science and technology are inferior to those at the disposal of our own workmen. No organisation like that of the City and Guilds Institute, or of the Science and Art Department, exists in any continental country, and the absence of any such organisation has been lamented by many competent persons with whom we came in contact abroad. In two very important respects the education of a certain proportion of persons employed in industry abroad is superior to that of British workmen—first, as regards the systematic instruction in drawing given to adult artisans, more especially in Belgium, France, and Italy; and secondly, as to the general diffusion of elementary education in Germany and Switzerland. In the evening schools of North Germany—Fortbildingsschulen—the studies of the ordinary elementary school are continued, the further instruction being confined mainly to book-keeping, rudimentary mathematics, and some notions of natural philosophy. In the schools of the same class in South Germany the instruction given is of a more technical character than in the north." In some States the attendance at these schools is compulsory on apprentices during two years of their apprenticeship. The action of the guilds has also had a beneficial effect on the training of artisans. Some years back trade guilds in Germany were abolished; the results of this measure were that apprentices who had to pass certain examinations would not study, and deserting their masters before their time was out, entered the service of other persons as journeymen, no certificate of proficiency being required. Manufacturers took young boys as apprentices and instructed them in a careless manner; thus, in a manufactory an apprentice was taught to make rivets and received a certificate as a locksmith; the tailor established himself as a builder, and the mason as a maker of implements. At the present time the guilds have recovered much of their former power over trade matters, and however much the exercise of it may conflict with free trade doctrines and individual liberty, the effect is considered to be highly beneficial in raising the standard of workmanship. The regulations of the various guilds differ, but the following may be considered typical:—Masters of the guild shall take only such young persons as apprentices as have acquired the necessary amount of education, and who have neither bodily nor mental defects which may prevent them from learning the trade. Masters are "responsible to the guild for carefully and conscientiously fulfilling all the duties towards their apprentices mentioned in the trade regulation of the empire." They are obliged to encourage and induce their apprentices to attend the school for further instruction, or trade school of the town, and to allow them the time required for punctual and regular attendance. The Committee of Apprenticeship has to see to the enforcement of all ordinances and resolutions relating thereto. They have to visit the various shops from time to time, see to the occupation of the apprentices, and once a year to satisfy themselves whether or not they have received and acquired the amount of instruction and skill to be expected for the time. The masters are obliged to give the committee all information required respecting their apprentices. Masters who neglect their duties towards their apprentices are, on the first complaint being proved, admonished; if this should be ineffectual, a fine not exceeding 10s. 0d. is inflicted. If the fine has not the desired effect, the master can be deprived of the right to take apprentices. Every apprentice to a master of the guild must be examined by the committee before being discharged apprentice and admitted as journeyman. If the apprentice does not pass the examimation the committee may order him to serve as an apprentice from three to twelve months longer. If the committee are of opinion that the deficient knowledge of the apprentice is through the master's fault, they may allow him to spend the further time required with another master, and his former master must pay him the customary wages of a journeyman during the time so served."

The Commission goes on to report, "In order to maintain the high position which this country has attained in the industrial arts, it is incumbent upon us to take care that our foremen, managers, and workpeople should, in the degree compatible with their circumstances, combine theoretical instruction with their acknowledged practical skill. In nearly all the great industrial centres and elsewhere more or less flourishing schools of science and art, together with numerous art and science classes, exist, and their influence my be traced in the productions of the localities in which they are placed. It is not desirable that we should introduce the practice of foreign countries as to technical education into England without considerable modification. As to the higher education, intended for those about to be managers and proprietors of industrial works, we do not wish them to continue their theoretical studies till the age of twenty-two or twenty-three in a Polytechnical School, and so lose the advantage of practical instruction in our workshops—the best technical schools in the world—during the years from eighteen to nineteen, when they are best able to profit by it. In determining what is the best preparation for the industrial career of those who may expect to occupy the highest positions, it is necessary to differentiate between capitalists who will take the general, as distinguished from the technical direction of large establishments, and those at the head of small undertakings, or the persons more especially charged with the technical details of either. For the education of the former ample time is available, and they have the choice between several of our modernised grammar schools, to be followed by attendance at the various colleges in which science teaching is made an essential feature, or the great public schools and universities, provided that in these latter modern languages and science take a more prominent place. Either of those methods may furnish an appropriate education to those persons to whom such general cultivation as will prepare them to deal with questions of administration is of greater value than an intimate acquaintance with technical details. It is different in regard to the smaller manufacturers and the practical managers of works. In their case, sound knowledge of scientific principles has to be combined with the practical training of the factory, and therefore the time which can be appropriated to theoretical instruction will generally be more limited. How this combination is to be carried on will vary with the circumstances and the trade of the individual. The best preparation for technical study is a good modern secondary school, of the type of the Manchester Grammar School, the Bedford Modern School, and the Allan Glens Institution at Glasgow. Unfortunately, our middle classes are at a great disadvantage compared with those of the Continent, for want of a sufficient number of such schools. The existing endowments are very unevenly distributed over the country, in many of the large manufacturing centres no resources of the kind exist, private enterprise is inadequate to do all that is required for establishing schools, and we must look to some public measure to supply this—the greatest defect in our educational system. In those cases in which theoretical knowledge and scientific training are of pre-eminent importance, the higher technical education may with advantage be extended to the age of twenty-one or twenty-two. In the cases of those who are to be managers where complex machinery is used, or where early or prolonged workshop experience is all-important, the theoretical training should be completed at not later than nineteen years of age, when the works must be entered, and the scientific education carried further by private study or such other means as do not interfere with the practical work of their callings. Many colleges have arranged their courses to meet these requirements, and some of them have workshops for the purpose of familiarising the students with the use of machine and hand tools. We have in the classes of our Science and Art Department a system of instruction for the great body of our foremen and workmen, susceptible certainly of improvement, but which in its main outlines it is not desirable to disturb. In the United Kingdom at least one-half of the cost of elementary education is defrayed out of Imperial funds, and the instruction of artisans in science and art is almost entirely borne by the State. Hence it will be necessary to look in the main to local resources for any large addition to the funds required for the further development of technical instruction in this country."

The report was not what those who were agitating for the necessity of technical instruction desired, as it emphatically stated that the continental system of technical instruction was not suited to this country, and all that was required could be done by a re-arrangement of existing machinery. From the general and technical press it did not receive the attention it deserved. Such notices of it as appeared related generally to some particular feature without reference to it as a whole. The hopes of the advocates of technical instruction being rudely dispelled, nothing more was heard of the subject for some time; but the advocates of the nostrum are again on the war path, blowing their trumpets at the street corners with power enough to set the teeth of the passers by on edge, some of them resorting to every possible distortion, evasion, exaggeration, and suppression. One prominent agitator, not long ago, in addressing a meeting, informed his audience that in Germany, thanks to the system of education there, the son of a washerwoman who could pass a certain examination would be entitled to claim exemption from two out of the three years' compulsory military service, but omitted to state that those who acquired the privilege, and consequently served as one-year volunteers, have to provide their own arms, clothing, and food during that period.

A study of the report on technical instruction will show how little there is required of it in this country. A study of the consular and diplomatic reports, both of this and other countries, will show that among the causes for loss of British trade want of technical instruction cannot be counted. C.

Westminster, S.W.

FREE TRADE AND NO TRADE.

Sir,—I see that Mr. Muir wishes me to communicate with him directly; perhaps even to call upon him at the London Institute. It may not be; yet awhile at all events. *Timeo Danaos et dona ferentes.* Was it not Mr. Muir who, metaphorically speaking, tried to scalp me a few months ago because I ventured to hint something about payments in gold for imports? Probably he is now waiting round a corner at the London Institute with ready Free Trade tomahawk for unwary skull. I shall wait a little.

Matters are I see developing. I have watched and read with interest not only the letters which have appeared in your columns, but the attitude of large sections of the public and the daily press. Strange to say even the *Times* now thinks it not beneath its dignity to refute the errors of Fair-Trade. As for myself I am learning fast, only my stupidity and ignorance are so great that I have much to absorb yet. Once more I venture to trespass on your space and ask questions. Some of your readers will, I am sure, set me right where I am wrong.

I find that in Great Britian there is a large section of the population which lives on the proceeds of foreign securities. I am sure I am right in this, because on a former occasion I asked through your pages, Sir, how it was that the value of our imports being, say, treble that of our exports, these same exports could pay for the imports; and I was then told by various Free Traders that they did not pay for them, but that the extra imports represented, to a large extent, interest on foreign loans and such like.

Now it is quite clear even to my stupid slow-working brain that the holders of these foreign securities will fight to the death in favour of Free Trade. They would lose a great deal, perhaps, if there was Protection. They now enjoy fixed incomes, and the cheaper things are, the better off the foreign stockholder is. These are the men, however, who have, to a large extent, the control of the daily press. They have weight in the country, and can make themselves heard. Now this being so I venture on my first question, which is: Is it likely that we shall have a strictly impartial and valuable opinion from these gentlemen as to the relative merits of Free Trade and Protection? and have those who hold opposite views an equal chance of making themselves heard?

Having so far unloaded my mind, and taken breath for another effort, I will go on to ask what would take place supposing that every one who had a fixed income derived from abroad determined that he would not buy any English-made goods of any kind? It seems to me that such a resolution would be extremely bad for manufacturers in this country. I think it is Mr. Froude who tells us that the Irish gentry never could be persuaded to use anything of Irish manufacture save linen. They bought in the English or French market. Was this a good thing or a bad one for Ireland? Possibly I am quite wrong in thinking this, but just for argument's sake let it be conceded that I am not wrong. Then it seems to follow that the reverse of this picture is true; and that the more English-made goods that foreign stockholders buy the better will it be for manufacturers here. Is this so?

Let me push this a little further. Let me suppose that the sum of £100,000,000 is received into this country every year in the shape of goods sent here to pay interest on foreign loans. These goods are virtually the property of what, for want of a better word, I must call the capitalists—that is to say, the people to whom France and Germany and Belgium and Russia, &c. &c., are indebted. Will some of your readers enlighten my ignorance, and tell me would it not be much better for large sections of the inhabitants of *this* country if these capitalists were paid in some other way than by goods which we can manufacture ourselves, and were driven to spend their money on native manufactures? Perhaps the answer will be that if we did not take the payment in "commodities" we should not get it at all. Is this certain? Are we to believe that the countries I have named would all repudiate if we adopted a Protectionist policy to-morrow? In reply to these last questions I do not want vague generalities; I want facts—I want proofs.

As an example of the kind of answer I do not wish to get, I may cite the reply of one of your correspondents, who pointed out some time since, for my benefit, that with five pounds' worth of English coal sent to Jacques Bonhomme about five silk dresses could be bought; dresses not only for my wife, but for my wife's relatives, in the United States. The statement reminded me vividly of a certain £5 note, the property of Mrs. Caudle, of happy memory, which note possessed unrivalled purchasing power. As one of your subsequent correspondents pointed out, coals do not buy silk dresses; and the whole argument was simply begging the question in dispute. If we were permitted to buy silk dresses with coals or iron or woollen or cotton goods, all would be well; but that is just what Jacques Bonhomme takes very good care not to let us do. From my point of view, the whole matter turns on this, that our exports do not nearly pay for our imports, and that the difference as now received comes to us in such a shape that British trade is seriously injured. It is with this difference that I want to deal. It is concerning this difference that I ask for information. I am a trader; I am not a political economist. No one who reads what I write can doubt that I am wholly ignorant of the science. But I am not ignorant of what goes on around me. I can see things that pass under my own eyes, and to me, in my ignorant, non-scientific way of looking at things, it seems certain that English trade is bad, and thousands of people are walking about idle and starving, because Germans and Frenchmen and all the nations of the world are working for Englishmen who have lent their money. It is all very well to say that if our silk trade has been ruined, the silk workers are free to follow other pursuits; but such talk is merely talk; it is the result of arrogant fatuity. There *is* no other pursuit open. To hear some men speak one would think that there were thousands of callings available, at which men can earn a good living. Such arguments (?) are beneath contempt.

I must hasten on to the end. I have already written much more than it is reasonable to hope you will find room for; yet the signs of the times are such that I think the question of Free Trade and no trade must be discussed somewhere, nay, everywhere, and so, thirsting for knowledge, I once more address myself to the work of question asking.

The annual Budget of this kingdom is in round numbers £100,000,000. We call ourselves Free Traders; yet it is a fact that many millions of the sum are raised by taxes on alcohol, tea, and tobacco. Will some one tell me why it is right and proper to tax tea, a poor man's necessary, while it is wrong to tax silk, a rich man's luxury? Will some one tell me why, if we raise one-fourth of our taxes by protective tariffs, it is wrong to hint that at least another fourth might be raised in the same way. It will perhaps be said that the cost of collection would be very large, that smuggling would be encouraged, and so on. But, I ask, is the cost of collecting the tax on whiskey and beer an appalling item now? Futhermore, it seems to me that in the matter of smuggling the whole question turns on whether it is worth while to smuggle or not. It might be worth while if the duty charged on, say, a silk dress was excessive; but a moderate tariff does not stimulate smuggling.

Lastly, will anyone explain to me why it is that England is the only country in the world that regards protection as worse than a crime—a blunder? And why do Englishmen, the moment they get out of the country, start as vigorous Protectionists? Surely these are remarkable phenomena.

My explanation is simply that the men who draw incomes from foreigners remain at home, and for the most obvious and selfish reasons foster Free Trade; while those who emigrate, not possessing any foreign bonds, look on Protection with totally different eyes. In this view I am probably quite wrong; but some of your readers will set me right, and meanwhile I relapse into silence. Like the boa constrictor, my digestion of—Free Trade and no trade—rabbits, to say nothing of bullocks, is slow. So your correspondents will not, perhaps, take it amiss if I do not write replies to their letters, with which, through your columns, I hope to be favoured. Trader.

London, November 27th.

Sir,—Being an old subscriber to The Engineer, will you kindly allow me to trespass on your valuable space with these few remarks anent "Free Trade and no trade."

In your last issue Mr. Brett says that it is an axiom in political economy that imports are income and exports expenditure, and that by fostering imports numbers of people are freed for other industries; all of which is no doubt true, so far as political economy or Free Trade political economy goes; but that these axioms (?) are absolute facts, like the fact that at the sea level water boils at a certain temperature all over the world, is, I think, doubtful, political economy not being an exact science. Does any other civilised nation on earth believe or act upon it except ourselves? Do the Americans believe it? Do they foster imports of corn, petroleum, iron, cotton, joinery, or anything else they can produce? I think not, if heavy duties are any argument. Times are not what they were when Free Trade was introduced, and we have held on to it on principle and got left. We see protected nations progressing and taking our markets while we are stationary or going back.

It seems to me that if the object of political economy is the benefit of the many, the shortest way to arrive at it is to provide remunerative labour for all who have strength to work. On these lines we should foster manufactures, &c., of what we can produce, and facilitate the importation of everything that we cannot make or grow, and for which we are entirely dependent on other nations. Does Mr. Brett believe that the English agricultural labourer is really thankful for the vaunted cheap loaf of the anti-corn law agitator, or the artisan either? The former is in one sense, because if the loaf were not very cheap just now, he would not have a loaf at all, as the hand that offered him the cheap loaf took away his means of paying for it by importing the corn for the said loaf instead of allowing the agriculturist to grow it. Fostering cheap imports is doing the same for the artisan.

I take it that England's welfare depends on the success of her coal, iron, woollen, cotton, shipping, agricultural, and a few other industries. We have fostered imports of foreign corn, flour, fruit, vegetables, and meat till the English agriculturist is nearly as extinct as the dado. He cannot live on the land or by the land if he has it without paying rent. We are doing the same thing with Belgian and German iron goods, bounty-fed sugars, ready-made joinery, machinery of all sorts, and from everywhere, till we have arrived at that state when capital and labour is free for other industries which used to be employed in the iron, sugar, &c., trades, and numbers of skilled artisans are idle, such as joiners, puddlers, &c. Now, will Mr. Brett be kind enough to tell me, what are these men, notably the agricultural labourers, to do? Coal mining, brewing, fishing, and dock labour are the resources open to them, and the first and last of these are overdone. Will the fisheries and breweries take all our surplus labourers, or must they go for sailors? Failing employment as such, they must emigrate.

Does not Mr. Brett and others of his creed think honestly that it is better for, say, a merchant here to export English machinery to Japan, thereby finding employment for our own people, than to buy the same in America, and possibly ship it by an American ship without it touching our shores at all?

I have heard all the stock arguments about goods being paid for in goods, and so forth, but the fact remains that we are losing our trade and manufactures in spite of the blessings of our one-sided Free Trade.

Will Mr. Brett or someone kindly point out the advantages of cheap imports and idleness, heavy poor rates, and subscriptions to this and that charity, or rather, charities of all sorts, over protected native industries and plenty of employment for all who are willing to work at a fair rate. A Sufferer.

November 29th.

Sir,—Remembering the glowing picture drawn by your correspondent "Trader" of the prosperity which a protective duty would confer on those concerned in the silk industry, I venture to think that the following quotation from an address delivered to the distressed Spitalfields weavers in November, 1826, may be interesting:—"All kinds of labour, agricultural and manufacturing, are rapidly approaching their fated equality, the level of competition, or the starvation price, the lowest that even in times of average employment will support a miserable existence." Such was the condition of "Trader's" chosen industry when the importation of French manufactured silks was absolutely prohibited, "protection" failing to protect even the most favoured industry. "Trader" admits that Protection would lower wages, but would risk this on the chance of a wider distribution of more remunerative employment. Now, according to a wide concensus of opinion, supported by much evidence in history, the best hope of a favourable solution to the population question lies in the chance that a rising standard of comfort will induce prudence among the working classes. This hope the protectionist openly abandons. So much for the future, for the first and immediate effect of a really operative means of so-called Protection, we should have to face a disastrous dislocation of our commerce and our industry.

Mr. Muir, who has, I hope, by now ascertained that we are not parting with securities in payment for imports, speaks feelingly of certain casualties that have befallen our industries under the existing system. That such casualties may and do occur under all systems does not lessen their piteousness nor the hardship of the process. But can he or any one familiar, as you have made your readers, with the nature and widespread effects of a disproportion of a few per cent. between the tonnage of our shipping and freightage, contemplate calmly the wholesale collapse which must result from measures designed to annihilate at one blow a full fourth of our trade over sea? For this is the least that effective Protection can mean. Not only shipping, but all who in any way produce or handle wares for export or import must feel the blow, and panic would aggravate its fatal range. May I not retort "Trader's" question, and ask why the State should say to us, "It is good and right for you to weave silk; forego, therefore, your ships and your export wares, and learn to weave silk or else stand idle?" Thus much of retort. With your leave I may at another time enter on a more independent criticism of the situation. W. A. S. B.

Kensington, November 30th.

SANITARY SURVEYORS.

Sir,—Will you afford me space thus publicly to express my personal indebtedness to you for the able and well-directed article upon the above subject in the latest issue of your paper? It is so seasonable, and thoroughly sound in its matter, that it must surely arouse the profession of urban and rural sanitary district surveyors to the discharge of the duty that devolves upon them, *i.e.*, reform of our existing sanitary law and practice—if they, along with medical officers of health, would exercise their reasonable and legitimate functions as conservers of the public health. It is their peculiar interest to observe the "signs of the times" in this connection, and such observation must convince them of the inefficiency—not to mention absurdity—of the present modes of election to many sanitary appointments, and the performance—or non-performance—subsequently, of the onerous and delicate duties such appointments invariably demand.

The two cases quoted and described in your article are instances of the grave folly sanitary authorities acting under the Public Health Act, 1875, may be guilty of without—any real—impunity, and form, along with other such cases, evidence and ground sufficient for an early reform in this as in other departments of sanitary law and government.

Our Local Government Board must be awakened from the dangerous torpor it seems to enjoy, and be required to exercise its large—I had almost said limitless—powers, especially in approving or vetoing the election or, it may be, the dismissal of sanitary officers, and the remuneration to be paid; while sanitary surveyors and nuisance inspectors, before election as such, should be required to hold a diploma or certificate of competence from some legally constituted examining Board—be it the Local Government Board itself, or other Board entrusted with the powers of examination and award of diplomas to candidates who may present themselves, and who would necessarily be limited to those only who had previously undergone a practical training as assistants in the office of an urban or rural sanitary surveyor or nuisance inspector, as the case might be.

Such an arrangement as that sketched is at work in the medical, teaching, and legal professions. Why not in ours?

November 28th. N. B.
C.E. and Surveyor.

FOOT *v.* METRE.

Sir,—I am not altogether in agreement with your correspondent, Mr. Child, that the adaptation of the present English foot into one of 10in. would be the best way of solving our present sorely-needed want of a reformed standard of measure. This "foot of 10in.," when further sub-divided into ten minor parts, would not then be sufficiently near for minute measurements, even of the handicraft type.

The question resolves itself into one of either reform or revolution. I think in this case revolution would be more desirable, and the paper read at the last meeting of the British Association advocating the adoption of the French metric system as a standard of measure has much to be said in its favour, as forming a more staple and adaptable mode of measurement, should we change at all. It is doubtless within the knowledge of your correspondent that a committee of the House of Commons has been sitting during the last session of Parliament considering the metric system of money; and upon the introduction of this—which is nearer at hand than imagined—a corresponding system of measure must go hand in hand. But why should the French system of coinage and measurement be preferable when changing may be reasonably asked. My answer to this is that our propinquity to France is a cause of the great intercurrency existing between the two nationalities, to encourage which statesmen of either country are not slow to recognise the paramount need of simplifying in every legitimate way.

Further, the United States populace, who speak the same language as ourselves, have had the French system of measurement legalised in their country since 1866.

I have been preparing during the summer a series of deductions and comparisons between the French and English measures, for the consideration of an important Government department, but a protracted illness has hindered their completion. Whilst doing this I was forcibly convinced of the easiness of its adaptation to our requirements.

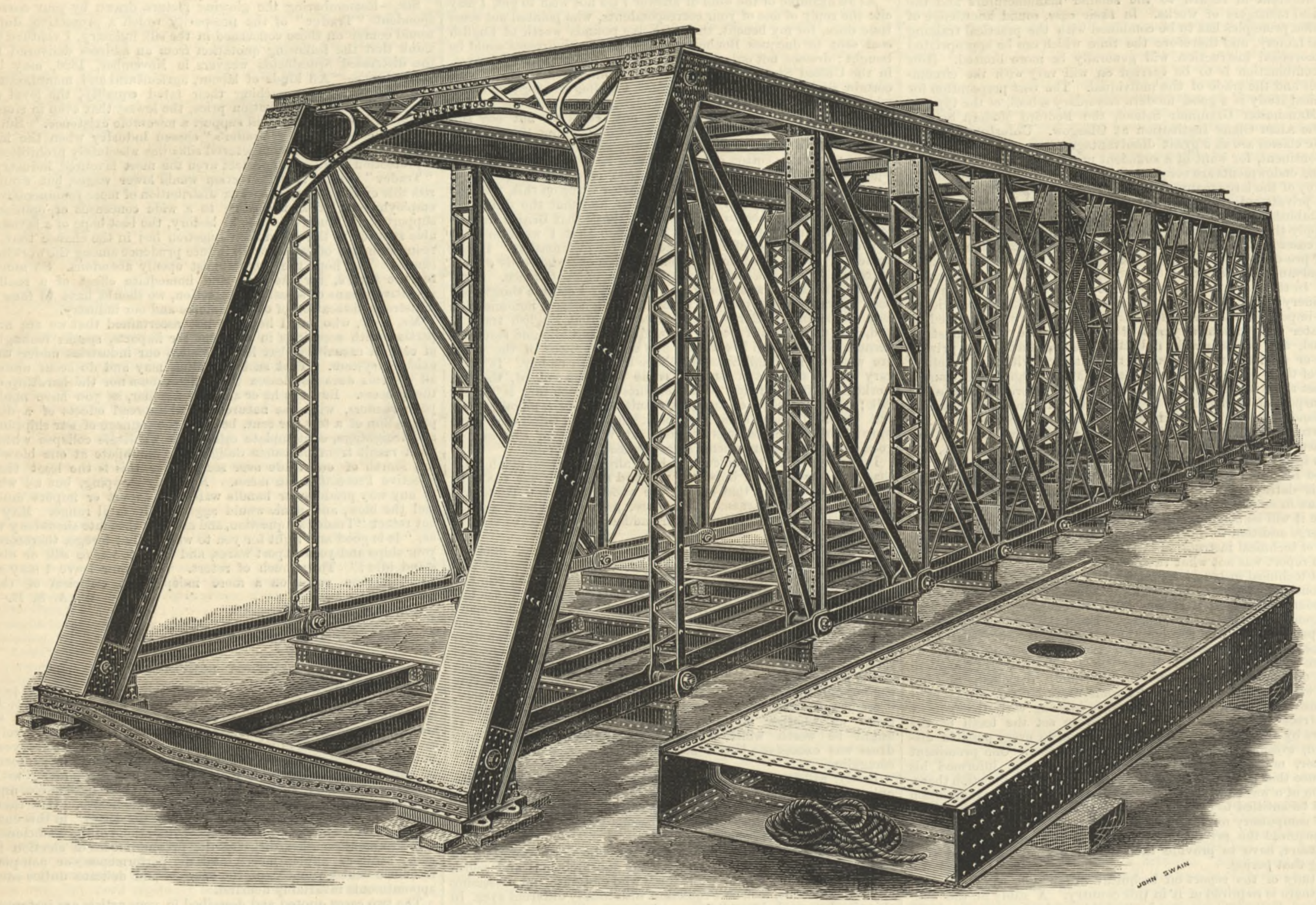
When there is a definitely expressed-consensus of opinion by the Government or scientific bodies that the time is ripe for a change in our standards of coinage and measure—in volume of the latter as well as otherwise—depend upon it that the more general public will not be behindhand in considering that its adoption would be a boon both for convenience and intercourse.

Laird, Plymouth, November 29th. Saddleton Frank Sainty,
Certificated Mathematician.

(*For continuation of Letters see page* 459.)

THE SIEE HO BRIDGE, CHINA RAILWAYS.

MR. C. W. KINDER AND MR JAMES CLEMINSON, MM. INST, C.E., ENGINEERS.



SIEE HO BRIDGE—CHINA RAILWAY.

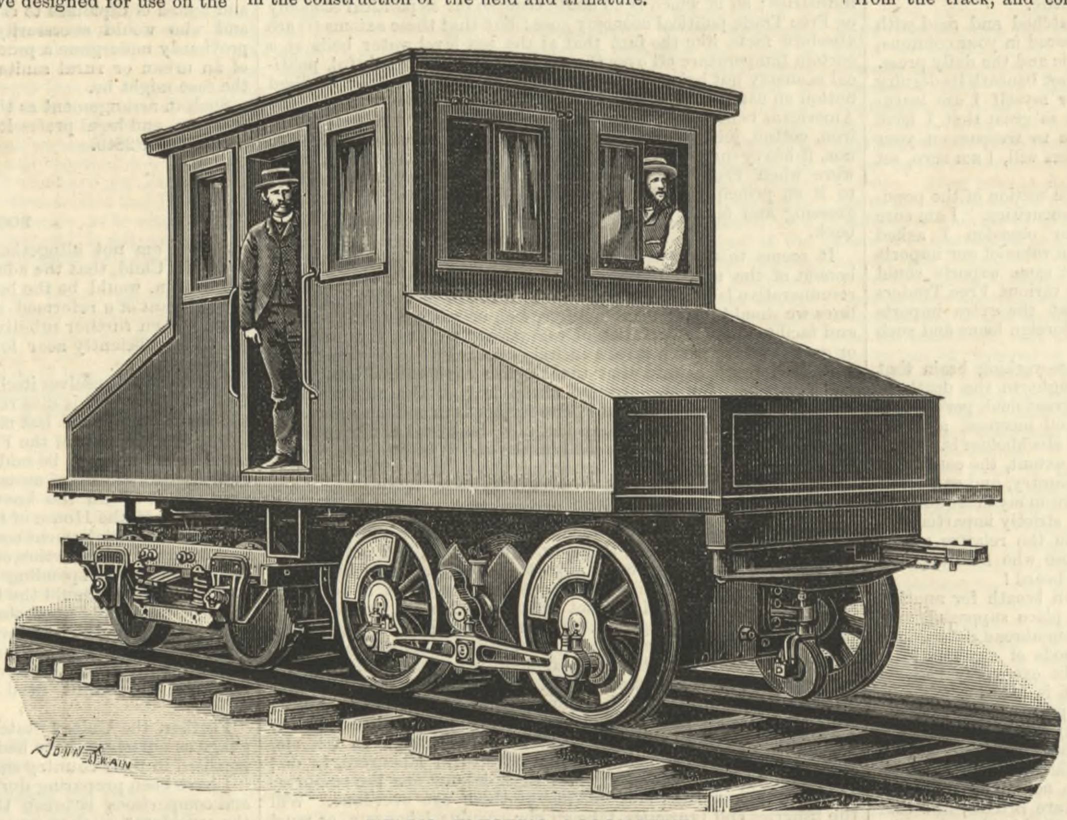
The bridge illustrated by the above engraving has been constructed in this country from the designs of Mr. J. Cleminsor, and in accordance with instructions from Mr. C. W. Kinder, resident in China. Of this bridge we shall publish details.

THE FIELD ELECTRIC LOCOMOTIVE.

For several months past Mr. Stephen D. Field has been engaged in the completion of an electric locomotive designed for use on the elevated railroads of this city, and within the last few weeks it has been in operation on the Thirty-fourth-street branch of the New York Elevated Railroad. The locomotive as it stands upon the track is shown in the accompanying engraving. The motor is mounted upon the rear truck, and the distinguishing feature is its mode of connection with the drivers. The arrangement, as will be seen, is exactly similar to that employed in the ordinary steam locomotive, and consists in the direct connection of the motor shaft with the drivers by means of a crank and side rod. The great advantage of this arrangement in the electric locomotive over the steam locomotive is apparent when we consider that in the latter the maximum effort is exerted on the drivers when the cranks stand vertically either above or below the centre, and when on the centres no effort whatever is exerted. In the electric locomotive, however, the armature exerts an uniform and continuous effort upon the side bar, which is transmitted directly to the drivers, no matter what the position of the cranks may be. It follows from this that the starting up is much quicker than in the case of the steam locomotive, where the power of only one cylinder is available at a time.

The motor, which is series wound, is regulated by means of a liquid rheostat placed in the cab of the locomotive. This rheostat consists of a trough divided into two compartments filled with acidulated water. A metal plate on either side of these troughs acts as a terminal for the circuit, which is led in by the two cables shown. The speed of the motor is regulated by inserting or withdrawing from the troughs two slabs of slate, which are suspended over the troughs and can be raised or lowered by means of the long lever travelling over the sector shown at the right in the cab. By means of this liquid rheostat the resistance can be graduated from practically nothing, *i.e.*, when the slabs are fully drawn up, to an infinite resistance when completely lowered into the troughs. On the standard which guides the slabs there will be seen a spring clip, and on the right-hand slab a plug. This is so arranged that when the slabs are full up the plug presses between the spring clips and cuts out the rheostat entirely. The reversing switch, for reversing the direction of the motor, is shown in the lower right-hand corner of the cab.

In designing the locomotive Mr. Field constructed special brush shifting apparatus for preventing sparking at the commutator with change of speed and load. This consisted of a small motor which shifted the brushes in accordance with the action of a relay in circuit with the terminals of two auxiliary brushes placed at the neutral points on the commutator. Actual practice, however, has shown that this refinement of brush regulation was unnecessary, the brush lead under the influence of the peculiar speed regulation employed having been found to remain fixed and at an angle of 45 deg., this no doubt being due to the large mass of iron employed in the construction of the field and armature.



FIELD'S ELECTRIC LOCOMOTIVE.

The following table gives the weight and dimensions of the locomotive:—

Weight of motor	9 tons
Weight of armature	1 ton
Weight of wire on armature	600 lb. No. 7
Weight of wire on field magnets	1600 lb. No. 4
Total weight of motor, car and forward truck ..	13 tons
Diameter of drivers	3ft.
Diameter of armature	2ft.
Length of armature	42in.
Wheel base..	5ft.

The track on which the motor was operated is one of the steepest grades in the city, on which account it was peculiarly well adapted to show up any weakness in the system employed. One passenger car forms a load for a 13-ton steam locomotive regularly employed. The motor easily drew one of the regular coaches up this grade at a speed of about eight miles per hour, with a current expenditure of 35 ampères under an E.M.F. of 800 volts. The loss in conversion was found to be very small.

Various potentials were at times employed, 1100 volts being used at one time with the same freedom from sparking as with the lower potential, the only change noticed being an increased speed of the motor.

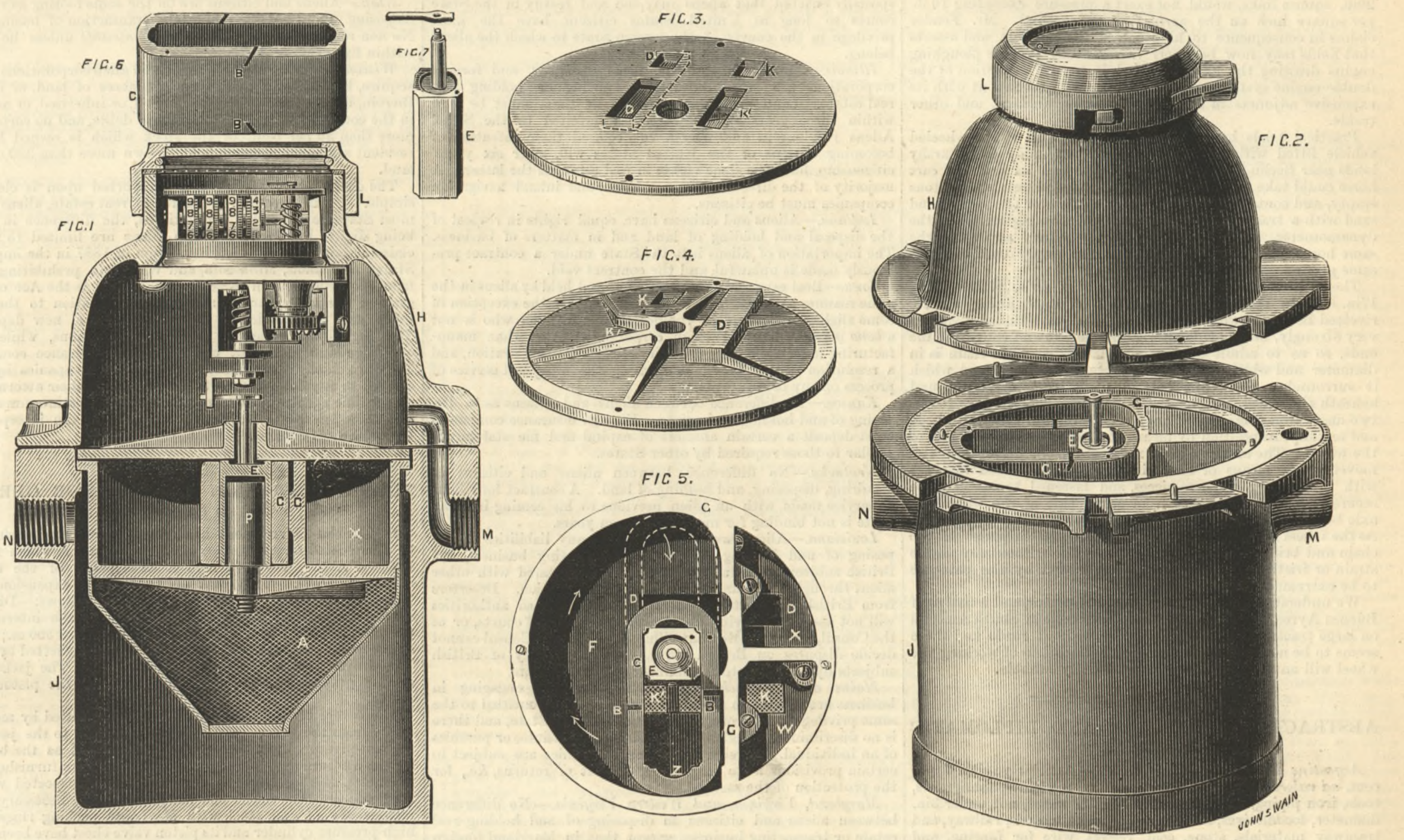
The generating plant was situated at a distance of half-a-mile from the track, and consisted of a single dynamo, built by Mr. Rudolph Eickemeyer, of Yonkers, in whose shops also the locomotive was built. This generator is of the ironclad type, and showed itself fully capable of handling the load placed upon it.

The tests made, which extended over several weeks, have so thoroughly convinced Mr. Field of the practicability of the new ideas embodied in this motor, that he is now preparing to demonstrate with apparatus on a large scale the practicability of electricity as a motive power for the elevated railways of this city. Among the other novelties embodied in the motor is the "pick-up" wheel of Mr. Field, which operates admirably, so that no sparking whatever can be observed.—*Electrical World.*

KENT'S "UNIFORM" WATER METER.

In our impression for the 23rd October, 1887, a description was given of the "Uniform" water meter, made by Mr. G. Kent under Walker's patent, and as shown in the Inventions Exhibition. Since that time Mr. Kent has made some important improvements in the meter, which are the subjects of patents under which the meter is now made as illustrated in the accompanying engravings. The necessity for and growing employment of positive water meters makes them a subject of much importance as well as of interest. Enormous numbers of inventions concerning them have been patented, but there are not more than four or five kinds of meters in use; and, as positive meters, only three are in very extensive employment. That which we illustrate has the advantage of being very small for a given size of pipe, it is exceedingly simple, and any parts are renewable by intelligent labourers, all being made to gauges. The meter itself is, moreover, independent of the case, and can be changed in two minutes for another whenever it is thought necessary to examine it. The measuring parts of the meter, that is to say, the parts A, G, E, F in Fig. 1, and shown separately in Figs. 3, 4, 5, and 7, are of Delta metal, the piston C—

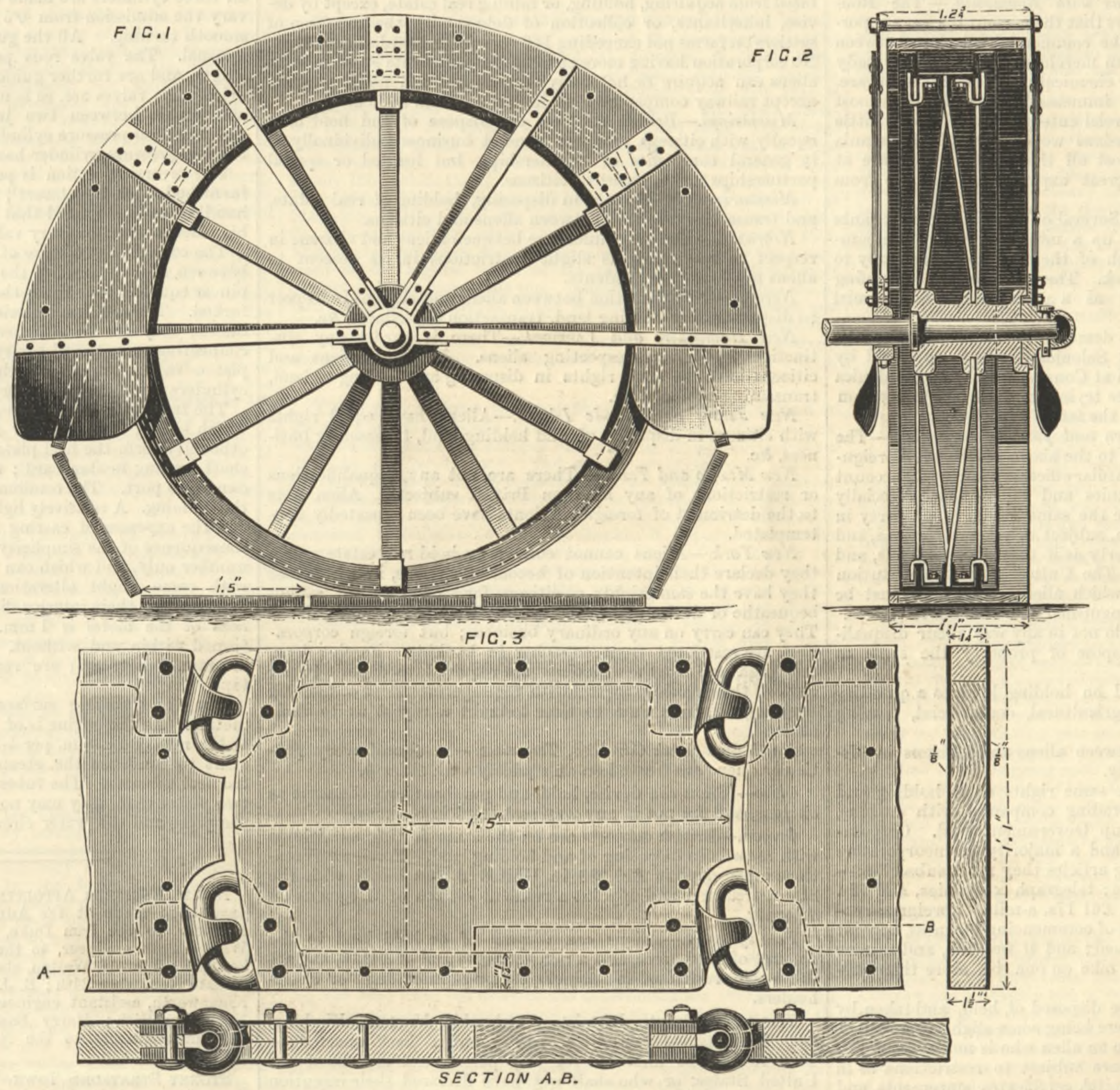
KENT'S UNIFORM POSITIVE WATER METER.



see Figs. 1, 2, 5, and 6—being of vulcanite. The whole of these parts are now carried in a separate distinct cast iron vessel J, H, lined with glass, the water entering at N. Here it enters an annular space and descends, where the space provided allows it to become comparatively quiet, and any gritty material collects in the bottom of the vessel J, the water passing through the fine perforations of the zinc cone A, Fig. 1. The action of the piston is peculiar, partly radial and partly a sliding end-on movement, as shown by the arrows. It is shown in section at C in Fig. 1, and in plan in Fig. 5. Its movement we will describe chiefly by reference to Fig. 5. The oblong space within it is accurately fitted to the central hub seen at Fig. 7, in section in Fig. 1, and in plan in Fig. 5. As seen in Figs. 1 and 2, its upper end carries a small arm, which moves the counter gear. It turns upon the fixed pin P, Fig. 1.

The water enters the space W, Fig. 5, by the port K, which is in communication with the port K^1 seen from within the piston. Similar ports K^1 K, are made in the cover—see Fig. 3—so that the water enters both below and above the piston. When the piston C is in the position indicated by the dotted lines, showing an outline of the piston, the water fills the whole of the chamber F, and exerts its pressure between the inner end of the inside of the piston and the square hub E, entering by means of the port K^1 and the semicircular inside end of the piston Z, and forcing the piston in a straight path across the chamber into the position the piston is shown in the full lines. Water then passes from the port K^1 through one of the small ports B in the edge of the piston into the small space shown between the piston and the diaphragm G, so that the piston is forced from the diaphragm, and the full supply of water from the port K^1 then pushes it round radially in the direction shown by the arrows, until it reaches the position shown by the dotted lines, pushing before it and out through the ports D the water that had been in the chamber F_1 at the previous stroke. That quantity of water having been measured by means of the registering gear, actuated as shown in Fig. 1, the water again enters the space Z from the port K^1, and again pushes the piston over into the position in which it is shown in full, the water from the interior of the other end of the piston being at the same time expelled through the port D into D and away. From this description it will have been seen that although a positive meter, the piston is balanced, and the necessity for packing is thus obviated, no water passing by the flat surfaces of the piston and the bottom and cover of the measuring chambers, although the piston moves quite freely. The registering gear, seen in Fig. 1, shows the quantity by direct reading, instead of by means of several small dials and pointers.

Meters we have seen at work gave accurate measures under various pressures, and with full discharge, as well as when discharging not more than about a gallon per hour. The reports of several well-known waterworks' engineers also show that they work within a very small percentage of accuracy. For instance a test after six months' work by a ½in. meter, by the Chelsea Waterworks, showed an error of only one half of one per cent. Tests made at the Grand Junction Company's works at Kew showed also that the obstruction by the meter was exceedingly small, and with a head of water varying from 10ft. to 100ft. the time occupied was less by a ¾in. uniform meter than by four others, two being inference meters, the time taken to pass 100 gallons being 9·5 minutes at 10ft. head, 6 minutes at 35ft. head, 5·25 minutes at 50ft. head, 4·25 minutes at 75ft. head, and 3·75 minutes at 100ft. head. The meter is equally applicable for delivering into cisterns as for other applications, and the very small space it occupies even with the dirt-collecting vessel in which it is placed. They are made in all sizes up to 6in., our engraving Fig. 1 being rather over one-third of the actual size of a ⅜in. meter, and about fifteen thousand of them have, we are informed, been sent out.



SECTION A.B.

FENDER'S ENDLESS RAILWAY.

FENDER'S ENDLESS RAILWAY.

Among the few novelties which will be shown next week under the auspices of the Smithfield Club at Islington, will be a pair of engine wheels, by Messrs. Richard Garrett and Sons, of Leiston, with Fender's Patent Endless Railway, which will recall Boydell and many other inventors to our readers' memories. Boydell's engine was brought out in 1854, and was with some success employed in the Crimean war for transporting artillery over land which was impassable without its use. Boydell's arrangement failed in consequence of its excessive wear and tear and the complication of its construction, which rendered it difficult of repair by comparatively unskilled mechanics. Mr. Fender claims for the apparatus we illustrate the possession of all the necessary qualifications for a really durable, simple, and detachable railway without any of the complication or liability to breakage, or the difficulty of repair attaching to its predecessors, and it will thus be found of great intrinsic value for all situations where bad roads exist, but especially for fens and sandy soils. Traction engines, ploughing engines, farm carts, &c., fitted out with Fender's Endless Railway can traverse ploughed fields without leaving any deeper track than that which the foot of a man would leave on the same ground, because the pressure is distributed over so large a surface. For instance, each of the two wheels of a vehicle weighing 3½ tons, and fitted with 20in. by 20in. square links, would not exert a pressure exceeding 10 lb. per square inch on the surface of the ground. Mr. Fender claims in consequence to have solved the problem, and asserts that fields may now be freely traversed by a single ploughing engine drawing the plough behind it, to the extinction of the double-engine system, and the complicated roundabout with its expensive adjuncts in the shape of ropes, anchors, and other tackle.

Practical trials have been carried out with a two-wheeled vehicle fitted with Fender's apparatus on sandy and marshy lands near Berlin, and it was then found that an ordinary cart horse could take the cart, which itself weighed nearly three tons empty, and contained 2 tons 4 cwt. of earth, over the swamp and sand with a tractive force of only 300 lb., as registered by the dynamometer, although without Mr. Fender's apparatus the same horse was incompetent to take the empty cart over the same ground.

The endless railway chain consists of a series of flat plates, 17in. long by 13in. wide, made of a hard wood lining securely rivetted between two plates of sheet steel and linked together very strongly, being made alternately concave and convex at the ends, so as to admit of free play laterally. This chain is in diameter and width considerably larger than the wheel which it surrounds; the three bottom plates rest on the ground beneath the wheel, and the rest of the chain hangs loosely round two angle iron rings, which are free to revolve around the wheel, and are kept in position by means of clips bolted to the rim of the wheel. The chain itself is restricted from undue sidewise movement by means of sheet iron side-plates bolted together with intervening distance-pieces, and fastened to radial arms secured firmly to the axles from either side of the wheel, the axle being in this case motionless and the wheel revolving on it. As the wheel revolves it moves along the bottom plates of the chain and brings the next plate into position without any undue strain or friction, the movement being stated by the patentee to be extremely smooth and pleasant.

We understand that Mr. Fender, the inventor, and a native of Buenos Ayres, has found the wheel invaluable in South America on large tracts of soft land practically without roads, and there seems to be no doubt but that for such conditions of working the wheel will answer well and prove eminently suitable.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Argentine Republic — Import tariff. — Articles paying 1 per cent. *ad valorem* duty, car wheels, drilling machines, immigrants, tools, iron piping, ungalvanised for gas or water, not under 3in. diameter, locomotives, machinery for steam vessels, railway, and tramway materials, stone, coal, vessels, wire for fencing, and telegraphs. Paying 6 per cent. *ad valorem* duty: Detached pieces of machinery, iron casks, iron hoops, lithographic presses, machinery of all kinds for agricultural or industrial purposes, ploughs, printing presses, steam engines. Paying 11 per cent. *ad valorem* duty: Iron, ungalvanised, in bars, plates, or sheets. The duties are levied according to a tariff of official valuations formed on the basis of the actual value of the imports.

Russia — Commercial relations with Roumania. — The Roumanian Express Orient considers that the present is a very opportune moment for cementing the commercial relations between Roumania and Russia. Russian merchants would find a ready sale for their exports, especially chemical products and hardware. There exists in Roumania an immense field, hitherto almost untouched, for Russian commercial enterprise, and a very little energy on the part of the Russians would persuade Roumania to purchase from Russia almost all the articles which are at present brought to them at great expense and trouble from Western Europe.

Sweden — Trade with Siam. — Several of the leading merchants of Sweden desirous of opening up a market in Siam have combined to send specimens of such of their goods as are likely to suit an oriental taste to Bangkok. The consignment containing 469 cases will be exhibited as a temporary commercial museum.

Turkey — Public works. — The demand for a concession for the construction of a tramway at Salonica has been approved by the Porte. Some persons both at Constantinople and Salonica acting for French capitalists are trying to secure a concession for extensive harbour works at the latter place.

United States — Status of alien and foreign companies.[1] — The recent changes in legislation as to the above led to the Foreign-office issuing a circular to its consular officers requiring an account of the status of alien companies and individuals, especially British: — Aliens generally have the same rights to property in the various States of the Union, subject to a few variations, and in most cases succeed to property as if they were citizens, and usually have the same rights. The United States Constitution provides that controversies to which aliens are parties must be decided by the Federal as distinguished from the State Courts.

Alabama. — British subjects do not in any way incur disqualification, and can hold and dispose of property the same as citizens.

Arizona. — Aliens are limited on holding land to a quantity not exceeding 320 acres for agricultural, commercial, grazing and mining purposes.

Arkansas. — No difference between aliens and citizens in disposing and holding real property.

California. — Aliens have the same rights as to holding and disposing of land and as to trading companies with citizens, except that they cannot take up Government land. Corporations exist only for fifty years, and a majority of incorporators must be residents. Before filing articles they must subscribe: — Railway companies, £206 a-mile; telegraph companies, £20 12s. a-mile; wagon-road companies, £61 17s. a-mile. Foreign corporations must, within sixty days of commencing business, appoint an agent who can sue and be sued; and if fire, life, and marine insurance companies, must not take on one risk more than one-tenth of their capital.

Colorado. — Real estate can be disposed of, held, and taken by aliens as by citizens, except there being some slight restrictions in the descent of real estate to an alien who is not a *bonâ fide* resident. Foreign companies are subject to restrictions as in other States with respect to capital, certificates, statements, and appointment of an agent upon whom process can be served.

Connecticut. — Aliens resident in the United States can convey and hold land equally with citizens, and non-resident aliens can do so for mining and quarrying purposes.

Delaware. — An alien can buy, hold, and sell land if he be resident, and has declared his intention of being naturalised. There are no special restrictions on aliens doing business.

[1] Commercial Paper 17, 1887.

Florida. — Aliens are not subject to any disqualification in disposing and holding property, and there are not any special restrictions on foreign companies.

Georgia. — Aliens have the same rights as citizens, but it is specially enacted that aliens may sue and testify in the State courts so long as United States citizens have the same privilege in the courts of the foreign State to which the aliens belong.

Illinois. — Non-resident aliens, firms of aliens, and foreign corporations are restricted from acquiring or holding any real estate. Land previously acquired by them must be sold within three years, or else becomes forfeited to the State. Aliens resident in and who have declared their intention of becoming citizens of the United States will, after six years' citizenship, have the same rights in real estate as the latter. A majority of the directors of fire, marine, and inland navigation companies must be citizens.

Indiana. — Aliens and citizens have equal rights in respect of the disposal and holding of land and in matters of business. The importation of aliens into the State under a contract previously made is unlawful, and the contract void.

Iowa. — Real estate can be disposed of and held by aliens in the same manner as by United States citizens, with the exception of some slight restrictions in the descent to an alien who is not a *bonâ fide* resident. Foreign corporations other than manufacturing must file a copy of their articles of incorporation, and a resolution of the board authorising the filing and service of process on any of its agents.

Kansas. — No difference between aliens and citizens as to disposing of and holding real estate. Foreign insurance companies must deposit a certain amount of capital and file statements similar to those required by other States.

Kentucky. — No difference between aliens and citizens in acquiring, disposing, and holding of land. A contract for labour or service made with an alien previous to his coming into the State is not binding for more than seven years.

Louisiana. — Aliens are not subject to any liabilities in disposing of and holding real estate, transacting business, &c. British subjects are at a disadvantage as compared with other aliens through the want of a consular convention. Deserters from British ships cannot be arrested. The local authorities will not assist in carrying out the orders of naval courts, or of the Consul, under the Merchant Shipping Act. The Consul cannot decide disputes on British ships, and the property of British subjects dying intestate is administered by the State.

Maine and Massachusetts. — British subjects engaging in business are subject to the same regulations and entitled to the same privileges and protection as citizens of the State, and there is no discriminating legislation touching the business or pursuits of an individual. Foreign insurance companies are subject to certain provisions as to inspection, deposit of returns, &c., for the protection of the assured.

Maryland, Virginia, and Western Virginia. — No difference between aliens and citizens in disposing of and holding real estate or transacting business, except that in Maryland foreign corporations doing business in that State must have a United States citizen as agent or attorney, upon whom process may be served.

Michigan. — Aliens are on an equal footing with citizens in respect of land, transaction of business, &c.

Minnesota. — Aliens who have not declared their intention of becoming United States citizens, and alien corporations, are prohibited from acquiring, holding, or mining real estate, except by devise, inheritance, or collection of debts, with the exception of settlers on farms not exceeding 160 acres before 1st January, 1889. No corporation having more than 20 per cent. of its stock held by aliens can acquire or hold any real estate, and no corporation except railway companies shall hold more than 5000 acres.

Mississippi. — British subjects can dispose of and hold land equally with citizens, and can transact business individually or in general companies or partnerships, but limited or special partnerships must consist of citizens.

Missouri. — No difference in disposing, holding of real estate, and transacting business between aliens and citizens.

Nebraska. — The only difference between aliens and citizens in respect to real estate is slight restrictions in its descent to aliens not *bonâ fide* residents.

Nevada. — No distinction between aliens and citizens in respect to disposing of or holding land, transaction of business, &c.

New Hampshire and Vermont. — There is hardly any distinctive legislation respecting aliens. Resident aliens and citizens have the same rights in disposing and holding of land, transacting business, &c.

New Jersey and Rhode Island. — Aliens have equal rights with citizens in disposing of and holding land, transacting business, &c.

New Mexico and Texas. — There are not any disqualifications or restrictions of any kind on British subjects. Alien Acts to the detriment of foreign residents have been repeatedly contemplated.

New York. — Aliens cannot convey or hold real estate unless they declare their intention of becoming citizens, in which case they have the same rights as citizens for six years; but cannot bequeathe or devise real property until they become naturalised. They can carry on any ordinary business; but foreign corporations are restricted from engaging in banking. Foreign loan, mortgage, and trust associations are required to deposit 10 per cent. of their paid-up capital with the superintendent of banking business, and from time to time to make a report as to their affairs.

North and South Carolina, Tennessee. — In almost every particular aliens are treated on an equality with citizens.

Ohio. — Aliens can devise, hold, and purchase land the same as citizens, and are not in any way restricted in business.

Oregon. — British subjects are on the same footing as citizens with regards to disposing of and holding land. Foreign corporations must deposit £10,280 in United States bonds with the States treasurer and appoint a resident citizen of Oregon as an attorney.

Pennsylvania. — Aliens can dispose of or hold land to the amount of 5000 acres, and a net annual rental of £4115, and are in no ways restricted in business, either as individuals or shareholders.

Territories, Dakota, District of Columbia, Montana, Washington, Wyoming. — Congress a few months back enacted: — That it shall be unlawful for any persons not citizens of the United States, or who shall not have declared their intention to become citizens, to acquire, hold, or own real estate, or any interest therein, in any of the territories of the United States or the district of Columbia, unless acquired by inheritance or by the ordinary course of justice in the collection of debts. That no corporation having more than 20 per cent. of its stock owned by associations, corporations, and persons not citizens of the United States shall acquire or own any real estate in any of the territories or the district of Columbia. That no corporation other than canal, railway, or turnpike companies in the said territories or district shall acquire or own more than 5000 acres of land, and not more than is necessary for the proper operation of the canal, railway, or turnpike. All property held in violation of this Act to be forfeited to the United States.

Utah. — Aliens and citizens are on the same footing as respects disposing of and holding real estate, transaction of business, &c. No non-resident alien can inherit *ab intestate* unless he claims within five years of death.

Wisconsin. — Non-resident aliens and alien corporations cannot acquire, hold, or own more than 324 acres of land, or interest therein, except such as may be devised, or inherited, or acquired in the course of justice in collection of debts, and no corporation more than 20 per cent. of the stock which is owned by non-resident aliens can acquire, hold, or own more than 320 acres of land.

The character of the legislation reported upon is clear and simple. Up till recently, in regard to real estate, aliens had in most States equal rights with citizens, the difference in States being slight; but in some States aliens are limited to time in claiming property. The late legislation of 1887 in the important States of Illinois, Minnesota, and Wisconsin prohibiting aliens from acquiring land in those States, as well as the Act of Congress of the same year extending the prohibition to the territories and the district of Columbia, form a new departure. The legislation regarding foreign corporations, while more extensive and stringent, chiefly affects insurance companies. They are chiefly distinguished from native companies by being obliged to appoint a United States citizen as their attorney and responsible agent, and to have a larger paid-up minimum capital, and in a few States to have a majority of the incorporators United States citizens.

TRIPLE EXPANSION ENGINES FOR GERMAN MAIL STEAMERS.

The German Government has ordered three mail steamers to be constructed for the service of the German line which runs to Eastern Asia. We give here a description of the engines of these boats. They are of the triple expansion type. The dimensions of the cylinders are as follows: — Diameter of the high-pressure cylinder, 910 mm.; of the intermediate cylinder, 1·450 m.; of the low-pressure cylinder, 2·300 m.; stroke of the piston, 1·500 m. The cylinders are all jacketted by liners. The liners are of extra hard cast iron. The jackets are of fine grained cast iron, and are cast with the piston valve chests.

The covers of all the three cylinders are heated by means of steam from the boiler. Glass gauges are fitted to the jacket of the low-pressure cylinder. The covers, as well as the bottoms of the medium and low-pressure cylinders, are furnished with manholes, so that they can be cleaned and inspected without the removal of the covers and the pistons being necessary. The pistons are of cast steel, with MacLaine packing rings. The high-pressure cylinder and its piston valve chest have been tested hydraulically at a pressure of twelve atmospheres; the trial pressures of the two other cylinders and of their respective valve chests were eight atmospheres for the medium-pressure cylinder and four for the low-pressure cylinder. The valve gear is of the Stephenson link type, the suspension-rods of which are jointed on to the link directly above the rod-pin of the go-ahead excentric. The points of suspension of the rods for all three cylinders are made variable, as is now usual, so as to vary the admission from 0·5 to 0·7, which is sufficient to secure smooth turning. All the gudgeons have adjustable bearings as is usual. The valve rods pass through stuffing-boxes of great length, and are further guided below. The rings of the cylindrical slide valves are, as is usually the case, made of cast iron, and placed between two junk rings of bronze. The high and medium-pressure cylinders have each one set of valves and the low-pressure cylinder has two.

The reversing action is performed by an oscillating engine furnished with a cataract; hand gear is also provided. The handles are so arranged that the engineer can, without changing his place, command every valve.

The connecting-rods are of Siemens-Martin steel; the length between the crosshead of the piston and the centre of the crank pin is equal to four times the crank. The connecting-rods are forked. The crosshead carries steel slides with six white metal liners; they can be adjusted for wear in the usual way. The connecting-rods, the piston-rods, those of the excentrics and the piston valves, are all of the same dimensions for the three cylinders; and they are therefore interchangeable.

The framing is constructed of eleven pieces in cast iron, six of which belong to the hollow frame of the cylinders, while the other five form the heel plate. Three of these carry the crank shaft bearing to starboard; the other two constitute the condenser to port. The condenser supports the three short legs of the framing. A relatively light framing has thus been obtained; and the expenses of casting have been very much reduced in consequence of the simplicity of the patterns, which are four in number only, and which can be used in casting all the pieces with some slight alterations. There are in the condenser 3478 tubes; their interior diameter is 19 mm.; and the thickness of the metal is 1 mm. They are of drawn brass, and tinned within and without. The tubes are placed in zigzag, 29 mm. apart, and are rendered tight by means of cotton tape.

The total cooling surface of the condenser is 660 square metres. As the engine is of 3500-indicated horse power this is at the rate of 1·219 m. per 1-horse power; this surface is sufficient to condense the steam at the necessary speed even in tropical climates. The tubes are supported in the middle by two plates that they may not bend. The steam flows around the pipes and the water circulates through them.

Naval Engineer Appointments. — The following appointments have been made at the Admiralty: — George E. M. Keey, fleet engineer, to the Iron Duke, to date November 18th; John C. Weeks, fleet engineer, to the Northumberland, to date November 24th; John H. Walton, staff engineer, to the Northumberland, to date November 24th; B. J. Watkins, T. P. Jackson, and A. F. Kingsworth, assistant engineers, to the Northumberland, to date November 24th; Harry Basson and J. H. Thompson, acting assistant engineers, to the Northumberland, to date November 24th.

Stoney Stratford Town Waterworks. — The local board at Stony Stratford, Bucks, has decided to provide a water supply for that town by means of artesian tube wells. There are to be three 5in. tube wells, placed 60ft. apart, and connected by 6in. cast iron horizontal mains. The ground has been tested, and an abundant supply of water, which analysis proves to be pure, has been found. The work is being carried out under the supervision and directions of Mr. A. F. Phillips, M.I.C.E., and the artesian borings, &c., are being made by Messrs. Le Grand and Sutcliffe, London. The population of Stoney Stratford is about 2000, and the water supply being provided is 60,000 gallons per day.

RAILWAY MATTERS.

A NEW station was opened on Wednesday on the main London and South-Western Railway between Weybridge and Woking stations, and at which ten up trains and nine down trains will stop daily. The station is in the centre of a good residential district, including Byfleet, Woodham, Ottershaw, Wisley, and Ripley.

THE fine express locomotive constructed by Robert Stephenson and Co. for the South-Western Railway, details of which were given by us in August, has been a leading feature of the Newcastle Exhibition during the past summer. It will be at Waterlooo-station early next week, and will remain there for a short time for inspection by the directors and officers of the railway company.

AMONGST the casualties which occurred on our railways during the nine months ending September were thirty-six cases of trains running through gates at level crossings, one case of the bursting of the dome of an engine, 606 failures of tires, 209 failures of axles one failure of a chain used in working an incline, one failure of a bridge, one failure of a tunnel, 182 broken rails, four cases of flooding of the permanent way, seven fires in trains, and four fires at stations or involving injury to bridges or viaducts.

DURING the ensuing session it is intended to apply to Parliament to incorporate a company under the title of the Shropshire Railways Company, with power for taking over the Shrewsbury, Potteries, and North Wales Railway, which has been in only a partially constructed state for several years, and to settle with different classes of debenture and shareholders according to their different rights. Carrying out this scheme would greatly improve the communication between North Wales, Shropshire, and the Potteries.

THE first truss of the Poughkeepsie Bridge, N.Y., was, the *Engineering and Mining Journal* says, finished and swung clear on the 7th inst. It is 525ft. long between the centres of the towers, 82ft. deep, and 35ft. wide, and is said to be the largest and heaviest steel truss in the world. It rests on steel towers 100ft. high, which stand on masonry piers whose foundations are 125ft. below high water, and its total height from the foundations is 337ft. It carries a floor system on top for a double-track railway, and is capable of supporting a rolling load of 3000 pounds to the running foot on each track.

THE Victorian order for 40,000 tons of steel rails is likely to give rise to keen competition amongst merchant firms as well as amongst makers. Messrs. W. Briscoe and Son, merchants, Wolverhampton, London, and Melbourne, who some time ago carried off a 45,000 tons rail order from the same source, are understood to stand a good chance for the order on this occasion. The former order was placed with a German maker, whose offer was more favourable than that of the English rail houses. But home makers are this time likely to make a greater effort to keep the work from the Germans.

OF the 606 tires which failed on our railways during the first nine months of this year, eleven were engine tires, four were tender tires, eight were carriage tires, twenty were van tires, and 563 were wagon tires; of the wagons, 418 belonged to owners other than the railway companies; 524 tires were made of iron and eighty-two of steel; sixteen of the tires were fastened to their wheels by Gibson's patent method, twenty-four by Mansell's, and two by Beattie's, none of which left their wheels when they failed; 559 by bolts or rivets, five of which left their wheels when they failed; and five by other methods, two of which left their wheels when they failed; twenty-six tires broke at rivet-holes, eight at the weld, ninety-four in the solid, and 478 split longitudinally or bulged.

THE Department of State of Dakota has issued its report of railroad building for nine months of 1887. It shows a total new mileage of 717 miles. The companies which have built most largely are the following:—Northern Pacific, Grand Forks to Pembina, 95 miles; St. Paul, Minneapolis, and Manitoba, Minot west, 150; Rugby Junction to Bottineau, 40; Park River to Langden, 40; Rutland to Ebendale, 40; Minnesota Line to Watertown, 41; Chicago, St. Paul, Minneapolis, and Omaha, Salem to Mitchell, 33; Chicago, Milwaukee, and St. Paul, Bristol to Lake Preston, 75; Chicago and North-western, Faulkton to Gettysburg, 44; Verdon to Groton, 14; Fremont, Elkhorn, and Missouri Valley, Rapid City to Sturgis, 25; Minneapolis and Pacific, Ransom to Monage, 53.

OUR Birmingham correspondent writes that the publication of Lord Henniker's letter on railway rates and charges, to which reference was made in an editorial note in THE ENGINEER last week, is being followed by other manufacturers adopting the action of Mr. Kempson, of Birmingham, in resisting the claims of the railway companies for excessive conveyance charges. One writer to a Birmingham contemporary remarks that, "As an example of how railway rates affect the carriage of one of the necessaries of life—to wit, milk—the rate for twenty miles is ½d. a gallon, or, in other words, 9s. 2d. a ton—nearly treble the rate charged for either potatoes or corn. But the Great Western Railway, not content with this difference, lately raised the price of milk I was sending to Brierley Hill, just 20½ miles, to 1d. a gallon, so that it costs as much for that distance as it does in sending to London—100 miles."

THE result of working of the Victorian railways for the twelve months ending December, 1886, was very satisfactory. The gross receipts from the railways were £2,453,000, equal to £1370 per mile of the average mileage—1791 miles—worked. On our home railways the mileage receipts were £3446 per mile. The working expenses amounted to £1,427,000, or £797 per mile. This compares with an average cost per mile in this country of £1816. The resultant profit on the working of the Victorian railways was £1,025,000, equal, as already stated, to rather less than 4½ per cent. on the total capital expended. The percentage of working expenses to capital in Victoria was 58 as against 50 per cent. in this country. The expenses, however, in Victoria do not, as in our home railway expenditure, include any provision for liability in case of accident. Every penny of profit received is absorbed by the State and placed to the credit of the Consolidated Fund.

THE advances which mark the steel industry have been of much assistance to the railway carriage and wagon building makers. Railway engineers have demanded that steel should in much part take the place of iron, not only in the construction of the permanent way, but also in the building of the rolling stock. Steel masters are losing no time in preparing to supply the demand. This involves in many cases the laying down of new mills, by firms who are determined to make a profit. This heavy capital expenditure is being incurred. Mills of this character, once possessed, may expect a large amount of employment from constructive engineers, as well as railway wagon builders, for sectional steel. Our Birmingham report last week showed what was being done in this respect just now by one of the leading Staffordshire companies, the Patent Shaft and Axletree Company. The demand for steel which the railway rolling stock builders are expressing at the present time is very considerable. Contracts in hand at the Birmingham and surrounding wagon shops are more healthy than for a long time past. Not only are orders more numerous, but values are better. The State Railway construction going on in Burmah is supplying good orders to the rolling stock makers, and the South American lines are also buying well. Iron and steel underframes for goods traffic wagons, rather than the completed wagons and carriages, are chiefly in call from India and Burmah. Steel is being used with increasing freedom daily, and steel masters and wagon builders are alike benefitting.

NOTES AND MEMORANDA.

THE deaths registered during the week ending November 26th in twenty-eight great towns of England and Wales corresponded to an annual rate of 23·5 per 1000 of their aggregate population, which is estimated at 9,244,099 persons in the middle of this year. The seven healthiest places were Leicester, Wolverhampton, Cardiff, Norwich, Sunderland, Brighton, and Hull.

THE results of meteorological observations made at the Radcliffe Observatory, Oxford, in the year 1884, contain daily means of eye observations and of the self-recording instruments, comparisons of the mean monthly temperatures at 5ft. and 105ft. above the ground, and rainfall observations on the ground at 22ft. and 112ft. Interesting tables are given showing the relations of pressure, temperature, &c., under different winds. The total sunshine during 1884 was 1260·9 hours, being 173·7 hours less than the mean of five years.

To fill the grain in wood to be polished with simple ingredients, the following is given by the *Carriage Monthly*:—"Take a small quantity of white beeswax, melt it down, and, while liquid, mix with whiting. As it gets thick, keep adding boiled oil until you have it as you wish it. When using it, sheet the wood over solid. Let stand until the next day, when you can remove the surplus by using No. ½ sandpaper. It is cheaper and easier than the shellac, and can be levelled sooner, leaving nothing but the pores or grain of the wood filled, which is better than having your wood all stained up with the shellac."

IN a recent number of the *Comptes Rendus* is a paper on "Researches on the Distribution of Temperature and of Barometric Pressure on the Surface of the Globe," by M. Alexis de Tillo. The author describes some general charts which he has prepared, based on the labours of M. Léon Teisserenc de Bort, and of Herr J. Hann, of Vienna, showing the mean isobars and isothermal lines for the year, and the months of January and July, for the whole world. For the general conditions of the terrestrial atmosphere he finds that, when the mean temperature falls or rises within the limits of 1·6 deg. and 4·7 deg., the pressure increases or diminishes to the extent of 1 mm.

MR. ALEXANDER WATT, author of "Electro-deposition," "Electro-metallurgy," &c. &c., has just completed a series of papers in the *Electrical Review*, on the "Electrolysis of Cobalt Salts," in which he has given the results of a great number of experiments with this interesting metal, and has endeavoured to explain the probable reasons why cobalt has not received much recognition at the hands of the electro-plater. From Mr. Watt's point of view, this metal should take its place as a substitute for nickel for coating various articles, its superior whiteness, and the readiness with which it may be deposited by electricity, being urged in its favour. The papers referred to are concluded in the current number of the journal referred to, and may prove of interest to some of our readers.

AT the last meeting of the Meteorological Society, a paper was read on "The Use of the Spectroscope as a Hygrometer simplified and explained," by Mr. F. W. Cory, M.R.C.S., F.R. Met. Soc. The object of this paper is to suggest as simple a way as possible of using the spectroscope as a hygrometer in order to facilitate its introduction amongst observers as a standard meteorological instrument. The best form of hygrospectroscope as a recognised standard for the purpose of investigating and scrutinising the changes of the three parts of the spectrum mentioned is that originally termed by Mr. Rand Capron "The Rainband Spectroscope." It ought to have a fixed slit, and in addition a milled wheel at the side for the easier adjustment of the focus. The author concludes by giving a set of hints to observers for taking weather observations with a pocket spectroscope.

A PAPER on "The Rainfall on and around Table Mountain, Cape Town, Cape Colony," read at the last meeting of the Meteorological Society by Mr. J. G. Gamble, M. Inst. C.E., calls attention to the great and in some respects peculiar differences that exist between the quantity of rain that is registered on and around Table Mountain. The most striking feature is the small fall on the signal hill. The signal hill, otherwise called "the Lion's Rump," lies to the west of Cape Town, between it and the Atlantic. The average annual fall there is only 15in., while the fall at the western foot is 21in., and in Cape Town 27in. The signal hill is 1143ft. above the sea. The fall at Platteklip, on the northern slope of Table Mountain, overlooking Cape Town, and 550ft. above the sea, is considerable, namely, 45in. The greatest fall is at Waai Kopje, about half a mile to the southward of the highest point of the mountain, at an elevation of 3100ft., or 450ft. below the top. Another station on Table Mountain further south, that is, to the leeward in the rainy season, and 2500ft. above sea level, has only 39in. The eastern suburbs, Rondebosch, Newlands, and Wynberg, all have a comparatively abundant rainfall, 40in. to 50in. and upwards, the greater part of which falls in winter time.

THE value or even interest that may possibly attach to the work of the proposed British Association Committee for prosecution of seismoscopographic observations in mining and other districts may be doubted. The occurrence of more or less continuous tremors is well ascertained, and as nothing but continued or sustained movement in a direction, or directions if at different places, can be of any importance, always excepting tremors of sufficient magnitude to become shocks, it appears almost like wasting time, money, and instruments, especially as one of the makers of these observed at a committee meeting that "to investigate fully the character of the motion, even at one station, required delicate and costly apparatus, and the cost was greatly increased when it was attempted to bring a number of stations into correspondence so as to determine the motion over a large area. It was possible, however, to record the fact that a tremor had occurred, and even to learn something of its character by means of inexpensive seismoscopes. From recent observations it appeared probable that tremors would be found wherever they were tested for with sufficient delicacy, so that a society undertaking the search was not likely to be disappointed." Evidently a very little is expected to prevent disappointment.

DR. DIETERICI gave an account at a recent meeting of the Berlin Physical Society of his experiments on the determination of the mechanical equivalent of heat by the indirect electrical method. He made this choice of method on account of the exactness with which electrical values can now be determined in absolute units. The speaker described the general arrangement of his experiments, and gave a detailed account of the ice calorimeter which he used, as specially modified by himself. As the result of his series of measurements he obtained closely agreeing values for the mechanical equivalent of heat, namely, 424·4 and 424·2 as the mean of each series, the highest and lowest values obtained differing but little from the mean of the determinations. When making his calculations, the speaker took as the specific heat of water the mean of the determinations made between 0 deg. C. and 100 deg. C. The statements which have been made respecting changes in the specific heat of water as dependent on changes of temperature differ so greatly with different observers that the mean values based on their results provide no constant factor; the speaker's determinations would have been considerably different had he taken as his basis any other value of the specific heat of water. He next compared the results of his experiments with those of earlier observers, and discussed the very marked differences in the values given for the specific heat of water at various temperatures. He thinks that the specific heat of water may best be determined by the electrical measurement of the mechanical equivalent of heat, and intends to investigate this question more fully at a later date.

MISCELLANEA.

MESSRS. JAMES SIMPSON AND CO. have obtained the order from the Metropolitan Board of Works to supply the whole of the fire hydrants required by the various metropolitan water companies for the next three years ending December 31st, 1890.

DURING November seven vessels, with an aggregate tonnage of 4107, have been launched from the Clyde shipyards as against twelve of 16,960 in the same month of 1886. The launches of the eleven months aggregate 170,013 tons against 162,482 in the corresponding period of last year. In the course of the month about 30,000 tons of new shipping has been placed with the builders, and the trade wears an encouraging aspect.

THE Council of the Society of Telegraph Engineers and of Electricians has definitely decided upon the alteration of the name of the Society to "The Institution of Electrical Engineers." This, it is supposed, may have a material effect upon the success of the proposal to establish a Society of Electrical Engineers, as it must extend the scope of the existing society, and cause it to deal with a greatly increased quantity of electrical engineering papers and subjects.

THE question whether the existence of the Iron Trade Wages Board, which has been languishing for want of funds, shall be continued, will be considered at a meeting to be held at Birmingham on the 8th of December. This meeting has been convened by the ironmasters, who have sent invitations to their *confrères* in other districts. An alternative to a dissolution of the Board will probably be the adoption of some plan to guarantee the payment of subscriptions.

SPEAKING at a Fair-Trade gathering, in Sheffield, on Monday night, Mr. F. J. Hall, manager of Wm. Jessop and Sons, Brightside Steel Works, mentioned that only that morning a firm in Leeds had written to say that his firm's price was altogether too large, and that the Germans were underselling him. The Germans had got near enough to Sheffield when they were at Leeds underselling them in steel. He also stated that the last large ship built at Hull of steel was of metal supplied from Germany.

A MEETING of local engineers was held at the Technical School, Sheffield, last Saturday, when it was decided to form an Association to be called "The Sheffield Society of Engineers." Professor Ripper conducted the party over the building, minutely explaining the appliances for teaching various subjects. The large drawing-room, which is considered one of the finest in the kingdom, was specially admired. Professor Ripper incidentally mentioned that students had come all the way from St. Petersburg and Sweden to be taught there.

A VERY singular incident was noted in connection with a recent mill fire in Carlton, Mich. The *American Miller* says, "The building was burning fiercely, but the big engine which drove the machinery continued to run all through the blaze, and by that means was saved from destruction, though there was not a wall standing on any side of it when the fire had finished. The pumps were also running, and kept the boiler supplied, so there could be no explosion. It was a peculiar spectacle to see the engine driving away at a slashing speed in the midst of the flames, but the motion somehow saved it from fire. All the rest of the machinery was a total loss."

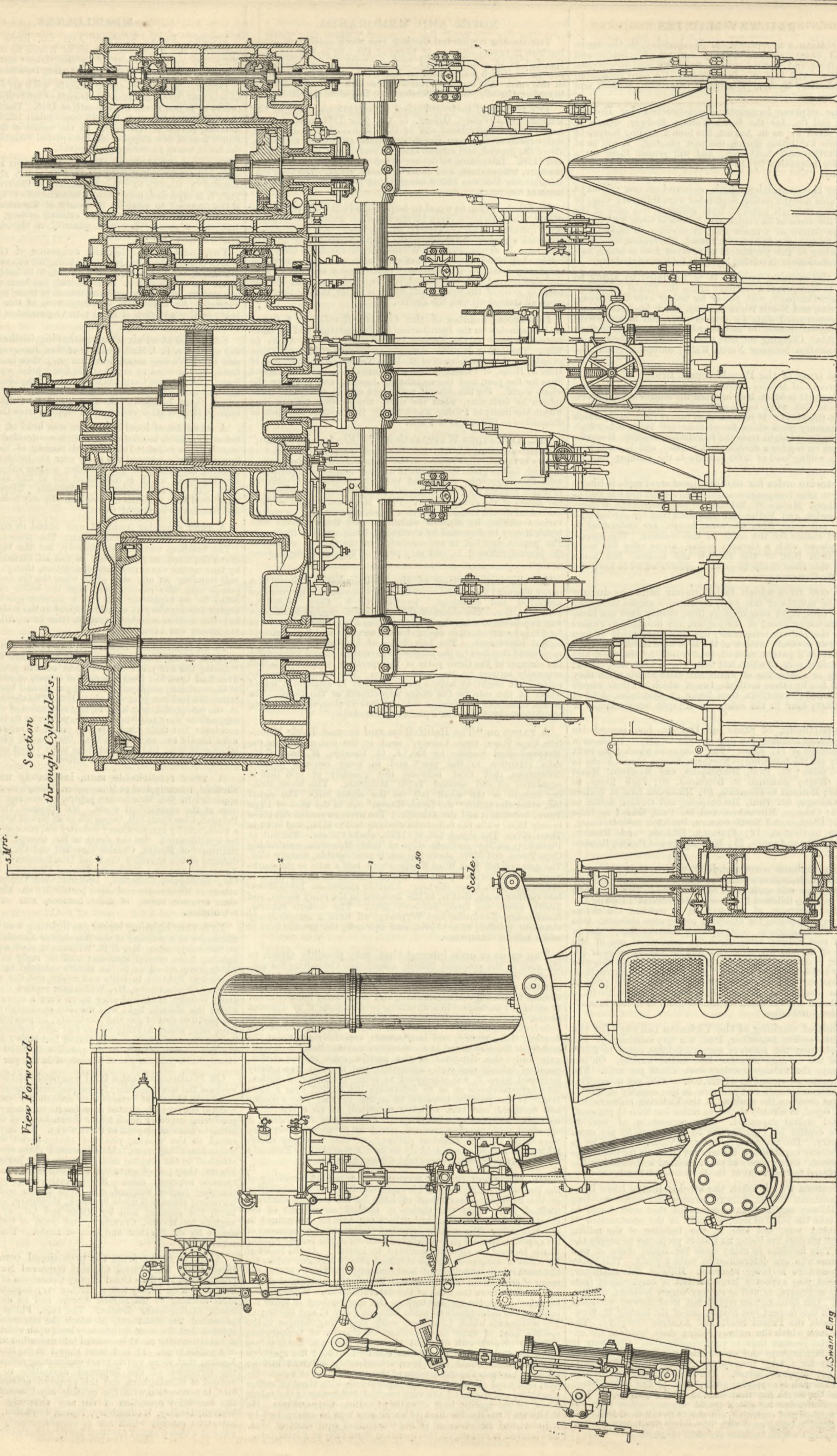
IN an interesting lecture on the Forth Bridge, delivered at Leeds on the 18th ult., Mr. B. Baker, M. Inst. C.E., stated that "during the five years the work had been in progress thirty-four lives had been lost from a variety of causes, or one per year in 300 of the workmen employed. Among guards and brakesmen of goods trains the loss last year was one in 192. The character of the work at the bridge did not lead to any relaxation of vigilance. Many suggestions were received from the public as to the prevention of accidents, but their kind advisers failed to remember that there were hardly two accidents alike. One Scotch gentleman, besides other criticisms, had declared them to be "head and ears in such a mess as no mortal man ever was before."

A VERY remarkable man, intimately associated with Sheffield, recently died at Manchester. Though no notice of him has appeared in the Manchester papers, he was one of the foremost men of the commercial world. Mr. Thomas Vickers, of Wilton Polygon, Cheetham-hill, began life as an errand boy on half-a-crown a week, and by extraordinary industry and force of character rose to be a millionaire. On the death of Mr. George Wilson he became chairman of Messrs. Charles Cammell and Co., and was also a director of the Staveley Coal and Iron Company, Messrs. Bolckow, Vaughan, and Co., Yorkshire Engine Company, J. G. Wells and Co., Eckington Collieries, Lydgate Coal Company, and many others at Manchester and other parts. He was a man of singularly clear common sense, of much humour, and utterly devoid of ostentation.

ELECTRIC lighting *versus* gas lighting was brought under discussion at a meeting of the Manchester Association of Engineers on Saturday, when Mr. J. R. Williamson read a paper on electric lighting from central stations; and in reply to some questions which were raised as to the results obtained in the application of electric lighting to mills and works, and the comparative cost of gas and electricity, Mr. Williamson replied that in the immediate vicinity of Manchester there were a score or more mills where the electric light was working successfully, and as to the comparative cost of gas and electricity, he pointed out that in one large mill, where lighting by gas had been replaced by 930 electric lamps, the cost over a certain period had been £362 for maintaining the electric lamps, as compared with £510 which had previously been paid for gas at the rate of 3s. 2d. per 1000ft.

ON Wednesday last a trial was made at the Consett Ironworks of the new machinery for cogging steel ingots, and for shearing them into blooms of various sizes suitable for rolling into plates. Some of the recently erected open-hearth furnaces were in operation, producing ingots of much larger dimensions and weights than have hitherto been attempted at these works. The ingots were brought round to the soaking pits and charged and drawn by aid of a steam travelling crane, which deposited them upon the live rollers attached to the cogging mill. Thence, after being reduced to long blooms, they passed on to the hot slab shears, which cut them into various required sizes. Subsequently they were placed upon charging bogies, weighed, and taken to the mill furnaces. The travelling crane was made by Black, Hawthorn, and Co., of Gateshead, the cogging mill by Miller and Co., of Coatbridge, the engines by Hawks, Crawshay, and Sons, of Gateshead, and the shears by J. Buckton and Co., of Leeds. The start was very satisfactory.

A DEPUTATION from the provisional committee of the Birmingham and Bristol Channel Improved Navigation Scheme presented to the Ship Canal Inquiry Committee of the Birmingham Corporation on Friday last a further very important statement of facts relating to the Severn scheme, and its development in the South Staffordshire district. The Hon. Philip Stanhope, M.P., presented the statement, in which the committee expressed the opinion that the most satisfactory basis upon which an undertaking of this character could be carried into execution was by the agency of a public trust. It had been shown in the latset report of Mr. Keeling that there was no great engineering difficulty in extending the terminus of the improved navigation to Wolverhampton instead of Birmingham, and this proposed extension would therefore, in connection with the existing canal branches, bring within the beneficial operation of the new waterway Wolverhampton, Walsall, Dudley, Wednesbury, Tipton, Darlaston, and other busy industrial centres which are at present severely handicapped for want of a cheap outlet for their heavy manufactures.



TRIPLE EXPANSION ENGINES, GERMAN MAIL STEAMERS.

(For description see page 452.)

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PARIS.—Madame BOYVEAU, *Rue de la Banque.*
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CONTENTS.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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

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

X. A.—*The Glenfield Company, Kilmarnock, N.B.*

LION.—*Apprentice him to a locomotive superintendent. The fee varies from* £300 *to* £1000.

H. A.—*Yes. See "Graphic and Analytic Statics," by R. Hudson Graham. London: Crosby Lockwood and Co.*

E. H. S.—*We never published a coloured engraving of a three-cylinder locomotive, so that we cannot comply with your request.*

H. E. W.—(1) "*Electricity," by Fleeming Jenkin; "Manuals of Elementary Science," published by the Society for Promoting Christian Knowledge.* (2) "*Elementary Lessons in Electricity and Magnetism," by S. P. Thompson. London: Macmillan and Co.* (3) "*Practical Electric Lighting," by A. B. Holmes. London: E. and F. N. Spon.*

MARINE.—*The first thing is to get your son employed in a "shore gang," repairing and refitting marine engines when ships come in from voyages. The next is to get him a berth as third engineer in a cargo boat. He must serve* 365 *days at sea, not necessarily consecutively, before he can go up for examination by the Board of Trade for a second-class certificate. It is usual to employ a professional grinder for a month before going up. There is a text-book published by Reid, in Sunderland, which is much used.*

F. DE V. (S. Lazaro).—(1) *The book on surveying referred to is L. D'A. Jackson's "Aid to Survey Practice." It, however, contains little description of instruments.* (2) *The error in the pamphlet concerning Eckold's tachimeter is carried through many pages, and through all the numerical examples given of the use of the instrument. The error has since been corrected in the pamphlet, but it is a curious illustration of how books are made up by copying, and* not *by being* written, *that* identically *the same error appears in Jackson's book and in Spon's Engineering Dictionary, in the descriptions given of this instrument. The error consists in the statement that the horizontal tangent scale is divided by help of micrometer screw into* $\frac{1}{500000}$*ths inch, instead of* $\frac{1}{50000}$*ths inch. It is a 5-figure reading that you get from this scale, for instance,* 37293. *But they make it out to be a* 6-*figure reading in the explanation and in all the examples. They do this by putting in a* 0 *where it has no business to be; thus, the above they would put down as* 370293, *thus, of course, making the thing all wrong. If they tacked on the* 0 *at the end, thus* 372930, *it might not be of any consequence; but the above shows that it is a real error, and not a slip.* (3) THE ENGINEER, *March* 18, 1887; *May* 20, 1887; *June* 24, 1887—"*Notes on Concrete and Works in Concrete," by John Newman, published by E. and F. N. Spon.* (4) "*Remunerative Railways for New Countries," by R. C. Rapier, published by E. and F. N. Spon, London.*

ICE-CRUSHING MACHINES.

(To the Editor of The Engineer.)

SIR,—Can any of your subscribers favour us with the names of manufacturers of the most approved ice-crushing machines suitable for placing on board shore hulks in the fish trade? J. C.

Cork, November 28th.

CAUSTIC SODA.

(To the Editor of The Engineer.)

SIR,—Perhaps some of your readers can tell us the name of a firm who make a speciality of improved apparatus—on the bicarbonate of ammonia principle—for producing caustic soda, as friends of ours abroad are about to put down such a plant, and are in want of plans and estimates.

November 25th. ATLAS.

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THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

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Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.

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.—Tuesday, December 6th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion: —"Electrical Tramways: the Bessbrook and Newry Tramway," by Edw. Hopkinson, M.A., D.Sc., Assoc. M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, December 5th, at the Westminster Town Hall, at 7.30: Ordinary meeting. Paper to be read:—"A New Formula for the Flow of Water in Pipes and Open Channels," by Edgar C. Thrupp, of which the following is a synopsis:—Mode of reducing results of experiments to a formula by graphical analysis—Relation of hydraulic radius to velocity—Effect of roughness of surface on the same—Decrease of effect of roughness with increase of hydraulic radius—Possibility of a formula with constant coefficients for each material—Reynolds' formula —Kutter's—Hagen's better—Author's, an improvement and elaboration of Hagen's—Velocities by formula compared with results of experiments —Tables of coefficients for different surfaces—Points on which evidence is scarce.

SOCIETY OF ARTS.—Monday, December 5th, at 8 p m. Cantor lectures: "The Elements of Architectural Design," by H. H. Statham. Lecture II. —Influence of the mode of covering in on the general design—The two systems of covering spaces, the beam and the arch.—Definition of "style" —Statical conditions of the beam system—Its architectural expression as worked out by the Greeks—The column—The entablature—The three styles employed by the Greeks—The superstition of the "Five Orders" —Roman and Renaissance application of Greek forms—Value of ancient classical forms to modern architecture. Wednesday, December 7th, at 8 p m.: Ordinary meeting. "The Chemistry, Commerce, and Uses of Eggs of Various Kinds," by P. L. Simmonds.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, December 7th, address of President, Mr. R. E. Middleton.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, December 8th, at the Institution of Civil Engineers, 25, Great George-street, S.W., at 8 p.m.: Annual general meeting for the reception of the annual report and the election of Council and officers for the year 1888. Paper to be read:—"On Safety Fuses for Electric Light Circuits, and on the Fusing Points of various Metals usually Employed in their Construction," by Arthur C. Cockburn, F.C S., Associate.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—The third general meeting will be held in the Lecture Hall of the Literary and Philosophical Society, Newcastle-on-Tyne, on Wednesday, December 7th, at 7.45 p.m. (1) Adjourned discussion on Mr. R. Thompson's paper on "Speed and Coal Consumption of Steamers Treated Commercially. (2) Paper on "Improvements in Ships' Keels, Stems, Sterns, and Rudder Frames," by Mr. E. F. Wailes.

THE ENGINEER.

DECEMBER 2, 1887.

THE EMIGRATION OF CAPITAL.

ONE of the signs of the times which it behoves all classes of Englishmen to note, is the shape which the emigration of capital is now taking. For a great number of years past English capital has emigrated all over the globe in the shape of loans, made for the most part to foreign Governments. Of late this outlet has to a considerable extent been closed through the failing credit of would-be national borowers. Instead, money is now going abroad to establish workshops and factories, in which will be employed artisans of foreign birth. We might cite numerous examples of this. Much is being done in a comparatively small and quiet way, so that little is heard of it outside narrow circles; but there are not wanting instances where the transfer of money and talent takes place on a very large scale. From Madrid news reaches us this week which must be taken for what it is worth. The Bilbao papers state that representatives of important English shipbuilding firms have recently sounded the owners of the principal ironworks on the banks of the Bilbao river with the view of establishing in Biscay extensive naval yards, similar to those which Sir William Armstrong created in Italy. As the Spanish Government is obliged by public opinion to build in Spain most of the new war vessels, for which the Cortes have voted nine millions sterling, and as their private and State yards are not sufficiently organised to undertake the construction of the new fleet, it is said that the present Government are willing to let foreign firms create yards in Spain, to which the majority of the contracts would be given. The policy of the Spanish Government thus indicated deserves particular attention. According to all the principles of political economy the policy is apparently wrong. It is an axiom that the consumer should always buy in the cheapest market, no matter what follows. Is or is not the action of the Spanish Government opposed to this principle, or is it in strict accord with it?

At the first view of the matter we are disposed to say that it is opposed to it. In other words, it is reasonable to suppose that war ships, and guns, and the products of our arsenals, could be obtained for a lower price from English or Scotch contractors working in Great Britain than in Spain. But there is an important element which must not be overlooked. In spite of the advantages which such firms as Sir William Armstrong, Mitchell and Co., and others possess, in a magnificent plant, a trained staff, cheap coal and iron, and such like, they have, on the other hand, to contend with high wages, short hours, and the imminent risk of strikes coming into operation at critical moments. The short hours prevent full advantage being taken of the plant, and the strikes may entail tremendous losses; while the bare possibility of their taking place may on the one hand induce customers to go to firms and centres of production where no such complications can arise; or on the other, will certainly lead to the insertion in contracts of strike clauses of serious import to engineers and shipbuilders. These things heavily handicap the English producer. In Spain he would be clear of them; wages would be low; strikes practically unknown; the hours of work long. The fact that £9,000,000 are to be spent on just those things which we can best produce, may well make the national mouth water, but our working classes will certainly get none of the money; and for the reasons we have set forth, it is not quite clear that the Spanish Government will have to pay more for war ships than they would have to pay here. As British capital cannot find employment at home, it goes abroad; and it goes abroad to build up that which will contribute to the national power and greatness of a nation which once played no insignificant part in the affairs of the world. We cannot suppress a feeling of regret that such should be the case. It is better, perhaps, that the English capitalist should have a share of the nine millions than it should all go into Spanish pockets; but we are very sorry that our working men will have no part of it.

What shall we say of that public opinion which in Spain asserts that, if money is to be spent, it shall be spent in the country in giving employment to its working classes? Such opinions are, we need scarcely say, held in direct opposition to all that the political economist can advance. They embody the whole doctrine of Protection in the fullest way. Spaniards think that if money is to be spent it should be spent at home, forgetting that whereas every ship they produce will now be dead loss, if they had imported them from England they would, according to the laws of political economy, have represented so much income. The whole scheme is based on the idea that the absolute wealth of a country is not of so much importance as the supply of means of subsistence in the shape of work to the greatest possible number of the inhabitants of it. So we shall probably see a great naval arsenal built up with English capital, and in this arsenal three or four thousand Spaniards will find employment, and the means of buying bread, and onions, and sour wine. All this in flagrant violation of the principle that nations as well as individuals should invariably buy in the cheapest market. This may seem to be folly, yet we are not certain that Spanish public opinion is wrong after all. We have something in this country curiously like it. Sheffield, for example, will by no means permit the English Government to make steel at Woolwich. It insists that the money of the taxpayers must be spent for the benefit of the Sheffield artisans; and be it noted that Sheffield has not one word to say about the cost. It is nothing to the point that the Sheffield steel may be dearer than Woolwich steel. Sheffield has a prescriptive right to make steel, and to Sheffield the Government must go. What is this but Protection pure and simple? What is it but the direct analogue of the working of popular opinion in Spain? The Sheffield folk hold that their citizens must have employment, and that it is worth the nation's while to pay a little more than they otherwise would in order that employment may be secured. That is what the Spaniards think also; and really when we look around us, and consider the condition of large masses of the population of this country, we may begin to ask ourselves is it really the soundest and wisest policy to buy always in the cheapest market, no matter what follows? A man with plenty of money in his pocket may find it to the advantage of his pocket to buy everything he wants. Yet it might now and then redound greatly to his personal advantage if instead of buying he made or grew things for himself. What is true of men may be true of nations, and it might be better for Spain after all if she made her own ships and guns than it would be to save money and buy them. We cannot have everything in this world, and Spain concludes that she cannot save money and employ Spaniards at the same time. Whether she is r ght or wrong must remain, we fear, a matter of opinion. The true-blooded political economist will say Spain is wrong, and, whatever we may think, is it for us to assert that political economy is not an exact science, or that its professors can make mistakes?

OUR COLONIES AND THEIR RAILWAYS.

THE condition of affairs in some of our Colonies which has been made public by recent revelations, pretty conclusively proves that the day of unlimited borrowing by them for the purposes of railway extension has almost passed by. The financial state of some of the foremost of these dependencies has been but lately made the subject of searching investigation; and in the cases of New Zealand and South Australia it seems certain that no further present expenditure for railway construction would be deemed justifiable. Sir Henry Holland lately foreshadowed, when replying to a question addressed to him in Parliament, the rapid approach to such a state of things. He publicly stated, with reference to some of our Colonies, that until matters in them with regard to revenue and expenditure showed a marked improvement it would be impossible for the Colonial Office to approve the undertaking of further public works of magnitude.

We need scarcely say that it is with regret that we find this decision to be justified by the results of late close investigations; but it is evident that, even in a matter so important to the development of a new country as the extension of railways, more than one of our Colonies have been going on too fast. We do not care—for it is scarcely within our province to do so—here to go into the collateral question of how far the investigations we have referred to go towards affording proof that the funds raised have been wastefully applied; but that they have been so, in some instances at least, is openly stated by the journals published in several Colonies. It is not long since we devoted an article to the consideration of the evil results of the system of the wholesale alienation of public lands by our Colonial Governments. So long as the funds raised by this means went to swell the revenue returns, so long was the extravagance of outlay on railways non-apparent to the ordinary class of investors. When we so wrote, we predicted that this source of revenue must soon become exhausted. This has now in several Colonies been arrived at, and the result is to be seen in the fact that borrowing-power to the extent formerly possible has sensibly diminished. Those of our home contemporaries who devote their columns to financial questions are urging this point upon the investing public, and to an extent which must materially affect the terms upon which loans for railway extension in the Colonies can, for some time to come, be placed upon the London market. It has constantly been pleaded, when we and others have before directed attention to this matter, that the outlay upon Colonial railways has represented a paying investment and not an expenditure incapable of recoupment. We wish we could believe that such a contention could be justified; but recent revelations seem to prove that it cannot be to anything like the extent that those who raise it insist upon. Hitherto there seems to have been held, almost generally, the conviction that nothing could arrest the progress of our Colonies. Unhappily, we have but too much evidence that that conviction is no longer fully tenable. Colonies, both those under British rule and those owning a foreign sway, are liable to the same interruptions to their progress as are countries of older settlement, and their conditions hardly warrant the hope that they are capable of quicker rehabilitation than are the latter.

We have a striking instance of decadence of this character in the present state of the Danish Colony of St. Thomas. The British Consul there writes that the trade of that island, "which has been steadily diminishing, has not yet reached its lowest limit." As a trade depôt, it is asserted that St. Thomas has practically ceased to exist, and that a revival is improbable, inasmuch as the decline is steady and progressive. Hitherto St. Thomas has enjoyed the position of a port of call for steamers seeking information and instructions as to their further proceedings; but, as Mr. Zohrab writes, "the extension of the submarine telegraph and the development of steam navigation in West Indian waters have enabled shipowners and charterers to communicate directly with each other." He states that, as the consequence of this change, "house after house closes its business." It may, we admit, be conceded that the characteristics of the Danish Colony differ widely from those of most of our own Colonies, which are principally agricultural. But agriculture, after all, is liable to vicissitudes to the full as great as those which are proving so disastrous to St. Thomas, and these must produce seasons of depression which, for a time at least, must necessitate an economy in expenditure, to the practice of which most of our Colonies have as yet been strangers. Such an evil time has at length arrived. The knowledge of it has been concealed from the public until the concealment has become no longer practicable, and the more sensible and prudent of our colonists feel that the day has come to set their house in order. If they did not the conviction would be forced upon them by the outcry now finding expression in our financial press. Almost without exception, investors are cautioned by it not to subscribe to colonial railway loans without first acquiring knowledge as to the state of public indebtedness of the colony demanding them, the proportion it bears to population, and the prospect of progress rendering it possible that that population can bear the burden without being overwhelmed by it. We know of several Colonies in which there are parties who desire to undertake further heavy extensions to their railway system. They are only now restrained from forcing the adoption of their views on their respective Governments by the knowledge that the raising of money on former easy terms is now certain to be impracticable. The excess of the evil is working its own cure, but it must take some time yet to fully accomplish it. While we regret the delay for many reasons, it will not improbably prove fruitful of several good results. The inconveniences to which it will subject many Colonies for some time to come, will rudely teach their settlers the impolicy of the course they have, until now, pursued almost unchecked. If the credit of our Colonies is to be maintained, it can only be by convincing home investors that for none but well-considered schemes will their money be asked, and by affording to them also a guarantee that its expenditure will be carefully controlled.

SPANISH ORE AND BRITISH STEAMSHIPS.

SINCE we commented in THE ENGINEER on the movement in Bilbao ore and on the cost of its carriage, there have been further developments which are important to our industries. The rise in the rate of freights has continued, and this not only to the United Kingdom, but to Holland and to America. To the United States, 15s. 6d. per ton of ore has been paid more than once; to Terneuzen about 7s. 9d. per ton has been paid, and to the Tees 6s. 6d. per ton has been paid. These rates are from 1s. 6d. to 3s. per ton above those which were charged a few months ago, and thus it is evident that the cost of hematite iron from that ore will be increased by about double that amount per ton of iron. There are rumours, also, that the cost of the ore in Bilbao will be greater next year, where contracts do not continue beyond that time; and should this be so, the cost of the hematite iron will be very much more next year than it has been of late. We depend very largely on the imported ore; for whilst last year we imported 2,878,469 tons of ore, this was about 400,000 tons more than the entire production of the West Cumberland and Furness districts. But, in the opinion of some whose views are at least entitled to consideration, Spain cannot materially enlarge the quantity she is sending out not only to the United Kingdom, but to Holland, the United States, and other nations, and meet her own requirements for smelting purposes. Hence, we are not likely to witness much further immediate enlargement of the exports of ore from Spain, though it is at least probable that her exports of hematite pig iron may be increased. Of late years the carrying of the Spanish ore from Bilbao cannot be said to have been profitable to the British steamers which do so much of the work; and though rates have increased, as we have pointed out, yet they are far below what they were a few years ago—in the case of the freights to our own ports they are still 30 per cent. below what they were about four years ago; and though the working of the steamers is a little cheaper than it then was, yet the decreased cost of work is anything but concurrent with the fall in the rate of freight. It is scarcely likely that we shall see these high rates of freight reverted to, but as the rate at which we are losing vessels is more than the rate at which we are building them, it is clear that we shall not be likely to have very low rates of freight again soon; and it is to be noticed that as other countries require these ores fair freights are needed for our vessels, for they do the bulk of the carrying to these countries, and low freights favour them in the international competition which is so prevalent. There is not only the question of the iron ore and the freights, but there is the pyritic and other ores which are treated at the smelting works on the Mersey, the Tyne, and other parts of the kingdom. Whilst the treatment of these ores is valuable to us, it is by no means essential that we should have them carried except at a good profit to the carrying steamships, for in some measure the resultant metals enter into competition with those of home production, and thus there is reason for the desire for at least a remunerative freight. The tendency in the last few weeks has been in this direction; and it is gratifying to believe from the shipping statistics that though there may be a lull in the depth of winter—when many oversea trades are closed—yet, with the heavy losses and light building usual in the winter, there will be a further recovery in freights next year, and the users of Spanish ores will have to pay dearer for the carriage.

IMPROVEMENT IN THE IRON TRADE.

THE signs of the times indicate a certain improvement in the iron trade. December has come in, bringing with it stronger markets all round, and iron and steel circles are talking hopefully of next year's outlook. Restriction of output in West Cumberland to the extent of 5000 tons a-week is running up the hematite market, and prices are already 1s. 6d. per ton better. Stocks were increasing to such an extent that it was high time that some attempt was made to bring supply and demand more nearly together. Speculation has begun in the Scotch warrant market. Much of the business is being done on account of London buyers, and on one of the days last week the transactions of that day alone amounted to 50,000 tons. Prices are steadily advancing, and at date the market is recorded strong, with a large business doing at 40s. 11½d. and 41s. 1½d., cash. This looks well, and Cleveland is participating in the improvement; then, more confidence is manifesting itself both amongst sellers and buyers, and prices, which were rising all last week, continue upwards. Merchants' quotation for No. 3 Cleveland pig has now advanced to 31s. 7½d. for prompt delivery, and makers have raised their quotations to 32s. We quote these prices that readers may see the actual state of the market at a glance. For next quarter's delivery there are a considerable number of inquiries, and trade looks healthier all round. What is badly needed, however, is some restriction of make in Scotland like that which has been determined upon on the west coast. The output at the present time is greatly excessive. Nor is the improvement confined to raw iron. Manufactured iron is beginning to show rather stronger prices. Iron plates have gone up 1s. 3d. in Cleveland, while the possibility of a syndicate amongst the makers for raising prices in Scotland similar to what has previously existed is now spoken about. Shipbuilding on the Clyde and Tyne and Tees is on the increase, and the effect upon the steel trade is good. Steel plates on the north-east coast have just risen 5s., and the Scotch steel-plate mills are all active. More money is wanted at date by the railmakers to make the business pay, and if this can be got the iron and steel markets will be in a fair way for improving all round.

ENGINEERING INQUIRY INTO THE LOWER THAMES DROUGHT.

AN engineering inquiry has at last been decided upon touching the scarcity of water in the lower reaches of the Thames. There was an important conference on the subject at the office of the Board of Trade at the close of last week, when representatives were present from the Board of Trade, the Thames Conservancy, and from the Surrey and Middlesex side of the river in the districts affected. It was agreed that the Board of Trade should name some eminent engineer to report upon the whole question, he first hearing evidence from engineers to be appointed respectively by the Thames Conservancy, the Richmond Vestry, and the Twickenham Local Roard. This week the representatives of the districts affected have specified as follows, for the guidance of the arbitrator, the points upon which a decision is required:—"Firstly, the necessity for some measures being adopted which would ameliorate the present condition of the river Thames within the parishes of Richmond and Twickenham'; secondly, as to what would be the best means, in an engineering point of view, to remedy the present loss of water within this area; thirdly, as to what would be the cost of a lock and weir, or other works between Richmond and Kew that may be suggested." The expenses of the arbitrator are to be borne equally by the Thames Conservancy and the two parishes, all of whom bind themselves—subject to obtaining from the Local Government Board any necessary borrowing powers—to do their best to carry into effect the arbitrator's recommendations. The arbitrator—whose task will not be a light one—and the representative engineers, if yet appointed, have not been announced. This resort to arbitration commends itself to us as more amicable and more direct than the instituting of a Royal Commission.

LITERATURE.

A Treatise on Azimuth, with a Study of the Astronomical Triangle, and of the Effect of Errors in the Data. By JOSEPH EDGAR CRAIG. New York: John Wiley and Sons. London: Trübner and Co. 1887.

THIS is a most painstaking and laborious work on a much-neglected branch of spherical trigonometry. The problem of determining the azimuth of a heavenly body is one which occasionally presents itself to the navigator, in order to deduce the variation or deviation of the magnetic needle or the true bearing of some visible object on shore. Hence it is important to have means of ascertaining, in any given locality, both the most favourable heavenly bodies to select for the purpose and also the most favourable position for observing the selected body.

Now, as the writer shows, the information on these points given by the ordinary text-books is not only incomplete, but also frequently misleading. Thus he quotes one work as making the curious statement that when a body is rising or falling rapidly, its movements in azimuth will also be rapid. Many similar statements are adduced which sufficiently demonstrate the carelessness with which the matter has been generally treated—a carelessness perhaps not wholly without excuse, when we note that in some cases the discovery of the most favourable position requires the solution of a trigonometrical equation of the fourth degree.

The particular method of investigation depends, of course, upon the nature of the data. If we choose a known body, its declination d will always be one of our data. In some cases the latitude L is known, when the third known element may be either the altitude h determined by observation, or the hour angle, which requires only a knowledge of the sidereal time, the body's right ascension being supposed known. In case the latitude be unknown, both the latter elements will be required. These are the only three important cases, and they are classified by the author as the problems of altitude-azimuth, time-azimuth, and time-altitude-azimuth, respectively. In any of the above cases the ordinary formulæ of spherical trigonometry will enable us to determine the azimuth Z. These are classified in a convenient form in Chapter II. The problem is now reduced to that of finding when $d\,Z/d\,h$ is a maximum or minimum—to take, for example, the case of altitude-azimuth—and similarly in the other cases. We shall then know the positions where a small error in the observed altitude will have the greatest or least effect on the deduced azimuth, *i.e.*, the most unfavourable and most favourable positions for an observation in altitude to deduce azimuth.

The third chapter is occupied with a full discussion of the differentiation of the equations connecting Z with the given data, in the different cases mentioned above. A complete table is given for reference of the differential coefficients of Z with respect to h, L, and d, in terms of the known elements of the triangle, thus enabling us at once to determine, to the first order of small quantities, the effect of a small error in one of the data on the deduced azimuth. The meridian is thus shown to be a position of absolute maximum of $d\,Z/d\,h$ for all bodies, and therefore the neighbourhood of the meridian is the most unfavourable position possible for an altitude observation to obtain azimuth. The position for a minimum is not obvious by inspection, but is nearer the six-hour circle than the prime vertical, where most of the text-books erroneously place it. The explanation of this error is that in the formula $d\,Z/d\,h = 1/\tan q \cos h$—where q is the parallactic angle—former writers have neglected the $\cos h$, and so make $d\,Z/d\,h$ a minimum when $\tan q$ is a maximum, *i.e.*, on the prime vertical.

We now come to the more important chapters, to which the preceding ones are but preliminary. These investigate the equations to the *loci* of maximum and minimum errors in the computed azimuth due to errors in the data. These equations are, of course, arrived at from the results already tabulated for $d\,Z/d\,h$, &c., by differentiating again and equating the results to zero. A *locus* is thus described on the sphere of the most and least favourable positions in any given latitude. To render it possible to plot these curves, some plane projection of the sphere must be chosen, and the author's choice falls upon the stereographic, with the point of sight at the observer's nadir, and consequently having the plane of the horizon as primitive. The prime vertical and meridian are then chosen as the axes of X and Y. The polar equation of the *locus* on the stereographic projection is at once deduced by writing r for $\tan \frac{1}{2} z$—z being the zenith distance—and θ for Z, and the Cartesian equation follows.

In Chapter VII. the properties of the curves thus obtained are fully discussed, and an idea may be gathered of the author's industry when we observe that some of these curves are of the seventh degree. Excellent tracings of the curves are given in a series of plates at the end of the work. Each curve is traced on the stereographic projection for latitudes 30 deg., 45 deg., and 60 deg., and as this is done for errors in altitude, declination, latitude, and hour angle, they are as complete as the most captious critic could require. To deduce from these diagrams the best positions for observing a known body, we have only to select the appropriate plate, fill in the body's declination circle—which is very simply done on this projection—and note where this circle cuts the *locus*.

In conclusion, we doubt whether this work will be found of very great practical utility to the navigator, since such extreme care in selecting the best possible position for observation is wholly unnecessary. It is chiefly to the theoretical astronomer that the book is interesting, on account of the light it throws on the manner of variation of the astronomical triangle. In addition to the investigations already noticed, the author indicates in an appendix how to deduce the variations in the other elements of the triangle.

So far as we have observed, the computations are singularly accurate; the draughtsmanship and the printing and binding are excellent.

Electrical Distribution by Alternating Currents and Transformers. By RANKIN KENNEDY. London: Alabaster, Gatehouse, and Co. 1887.

As the use of high-tension alternating currents and transformers for reducing the tension in the distributing circuits is apparently very likely to receive wide extensions in the near future, this pamphlet will be found to be of very considerable interest to electrical engineers. It gives sufficient of the history of the invention and development of induction coils from the simple stage up to that at which they became what are now called, transformers. Several of the well-known forms in use are then described. Anyone unacquainted with this class of electrical apparatus can obtain a good general idea of its character and its mode of application in practice from the pamphlet, but the author errs in giving too little prominence to the well-known form of transformers introduced by MM. Goulard and Gibbs, and to some of the recent inventions besides his own. This is partly due to the greater attention he wished to direct to the use of transformers in parallel instead of in series, as was the case with all, or nearly all, until after 1884. The descriptive information concerning these induction coils, rules, and descriptions of systems of supply with the clear diagrams, will make this pamphlet useful to many.

STEAM ENGINES AT THE ROYAL AGRICULTURAL SOCIETY'S NEWCASTLE SHOW.

No. III.

IN our last impression we referred to the loss of heat radiated from the boiler of Mr. Foden's engine as exerting an influence on its evaporative economical efficiency. The report we are considering goes at considerable length into the question of radiation, lays down the theory of the subject, and gives a description of the mode actually used to obtain the requisite data. The results are set forth in the following Table IV., which is Table IX. in the report. We have omitted the catalogue reference numbers, however, and substituted the names of the makers, in order to render the figures intelligible to our readers.

TABLE IV.—*Rate of Cooling of Engines and Boilers.*

	Simple engines.				Compound engines.			
Name of maker	Foden.	Jeffery.	Paxman.	Humphreys.	Cooper.	Foden.	Paxman.	McLaren.
1. Weight of water in boilers at normal level ... ... lbs.	1,134	329	1,317	1,477	1,346	987	1,393	1,428
2. Volume of steam space ... ... cub. ft.	12·83	6·41	18·23	17·62	12·49	11·30	19·37	15·86
3. Estimated weight of engines and boilers affected by heat... ... ... lbs.	17,752	2,147	8,052	7,756	7,097	19,488	8,314	8,648
4. Steam pressure above atmosphere during trials ... ,,	120	60	95	85	125	250	150	155
5. Temperature due to steam pressure ... ... F.°	350	307	334	327	353	406	369	368
6. Brake horse-power, including friction of brakes H.P.	11·37	3·798	16·94	17·08	17·25	17·57	20·33	21·07
7. Coal consumed per hour... ... ... lbs.	31·48	27·01	44·03	87·389	63·43	34·19	37·61	46·02
8. Units of heat evolved from coal per hour (14,940 units per 1 lb.)	470,310	403,530	657,820	1,305,600	947,640	510,800	562,050	687,550
9. Rate of cooling at the working pressure in units per hour	70,813	41,060	43,688	46,105	51,159	84,143	62,477	46,510
10. Ratio of heat dissipated by cooling to heat evolved by coal	·151	·102	·066	·035	·054	·165	·111	·C68
11. Units of heat dissipated by cooling per brake horse-power per hour	6,228	10,811	2,579	2,699	2,966	4,789	3,073	2,208

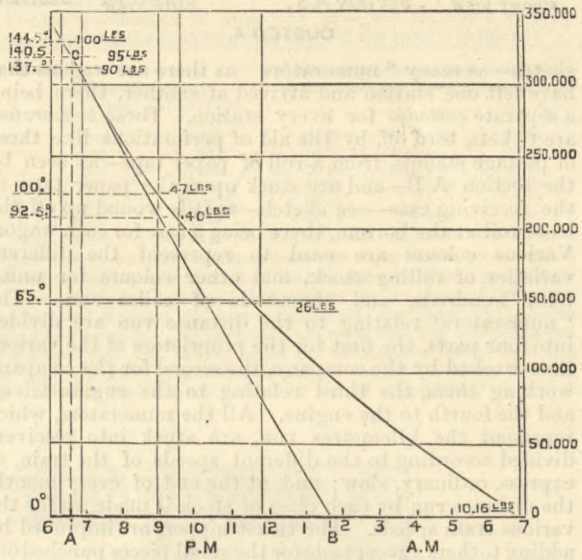
It is to be regretted that this table presents anomalies which render it of very little value. The basis on which it has been partly constructed appears to us to be erroneous, because the standard selected, namely, the brake horse-power, is a variable of indeterminable amount as regards any group of engines.

But besides this, the figures obtained do not bear any definite relation to the conditions obtaining. Let us, for example, take Foden's two traction engines, one compound the other simple. These engines were lagged in the same way, and beyond all question the compound engine was placed at a disadvantage as compared with the simple engine, because the steam pressure and temperature were much higher, and the weight of metal heated was more considerable. The approximate weight of heated metal in the simple engine was, it will be seen, 17,752 lb., while in the compound engine it was 19,488 lb. The pressure in the simple engine was 120 lb., and in the compound engine 250 lb. It is obvious that, under these conditions, like causes producing like effects, the compound engine ought to have lost more heat per hour than the simple engine, and by calculation this appears to have been the case; because the rate of cooling at the working pressure of the simple engine was 70,813 units per hour, while the compound engine cooled at the rate of 84,143 units per hour. In round numbers, 44 units per min., or 60 × 44 = 2640 units per hour are = 1-horse power, and $\frac{84,143}{2640}$ = 31-horse power. The engine indicated 18·63-horse power, so that apparently nearly twice as much heat was wasted by cooling as was converted into work. This statement requires some explanation.

Before saying anything on this point, however, we must call attention to the fact that if we estimate the radiation in terms of the horse-power it will be seen that the compound engine has greatly the advantage of the simple engine, for it lost only 4789 units per brake horse-power per hour, while its fellow, the simple engine, lost 6228. The radiation remaining a constant quantity, the loss will vary per horse-power per hour with the power. The figures must all be taken with much reserve. The report points out that in the case of the Paxman compound engine, for example, the rate of cooling was 27½ per cent. more rapid than was the case with the simple engine; and this seems to have been due to the circumstance that the ashpan door of one engine fitted tighter than the other. The method of obtaining the data consisted in shutting up all openings to the boiler as closely as possible, and taking the temperature of the water within the boiler from time to time, and plotting curves from the figures obtained. To make this clear, the following extract from the report will suffice. It refers to Messrs. Davey Paxman and Co.'s simple engine. "Its trials were completed at 6.17 p.m., and at that time the pressure gauge marked 100 lb., corresponding to 338·5 deg. temperature. The steam space of this engine measured 18·23 cubic feet, the water at working level weighed 1317 lb., the weight of metal affected by heat was 8052 lb. From Mr. Cotterill's tables it appears that a cubic foot of steam at 100 lb. pressure weighs ·2609 lb., and that 1 lb. of steam contains 1185·1 units of heat above 32 deg., and 1 lb. of water at the temperature of the steam contains 310·23 units. Hence the total units of heat above 32 deg. in the engine were:—

			units.
	c. ft.	lb. u	
Steam...	18·23	× ·2609 × 1185·1	= 5,636
Water...	1317 lb.	× 310·23u.	= 408,580
Metal...	8052 lb.	× ·1138 × (338·5 deg. − 32 deg.)	= 280,850
Total units of heat above 32 deg.			695,066

As the engine cools, a portion of the steam is condensed, so that the weight of steam is constantly diminished, while the weight of water is increased, the sum of the two being constant at all times. It will be noticed that no observation was made when the steam was at 95 lb., its working pressure, yet it is at this point that we must know the rate of cooling. To ascertain this, we construct the diagram, on the base line of which we mark off the times at which the readings were taken, and on the ordinates or vertical lines, the units of heat which remained in the engines at each moment of observation; but to avoid an inconveniently large diagram, we make the zero-point at the last reading, or 6.50 a.m. on the day after the trial, by deducting the heat in the engine at that hour, namely, 364,600 units, from all the values above it. Having determined these points, a line is run through them, and it will be seen that they fall in very closely to a uniform curve, which shows that the rate of cooling decreases with the decrease of pressure and temperature, a fact which is in accordance with the law that the rate of cooling is proportional to the difference of temperature between the hot body and the surrounding space. If now we make the ordinate of the observation at 6 h. 17 min. equal to 144·5 deg., and set off upon it the other differences to the same scale, and draw horizontal lines so as to cut the curve, it will be seen that the points of intersection coincide very nearly with the points indicating the units of heat, thus showing that the loss of heat follows the same rate as the decrease in the difference of temperatures."



But there still remains the question—What is the rate of cooling at the working pressure, 95 lb.? The number of units of heat in the engine at 95 lb. was 321,105 above the lowest observation. Plot this value on the ordinate of the 6 h. 17 min. observation, and draw a horizontal line till it cuts the curve at C, and draw the ordinate A C. This ordinate meets the base at 6 h. 30 min.; hence the steam fell to 95 lb. at that time. Next, from the point C draw a tangent to the curve cutting the base at the point B, which proves to be 7 h. 21 min. distance from A. It is clear that if the rate of cooling were uniform, as represented by the tangent C B, the 321,105 units of heat at C would be dissipated in 7 h. 21 min.—or 7·35 hours—instead of 12¼ hours, as was actually the case, but at C the tangent coincides with the curve, so at that point of it the rate of cooling was 43,688 units per hour."

No attempt has been made to ascertain the radiation per square foot of heated surface per hour, and we confess that we regard all the figures as to a large extent misleading. We shall probably not be very far wide of the mark if we take the whole external radiating surface, say of Foden's simple engine, as 100 square feet. It would appear then that the loss of heat by radiation, &c., proceeded at the rate of not less than 715 units per hour per square foot of surface. The temperature of the external air was 70 deg.; that of the steam, 350. The difference was 280, so that the loss of heat took place at the rate of $\frac{715}{280}$ = 2·55 units nearly per hour per degree of temperature. Now there are available a great many data concerning the cooling of steam pipes. Much information on the subject will be found in a very compact shape in Mr. D. K. Clark's "Rules, Tables, and Memoranda;" but among all his experiments we find nothing approaching the rate given in the table we reproduce. Uncovered cast iron pipes radiate heat at about the rate of 2·812 units per square foot per hour per degree of temperature inside and outside the pipe. Steam pipes coated with straw lost only ·968 units per foot per hour per degree of difference of temperature. Coated with old felt they parted with heat at the rate of 1·51 units. Mr. Grouville has found the rate for uncovered cast iron pipes with 20 lb. steam to be 2·26 units. From all this we are to gather that a boiler carefully clothed, first with about 2in. of hair felt, then 1in. cleading boards, and finally a sheet iron casing, lost heat two and a-half times as fast as cast iron pipes coated with straw, and not much less slowly than uncovered pipes. We say plainly that we do not believe this. A very considerable proportion of the loss took place by the flow of a current of cold air through the interior of the boiler, which it was impossible to prevent, and which current could not operate at all when the boiler was at work, for then the tubes would be traversed by hot instead of by cold air. Furthermore, experiments made by Mr. Head, of Middlesbrough, have shown that in the still air of a room the loss of heat from an unlagged boiler was only about one-fifth of that which took place when the boiler was exposed to draughts of air. Now, during the Newcastle trials, some of the days were hot and calm, others were chilly, without much change in the thermometer, and rainy. All this would affect the observations. Some of the engines cooled down in the trial shed, others out of doors. The attempt to obtain some data concerning loss of heat from portable engines was no doubt laudable; but the results must, we think, be held to be unsatisfactory regarded as scientific data. The figures may show indeed how fast the engines cooled down when the fires were out, but they tell us nothing of the loss which took place by external radiation and conduction while the engines were at work.

We have said that the Foden engine apparently lost by radiation more heat by nearly two to one than it converted into power. This sounds startling, but it must not be assumed that if all radiation were stopped the heat so saved could be converted to a useful purpose. This is not the place to repeat an oft-told story at length. It will suffice to say that the great bulk of the heat produced by the combustion of the coal in any steam engine is expended in making the working fluid-steam, which fluid we throw away when it is done with; and one reason why a hot-air engine is so economical is that we have the working fluid ready made to our hand. In any and all steam engines the percentage of heat utilised is very small. Take, for example, the Paxman compound engine, one of the most economical engines in existence, and we find that the total units of heat evolved from the coal burned amounted to 562,050 per hour, of which only 58,972 units were converted into work, or less than one-ninth of the whole.

There can be no dispute, however, that radiation and conduction represent a serious loss of heat, which ought to be guarded against by all means. A case came under our notice recently in which three large Lancashire boilers were tested for fuel consumption for twenty-four hours continuous steaming. The boilers were entirely unclothed above the brick seating, and exposed to the air without shed or covering of any kind. They were not hard pressed, and were fired with good North-country coal, and the evaporation turned out to be less than 5½ lb. of water per 1 lb. of coal. As we have said, we are very far from saying that the judges at the Newcastle Show ought not to have tried to take cooling data; but we do say that the data obtained appear to us to be too uncertain in their character to be of much value. Such as they are we have placed them before our readers.

THE MEDITERRANEAN RAILWAY.

IN our article on Italian Railways—see p. 365, Nov. 4th—we stated that, with few unimportant exceptions, the railways on the mainland of the peninsula are divided longitudinally into two working systems. That on the west, shown by thick lines on the map—p. 365, Nov. 4th—is the Rete Mediterranea; and the Company working it bears the title of Compagnia delle Strade Ferrate del Mediterraneo, whose capital is 135,000,000 lire, or £5,400,000. The administration of the R. M. is carried on at the Palazzo Litta, Milan, where are the offices of the general manager, Com. Ing. Massa, and of the chief engineer of permanent way, Cav. Ing. Bianco. The technical direction of *matériel* and traction, however, is at Turin, where Commendatore Ingegnere C. Frescot holds the post of Direttore del Materiale, corresponding to that of Mr. Aspinall on the L. and Y. Railway. Under Signor Frescot's control is the drawing office, in charge of Ing. Cervini, where new types of rolling-stock are designed.

The Mediterranean Railway has now 4554 kilom., or 2830 miles, of way in operation, of which the Milan and Genoa section is a double line. It is also decided to make the Milan-Turin and Rome-Pisa sections double forthwith, and subsequently that between Rome and Naples. An idea of the importance of the system will be afforded by remembering that the distance between Rome and Milan is about the same as between London and Edinburgh. The main trunk is that from the St. Gothard Tunnel to Turin, Alessandria, Novi, Genoa, Pisa, Rome, and Naples, whence there is a branch to Brindisi in the Adriatic Company's territory, and another to Reggio—the direct line in course of construction superseding a circuitous route—for affording communication by steamboat with Messina. The distance between Italy and Sicily is only 3 kilom. or not two miles; and there is a project by Signor Gabelli for making a tunnel, 7 kilom. = 4 miles long including approaches, at a cost of 70,000,000 lire, or £2,800,000.

The company works the St. Gothard Tunnel from Modane, on the French side; and will have the working of the Simplon Tunnel if made, or of the alternative route, through Monte Bianco, if that project be ultimately adopted.

The greatest amount of traffic is between Novi, an important junction, and Genoa, producing 150,000 lire per kilometre of double line, or £9600 per mile, per annum. There is, however, a six mile gradient of 1 in 28, so that an almost entirely new line 24 kilom., or 15 miles long, has been made at a cost of 40,000,000 lire, or £1,600,000, with a tunnel of 8 kilom. = 5 miles, and a gradient of 1 in 70 for the whole length. This is nearly ready for opening; and there is a project for modifying the line between Rome and Naples, which has acquired far greater importance than when it was made, owing to the incorporation of the Pontifical States in the kingdom of Italy, and the subsequent development of traffic. At present the line is 260 kilom., or 160 miles, long, and has three ascending and three descending gradients of 1 in 40, not far distant from each other. While the gradients will be reduced to 1 in 70, a distance of 37 kilom., or 23 miles, will be saved. A direct line from Rome to Sienna, where there is a repairing shop, is also projected.

The Mediterranean Company has not adopted the block system except on portions of the line where there is much traffic; but there is invariably a telegraph from station to station. An electric bell is constantly ringing in the cabin whence the distance signal is worked, when that signal shows "line clear;" but where there are many such wires, only two bells of different sounds ring, the others being replaced by visible signals. When the projected works are complete, the steepest gradient will be 1 in 70, and the sharpest curve one of 300 metres or 10 chains radius. All new way is laid with Vignolles rails, weighing about 36 lb. to the yard, and 9 metres, or 30ft., long; but some of 12 metres, or nearly 40ft., are now being tried. The 9-metre rails are laid on eleven oak sleepers, 260 by 22 by 14cm. = 8ft. 6in. by 8½in. by 5½in., with unsupported joints. The ballast consists of gravel free from sand, which latter is liable to be washed away and also displaced by vibration. The fences consist chiefly of rough-hewn granite pillars two metres apart, with two wood rails of triangular section between them, the ends entering mortices in the stone, and fifteen flat sharp-pointed uprights, also of wood.

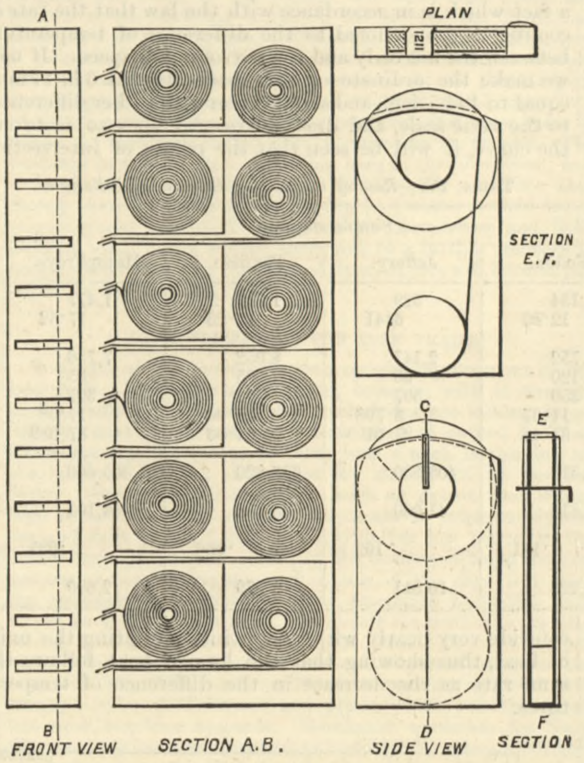
Last year three accidents occurred through the signals not corresponding with the points, owing to a fracture in the rods working the latter. This difficulty is obviated by a hydraulic arrangement for working both points and signals, invented by Sig. R. Bianchi, Capo Sessione del Materiale, who spent a year at Penn's, Greenwich, after obtaining by examination his grade of "Ingegnere." His system was first applied to the station of Abbiategrasso, between Milan and Mortara, which was visited by the members of the International Railway Congress. It has been in operation there for a year, the period of trial enjoined by the State engineers, and has been favourably reported upon by them. The system is now being applied to the Savona station, between Genoa and Ventimiglia, where there are seventy-five levers, and is in course of application to the new Roma-Trastevere station, with 165 levers. Indeed, it has been decided to adopt the arrangement for all new works. The same water is used continually, and the addition of 10 per cent. of glycerine prevents it from freezing. A small hydraulic press, laid horizontally and transversely between the rails, works the points directly, the water being led by a ½in. pipe, which is, of course, more easily laid than movable rods. At Abbiategrasso the semaphore arm is moved mechanically from a hydraulic press on the ground, because this was only a trial; but at Savona the ram works the semaphore directly, the water being led up the post. The cost of applying the system is no greater than the usual arrangement for small stations, and considerably less for large. The small accumulator at Abbiategrasso is pumped up by one man in two hours each day. As the points and signals are moved by the mere opening of a valve, this operation may be performed by a woman, or by the station-master himself from his office.

Up to the present time locomotives, carriages, and wagons have been made at Turin, and at the Pietrarsa and Granile Works, Naples; but it is decided in future to make only new types of locomotives and carriages, and to let the making of all the rest by public contract. While extensive works are being put up at Turin, those existing will be reconstructed, all being devoted entirely to repairs. The following are the places where the works are situated, with the number of hands employed at each:—

	Hands.
Turin	2000
Naples	1300
Milan	300
Siena	350
Rome	250
Taranto	250
	4450

This number, which will eventually be brought up to 5000 by works projected at Rivarolo near Genoa, is exclusive of the shops attached to running sheds for small repairs, and employing from thirty to fifty hands each. The Rete Mediterraneo now possesses the following stock:—Locomotives, 1200; carriages and guards' vans, 4320; wagons, 22,800.

Most railway companies employ a large staff of clerks for making up the traffic statistics; which even then are far from being kept up to date. The Mediterranean Company has been the first to adopt the Bonazzi mechanical system of statistics; and, although four months have scarcely elapsed since it was started, opinions are generally agreed in its favour. Whereas forty clerks were formerly employed in collecting the figures, only twenty at lower salaries are now engaged in ascertaining the distance run by the different classes of stock—including engines and drivers' time—and twenty-four clerks in checking the movement of nearly 23,000 wagons. The principle consists in keeping before the eyes the results of working, with particulars of service, by means of figures which, taken out of one case and posted in another, show a continual debtor and creditor account. When a goods train reaches its destination, the waybill—bearing the numbers of the wagons—is sent to the statistics' office, where a clerk takes from the "custodia"—see annexed

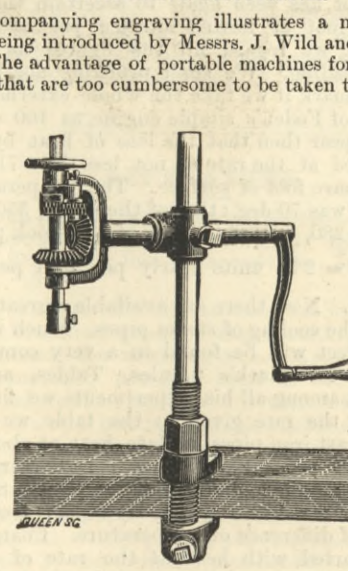


CUSTCD A.

sketch—as many "numerators as there are wagons that have left one station and arrived at another, there being a separate *custodia* for every station. These *numerators* are tickets, torn off, by the aid of perforations like those of postage stamps, from a roll of paper tape—as seen by the section A B—and are stuck upon the paper tape of the receiving case—see sketch—as it is wound up off the loose roll at the bottom, there being a case for each wagon. Various colours are used to represent the different varieties of rolling stock, and other colours for units, tens, hundreds, and thousands of miles run. The "numerators" relating to the distance run are divided into four parts, the first for the proprietors of the various lines worked by the company, the second for the company working them, the third relating to the engine-driver, and the fourth to the engine. All the numerators, which represent the kilometres run, are stuck into receivers divided according to the different speeds of the train, as express, ordinary, slow; and, at the end of every month, the distance run by each class of stock is made up for the various train speeds. The ticket nippers are improved by adding to them a receptacle for the small pieces punched out of each ticket, the colours indicating the class, while a small numbering-machine attached to one of the handles and worked by it during the action of punching, affords an additional check on the total numbers. This mechanical system of collecting and collating statistics, which is capable of constant improvement and modification so as to adapt itself to particular requirements, is applicable to a great number and variety of purposes; as, for instance, taking the men's time in a large factory, with the cost and proceeds of work. To quote the words of Cav. Ing. Bertholdo, professor of mechanics, "It is a faithful mirror which daily reproduces the whole movement of an administration, and serves as a guide to those who have to direct or modify the same."

WILD'S IMPROVED PORTABLE HAND-POWER DRILLING-MACHINE.

THE accompanying engraving illustrates a neat and handy tool now being introduced by Messrs. J. Wild and Co., of Chadderton. The advantage of portable machines for drilling holes in objects that are too cumbersome to be taken to the ordinary



machine is so great and well-known that the economy arising from their use need not be here discussed. In designing this machine care has been taken to make the parts as few and as simple in construction as possible, and at the same time strong, durable, and complete; so that when in combination they should produce a machine which would be so complete as to meet all the requirements of every-day use, and which should be so neat, handy, and useful as to readily commend itself to the minds of all practical men. Several new features have been introduced into this machine, viz.:—In addition to the differential automatic feed motion there is a hand feed, which will be found very useful for many purposes; and in order to annihilate the friction due to the thrust of the feed a roller bearing is provided between the feed nut and the bracket, so that all the work is transmitted to the drill, and is there expended in accomplishing the object in view, and not in slowly rubbing away the feed nut and bracket—as in the older types—a process which is very laborious and expensive. The spindle is of forged steel and is turned and fitted into unusually long bearings. All the wheels are of malleable cast iron. All the set screws are provided with dies, so as to prevent damage to the parts gripped. All parts are made interchangeable, so that in case any of them should wear out, the size of the machine and number of the part is all that will be required in ordering a new one.

THE INSTITUTION OF CIVIL ENGINEERS.

ACCIDENTS IN MINES.

AT the ordinary meeting on Tuesday, November 15th, the paper read was on "Accidents in Mines," Part II., by Sir F. A. Abel, C.B., F.R.S., Hon. M. Inst. C.E.

In the first part of his memoir, on the causes, &c., of accidents in mines, which was read on the 24th May last, the author, after reviewing the statistics relating to mine accidents and progressive legislation connected with mines, dealt with the subjects of accidents due to falls of coal or stone, shaft accidents, and casualties of a miscellaneous character, and with the directions in which improvements in methods of working, of appliances, and of regulations had already brought about, and might still be expected to accomplish, a reduction in the proportions borne by accidents to the total number of men employed in mines. An examination was made into the nature of fire-damp, into the condition of its existence in coal and adjoining strata, the probable sources of blowers and sudden outbursts of gas, and the means for detecting and estimating the proportion of fire-damp in the air of mines. Suggestions for dealing with fire-damp, as well as recent great improvements effected in the ventilation of mines, were discussed. It was pointed out that the existence, under normal conditions of work in extensive coal mines of a fiery character, of any but very small proportions of fire-damp in the workings and mine-ways was very exceptional, but that certain conditions, prevalent in many mines, were now recognised as constituting an important element of danger, additional or supplementary to, or possibly even independent of, the existence of fire-damp.

The second part of the memoir, read at the meeting of the 15th inst., resumed a consideration of the views which have been entertained and challenged regarding the influence of variations in atmospheric pressure upon the liability to a sudden contamination, to a dangerous extent, of the air in a coal mine by fire-damp. The careful examination of existing observations and speculations led the late Royal Commission to conclude that, while certain coincidences of fall and rise of barometer with explosions might be selected to support particular views or theories, no general connection had been satisfactorily established between colliery explosions and sudden barometric changes; and that the official issue to colliery districts of warnings of approaching changes in atmospheric conditions was to be deprecated, as tending to encourage a false sense of security, and to divert attention from other sources of danger which might be more potent. Attention was directed to the accumulation of gas, or explosive gas and air mixture, in the goaves or old working places, imperfectly filled up with *débris*, and often inaccessible to anything approaching efficient ventilation, of which extensive areas existed in many mines. The possibility of a communication being established between the gas-laden spaces in such goaves and those parts of adjacent coal seams or stone strata in which blasting was being carried on by fissures resulting from settlement of the roof or other causes was pointed out, and it was indicated that even the flame from a "blown out" shot might, in particular classes of workings, and where inflammable dust existed in abundance, extend to goaves where an explosive mixture of fire-damp and air might lurk. The importance of filling up, as completely as possible, the worked-out places or goaves in localities underground where there was any possibility of fire-damp accumulations being produced, and where they could not be effectually dealt with by the existing ventilating appliances, was therefore insisted upon.

The influence of coal dust in extending and aggravating the effects of fire-damp explosions, which was first demonstrated by Faraday and Lyell in an official report to the Home Secretary on the Haswell Colliery explosion in 1844, was next discussed. The fact that, even in the complete absence of fire-damp in the air, a sufficient coal dust deposit in the immediate vicinity of a working, or the employment of coal dust as tamping, gave rise to a considerable elongation of the flame projected by a "blown-out" powder-shot, had been abundantly demonstrated by many experimenters since that time, although the scale, and the attendant conditions, of the experiments had but in very few instances sufficiently approximated to conditions occurring in a coal mine itself to allow of deductions which could be considered to apply to the latter. Experiments made a good many years ago, by Messrs. Hall and Clark, in an adit driven into a coal seam, others by the author in some military mine galleries at Chatham fortifications, and more especially a series of experiments with various descriptions of coal dust, made upon a scale representing actual practice by the Fire-damp Commission of the Prussian Government, had, however, fully confirmed the conclusions previously arrived at regarding the important part played by coal dust in mine explosions. This was now so thoroughly recognised that precautionary measures, bearing specifically upon the dangers which might arise in carrying on blasting operations in dusty mine workings, constituted an important feature in the Mines Regulation Act passed last session. The manner in which the dangers arising from the presence of dry, very fine, and inflammable dust in mine ways and workings were increased by the presence in the air of a proportion of fire-damp, so small as to escape detection by the most skilful inspector by searching with a safety lamp, was described, and the possibility of disastrous explosions resulting from the ignition by a powder-shot of highly inflammable, dry, and exceedingly fine descriptions of dust, even in the complete absence of fire-damp, was indicated. The necessity for removing dust from the workings, supplemented by copious watering, immediately before the firing of a shot, and other practical precautions, was therefore insisted upon, if powder was to be allowed as the blasting agent in dry and dusty places. The merits of other explosive agents which had been proposed as substitutes for powder were discussed, as also the origin and development of methods extensively tried by the late Royal Commission and others for applying water, in conjunction with the explosive as a means of extinguishing flame and sparks produced in firing shots. It was shown that, while none of these could be relied upon as a safeguard when powder, or any explosive analogous to powder was employed, the water cartridge—*i.e.*, a charge of explosive surrounded on all sides by water—as originally devised and made public by the author, and the comparatively simple and even more efficient method of using water in conjunction with a porous body, such as sponge or moss, allowed of the perfectly safe employment of nitro-glycerine preparations, such as dynamite and gelatine-dynamite, and of some other "high explosives" in dusty workings; this was so, even where fire-damp was present in small proportion, or where there was a possibility of the emission of gas in considerable proportion. Proposals to employ substances as tamping, or in admixture with the charge, which would evolve vapour of water, or non-combustible gases, when exposed to heat, were viewed unfavourably, inasmuch as the almost instantaneous duration of exposure to heat of such materials, when the shot was fired, would be insufficient to accomplish the desired generation of non-combustible vapours or gases to an extent calculated to exert any important extinguishing effect. The practical experience gained in the employment of compressed lime and water, according to the plan devised by Messrs. Smith and Moore, had demonstrated that this method of getting coal, which was absolutely safe in its nature, admitted of decidedly advantageous application in some varieties of coal, though it could by no means be generally substituted for explosive agents. Improvements, in point of safety, in methods of firing shots were pointed out, and stress was laid upon the advantages which would in many localities be secured by the application of electricity to the firing of shots.

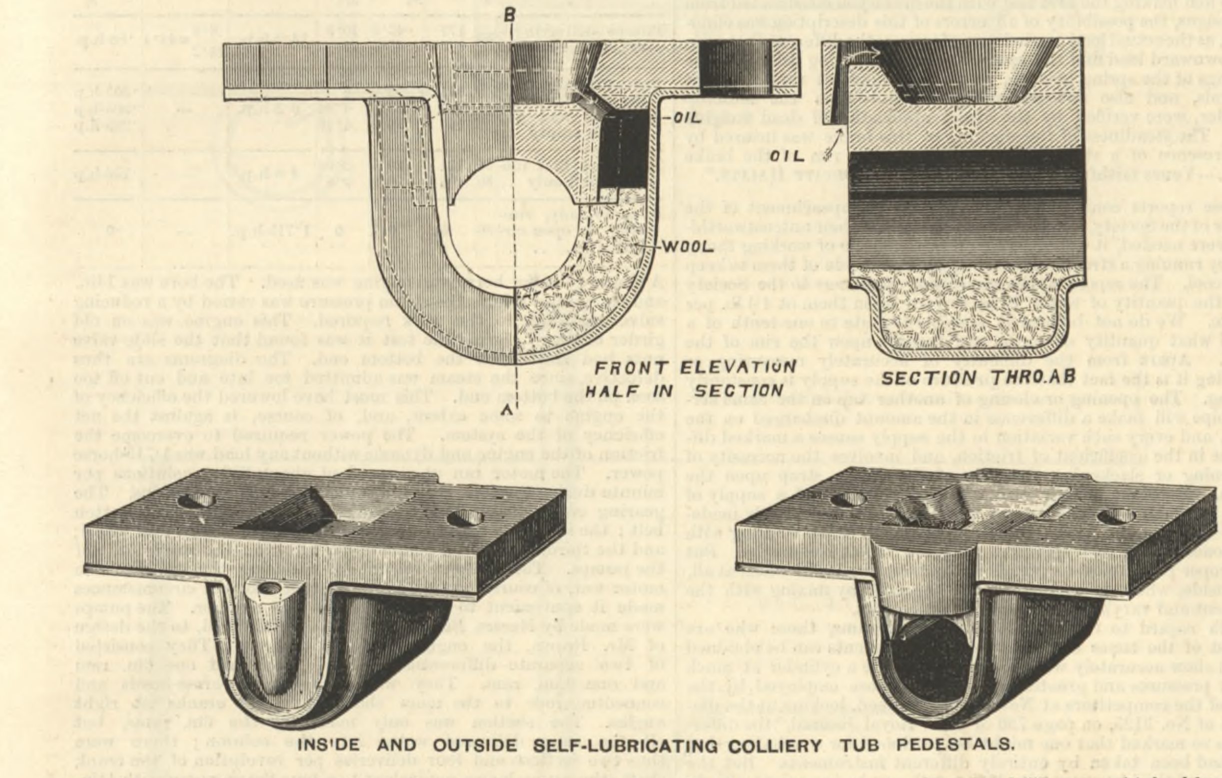
The author next devoted much attention to the subject of safety lamps; the elaborate systematic experiments carried out by the late Royal Commission with upwards of 250 lamps were discussed, and the results of similar experimental investigations by associations of mining engineers and others were referred to. Much stress was laid upon the unsafe nature of the Davy, Clanny, and Stephenson lamps, in their original forms, under the present conditions in regard to the air-currents met with in mines, as pointed out by observers previous to the experiments of the Commissioners, and as officially recorded by the latter in 1880. It was pointed out that simple modifications of these, applicable to existing lamps, rendered them comparatively very safe, so that the exclusion of the ordinary or "unprotected" forms of those lamps by the Act recently passed need not have entailed any serious hardship or inconvenience. The Commissioners had specified several lamps as combining safety in a high degree with comparative simplicity and efficiency in light-giving power, and further important improvements in safety lamps had been made since the final report of the Commission was completed. Information in regard to improvements in the locking of lamps and in the illuminating agents to be used in lamps was given, and the great importance of providing, at all mines where safety lamps had to be used, efficient means for testing these in gas, before they were issued for use, was insisted upon.

An account was given of the great progress which had been made, within the last two years, towards providing the miner with a thoroughly portable, self-contained, electric lamp, capable of furnishing a light equal to that of the best safety lamps, during the entire period of a working shift. The results obtained with secondary-battery lamps devised by Mr. Swan and Mr. Pitkin, and with the primary-battery lamps of Schanschieff, Coad, Blumberg, and others, were described. Extensive trials of the Swan lamps, as manufactured by the Edison-Swan Company, had already established their efficiency underground, and primary-battery lamps, of the Schanschieff type, and, perhaps, of others, seemed likely to enter into a serious competition with them, in regard to size, weight, illuminating power, and cost. The latter item appeared at present the most serious obstacle to the extensive use of electric lamps by the miner. Electric-light installations, for illuminating the pit-bottom, the main haulage roads to some distance, and the screens, sidings, offices, &c., on the surface, had already been adopted at some extensive collieries with beneficial results, and a very important future was opening up for the applications of electric lighting in connection with coal mines.

The author referred, in conclusion, to illustrations of the important extent to which the labours of the late Royal Commissioners and of others had been applied to the future benefit of the miners in the Coal Mines Regulation Act of 1887.

SELF-LUBRICATING PEDESTALS FOR COLLIERY TUBS.

THE Hardy Patent Pick Company is introducing a pedestal for pit tubs, which appears to overcome the difficulty of self-lubricating and protecting the bearings, a want greatly felt in mines, especially dusty coal mines.



INSIDE AND OUTSIDE SELF-LUBRICATING COLLIERY TUB PEDESTALS.

The oil or lubricant applied each time by the old method would be sufficient thoroughly to lubricate the tub for many days if protected from dirt, and the bearing could get it as required. And this is precisely what is effected by the pedestal in question. The top, or part which bears the load, is similar in construction to those generally in use, and made to fit into a steel dish, which takes the place of, and answers the same purpose, as the ordinary strap, which passes underneath the bearing to prevent the wheel and axle getting out of place. This dish is stamped in sheet steel, and entirely envelopes and protects the bearing from dirt. The dish part also holds some wool or felt, which is saturated with oil, and bears against the under side of the axle, thus keeping the axle always lubricated, and acting as a reservoir to hold the lubricant and give it up as required. The wool or felt also forms an excellent packing to keep out all dust or dirt. The result of this arrangement is that the tubs will run from two to three months with once oiling, and be perfectly lubricated, the quantity of oil to charge, in the first place, each pedestal being about five ounces, and afterwards about two.

There are now, we are told, some thousands in daily use, and each order has been given after a trial of a small number. The dish before mentioned is stamped sheet steel and remarkably light, strong and cheap, and admirably adapted for its purpose. There is also an ingenious arrangement for re-oiling the pedestals, when they require it, by turning the tub upside down in a lifter; a hole is to be seen for the introduction of the oil, and when the chamber into which this hole leads is full of oil, the tub may be returned on to its wheels and the oil cannot escape, excepting into the wool or felt. When outside bearings are used the oil can be put in at any time, as the tub stands on its wheels, and the arrangement of the pedestal is such that the whole of the bearing is perfectly protected from dust and dirt.

LETTERS TO THE EDITOR.

(*Continued from page 449.*)

TIDAL ESTUARIES AND THE BAR OF THE MERSEY.

SIR,—With reference to an article in your issue of November 11th on "Tidal Estuaries and the Bar of the Mersey," permit me to state that Mr. Wheeler under-estimates the effect of the scour on the bar of the river Tees. The depth on the bar has been increased from 3ft. 6in. to 19ft., which has been effected entirely by scour, as, with the exception of a very small portion half a mile from the bar, no dredging has been done within a distance of two miles from it.

Referring to a letter in your issue of October 28th by "Engineer," on the Ribble scheme, the training walls on the Tees, although laid down to the bar, were not found necessary beyond the fifth buoy mooring pool, which is a mile and a-half distant from it. C. P. J.

Stockton-on-Tees, November 29th.

THE CALORIFIC VALUE OF COAL

SIR,—The discussion which you have raised upon the calorific value of coal has already given rise to some very interesting correspondence. On some of the points connected with this question, and in the hope of eliciting further views on this subject, I venture to place the following ideas before you.

Permit me therefore to draw your attention to a series of experiments made by Messrs. Scheurer-Kestner and Meunier on the calorific value of a number of samples of coal, with an improved form of the calorimeter used by Favre and Silberman. The results, which are accessible to English readers in the volume for "Fuel," by Dr. Percy, show an extraordinary discrepancy between the values obtained experimentally and those obtained from calculations based upon chemical analysis. The former are in every instance greatly in excess of the latter.

For the convenience of those who have not the above work by them, I append the following summary of the results obtained:—

	Calorific valve. Calculated. Calories.	Calorific valve. Observed. Calories.	Per cent. of composition exclusive of water and mineral matter. C	H	O + N
1	5782	6991	66·31	4·85	28·84
2	6533	7363	70·57	5·44	23·99
3	7056	8215	76·87	4·68	18·45
4	7871	8724	83·82	4 60	11·58
5	8384	9622	88·48	4·41	7·11
6	8585	9293	90·79	4·24	4·97
7	8553	9456	92·36	3·66	3 98

Now it may be fairly assumed that the experiments were carried out with every care, and that neither in those of Favre and Silberman on the heat of combustion of carbon, nor in those of Scheurer-Kestner and Meunier did the experimental errors amount to more than 2 or 3 per cent. Whence then are we to seek for an explanation of the fact that the values based on calculations made with the thermal equivalent of each constituent in the coal are from 10 to 15 per cent. less than those obtained by actual experiment.

First let us see what valnes Favre and Silberman obtained for the different allotropic forms of pure carbon.

Wood charcoal	8080
Gas retort carbon	8047
Native graphite	7792
Artificial graphite	7762
Diamond	7770

Further, Favre and Silberman found that carbon burnt to form CO gave out only 2418 heat units, whilst completely burnt to CO_2 8080 heat units were developed, that is, the addition of a second oxygen atom to CO results in the development of more than twice the amount of heat generated by the union of a single atom of carbon with a single atom of oxygen.

In the case of several metals capable of forming a higher and a lower oxide the same experimenters found that the amount of heat developed in the formation of the higher oxide was approximately double that developed in the conversion of the lower oxide into the higher. Thus:—

Tin. forming SnO_2 developed 1147 units.
SnO forming SnO_2 developed 519 units.
Cu forming CuO developed 603 units.
Cu_2O forming CuO developed 256 units.

Now, why does not carbon follow the same law? Because, whilst the oxides of the metals are solids, those of carbon are gases, and the small amount of heat evolved in the formation of CO compared with that evolved when CO_2 is formed, is probably due to the fact that a large amount of energy is absorbed in the gasification of the carbon when CO is produced whilst no absorption takes place when CO is burnt to CO_2; the difference in calorific value of the various allotropic forms of carbon is then probably due to the fact that the amount of energy required to convert each modification to gaseous carbon is different. If this is so, can we not explain the difference between the calculated and observed values obtained by Messrs. Scheurer-Kestner and Meunier by the assumption that the carbon in coal is still more easily converted into CO than any of the pure forms of carbon on which experiments have been made? A comparison of a sufficiently large number of determinations of the calorific value of different kinds of coal might lead to a new heat equivalent for the carbon in coal which would enable chemical analysis to afford an accurate basis on which to determine the heat equivalent of samples of coal.

Before concluding I might suggest that if the calorific value of pure carbon is to be re-determined, an attempt should be made to do it electrically by measuring the consumption of carbon in a battery and the amount of electric energy developed. The battery to which I allude is one in which amorphous charcoal, steeped in sulphuric acid and placed in a porous jar, forms the positive elements, a platinum plate the negative pole, and a mixture of sulphuric acid and potassium chlorate the oxidising agent. No doubt the experiment is a difficult one on account of the explosive nature of the compounds formed, but the results would be a valuable check on the values obtained by direct combustion.

ALFRED CHATTERTON.

10, Viceroy-road, South Lambeth, November 23rd.

SIR,—If Mr. Donkin's valuable suggestions were acted upon by coal users, they would be able to find out whether they were obtaining from the coal they used the work they had a right to expect. Perhaps Mr. Donkin will be interested to know that a paper is published in the British Association Proceedings for 1886 on "Calorimetry of Fuel," by Mr. B. W. Thwaite, C.E., and in this paper mention is made of several forms of calorimeters. It would be interesting to know where an illustrated description of the best calorimeters could be found. PRACTICAL.

Oakwood Lodge, Roundhay, near Leeds, November 20th.

R.A.S.E. STEAM ENGINE TRIALS.

SIR,—With your permission we will make some observations on the trials of steam engines carried out by the R.A.S.E. at their Show held in Newcastle in July last.

Lest we should be misunderstood, we beg to state that at the outset that we do not call in question the decisions of the judges, which we believe to have been made in good faith by honourable men. Neither do we underrate the importance of properly conducted and exhaustive trials, for which, on the contrary, we have agitated for eight or nine years, and which we think are of the greatest value. Nor do we mean this letter as the expression of vexation or disappointment at our own want of success in the late competition. We are moved to write by a sense of public duty to call attention to certain grave errors in the conduct of those trials, which those responsible for them have either overlooked altogether, or have disregarded on the supposition that they were so trivial that they could not in any sensible degree affect the accuracy of the results. It appears to us, however, that the errors in the instruments used, and the mode of testing adopted by the Society, are such that it is impossible to obtain accurate conclusions, and we venture to state that the published results of the Newcastle trials as to brake-power developed and relative consumption of fuel are entirely misleading and untrustworthy.

In order that such trials should possess any scientific or commercial value, it is of the first importance that they should be made with the greatest possible accuracy; that nothing should be taken for granted which can be proved, or anything estimated which can be measured; and when a respectable and influential body like the Royal Agricultural Society of England comes forward and offers important prizes for engines, the competitors are entitled to anticipate that the best available testing and recording appliances will be used to gauge the performances of their engines.

At Newcastle, however, one of the most important instruments for watching and recording automatically the behaviour of steam engines was conspicuous by its absence, and several of those instruments which were used by the Society were not only antiquated, but inaccurate.

With respect to the instrument which was not used—we refer, of course, to the Moscrop recorder, of which there are at present some thousands at work—it, as you are aware, consists of a powerful clock, which at once shows the accurate time and gives a regular motion to a broad paper band. Upon this band is automatically recorded a line showing the rise and fall of the steam pressure, and a second line showing graphically the slightest variation in the speed of the engine. It can also be fitted with a device to show any variation of the load or the unsteadiness of the working of the brake. By its means the exact moment of starting or stopping the engine, the slightest increase or decrease of speed, the rise or fall of the steam pressure, and every variation of the pull on the brake, are noted down in black on white, so that they can be read off fifty years hence if required. Surely such an instrument is necessary when scientific accuracy is aimed at.

With respect to the instruments actually used at Newcastle, we propose to prove that the most important of them, by which we mean the friction brakes, were inaccurate and untrustworthy, and that the mode of working them was calculated to aggravate the error. The indicator diagrams also bear evidence on their face of error and inaccuracy, to which we shall refer later on.

The brakes of the R.A.S.E., in the course of their long career, have been the objects of considerable suspicion and criticism. Eleven years ago, the late Mr. Rich described them in a paper he read before the Institution of Mechanical Engineers at Birmingham. In the discussion which followed several speakers pointed out what they considered defects in their construction affecting the accuracy of the results obtained from them. Last year, and before the same Institution, Professor Kennedy publicly called the attention of the R.A.S.E. to what he described as a very measurable error in the construction of their brakes, and expressed a hope that they would look into the matter, and make the necessary alterations before making any new trials of engines. Several years ago a letter appeared in one of your contemporaries from Mr. Schönheyder pointing out the same error, and suggesting certain formulæ for estimating it. So lately as the spring of the present year the question of brakes cropped up at the Institution of Civil Engineers, when more than one speaker referred to the same weak point in the construction of the Society's brake; but only Professor Kennedy and Mr. Schönheyder seem to have realised anything like its real importance.

For our own part, we were too much absorbed in designing and constructing our engines for the competition at Newcastle to give either time or attention to the accuracy or otherwise of our own brake, which is constructed on the same principle as those of the R.A.S.E. We were, however, sufficiently impressed with the important bearing which any difference in the brakes might have in a trial to suggest that at Newcastle our engines should be run on the same brake as those of Messrs. Davey, Paxman, and Co. This, we were informed, was impracticable, so we had to be content with the assurance that the accuracy and trustworthiness of the brakes were beyond question. We were convinced, by our observation and experience at Newcastle, that this was not so, and after the trials we commenced to investigate the matter for ourselves.

Following up the clue suggested by Professor Kennedy and Mr. Schönheyder, we ascertained that the error pointed out by them might be a very serious matter indeed, and that at its best it was sufficient in an accurate trial to make all the difference between winning and losing. Impressed by the serious nature of these revelations and their important bearing upon the published results, not only of the Newcastle trials, but of those held on former occasions, we considered it advisable to have our conclusions checked by some independent scientific authorities. We therefore secured the co-operation of Mr. Druitt Halpin and Professor Barr, of the Yorkshire College, Leeds. These gentlemen experimented with the compound engine which we showed in competition at Newcastle. (1) With a brake on Mr. Halpin's plan, in which the heat generated by the friction of the brake blocks is absorbed by water carried round in the rim of the brake wheel without coming in contact or interfering with the uniform lubrication of the blocks, and in which no compensating levers were employed; and (2) with a brake on the same principle as those of the R.A.S.E., but fitted with an arrangement for recording on the Moscrop slip the variations and extent of the forces composing the error.

The report of these gentlemen describes fully the manner in which their trials were conducted and the results obtained, so with your permission we will give it in full. It is as follows:—

"9, Victoria-chambers, Westminster, London, S.W.,
September 30th, 1887.

"Messrs. J. and H. M'Laren, Midland Engine Works, Leeds.

"Dear Sirs,—In accordance with your request we have made two tests of your compound portable engine, No. 291, in order to determine its consumption of fuel and water, and to ascertain its regularity of working.

"So far as we could learn, the engine was in all respects identical with your ordinary engines of the same type, with the exception that the fire-box sides and cylinder ends were lagged, and that it was provided with a feed heater. It will thus be obvious that the engine was not in any way what is technically known as 'a racer.' The engine was of the compound intermediate receiver class, having the cranks at right angles, and the valves outside. The distribution of the steam in the small cylinder was effected by means of a distribution valve worked by a fixed excentric carrying an expansion valve on its back, actuated by a shifting excentric, controlled directly by a Hartnell-Turner governor, while the steam in the large cylinder was admitted and released by a plain slide valve with a fixed stroke. The cylinders were 5¾in. and 9in. diameter by 15in. stroke, and were bolted directly to the top of the fire-box casing, both being surrounded by the steam passing from the boiler to the high-pressure valve chest. The boiler was fed by an ordinary feed pump, with a bye-pass delivering the excess of feed-water back into the feed tub.

"In order to make the test as accurate as possible a Moscrop recorder was attached to the engine, from which automatic diagrams were obtained, showing the variations of the steam pressure during the trials, the variations in speed, and the tensions on the brake spring balances, the arrangements of which we will now describe.

"During the first test a brake was used having a trough-shaped rim, into which water flowed continuously and uniformly at a rate of about 14 lb. per minute, and from which the water was led off by means of a fixed pipe so placed as to catch the water being carried round. By this means it was possible to control the temperature of the rim of the brake, the greater part of the heat produced by the friction being carried off in the water. The outside of the brake was lubricated with oil, all water being completely prevented from having access to it. The bands carrying the blocks on this brake were at one end led vertically downwards and carried the load, and at the other end led vertically upwards, and attached to a spring balance, the bands and brake blocks making one complete turn round the wheel. It will thus be evident that the load actually carried was the difference between the downward dead weight and the upward pull of the spring balance. The variations of the latter, as before stated, were autographically registered on the moving paper of the Moscrop recorder, besides being read off every few minutes.

"During the second test a brake of the type adopted by the Royal Agricultural Society of England was made use of, fitted with the Appold compensating levers; the inner ends of these levers were attached by means of a yoke to two spring balances placed side by side, one balance of sufficient strength not being at hand.

"As in the former case, the pull of these balances was recorded on the Moscrop recorder paper, and also read off at very frequent intervals. This brake was lubricated by means of a stream of water running on to the outside of the rim of the brake wheel.

"The spring balances used in the two trials were tested by loading them with dead weights.

"The engine trials were carried out as follows:—

"Steam was first got up in the ordinary way, and the engine was run for a short time so that the cylinders might become thoroughly warm, the fire was then drawn and relighted with a certain amount of weighed wood and a weighed amount of coal—Powells Duffryn—which was hand picked, the whole of the coal taken for the trial being burnt, and no smudge or inferior pieces being returned and credited back. A water tank, capable of containing 80 lb. of water, and provided with a glass gauge tube, was filled with weighed quantities of water, and the gauge glass graduated accordingly. The water supplied to the feed tub during the test was taken from this tank. The water condensed in the feed heater was not so returned to the feed tub, but thrown to waste after being weighed. The same scales were used for all weighings.

"The levels of the water in the boiler at the beginning and end of each test were marked on the gauge glass, at the same steam pressure, and the value of the difference was ascertained by filling up the boiler with weighed amounts of water.

"A fixed Harding counter actuated from the indicator gear lever was used. The counter readings were noted at the beginning and end of the tests, and the speed per minute was ascertained when the diagrams were taken by means of a hand counter and stop watch.

"Indicator diagrams were taken at intervals of about twenty minutes from each end of each cylinder by four Crosby indicators, screwed directly on to its cylinders without the intervention of any bands or pipes.

"The readings of the indicators were checked by Professor Barr under steam pressure against the readings of a very open sealed gauge, which had been previously tested against an open mercury column by Mr. Halpin.

"The mean effective pressures were obtained from the indicator diagrams by aid of a planimeter. These were plotted as ordinates from a line representing the duration of the test, and curves were thus obtained from which the average mean effective pressure for each end of each cylinder was deduced by aid of a planimeter.

"The mean pull of the brake spring balance was similarly obtained for each test from the readings noted and the record on the Moscrop paper.

"The following are the results we obtained from the trials on the two days:—

	1887. Sept. 13th.	Sept. 14th.
Mean temp. of air in shed	55·4° F.	63·8° F.
,, ,, entering ashpan	56·4° F.	—
,, ,, in smoke-box	434·2° F.	408·6° F.
Temperature of water entering feed tank	57·0° F.	57·0° F.
Mean temp. of water in feed tub	65·3° F.	64·4° F.
Temperature of feed entering boiler (one reading)	203° F.	—
Mean steam pressure, about	140 lb.	142 lb.
Grate area	2 sq. ft.	2·5 sq. ft.
Radius of load on brake	32·19in.	33·38in.
Load on brake	427 lb.	381 lb.
Radius of pull of spring	32·19in.	14·62in.
Mean pull of spring	156 lb.	313 lb.
Amount of wood used in relighting fire	14 lb.	14 lb.
Amount of coal consumed	160 lb.	160 lb.
Amount of water consumed	1673 lb.	1640 lb.
Engine started for the trial	9.58 a.m	7.21 p.m
Engine stopped	1.43 p.m	11.15 p.m
Running time	3h. 45m.	3h. 54m.
Total number of revolutions during trial	32,780	34,742
Mean number of revolutions per min.	145·7	148·5
Average M.E.P. high-pres. cyl. front, lbs. per sq. in.	44·0	48·0
,, ,, ,, back, ,,	41·3	33·4
,, low-pres. ,, front,	16·4	15·0
,, ,, ,, back,	17 4	15·0
Indicated horse-power	23·7	22·2
Brake horse-power	20·2	19·1
Mechanical efficiency of the engine	·85	·86
Coal used per indicated horse-power per hour	1 80	1·85 lb.
Coal used per brake horse-power per hour	2·11 lb.	2·14 lb.
Water used per indicated horse-power per hour	18·8	18·9
Water used per brake horse-power per hour	22·1	22·0

"The engine had the following dimensions:—High-pressure cylinder, 5·78in. diameter; piston-rod, 1⅜in. diameter; area of back face of piston, 26·2 square inches; net area of front face, 24·8 square inches; low-pressure cylinder, 9·00in. diameter; piston-rod, 1⅜in. diameter; area of back face of piston, 63·6 square inches; net area of front face, 62·1 square inches; stroke, 15in.

"We are, dear Sirs, yours faithfully

"Daniel Halpin.
"Archibald Barr.

This report, as you will see, does not draw special attention to the errors produced by neglecting the forces acting at the inner ends of the compensating levers. Therefore Mr. Halpin, at our request, made a supplementary report, which we also give without comment, as it speaks for itself:—

"9, Victoria-chambers, Westminster, London, S.W.
"22nd November, 1887.

"Messrs. J. and H. McLaren, Midland Engine Works, Leeds.

"Dear Sirs,—In answer to your letter of the 18th instant referring to the two trials Professor Barr and myself made of your compound portable engine, with two different brakes, on the 13th and 14th of September, of which we reported to you on the 30th of September, I would say the special object of the second test was to determine by actual experiment the error in the results shown by the Appold brake as used by the Royal Agricultural Society.

"The object of a friction brake is, of course, to absorb mechanical power by friction, and it is obvious that in order to obtain reliable results one must be able positively to measure the whole of the forces acting on the brake strap from without.

"In order to make this perfectly clear by an absurd assumption, let it be assumed that instead of carrying, as is usual, a known load, the brake strap was rigidly chained down to the ground. Under these circumstances, it is obvious that it would be absolutely impossible to calculate the amount of work absorbed by the brake.

"It has repeatedly been pointed out publicly, notably by Professor Kennedy in the discussion at the summer meeting of the Institution of Mechanical Engineers in 1886, that an error in determining the brake-power must arise from the practice of making the inner ends of the compensating levers fixed points, and not being in a position to measure the forces passing through them. The magnitude of these forces was very clearly shown during our second trial, when their average amount was 313 lb. The result of this was that this force, acting through the radius of the inner end of the compensating levers from the centre of the brake shaft, produced an equivalent of 10·85-horse power. Had the horse-power been calculated in the ordinary way, taking account of the suspended weight alone by multiplying the suspended load by the brake radius, it would have been 29·95-horse power, a perfectly absurd quantity, seeing that the total mean indicated horse-power of the engine was 22·2-horse power.

"If the horse-power due to the reaction of the inner ends of the compensating levers, viz., 10·85-horse power, be subtracted from 29·95-horse power, the correct horse-power of 19·10 is the result; this 19·10 brake horse-power against 22·2 indicated horse-power, giving a very fair efficiency of 86 per cent. It will also be seen that this 10·85-horse power is as much as 56·8 per cent. of the true horse-power, viz., 19·10, an error which is well worth considering in accurate engine tests.

"We found experimentally during the second test that the reaction on the inner ends of the compensating levers very largely depended on the amount of water run on the outside of the brake wheel, this pull being clearly and autographically shown on the diagram traced by the Moscrop recorder during the trial.

"When making the first test with the brake you constructed from my designs, the possibility of all errors of this description was eliminated, as the actual load carried was, of course, the difference between the downward load and the upward pull of the spring balance. The readings of the spring balance, which were taken at very frequent intervals, and also autographically registered on the Moscrop recorder, were verified by the direct application of dead weights to it. The steadiness of the working of this brake was insured by the presence of a stream of water inside the rim of the brake wheel.—Yours faithfully, "Druitt Halpin."

These reports constitute a most effective impeachment of the brakes of the Society, and if further evidence of their untrustworthiness were needed, it would be found in the mode of working them, viz., by running a stream of water upon the outside of them to keep them cool. The report of the consulting engineers to the Society gives the quantity of water thus thrown upon them at 4·4 lb. per minute. We do not believe it possible to state to one-tenth of a pound what quantity of water was thrown upon the rim of the brake. Apart from the difficulty of accurately measuring or weighing it is the fact that the pressure of the supply is constantly varying. The opening or closing of another tap on the same service pipe will make a difference in the amount discharged on the brake, and every such variation in the supply causes a marked difference in the coefficient of friction, and involves the necessity of tightening or slackening the grip of the brake strap upon the blocks. Moreover, in our own experience we found a supply of 4·4 lb. of water—as nearly as we could measure it—entirely inadequate to keep the brake wheel cool enough when working with such loads and at such speeds as were the rule at Newcastle. But the proper place for the water is not outside the brake wheel at all, but inside, where it cannot do any mischief by mixing with the lubricant and varying the coefficient of friction.

With regard to the indicators and diagrams, those who are abreast of the times know that such instruments can be obtained as will show accurately what is going on inside a cylinder at much higher pressures and greater speeds than those employed by the most of the competitors at Newcastle. Indeed, looking at the diagrams of No. 3125, on page 736 of the "Royal Journal," the difference is so marked that one might be pardoned for concluding that they had been taken by entirely different instruments. But the question of the instrument itself is not the only important one in this connection. We hold that it is entirely wrong to make a comparison between brake and indicated horse-power, unless the diagrams for the purpose are taken at frequent intervals during the whole test, along with the brake observations. In no single case was this done at Newcastle. In one case the diagrams were not even taken on the same day as the official run on the brake! On this account we maintain that the comparisons made between the B.H.P. and I.H.P. are worthless; and in this we consider we are confirmed by the report of the consulting engineers themselves, who in one case find a brake ratio of ·943, a result which is absurd in the face of the diagrams on which it is based.

In the report of the consulting engineers a very suggestive omission occurs, in connection with the statistics of the weight of steam used per B.H.P. and per I.H.P., and the coal consumed per I.H.P. These particulars have been given in previous reports, and those who care to work them out for themselves, as we have done, will find the matter still more complicated, and the absurdity of the situation more marked. In the report a good deal of space is devoted to the construction of a diagram purporting to describe graphically the cooling of the engine. This curve, we may state, would have been given autographically, and with absolute accuracy, by the Moscrop recorder.

We also note in connection with the report a balance-sheet of the engine No. 3125, in which the whole of the heat expended purports to be accounted for, except about 3¾ per cent. But a fundamental error is apparent here, inasmuch as the working pressure is given throughout as 95 lb. on the square inch whereas it was actually 105 lb., as stated correctly in Mr. Pidgeon's report, an error of 10 lb. in the pressure, involving a corresponding error in the temperature, which is manifestly a serious discrepancy not without its influence on the totals given.

The Royal Agricultural Society, in their offer of prizes, intimated that the brake trials were designed to elucidate merit under the following heads, viz.:—"Construction: Efficiency, *i.e.*, proportion of actual work done to work indicated, economy of fuel, of steam, of lubricant, perfection of combustion, price." But apparently at Newcastle the sole test of merit was coal economy per brake horse-power. In no case was complication of mechanism or inaccessibility of parts considered a drawback, or simplicity of construction, with consequent saving of first cost, considered an advantage. Even the reports of the judges and the consulting engineers of the Society partake more of the nature of a scientific treatise on the theory of heat in relation to the steam engine than an account of the trials by which a farmer could be guided in his choice of a steam engine which would combine the three essentials which a purchaser desires, viz., economy of first cost and of subsequent fuel, and wear, and tear, simplicity of construction and consequent ease of management, and facility of repairs and durability.

Even in the matter of coal, by-the-bye, at least one competitor at the Newcastle trials had an advantage in being allowed to weigh back his smudge, a piece of luck which was not participated in by any of the other competitors, so far as we are aware.

But as mere economy of coal is not the only point of merit in any engine—least of all in one for farm purposes—we contend that the late trials of the R.A.S.E. have failed of their purpose, even if the results which they profess to establish were trustworthy. As the business stands at present, the Society owe it to themselves and the public to take the matter up and prosecute it to the only possible conclusion, viz., to discard the present discredited brakes, and by means of new trials at the earliest possible date and with the most approved scientific testing apparatus, investigate the matter afresh. In conclusion, we may add that as a matter of courtesy we offered to lay the results of our observations before the consulting engineer to the Society before making them public. As he did not feel at liberty to look into the matter without instructions from the R.A.S.E., we decided to send them to the press at once.

Midland Engine Works, J. and H. McLaren.
Leeds, November 30th.

PUMPING BY ELECTRICITY IN COAL MINES.

The following account of an electrical pumping plant erected for Messrs. Locke and Co., at the St. John's Colliery, Normanton, will be, no doubt, of interest to the mining world. It is, as far as the writer knows, the largest pumping plant run by electricity. This electrical plant was built by Messrs. Immisch and Co., Kentish Town, London, and erected under their superintendence; the steam power, the pumps and piping, being supplied by the colliery owners. The particulars and a test of the plant are appended, and will serve to show, that even with ordinary steam engines, and pumps not specially designed for use with electrical plant, the commercial return of useful work is very high. Indeed, the efficiency of electrical plant is as much as 66 per cent. in favourable cases. And, since the efficiency falls off very slowly with the increase of distance through which the power has to be transmitted, this method of driving pumps will, no doubt, find many applications where circumstances are favourable.

Pumping Plant at St. John's Colliery, Normanton.
Pumps delivering 39 gallons per minute through a head of 530ft. = 6 3-h.p. in the water.

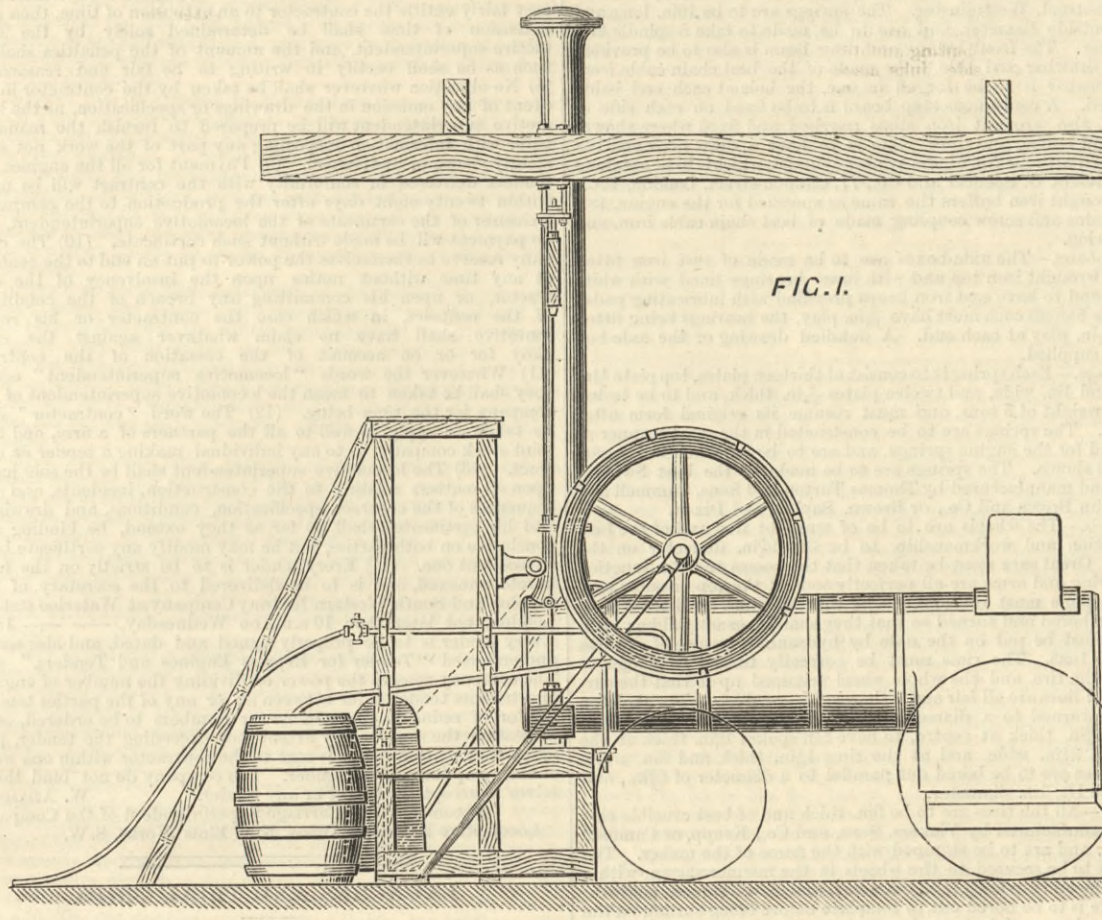
Work done.	Speed of engine.	Volts on dynamo.	Average amps. given out by dynamo.	E.H.P given out by dynamo.	Work done in cylinder of engine.	Efficiency per cent.	Loss in cables res. 29 ohms. 800 yards. 19/16
Pumps delivering 39 gals. per minute	86	171 173·5	47·5 47·5	10·9 11	14·2-h.p.	$\frac{6·3}{14·2}$ = 44·4	·88-h.p.
Pumps running with the suction clack lids off and the column empty ..	86	134 128 127	28 28 26	5 4·82 4·45	6·3-h.p.	—	·305-h.p ·305-h.p ·265-h.p
Motor and first motion shaft only ..	88 86	111 105	20 20	2·96 2·8	4·8-h.p.	—	·156-h.p
Dynamo only, running on open circuit	86	0	0	0	1·715-h.p.	—	0

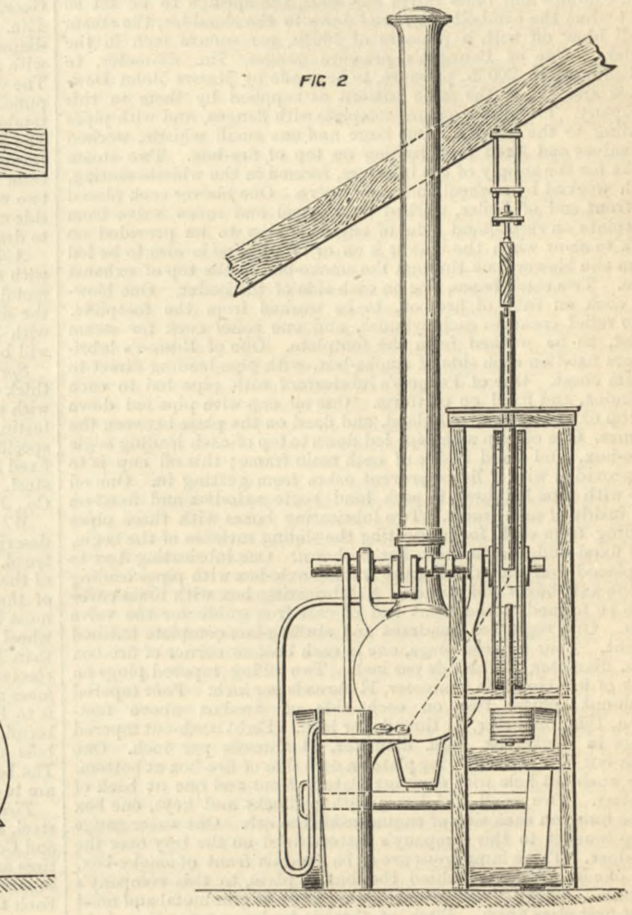
A single-cylinder horizontal engine was used. The bore was 14in. and the stroke 15in. The steam pressure was varied by a reducing valve according to the work required. This engine was an old girder engine. During the test it was found that the slide valve nuts had shifted on the bottom end. The diagrams are thus defective, since the steam was admitted too late and cut off too soon on the bottom end. This must have lowered the efficiency of the engine to some extent, and, of course, is against the net efficiency of the system. The power required to overcome the friction of the engine and dynamo without any load was 1·715-horse power. The motor ran at a speed of about 650 revolutions per minute during the test, the pumps making eight revolutions. The gearing consisted of three transmissions. The first a 10in. cotton belt; the second, a mortised pinion gearing into a cast iron wheel; and the third, a cast iron pinion and a wheel on the crank shaft of the pumps. This complex system for reducing the speed of the motor was, of course, not originally designed so, but circumstances made it convenient to use gearing in this manner. The pumps were made by Messrs. Bradley and Co., of Wakefield, to the design of Mr. Brown, the engineer at the colliery. They consisted of two separate differential pumps. Each had one 6in. ram and one 4½in. ram. They were coupled by cross-heads and connecting-rods to the main shafts with the cranks at right angles. The suction was only made by the 6in. rams, but all the rams delivered water into the column; there were thus two suctions and four deliveries per revolution of the crank shaft, the pump being equivalent to a four-throw pump with 4½in. rams. The division of the work done by the large rams was not by any means equal. Though to casual inspection the work done throughout a revolution was constant, an ammeter in circuit with the motor showed considerable fluctuations of current at regular periods. The difference of load thus experienced was as much as 25 per cent. and caused at first some trouble by heating the armature and pole-pieces, if the average current exceeded 50 ampères. This difficulty, however, was successfully overcome. The same plant was tested under different circumstances about three weeks before these tests were made, and the conversion was then 42 per cent. with a delivery of about 42 gallons per minute through 850 ft. The rise of efficiency to 44·4 per cent. is probably due to the friction of the bearing surfaces being lessened by wear and by the shortened length of piping, but more so by the introduction of the belt transmission which protected the motor from the vibration which is inseparable from high-pressure pumping plant. These figures have been supplied by Messrs. Immisch and Co., who inform us that they have in hand for the same firm another dynamo and motor to deliver 120 gallons per minute through a head of 900ft.

Bristol University College Engineering Society.—On Tuesday, the inaugural address was delivered to this Society by its president, Professor Ryan, M.A., D.Sc. The first paper was read by Mr. Fonsica, of Rio Janeiro, on "The Early Forms of Stamping Machinery Used in Brazil." The second, by Mr. Littleton, on "Submarine Torpedo Boats."

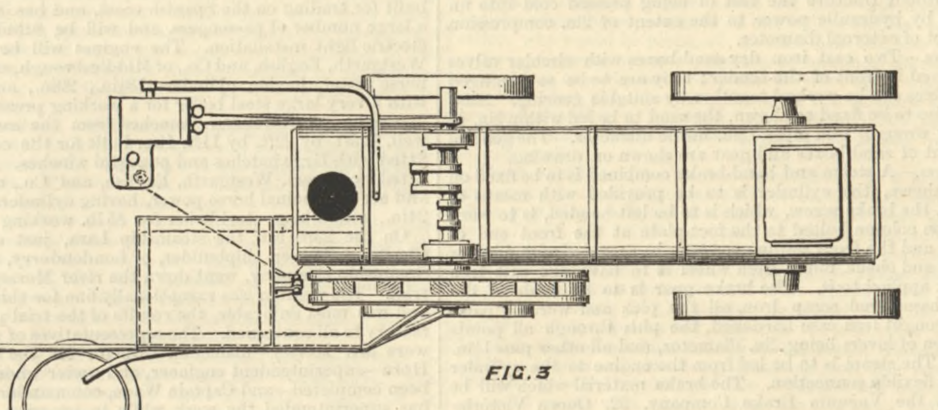
TESTING APPARATUS, MESSRS. McLAREN'S ENGINE TRIALS.

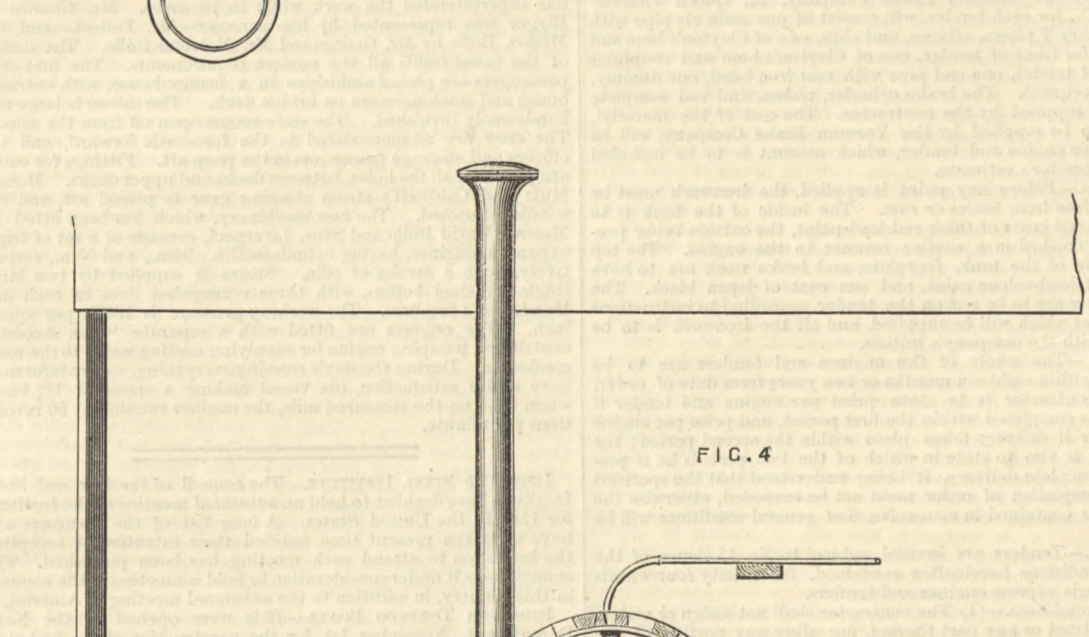
(*For description see page 460.*)

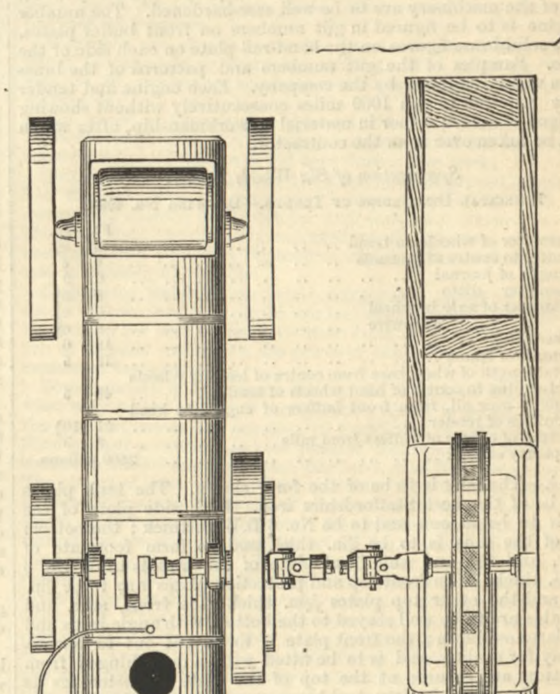




Figs. 1, 2, & 3.—ELEVATIONS AND PLAN OF APPARATUS WITH MESSRS. McLAREN'S BRAKE.







Figs. 4 & 5.—APPARATUS WITH R.A.S.E. FORM OF BRAKE.

LONDON AND SOUTH-WESTERN RAILWAY LOCOMOTIVE.

(*Concluded from page* 432.)

General mountings.—Each engine is to be supplied with the following:—One Ramsbottom's patent duplex safety valve with cast iron columns and brass valves and seats, the springs to be set so that when the eye-bolt is screwed down to the shoulder, the steam shall blow off with a pressure of 160 lb. per square inch in the boiler. One of Bourdon's pressure gauges, 7in. diameter, to indicate up to 200 lb. pressure, to be made by Messrs. John Dewrance and Co. of the same pattern as supplied by them to this company. Two water gauges complete with flanges, and with pipes leading to the ashpan. One large and one small whistle, worked by valves and fixed to a seating on top of fire-box. Two steam cocks for the supply of the injectors, formed in the whistle seating, each worked by a wheel and screw valve. One blower cock placed on front end of boiler, worked by a wheel and screw valve from footplate on right-hand side of engine, a stop to be provided on cock to show when the blower is on or off; a pipe is also to be led from the blower cock through the smoke-box to the top of exhaust pipe. Two clack-boxes, one on each side of the boiler. One blow-off cock on back of fire-box, to be worked from the footplate. Two relief cocks to each cylinder, and one relief cock for steam chest, to be worked from the footplate. One of Roscoe's lubricators fixed on each side of smoke-box, with pipe leading direct to steam chest. One of Furness's lubricators with pipe led to each cylinder, and fixed on platform. One oil cup with pipe led down to top of each piston-rod gland, and fixed on the plate between the frames. One oil cup with pipe led down to top of each leading bogie axle-box, and fixed inside of each main frame; this oil cup is to be provided with a lid to prevent ashes from getting in. One oil cup with pipe led down to each hind bogie axle-box and fixed on the inside of each frame. Two lubricating boxes with three pipes leading from each, for lubricating the sliding surfaces of the bogie, and fixed underneath the boiler as shown. One lubricating box to be placed over each driving and trailing axle-box with pipes leading to the axle-boxes and guides. A lubricating box with brass cover is to be formed in the front end of cast iron guide for the valve rods. One regulator quadrant and stuffing-box complete finished bright. Four tapered plugs, one in each bottom corner of fire-box $1\frac{3}{4}$in. diameter, 11 threads per inch. Two filling tapered plugs on back of fire-box, $1\frac{1}{2}$in. diameter, 11 threads per inch. Four tapered wash-out plugs, two on each side of fire-box above footplate, $1\frac{3}{4}$in. diameter, 11 threads per inch. Eight wash-out tapered plugs in smoke-box, $1\frac{1}{2}$in. diameter, 11 threads per inch. One wash-out hole with covering plate on each side of fire-box at bottom. One wash-out hole with covering plate in front and one at back of fire-box. Two small tool boxes with padlocks and keys, one box to be hung on each side of engine inside the cab. One water gauge lamp bracket to this company's pattern fixed on the tray over the fire-door. Three lamp irons are to be fixed on front of smoke-box, and one on platform behind the buffer plate, to this company's pattern. All plugs and mountings are to be of gun-metal and must be of first-class finish. Pitch of threads for brass mountings is to be 11 threads per inch, unless otherwise shown on drawing. The water gauges and blow-off cock to be asbestos packed, and are to be obtained from Messrs. John Dewrance and Co.

Testing.—The boiler is to be tested by the contractor to a pressure of 200 lb. per square inch with warm water, and afterwards to 160 lb. in steam, and must be tight under these pressures before being lagged. The boiler is to be tested in the presence of the locomotive superintendent or his agent; and the safety valve is to be screwed down as before explained to a working pressure of 160 lb. per square inch.

Quality.—All the materials and workmanship are to be of the very best description, and all the parts are to be applied in the best and most approved manner. All the ironwork is to be stamped with this company's initials. The contractor will be required to make complete general and detail drawings of the engines and tenders, and to supply this company with two complete sets of cloth tracings of them, free of charge. Great care must be taken that all parts of the engines are precisely of the dimensions shown, so that they may be duplicates of each other. One of the engines and tenders is to be photographed at the contractors' expense, and twelve copies are to be supplied to the company. All the working parts of the machinery are to be well case-hardened. The number of engine is to be figured in gilt numbers on front buffer plates, and in solid brass figures on the hand-rail plate on each side of the engine. Samples of the gilt numbers and patterns of the brass figures will be supplied by the company. Each engine and tender will be required to run 1000 miles consecutively without showing any signs of defect, either in material or workmanship, after which it will be taken over from the contractor.

Specification of Six Wheels Tender.

Principal Dimensions of Tender.—Drawing No. 4039.

	Ft.	In.
Diameter of wheels on tread	3	$9\frac{3}{4}$
Centre to centre of journals	6	6
Length of journal	0	9
Diameter ditto	0	$5\frac{1}{4}$
Diameter of axle in wheel	0	$6\frac{3}{4}$
,, ,, at centre	0	$6\frac{1}{4}$
Wheel base	13	0
Length of frame	19	5
Total length of wheel base from centre of leading wheels of engine to centre of hind wheels of tender..	43	5
Length over all, from front buffers of engine to hind buffers of tender	51	$10\frac{3}{4}$
Height of centre of buffers from rails	3	5
Capacity of tank	2800 gallons.	

Tank.—The tank is to be of the form shown. The tank plates are to be of the best Staffordshire iron. Each side plate of the tank is to be in one, and to be No. 6 B.W.G. thick; the bottom plate of the tank is to be $\frac{3}{8}$in. thick and to form footplate of tender, and the end and front plate of the tank is to be No. 6 B.W.G. thick. The front top and protection plates are to be $\frac{3}{8}$in. thick, and the other top plates $\frac{5}{16}$in. thick; the front, side, and end plates are to be well stayed to the bottom with angle irons and stay plates as shown; the front plate is to be cut out to form a doorway for coaling, and is to be fitted with a door hinged from the bottom and secured at the top of the plate by fastenings as shown. Two wrought iron tool-boxes are to be provided at the front of tank, one on each side of the tender, to be fitted with false bottoms, perforated with small holes; great care must be taken that the tool-boxes are perfectly water-tight on the top. The tool-box is to be fixed across the tender on the top at the back, and to be fitted with a false bottom, perforated with small holes; this tool-box must be made perfectly water-tight at the top. The tool-boxes are to be provided with padlocks and keys. The side and back coping plates are to be finished with a wrought iron half-round moulding piece as shown on drawing. One hand rail is to be fixed on each side and at the back of the tank, and is to be finished bright; four lamp irons to this company's pattern are to be fixed on the back of the tank, and one lamp iron on each side of the tank as shown. One water-gauge glass fitted with a cock, and a manhole and lid are to be fixed as shown. The tanks are to be provided with Holt's feed pipe and cock arrangement; the outlets for the feeds to be covered with a perforated copper sieve. One filling cock for bucket with pipe led down to well is to be fixed on left-hand side in front of tank as shown.

Frame.—The frame plates are to be not less than $\frac{7}{8}$in. thick, being made of good tough fibrous Yorkshire iron of frame plate quality of approved make, and they are to bear the brand of the maker in a legible manner. Each frame is to be made of one plate, and all holes are to be marked and drilled from one template. The horn blocks are to be made of cast iron, planed, fitted, and bolted to frame. The hornstays are each to consist of two $1\frac{1}{8}$in. bolts, with cast iron distance pieces accurately fitted between horns. All the cross stays are to be accurately fitted to the frames and rivetted to them by $\frac{3}{4}$in. diameter rivets. The frames are to be accurately tested by longitudinal, transverse, and diagonal measurement, and must be perfectly parallel to each other. The front buffing and draw beam is to be constructed as shown, and is to be provided with buffers, fitted with unequal section steel spiral springs, which are to be obtained from I. A. Timmis, 17 Great George-street, Westminster. The springs are to be 10in. long and $4\frac{1}{4}$in. outside diameter, and are to be made to take a spindle 2in. diameter. The front buffing and draw beam is also to be provided with a drawbar and side links made of the best chain cable iron. The drawbar is to be forged in one, the hole at each end being punched. A continuous step board is to be fixed on each side of tender, also wrought iron steps roughed and fixed where shown. The hind buffing and draw plate is to have a draw hook and bar furnished with one No. 6 india-rubber cylinder, which is to be obtained from Messrs. G. Spencer and Co., 77, Cannon-street, London, E.C., two wrought iron buffers the same as specified for the engine, two side chains and screw coupling made of best chain cable iron, and to drawing.

Axle-boxes.—The axle-boxes are to be made of cast iron fitted with a wrought iron top and with brass bearings lined with white metal, and to have cast iron keeps provided with lubricating pads; the side flanges each must have $\frac{1}{16}$in. play, the bearings being fitted with $\frac{1}{16}$in. play at each end. A detailed drawing of the axle-box will be supplied.

Springs.—Each spring is to consist of thirteen plates, top plate $\frac{1}{2}$in. thick and 4in. wide, and twelve plates $\frac{7}{16}$in. thick, and to be tested with a weight of 5 tons, and must resume its original form after testing. The springs are to be constructed in the same manner as specified for the engine springs, and are to be attached to hangers fixed as shown. The springs are to be made of the best Swedish steel, and manufactured by Thomas Turton and Sons, Cammell and Co., John Brown and Co., or Brown, Bayley, and Dixon.

Wheels.—The wheels are to be of wrought iron and of the best description and workmanship, to be 3ft. $9\frac{3}{4}$in. diameter on the tread. Great care must be taken that the bosses and the junction of the ring and arms are all perfectly sound; the top or outer part of the spoke must be forged solid with the rims. All the wheels must be bored and turned so that they shall be exactly alike; each wheel must be put on the axle by hydraulic pressure of not less than 50 tons. The rims must be correctly turned to gauge to receive the tire, and the whole wheel trimmed up so that the surfaces and lines are all fair and a thoroughly good job. The skeleton is to be turned to a diameter of 3ft. $3\frac{3}{4}$in., the rims to be $4\frac{7}{8}$in. broad, $1\frac{3}{4}$in. thick at centre, to have ten spokes $1\frac{5}{8}$in. thick at the boss and $3\frac{1}{2}$in. wide, and at the rims $1\frac{1}{8}$in. thick and 3in. wide. The bosses are to be bored out parallel to a diameter of $6\frac{3}{4}$in., and are to be 1ft. 1in. diameter.

Tires.—All the tires are to be 3in. thick and of best crucible cast steel, manufactured by Vickers, Sons, and Co., Krupp, or Cammell and Co., and are to be stamped with the name of the maker. The tires are to be secured to the wheels in the manner shown, with a square lip, and tap bolts $1\frac{1}{8}$in. diameter, and eleven threads per inch. Each tire is to be bored out to template before being shrunk on the wheels and accurately turned so that the diameters and thickness of all the tires shall be exactly similar. Each tire to be guaranteed to stand without fracture the test of being pressed cold into an oval shape by hydraulic power to the extent of 2in. compression for each foot of external diameter.

Sand-boxes.—Two cast iron dry sand-boxes with circular valves are to be fixed in front of the tender; they are to be so arranged that the valves can be worked together by suitable gearing. Sand pipes are also to be fixed as shown, the sand to be led within 2in. of the rails by wrought iron pipes $1\frac{1}{2}$in. inside diameter. The general arrangement of sand-boxes and gear are shown on drawing.

Steam-boxes.—A steam and hand-brake combined is to be fixed on tender as shown, the cylinder is to be provided with means of lubrication, the brake screw, which is to be left-handed, is to work in a cast iron column bolted to the foot-plate at the front end of the tender, and the front pulling rod is to be provided with a screw adjustment and check nuts; each wheel is to have one cast iron brake block applied to it. The brake gear is to be made of the very best hammered scrap iron, all the pins and working parts being of wrought iron case hardened, the pins through all points of suspension of levers being 2in. diameter, and all other pins $1\frac{1}{2}$in. diameter. The steam is to be led from the engine to the cylinder with Holt's flexible connection. The brake material which will be supplied by the Vacuum Brake Company, 32, Queen Victoria-street, E.C., for each tender, will consist of one main air pipe with the necessary T pieces, elbows, and clips, one of Clayton's hose and couplings for front of tender, one of Clayton's hose and couplings for back of tender, one end pipe with cast iron bend, one dummy, one drip recipient. The brake cylinder, piston, and rod complete are to be supplied by the contractor. The cost of the material, which is to be supplied by the Vacuum Brake Company, will be £43 10s. per engine and tender, which amount is to be included in the contractor's estimate.

Painting.—Before any paint is applied, the ironwork must be clean and free from scales or rust. The inside of the tank is to have two good coats of thick red-lead paint, the outside being prepared and finished in a similar manner to the engine. The top and bottom of the tank, footplate, and brake work are to have one coat of lead-colour paint, and one coat of japan black. The gilt numbers are to be put on the tender according to instructions and samples which will be supplied, and all the ironwork is to be stamped with the company's initials.

Delivery.—The whole of the engines and tenders are to be delivered within eighteen months or two years from date of order, and the contractor is to state price per engine and tender if the order is completed within the first period, and price per engine and tender if delivery takes place within the second period; the contractor is also to state in which of the two periods he is prepared to complete delivery, it being understood that the specified date for completion of order must not be exceeded, otherwise the stipulations contained in clause No. 6 of general conditions will be enforced.

Quantity.—Tenders are invited, subject to No. 15 clause of the general conditions hereinafter contained, for twenty four-wheels coupled bogie express engines and tenders.

General conditions.—(1) The contractor shall not assign or underlet the contract or any part thereof, nor allow any portion of the work to be done elsewhere than in his own establishment without the express consent in writing of the locomotive superintendent being first obtained. The contractor shall pay all royalties and patent rights arising out of the contract. (2) The contractor shall afford the company or their agent every facility for inspecting the engines and tenders during the progress of their construction. (3) The engines and tenders shall be delivered by the contractor to the company at their Nine Elms Works, London, free of all charges for carriage or otherwise. (4) In case of any engines or tenders being delivered on the company's premises which are not in accordance with the specification, the contractor shall, upon receiving an order in writing from the locomotive superintendent, forthwith remove the same and replace them by others of approved make and quality. If any engines and tenders so ordered to be removed are not removed within twenty-one days, the company may dispose of or appropriate them in any way which they may think fit without giving notice to the contractor, and the contractor shall have no claim against the company in respect thereof. (5) In case of any engines or tenders being delivered on the company's premises which have been previously rejected by the locomotive superintendent or his inspector, the contractor shall be liable to a penalty of £5 for every engine or tender so delivered—which penalty may be deducted from any money then or thereafter payable to him under the contract—and shall forthwith at his own expense remove such rejected engines or tenders from the company's premises, and replace them with others of approved make and quality. (6) In case of the delivery of engines or tenders not being completed within the specified time the contractor shall pay to the company, as liquidated damages in respect of every engine or tender not delivered, the sum of 10s. per diem until such delivery shall be made, and such damages may be deducted from any money then or thereafter payable to the contractor under the contract. (7) Should any alteration be made in the design or details of the engines and tenders, or in the mode of carrying out the work, which in the opinion of the locomotive superintendent may fairly entitle the contractor to an extension of time, then such extension of time shall be determined solely by the locomotive superintendent, and the amount of the penalties shall be such as he shall certify in writing to be fair and reasonable. (8) No objection whatever shall be taken by the contractor in the event of any omission in the drawings or specification, as the locomotive superintendent will be prepared to furnish the manufacturer with information respecting any part of the work not sufficiently shown or understood. (9) Payment for all the engines and tenders delivered in conformity with the contract will be made within twenty-eight days after the production to the company's treasurer of the certificate of the locomotive superintendent, and no payment will be made without such certificate. (10) The company reserve to themselves the power to put an end to the contract at any time without notice upon the insolvency of the contractor, or upon his committing any breach of the conditions of the contract, in which case the contractor or his representative shall have no claim whatever against the company for or on account of the cessation of the contract. (11) Wherever the words "locomotive superintendent" occur, they shall be taken to mean the locomotive superintendent of the company for the time being. (12) The word "contractor" shall be taken to apply as well to all the partners of a firm, and to a joint stock company, as to any individual making a tender or contract. (13) The locomotive superintendent shall be the sole judge upon all matters relating to the construction, incidents, and consequences of the contract, specification, conditions, and drawings, and his certificates shall, so far as they extend, be binding and conclusive on both parties, but he may modify any certificate by a subsequent one. (14) Every tender is to be strictly on the form hereto annexed, and is to be delivered to the secretary of the London and South-Western Railway Company at Waterloo station, London, not later than 10 a.m. on Wednesday, —— —— 1883. Every tender is to be properly signed and dated, and also sealed and endorsed "Tender for Express Engines and Tenders." (15) The company reserve the power of dividing the number of engines and tenders tendered for between all or any of the parties tendering, or of reducing the number or numbers to be ordered, or of increasing the same to any extent not exceeding the tender, provided that written notice is sent to the contractor within one week of the acceptance of the tender. The company do not bind themselves to accept the lowest or any tender.

W. Adams,
Locomotive and Carriage Superintendent of the Company.
Locomotive Engineer's Office, Nine Elms Works, S.W.

LAUNCHES AND TRIAL TRIPS.

Messrs. Craig, Taylor, and Co., Stockton, have launched the steel s.s. Torre-del-Oro, 240ft. by 32ft. by 18ft. This vessel is built for trading on the Spanish coast, and has accommodation for a large number of passengers, and will be fitted with a complete electric light installation. The engines will be fitted by Messrs. Westgarth, English, and Co., of Middlesbrough, and are 135-nominal horse power, having cylinders $18\frac{1}{2}$in., 29in., and 48in. by 36in., with a very large steel boiler for a working pressure of 160 lb.

Also on 8th November, launched from the same yard, s.s. Oakwell, 125ft. by 22ft. by 11ft. 1in., built for the coasting trade and fitted with large hatches and powerful winches. Engines are being fitted by Messrs. Westgarth, English, and Co., of Middlesbrough, and are 50-nominal horse power, having cylinders 18in. by 36in. by 24in., with a large steel boiler for 85 lb. working pressure.

On the 23rd ult. the steamship Lara, just completed by Mr. Charles J. Bigger, shipbuilder, of Londonderry, for the Waterford Steamship Company, went down the river Mersey upon her official trial. The weather was exceptionally fine for this time of the year, and was most enjoyable, the results of the trial proving most satisfactory to all concerned. The representatives of the owners present were Mr. Morley—managing director for the company—Mr. A. Horn—superintendent engineer, and under whom the contract has been completed—and Captain Wade, commander of the vessel, who has superintended the work while in progress. Mr. Charles J. Bigger was represented by his manager—Mr. Pollock—and the Messrs. Rollo by Mr. George and Mr. Malcolm Rollo. The design of the vessel fulfils all the modern requirements. The first-class passengers are placed amidships in a bridge-house, with entrance house and smoking-room on bridge deck. The saloon is large and handsomely furnished. The state-rooms open off from the saloon. The crew are accommodated in the forecastle forward, and the officers and steerage passengers in the poop aft. Fittings for cattle are placed in all the holes, between decks and upper decks. Messrs. Muir and Caldwell's steam steering gear is placed aft, and the windlass forward. The new machinery, which has been fitted by Messrs. David Rollo and Sons, Liverpool, consists of a set of triple expansion engines, having cylinders 21in., 34in., and 55in., respectively, with a stroke of 36in. Steam is supplied by two large single-end steel boilers, with three corrugated flues in each and Henderson's fire-bars. The working pressure is 160 lb. per square inch. The engines are fitted with a separate "Bon Accord" centrifugal pumping engine for supplying cooling water to the main condenser. During the day's running everything, we are informed, gave entire satisfaction, the vessel making a speed of $12\frac{3}{4}$ knots when tried on the measured mile, the engines running at 90 revolutions per minute.

Iron and Steel Institute.—The council of the Iron and Steel Institute have decided to hold an autumnal meeting of the Institute for 1888 in the United States. A long list of the members who have up to the present time notified their intention of accepting the invitation to attend such meeting has been published. The council have it under consideration to hold a meeting in the summer in this country, in addition to the autumnal meeting in America.

Bids for Torpedo Boats.—Bids were opened at the Navy Department, November 1st, for the construction of one first-class torpedo boat, for which an appropriation of 100,000 dols. was made by Congress, August 3rd, 1886. But two bids were received, one from the Vulcan Ironworks, of Chicago, Ill, in amount 84,800 dols., and the other from the Herreshoff Manufacturing Company, of Bristol, R.I., for 82,750 dols. This vessel is to be of the best and most modern design; to be constructed of domestic steel of not less than 60,000 lb. per square inch, and an elongation in 8in. of not less than 25 per cent., and to have the highest attainable speed. Premiums will be paid at the rate of 1500 dols, for each quarter knot in excess of 23 knots, and including 24 knots; 2000 dols. for each quarter knot in excess of 24 knots. Should the speed fall below 22 knots a penalty of 4000 dols. will be enacted, and if below 20 knots, the Department reserves the right to reject the boat. The trial is to consist of a run of three hours' duration in smooth water. The approximate length of the boat is 135ft.; beam, 15ft. depth under spar deck, 6ft. 2in.; draught forward, 2ft.; aft, 5ft. 2in.; displacement at L.W.L. about 100 tons. It is to have a ram bow, and the stern is to be adapted to twin screws. The deck is to be elliptically curved, and is to have a maximum rise of not more than 2ft. 4in. at the greatest breadth of beam. There are to be two conning towers placed approximately 30ft. from the bow and 30ft. from the stern respectively. From the forward conning tower to the stem of the boat the deck is to assume the form of a whale back, so as to completely enclose and cover two torpedo launching tubes. The main engines are to consist of two sets of compound triple expansion condensing engines, with direct connection to propeller shafts, with separate engines for working the circulating and air pumps.—*U.S. Army and Navy Journal.*

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

(*From our own Correspondent.*)

THE firmness of the Staffordshire iron trade is still maintained by the causes which have operated to this end during the past week or two. The market is strengthened by the more favourable reports from the North, and there is an inclination to regard the advance in tin and copper as a precursor to a similar, though less remarkable, movement in iron. Indications combine to foreshadow a favourable future.

Marked bars on 'Change in Birmingham this—Thursday—afternoon were in moderate request at the former rates of £7, and for medium bars £6 is asked, with £4 12s. 6d. to £5 and upwards for the lower qualities. A better business is reported from Australia, but the home and continental buyers are only ordering in limited quantities. It is likely, with pig iron fetching more money, that the quotations for bars will grow stronger. Second and third-class bars are in much the same demand as a week ago, and prices are mentioned at £5 10s. to £6 for the former, and £4 15s. to £5 for the latter.

There is no perceptible quickening of the demand at present for hoops, strips, and similar light descriptions of manufactured iron, and makers find that the orders being received are at date sufficient to keep their works in only partial employment. Those cases are rather exceptional where the plants are being run to their full capacity. Better things are, however, hoped for. Common hoops are £5 5s.; superior sorts, £5 10s.; gas strip, £5; horseshoe bars, £5 5s.; and best tube strip, £6 10s. to £7 10s. according to gauge.

More orders are being received at the sheet mills, and this speaks well for the vitality of the galvanising trade. The sheet works are in truth very busy, and the only drawback is the comparative lowness of present prices, but prospects in this direction are partaking of the general improved condition of the trade. Pigs will assuredly advance to a point which will afford the sheet makers an opportunity of putting up their quotations to a more profitable level. At present singles are £6 5s., and occasionally £6 7s. 6d. is asked. Doubles are £6 10s., with £6 15s. for future delivery.

There is still only a limited demand for tank and boiler plates. The only brisk enquiry is from the constructive engineers and railway wagon builders. The works are irregularly employed, and this experience is becoming more common in proportion to the increasing favour which is being shown by consumers for steel plates. Tank plates remain at £6 10s.; common boiler plates, at £7 10s. to £8 10s.; and superior ditto, at £9 to £10.

The firmness which has been noticeable in the steel trade is maintained. Indeed, prices are rather better this week since makers are confident of a resumption of vigorous negotiations at the beginning of the New Year. The orders which are now being received are mainly on account of constructive engineering work and sheet manufacture, though a fair volume of business is also being done with the tube strip firms. Best soft steel stamping sheets are £10 to £10 10s. for doubles, and £11 to £11 10s. for battens; while soft steel plates for boiler purposes are £7 15s. at works.

The intimation that has this week been made by the New British Iron Company, Corngreaves, near Birmingham, that their works will continue in active operation during the liquidation proceedings that have been resolved upon, has occasioned satisfaction in the district, and hopes are entertained that the scheme of reconstruction, or of handing over the work to a new proprietary, will be carried out.

Pig iron is improving. Deliveries are going away from the local blast furnaces in such bulk that the necessity for making any addition to stock is prevented. There is a larger inquiry for mediums and common sorts. This has in some measure resulted from a lessened supply of imported Midland pigs.

Higher prices are this week being quoted. Staffordshire pigs have advanced in actual business about 1s. per ton; hot blast allmines are nominally 50s. to 52s. 6d.; part-mines are 37s. 6d. to 42s. 6d.; and common, 30s. The advance on Midland pigs compared with a fortnight ago ranges from 1s. to 2s. per ton. Northamptons are now an average of 37s. 6d. to 38s. delivered to works; Derbyshires, 38s. to 39s.; and Lincolnshires, 41s.

In the hematite pig market there is considerable competition in these local exchanges between West coast and Welsh sorts. The former were decidedly stronger this—Thursday—afternoon in Birmingham in consequence of the restrictive proposals. But they were at some disadvantage compared with the Welsh pigs on account of 2s. 6d. per ton increase in railway carriage, which West-coast makers have to bear compared with the Welsh producers. Welsh hematites remain at 51s. 6d. for forge, and 52s. 6d. for foundry sorts delivered, while the Barrow Co.'s hematites are 53s. to 54s. for forge sorts, and other best Cumberland brands 54s. 6d.

Circulars have reached iron and steel masters in this district intimating that the Council of the Iron and Steel Institute have now determined to hold their autumnal meeting in the States. The meeting will probably be held at the close of next September, and the trip will, it is expected, occupy as long, perhaps, as six weeks. 250 members of the Institute, out of a total of 1300, including some eighteen in Germany, Belgium, Austria, France, Sweden, Westphalia, Rhenish Prussia, Italy, and Spain, have already intimated their intention to be present. The council hope that many others will yet send in their names: and they intimate that they have it also under consideration to hold a meeting in the summer in this country.

Constructive ironwork contracts are held for valuable work for India, South America, Australia, and several other foreign markets, but home requirements are of a languid character. The frequency with which the Indian railway companies appear upon the market for supplies of iron and steel in various forms is a matter of much satisfaction to engineers and iron and steel makers in this district. The Indian State Railways are this week inquiring for railway wagon ironwork, and the Bombay, Baroda, and Central India Company are among the Indian lines who are offering their annual tenders for stores, including such goods as locomotives, iron underframes, ironwork for roofing, wheels and axles, buffers, brass and copper tubes, wagon springs, and steel crossings and switches.

The heavy ironfounders are rather better employed, and iron pipe firms are receiving some few new inquiries, including one from the Southwark and Vauxhall Water Company, but the low prices at which all work of this kind has now to be taken makes the trade anything but satisfactory.

Inquiry was made from some of the makers of railway wheels and axles and similar railway material on 'Change this afternoon concerning the correctness of a report that something like a combination has been formed between the Belgian and German makers of railway tires, and that a proposition has been made by continental producers to include the English firms in the compact. Only little information could be learned in reply. This, however, went to show that at present, at any rate, no consent has been given by native firms to the syndicate, and that they do not look upon the proposal as being, in the present state of trade, very practicable.

The upward movement in metals is still being favourably felt by the hardware trades. The spelter markets having also shown a continued strengthening tendency, the Association of General Galvanisers in Birmingham and district have given notice that the price for galvanising all goods will be advanced from to-day. The extent of the rise will probably be 5 or 10 per cent.

The machinery for the new torpedo vessel, the Sharpshooter, now being built at Devonport by the Admiralty, will be supplied by Messrs. G. E. Belliss and Co., Ledsham Steel Works, Birmingham, who have secured the work in competition with the chief London engineers. The propelling machinery will be triple expansion type, indicating 4500-horse power. The firm have also in hand three sets of machinery and boilers for Italian torpedo boats.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The considerable weight of buying to which I have referred during the past two or three weeks as going on in pig iron has tended to give a stronger tone to the market, and although no very appreciable advance in prices is really obtainable, buyers are now willing to pay prices which they have recently hesitated about giving, and makers are less anxious to sell. The continued upward movement in warrants at Glasgow and Middlesbrough, although it is believed to be largely due to speculation, also helps to strengthen the market here, and generally there is a better feeling than a short time since seemed possible. There is, however, one consideration not to be lost sight of, that the bulk of the buying has been for forward delivery, and does not represent any really increased weight of actual requirements on the part of consumers, who have simply, at the low prices which have recently been ruling, been covering their probable future wants as far forward into next year as makers have been disposed to go, and for a considerable time to come many of them will be practically out of the market, so that only a quiet trade can be looked forward to, which will render the maintaining of any materially advanced prices very doubtful. For any business at present offering, makers are, however, holding out for an advance upon the prices they have recently been taking. An upward move has also been given to hematite prices, but this has been brought about by the restriction of the output; with the recent advance in freights and the price of ore, makers are certainly placed under the necessity of seeking some means of getting better prices, but until the present upward move is backed up by an actually increased trade, it can scarcely be looked upon as established on any really substantial basis, and buyers evidently do not regard the advance as more than a temporary artificial movement. The manufactured iron trade remains without any material change, except that perhaps the stronger tone in pig iron operates as a check upon any tendency to weakness which might previously be showing itself, and with forges generally still kept fairly well occupied with work in hand, makers are for the most part holding steadily to late rates.

The Manchester iron market on Tuesday brought together a full average attendance, and although there was, perhaps, not so much buying going on as during the last week or two, there was a fair amount of business offering, and the market all through was characterised by a decidedly firmer tone. For Lancashire pig iron quotations remained at 38s. 6d. to 39s. 6d., less 2½, for forge and foundry delivered equal to Manchester, with but little doing; but in the district brands makers generally were quoting about 6d. to 1s. per ton above the prices which have recently been taken, and for delivery equal to Manchester the minimum quotations were about 36s. 6d. to 37s. 6d., less 2½, for forge and foundry Lincolnshire, and 40s. to 40s. 6d., less 2½, for No. 3 foundry Derbyshire, with business doing at about these figures. Outside brands are also firmer, good named foundry Middlesbrough averaging 40s. 6d. to 41s., net cash, delivered equal to Manchester, with Scotch iron offering less freely at under makers list quotations, which show, if anything, a tendency in an upward direction.

For No. 3 foundry hematite, delivered in the Manchester district, makers are now generally quoting about 52s. 6d., less 2½. Buyers are disposed to give about 6d. over late minimum rates, but the above figure seems to be out of the market, and there are sellers who would be prepared to take 51s. 6d., less 2½, to secure orders. Consumers seem prepared to recognise the fact that they cannot buy at quite such low prices as were being taken a week or two back, but they do not believe in the advance which makers are endeavouring to establish, and although the upward movement is bringing forward more inquiry, the actual business doing is only small.

There would seem to be some probability of a strong upward movement in steel plates, as makers on Tuesday had withdrawn their quotations, and in some instances sellers were asking about 5s. to 7s. 6d. per ton above recent minimum rates, but prices were simply nominal, as the leading makers were not quoting at all.

Manufactured iron shows, if anything, a rather steadier tone. Bar iron is in some instances still to be got at under £4 17s. 6d., and even as low as £4 15s. per ton delivered into the Manchester district, but the first-named figure is the minimum quoted price for bars of good quality, and £5 5s. for hoops, whilst sheets of the better qualities suitable for galvanising purposes remain firm at £6 10s. to £6 12s. 6d. per ton. Forges are mostly kept well occupied on the work which makers have in hand, but except that there is a continued brisk demand for sheets, the weight of new work coming forward is only small, and in some instances makers are showing more anxiety to secure specifications.

The continued strong speculative upward movement in tin and copper is quite disorganising the metal market; sellers, on the one hand, are very chary about committing themselves to transactions of any weight, and only entertain business subject to the day-to-day current prices; whilst consumers, on the other hand, buy only from hand-to-mouth as they are absolutely compelled to cover actual requirements, as they have no belief in the permanence of present prices.

With regard to the engineering branches of industry, I can do little more than repeat what I have reported of late. At low unremunerative prices there seems to be sufficient work to be got to keep engineers and machinists fairly employed, but trade shows no indication of getting above this unsatisfactory condition.

The Wenham Company, which has just opened a specially fitted-up show room in Manchester for the purpose of exhibiting its method of gas lighting and ventilation, has introduced a new lamp which has been specially designed to meet the requirements for the safe lighting of Lancashire cotton mills. In this lamp every possible precaution would seem to have been adopted to prevent either the ignition of the light fluff constantly floating about in a cotton mill, or the lamp becoming choked with this material. Instead of using, as it has hitherto done, an open metal top, it has introduced an asbestos top, by which the heat at the top of the lamp is reduced to a minimum, which prevents any possibility of ignition by the fluff collecting on a highly-heated surface; whilst to guard against the fluff getting down between the heat disperser and the chimney, the intermediate space has been enclosed with a double-perforated screen, which, whilst admitting sufficient air for the proper burning of the lamp, effectually prevents any particles of fluff getting inside the lamp. To further protect the lamp from the possibility of getting choked with particles of dust, an entirely new kind of burner has been introduced, which, in the place of the series of small perforations as in the usual Argand burner, is formed with a small slot or ring cut through a non-corroding metal cap, which admits of being readily and easily cleaned whenever required, and which gives a clear, steady light. In other respects the lamp embraces all the improvements of the Wenham "Acme" mill lamp.

The question of education has been brought very prominently to the front in Manchester during the past week, by a special address on the subject from Professor Huxley, and a munificent offer, having practically the same object in view, made by the residuary legatees under the late Sir Joseph Whitworth's will, cannot fail to stimulate the efforts which are being made to provide more ample means for efficient instruction than are at present possessed in Manchester. Further assistance in this direction is also being looked forward to from the disposal of the surplus which will result from the recent Manchester Exhibition. What the amount of this surplus is likely to be has not been allowed to officially transpire, but some very sanguine expectations are being entertained, and that some portion of it will be devoted to the promotion of education has already been practically guaranteed.

A very quiet tone prevails throughout the coal trade, with all descriptions of fuel plentiful in the market, and prices still practically on the basis of the summer rates. The leading colliery firms in the Manchester district who have so far made no real advance upon their summer rates, do not even now, with the commencement of December, feel themselves in a position to attempt any general advance, and this practically means that prices will have to remain on about their present basis all through the winter. The action of the Manchester firms also renders impracticable any material upward movement in other districts, and at the pit mouth prices do not average more than 9s. for best coals; 7s. to 7s. 6d., seconds; 5s. 6d. to 6s., common house fire coals; 5s. to 5s. 6d., steam and forge coals; 4s. 6d. to 4s. 9d., burgy; 3s. 6d. to 3s. 9d., good qualities of slack; and 2s. 6d. to 2s. 9d. for common sorts.

The shipping trade continues very depressed, with steam coal delivered at the high level, Liverpool, or the Garston Docks, still offering at 6s. 6d. to 6s. 9d. per ton, whilst colliery proprietors are repeatedly under the necessity of forcing sales at excessively low figures to clear away stocks.

Barrow.—The past week has witnessed a further improvement in the hematite pig iron trade. The demand is steady, and a large business has been done at the fuller prices which are now ruling. The quotations for Bessemer iron are steady, and are given at from 44s. to 44s. 6d. per ton net, f.o.b., for mixed numbers of Bessemer iron, and at 43s. 6d. to 44s. per ton for forge No. 3, with 6d. per ton advance on forward deliveries. There is a firmer tone all round, and it is confidently expected that the restricted production of pig iron as a result of blowing out several furnaces will be shown in running up prices to 47s. per ton before the opening of the spring season. The great drawback to any improvement of moment will be the heavy stocks which are held by makers throughout the district and in stock at the various store-yards, but it is noticeable that these stocks are being reduced, although not to a very appreciable extent. There is an improvement to note in the steel trade, and the demand for rails is more active than of late. Prices have advanced, and are now firmly quoted at from £4 1s. 3d. to £4 5s. per ton net f.o.b. There is a good inquiry, especially for heavy sections, which have been largely sold forward, but light rails are in demand, and the merchant mills are well employed. There is, in fact, a larger output of steel, chiefly of the Bessemer quality, than for many years past, and this position is likely to be maintained, as makers are all round so fully sold forward. Siemens-Martin steel is in good request, although at the plate mills very little is doing. There is a steady tone in billets and hoops, but slabs are a quiet trade, and nothing is doing in blooms. There is no change to note in shipbuilding and engineering, although a better look-out is showing itself for next year. Finished iron is in quiet demand. Iron ore is brisk, and ordinary qualities are selling from 8s. 9d. to 11s. 6d. per ton net at mines. There is a good demand for the better qualities of iron ore, but sales are very limited, as some of the raisers of best material are so busy that they are not in a position to quote. The West Cumberland Iron and Steel Company has decided to reduce its capital of £600,000 to £360,000, to cover losses incurred. One of the items in the losses is £160,000 on colliery account. The Maryport Hematite Company has blown out one of its furnaces—No. 6. Mr. J. Cooper, manager of the Workington Hematite Iron and Steel Company, has undertaken the general management of the Swansea Hematite Company.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

CONSIDERABLE business has been done in Cleveland pig iron during the last few days, and prices are steadily advancing. Consumers appear to have come to the conclusion that no further change for the worse is likely to take place, and they are anxious to buy over the first quarter of next year. For prompt delivery, 31s. 3d. per ton was the price paid for No. 3 g.m.b., at the beginning of last week; this increased to 31s. 6d. on Friday, and by Tuesday, 31s. 7½d. was given. Makers who were quoting 31s. 6d. last week, are now asking 6d. per ton more. There is considerable inquiry for next year's delivery, but sellers will not take the prices offered, and not many purchases are made. The demand for forge iron is improving, and prices are firmer. Transactions took place on Tuesday at 30s. 3d. per ton, which is an advance of 3d. per ton upon last week's price; and even more is now demanded by some firms.

Stevenson, Jaques, and Co.'s current quotations: "Acklam Hematite," Mixed Nos., 44s. per ton; "Acklam Yorkshire," Cleveland, No. 3, 33s.; "Acklam Basic," 35s.; refined iron, 48s. to 63s., net cash at furnaces.

Warrants are also in somewhat greater request, and the tendency to speculate in them has revived. The price on Tuesday was 32s. 3d. per ton, or an advance of 9d. upon that of the previous market day.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s Middlesbrough store on Monday last amounted to 326,904 tons, representing an increase of 341 tons during the week.

Shipments of pig iron from the Tees have improved during the last few days, but they are still behind those which took place during the months of September and October. From the 1st to the 28th inst., the quantity exported was 61,295 tons. During the corresponding period in September, the exports were 67,601 tons, and in October 67,781 tons.

Orders for finished iron are coming more freely to hand, and some makers are now even under some pressure for delivery. Quotations for ship plates have risen from £4 7s. 6d. to £4 10s. per ton at makers' works, but the prices of other kinds of finished iron remain so far unaltered.

Some anxiety is at present felt in the North of England as to what may be the result of the agitation which is going on among the coal miners on the question of restriction of output. On the 22nd instant a conference took place at Newcastle, at which representative miners from England, Scotland, and Wales were present. The object of the meeting was to consider reports from various districts as to the resolutions passed at a similar conference held at Edinburgh in the month of October. The resolutions which were then formulated for the consideration of all the miners in Great Britain were as follows, viz.:—"(1) That no miner should in future be permitted to work more than eight hours per day above ground, or seven hours per day underground, reckoning the time from bank to bank. (2) That there should be one day's play per week on the part of every miner, whether he has been recently fully employed or not. And (3) That a week's holiday should be taken at once, and such other holidays as may be found necessary, from time to time, to clear off stocks, and obtain a 10 per cent. advance in wages.

The first thing observable at the Newcastle conference when the above resolutions came to be discussed, was that there were no delegates from South Wales nor from the county of Durham, a significant fact which seemed to weigh rather heavily on the minds of those present.

At the meeting held on the 24th a committee was appointed to see and negotiate with the men of these two districts, with the hope of inducing them to join with the rest. A resolution was passed favourable to the general adoption of the resolutions, and fixing the 1st of January next as the date for commencing to enforce them.

Meanwhile the coalowners everywhere will be interviewed with a view to obtain, if possible, what is demanded in an amicable way. What the result will be it is impossible to foresee, as the men, nothwithstanding their many severe experiences, do not seem as yet to have learned the impossibility of success to those who attempt to interfere with the natural course of economic laws. To imagine that they can secure an extra hour per day for their own purposes, and an extra day per week, and an extra week now and then, and obtain as their remuneration not only the same share of the necessaries of life, but 10 per cent. more than formerly, and that by engaging in a strife, for which they are financially quite unprepared, is utterly ridiculous.

It is not in the least likely that the coal-owners will make any concession in wages—in fact, they cannot afford to do so. The

Northumberland employers, who recently sustained a six months' strike, did so only under the pressure of absolute necessity. It was this that bound them together throughout the whole period, and made them successful in the end. The terrible sufferings the men underwent are now a matter of notoriety. It is therefore not in the least likely that the Northumberland employers will surrender the small profits they are now making, under threat of the renewal of a battle in which so lately they carried all before them. The attitude of the other coal-owners throughout the country will, no doubt, be the same, and so the movement must ultimately collapse. Meanwhile, considerable disturbance of the coal and all other trades may not improbably ensue. This is particularly regrettable just now, when trade shows some indications of returning prosperity, provided it be carefully nursed. Obviously, if the men persist, they must be fought, for the support which their eminently absurd and economically unsound resolutions appear to have received shows that no amount of argument is likely to have any effect upon them.

The shipbuilding trade of the North-east coast seems to be slowly reviving, new work has latterly come into several of the shipyards at Sunderland, including those of Messrs. Short Brothers, Doxford and Sons, and R. Thompson and Sons. It is said also that Messrs. Pickersgill and Co., whose works have been for some time inoperative, will shortly recommence shipbuilding upon an order they have just received. Besides new work, there is a considerable amount of repairing in progress at most of the yards. At Whitby things are also looking brighter, and it is now said that those engaged in shipbuilding in that part have every prospect of full employment throughout the approaching winter.

Marine engineering naturally keeps pace with shipbuilding. Enquiries have recently been very numerous, and some of these have led to orders. All new engines are of the triple expansion type, and good results as to economy are becoming more and more apparent. The engines constructed by Messrs. Blair and Co., of Stockton, are now working wherever circumstances are favourable with about 1½ lb. of coal per indicated horse-power per hour.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE War-office contract for files has again been secured by Messrs. Sanderson Brothers, Sheffield. This company had the contract for three successive years; but it missed the work last season.

Steel has been regarded as unusually languid for the time of the year, and though this is pretty certain to be the rule for the United States market to the end of 1887, it is equally clear that the business for other quarters is not so attenuated. One very large firm of crucible steel manufacturers have been favoured with important orders during the last few days. The complaint appears still to be not so much of the volume of work as the low prices obtained for it.

The iron and steel trades are likely soon to have placed before them a subject of great interest to them. The Council of Civil Engineers, Great George-street, London, have accepted two papers by a townsman for reading and discussion. They are by Mr. Robert Abbott Hadfield, associate member of the Institute of Civil Engineers. The first is entitled "Manganese in its Application to Metallurgy;" the second, "Some Properties of Iron and Manganese." These papers, I understand, will open up an entirely new field in metallurgical science, and introduce processes hitherto unknown in the steel trade. The results are new and will startle "old-fashioned Sheffield steel makers," as contrary to all their experiences. The subjects, though technical, are understood to be so lucidly presented that any one of intelligence cannot fail to profit thereby. Great research as well as thought have been expended in their compilation, and I am assured they will take rank with "Percy's Metallurgy," which was the standard work of its day. These papers give the result of many hundreds of analyses and mechanical experiments, as well as the chemical, electrical, tensile, torsional, ductile, elongation, and other tests. These have been further tested and verified by the highest English and foreign metallurgical authorities known, who were all greatly interested in the extraordinary results obtained. Several eminent American steel makers and capitalists, who investigated it, have been and are deeply interested in the processes; and, with their usual acuteness and quickness, are testing this material in every form and shape in America, and have arranged to erect works on an immense scale for the purpose of introducing and developing it here. The processes, of course, are patented, and have to be worked under royalties.

A proposal is being energetically, though unostentatiously, pushed in the Midlands, to connect Birmingham with the Humber. This is known as the Tame Valley and Trent Navigation scheme, which, it is urged, could be connected by means of a short canal, and thus secure for steam-propelled barges cheap and ready access to the German Ocean. It is estimated that merchandise can thus be taken from Birmingham to the Humber in twenty-four hours, at about 8s. per ton; the railway charges for this distance—170½ miles—are very much higher.

Mr. Thomas Fairies, of Mount Pleasant, Chapeltown, near Sheffield, has obtained a patent for an invention for jointing and locking together gas, water, and other pipes. Inside the pipe socket is a groove or slot running round the pipe. At the spigot end of the pipe a stud, wedge-shaped, is cast on each side, and when the pipes are placed in position the stud at the spigot end of the pipe enters the groove or slot, when, by giving the pipe a slight twist the two are fast coiled together. A great saving of material, time, and labour is claimed for this invention in laying and lifting pipes of all kinds.

Two Sheffield men of great wealth and influence have died this week—Mr. Samuel Roberts, M.A., J.P., of Queen's Tower, aged eighty-seven, and Mr. Thomas Jessop, J.P., of Endcliffe Grange, aged eighty-four. Mr. Roberts was descended from an old Yorkshire family who were among the pioneers of silver-plating in Sheffield. Mr. Jessop was the head of William Jessop and Sons, Brightside Steel Works, the largest works in the world exclusively engaged in the production of crucible steel. Shortly after the conversion of the firm into a limited company in 1875, Mr. Jessop accepted an invitation to become the chairman, and consented. He occupied the position up to his death. Both gentlemen were most munificent benefactors to Sheffield. Mr. Jessop, at a cost of over £30,000, founded the Jessop Hospital for Women.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron warrant market has shown more than usual animation and strength this week. The attempt made last week, by means of a forged order, to sell 15,000 tons of warrants, to depress the market, completely failed as far as any permanent decline was concerned, and the quotations have since advanced, and, on the whole, been well sustained. The position of the market was also strengthened by the large shipments of the past week—13,594, as compared with 4870 in same week of 1886. Of the quantity dispatched abroad, 246 tons went to France, 350 to Australia, 400 to Holland, 1600 to the United States, and 4307 to Italy, the coastwise shipments being 3506 tons. A considerable amount of pig iron has yet to be despatched to Italy before the close of the year. The amount of the pig iron production is unchanged, there being still eighty-four furnaces in blast at the time of writing. There is, however, a disposition to take some of the furnaces off ordinary pigs and put them on hematite, in consequence of the improving demand for that class of pig. The stocks in the warrant stores continue to increase at the rate of about 1300 tons a week.

The prices of makers' pigs are firmer all round, and in certain cases higher. Free on board at Glasgow, Gartsherrie No. 1 is quoted at 46s. 6d.; No. 3, 42s. 6d.; Coltness, 50s. and 42s. 6d.; Langloan, 47s. and 43s. 6d.; Summerlee, 49s. and 42s. 6d.; Calder, 46s. 6d. and 40s.; Carnbroe, 42s. 6d. and 39s.; Clyde, 45s. and 40s.; Monkland, 42s. and 38s. 9d.; Govan, at Broomielaw, 41s. 9d. and 38s. 9d.; Shotts, at Leith, 47s. and 44s. 6d.; Carron, at Grangemouth, 49s. and 43s.; Glengarnock, at Ardrossan, 45s. 3d. and 40s.; Eglinton, 41s. 9d. and 38s. 9d.; and Dalmellington, 42s. and 39s.

The values of malleable iron, which were at the lowest a few days ago, have exhibited some tendency towards improvement. Manufacturers are well supplied with work at present, and it is hoped that the hardening of prices may bring out some additional orders. There have of late been numerous inquiries on foreign account, which have so far produced little result, but the anticipation is that the prospect of higher rates will induce agents to come to business. Merchants quote:—Best bars, £5; merchant bars, £4 15s.; angles, £4 13s. 9d.; rivet iron, £4 15s.; nut iron, £4 11s. 3d.; and plates, £5 7s. 6d., all less 5 per cent. discount. For unmarked bars the demand is very quiet at the moment, the quotation being £4 6s. There is also little doing in old rail and scrap iron.

It is believed that the makers of steel will be obliged to increase their prices 2s. 6d. to 5s. per ton without delay. Ironmasters who produce hematite pigs are not in a position to supply the wants of the steel makers at the old prices in consequence of the higher figure they are charged for Spanish ore used in the production of the pigs. The prices of the latter have been advanced, and steel makers will have to meet the case by an advance on their products. The great proportion of the work secured for shipbuilding purposes within recent weeks is understood to have been taken at low prices, but further contracts are likely to be placed on rather firmer terms.

Despite the fact that freights are much increased, and that ships have been scarce, owing to the prevalence of contrary winds, the past week's coal shipments were above the average in amount. At Glasgow 22,464 tons were got away; Greenock, 262; Ayr, 9847; Irvine, 2805; Troon, 5263; Ardrossan, 2419; Burntisland, 14,250; Leith, 6450; Grangemouth, 13,197; Bo'ness, 2709; Granton, 2887; total, 82,553, as compared with 78,708 tons in the same week of 1886. There is as yet really no improvement in the prices of coal, which are not much above the lowest figures touched this season. The supply is ample, and there is therefore no such chance of improving the quotations as would be furnished by a shortness of coals.

During the past week there was shipped from Glasgow machinery to the value of £10,600, for the most part to India and South America; sewing machines, £4024; steel goods, £7700; and general iron manufactures, £28,800.

The Executive Board of the Fife Miners' Association have instructed their secretary "to communicate with the coalowners in the county in order to ascertain if they view with favour the idea of co-operating with the men in carrying out the proposed scheme of restriction." The proposal is that the miners all over the country should take a week's holiday in January to create an artificial scarcity of coals such as, the men are of opinion, might be the means of raising prices.

The strike among the shale miners of the Broxburn Oil Company is now at an end after lasting about four months. Prices of oil having shown a certain improvement, the men have gone back to work on the promise of a portion of the reduction of wages being returned to them at the beginning of the year.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

TRIAL shafts have been sunk on the East Moors, Cardiff, with a view of getting good foundation for the heavy machinery of the Dowlais works, and the result has been satisfactory. Solid marl was found at 12ft. in one place, and 15ft. in another. The sinkers also came upon the remains of an ancient forest, which is regarded as the boundary of the great South Wales coalfield.

The next Parliamentary Session will be one of the most important for Wales. I am assured by one of the principals that a more exciting one has not occurred for many years. Bills of magnitude, involving measures of extreme consequence to various railway, dock, and corporate interests, are being placed. First in consideration is the Taff Vale and Bute Dock almalgamation scheme, which is finding more and more favour every day. The fact that the Taff Vale is nearing the maturity of its development, while the Bute Dock estate is capable of still greater expansion, should weigh with those who contrast the 14 per cent. of the one and the 4 per cent. of the other. It is also submitted, by the many who favour the scheme, that each will gain *pro rata*; while, as regards the coal and shipping interests, the advantage of the two concerns being under one control is self-evident.

It is gratifying to state that the staple industries of Wales are decidedly looking up. In coal the increased demand that has set in is sustained, and at all the ports additional activity is visible. Cardiff, Swansea, and Newport totals are encouraging. It was announced on 'Change at Cardiff, on Wednesday, that a Cardiff firm had a "stem" on of 30,000 tons, and the week's total will be large.

In corresponding movement to that of quantity is price. The latest quotations in the market at Cardiff were—Best steam, 9s. 3d. to 9s. 6d.; second, 8s. to 8s. 6d.; the lowest prices in the market for steam are 7s. 9d. This may be considered as low enough in all reason, being but about 5s. 9d. at pit. Rhondda No. 3 is going up firmly; small is scarce at 7s. to 7s. 3d., the requirements of coke makers being large. For large Rhondda No. 3, 8s. 3d. to 8s. 6d. remain the leading figures.

In the steel trade a tolerable amount of trade is being done. In the course of a visit in the neighbourhood of Ebbw Vale, Tredegar, Rhymney, Dowlais, and Cyfarthfa this last week this was very evident. For rails there is an appreciable increase in demand, and prices are sufficiently low to tempt purchasers. A good cargo was despatched this week of 2200 tons to Galveston, and another of 1600 tons to New Orleans from Newport, Mon.

The latest quotations in the iron and steel trade are as follows:—Glasgow pig, cash, 40s. 9d. The improvement in price has affected other kinds. Bessemer pigs, 43s. to 44s.; Swansea hematite, 47s. 6d.; merchant bars, £4 7s. 6d. to £4 10s.; steel rails, heavy section, from £4; light, from £4 17s. 6d.; steel sheets, from £7 10s.; Bessemer blooms, £4 5s.; bars, £4 15s.; Siemens bars, £5 2s. 6d.

For tin bar a steady run of make continues, though the continued advance in tin is perplexing to the tin-plate workers, and somewhat hampers trade.

Tin-plate makers have had no alternative but to put up prices or close their works. Last week saw the figure of £150 reached. Now it is rapidly nearing £160. Makers have advanced accordingly; but even with quotations of 2s. and even 2s. 6d. advance, they are chary in booking forward. No one knows the point to which the price of tin may not be extended, and henceforward business is in a high degree hazardous.

Most of the works are busy in the Nantyglo Valley, the Old Lion Mill, and at Blaina the extensive works keep on well, while the usual large bulk of business is being done at Swansea, Llanelly, and district.

Exports at Swansea keep well up to average.

Another ironworks was scattered by the auctioneer this week. This was Machen in Monmouthshire. The sale realised £3000. It may be interesting to note some of the prices. Cast iron realised about 36s. per ton. A Galloway boiler was knocked down for £95, a horizontal engine at £75, and the plant for brick-making £82 10s. It is intended to sweep off all the plant.

There was a whisper in the district lately that other works were likely to follow the course of Dowlais in making for the sea, but I think it is premature. The works on the hills, such as Ebbw Vale, Tredegar, and Rhymney, have large fields of coal. Dowlais, placed on the north edge, may be said relatively to have exhausted its original great resources. Yet it is in a good position to make extensive additions lower down the valley, and with this and its own coalfield must long figure prominently in the coal world.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

IT cannot be otherwise reported than that the iron manufacturing industry is now in a very satisfactory position, and the future prospects of the markets good. How the workers-up of iron, however, will be situated is another question, as unless they can improve their position in like manner by creating conventions, which with present competition will be difficult, we shall soon hear them crying out that they cannot manufacture so cheaply as their rivals, who happen to be more fortunately situated. At present the iron conventions do nobody any good, except just the works concerned, or the "rings," as they may almost be called.

The iron prices in Rheinland-Westphalia have been well maintained, and some have advanced; and from Silesia the reports concerning both pig and finished iron are also very satisfactory. Another furnace has been blown in, which makes twenty-eight at present in full blast. Forge pig for next year has advanced in price, and best foundry sorts are M. 54 to 55; bar iron outside the convention radius, 135 to 140; girders, 150; and common plates, 160 to 165 p.t. The steel works are sending away with regularity moderate quantities of rails, sleepers, blooms, &c. In the Siegerland the Exchange was well attended, and in consequence of a brisk demand the market was favourably affected. This is partly to be ascribed to the continued high sea freight from Spain, which is beginning to favourably affect the native mines. The prices of iron ores ranged from M. 8·60 for raw to 12 for calcined steelstone; brown ore, 8·80 to 9; and iron glance, 9 to 9·20 p.t. at stations. Luxemburg ores are in good demand, and prices firm at M. 2·20 to 4·10 p.t., according to sort. Pig iron is more in demand again, and although there was an increase of the output in October of 12,700 t., stocks were reduced by 1700; another favourable moment having been the prolongation of the pig iron convention till the end of 1888. The output of pig iron for the month of October, including Luxemburg, was 354,925 t. Of spiegel and forge pig, 172,874; Bessemer, 35,089; basic, 107,066; and foundry iron, 39,896 t. From January 1st to October 31st, 3,204,406, against 2,780,370 t. for the same period last year. At a meeting of the chiefs of the pig iron manufacture just held, the prices of all sorts of puddling iron have been advanced M. 1½, basic 1, hematite 1, foundry 1, Bessemer 1½ p.t. Spiegel is in continued good demand for home consumption and abroad, and the prices could be sustained at M. 50 to 68 for from 8 to 10 to 20 p.c. Mn. respectively. Forge pig is more brisk than it was a week or two ago for present and especially for future delivery, for contracts are in hand till May next year, and producers are of opinion that the iron is for covering actual wants at the works, and none at all for speculation. This is possible, for the producers, through their energetic action, have beaten the dealers, who desired to break up the convention, and consequently the latter would not care much about speculating. In this connection it might be mentioned that the iron interest in this country has protested against the proposed introduction into Parliament of a warrant law, because of no value to the producers and disadvantageous for traders in iron. Forge pig costs M. 46·150 to 47 p.t. Foundry iron is also in better request, and prices have been well kept up at M. 50 to 56 for the three numbers; Bessemer is selling at 49·50; basic, 44; of neither of which there is anything particular to report, except it were that there is a great cry out in Westphalia that freights are too high from Luxemberg, the oolitic, cheap ore from whence they must have to make their basic pig with, if they are anywhere to compete. Phosphoric pig, rich in Ph., has been fixed at M. 43·50 at works in Westphalia. Luxemberg forge costs M. 33·50 to 34 p.t. on trucks at works stations. The manufactured iron branch is in an equally satisfactory condition. The accession of the Saar and Moselle group to the convention had no small share in bringing this about, but another circumstance, which at first seems remarkable, may be added, namely, that the convention carried off the orders for wrought iron which have been recently tendered for by the State railways at Strasburg and Elberfeld, in the teeth of other large works which tendered but do not belong to the convention. A second time this may not be the case when the outside works have once felt their way. This shows what a precarious existence such an artificial arrangement as this convention will continue to lead. In general the rolling mills are fully employed, orders flow in in sufficient quantities to keep them on regularly and in some cases to last till next spring even, and prices are quite firm, as in these circumstances might be expected. Girders keep firm, though foreign demand is diminishing in bulk. Hoops continue brisk and prices could be well maintained. In neither plates nor sheets is any alteration to note, the works remain in constant full employment, and are still so well supplied with orders that they will have regular work for a considerable time to come. Plates above 5 mm. gauge are noted M. 150 and sheets 140 to 142, the same in steel 155 to 160 p.t. as base price. The export of wire rods has almost come to a standstill and export prices are lower, but the native consumption, both in iron and steel, keeps up, and the prices too, pretty well. We are still awaiting the formation of some kind of combination to raise prices. More orders for rails, sleepers, and small ironwork are in expectation by the steel works from the State Railways, but the works as it is are pretty tolerably supplied with orders, although of late the export of blooms and billets has much shrunk in quantity. The wagon factories have a little more to do, and seventy-two coaches, twenty-two baggage vans, and 293 wagons have just been advertised for. The foundries and machine shops are satisfactorily employed for the moment, and it would appear as if prices had at last touched bottom, and a more favourable state of things had approached. The present base prices are, for merchant bars, M. 122·50 to 125; angles, 128 to 130; rolled girders, 115; iron hoops, 125 to 127·50; in steel, 135 to 140; iron wire rods, 110 and higher; and steel or iron wire, 130 and higher p.t.

The iron trade in Belgium is in a most flourishing condition, so far as it concerns pig and manufactured iron. The works are all quite fully engaged, and orders in large numbers are now coming in for 1888, so that several mills have sold their whole output for some months to come at remunerative prices, which are far higher than those of this time last year. The Cockerill Company has now received, besides the rails, all the small accessory ironwork for the Roumanian Railways, and Angleur the 2000 axles. Coke is 10·50f., but a few contracts have been made at 10·75 p.t.

Since the two groups of mills and forges in the Nord have agreed in principle to the formation of a sales bureau or some equivalent arrangement to improve their position, the iron trade in France has taken a turn for the better, and even the Paris houses seem to have taken the hint, for in just the same motiveless manner they have now run up prices as they ran them down previously, so now they are demanding 135f. for merchant bars and 130 for rolled girders, which buyers are not inclined to give, and require large concessions on these figures, and the unfortunate political situation works rather in their favour for obtaining them. The demand is not quite so good as it was; but when the rise, in prospect of the sales bureau, is taken into consideration, it may be, nevertheless, pronounced tolerably brisk. Plates are just now in great request, and No. 2 sort, or common, are noted at works 150f. and at Paris 170f. In the Haute-Marne district bars are particularly firm at 125f., and occasionally at 130f. p.t. The great strike at some works in the Ardennes has ended in a mutual compromise. The coal and coke trade is as yet unaltered, but the better look-out at the ironworks, which use up 20 per cent. of the output, is expected soon to cause a rise in prices, and a brisker business than of late was the case.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, Nov. 21st.

The phenomenal earnings of the railroads in nearly all sections of the country continue. During October the reports from 102 roads show an increase from 30,321,322 dols. to 33,879,888 dols. This is an increase of 12 per cent. For the ten months up to November 1st, ninety-eight railroads show aggregate gross earnings of 277,071,160 dols., against 242,349,166 dols. for the same time last year. This is an increase of 14 per cent. In October, 1887, the gross earnings per mile on 102 roads was 537 dols., against 508 dols. in 1886, as compared with 511 dols. in 1885. In the returns for the ten months the Southern roads are prominent in showing large gains. Through the South-Western roads the coal carriers and trunk lines are all far ahead of last year. Estimating operating expenses at 65 per cent., the net earnings of the ninety-eight roads for ten months would be about 97,000,000 dols., or nearly 117,000,000 dols. for the year. The Southern mileage is about 60,000 miles. The funded debt is 31,000 dols. per mile. The approximate aggregate debt of the Southern roads is 1,860,000,000 dols., of which the 117,000,000 dols. of net earnings is equivalent to a dividend of 6⅜ per cent. The Treasury of the United States is overflowing with money. The accumulation of money beyond the absolute needs of the country will form one of the leading, if not the leading, political issue in Congress during the coming winter—probably the chief issue during the coming presidential campaign. How to keep from getting rich is an issue which may probably shipwreck the present Administration.

The iron trade throughout the country is in a very vigorous condition. Imports of foreign iron and steel are light, but few orders are now going abroad. The consumers in iron and steel throughout the United States are anticipating a little reaction in prices. Manufacturers declare a decline is impossible at present cost of production. Copper is very active. Immense sales are taking place; 1,000,000 lb. of Lake sold at 12·50c.; 800,000 lb. for November, 12·50c.; 1,000,000 lb., December, 12·75c.; 2,750,000 lb., January, 12·85c. The exports of copper since January 1st are 10,340,251 lb., against 16,508,391 lb. for same time in 1886, and 31,975,268 lb. for same time in 1885. The speculative feeling in lead has abated. Tin-plates are very strong; under cable advices from abroad demand has been stimulated. Buyers who have been remaining out of the market are now covering. Steel rails are dull at 32·50 dols. to 34 dols. The syndicate is not yet determined whether to restrict or submit to the declining tendency, which consumers say will reduce prices within sixty days to 30 dols. per ton. The American production of crude iron is 148,000 tons. Stocks are light at furnaces and in consumers' hands. The present consumption is sufficient to prevent any accumulation excepting on very poor brands. The bridge builders are beginning active work in the West, and about ten miles of their extensive work will be erected across the larger rivers in the West this winter. Heavy engineering requirements are looming up. Railroad building enterprises are also attracting the attention of financiers throughout the East. There is no weakening in confidence and no indications of a subsidence of the activity that has characterised the American market since the opening of the year.

NEW COMPANIES.

The following companies have just been registered:—

Anglo-Argentine Tramways Company, Limited.

This is a reconstruction of the existing company with the same title. It was registered on the 19th ult., with a capital of £800,035, in £5 shares. The subscribers are:—

	Shares.
*A. J. Lambert, 9, Craven-hill, merchant	1
R. Cunliffe, 43, Chancery-lane, solicitor	1
*J. R. Carbett, Betchworth, Surrey	1
*Lord R. H. Browne, Reigate, Surrey	1
T. Fennelly, 4, Copthall-buildings	1
J. W. Alison, 4, Copthall-buildings	1
W. F. Cunliffe, 43, Chancery-lane, solicitor	1

The number of directors is not to be less than three, nor more than seven, the first being the subscribers denoted by an asterisk; qualification, 200 shares. The remuneration of the board will be £1500 per annum, or such larger sum as the company in general meeting may determine.

Automatic Trading Company, Limited.

This company was registered on the 22nd ult., to manufacture and sell automatic delivery boxes, and to acquire the invention of Alfred William Armstrong for the adaptation of electricity to automatic and other apparatus, together with the goodwill and business carried on by Mr. Armstrong in connection therewith. The capital is £100,000, in £1 shares, and the first subscribers are as follows:—

	Shares.
James Phillips, Daneville-road, Denmark-hill, clerk	1
Henry Wade, 25, Maxted-road, Peckham, architect	1
H. Sprague, 17, Charles-street, Northampton-square, E.C., clerk	1
R. J. Howard, 36, Gordon-dwellings, Camberwell, timekeeper	1
J. L. Cooper, 14, St. Paul's-road, Camden-square, accountant	1
C. Wren, 79, Church-crescent, Luton, clerk	1
Robt. Howard, 26, Claude-road, Peckham Rye, S.E., merchant	1

The number of directors is not to be less than three, nor more than seven; the subscribers nominate the first. The remuneration of the board will be at the rate of £100 per annum in respect of each director, with £50 extra for the chairman, and an additional bonus of 10 per cent. on the net profits remaining after payment of 10 per cent. per annum dividend, to be divided as they may determine.

Breikvam Zinc Company, Limited.

This company proposes to purchase the rights and interest of George Hamilton Hargreaves, of 174, New Bond-street, in the mining property known as the "Breikvam Zinc Property," situate about six miles from Saude Fiorde, province of Stavanger, in Norway, extending about 3500 metres along its mineral lode. It was registered on the 23rd ult., with a capital of £50,000, in £1 shares. The purchase consideration is £35,000, payable £1000 in cash on delivery of the documents of title, £32,500 in fully-paid shares, and £1500 in cash as soon as the company's auditors certify that the company has earned sufficient profits to justify the declaration of £5 per cent. dividend on the issued capital in any one half-year. The subscribers are:—

	Shares.
*G. H. Hargreaves, 174, New Bond-street	1
F. D. Mackenzie, 6½, Austinfriars, merchant	1
M. Macnaughtan, 48, Duke-street, St. James', clerk	1
G. E. Lake, 18, New-square, Lincoln's-inn, solicitor	1
*J. Duncan Stuart Sim, 14, King's Bench-walk, barrister	1
T. Wise, 50, Gresham-street, chartered accountant	1
*W. Macnaughtan, 6½, Austinfriars, merchant	1

The number of directors is not to be less than three, nor more than six; the first are the subscribers denoted by an asterisk and Mr. W. S. Hansen, of Stavanger; qualification, 250 shares. The remuneration of the board will be at the rate of 10 per cent. on the amount of the annual dividend upon the ordinary shares.

Marine Life-saving Appliances Company, Limited.

This company proposes to purchase the patent rights of Frederick Hargrave in respect of Hargrave's patent safety night and distress signals and rocket discharger, Hargrave's patent electrical sounding apparatus, and Hargrave's patent improved cork life-buoy. It was registered on the 17th ult., with a capital of £60,000, in £1 shares, with the following as first subscribers:—

	Shares.
J. Foskett, Essex, accountant	1
W. Balch, 32, Elderfield-road, Clapton, electrician	1
T. H. Letts, 31, Chiswick-road, Gunnersbury, architect and surveyor	1
A. S. Forbes, 85, Ladbroke Grove-road, clerk	1
J. W. Morley, 185, Earl's Court-road, auctioneer	1
Charles Jayne, Southend, architect	1
F. Hargrave, 35, Queen Victoria-street, electrician	1

The number of directors is not to be less than three, nor more than seven; the subscribers appoint the first, and act *ad interim*. Mr. Hargrave will join the board after allotment. Qualification for subsequent directors, 250 shares. The remuneration of the board will be £1000 per annum.

Thompson's Patent Gravity Switchback Railway Company, Limited.

This company was constituted by articles of association on the 1st ult., and registered as a limited company on the 18th ult., with a capital of £20,000, in 2000 shares of £10 each, 400 of which are taken up and are fully paid. It proposes to acquire and use the invention known as Thompson's gravity switchback railway, and the business in connection therewith, carried on by Alfred Pickard and George Grant, at 5, John-street, Adelphi. The subscribers are:—

	Shares.
*Vincent Augustin Applin, 5, John-street, Adelphi, solicitor	40
*R. Lilburn Barnes, Phœnix Works, Hackney Wick, manufacturer	40
*G. Grant, 5, John-street, Adelphi	119
*A. Pickard, 5, John-street, Adelphi	159
A. B. Pickard, 5, John-street, Adelphi	1
*J. H. Sams, 5, John-street, Adelphi	40
A. Innes Keys, 40, Whitehall	1

The number of directors is not to be less than three, nor more than seven; qualification, £200 in shares; the first are the subscribers denoted by an asterisk. Mr. J. H. Sams is appointed managing director at a salary of £500 per annum. The other members of the board will be entitled to £800 per annum, and also to a commission of 10 per cent. on the surplus profits remaining after payment of 10 per cent. dividend.

Automatic Recording Till Company, Limited.

On the 22nd inst. this company was registered, with a capital of £30,000, in £1 shares, to acquire an improved automatic recording till, for which provisional protection for patent—dated May 5th, 1887, No. 6626—has been granted to Henry Thomas Davis. The subscribers are:—

	Shares.
F. H. Relph, 101, Leadenhall-street, director of a company	1
W. G. Hannay, 48, Castle-street, Oxford-circus, journalist	1
G. E. Way, 18, Gascony-avenue, Kilburn, merchant	1
W. H. Chase, 39, Lombard-street, merchant	1
R. J. Berryman, 1, Verulam-buildings, Gray's-inn, clerk	1
S. J. R. Allen, 42, Endymion-terrace, N., clerk	1
W. G. Raikes, Suffolk House, Laurence Pountney-hill	1

The number of directors is not to be less than three, nor more than nine; the subscribers are to appoint the first; qualification for subsequent directors, 400 shares. After 5 per cent. per annum dividend is paid, the board will be entitled to remuneration at the rate of £100 per annum for each director.

King's College Engineering Society.—At a general meeting held on Tuesday, November 29th, Mr. Sparks read a paper on "Diving Apparatus." The author commenced with a history of diving from the earliest times, mentioning the successive inventions. He then passed on to the diving dress as used when supplied with air pumped down from the surface, Messrs. Siebe, Gorman, and Co.'s dress being especially mentioned and approved of. The Fleuss apparatus was next explained, by means of which the diver takes down a supply of oxygen with him, and is thus free from the incumbrance of pipes. The question of lights was then touched upon, including a good form of oxyhydrogen lamp, and also both arc and incandescent electric lights. A discussion then took place, and, after a vote of thanks to Mr. Sparks, the meeting adjourned.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

22nd November, 1887.

16,004. Facilitating the Supply of Gas, G. Delaporte, London.
16,005. Tape Measures, &c., F. O. Ferguson, London.
16,006. Football Cases, E. H. Seddon, Brooklands.
16,007. Velocipedes, R. J. Urquhart, Chorlton-cum-Hardy.
16,008. Controlling, &c., Clocks, G. D. MacDougald, Dundee.
16,009. Extinguishing Lamps, F. R. Baker, Birmingham.
16,010. Raising Galleries of Oil Lamps, F. R. Baker, Birmingham.
16,011. Regenerative Furnace, R. Horsburgh, Glasgow.
16,012. Carding Machines, G. and E. Ashworth, Manchester.
16,013. Ventilators, C. Gannaway, Glasgow.
16,014. Fastening Knobs for Doors, R. Hall and J. Tinline, Manchester.
16,015. Books, J. Hess, London.
16,016. Boilers, I. Jackson, Manchester.
16,017. Loom Spindles, W. Atkinson and G. A. J. Schott, Bradford.
16,018. Flexible Films for Photography, J. E. Thornton, Manchester.
16,019. Hog-rings, T. R. Cattell, Birmingham.
16,020. Grinding Rods, W. Stokes and F. Makepeace, Birmingham.
16,021. Looms, J. T. Butterworth, Rochdale.
16,022. Printing Machines, J. H. Buxton, D. Braithwaite, and M. Smith, Manchester.
16,023. Blowing Engines or Motors, J. T. H. Asbury, Birmingham.
16,024. Separating Threads of Cotton, G. Eastwood, Rochdale.
16,025. Saws, E. M. Boynton, London.
16,026. Pocket Knives, E. M. Boynton, London.
16,027. Separating Precious Metal, C. E. Tripler, London.
16,028. Railway Ties, W. P. Hall and C. C. Barnett, London.
16,029. Gas Motor Engines, H. Williams, Manchester.
16,030. Gas Motor Engines, H. Williams, Manchester.
16,031. Cutting Glass Tubes, E. S. Baldwin.—(*D. Mitchell, New Zealand.*)
16,032. Dynamo-electric Machines, &c., W. Main, London.
16,033. Driving Chains, &c., J. Marston and J. Muir, London.
16,034. Ornamental Head-dress, &c., J. C. Edwards, Manchester.
16,035. Folding Letters, Parcels, &c., E. A. Bouët, Kidderminster.
16,037. Life Guard for Steam Trams, H. J. Watkins, Yardley Wood.
16,037. Anchor, H. F. Alexander, Glasgow.
16,038. Engraving Processes, J. Stephen, London.
16,039. Telescopic and Safety Lamp, A. Kingshott, London.
16,040. Horseshoes, W. Greaves and J. Goodall, Sheffield.
16,041. Apparatus for Fire-bars, &c., R. H. Radford, Sheffield.
16,042. Top Bars for the Ribs of Fire-places, R. Peel, London.
16,043. Gauges, J. Jackson, London.
16,044. Wrought Iron Tire Platform, A. Hopton, London.
16,045. Applying Grease to Axles, &c., J. E. Walker, London.
16,046. Stoppering Bottles, &c., T. W. Callow, London.
16,047. Antifriction Journal-boxes, A. J. Boult.—(*W. S. Sharpnecks, United States.*)
16,048. Raising, &c., Window Sashes, T. Wilkins, Liverpool.
16,049. Car Brakes, A. J. Boult.—(*E. E. Dougherty, United States.*)
16,050. Steering Apparatus, S. H. Wilson and W. Kermode, Liverpool.
16,051. Timepieces, M. Van B. Ethridge, H. E. Waite, and J. Swann, London.
16,052. Envelope with Dial on Flap, C. J. Eyre, London.
16,053. Machines for Making Rope, &c., T. B. Dooley, London.
16,054. Filtration of Liquids, R. Pol, London.
16,055. Studs, P. Wondra, London.
16,056. Velocipedes, H. M. Himerl, London.
16,057. Clasps for Books, P. A. Newton.—(*A. Liebenroth, United States.*)
16,058. Telephonic Apparatus, G. F. Redfern.—(*L. de Combettes, France.*)
16,059. Photographic Printing, J. B. Germeuil-Bonnaud, London.
16,060. Automatic Gas Valves, J. Winterflood, London.
16,061. Ventilation of Soil Pipes, &c., R. H. Reeves, London.
16,062. Burners for Petroleum, &c., Lamps, A. Böhlmark, London.
16,063. Holding and Fixing Scaffold Poles, &c., J. Beesley, London.
16,064. Railroad Rails, F. Lightfoot, London.
16,065. Cartridge Shells, L. W. Lombard, London.
16,066. Apparatus for Heating by Gas, A. H. Hearington, London.
16,067. Packing in Steam Engines, &c., H. J. Haddan.—(*P. F. E. Carré, France.*)
16,068. Quilted Fabrics, A. B. and C. E. Dobell, London.
16,069. Ventilating Fans, E. Grube, London.
16,070. Ventilators, &c., H. J. Haddan.—(*H. Klein, Germany.*)
16,071. Hollow Buoyant Block or Case, A. M. Wood, London.
16,072. Stamping Typographical Printing Surfaces, A. J. Engelen, London.
16,073. Moderator and Carcel Lamps, C. D. Aria, London.
16,074. Chronographs or Stop Watches, V. Jeannot, London.
16,075. Couplings or Joints for Pipes, &c., C. Heer, London.
16,076. Axle-boxes, J. Donnelly, W. McLaren, and A. Trask, London.
16,077. Making Smooth Surfaces on Stone, &c., J. S. McCoy, London.
16,078. Decorating Fibres, A. M. Clark.—(*J. B. Vogel, United States.*)

23rd November, 1887.

16,079. Time Indicator, T. S. James, London.
16,080. Hosiery, F. Moore and J. Palmer, London.
16,081. Spiral Shoot, L. H. Ballantine, Linlithgow.
16,082. Valves for the Steam Cylinder of Direct Pumps, W. H. Blakeney, Nethergate.
16,083. Self-extinguishing Match, W. H. Percival, London.
16,084. Generating Carbonic Acid Gas, F. Foster, London.
16,085. Knife for Cutting Leather Laces, &c., W. G. Old, Northampton.
16,086. Drilling and Boring Machines, J. Wild, Chadderton.
16,087. Electric Contact Maker, J. S. Farmer, Manchester.
16,088. Cloth for Billiard Tables, &c., G. E. Stead, Manchester.
16,089. Veneering Felt Hats, F. W. Cheetham, Manchester.
16,090. Winding Frames, E. Whalley, Manchester.
16,091. Lap Holders for Carding Engines, G. and E. Ashworth, Manchester.
16,092. Glaziers' Wheel Glass Cutters, J. Hewitt, Sheffield.
16,093. Hydraulic Lifts, J. S. Stevens and C. G. Major, London.
16,094. Drop Box Looms, C. Hahlo, C. E. Liebreich, and T. Hanson, Halifax.
16,095. Self-contained Spindles, S. Tweedale, Halifax.
16,096. Mechanical Stokers, W. Leach, Halifax.
16,097. Waist Handkerchiefs, A. W. Patching, Birmingham.
16,098. Markers for Lawn Tennis, A. W. Patching, Birmingham.
16,099. Driving Chains, W. H. Crowley and S. Edwards, Sheffield.
16,100. Treating Milk, &c., W. H. Wells, Evershot.
16,101. Ball Castors, T. S. W. Good, Birmingham.
16 102. Coupling, &c., Railway Vehicles, E. Bassett, London.
16,103. Bottle Capsuling Instruments, G. Summers, Glasgow.
16,104. Pulley, Fly, or other Wheels, A. J. Scott, London.
16,105. Fire-tongs, I. Whitehouse, Birmingham.
16,106. Preventing the Fouling of Beer or other Barrels, A. Dickinson, Birmingham.
16,107. Padlocks, G. Harrison, Birmingham.
16,108. Foot Baths, J. A. McKee, London.
16,109. Extinguishing Fires, G. W. Crawshaw and J. Tonge, London.
16,110. Tricycles, W. Phillips, London.
16,111. Lock for Securing the Receipt of Coins, W. F. Hurndall, London.
16,112. Bells or Gongs for Cycles, &c., G. Singer, London.
16,113. Chain and other Links, J. E. Bott and C. H. Cousins, London.
16,114. Fuel Economisers, A. Lowcock and T. Sykes, Manchester.
16,115. Velocipedes, J. Asbury, London.
16,116. Kieselguhr-dynamite, E. Grüne, London.
16,117. Hearthstones, S. J. Payne, West Thurrock.
16,118. India-rubber Soles for Boots and Shoes, I. B. Harris, Glasgow.
16,119. Water-closets, &c., G. de A. Magalhaes, London.
16,120. Voltaic Batteries, E. Tyer, London.
16,121. Protecting Fingers whilst Sewing, J. Barnes, London.
16,122. Life-saving Jacket, S. M. y Valdivielso, London.
16,123. Oil Lamps, J. D. and J. H. Dobson, Wakefield.
16,124. Converting Reciprocating Motion into Rotary Motion, C. Stuart, London.
16,125. Photo-engraving or Etching, E. Albert, London.
16,126. Brooch, J. Friedberger, C. Hammer, F. F. Mock, A. Bucher, and M. Häderer, London.
16 127. Lock-stitch Sewing Machines, F. Smith, London.
16,128. Mechanical Stokers, W. H. Munns.—(*J. P. Sunderland and D. M. Monjo, United States.*)
16,129. Fasteners for Stays, &c., D. I. Emery, London.
16,130. Ticket Punches, J. M. Black, London.
16,131. Securing the Leaves in Albums, &c., C. H. Hammann, London.
16,132. Heddles for Looms, W. R. Lake.—(*G. V. Morey, United States.*)
16,133. Railway Couplings, J. P. Cito and P. Funck, London.
16,134. Voltaic Batteries, T. J. Jones, London.
16,135. Fastening for Ties, J. Welch.—(*W. H. McLeod, New York.*)
16,136. Application of Photography to Automatic Machines, E. J. Ball, London.
16,137. Stop and Catch for Doors, R. W. Deacon.—(*C. Watt and N. H. Richards, Victoria.*)

24th November, 1887.

16,138. Swivel for Watches, F. V. Hawley, London.
16,139. Fastening Truss Spring Belt, &c., C. W. Weisbarth, Truro.
16,140. Carding Engines, G. Kilner and C. E. Kilner, Huddersfield.
16,141. Sockets for Window Curtain Rods, A. Edmonds, London.
16,142. Producing a Crystalline Effect on Glass, &c., G. J. Atkins, London.
16,143. Buttons, &c., H. Owen, Birmingham.
16,144. Gas-motor Engines, H. Williams, Manchester.
16,145. Oil Chandeliers, &c., G. Carter, London.
16,146. Starting Gas Motor Engines, H. Williams, Manchester.
16,147. Nails, H. Munslow, Birmingham.
16,148. Bricks or Blocks of Ironstone Waste, L. A. Brode, Glasgow.
16,149. Boxes, W. P. Thompson.—(*M. Heinemann, Germany.*)
16,150. Lamp-burners, W. P. Thompson.—(*F. Deimel and E. von Bühler, Germany.*)
16,151. Attaching Handles to Paper Bags, J. E. Kingsford and A. T. Hope, London.
16,152. Circular Knitting Machines, W. H. Dorman, Staffordshire.
16,153. Sighting of Military Rifles, G. A. Lewes, Farnborough.
16,154. Paper-feeding Machines, J. G. Cumming, Edinburgh.
16,155. Perforated Bottoms and Backs for Chairs, J. Jack, Grantham.
16,156. Mounting of the Under Grids of Carding Engines, G. and E. Ashworth, Manchester.
16,157. Controlling the Grinding of Carding Engine Flats, J. M. Hetherington, Manchester.
16,158. Feeding Bees and other Insects, J. T. Sibree, Stroud.
16,159. Boxes for Preserved Fruit, &c., H. Faulder, Manchester.
16,160. Ornaments for Bedsteads, &c., W. Allman, London.
16,161. Raising Nap upon Textile Fabrics, W. Hampson and E. Marshall, Manchester.
16,162. Hydraulic Motor, M. Immisch, London.
16,163. Link Belting for Machinery, W. W. Oldfield, Glasgow.
16,164. Letter or Paper Weight, B. McEvoy, Birmingham.
16,165. Pavements and Roadways, B. L. Moseley, London.
16,166. Serviette or Napkin Holders, F. A. Walton, Birmingham.
16,167. Lamps, F. Devoney and T. Askey, Birmingham.
16,168. Ornamentation of China, &c., T. Taylor, W. Tunnicliff, and W. H. Slater, Birmingham.
16,169. Shades and Globes, A. T. Woodhall, London.
16,170. Calendars, J. A. Fisher, Anerley, and G. N. H. Whales, London.
16,171. Knitting Machines, W. H. Heyle, London.
16,172. Counters, Dressers, &c., G. Vaughan and J. J. Westacott, London.
16,173. Roundabouts, S. Keeton and J. W. Danby, London.
16,174. Producing Designs on Celluloid, &c., Compounds, A. Bensinger, London.
16,175. Type Writers, F. Mitchell, London.
16,176. Garments for Lying-in Women and Invalids, A. L. Jones, London.
16,177. Playing Card Cases, T. C. Underhill, London.
16,178. Milking Cows, W. Barr, jun., Glasgow.
16,179. Cylinder Printing Machines for Calico, &c., J. Blair, Glasgow.
16,180. Cigarettes, M. M. Yergatian, London.
16,181. Button-hole Sewing Machines, W. Norris and F. Simmons, London.
16,182. Single-action Motive-power Engines, F. W. Dodd, London.

16,183. Extracting Gold from Ores, J. B. Spence, London.
16,184. Gas Union, H. P. Miller, London.
16,185. Electric Meters, W. J. S. Barber-Starkey, London.
16,186. Rail Fastenings for Sleepers, C. W. E. Marsh, London.
16,187. Medicated Biscuits and Sweetmeats, H. Wœrn, London.
16,188. Medicated Biscuits and Sweetmeats, H. Wœrn, London.
16,189. Elevating Grain by Injector Action, A. Nosbaume, London.
16,190. Women's Indoor Cap, J. Cryer, London.
16,191. Regulating Draught to Chimneys, J. Lyle, London.
16,192. Amalgamated Plates used in Treating Gold Ores, P. J. Ogle, London.
16,193. Tennis Court-marking Machine, E. J. Taylor, London.
16,194. Coffins, H. Guillery, London.
16,195. Cutting Hay, &c., G. F. Redfern.—(*D. Quertain and J. B. Masurelle, Belgium.*)
16,196. Sewing Machine for Two Lines of Sewing, T. R. Rossiter, London.

25th November, 1887.

16,197. Construction of Ships' Boats, J. Russell, Cork.
16,198. Gas Motor Engines, H. Williams, Manchester.
16,199. Gas Motor Engines combined with Pneumatic, &c., Pumps, H. Williams, Manchester.
16,200. Surface Condensers for Tramway and other Engines, G. W. Blackburn, Leeds.
16,201. Stockinette Frames, R. H. Londrum and S. Mitchell, Halifax.
16,202. Egg Boiler, J. A. de Macedo, Thorner, Yorkshire.
16,203. Press for Lawn Tennis Racquets, R. Baily and W. Wall, Bradford.
16,204. Folding Post Letter Card, A. Fielding, London.
16,205. Automatic Floating Ball Valves, F. W. Cannon, London.
16,206. Automatic Match Delivery Boxes, F. W. Cannon, London.
16,207. Hair Brush, R. Parry, Westcote, Hoole.
16,208. Railway Mat and Border, T. J. Fry, Dublin.
16,209. Fixing Ornaments to Lamp Stands, A. L. Bayley, Sutton Coldfield.
16,210. Drop Sight Feed Lubricators, F. T. Schmidt and R. C. Douglas, Bradford.
16,211. Match and other Slide Boxes, C. Baker, Dewsbury.
16,212. Frames for Photographic, &c., Pictures, J. Cadbury and W. H. Richards, Birmingham.
16,213. Colouring Matter, I. Levinstein, Manchester.
16,214. Weighing Machines, W. Cunningham, Glasgow.
16,215. Safes, W. S. Masters and E. G. Wood, Liverpool.
16,216. Ticket Holders for Railway Trucks, &c., J. Sime, London.
16,217. Automatically Conveying Letters by Electricity, F. C. Allsop, Bexley.
16,218. Coat Collar Adjuster, M. W. Carmichael, London.
16,219. Reading Railway Light, H. Nicoll, London.
16,220. Regenerative Furnaces, J. Powell, London.
16,221. Altering and Adjusting Outlet Liquid Level in Tanks, S. Cutler, London.
16,222. Gas Washers or Scrubbers when more than one are Employed, S. Cutler, London.
16,223. Furnaces for Steam Boilers, J. Hodgkinson, London.
16,224. Resters for Packing Felt Hats, C. Blyth, London.
16,225. Castors, G. Y. Iliffe, Birmingham.
16,226. Chromograph, J. Eagle, Harrow-on-the-Hill.
16,227. Metallic Bedsteads, W. W. Cave, London.
16,228. Arc Lamps for Electric Lighting, W. F. C. Ward and E. W. Willey, London.
16,229. Making Buttons from Horn, E. G. Brewer.—(*D. Robbiati, Italy.*)
16,230. Infant's Chairs, A. Plant, Glasgow.
16,231. Cigarettes, J. S. Rhodes, Birmingham.
16,232. Driving Machinery without Labour, Gas, Steam, or Electricity, D. Jones and C. E. Quilter, London.
16,233. Decorating Metallic Surfaces, W. R. Deykin and C. Preston, London.
16,234. Wall Ties or Bond Iron, J. Sheldon, London.
16,235. Enamelled Letters, H. Griffin, London.
16,236. Sewing Machines, W. R. Lake.—(*N. Wheeler, United States.*)
16,237. Valve Taps, R. L., C. A. L. Burkitt, and J. Borland, London.
16,238. Flushing Cisterns, C. H. Onions, London.
16,239. Compressing Drugs, J. Tinlin, J. J. Piatkowski, S. M. Burroughs, and H. S. Wellcome, London.
16,240. Lamps, E. Edwards.—(*A. Jousset, France.*)
16,241. Coating Glass with Fluid, F. J. Vergara, London.
16,242. Sheaf Binder, E. Edwards.—(*J. B. Maïs, France.*)
16,243. Loading Coal &c., into Vessels, W. T. Lewis, Aberdare, and C. L. Hunter, Roath.
16,244. Soldering Glass to Metals, A. Romberg-Nisard, London. [Received 25th November, 1887. Antedated 25th May, a.d., 1887. Under International Convention.]
16,245. Corrugated Plates, R. Baillie, London.
16,246. Valve Apparatus for Brakes, F. A. Brüggemann, London.
16,247. Lamps, T. C. J. Thomas, London.
16,248. Safety Letter-box, E. P. Everett and J. I. Richmond, London.
16,249. Liquid Meters, G. Hughes.—(*A. Kaiser, Switzerland.*)
16,250. Envelopes, J. Richmond and W. Whiting, London.
16,251. Four-wheeled Road Vehicles, F. West, Southampton.
16,252. Arc Lamps, J. Kent, London.
16,253. Oil Lamps, H. A. Kent, London.
16,254. Obtaining Products from Solutions Containing Barium, The Tyne Alkali Company and T. Gibb, London.
16,255. Boats, F. E. Clotten, London.
16,256. Deodorising and Disinfecting Material, W. R. Lake.—(*J. W. Culbertson, United States.*)

26th November, 1887.

16,257. Improvements in Gas Engines, P. J. Ravel, London.
16,258. Engine Indicators, T. S. McInnes, Glasgow.
16,259. Metallic Bedsteads, &c., R. G. V. Avezathe, Birmingham.
16,260. Churns, T. Bradford, Manchester.
16,261. Suspending Umbrellas, Pipes, &c., R. Heaton, Birmingham.
16,262. Metallic Lathing for Ceilings, F. N. Seyde, Birmingham.
16,263. Pigments, &c., F. M. and D. D. Spence, Manchester.
16,264. Oil Lamps, &c., A. Neilson and J. Taylor, Glasgow.
16,265. Polishing Hackle Pins, F. and D. Halley, Glasgow.
16,266. Folding Bicycles, W. Anyon and J. F. Corner, Manchester.
16,267. Bicycles, L. A. Groth.—(*M. Frankenburger and M. Ottenstein, Germany.*)
16,268. Lamp Globe, W. J. Payne, London.
16,269. Telescopic Blind Roller, T. Byfield, Birmingham.
16,270. Refractory Gold, &c., Ores, H. Hutchinson, London.
16,271. Rope Pulley Blocks, H. D. Gough, Birmingham.
16,272. Elastic Finger Protector, &c., F. Redmond, Ranelagh.
16,273. Automatic Extinguishing Burners, A. Rochford, Dublin.
16,274. Detachable Magazine Fire-arms, P. Mauser, London.
16,275. Twine and Thread, R. J. and W. D. Foster, London.
16,276. Incandescent Gas Lamp Globes, W. W. Kennedy, Edinburgh.
16,277. Football Bladders and Gas Bags, H. Swales, London.
16,278. Transferring Railway Wagons, W. W. Rutherford, London.
16,279. Roller for Window Blinds, C. M. Officer, jun., London.
16,280. Manufacture of Brass, &c., Tubes, W. E. Everitt, London.
16,281. Metallic Hinges, S. Bott, London.
16,282. Tailors' Measuring Apparatus, F. A. Meyer, London.
16,283 Washing Clothes, W. Morris and L. Wilkinson, London.
16,284. Refrigerators, W. T. Taylor, London.
16,285. Mitreing Tools, A. Johnstone, Glasgow.
16,286. Guiding Driving Bands, R. Hornsteiner, London.
16,287. Automatic Time-interval Apparatus, B. D. Wise, London.
16,288. Ships' Berths, E. Lawson, London.
16,289. Opening &c., Fanlights, &c., A. Illidge, London.
16,290. Machine Tools for Cutting Metals, W. Craven, London.
16,291. Gas Meters, S. Cutler, London.
16,292. Firing Mechanism, W. Lorenz, London.
16,293. Air Forcing Apparatus, L. Sterne, London.
16,294. Apparatus for Forcing Air, L. Sterne, London.
16,295. Brake Gear of Cable Tramcars, N. H. Richards, London.
16,296. Galvanic Batteries, A. F. St. George and C. R. Bonne, London.
16,297. Ball Bearings, A. W. Kirsch and J. Goldschmidt, jun., London.
16,298. Tires, G. Pickhardt, London.
16,299. Control Pressure Gauges, R. Gradenwitz and E. A. Taenzer, London.
16,300. Automatic Flushing Tanks, O. Elphick, London.
16,301. Extraction of Organic Bases from Coal, I. Lewkswitsch, London.
16,302. Dished Discs for Washing, W. S. Simpson, London.
16,303. Vent Nozzles for Bottles, &c., D. Wood, London.
16,304. Plates for Engraving, W. R. Lake.—(*Hoke Engraving Plate Company, United States.*)
16,305. Voltaic Cells, H. C. Donovan and T. Weatherall, London.

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16,306. Metal Tires, A. S. Tanner, London.
16,307. Dobbies, C. T. Bradbury, W. Halliday, and H. Livesey, Bradford.
16,308. Boat Launching Apparatus, J. Beynon, London.
16,309. Gas Engines, T. Sturgeon, London.
16,310. Lamp-burners, M. Graetz, Berlin.
16,311. Conveying the Oil to Wicks, F. V. Smythe, Gravesend.
16,312. Roughing Horses' Shoes, J. Head, Cheltenham.
16,313. Securing Bows of Keyless Watches, W. S. Leete, London.
16,314 Horse Bit, F. E. Jones, Birmingham.
16,315. Eyeletting Machines, C. H. Guest and L. Barrow, Birmingham.
16,316. Brace End, &c., Attachment, A. Breese, London.
16,317. Stamp and Label, D. Gilmore, Belfast.
16,318. Inhaler, T. D. Harries and G. Davis, Aberystwith.
16,319. Spun Silk Yarns, J. H. Chambers, Horsforth.
16,320. Horse Rakes, C. E. Mumford and D. Hearn, Bury St. Edmunds.
16,321. Spinning of Wet-spun Yarns, J. V. Eves, Belfast.
16,322. Draught and Dust Excluder, W. Birdthistle, London.
16,323. Preparing the Skins of Birds, &c., F. C. Gibbs, Bristol.
16,324. Electro-mechanical Striking Gongs, F. T. Schmidt, Bradford.
16,325. Electrical Switches and Cut-outs, F. T. Schmidt, Bradford.
16,326. Duplex Steam Engines, A. G. Brookes.—(*C. C. Worthington, United States.*)
16,327. Ornamenting Wood, &c., D. B. Burdett and J. A. Leach, London.
16,328. Automatic Delivery Boxes, B. W. Warwick, London.
16,329. Incorporating Mineral Oils into Soap, F. Rainbow, Luton.
16,330. Non-inflammable Cellulose Matters, A. C. Henderson.—(*C. Stocker, France.*)
16,331. Shaking Mechanism for Thrashing Machines, W. Hennecke, London.
16,332. Locks, F. Spengler, Liverpool.
16,333. Mechanical Appliance for Clocks, &c., A. B. O'Connor and G. W. Butterfield, London.
16,334. Bath and Flesh Brush, K. A. Lingner and G. W. Kraft, Berlin.
16,335. Cleaning Metallic Bodies, J. W. Hughes and G. C. Fricker, London.
16,336. Shearing Wool or Clipping Hair, V. Petherick, London.
16,337. Preventing Waste in Uncorking Bottles, R. C. and W. H. Mann, London.
16,338. Cellular Bottoms of Ships, R. S. White, London.
16,339. Oil Lamps, J. Smith, London.
16,340. Roasting Machines, E. de Pass.—(*E. Lacroix and D. P. F. Cardozo, France.*)
16,341. Game called Union Jack, R. Wakely, London.
16,342. Phonographic Apparatus, G. L. Anders, London.
16,343. Counting Apparatus, &c., H. A. A. Thorn, London.
16,344. Nose-bag J. B. Champion, London.
16,345. Shuttle Driving Mechanism, J. B. Robertson, London.
16,346. Tuyeres for Furnaces, H. B. Scott and W. Gentles, London.
16,347. Smelting of Copper, H. B. Scott and W. Gentles, London.
16,348. Carriage Windows, J. U. Burt, London.
16,349. Mouldings, A. Spiess, London.
16,350. Spinning and Doubling Machinery, W. Mair, Glasgow.
16,351. Electric Belts, A. Owen, London.
16,352. Measuring Muscular Exercises, H. J. Haddan.—(*G. Gaertner, Austria.*)
16,353. Dipping Match Splints, H. C. Zappert, London.
16,354. Filling Match Boxes, &c., H. C. Zappert, London.
16,355. Producing Cloisonne Designs, J. Y. Johnson.—(*M. Aubriot, France.*)
16,356. Breech-loading Small-arms, T. H. Morten and E. Hughes, London.
16,357. Extinguisher for Oil Lamps, C. H. Fitzmaurice, London.
16,358. Cuff Holders, C. E. Candee, London.
16,359. Producing Drawings on China, E. M. MacDonald, London.

SELECTED AMERICAN PATENTS.

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

369,920. Apparatus for the Preparation of Concrete, *E. Coignet, Paris, France.—Filed December 14th*, 1887.

Claim.—(1) The mode herein described of preparing concrete composition, said mode consisting in first mixing the materials in a dry condition, spreading the mixed material in thin layers and wetting the layers, and finally triturating or reducing the mixed and wet material, all substantially as set forth. (2) The mode herein described of preparing concrete composition, said mode consisting in first mixing the materials in a dry condition, then wetting the materials and mixing chloride of calcium therewith, and reducing the mixture, substantially as specified. (3) The mode herein described of laying concrete, said mode consisting in forming in the upper surface of one layer tapering or wedge-shaped recesses facing in opposite directions and ramming the fresh concrete into these recesses for the next layer, in order to interlock the layer, substantially as set forth. (4) The combination

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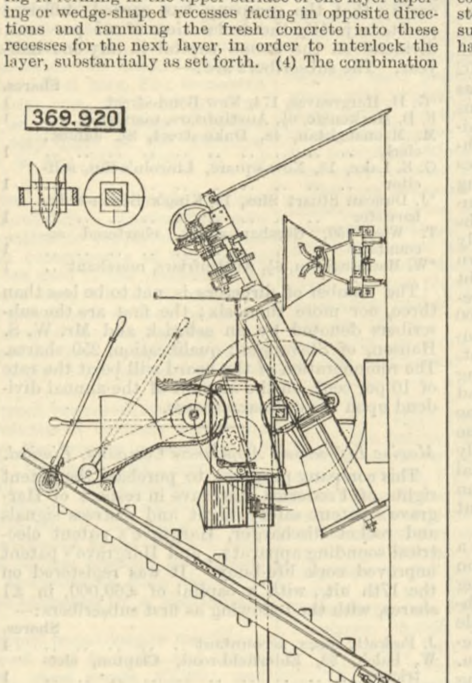

of the mixer with a hopper, shaking table, and reducing mill, substantially as described. (5) The combination of the mixer and shaking table below it with a reducing or triturating mill, into which the material from the table is fed, substantially as described. (6) The combination of the mixer and shaking table below it with a reducing or triturating mill and a tank to sprinkle liquid over the mixed materials, substantially as set forth. (7) The herein-described apparatus for preparing concrete, said apparatus consisting of a mixer, hopper, and elevator therefor, with a shaking table below the mixer, a water sprinkler, and a triturating or reducing mill, all substantially as set forth.

369,922 Jacket for Steam Cylinders, *R. Creuzbaur, Brooklyn, N.Y.—Filed November 18th*, 1886.

A working cylinder of a steam engine provided with a jacket covering its exterior surface wholly or in part, and with heat pegs projecting from its exterior surface into the space in said jacket, with free passage for the heating medium around each of such pegs, as set forth. A steam-engine cylinder provided with a jacket formed by an outer metallic shell I, and having isolated heat pegs *a*, formed integrally with said shell

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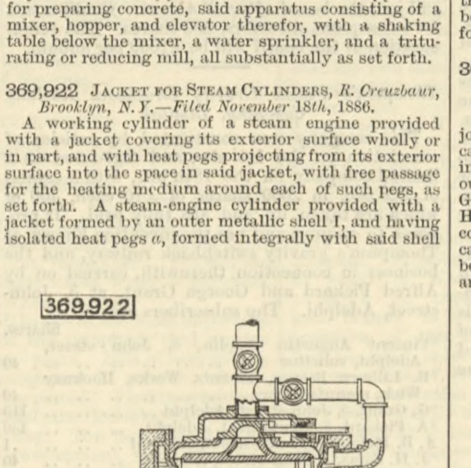

and said cylinder and extending across the space in said jacket. A steam engine cylinder provided with a jacket formed by an outer metallic shell I, with a non-conducting exterior covering X, to prevent radiation, and having isolated heat pegs *a* formed integrally with said shell and said cylinder and extending across the space in said jacket. The combination of a steam boiler, a superheater connected with said boiler by a steam pipe, and a steam engine cylinder provided with a jacket formed by an outer metallic shell protected by a non-conducting covering, and having isolated heat pegs extending across the space in said jacket, said heat pegs being formed integrally with said cylinder and outer shell, and said jacket being connected by a steam pipe with said superheater, whereby a current of heated steam is made to pass through said jacket and around said isolated pegs.

369,923. Compound Single-acting Steam Engine, *R. Creuzbaur, Brooklyn, N.Y.—Filed November 18th*, 1886.

Claim.—(1) A compound engine composed of single-acting cylinders arranged tandem, having the high-pressure piston connected on its non-working side with the working side of the intermediate piston by means of a pair of rods passing through the top of the intermediate cylinder, and having its ported valve casing and valve arranged in the cylinder axis between said rods. (2) A compound engine composed of three single-acting cylinders arranged tandem, and with their common axes vertical, having its crank shaft above said cylinders, the low-pressure piston coupled to one set of crank pins, and the intermediate piston coupled to another set of crank pins set at right angles to the first-named set, the steam distribution valves and their casings arranged in the cylinder axes, and the high-pressure cylinder coupled on its non-working side to the working side of the intermediate piston by means of two rods which pass through the top of the intermediate cylinder. (3) A compound engine composed of single-acting cylinders, having a cushion chamber arranged under one of its working pistons, in which a constant cycle of pressures is automatically maintained by connecting said chamber momentarily at the end of the upstroke with a body of an elastic fluid having an approximately constant tension. (4) A compound engine composed of single-acting cylinders, having a cushion chamber under one of its working pistons, which chamber has a port opening to the atmosphere and controlled by the said working piston, substantially as set forth. (5) A compound engine composed of single-acting cylinders, having connected steam jackets on said cylinders, forming a passage for steam to the high-pressure cylinder, having oppositely arranged inlets for the steam to said jacket, and having centrally arranged exhaust passages from one cylinder to the other, as set forth. (6) A compound engine composed of single-acting cylinders, having connected steam jackets on said cylinders, forming a passage for superheated steam to the high-pressure cylinder, and having oppositely arranged inlets for the steam to said

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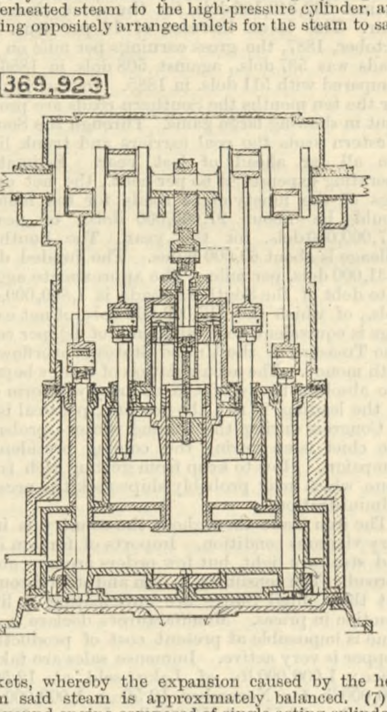

jackets, whereby the expansion caused by the heat from said steam is approximately balanced. (7) A compound engine composed of single-acting cylinders, having its low-pressure cylinder closed at both ends and provided with exhaust ports in its walls, which form the only communication from said cylinder to the exterior exhaust channels of said cylinder, the low-pressure piston controlling said exhaust ports, and said exhaust ports arranged at a point where they will be closed by the low-pressure piston before it reaches the end of its outstroke, whereby exhaust steam will be entrapped under said piston for cushioning, as set forth.

369,937. Means for Controlling Elevator Valves, *T. W. Heermans, Chicago, Ill.—Filed March 16th*, 1887.

Claim.—(1) The combination of the sleeve E journalled in the bearing V, secured to the side of the car, carrying on its outer end the sheave J and on its inner end the disc F, and the shaft B, carrying on its outer end the sheave K and on its inner end the disc G, with the hand wheel A, carrying the coned rollers H H between the discs F G. (2) In an apparatus for controlling the operation of elevators, the spindles I I, carrying coned rollers H H, interposed between the bevelled friction discs F G and radially adjustable, as and for the purpose specified. (3) The combination of

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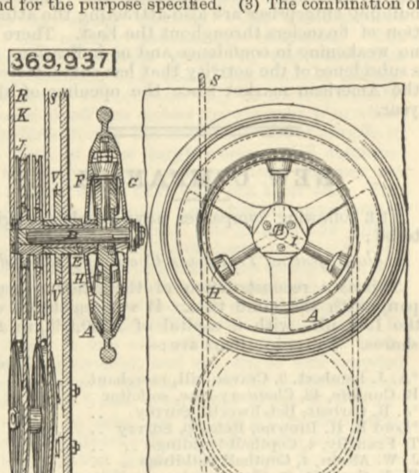

the ropes R S passing over sheaves K J in contrary directions, each sheave connected to and driving one of two opposed bevelled friction discs, and coned rollers carried by a hand wheel between said discs said hand wheel being provided with flanges *f f*, extending to meet said discs, as and for the purpose set forth. (4) In a control apparatus having opposed friction discs and interposed rollers, said discs being mounted respectively upon a concentric shaft and sleeve, a thrust-collar comprising a ring N and rollers T T, interposed between the sheaves carried upon the opposite ends of the shaft and sleeve.

370,017. Pulley, *W. R. Johns, Rockford, Ill.—Filed April 21st*, 1887.

Claim.—(1) The combination of a wheel, a thimble within the hub of the wheel, and a clutch collar to connect the thimble with the wheel or disconnect it therefrom, substantially as and for the purpose set forth. (2) The combination of a wheel, a thimble within the hub of the wheel, a clutch collar on the thimble, and a feather connection of the clutch collar

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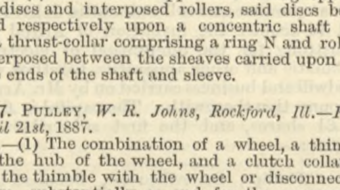

with the thimble, said clutch collar capable of an axial sliding movement in its feather connection with the thimble to connect or disconnect the wheel and thimble, substantially as and for the purpose set forth. (3) The combination of a wheel, a thimble within the hub of the wheel, a clutch collar on the thimble, and a spring-actuated stud within the clutch collar to engage the oil hole in the thimble, substantially as and for the purpose set forth.