SCREW PROPELLER EFFICIENCY.

By PROFESSOR A. G. GREENHILL.

No IV.

IV.—INVESTIGATION OF THE PRESSURE IN THE PROPELLER WAKE.

(42) IT has already been mentioned that the action of the screw propeller should be compared with that of the pressure or reaction turbine, in which the passages are always full of water, and which can therefore work under water if required, rather than that the screw propeller should be compared in its action to the impulse turbine, as in the theories of Rankine, Froude, and the French writers; because the impulse turbine must necessarily work above the tail water, and stops its action when drowned, and in its ordinary action the impulse turbine has the passages only partly filled with water.

(43) We shall now therefore attempt the solution previously promised of the determination of the pressure of the water passing through the propeller at any point of its path, and begin, as at first, by supposing the propeller working inside a closed cylinder, in order to avoid the necessity of the consideration of the pressure and its discontinuity at the surface of the propeller wake. It will be necessary, in order to avoid shock at entrance, to suppose the leading edge of the blades of the proper pitch $\frac{u}{n}$, and to suppose the propeller of properly increasing pitch; and it will simplify the hydrodynamical equations if we suppose the propeller fixed, and the water flowing through it with axial velocity u. In practice this will represent the case of a steamer just holding her own position against a strong tide or current by the action of the engines.

(44) Taking the axis of x in the sternward direction of the shaft, we must first transform the ordinary hydrodynamical equations in x, y, z, into corresponding equations for the so-called cylindrical co-ordinates x, r, θ; r and θ now denoting the polar co-ordinates of any arbitrary point in a plane perpendicular to the axis of x.

Now denoting by u, v, w, X, P, Θ, the component velocities and impressed forces at the point $(x\, r\, \theta)$ in the directions in which these co-ordinates increase independently as variables, and denoting the pressure by ϖ, the hydrodynamical equations became transformed into

$$X - \frac{1}{\rho}\frac{d\varpi}{dx} = \frac{du}{dt} + u\frac{du}{dx} + v\frac{du}{dr} + w\frac{du}{r\,d\theta},$$
$$P - \frac{1}{\rho}\frac{d\varpi}{dr} = \frac{dv}{dt} + u\frac{dv}{dx} + v\frac{dv}{dr} + w\frac{dv}{r\,d\theta} - \frac{w^2}{r},$$
$$\Theta - \frac{1}{\rho}\frac{d\varpi}{r\,d\theta} = \frac{dw}{dt} + u\frac{dw}{dx} + v\frac{dw}{dr} + w\frac{dw}{r\,d\theta} + \frac{vw}{r};$$

now denoting, instead of m, the density of the water.

(45) Supposing, as explained above, the motion considered as relative to the vessel, and to be a *steady motion*, then $\frac{du}{dt}$, $\frac{dv}{dt}$, and $\frac{dw}{dt}$ vanish; also the equation of continuity of the motion—

$$\frac{du}{dx} + \frac{dv}{dr} + \frac{dw}{r\,d\theta} = 0,$$

requires u to be constant for the tube to be filled, and v to be zero; and consequently $\frac{dw}{d\theta}$ to vanish, or w to be independent of θ.

Consequently our equations of motion reduce to

$$X - \frac{1}{\rho}\frac{d\varpi}{dx} = 0 \quad . \; . \; . \; . \; . \; . \; . \; . \quad \text{(i.)}$$
$$P - \frac{1}{\rho}\frac{d\varpi}{dx} = -\frac{w^2}{r} \quad . \; . \; . \; . \; . \; . \; . \quad \text{(ii.)}$$
$$\Theta - \frac{1}{\rho}\frac{d\varpi}{r\,d\theta} = u\frac{dw}{dx} \quad . \; . \; . \; . \; . \; . \; . \quad \text{(iii.)}$$

(46) Supposing the pressure ϖ independent of θ, and a function of x and r only, then equation (iii.) reduces to

$$\Theta = u\frac{dw}{dx}.$$

But supposing the pitch to increase from $\frac{u}{n}$ to the pitch q, in an axial length x at a distance r from the axis, then

$$w = 2\pi r\left(n - \frac{u}{q}\right),$$

so that

$$\Theta = 2\pi r\,\frac{u^2}{q^2}\frac{dq}{dx}.$$

$$\text{Also } X = \frac{2\pi r}{q}\Theta,$$

the impressed forces being supposed due to the normal reaction of a smooth screw surface of pitch q; and therefore from (i.)

$$\frac{1}{\rho}\frac{d\varpi}{dx} = X = 4\pi^2 r^2\frac{u^2}{q^3}\frac{dq}{dx};$$

and integrating

$$\frac{\varpi - \varpi_0}{\rho} = 2\pi^2 r^2\left(n^2 - \frac{u^2}{q^2}\right) \quad . \; . \; . \; . \quad \text{(iv.)}$$

ϖ_0 denoting the pressure in the plane $x = 0$, and therefore in the water before the screw has acted upon it.

(47) Then the thrust of the propeller

$$T = \int\!\!\int \rho\, X\, dx\, 2\pi r\, dr$$
$$= \int(\varpi - \varpi_0)\, 2\pi r\, dr$$
$$= 4\pi^3\rho\int\left(n^2 - \frac{u^2}{q^2}\right)r^3\,dr \quad . \; . \; . \quad \text{(v.)}$$

and the turning moment of the engines,

$$L = \int\!\!\int \rho\,\Theta\, dx\, 2\pi r^2\, dr$$
$$= 4\pi^2\rho u^2\int\!\!\int\frac{1}{q^2}\frac{dq}{dx}\,dx\, r^3\, dr$$
$$= 4\pi^2\rho u^2\int\left(\frac{n}{u} - \frac{1}{q}\right)r^3\,dr$$
$$= 4\pi^2\rho u\int\left(n - \frac{u}{q}\right)r^3\,dr \quad . \; . \quad \text{(vi).}$$

the angular momentum generated per second in the propeller wake; and the loss of kinetic energy in the wake per second

$$= 2\pi L n - T u = 4\pi^3\rho u\int\left(n - \frac{u}{q}\right)^2 r^3\,dr.$$

(48) With fan-shaped blades we can replace q by p, the constant final pitch of the propeller; and then

$$T = 4\pi^3\rho\left(n^2 - \frac{u^2}{q^2}\right)\int r^3\,dr$$
$$= \tfrac{1}{16}\rho^3 e\left(d^4 - a^4\right)\left(n^2 - \frac{u^2}{p^2}\right)$$
$$= \pi\rho\,(A^2 - B^2)\left(n^2 - \frac{u^2}{p^2}\right),$$

and

$$L = 4\pi^2\rho u\left(n - \frac{u}{p}\right)\int r^3\,dr$$
$$= \rho(A^2 - B^2)\,u\left(n - \frac{u}{p}\right),$$

as before in § (13).

(49) But in a propeller as usually constructed—Griffith's propeller, for instance—the blades, instead of being fan-shaped, are shaved off very much to a point; so that we must treat q as a function of r in equations (v.) and (vi.). Suppose, for instance, that $n - \frac{u}{q}$ increases uniformly with x from its initial value 0; then we can put

$$n - \frac{u}{q} = \left(n - \frac{u}{p}\right)\frac{x}{l},$$

supposing l the greatest axial length of the propeller, and p the greatest final pitch.

Then, for the projection of the curve formed by the following edge of a blade on a plane perpendicular to the axis of the propeller, the leading edge being supposed straight—

$$\frac{d\theta}{dx} = \frac{2\pi}{q}$$
$$= \frac{2\pi n}{u} - \frac{2\pi}{u}\left(n - \frac{u}{p}\right)\frac{x}{l};$$

so that

$$\theta = \frac{2\pi n}{u}x - \frac{\pi}{u}\left(n - \frac{u}{p}\right)\frac{x^2}{l}$$
$$= \frac{\pi l}{u}\,\frac{n^2 - \frac{u^2}{q^2}}{n - \frac{u}{p}}$$

so that the curves of intersection of the screw surface with coaxial cylinders will develope into parabolas.

(50) Therefore, from (v.), the thrust of the propeller can be expressed in the form—

$$T = 4\pi^2\rho\frac{u}{l}\left(n - \frac{u}{p}\right)\int\theta\, r^3\,dr$$
$$= 4\pi^2\rho\frac{u}{l}\left(n - \frac{u}{p}\right)\beta k^2$$

where βk^2 denotes the moment of inertia of the projection of the area of the blades on the disc area, about the axis of the propeller.

This is the same as for a propeller with fan-shaped blades of uniform pitch p, and in which with the previous notation, $A^2 - B^2$ is replaced by

$$2\pi\frac{p}{l}\beta k^2.$$

Then from (vi.)

$$L = 4\pi^2\rho\frac{u}{l}\left(n - \frac{u}{p}\right)\int x\, r^3\,dr$$
$$= 2\pi\rho u\left(n - \frac{u}{p}\right)\frac{VK^2}{l},$$

when VK^2 denotes the moment of inertia about the axis of the propeller of the volume V generated by the revolution of the blades, so that in the previous notation for fan-shaped blades $A^2 - B^2$ must be replaced by

$$\frac{2\pi VK^2}{l}.$$

(51) By shaving off the blades to a point at the tips, we make $q = \frac{u}{n}$, and therefore $\varpi = \varpi_0$ at the cylindrical surface of the propeller wake, and this will be true even when the variations of pressure due to gravity are allowed for, so that the cylindrical casing of the propeller we have introduced may now be dispensed with without introducing discontinuity of pressure.

(52) In order that the cylindrical vortex formed by the propeller should be stable, Maxwell has shown that it is necessary for $w\,r$, or the angular momentum of a cylindrical layer, to increase with r; if $w\,r$ diminishes as r increases, the vortex is unstable; the separating case when $w\,r$ is constant being Rankine's free circular vortex.

In order for the propeller to form such a vortex, we must have—

$$r^2\left(n - \frac{u}{q}\right) = R^2\left(n - \frac{u}{p}\right)$$

or

$$r^2 x = R^2 l,$$

where R is the radius when the pitch is p, practically the radius of the boss of the propeller.

The profile of a blade seen projected on a fore-and-aft axial plane will therefore be given by Fig. 12, and then

$$\theta = \frac{2\pi n l}{u}\frac{R^2}{r^2} - \frac{\pi l}{u}\left(n - \frac{u}{p}\right)\frac{R^4}{r^4},$$

the polar equation of the projection of the following edge of a blade on the disc area, as in Fig. 13.

By doubling these areas symmetrically so as to curve the leading edge, along which the pitch is $\frac{u}{n}$, similarly to the curve of the following edge, we obtain in Figs. 12 and 13, blades curved in a manner very much resembling those of ordinary propellers in use, as Mangin's or Griffith's.

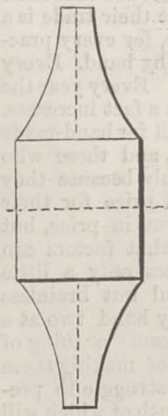


FIG. 12

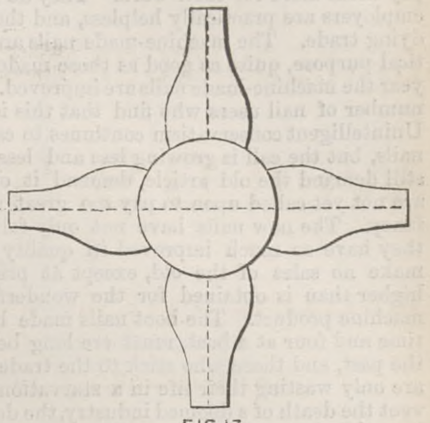


FIG. 13.

(53) Then

$$\beta k^2 = \int\theta\, r^3\,dr$$
$$= \frac{\pi n l}{u}R^2(r^2 - R^2) - \frac{\pi l}{u}\left(n - \frac{u}{p}\right)R^4\log_\epsilon\frac{r}{R};$$

whence the thrust of the propeller is determined by

$$T = 4\pi^3\rho n\left(n - \frac{u}{p}\right)R^2(r^2 - R^2)$$
$$- 4\pi^3\rho\left(n - \frac{u}{p}\right)^2 R^4\log_\epsilon\frac{r}{R}$$
$$= 4\pi\rho n\left(n - \frac{u}{p}\right)B(A - B)$$
$$- 2\pi\rho\left(n - \frac{u}{p}\right)^2 B^2\log_\epsilon\frac{A}{B}.$$

Also we shall find, since

$$n - \frac{u}{q} = \left(n - \frac{u}{p}\right)\frac{R^2}{r^2},$$

that the corresponding turning moment of the propeller is

$$L = 4\pi^2\rho u\left(n - \frac{u}{p}\right)R^2\int r\,dr$$
$$= 2\pi^2\rho u\left(n - \frac{u}{p}\right)R^2\left(r^2 - R^2\right)$$
$$= 2\rho u\left(n - \frac{u}{p}\right)B(A - B)$$

(54) The turning moment, and consequently the indicated horse-power required for a propeller of this nature will therefore be

$$\frac{2B(A - B)}{A^2 - B^2} = \frac{2B}{A + B}$$

of the turning moment and indicated horse-power of a propeller of the same dimensions and working at the same speed, but furnished with fan-shaped blades, forming a complete column of uniform revolution; also the ratio of the thrust in these two cases will be

$$\frac{2B}{A + B} - \frac{B^2}{A^2 - B^2}\left(1 - \frac{u}{np}\right)\log_\epsilon\frac{A}{B},$$

which may generally in practice be replaced by $\frac{2B}{A + B}$; so that the efficiency is practically the same in the two propellers.

(55) For the stability of the vortex of the propeller wake, according to Maxwell, wr or $r^2 x$ must increase with r; so that the blades should be fuller in area, not finer, than that given above in Figs. 12 and 13. Then by pointing the blades so as to make $q = \frac{u}{n}$ at the tips, we make $\varpi = \varpi_0$ at the surface of the propeller wake. The pressure will then increase at first in going towards the axis of the propeller wake; and where the pressure is a maximum, we may assert that the blades are most efficient. Afterwards, in going nearer to the axis, the pressure will in general be found to diminish again; so that this part of the propeller wake will tend to draw air down, this effect being variously called the sucking action or centrifugal action of the propeller.—Cotterill, "Annual" of the R.S.N.A., 1873.

THE BIRMINGHAM EXHIBITION AND SOME INDUSTRIAL LESSONS.

VISITORS agree in praising the Birmingham Exhibition, and it is probably one of the most entertaining that has been opened for many years to those interested in the science and arts of manufactures. No other district in the world could present so great a diversity of local productions and illustrations of local arts, the old by the side of the new, and in most cases struggling against its effacement by modern forms, methods, systems, and tools. In a few cases the old survives unassailed, in some others it survives but is dying an inevitable death. In some trivial instances it has been in part revived. In many cases the changes are affecting those who themselves are unable to effect a change. In illustration of some of the lessons which we think may be learned in the Birmingham Exhibition we find an example of the modern kind in the first trophy which meets the eye on entering the Bingley Hall. This is one by Nettlefolds of Birmingham. Here and on the stand of Mr. Felix Hadley we find specimens of every kind of nail, spike and tack, all made by machines that produce by the ton and without notion of number. At the other end of the building are a man and his wife and a lad making tacks and hob-nails by hand, and representing the nail-making industry, and the people now on strike. No wonder they are on strike; but how futile the struggle. The man in this Exhibition, an intelligent, and said to be an excellent workman at his trade, can earn as the result of a long day from 2s. to 2s. ¾d., and the woman making wrought tacks does well when she earns 1s. per long day during those months of the year that she can work at all. These people work from about 7 a.m. to 8 or 10 p.m. Yet they persist in thus working hard for a starvation wage, and why? Their notion is that their employers ought to pay them more for their work. They do not see that their employers are practically helpless, and that their trade is a dying trade. The machine-made nails are, for every practical purpose, quite as good as those made by hand. Every year the machine-made nails are improved. Every year the number of nail users who find that this is a fact increases. Unintelligent conservatism continues to call for hand-made nails, but the call is growing less and less, and those who still demand the old article, demand it only because they are not yet called upon to pay too great a price for their fancy. The new nails have not only fallen in price, but they have so much improved in quality that factors can make no sales of the old, except at prices only a little higher than is obtained for the wonderful but brainless machine product. The boot nails made by hand two at a time and four at a beat, must ere long become a thing of the past, and those who stick to the trade of making them are only wasting their life in a starvation struggle to prevent the death of a doomed industry, the death of which will hurt nobody but themselves. The nail-maker at the Bingley Hall, and the others too, could earn more money in most districts as useful labourers, and the woman could double her wages almost anywhere as a charwoman, and both of them work several hours less per day. They are strong and willing, and yet seem to have no idea of moving out of their groove, or of emigrating to countries where willing hands under intelligent heads are wanted. Most of the hand nailers then will probably linger on at this trade some few years longer, with decreasing wages and decreasing strength, and then be incapable of the new work to which they might turn if they gave up their starvation drudgery at once.

Turning again to Messrs. Nettlefolds' trophy, we find a large number of articles made from steel and iron wire by machinery, while articles for the same purposes are yet being made by hand. Some of these things are at present better made by hand; but the hand-made articles are probably doomed at least to a very seriously diminished demand. Amongst those which have now nearly displaced the hand-made article are hooks and clothes pegs of numerous kinds, and of those which indicate the new path are corkscrews, button-hooks, small pincers, and pliers, scissors, and other things of the same order. As an illustration of the old which could be produced in the same way, we see at the other end of the hall boot-lifting hooks being made by the method of forging, and filing, and polishing. These boot-hooks are probably not made in very great numbers, but they afford an illustration in point, inasmuch as they are of the sort that could be made by machinery such as that used by Messrs. Nettlefolds for button-hooks, and could be made to look as well and do the work as well in every particular. The corkscrews made by this machinery are being better made every day as far as finish goes, but they have now been made for some time of steel wire, and as capable of dealing with obstinate corks as any corkscrew ever made by hand. These are sold retail for twopence and some for one penny. Some of the handiest and most efficient button-hooks ever made can be sold for one penny, made of steel wire and brass plated, and it is known that many people possessed of the ivory-handled regulation pattern button-hook prefer to use these penny hooks.

All these things and many more of the same kind indicate the way in which old industries are assailed, and the necessity for the old to look out for new lines of activity, unless those engaged are to be left either without an occupation or with one which will gradually lead to starvation.

With respect to the pincers and scissors above mentioned, we do not for one moment wish to suggest that they are at present useful for all purposes, but the pincers are for many, and being made of steel might have their points hardened, and would satisfy the requirements of several people. The halves are bent, and then the flattening for the joint and the forming and roughening of the nose are performed at one operation including punching the hole for the rivet. Now, we may ask, what is to prevent the extension of this system of manufacture by pressing and forging. In fact there is no reason why such things as seed harrows should not at once be made from bent steel rods, and whippletrees strong enough to haul them, from a light tube and steel wire rod.

Speaking of harrows reminds us of agricultural machinery generally, and of the surprise which a visitor feels when the very meagre display of this class is noticed; in fact, there is scarcely anything that is more necessary to the farmer than to the gardener or to anyone who keeps a horse; yet there must be a considerable quantity of farmers' requisites made within the district which the Exhibition is intended to represent. Yet this order of the manufactures of the "workshop of the world" is represented by a few chaff cutters, very much of the same designs as those sent out by their makers a quarter of a century ago, and a three-row corn drill. Birmingham has not, perhaps, turned its inventive capacity into this field. It is one which does not, perhaps, offer much scope, but still it is noteworthy that what it does show is of what would be considered antiquated design.

THE ATLANTA.—"The new U.S. cruiser Atlanta will be ready for sea about Sept. 15th, and will shortly afterwards start on a week's trial trip at sea, going in the direction of the Gulf Coast without making any port. The purpose is to test the vessel to her full capacity, and with that end in view the best fuel and well-trained firemen will be procured. Engineer-in-Chief Loring will be on board to supervise the engines and machinery. The Naval Advisory Board may also be invited to make the trip. The vessel is to undergo a trip similar to that of the Dolphin. If a storm can be found it is not the intention to avoid it, and her performance in both light and heavy seas is to be carefully noted. Nothing has yet been determined as to the Atlanta's station after the trial trip is completed, but she will, of course, remain on the home station until her battery is placed aboard. Her guns are finished, but have still to undergo the statutory test before they are placed on board, and two or three months will have elapsed before that is done." This is what an American exchange says. Bearing in mind the results obtained with the Dolphin, it seems a little premature to talk of a week's trip, and of what the ship's ultimate station will be.

VISITS IN THE PROVINCES.

STOKE PRIOR SALT WORKS.

On Saturday, September 4th, about a hundred members of the British Association joined the excursion to the salt works at Stoke Prior, near Droitwich, which are the most complete in Worcestershire, and also the largest individual works in England. They had caused the ruin of at least two large companies when Mr. John Corbett, now M.P., took them in hand. Living on the works, he studied the causes of former failure, and turned past experience to account, with the result that, in making his own fortune, he affords the means of existence to a large population, and has given a great impetus to the general trade of the district. So important is the traffic created by these works—about a thousand tons in and out together—that the Great Western Company made a special goods branch to the works from Droitwich, their terminus in this direction. There is also a siding with the Midland Railway, while the works have grown up on both sides of the Birmingham and Worcester branch of the Sharpness New Docks Navigation Company's canal. Several arms of this canal are carried into the works, and are in most cases overlaid by a railway siding, so that the salt may be sent away by whichever route best suits the destination of an order. The works cover about thirty acres, including a new department—only started on Monday week, September 6th—which will turn out 350 tons of salt weekly, in addition to the 4000 tons per week already produced.

The brine is raised by three out of four shafts, 6ft. in diameter, and about 50 fathoms deep, tubbed for the most part with cast iron rings. In one of the shafts, however, this tubbing was superseded eleven years ago by three courses of Staffordshire blue bricks, made specially to the required sweeps, and with ½in. space between the courses filled with the best Portland cement, to resist the great pressure of water behind. From the bottom of the shafts a 6in. bore-hole, lined with copper pipe to keep out water, leads down to the brine, about 166 fathoms below the surface, rising to about 23 fathoms from the surface. The brine is pumped the 140ft. by old 40-horse power nominal engines, with horizontal cylinders, geared 3 to 1, and exerting about 100-horse power. Each pump, 15in. in diameter, raises 50 gals. at every stroke of 9ft., which, at ten strokes per minute, gives 500 gals. The brine is delivered into a tank 55ft. above the works' level, whence it gravitates to a reservoir capable of holding 5,000,000 gals. From the reservoir the brine is drawn, as required, into plate-iron evaporating pans, which are all 18in. deep, and vary from 30ft. by 20ft. to 40ft. by 24ft. These open pans are heated directly by furnaces underneath, the degree of heat varying with the sized grain of salt it is required to produce. Thus, a temperature of 120 deg. Fah. is sufficient to produce the coarse "bay" salt; but for fine table salt one of 225 deg. Fah. is required. The brine is continually agitated by rakes, to favour the formation of the crystals, the salt "making" on the surface and soon sinking to the bottom. It is taken out by perforated shovels four times in the twenty-four hours, and filled into tapered wooden "tubs" of irregularly octagonal section, having slits in the bottom for the water to drain off. After setting for an hour, the "square" or block—of which about 160 go to a ton—is turned out, and placed for a day in the drying house—kept at a temperature of 150 deg. to 170 deg.—on the plate-iron flues, 3ft. 6in. square, leading the gases from the evaporating pan furnaces. The blocks are then ready for loading on to the adjacent siding or canal, as the case may be.

Mr. Corbett, who retains the active management of these works, has designed and patented some circular pans having close conical covers, and provided with mechanical agitators. Their diameter is 28ft., and the height 8ft.; that is to say, the cylindrical portion 3ft., and the conical cover 5ft. to the apex. A vertical shaft carrying four arms, with rakes attached, is made to revolve slowly by bevel gear and shafting from an engine. At the sides of the pan, and communicating with it under the brine level, are open "pockets" or tanks, towards which the salt is continually being worked by the rakes, and whence it is taken out. The pressure on the surface of the brine in these closed pans is but slightly lower than that of the atmosphere. The steam evaporated from two closed pans, led in 18in. pipes, coated with Bell's asbestos, serves to heat an open pan 140ft. by 24ft. by 18in., the waste heat from some pans also serving to evaporate the water in others. There are altogether nine closed pans for making "butter" salt—that is a salt exported for salting butter—seven closed pans for making "squares" for table salt, forty open pans also for "squares," and thirty open pans for "broad" or coarse salt, making eighty-six pans in all.

The brine is remarkably pure, analysis showing that it does not contain 1 per cent. of extraneous matter—that is to say, what is neither salt nor water. Besides the good salt which forms on the surface of the water in the evaporating pans, a cake is deposited at the bottom. As this becomes discoloured by contact with the iron, and is also to some extent burnt, it is loaded into wagons, tipped at the foot of an elevator, and raised above cast iron rolls, the top pair grooved, and the two others plain, by which it is crushed, the product being again raised by an elevator at the back and tipped into railway wagons, to be sold for agricultural purposes.

The "squares" are either sent away as they are or are sawn by a circular saw into bars, 6in. by 2½in. by 2½in. For producing table salt, the blocks are raised by an elevator and dropped between rolls cast with blunt spikes, the pieces falling between two plain rollers and then two others set close together. The very finest salt is divided by rolls into pieces the size of a hazel nut, and then treated in a disintegrator and sifted. Table salt is made up in packets, jars, and bottles, this department being warmed by the exhaust steam of the boilers, so as to prevent any setting of the product. The steam is led in pipes of rectangular section designed to occupy as little floor space and give as large heating surface as possible. Salt for dairy purposes—not, however, the coarse "butter" salt, sent away loose—is also ground; and salt for curing is broken up between spiked rolls into pieces the size of a walnut. All these rolls are of gun-metal, so as not to discolour the salt.

The mills, as well as all the engines and machinery about the works, except a 25 horse-power Tangye engine for driving the shops, were made on the ground, under the immediate direction of the engineer, Mr. John Gardner. All the wagons too—of which there are about 700—are turned out at the works, at the rate of two a week, besides repairs. New wagons and renewals are fitted with Mansell wheels; and none but B B H iron is used in their manufacture. Packing cases, &c., are made from elm grown on Mr. Corbett's estate, this wood being found very suitable for salt, as it becomes saturated, and thus preserved. Besides the wagon works, with their traverser, there are a foundry, smiths' shops, boiler shops for making pans, fitting shops and a saw mill. There are twenty locomotives for shunting in the works alone, and fifty canal boats engaged in bringing the raw material—chiefly coal—to the amount of 2000 tons a-week. No work is done on Sunday, although the stoppage entails a severe loss; and great solicitude is shown as to the well-being of the workpeople, of whom the men work eight hours and the women only seven hours a-day.

MESSRS. S. ALCOCK AND CO.'S FISHING-TACKLE FACTORY, REDDITCH.

Those members of the British Association who joined the Redditch excursion on September 9th first visited the fishing-tackle works of Messrs. Samuel Alcock and Co., which gives employment to between four and five hundred persons, about half of whom are men. Fish-hooks appear to have been made to a limited extent at Redditch towards the close of the last century; but the trade has so rapidly developed that this little country town is now the seat of the fishing-tackle as well as of the needle manufacture in England. It is astonishing to find what a large number and variety of materials enter into the composition of fishing-tackle—steel for the hooks, brass and gun-metal for the reels, wood and cane for the rods, hair and silk for the lines, cork and quill for the floats, and a still greater variety of substances for artificial bait and flies. This varied manufacture has been reduced to a system by Messrs. Alcock, by far the largest manufacturers of these goods, although the mechanical appliances are not very elaborate; and the excellence of the produce depends almost entirely on the skill of the operator, combined with a careful selection of material.

For making hooks, crucible cast steel wire is sheared to the required length. One or more lengths together, according to size, are then "bearded" or barbed, by being arranged on a plane surface with their ends against a stop, when a knife, ground hollow, is placed with its end against an upright as fulcrum, drawn into the substance of the wire, and then slightly turned so as to raise the barb from the shank—an operation requiring great skill, so as to avoid cutting too deeply or raising the barb too much. The points of best hooks are now formed by a flat file, with the sharp edge ground off so as to produce the "hollow" point, as it is termed. The wire is then bent to the required shape either by hand, singly on a metal form at the end of a stick, or several together in a simple machine, which exerts the same action. The end to be attached to the line is either "flatted" by hand hammer on a small anvil, or by a drop hammer in the case of very large hooks; or it is "marked," that is, it receives a series of small notches from top and bottom dies in a stamping machine; or, again, it is "ringed," either by hand in a manner similar to the bending, or in a machine, which is the least elementary of all the mechanical appliances used. It consists of a lever attached to a toothed sector gearing with a spur pinion on a vertical spindle, having an excentric pin at its lower end, which, being given almost an entire revolution by the operator pulling the lever, bends round the end of the wire into an eye, just as would be produced by a pair of round pliers. The parts are brought back by a strong spiral spring; and a cam on the spindle works a pair of clamps that hold the wire firmly while the end is being bent.

The hooks are hardened by being placed, a great many together loosely, on a pan in a furnace, where they are raised to a temperature depending on the size of hook, and then quenched in cod oil. With hooks of a certain size the adhesive oil is flared or burnt off; but very small hooks, which would suffer by this operation, are washed with soap and water in revolving barrels. Tempering is effected in a pan containing emery powder, over a moderate fire, the hooks and emery being kept constantly in motion until attaining the right temper, which is ascertained by frequent testing. Small hooks are polished by being shaken in a bag with emery powder, and those of larger size by sawdust in barrels, made to revolve on a slightly excentric axis at an angle of about 45 deg. with the horizon. The finished hooks are then, according to their purpose, tinned, japanned, browned, or blued, for protecting them from the action of rust, after which they are made up in packets or boxes for the market. There are no less than 180 different kinds of hook, each with from twenty to thirty sizes; and 6000 of the smallest go to an ounce.

The most usual materials for fishing-rods are lancewood, greenheart, hickory, ash, and hazel, with various canes; and their selection for the best rods requires much care and experience. An improvement, which secures great strength with lightness, has recently been introduced, in building up the various joints or lengths of rod with six segments of the same or different woods and canes, by which the effect of irregular grain is counteracted as far as possible. Tapering is effected by inserting one end of a length in the mandril of a lathe and working it down by a hinged wooden tool, like the clamp used for polishing metal rods, but having a plane iron set in one half. The "butts" are frequently hollowed, by careful boring with an auger, so as to carry spare "tops." The ferrules are turned out of brass tube and adjusted; the rings are whipped on the top with stout silk; and a flat is formed on the butt and fitted with rings to receive the reel or winch. The latter is generally made of brass or gun-metal, the several parts being either cast or stamped out of the sheet.

The best floats are cut out of cork, turned in the lathe,

THE LARTIGUE SINGLE TRACK RAILWAY.

For description see page 225.)

Fig. 2

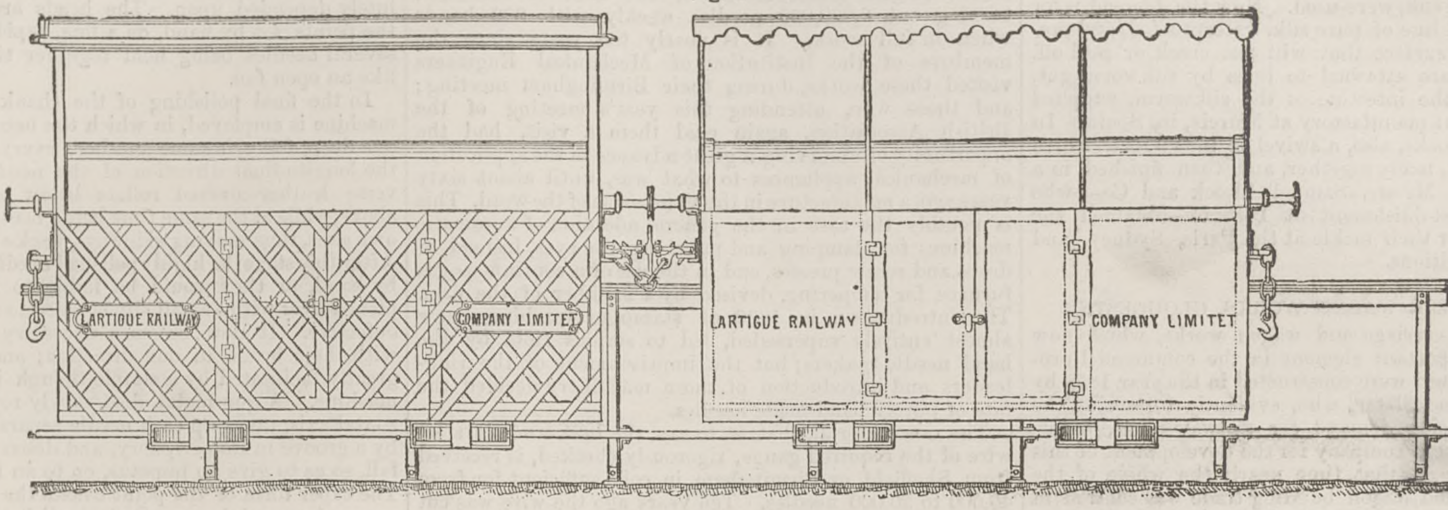


Fig. 1

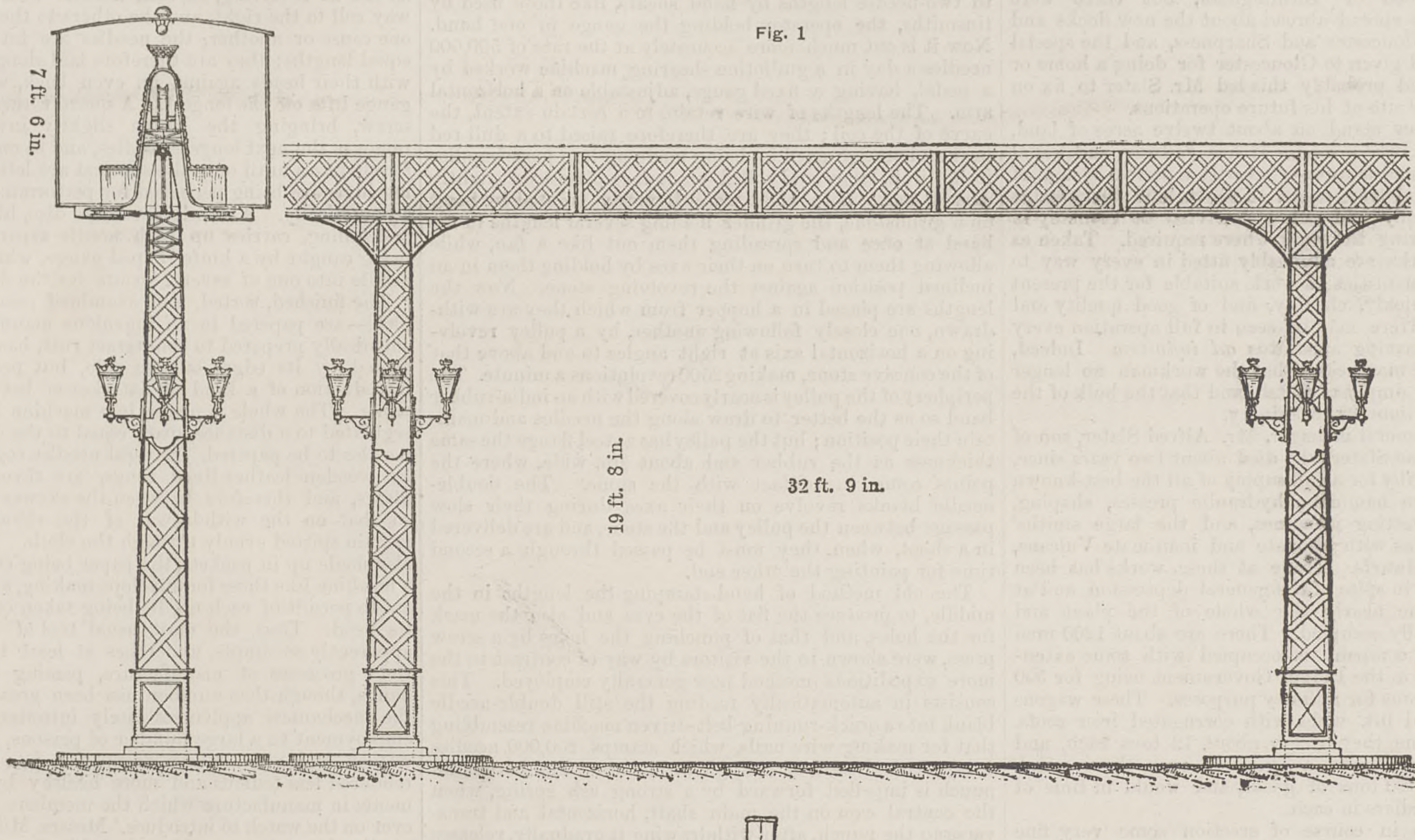


Fig. 4

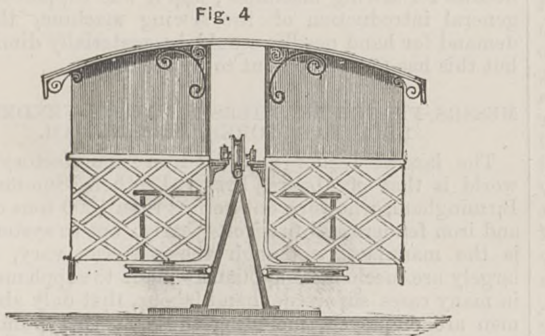


Fig. 5

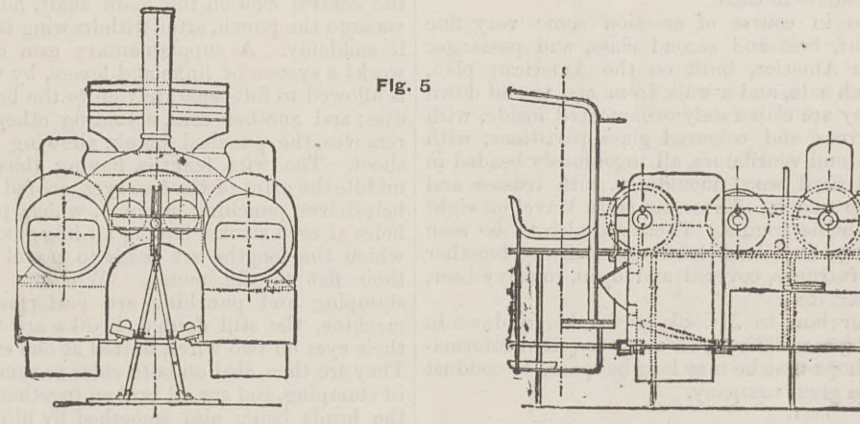


Fig. 6

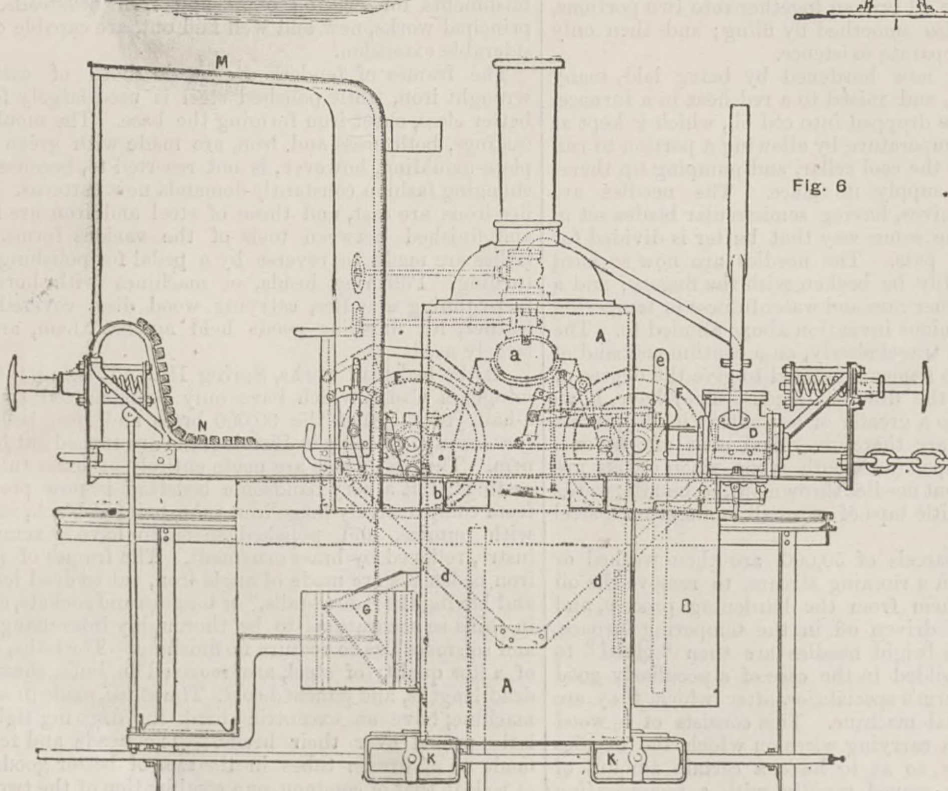
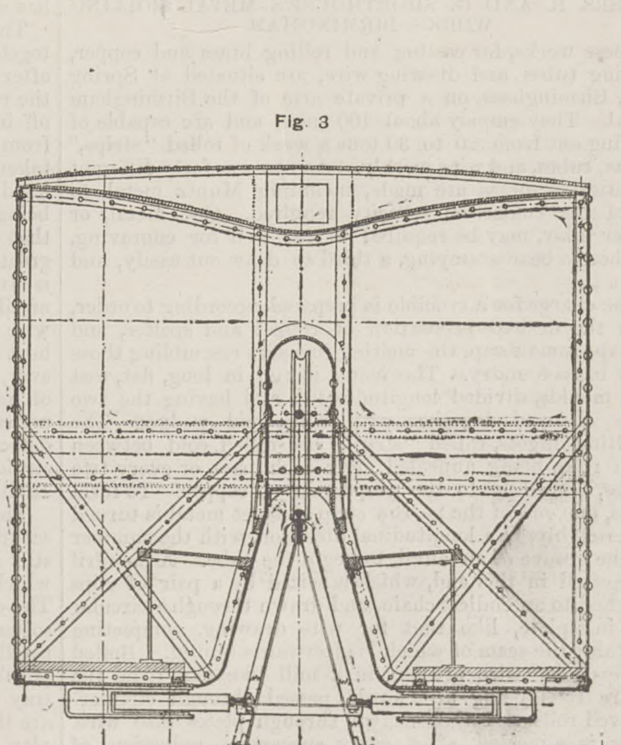


Fig. 3



smoothed on a grindstone, and "stopped" with putty, after which they are painted and varnished. An improved form has a saw cut to the central hole, for receiving the line, which is clamped by the plug. Lines were formerly made by twisting or plaiting horsehair; then hair and hemp, or hair and silk, were used. Now the demand is for a flexible, braided line of pure silk, waterproofed, and presenting a smooth surface that will not crack or peel off. The best hooks are attached to lines by silkworm gut, which is really the intestine of the silkworm, supplied from the firm's gut manufactory at Murcia, in Spain. In the case of best hooks, also, a swivel is interposed, which is cast or stamped, many together, and then finished in a special machine. Messrs. Samuel Alcock and Co.—who have a branch establishment at Toronto—obtained the highest awards for their tackle at the Paris, Sydney, and Melbourne Exhibitions.

THE GLOUCESTER WAGON WORKS, GLOUCESTER.

These railway carriage and wagon works, which now form such an important element in the commercial prosperity of Gloucester, were constructed in the year 1858 by the late Mr. Isaac Slater, who, evidently foreseeing the great and increasing demand for railway plant, determined to form a new company for the development of this particular trade. At that time nearly the whole of the railway carriage and wagon building trade was centred in the neighbourhood of Birmingham, but there were glowing accounts spread abroad about the new docks and ship canals at Gloucester and Sharpness, and the special facilities this had given to Gloucester for doing a home or foreign trade, and probably this led Mr. Slater to fix on Gloucester as the site of his future operations.

The works now stand on about twelve acres of land, situated in the Bristol-road. It has railway and canal accommodation, and is intersected with a perfect system of traverse ways and tram roads. The various departments have been skilfully laid out with a view to economy in labour in delivering the work where required. Taken as a whole, the works are admirably fitted in every way to turn out large quantities of work suitable for the present markets, *i.e.*, quickly, cheaply, and of good quality and workmanship. Here may be seen in full operation every kind of labour-saving apparatus *ad infinitum*. Indeed, it may be said in many cases that the workman no longer has to work, but simply to watch, and that the bulk of the real labour is all done by machinery.

The present general manager, Mr. Alfred Slater, son of the late Mr. Isaac Slater who died about two years since, has gone in specially for a full supply of all the best-known systems of steam hammers, hydraulic presses, shaping, drilling, and rivetting machines, and the large smiths' shop fairly bristles with animate and inanimate Vulcans, from giants to dwarfs. Trade at these works has been well maintained, in spite of the general depression, and at the present time nearly the whole of the plant and machinery are fully occupied. There are about 1200 men at work, and the company is occupied with some extensive orders, one for the Indian Government being for 500 iron-covered wagons for military purposes. These wagons are 32ft. long and 9ft. wide, with corrugated iron roofs. When on the line they weigh about 12 tons each, and would, if coupled, cover a space of over three miles. They carry 15 to 20 tons of goods, and would in time of war carry 100 soldiers in each.

There are also in course of erection some very fine carriages—saloons, first and second class, and passenger vans—for South America, built on the American plan, with seats on each side, and a walk from end to end down the centre. They are elaborately ornamented inside, with gilt-framed mirrors and coloured glass partitions, with fretwork panels and ventilators, all ingeniously beaded in various-coloured hard wood mouldings, with trusses and principals, &c., to match. These carriages travel on eight wheels fitted in bogie frames. There are also to be seen iron wagons for the Oude and Rohilkund Railway, together with all sorts of trucks, covered and open, to carry beer, coal, lime, salt, &c. &c.

In making our bow to Mr. Slater for his kindness in furnishing our representative with every required information, we beg to hope that he may long be spared to conduct the affairs of this great company.

MESSRS. B. AND G. SHORTHOUSE'S METAL ROLLING WORKS, BIRMINGHAM.

These works, for casting and rolling brass and copper, making tubes and drawing wire, are situated at Spring Hill, Birmingham, on a private arm of the Birmingham Canal. They employ about 100 men, and are capable of turning out from 20 to 30 tons a week of rolled "strips," sheets, tubes, and wire weekly. As many as forty different qualities of brass are made, including Muntz metal, to afford the colour or tenacity required. One metal, or rather alloy, may be required to cut well for engraving, another to bear stamping, a third to draw out easily, and so on.

The charge for a crucible is prepared, according to order, with the desired proportion of copper and spelter, and perhaps some scrap, the melting furnaces resembling those of a brass foundry. The metal is run in long, flat, cast iron moulds, divided longitudinally, and having the two parts clamped together with rings and wedges. The resulting ingots, called "strips," are rolled cold between plain rolls, being annealed after each pass, or every two passes, according to the proportion of copper. To form tubes, one end of the narrow strip of sheet metal is turned over roughly, in a longitudinal direction, with the hammer on the groove of an anvil, to begin the tube. A mandril is inserted in this end, which is seized by a pair of clips attached to an endless chain, and drawn through a circular hole in a plate, like that for wire drawing, completing the tube, the seam of which is afterwards brazed. Rolled "strips" for wire are slit in a mill like nail rods, the square rods being afterwards passed through circular-grooved rolls and then drawn through plates into wire. Brass is annealed after every successive reduction of diameter, and copper after every three drawings.

HENRY MILWARD AND SONS' NEEDLE FACTORY, REDDITCH.

Redditch is the seat of the needle manufacture in England; and Messrs. Milwards' factory, founded in 1730, is the largest establishment of the kind in existence, turning out 8,000,000 needles weekly with 800 hands when in full work. It is nearly ten years since the members of the Institution of Mechanical Engineers visited these works, during their Birmingham meeting; and those who, attending this year's meeting of the British Association, again paid them a visit, had the opportunity of observing a great advance in the application of mechanical appliances to what was, until about sixty years ago, a manufacture in the strict sense of the word. This is notably the case in the general adoption of automatic machines for stamping and punching the eyes, instead of drops and screw presses, and in the use of a continuous gas furnace for tempering, devised by a member of the firm. The introduction in 1830 of stamping machines, now almost entirely superseded, led to serious riots by the hand needle makers; but the imprisonment of the ring-leaders and introduction of more machinery decided the fate of purely hand-made needles.

The raw material, that is to say, the best crucible steel wire of the required gauge, rigorously checked, is received from Sheffield or Birmingham in coils sufficient for from 40,000 to 50,000 needles. Ten years ago the wire was cut to two-needle lengths by hand shears, like those used by tinsmiths, the operator holding the gauge in one hand. Now it is cut much more accurately at the rate of 500,000 needles a day in a guillotine shearing machine worked by a pedal, having a fixed gauge, adjustable on a horizontal arm. The lengths of wire retain, to a certain extent, the curve of the coil; they are therefore raised to a dull red heat and straightened by being made up into loose bundles inside iron rings and rolled on a face plate by a slightly curved bar. Both ends were formerly pointed by hand on a grindstone, the grinder holding several lengths in his hand at once and spreading them out like a fan, while allowing them to turn on their axes by holding them in an inclined position against the revolving stone. Now the lengths are placed in a hopper from which they are withdrawn, one closely following another, by a pulley revolving on a horizontal axis at right angles to and above that of the concave stone, making 2500 revolutions a minute. The periphery of the pulley is nearly covered with an india-rubber band so as the better to draw along the needles and maintain their position; but the pulley has a steel flange the same thickness as the rubber and about ⅛in. wide, where the points come in contact with the stone. The double-needle blanks revolve on their axes during their slow passage between the pulley and the stone, and are delivered in a shoot, when they must be passed through a second time for pointing the other end.

The old method of hand-stamping the lengths in the middle, to produce the flat of the eyes and also the mark for the holes, and that of punching the holes by a screw press, were shown to the visitors by way of contrast to the more expeditious method now generally employed. This consists in automatically feeding the still double-needle blank into a quick-running belt-driven machine resembling that for making wire nails, which stamps 200,000 needles a day, with the aid of a single attendant. The horizontal punch is impelled forward by a strong ash spring, when the central cam on the main shaft, horizontal and transverse to the punch, after withdrawing it gradually, releases it suddenly. A supplementary cam on the same shaft works a system of links and levers, by which each length is allowed to fall separately on to the bed between the two dies; and another cam, actuating other links and levers, removes the punched blank, allowing it to drop down a shoot. The wire lengths, having thus received in their middle the print of the two eyes, are fed in under a vertical belt-driven punching machine, which pierces the two oval holes at each stroke, having an ingenious arrangement by which the lengths are made to travel up so as to present their flat to the punch. Whether the operations of stamping and punching are performed by hand or by machine, the still double blanks are "spitted" through their eyes on two wires, flatted at one end to retain them. They are then filed on both sides to remove the burr made in stamping, and are all broken together into two portions, the heads being also smoothed by filing; and then only has each needle a separate existence.

The needles are now hardened by being laid, many together, on a plate, and raised to a red heat in a furnace, after which they are dropped into cod oil, which is kept at the required low temperature by allowing a portion to run off into a cistern in the cool cellar, and pumping up therefrom sufficient to supply its place. The needles are taken up by two knives, having semicircular blades set in handles, much in the same way that butter is divided for being made up into pats. The needles are now so hard that they may readily be broken with the fingers; and a great deal of the former care and watchfulness in tempering is saved by the ingenious invention above alluded to. The needles are made to travel slowly, on a continuous band of wire gauze, over gas flames regulated to give the degree of heat necessary for the different sizes. They have, however, become bent to a greater or less extent in the process of hardening, and are therefore rolled over one by one, under the finger upon a smooth stone, when crooks are detected, and the bent needles thrown out, to be afterwards straightened by gentle taps of a small hammer on a steel anvil.

The needles, in parcels of 50,000, are then washed or scoured with soap in a running stream, to remove the oil still adhering to them from the hardening process, and which has not been driven off in the tempering furnace. The eyes of the now bright needles are then "blued" to soften them, and gilded in the case of a peculiarly good needle, one of the firm's specialities, after which they are polished in a special machine. This consists of a wood tray with standards carrying wires on which the needles are threaded loosely, so as to have a certain amount of play. The tray is moved rapidly, with a reciprocating motion in a horizontal plane, on V guides, not continuous, but at the four corners, the needles dancing wildly for about an hour, when the inside of the eye has become so smooth as not to cut the thread. The eyes of best needles are, however, still hand-polished on flax threads with fine emery powder, as, in such a case, each one can be absolutely depended upon. The heads are then ground and the points set by hand, on a fine, rapidly-revolving stone, several needles being held together tightly in the hand, like an open fan.

In the final polishing of the shank another ingenious machine is employed, in which the needles are fed in rows one deep, following one another, every fifteen seconds, in the longitudinal direction of the needles between transverse leather-covered rollers below and holding rollers above, while at the same time being made to revolve on their own axes, thus moving sideways, backwards, and forwards. After this stage the highly polished needles are never touched by hand, or they would be liable to rust; but they are picked over with a small slip of wood to remove any that are defective. It now becomes necessary to lay the needles with their heads in one direction; and this operation is greatly facilitated by a simple though ingeniously devised machine. A gun-metal disc, slowly revolving on a horizontal axis, takes up each needle separately from a hopper by a groove in its periphery, and delivers it with a certain fall, so as to give an impetus, on to an inclined glass plate. The taper form of the point causes the needle to describe an arc in revolving, so that needles with the points one way roll to the right, and the others to the left. Owing to one cause or another, the needles are far from being of equal lengths; they are therefore laid along a straight edge with their heads against an even back, when a straight gauge lifts off the longest. A quarter turn is given to a screw, bringing the gauge slightly inwards, when it removes the next longest needles, and so on, five or six different times until only the shortest are left behind. Some machines are being perfected for performing this operation automatically. A slowly revolving disc, like that for head-and-tailing, carries up each needle separately, its point being caught by a knife-shaped gauge, which delivers the needle into one of several spouts for the different lengths.

The finished, sorted, and examined needles—now complete—are papered in an ingenious manner. The paper, chemically prepared to counteract rust, has a strip of cloth pasted by its edges on one side, but permitting of the introduction of a kind of flat skewer between cloth and paper. The whole is placed in a machine between plates, regulated to a distance apart equal to the diameter of the needles to be papered. Several needles together, taken up by wooden leather-lined tongs, are thrust between the plates, and therefore between the skewer and the paper, so that on the withdrawal of the skewer the needles remain spitted evenly through the cloth. The needles are also made up in packets, the paper being cut and folded in a machine like those for envelope making, and having a flap cut to permit of each needle being taken out separately by its head. Thus, the most usual tool of every-day life, apparently so simple, undergoes at least twenty-two distinct processes of manufacture, passing through many hands, though that number has been greatly reduced by the mechanical appliances lately introduced, and giving employment to a large number of persons, including many women and girls, whose occupation is constantly being rendered less tedious and more healthy by the improvements in manufacture which the members of the firm are ever on the watch to introduce. Messrs. Milward also make needles for sewing machines; and it was supposed, on the general introduction of the sewing machine, that the demand for hand needles would be materially diminished, but this has not turned out to be the case.

MESSRS. FRAZER BROTHERS' FIRE-IRON, FENDER, AND BEDSTEAD WORKS, BIRMINGHAM.

The largest fender and fire-iron manufactory in the world is that of Messrs. Frazer Brothers, Summer Hill, Birmingham, who turn out no less than 1000 tons of brass and iron fenders and fire-irons yearly; but so systematised is the manufacture though the patterns vary, and so largely are mechanical appliances made to supplement, and in many cases supersede, hand labour, that only about 300 men are employed, including those at the branch establishments for making brass and iron bedsteads. The principal works, new and well laid out, are capable of considerable extension.

The frames of fenders are made both of cast and wrought iron, while polished steel is used largely for the better class, sheet iron forming the base. The moulds for castings, both brass and iron, are made with green sand; plate-moulding, however, is not resorted to, because ever-changing fashion constantly demands new patterns. Brass fire-irons are cast, and those of steel and iron are forged and finished between tools of the various forms. The lathes are made to reverse by a pedal for polishing after turning. Polishing heads, or machines with horizontal fast-running spindles, carrying wood discs covered with leather, for finishing goods held against them, are also largely used.

At the bedstead works, Spring Hill, adjoining the Birmingham Canal, which have only been started two and a-half years, 500 of the 30,000 brass and iron bedsteads that are made weekly in Birmingham are turned out by this firm. The best goods are made entirely of brass tube and castings; but a very handsome bedstead is now produced from comparatively large iron tube, painted black, scoured with pumice, and polished so as to have a semi-matt lustre, relieved by brass ornament. The frames of purely iron bedsteads are made of angle iron, cut to dead lengths, and having the "dove-tails," or tongues and sockets, cast on in chills so accurate as to be thoroughly interchangeable, and so smooth as to require no finishing. The laths, rolled of a low quality of steel, are received in bulk, sheared to dead lengths, and punched cold. The studs, made in a rivet machine, have an excentric shank for drawing tight the laths passed over their heads. The heads and feet are made up of drawn tubes in the case of better goods, and of rods in that of common, or a combination of the two, connected by castings. Chills for the latter are clamped to stout frames, in accordance with the pattern, and the rods or tubes, roughly sheared and some bent to the desired form, are laid in the chills, the molten metal being run round them. Stoves are used for baking the goods after being painted or japanned.

THE LARTIGUE RAILWAY.

ON the site of the old Westminster prison, close to Victoria-street, engineers will find an elevated single-line railway which will repay inspection. The idea of using a single line of rails for the conveyance of goods and passengers is very far from being new, but it has never been carried out so thoroughly as in the present instance. The inventor is a French engineer, M. Lartigue, who has been assisted in working out details by M. Mallet. The general idea is that which was made familiar to engineers some years ago by Mr. Haddan, since deceased. A single rail is erected on posts, trestles, or even on a wall. On this track run wheels, and these wheels support vehicles which straddle over the rail. The centre of gravity being below the rail, the carriages are in stable equilibrium. The Lartigue railway consists of sets of angle iron A-shaped trestles, resting on and secured to metallic sleepers laid on the surface of the ground. The line is kept level—or, more strictly speaking, even—by varying the height of the trestle to suit it. Very steep inclines are permissible, as much, indeed, as 1 in 13 or more. A section of the line in Westminster rises at the rate of 1 in 10. The vehicles are kept steady by horizontal wheels, which bear against two continuous bars bolted to the sides of the trestles about 2ft. from the top. When the loads are evenly distributed in the vehicles these guide wheels press very lightly against the guide rails. The train may be propelled by mules or horses walking along the side of the track, or by locomotives, or by electricity. At the Ria mines, Pyrénées Orientales, there is a very curious Lartigue railway, over which iron ore is carried for a distance of six and three-quarter miles. The line is worked by electricity, on a system designed by Messrs. Siemens, the full trains running down generating a current of electricity sufficiently powerful to haul the empty train up. The details of the system have not reached us, but we believe they consist in using the motor on the descending train as a dynamo, which generates sufficient current to work the motor on the ascending train, the difference between the weights of the two trains being enough to compensate for the loss of electrical efficiency.

The railway at Westminster is worked by little locomotives constructed by the Société Tubize, Belgium. It consists of two small vertical boilers, one at each side of the rail, supplying steam to a little double-cylinder engine stowed away between the boilers. To the engine is coupled a second piece of mechanism, consisting of a vehicle carrying a Westinghouse compressing engine and a reservoir, the passenger and other vehicles used at Westminster being fitted throughout with the Westinghouse brake. This little carriage is also fitted with a pair of cylinders constituting an auxiliary engine, supplied with steam from the boilers through a flexible pipe, for ascending inclines. The weight of the main engine and boiler is about 2½ tons; the auxiliary carriage weighs about 11 cwt., and is fitted with a toothed driving-wheel which gears into a rack bolted alongside the rail. On the Westminster line this is not found necessary, the engine getting up the incline of one in ten with a load of its own weight without assistance. It would be impossible, within the space at our disposal, to describe the numerous and extremely ingenious arrangements which have been introduced to get over difficulties. From beginning to end the experimental line supplies evidence of great engineering ability and mechanical skill and forethought. For larger lines a different type of engine would be employed with two horizontal boilers, and M. Mallet has designed a compound engine especially for the Lartigue railway.

Engineers in this country will ask of what practical use such a line can be, and the best answer lies in stating what M. Lartigue has already done. We have already mentioned the Ria line. The first line on this system was constructed in Algeria to develope the Esparto business. There are now over sixty miles of the line at work. The Esparto grows in tufts over vast tracts of land, and the railway has to be moved from time to time to follow the Esparto, so to speak. The line has been so successful that the Bey of Tunis has allowed the Anglo-French Lartigue Company to construct another line of sixty miles. The plant at Westminster is a portion of this line. In Russia the line has been tested for military purposes by special committee. The rail stood 3ft. 3in. above the ground, and it was found that three men could put up two metres of it in six minutes, at which rate thirty men could put up a mile in about eight hours. A horse drew with ease five tons. The committee reported on the experiments, and the end of the report on these experiments says:—"To give an idea of the important results to be obtained when it is possible to use gradients of 1 in 17; in a length of about 660ft. a difference of level of 40ft. was obtained, and in a distance of 3300ft. a difference of level of 200ft. was attained. It is easy to understand the advantages to be gained by the use of this system in our Asiatic possessions and on the Steppes, where it is at present necessary to use large numbers of beasts of burden for military transport. In that particular case the Lartigue railway presents advantages which can only be described as incalculable."

Numerous experiments were also made at the camp of the Imperial Guard at Oust-Sjord, near St. Petersburg, with the most satisfactory results. A special kind of rolling-stock for transporting soldiers and wounded men was used. Cars arranged with seats carrying three men on each side of the line and protected overhead by a tent were connected, and formed a very long train drawn by a single horse. Other cars intended to carry the wounded are arranged to make two stretchers one above the other on each side of the line, and allow of a rapid withdrawal from a field of battle, whilst providing the wounded soldiers with a secure, easy, and exceedingly comfortable means of carriage.

On p. 223 we give several views of the Lartigue plant. Fig. 1 shows a line specially designed for suburban traffic. The installation would be exceedingly simple. Light columns at short intervals connected by a girder, which would be the rail, would form the line. Our engravings show a design proposed for the metropolitan line in Paris, and also proposed to be adopted for the carrying of visitors to and from the different parts of the International Exhibition to be held in Paris in 1889.

Fig. 2 shows an open passenger and a goods wagon in use on the Westminster line. The carriage is composed at each end of a very strong horseshoe-shaped wrought iron bar—Fig. 3—placed above the rail, and which, as it is prolonged downwards, runs parallel with the trestles of the line till it reaches within about 1ft. 3in. of the ground, when it turns outward and becomes horizontal. This last portion carries the flooring of the carriage, the part which is parallel with the trestles forms the back of the seats, and the horseshoe-shaped upper part above the rails leaves the necessary space for the wheels and brakes and for their proper examination, &c. To this part is attached a horizontal wrought iron bar, which stretches out from the line on each side as far as the outside of the flooring of the carriage. By uniting this flooring with the horizontal bar by means of flat iron stays crossed, a stiff body of uniform shape and quite symmetrical as regards the line is obtained, which forms an excellent framework, to which panels, either of ornamental wood or painted and varnished sheet iron, can be fitted according to circumstances.

Fig. 4 shows a small open passenger carriage, which seats three persons on each side. It only weighs about 500 kilogrammes.

Fig. 5 shows the locomotive designed by M. Mallet for working the Lartigue Railway. This engine has three-coupled wheels. Its construction will be understood almost at a glance from our engravings.

Fig. 6 illustrates the engine working at Westminster, and designed by M. Mallet. This engine is composed of two vertical tubular boilers A A, placed one on each side of the line and connected at one end by a large pipe *a*, which both acts as a steam dome and carries the two boilers on the framework of the machine, and at the other by a pipe of smaller diameter, which allows the water to pass from one boiler to the other. This pipe is placed at a height at which there is always water, so that it is never empty. By this arrangement it is sufficient to feed only one boiler, which supplies the other, the pipe at the same time preventing the water in the inner boiler from rushing into the outer one, owing to centrifugal force, when the engine passes rapidly round a curve. The safety valves, whistles, &c., are fitted on the large pipe *a*. The engine is carried by two grooved wheels F F on a framework, to which the boilers are attached by the bars *b* and the diagonal stays *d*, as well as by the steam pipe *a*, as already stated. The cylinders D D, which occupy a horizontal position at the front of the engine, drive the cranked axles of the wheels which are coupled, in the usual manner. The firing is done by the engine driver, by means of hoppers fixed at the rear of the boilers, who, sitting astride of his seat N, and protected by the roof M, can easily throw into the hoppers the coke which he takes out of the bucket under his seat. The feed-water is contained in tanks placed in front of the boiler, which are connected by a syphon which reaches to the bottom of each boiler and prevents any difference of level in the water in either tank. Although the machine is balanced by its construction, since it is symmetrically even with the plane of the line, in order to avoid its being thrown out of equilibrium by any accident or by centrifugal force when going round curves, horizontal pulleys K K, running on longitudinal guides attached to the trestles which carry the line, as was stated above, hold the engine in a vertical position and prevent it from leaning over to either side. Thus arranged, and in working order, this engine weighs about 2½ tons—that is, 1¼ tons on each axle. The wheels are 15in. in diameter, and the cylinders 4½in., with a 7in. stroke. The boilers have, together, a heating surface of about 70 superficial feet. With a steam pressure of 100 lb. to the square inch the engine will haul about 70 tons on the level, 18 tons on an incline of 1 in 100, 9 tons on an incline of 1 in 50, and 6 tons on an incline of 1 in 33, at a speed of five or six miles an hour, which, with a smaller load, can be increased to ten or fifteen miles an hour. This engine can easily go round curves of 30ft. radius.

It is very easy to see that the Lartigue system possesses very great advantages, under special circumstances, over any other system of road that can be devised. One is, that being raised a considerable distance above the surface of the ground, it cannot become obstructed by sand or mud, a very important consideration in wild countries. Such a line might with great ease have been laid from Suakim to Berber, during the Egyptian campaign, and would no doubt have given that expedition a different result. It will be a mistake to assume that the Lartigue system can in any sense or way supersede the normal type of railway; but it is not intended to supersede it, but to supplement it. Nor will it be right to compare it with the Haddan and other systems which have gone before. The only resemblance is in principle, the differences are in details. To certain minds principles are everything, details nothing. But the engineer knows that in real life details are everything; principles are of secondary value. That is to say, whether a principle succeeds or fails is altogether a question of the way in which the details are worked out. Mr. F. B. Behr, C.E., the managing director of the Lartigue Company, has developed and improved many of the details of the Westminster line, and does not hesitate to say that further improvements in detail can be effected; but the line as it stands leaves little to be desired. It is a very novel and curious piece of engineering, the most novel and curious that we have seen in London for many a day; and we can assure our readers that they will not regret paying a visit to the old Tothill Fields prison ground.

LAUNCHES AND TRIAL TRIPS.

THE screw steamer Abeona had her trial trip on Monday last. She has been built by Messrs. W. Gray and Co., of West Hartlepool, to the order of Messrs. Rickinson, Son, and Co., of the same place, and is intended for general trading. She is built of steel, is of the well-decked type, to class 100 A1 at Lloyd's, and is fully equipped with subsidiary machinery for working cargo. Her length is 275ft.; breadth, 37ft. 2in.; depth, moulded, 19ft. 11in.; gross tonnage, 2152; and she will carry 3060 tons of dead-weight cargo on a draught of 20ft. 9in. The engines have been supplied by the Central Marine Engineering Company, of West Hartlepool, are of the triple expansion type, with cylinders of 21in., 35in., and 57in., by 39in. stroke, made from the same pattern as those of the steamship Coot, which was illustrated in our number of April 16th. These engines occupy no more length in the ship than ordinary compound engines, and still have the long main bearings, owing to the use of their dynamic valve gear and piston valves, for which that firm is noted. The boilers are of Siemens steel, with a working pressure of 150 lb. per square inch, and are cleaded with a special non-conducting composition for reducing the radiation, and also for lessening the heat of the engines and boiler rooms. After adjusting compasses in the Bay, the vessel was put at full speed ahead for Sunderland, the engines running at 72 to 76 revolutions with the greatest regularity. The absence of vibration at that high speed, both of ship and engines, was very marked. This is very largely owing to the special form of propeller, designed by Mr. Thomas Mudd, M.I.M.E., the manager of the company. There was no heating of any of the parts, and the log showed a speed, although there was a 2-knot tide against the ship, of 11·568 knots per hour over the whole distance run to Sunderland, where the Abeona is to load for Constantinople. A large party of friends of the owners and builders accompanied the vessel, and were much pleased with the result.

A new paddle-steamer, 65ft. in length, by 8ft. in breadth, and 3ft. deep, of peculiar construction, made in eight sections for shipment to the Brazils, had a most successful trial trip on Tuesday last, between Mortlake and Putney. She was built and engined by Mr. Edward Hayes, of Stony Stratford.

On Wednesday last, a new screw steamer for the Egyptian Government, of light draught, 57ft. in length, by 9ft. in breadth, and 9ft. deep, fitted with compound surface-condensing engines, also ran a most satisfactory trial trip on the measured mile at Long Reach. She was built and engined by Mr. Edward Hayes, of Stony Stratford.

THE MAINTENANCE OF THE BELAH AND DEEPDALE VIADUCTS ON THE NORTH-EASTERN RAILWAY.[1]

By WILLIAM JOHN CUDWORTH, Assoc. M. Inst. C.E.

IN a paper on the Hownes Gill Viaduct in the county of Durham,[2] by the author's father, William Cudworth, M. Inst. C.E., read on the 25th November, 1862, a comparison was made between that viaduct, which is of fire-brick, and the iron viaducts with trellis piers and lattice girders, then recently erected from the designs of the late Sir Thomas Bouch, M. Inst. C.E., to carry the South Durham and Lancashire Union Railway over the Belah and Deepdale Valleys. The Hownes Gill and Deepdale Viaducts are of somewhat similar dimensions, but for a single line and double line respectively; and, in order to make the comparison as close as possible, estimates based on the actual cost of both viaducts were made for a double-line fire-brick viaduct over Hownes Gill, and also for a double line iron viaduct over the same valley, of similar design to that at Deepdale. The estimate in the former case was £20,681, and in the latter £16,248. It was thought that the interest on the difference in cost, taken at 5 per cent., viz., £222 per annum, might be absorbed by the needful painting and repairing of the iron viaduct, so that the brick viaduct would not in the long run be more costly. The experience gained by over twenty-five years' use of the viaducts makes it possible to compare this forecast with the actual cost of maintenance. This cost has been as under over the last eighteen years:—

Belah Viaduct.

(Length over all, 1007ft. Height of rail from bed of stream, 195ft. For double line.)

	£	s.	d.
One renewal of timber cross-bearers, way beams, and planking	1802	17	2
One additional renewal of way beams	333	10	0
Painting once every three years, and general repairs	1395	12	4
Total	3531	19	6

Divide by eighteen years = per annum £196 4s. 5d.

Deepdale Viaduct.

(Length over all, 710ft. Height of rail from bed of stream, 158ft. For double line.)

	£	s.	d.
One renewal of timber cross-bearers, way beams, and planking	1234	12	8
One additional renewal of way beams	265	7	9
Painting once every three years, and general repairs	896	5	6
Total	2396	5	11

Divide by eighteen years = per annum £133 2s. 6d.

From these figures it will be seen that the actual cost of maintenance is less than was expected. Taking the viaducts as unpierced solids, the cost of maintenance is, in the case of Belah, 3s. 2½d. per 100 cubic yards, and in that of Deepdale 2s. 11d. per 100 cubic yards per annum. The maintenance of the Hownes Gill Viaduct has cost a very small sum. With the exception of triennial painting of the cast iron parapet railing, costing £12 each painting, and of some staging of the cast iron parapet railing, recently done, at a cost of £47 3s. 6d., there has been no expenditure whatever upon it since its completion in 1858. The spandrels will, however, require a little pointing ere long, the cost of which may be estimated at £120. Dividing this and the cost of the staging over thirty years, and adding to it the cost of painting the iron parapet railing, brings the cost of maintenance to only £9 11s. 5d. per annum. As the viaducts become older the cost of maintenance of the iron ones might be expected to increase in a more rapid ratio than that of the brick one; but their life has not as yet been sufficiently long to make this apparent. The Belah and Deepdale Viaducts were painted during the summer of 1885, and the cost of painting them was carefully taken out, and is shown below. One coat of paint only was given throughout, and the weather was fine:—

Belah Viaduct.

Labour:—

	£	s.	d.		Sq. yds.		Per sq. yd.
Nineteen men at an average rate of 4s. 2¾d. per day, and one foreman at 6s. per day	105	2	6	÷	18,346	=	1·32d.

Materials:—

	Cwt.		s.	d.		£	s.	d.
White lead ..	25	at	16	6	=	20	12	6
Dryers	5	,,	14	0	=	3	10	0
Umber	3½	,,	28	0	=	4	7	6
Red oxide ..	3	,,	11	6	=	1	14	6
	Gallons.							
Raw oil	114	,,	1	8	=	12	0	0
Boiled oil ..	12	,,	1	9	=	1	1	0
Turpentine ..	12	,,	2	0	=	1	4	0
Brushes, &c.						2	8	6

46 18 0 ÷ 18,346 = 0·61

Tackling, &c.:—

	£	s.	d.	
One-tenth prime cost of ropes, cradles, pulleys, planks, &c., used	8	0	0	÷ 18,346 = 0·21
Superintendence and general charges, 5 per cent.	8	0	0	
Total	£168	0	6	= 2·14d.

Deepdale Viaduct.

Labour:—

	£	s.	d.		Sq. yds.		Per sq. yd.
Nineteen men at an average rate of 4s. 2¾d. per day, and one foreman at 6s. per day	86	0	5	÷	12,459	=	1·66d.

Materials:—

	Cwt.	qrs.	lbs.		s.	d.		£	s.	d.
White lead	14	3	14	at	16	6	=	12	4	5
Dryers ..	3	2	0	,,	14	0	=	2	9	0
Umber ..	1	3	14	,,	28	0	=	2	12	6
Red oxide	1	1	0	,,	11	6	=	0	14	5
	Gallons.									
Raw oil	92			,,	1	8	=	7	13	4
Boiled oil ..	6			,,	1	9	=	0	10	6
Turpentine ..	6			,,	2	0	=	0	12	0
Brushes, &c.								1	13	11

28 10 1 ÷ 12,459 = 0·55

Tackling:—

	£	s.	d.	
One-tenth prime cost of ropes, cradles, pulleys, planks, &c.	8	0	0	÷ 12,459 = 0·27
Superintendence and general charges, 5 per cent.	6	2	6	
Total	£128	13	0	= 2·48d.

The same ropes, cradles, and other tackling are used for both viaducts, and they are reserved for them alone. Their cost is estimated at £80, and they will last for five of the triennial paintings, great care being taken of them when not in use.

The cost of painting these viaducts compares favourably with that of painting other iron bridges in the same district.

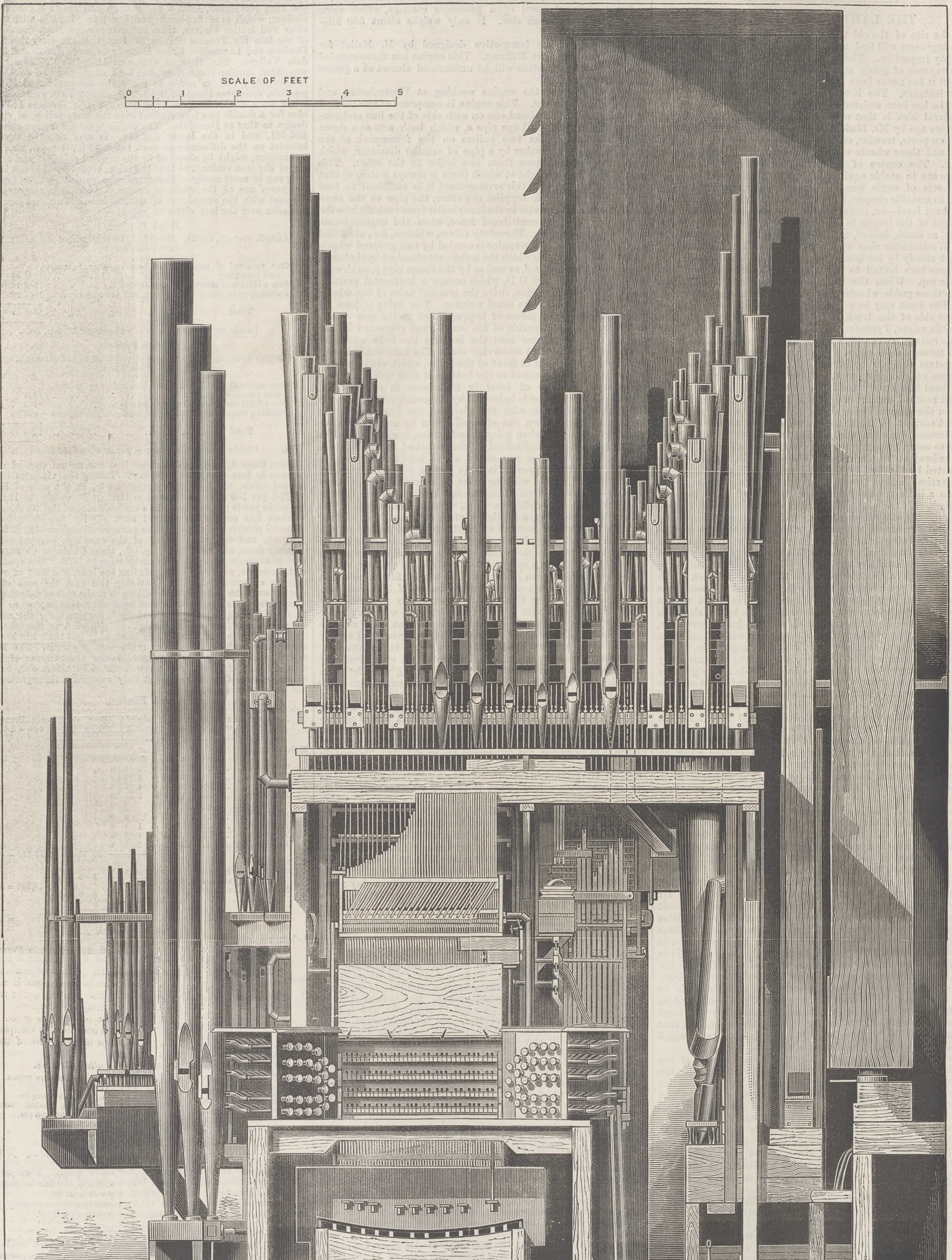
SOCIETY OF ENGINEERS.—Arrangements have been made, by permission of Messrs. Westwood, Baillie, and Co., for the members and associates of the society and their friends to visit, on Tuesday, September 21st, the London Yard Engineering Works, Isle of Dogs, to see, among other works in progress there, the great cantilevers of the Sukkur Bridge. On the occasion of the society's visit last year, the staging for this work was partially erected, and the first cantilever was being commenced. There will now be the opportunity of seeing the latter far advanced toward completion. Special carriages will be attached to the train leaving Fenchurch-street Terminus at 12.10 p.m., and to the train returning from Millwall Dock-station at 4.55 p.m. Tickets for the visit, without which no one will be admitted to the works, to be obtained from the secretary of the society.

[1] Minutes of "Proceedings" of the Institute of Civil Engineers, vol. lxxv.
[2] Minutes of "Proceedings" of the Institute of Civil Engineers, vol. xxii., p. 44.

ORGAN IN THE LIVERPOOL EXHIBITION.

CONSTRUCTED BY MESSRS. MICHELL AND THYNNE, ADDISON WORKS, KENSINGTON.

(*For description see page* 227.)



ORGAN IN THE LIVERPOOL EXHIBITION.

CONSTRUCTED BY MESSRS. MICHELL AND THYNNE, ADDISON WORKS, KENSINGTON.

ORGAN IN THE LIVERPOOL EXHIBITION.

In our last issue we gave a full page illustration of the fine organ of Messrs. Mitchell and Thynne, selected by the musical committee of the Liverpool Exhibition for the grand concert room, where it now stands. It was originally exhibited at the Inventions Exhibition, where it gained a prize and attracted marked attention and approval from some of the best organists of the day.

The advanced taste of the present day is continually demanding deviation towards perfection from the old beaten track of organ design; and in this instrument the builders we think fairly claim to have remedied many faults and made important improvements in that direction. Since its removal from South Kensington it has been partly remodelled and completely finished. The best organists agree that the duplication of stops, which marks the design of most organs of the present day, is a needless complication, rendering the organ less easy of management, and occupying valuable room indispensable for the free speech of the pipes.

It will be seen that in the present organ, which has been justly termed a *multum in parvo*, there are but thirty-six sounding stops, yet it contains in itself capacity and grandeur surpassing many instruments of double its size, and this is due to the fact that no two stops in the whole organ are alike, but each possesses a strongly marked individuality and distinctive character of tone. Amongst its most prominent specialities, which are peculiar to this instrument, may be named the gambas and flutes. These will be found a perfect imitation of the violoncello in the solo organ, and the zauberflotte in the choir is a stopped harmonic flute of novel character and peculiar construction, possessing a tone which when used as a solo stop is strikingly telling, but when used in combination modifies wonderfully, and is curiously accordant with the softest stops.

The instrument consists of four manuals, choir, great swell, and solo organs, each for full compass, CC to C, with a pedal organ. The sound-boards are so placed that each organ has ample speaking room. The choir organ, as will be seen from the front elevation, an engraving of which we publish above, being prominently to the front, the delicate stops thus speak directly into the room without impediment, lending a charm which no other position would render possible. Above this organ is placed the great or chorus organ with its sonorous diapasons and brilliant mixtures, and at higher level the swell organ. The manuals are placed at the side of the instrument with the basses towards the audience, and above these, as will be seen by reference to our engraving, p. 226, is the solo organ with a portion of the harmonic flute and violoncello forming a front. At the back of this will be seen the tuba, a very fine reed able to assert itself over the full organ. The pedal organ may be seen to the side of the player, three stops of which are placed at the back of the organ, the 32's and great flute being on the other side. Immediately above the keys our engraving shows the tubular pneumatics as applied to the solo organ, which players pronounce to be perfect in promptness of touch and repetition. Tubular pneumatics of a similar kind are now applied to the swell with equal success, the great organ being commanded through by the ordinary or French pneumatic lever. Within the organ are four large reservoirs, two being placed under the great organ sound-board, with a main reservoir on lighter wind supplying the choir organ and basses of the great organ under these. Beneath the swell is the heavy pressure wind reservoir which feeds the reeds. Under the orchestra on which the organ stands are the bellows—six very large French feeders supplying two feed reservoirs, and worked by a 4-horse Otto gas engine. We give above, for the benefit of our readers, the blowing action as seen when the organ stood in the small concert-room at South Kensington. The feeders will here be seen to be mounted on gun-metal wheels, which allow them to work horizontally freely with a minimum of friction.

For the first time in any English organ a mechanical movement of singularly simple and ingenious construction is applied to the great organ keys, by which the player can at will retain any note or chord which he strikes, while his hands are free for another manual; and a second note or chord held on the same manual instantly releases the first one retained. Many beautiful and novel effects are capable of being thus produced. Two ventils or stops, governed by pneumatic pistons of double action placed beneath the keys, will be found to each organ in addition to the ordinary composition pedals, thus rendering the management of the instrument easy and thoroughly complete.

We append to this description a list of stops, as given by the builders. Every stop in this organ is complete in compass from CC to C in alto—61 notes. The stops marked* are of new construction :—

Choir organ, CC to C in alto—61 notes.

	Feet.	ACCESSORY STOPS.
1 Spitzflote (metal)	8	1 Ventil.
2* Viole sourdine (metal)	8	2 Super octave coupler.
3* Gedact (wood)	8	3 Pneumatic piston acting on No. 1, off and on.
4 Gemshorn (metal)	4	4 Swell to choir.
5* Zauberflote ,, ...	4	5 Tremulant.
6 Flautina ,, ...	2	
7 Clarionet	8	

Great Organ, CC to C in alto—61 Notes.—Supplied with Three Pressures of Wind.

	Feet.	ACCESSORY STOPS.
1 Violon (metal)..	16	1 Sub octave choir to great.
2 Great open diapason (metal)	8	2 Swell to great.
3 Small open diapason ,,	8	3 Solo to great.
4 Claribel (wood open through)	8	1 Ventil, flue to quint mixture.
5 Octave	4	2 ,, great mixture and reed.
6 Flute octaviante	4	Two pneumatic pistons acting on ventils placed beneath the keys as in choir.
7 Quint mixture, 12, 15.		Three composition pedals.
8 [1]Great mixture, 4 ranks, 19, 22, 26, 29.		*Prolongement harmonique.
9 [1]Tromba	16	
10 [1]Trumpet	8	

Swell, CC to C in Alto—61 Notes.—Swell Box made in Three 1in. thicknesses, Felted between each and Lined.

	Feet.	ACCESSORY STOPS.
1 Flauto traverso (metal) ..	8	Super octave coupler.
2 Open diapason ,, ..	8	1 Ventil flue to geigen.
3* Viole de gambe ,, ..	8	2 ,, mixture and reeds.
4* Voix celeste ,, ..	8	Two pneumatic pistons acting on ventils, as in great organ.
5 Geigen ,, ..	4	Tremulant.
6 [2]Mixture, 3 ranks, 15, 19, 22.		Three composition pedals.
7 [2]Contra posaune (metal) ..	16	
8 [2]Horn ,, ..	8	
9 Oboe ,, ..	8	

[1] On heavy wind. [2] On heavy wind.

Solo Organ, CC to C in Alto—61 *Notes.*

	Feet.	Accessory Stops.
1 Harmonic flute (metal).. ..	8	1 Super octave coupler.
2* Violoncello (metal and wood)	8	Two ventils. Two pneumatic pistons, as in other manuals.
3 Tuba (metal) (heavy wind) ..	8	Tremulant.
4 Voix humaine (metal, enclosed in a swell box)	8	

Pedal Organ, CCC to F.—30 *Notes.*

	Feet.		Feet.
1* Harmonic bass (wood).. ..	32	4 Great flute (wood)	8
2 Great bass ,, ...	16	5 Bombarde (metal) (heavy wind)	16
3* Dolce ,, (wood open) ..	16		

Pedal Couplers.

1 Choir to pedals.	3 Swell to pedals.
2 Great ,, on a double-acting pedal.	4 Solo ,,

Manual Couplers.

1 Choir super octave (with choir stops).	4 Choir sub octave to great (with great stops).
2 Swell super octave (with swell stops).	5 Swell to great (with great stops).
Solo super octave (with solo stops).	6 Solo ,, (,, ,,).
	7 Swell to choir (,, choir ,,).

The tremulants are brought on to the action of one pedal by the use of the draw stops, separately or collectively. The draw stops are of solid ivory with ebony knobs, placed diagonally so as to afford the greatest facility for management. The instrument is constructed throughout of the finest materials and workmanship.

LETTERS TO THE EDITOR.

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

THE PROBLEM OF FLIGHT.

SIR,—Permit me to give you a very brief account of the presentation of my paper on the "Soaring Birds" before the A.A.A.S., at Buffalo, during their meeting from August 18th to the 24th. As you have treated me with such fairness and kindness in relation to the same subject, I wish you to have my version of this affair, as you, doubtless, will get others. The vice-president of the Association, Mr. O. Chanute, consulting engineer of Kansas City, visited me last month on account of letters he saw in THE ENGINEER. He pronounced my observations to be most important, and my paper on "The Wings of Birds," finally printed in the "American Naturalist," to be valuable. He wished me to present the subject to the A.A.A.S. at their Buffalo meeting. I agreed to do so. He criticised my paper, and I amended it to his liking. As written it would occupy an hour in the delivery; thirty minutes were assigned me on account of the very crowded condition of the section. I cut out all the mechanical portion, and read the observations, the greater part of which you have printed. It was well received. They kept me on the stand the entire afternoon to the hour of adjournment, asking questions, finding me well fortified with facts, and everyone seemed satisfied. Finding that a part of the paper had been omitted, they took a vote to have the balance of it on the 23rd at the forenoon meeting. I was repeatedly asked if I had with me any of those floating devices; the reply was, that I had not. That I had never worked out the matter so as to have precise knowledge which would enable me to construct one of those things so that I knew it would float before I tried it. Many of them would float, many of them would not, and I could not locate the precise construction which caused the difference. That I could not possibly spare the time needed to come to Buffalo and experiment with the risk of having no suitable wind during the whole time of the convention. All this was thoroughly explained to Mr. Chanute and to the section before and at the time the vote was taken.

They nevertheless voted unanimously to have the rest of the paper. Mr. Chanute left Buffalo for New York on the 20th. I was not in town on the 22nd, and got to the room on the 23rd a few minutes before the section met, when my paper was the first in order. There was a dense crowd. I read them a ten-minute paper in the most guarded terms. As I went on I was sensible of great dissatisfaction somewhere, and when I ended there was a perfect hubbub. They all wanted to know where my models were. I was charged with duplicity by one, and defended in a weak way by another. At last the president, Mr. Morse, of Salem, said, that "it was the first time in the history of the Society in which so important a matter was presented without models." The president of the section then told them that I had fully informed them that I had no models, and that no blame could attach to me on that account; but that he had understood that I had afterwards supplied myself with models. Then they had some trouble among themselves, and adjourned after occupying the whole morning in a sort of wrangle, during which time I was in a sort of dazed condition over what it all meant.

After the adjournment, someone handed me a city paper, where, with a great array of headlines, the announcement was made that their reporter had arranged with me to float in one of my patent machines from the cupola of the school-house, and that I would present many marvellous devices which completely turned over the laws of gravitation. This was a Sunday paper, the 22nd. Pretty much all the morning papers took their cue from this, and the entire Convention, as well as all Buffalo, had done the same thing. I was set down as a fraud on account of these preposterous lies.

Well, it seems to me that the officers of that Convention prefer to sacrifice me than to admit that they were taken in by a newspaper squib. I except Mr. Chanute, whom I have not seen since the Convention, but whom I cannot connect in the most remote manner with any of this unfairness.

I send you a Buffalo slip, which will show the *modus operandi* of the city papers. This newspaper made their reporter offer me their building instead of the school-house. I never said a word to this reporter nor to any other reporter. None of that fraternity ever approached me. My paper of the 23rd was not discussed. It was entirely lost sight of.

Now comes the most astounding part of this strange matter. As I was leaving the city the next day, this scoundrel, who had perpetrated the whole thing, met me, and proceeded to glorify himself as having made me famous. He talked for half an hour, and wanted me to give him a 10 dol. fee for doing me a great service!

I expect to return to Florida this coming winter and take a step further in this matter, having at length an income sufficient for the purpose without danger of getting into the poor-house. I am trying to get an order from the Navy Department to permit me to use the Egmont lighthouse, at the entrance to Tampa Bay, to float planes from during the day, which would relieve me from the expense of erecting an elevated platform. If I were a grog-shop keeper influencing votes it might be done. I did work from there while the keeper was asleep, but could not use it with any propriety without an order. I. LANCASTER.

Chicago, August 28th.

SOFTENING WATER.

SIR,—My attention has been drawn to a letter in your last issue under the above heading and signed Andrew Howatson, of Boulevard Anspach, Brussels. Is this the Mr. Andrew Howatson, who about two years ago was the London agent of Messrs. Caillet and Huet, of Lille? and who transferred his rights in the agency to Messrs. Cordner, Allen, and Co., covenanting under seal, dated November 11th, 1884, as follows:—

"And the said Andrew Howatson doth hereby covenant with the company that the said Andrew Howatson will not at any time hereafter previous to the 22nd day of February, 1897, directly or indirectly by himself or his agents, and either alone or jointly with any other person or persons, and either as principal or assistant engage in the working of any existing or future process for the softening or purification of water in the United Kingdom."

Is this the same Andrew Howatson who about the same time favoured the writer with a call, asking him various questions as to how much time this or that chemical reaction took to complete itself, professing that his studies of the subject did not refer in any way to work to be done in the United Kingdom? Is this the same Andrew Howatson, who within a few days or weeks—the ink of the above covenant was hardly dry, and the sound of his words hardly dispersed—allowed his name to appear on a circular issued in England describing Howatson's water softening process?

If he is, then what reliance can we place on any information which he vouchsafes to furnish on what he calls *his process?*

Take away from his so-called process what resembles the apparatus of his former employers, and what is there left? Just what could be easily done with two water tubs and a faggot of twigs!

As an example of this gentleman's accuracy, it will suffice to single out one statement of his letter to you. For instance, he says that the water of hills is reduced from 30 deg. to 4 deg.," and that the Lambeth water could be reduced from "14 deg. to 4 deg."

The readers who know that Lambeth water is 14 deg. by Clarke's scale would naturally conclude that the hill water was 30 deg. by the same scale; evidently Mr. Howatson does not know that 30 deg. hydrotimetrique are just equal to 21 deg. by Clarke's scale and no more. I have endeavoured to follow Mr. Howatson in his argument concerning my utilisation of the sediment or precipitate, and about one lime being richer than another. but I have failed to see his point. My view of the case is simply this:—Why go to this or that lime kiln for a supply when we can get all we want from the water itself? and of a quality which is surely always the same? and at much less cost than that at which it could be brought from the nearest lime kiln? Why choke up the drains with what I have proved can be utilised with advantage? My experience as to the best way of applying the softening reagents has happily led me to a conclusion entirely opposed to that of Mr. Howatson. I have found by two years' actual work that it is possible to regulate the automatic supply of a powder to a grain per gallon nearly, and I am afraid those who use solutions must experience some difficulty with corroded or choked up pipes and taps. This, however, must be allowed to remain a matter of taste and experience.

I shall be very happy to give all information in my power concerning my different water-softening patents to any of your readers who will favour me either with a call or a letter, but I do not think it right to occupy your valuable space in giving Mr. Howatson the information he desires. P. A. MAIGNEN.

32, St. Mary-at-Hill, Eastcheap, London,
September 7th.

MIXED TRAINS.

SIR,—I have read your article upon this subject with great interest, and I think there can be no difference of opinion as to the necessity for such trains being discontinued. With regard to the proper position for the passenger carriages to be placed in a train, very important points can be brought forward on either side, but I most certainly agree with the views of the Board of Trade and the Amalgamated Society of Railway Servants, that the balance of advantages show in favour of placing the carriages next the engine and in front of the wagons. The carriages can be fitted with continuous automatic brakes, and with a communication cord. The driver can without trouble stop the carriages at the platforms, which is a difficult matter when they are at the rear of a long coal train. Much greater fear is to be apprehended from the breaking of wagon axles, tires, and couplings, or from wagons leaving the line, than from collisions. It must also be remembered that the risk of collisions will be very greatly reduced by the use of the continuous brakes, and further, we must not lose sight of the fact that when the carriages are at the rear they are quite as liable to be run into by a following train.

Quite recently a London and South-Western mixed train became uncoupled near Crewkerne, and the two portions came into collision, the passenger carriage was at the rear, and six passengers and the guard were injured. That is one instance out of many in which had the passengers been next the engine they would have escaped all risk. CLEMENT E. STRETTON,

Saxe Coburg-street, Leicester, Consulting Engineer,
Sept. 11th. Amalgamated Society of Railway Servants.

[Mr. Stretton advances nothing to make us alter the view we have expressed on this subject.—ED. E.]

REDUCED HOURS.

SIR,—At this critical period of our country's history, no subject is more interesting, although appalling, than the depression of trade. It bears a mournful interest to engineers when they look around and see thousands of competent mechanics tramping the country. Messrs. Sharp, Stewart, and Co. have decided to start their works at 8.30 a.m., in order that they may not be under the necessity of discharging hands, and thus throwing more men into the congested labour market. The questions for our works' managers seem to be:—Is the work before breakfast beneficial to the men's health, and does it pay the master? as it is often admitted by managers that the first quarter is the most unremunerative period of the whole day.

If the example of the above-mentioned firm was followed, it seems apparent that very few hands would need to be dismissed for shortness of work; and even with exceptional firms where there is ample work, more hands might be employed, owing to the shortening of the hours for the existing staff. Then would working-men share their trouble together whilst the dark cloud of depression hovers over our beloved country. LOCO.

London, September 13th.

THE ECONOMICAL USE OF COAL.

SIR,—During the past month some interesting experiments have been made at the Fishponds Brick and Tile Works with Hill's patent apparatus for economising fuel, &c. This apparatus was attached to a double-flued Lancashire boiler, 7½ft. diameter and 31ft. long. The result of these trials—extending over several days—was, with the apparatus, the consumption of 18 cwt. coals in 7½ working hours, as against 28 cwt. of coal consumed in the same time when working by the ordinary method, the same work being performed under both systems, thus showing a saving of nearly 38 per cent. These experiments were made under the direction of Mr. L. Gunning, the company's engineer, and were considered highly satisfactory. The apparatus is extremely simple and inexpensive, the total cost not exceeding £20. The insertion of the above may possibly interest some, at least, of your numerous subscribers, and will oblige H.

Bristol, September 15th.

A NEW ILLUMINANT FOR LIGHTHOUSES.[1]

By J. R. WIGHAM.

THE behaviour of the electric light in the experiments recently made with lighthouse illuminants at South Foreland, as described in the report of the Trinity House, showed so conclusively to what a great extent the small size even of the extraordinarily large arc lights used there unfitted it for lighthouse purposes, that it occurred to me that if a light of equal intensity but of larger size were used at lighthouses, a long-looked-for desideratum would be attained. I have had the honour of explaining to the British Association at previous meetings the construction of the gas burners with which the lighthouses which have been lighted under my system in Ireland are supplied. They are constructed so as to admit of their being applied in various degrees of power as required by the state of the atmosphere. The smallest power used in Ireland is that of 429 candles from twenty-eight jets, consuming 50 cubic feet per hour, the largest from a triform of 108 jet burners, as at Mew Island, having an illuminating power of 8802 candles. No oil light in the experiments approached that illuminating power, but the electric light was at short ranges much more intense. It was, however, defective as a lighthouse light, for the report shows that in order to show to its best advantage it had to be focussed upon a given point. This method of proceeding, it is needless to say, is quite inadmissible in lighthouse practice, because other parts of the horizon are thus left in total darkness; hence the necessity for a light free from that defect. Tested as naked lights, and viewed from a distance, the greater size of the gaslight far more than compensates for the greater intensity of the electric light, but close at hand its intensity produces the optical illusion which causes its size to appear much greater than is really the case, and the occurrence of fog reveals this peculiarity.

The method I have adopted to unite the advantages of the volume which is found in gaslight with the intensity which is produced by the electric light, is to use in connection with my gaslight a solid carbonaceous body converted into vapour, and made to produce intensely white light by compressed oxygen. I use the oxygen at a pressure of about 1000 lb. to the square inch. I get by this arrangement all the advantages of intensity added to volume without any costly machinery, such as the steam engines, dynamos, and expensive lamps and cables used for the electric light. The naked light of a triform on this principle would have an illuminating power quite as great as the highest power of the most powerful electric light, or combination of electric lights, shown at South Foreland, while its size is such that in ordinary lenses it will be sufficient to illuminate with equal brilliancy the whole horizon, and the entire intervening space between the horizon and the base of the lighthouse tower—an effect not attainable with the electric light without materially diminishing its illuminating power.

As respects cost: The cost of this new illuminant is but little over that of the ordinary gas light, for the application of the oxygen is only made on the occurrence of fog. Experience has shown that there are not, on an average, many hours of fog in the year; but while that most dangerous condition of the atmosphere surrounds the mariner, I think that you will agree with me that no expense would be too great to save life and property.

[1] British Association—Section G.

BELL'S LATEST INVENTION.—Prof. Alexander Graham Bell and his cousin Chichester Bell, of Washington, have recently made a very remarkable discovery, which they think is quite as important as the transmission of the tones of the human voice through the telephone. They have discovered that a falling jet of water or a flame of gas burning in a room reproduces every word spoken and every sound uttered within a given distance. When two people join in conversation in a room in the evening the gas which burns above their heads repeats every word they say, and sounds uttered in the vicinity of flowing water produced vibrations. It is well enough understood that whatever can repeat the waves of air produced by any loud sound can repeat the sound itself. It is the principle of the telephone. But in the telephone the original impulses are repeated instantly, and die away for ever. In this new apparatus assuming that it really does all that is described, the waves are not reproduced in that form, but their effect on a jet of water, long known to be sensitive to such impulses, is caught by instantaneous photography and permanently recorded on a glass plate in the form of minute irregularities of surface. By suitable apparatus these elevations and depressions which correspond to pulsations of air, are retranslated into air waves, and the voice is heard again. The water or liquid of whatever kind it may be is coloured with a bichromate of potash. If it were perfectly clear it would not answer, because the light used in photographing would pass through without resistance, and no record would be made on the tablet. The water is coloured for photographing, and the jet is made to fall obliquely on a glass plate. The water spreads itself out on the glass plate and runs off. It is the water so spread out that is to be photographed as it passes. Words spoken cause the jet of water to vibrate; the vibrations in the jet cause corresponding vibrations in the film of water as it breaks snd spreads on the glass plate and runs off. A ray of light is passed through that film and through the glass plate to a sensitive tablet behind. The vibrations in the liquid film are reflected in the variations of intensity of the impression made on the photographic tablet. Speaking continues, the jet keeps running, the film keeps passing over the plate, the recording tablet keeps moving as the film keeps moving, and the light passing through this film to the tablet makes a record of the speech far more accurate than any stenographic report.—*American Manufacturer.*

A NEW TORPEDO-BOAT.—Persons walking along Riverside Drive at 86th-street, on August 24th, saw a black object skimming along on the surface of the Hudson. Then they didn't see it for a long time. Again it would appear at a distance. The object was not a sea serpent, but a submarine torpedo-boat, the work of Professor J. L. Tuck, who showed it off to a few friends yesterday. The boat is intended to approach a big naval vessel during war times under water, and, having left a couple of torpedoes under her hull, to withdraw to a convenient distance and fire them by means of an electric current from a battery. The little craft of iron and steel, weighing 20 tons, is named the Peacemaker. She is 30ft. long over all, 8½ft. breadth of beam, and 6ft. deep. Placed at each side of the keel is enough lead to load the boat to the water's edge. To sink the vessel below the water there are compartments which can be filled or emptied as required. Compressed air is held in iron pipes, to be liberated as the air grows foul. A common rudder steers the craft, and a horizontal rudder, centrally hinged in a frame at each side of the stern, raises or sinks the boat. On top is a little dome 12in. high and 14in. in diameter, with glass windows for light. When a ship is to be blown up as the boat passes beneath her a strong insulated wire, carrying two cartridges, one at each end, is released. The cartridges are filled with a powerful explosive, and are lightened with corks, so that they will rise against the bottom of the vessel. Then by means of the electric battery, after the boat has withdrawn, the explosion is effected. Yesterday the little craft dived to a depth of 40ft. in the river, and then took a submarine trip up toward Yonkers, remaining under water over seven minutes. The trials were a success, and the gentlemen interested in the boat were all pleased. Professor Tuck said she had made 12 miles an hour, and that she could remain under water several hours. A second exhibition was given on Thursday. About 3.30 p.m. the process of filling the Peacemaker's receivers with caustic soda was begun. The soda had been saturated with water, and in a few minutes the steam gauge showed 100 lb. pressure. Compressed air was then forced into pipes, placed so that small quantities could be released from time to time as the atmosphere in the hold grew foul. The pilot took his place amidships with his head inside the windowed dome, which rises 2ft. above the deck; the engineer followed him and firmly screwed down the manhole from the inside. These two men compose the entire crew. At once the vessel started up the river at a speed of about six miles an hour. By the use of her lateral rudders she sank below the surface almost immediately, and appeared again about half a mile up the river, after a submersion of five minutes. On the second trip a reporter was added to the crew, and the Peacemaker made the longest dive that she had yet attempted, from one and a-half to two miles, passing under two steamers, and rising within 10ft. of a tow of canal boats. A third dive was attempted, but owing to the water in the boiler giving out, it was unsuccessful. Friday the vessel was to be hauled out of the water at 13th-street, and several improvements made. Electric lights will take the place of the candles now used, a water gauge will be attached to the boiler, an additional reservoir for water will be added, the manhole by which the hold is entered will be made flush with the deck, and the machinery necessary for carrying and discharging torpedoes attached to her sides. The promoters of the enterprise are confident of success, and will build a second boat at once, 20ft. longer—that is, 50ft. over all.—*New York Times.*

RAILWAY MATTERS.

Lieutenant-Colonel H. J. Nuthall has been appointed engineer-in-chief of the Ajmir-Bhawalpur—India—Railway Survey.

Surveyors have gone to Algoma to arrange the details for the extension of the Canadian Pacific Railway to Sault Ste. Marie to connect with the American lines. It is expected that connections will be made in twelve months. The line between the North-Western States and the Atlantic Ocean will be 400 miles shorter than any other.

The entire length of railroads of the world, up to the end of 1884, as recently published by the Prussian Minister of Public Works, was 291,000 miles, an increase of 27 per cent., or over 60,000 miles, during the preceding five years. Of the entire length, very nearly one-half is that of the American railroads, mainly in the United States.

The first line of railway authorised in the Australian Colonies under the land grant system is that between Beverley and Albany in Western Australia, which Messrs. C. and E. Millar have just obtained the contract to construct. The whole of the line is to be constructed within three years, and a commencement will be made early in next month. The contract price is £1560 per mile, and £300,000 of the capital of the company has already been subscribed. The country through which the line will run is very level, and some of it contains valuable forests of jarrah.

The net receipts of the railways of the United Kingdom for 1885 are only equal to the payment of 4·02 per cent. on the capital expenditure, being the lowest range of railway profits in this country since 1867, when the net receipts represented 3 91 per cent. on the capital expenditure. The source of loss must be sought for more especially in the reduced ton-mile rate, which appears to evidence either that the rates and fares have been considerably lowered, or that the average weight of the train has been reduced instead of being increased, as it is being in most other countries, or both together. This is with an increase during the year of about 2½ millions in the number of passengers carried, and of over 160,000 tons in the quantity of minerals transported, while in the quantity of general merchandise carried the decrease has only been a little over two millions of tons.

According to a report on the Swiss railways, down to the end of 1884, the system was worked with 619 locomotives, 1807 passenger cars, with seats for 80,245 persons—44⅓ per car—and 9031 freight cars with capacity for 102,322 tons—11⅓ tons per car. The number of locomotive miles was 10,802,290, averaging 17,420 per locomotive; and the number of train miles was 9,122,470, which is equivalent to very nearly seven trains each way daily over the entire mileage; 23,488,640 passengers were carried an aggregate distance of 323,836,170 miles, the average journey being 13·8 miles, and the whole movement equal to 181 passengers each way daily over the whole mileage. The average passenger fare was 3·66c. per mile on the ordinary rail, and 38·75c. on the mountain roads, which is very high, and is the more noticeable because only 1½ per cent. of the passengers travelled first-class, and 82¼ per cent. were third-class.

The other day the ceremony of breaking through the Woy-Woy Tunnel, New South Wales, and firing the last shot was, at the invitation of the contractor, Mr. George Blunt, witnessed by a number of visitors from Sydney, including several members of Parliament. This tunnel is on the Homebush-Waratah line of railway, which is to connect the Southern with the Northern system of railways. The length of the tunnel is 1 mile and 4 chains, the excavation of rock being 124,500 cubic yards. The work was commenced on March 1st, 1884, the last shot to complete the line of communication being put in on July 17th. Some idea of the magnitude of the task may be gathered from the fact that to complete this work it is estimated some 10,000,000 of bricks will be required, and the number of casks of cement no less than 10,000. From the start of the undertaking work has been carried on without cessation night and day, excepting Sundays. In the work of removing the rock over 100 tons of gunpowder and 10 tons of dynamite have been used. The work of perforation has been carried out by means of ten percussion rock drills, worked by compressed air, the power being obtained by a 40-horse engine.

From a statement printed in the *Railroad Gazette*, it appears that up to the beginning of August 2262 miles of new track had been laid down in the United States. This mileage is larger than that constructed in the corresponding period of any previous year since 1872, excepting the four years from 1880 to 1883. In 1872 the mileage to that date was 3372; in 1880 it was 2631; in 1881, 3115; in 1882, 5667; in 1883, 2796. These figures have reference to main track only, and do not include additional tracks and sidings. Judging from the present great demand for rails in the United States, there must be a large amount of additional tracks and sidings in process of construction and in contemplation. The new main track reported up to the above date—2262 miles—would require less than 225,000 tons of rails. Assuming that 5000 miles of new main track will be laid during the whole of the year, the amount of rails required would be less than 500,000 tons. Deducting this from the estimated production—1,400,000 tons—of rails in the current year—an estimate based upon orders already executed and those still in hand—this leaves 900,000 tons for renewals, additional tracks, and sidings, or nearly three-fifths of the total production.

A serious railway accident has happened near Niagara Falls. An excursion train on the Nickel Plate Railway was on its way for Niagara Falls, on Tuesday; it consisted of seventeen loaded cars, and was proceeding at the rate of eight miles an hour, when it came into collision with a freight train going at thirty miles an hour, while rounding a curve near Silver Creek, New York State. So instantaneous was the shock that the air brakes of the freight train were not set, and the slower passenger train not stopped, although its engineer quickly reversed the engines. The trains met squarely, with a noise like that of an explosion. The baggage car of the excursion train was driven through the smoking car, telescoping it up to the rear door. Fourteen occupants of the latter were instantly killed, and the injuries were so dreadful that it was nearly impossible to place the remains of each body together. Three persons have since died, and a score are terribly wounded. One account says the freight train, presuming that the excursion train was late, passed the station where it had been ordered to meet the excursion train. Another and more probable story is that both trains were proceeding under orders, the man who despatched them having blundered regarding the side track where he intended the trains to pass one another.

Messrs. R. Stephenson and Co. are now manufacturing Garrett's patent locomotive weighing apparatus, which seems to be the quickest and simplest method of weighing engines. The apparatus consists of short and strong hydraulic cylinders with rams, which are placed, one under each wheel, on a planed, level, cast iron bed, such as is usually fitted to locomotive erecting or overhauling pits. The engine is then lifted by the crane and placed with the wheels perfectly central on the rams. The height of all the rams must be exactly the same, and for the purpose of adjusting this height a screw plug is provided on the side of each cylinder. The weight of the engine is then read off from pressure gauges, the total weight as well as the weight on each pair of wheels being at once indicated. In shops where there are no cranes a special arrangement of side walls to the pit is made, and the rams are carried below the level of the rails. The rams are adjusted under the flanges of the wheels, and by means of a small hydraulic force pump the rams can in a very short space of time be raised so that the wheels are lifted clear of the rails, and at the same time are adjusted perfectly level. The weights are then read off from the gauges as before. The gauges are made to register up to 5 tons on each wheel for light engines, and to 10 tons on each wheel for heavy engines.

NOTES AND MEMORANDA.

The production of kainit and karnallit has begun at the Vienenburg potash mines. About 1000 centners of karnallit are sent daily to Aschersleben by rail. The railroad junction to the mines is nearly completed.

Recent experiments by Professors J. J. Thomson and Threlfall have brought them to the conclusion that, just as ozone is formed by the passage of electric sparks through oxygen, so an allotropic modification of nitrogen is formed by sparking in nitrogen.

A discovery which is of vast importance to New Zealand is announced. Oil has been struck near Gisborne, and the well is now producing fifty barrels a day. It is believed that there is an unlimited supply, requiring only further appliances to increase the quantity obtained very largely.

Dr. Lucien C. Rose, of Ohio, has sailed for Gothenburg, Sweden, where arrangements have been made for a public test of his telephone, and his trip abroad is to enable him to be present at the test. Dr. Rose claims to be able to speak and hear with ease and satisfaction with his instrument over a distance of 2500 miles.

Chloride of tin as a disinfectant is recommended by Dr. Abbot as being more active than zinc chloride, copper sulphate, zinc sulphate, or ferric sulphate, spores being killed after exposure to one per cent. solution for two hours. It is cheap, tolerably safe, and will not corrode lead pipes. It is advised, when required to be kept, and to prevent formation of insoluble oxichloride, to mix it with an equal quantity of ammonium chloride.

Mr. Thomas Andrews has carried out a long series of tests on pieces of iron and steel submerged at the mouth of rivers, where the fresh water began to mix with the salt water of the ocean. The tests have proved that under these circumstances the corrosion is from 15 to 50 per cent. greater than when the article is submerged in pure ocean water. This increased action is attributed by Mr. Andrews to a galvanic action that is brought into play by the difference of potential caused by the mixture of the waters.

To get an absolutely clear solution of shellac has long been a desideratum. The *National Druggist* says it may be prepared by first making an alcoholic solution of shellac in the usual way; a little benzole is then added, and the mixture well shaken. In the course of from twenty-four to forty-eight hours the fluid will have separated into two distinct layers, an upper alcoholic stratum perfectly clear, and of a dark red colour, and under it a turbid mixture containing the impurities. The clear solution may be decanted or drawn off.

By a decree dated June 11th, 1882, the Government of France offered a reward of 50,000f. for the discovery of greatest value relating to the utilisation of electricity for any of the following purposes:—As a source of heat, of light or of chemical action; as a means of transmission of mechanical power, or of verbal communication in any form; or, finally, as a curative agent. The Minister of Instruction has now announced that June 30th, 1887, will be the latest date for entering the competition, and that the prize will be awarded in the following December. The competition is open to all without restriction, and *savants* of all nations are invited to participate in the award.

Some time since a sensational paragraph went round the press concerning an ice-cream poisoning case, which occurred in New Jersey. Professor Vaughan discovered that the cream contained tyrotoxicon, and announced that, under certain conditions, milk became highly poisonous. It seems that the authorities were not content with this conclusion, and as one of the victims died, a post-mortem examination took place, and the organs of the deceased were submitted to Professor Austen, of Rutgers College. He has just announced the discovery of arsenic in sufficient quantity to cause death. We can go back to the use of milk again in comfort—which is satisfactory, seeing how little the Professors have left us to eat and drink.

The invention is announced of an entirely new fabric called Berandine from the name of the discoverer, Berand, who has found out a method of extracting from the outer covering of a peculiar kind of peat a textile which has valuable properties. The articles manufactured from this fibre resemble some woollens, but can be produced at a far cheaper rate, are very strong and serviceable, and keep their colour well; mixed with wool the result is very satisfactory. As yet, however, the manufacture is quite in its infancy, but those learned in such matters consider that Berandine has a future before it, and we may expect to see it utilised in this country before long. The discoverer comes from Maastricht. The preceding statement must be taken for what it is worth. We are extremely doubtful that anything worth weaving can be got from peat.

From a paper on "Secondary Electrolysis," by E. Semmola—*Comptes Rendus*—it appears that, if a small ribbon of platinum is immersed in a voltameter containing acidulated water, in such a way that its ends are opposite the electrodes of the voltameter, and a powerful current is passed through the latter, hydrogen and oxygen are evolved not only from the electrodes but also from the ribbon. This secondary electrolysis varies greatly with different conditions, and ceases altogether when the current is not strong; but if oxidisable metals are used instead of platinum, it becomes much more energetic. The phenomena are well seen with amalgamated zinc, which is not attacked by acidulated water except when the current passes. When the circuit containing the voltameter is closed hydrogen is given off from one half only—the negative half—of the zinc, while oxygen is absorbed by the other half. If several pieces of zinc are immersed in the water in the voltameter hydrogen is given off from each of them. This secondary electrolysis is due to a current derived from the immersed zinc.

Mr. E. L. Nichols, in the *Journal of the Chemical Society*, describes a set of experiments with aqua regia, nitric acid, hydrochloric acid, and sulphuric acid, to illustrate the phenomenon that when finely-divided iron is placed in a magnetic field of considerable intensity and exposed to the action of the acid, the chemical reaction differs in several respects from that which occurs under ordinary circumstances. With aqua regia, it was found that the speed of reaction is greater in the magnetic field than without, and that the heat of chemical union is much greater. With nitric acid, the effect of the magnet was to greatly increase the speed, reducing the average time from eight minutes to less than one minute. With sulphuric acid, the reaction was uniform and complete, and apparently of the same chemical character within and without the fluid. The magnet was found, however, to increase the speed of reaction, and to decrease the amount of heat produced. A series of measurements was made with nitric acid, in which powdered copper was substituted for iron. The reaction in the field was found to be identical with that which occurred when the magnet was not in action.

In 1883 the president of the Denver Water Company, one of the owners of landed estate in North Denver, on the highlands, just across Platte River, immediately opposite the business section of the city, conceiving his land to be underlaid at considerable depth with valuable coals, began boring for them. At a depth, says the *Scientific American*, of about 300ft. a stream of water was suddenly projected, with great force, from the bottom to a height 30ft. or 40ft. above the surface, completely drenching his men and compelling a suspension of work. At first it was thought to be but temporary; but as it continued day after day without any perceptible decrease of force or volume, and as the theory of its projection from true artesian sources, so to speak, became more and more apparent, Mr. Zang, owner of a large brewery near by, concluded to test the matter for himself. In due time, apparently the same water was encountered at a depth of 300ft., and then followed a succession of like enterprises, all of which were successful. Many wells are now in operation, varying in depth from 250ft. to something over 700ft., the deepest being that sunk by the county of Araphoe, near its splendid Court-house, which well is 910ft. deep, the whole producing about 3,000,000 gallons per day of twenty-four hours. The water is very pure and fine.

MISCELLANEA.

Tenders have been invited for the lengthening of the South Brisbane wharf.

We regret to learn that difficulties arising out of the re-organisation of the Imperial College of Engineering, Tokio, have resulted in the loss to the new University of Japan of the services of Prof. T. Alexander.

A telegraph cable is to be laid between Cape York and Thursday Island, Queensland. The tender of the Eastern Extension Company for the making, transportation, and laying of the cable for £10,000, will probably be accepted.

Constantinople has at the present time a water supply from Lake Dercos, twenty miles from the city. This was introduced by a French company, and was intended to supplant or supplement the supply, which the city has had for years, from an open reservoir six miles distant, in which the rain collected, and from which it was brought in iron pipes.

The germs of a new manufacture, which might become of considerable importance, appear in certain special exhibits of Muntz's Metal Company, now to be seen at the Birmingham Exhibition. These are specimens of three coils of small gas tube ¼in., ⅜in., and ½in., which are intended for use instead of ordinary composition piping. The exhibits are the invention of Mr. Thos. Budworth Sharp.

At a meeting of the Waterworks Committee of the Leeds Corporation on Wednesday, it was decided to recommend the Town Council to adopt the scheme of Messrs. Filliter and Rofe, civil engineers, of Leeds, for the construction of a new tunnel in connection with the waterworks for the borough, at an estimated cost of £35,700. Another scheme which was advocated would have involved an extension at a cost of £90,000.

Sir John Coode has sent an important report to the Melbourne Harbour Trust, in which he estimates the cost of constructing a dock that will cover 63 acres at £1,336,000, and expresses the opinion that if the works were carried on with vigour they might be completed in six years. He also insists that, considering the character of the strata which underlie the West Melbourne swamp, the contemplated dock should either be constructed with concrete walls, or not constructed at all.

Mr. Wm. Morgans, F.G.S., one of the examiners for mine managers' certificates, has been appointed Lecturer on Practical Mining in the Merchant Venturers' School, Bristol, and Mr. Cook, Associate in Mining, Royal College of Science, has been appointed as his assistant. Properly equipped workshops have also now been added to the establishment. Mr. Sydney Everett, late a student in this department of the School, has recently been awarded a national scholarship by the Department of Science and Art.

The following are the bids recently received for the construction of waterworks at Martin's Ferry, Ohio, U.S.A. Four classes of pumping engines were bid on, viz.—(1) Vertical, direct-acting, compound, duplex engine, capacity 1,500,000 gallons; (2) same type, capacity 1,000,000 gallons; (3) vertical, direct-acting, single cylinder, duplex engine, capacity 1,500,000 gallons; (4) same type capacity 1,000,000 gallons. The contract was awarded to the Gordon Maxwell Co., Class 2, at 7900 dols. The contract for the pipes and castings was awarded to the Cincinnati and Newport Iron and Pipe Co., at 30·83 dols. per ton for cast iron pipe, and 60 dols. per ton for special castings.

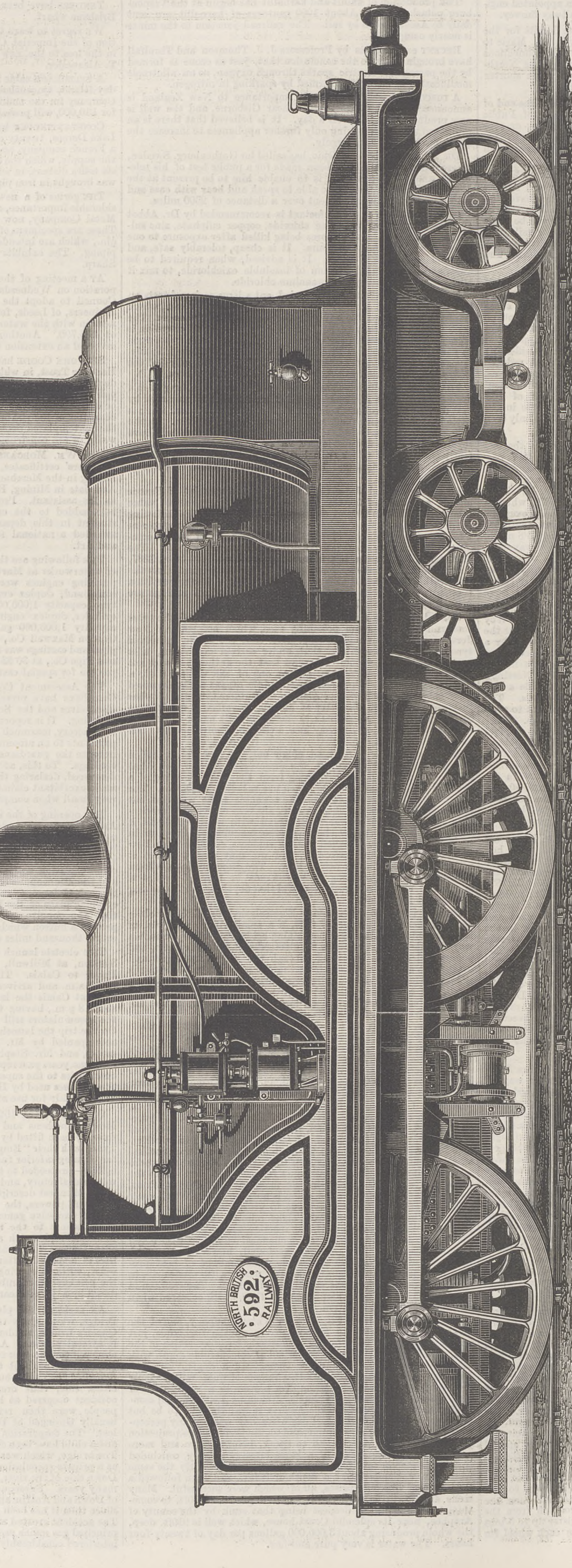
The Assessment Committee of the West Bromwich Board of Guardians have presented a report upon the litigation between themselves and the South Staffordshire Waterworks Company as to rating. It is reported that the result of the litigation has been satisfactory, inasmuch that the company will have to increase its payments to an amount which, in the course of five years, will reimburse the guardians for the expense involved in the legal proceedings. To this, at the board meeting, some of the guardians demurred, declaring that the committee had in the first instances made exorbitant claims, and that the results of the litigation were very small when compared with the enormous expense.

The opening of the industrial exhibition at Minneapolis, Minn., August 23rd, was made somewhat memorable by the fact that the machinery was set in motion by the President's wife from Upper Saranac Lake, in the Adirondacks. All the other arrangements for the purpose having been previously made, direct telegraphic communication was established between the exhibition building and the Minneapolis office of the Western Union Company, thence through Chicago, Cleveland, and New York city, with the country stopping place of the President's party, when, upon a given signal that the circuit was open the whole distance, Mrs. Cleveland pressed a button which set the wheels turning in the Exhibition, over a thousand miles distant.

The electric launch Volta, which was designed and built by Mr. Skelton, at Millwall, has just made a very successful trip from Dover to Calais. The launch left Dover on the 13th inst. at 10.30 a.m. and arrived at Calais at 3 p.m. After a considerable delay at Calais the launch returned to Dover, where it arrived about 8 p.m., having travelled fifty miles, while the current from the accumulators still remained powerful enough for more work. On the trip the launch was in charge of Mr. Toms, pilot, who was accompanied by Mr. Reckenzaun, the patentee of the electric motor, and Mr. Stephens, one of the owners. Mr. Skelton has for some years past repeatedly called the attention of the Admiralty authorities to the superiority of the electric power over steam for the furnaces used by H.M. service, as they would be noiseless and always ready for use at an instant's notice.

On Friday, the 10th inst., the steamship Racilia, belonging to Messrs. Stephens and Mawson, of Newcastle-on-Tyne—which has recently been fitted by Messrs T. Toward and Co., of Newcastle-on-Tyne, with their "Emphresis" patent forced-combustion apparatus, for burning inferior fuel and increasing the steaming power of the boilers—proceeded to sea for a trial of the apparatus. The results were satisfactory, and notwithstanding that the bunkers were full of the cheapest description of coal, and the engines opened out to their full powers, the draught had repeatedly to be eased, owing to the excessive generation of steam. After transferring those going ashore to the tug, the Racilia proceeded on her voyage to Constantinople, with a cargo of over 2000 tons. We may mention that Messrs. T. Toward's system includes closed ashpits, and fire-bars of a special pattern, very thin, and placed closely side by side—*i.e.*, without spacing pieces; also an arrangement of air tubes to the combustion chambers and furnaces, the air pressure being produced by a jet of steam.

An accident took place on the 14th inst. in Belfast. The Albert Bridge, which spans the Lagan some distance further up than the Queen's Bridge, suddenly collapsed, and, it is feared, carried with it several persons. A gradual sinking of the structure has been observed for the past two or three weeks, and just when the corporation were about to commence operations to have the defect remedied the centre buttress gave way, carrying with it an arch on either side, thus creating a gap some 60ft. in length. The accident occurred at half-past seven o'clock, and as the work-people were then returning from business, and the bridge is usually thronged at that hour, it is feared many lives have been lost. The corporation watchman has disappeared, and one woman and a child have been dragged from the ruins in a helpless condition. The bridge, which was of stone, was built in 1831. It was erected as a private speculation for the purpose of developing the county Down side of the river, and a toll of one halfpenny was charged for many years. Subsequently it was purchased by the grand juries of Down and Antrim and the corporation, and the toll was abolished. Since then it has been gradually becoming too small for the traffic. The accident created much alarm in the neighbourhood, for as the principal gas mains pass over the bridge, their suddenly snapping interfered considerably with the light.



EXPRESS ENGINE—NORTH BRITISH RAILWAY.

MR. M. HOLMES, COWLAIRS, ENGINEER.

(*For description see page 234.*)

CONTENTS.

THE ENGINEER, September 17th, 1886.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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

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

W. R.—*There was a book published on the subject which you might get through Messrs. Spon, Charing-cross. See also the "Transactions" of the Institution of Civil Engineers.*

J. H. H.—*Chief engineers get from £12 to £18 a month, according to the service they are employed in, supply and demand; second engineers get £9 to £12, and third engineers £5 to £6. A good table is kept for them as well.*

PUZZLED STUDENT.—*We have fully dealt with the question you raise under another form in an article "On Pile Driving," which you will find in our impression for April 2nd, 1886. No answer can be given to your question as it stands because it is incomplete. The crane jib is not rigid, and unless the amount of deflection is known, it is impossible to say what the strain on it would be. Assuming what is impossible to be possible, and that the crane, the chain, &c., were absolutely rigid, then the strain due to the fall of the weight would be infinite.*

PLATINA GLOW LIGHTS.

(*To the Editor of The Engineer.*)

SIR,—I shall feel obliged if any reader could give me the name and address of the makers of the Lewis platina glow light. A. W.

Manchester, September 9th.

HYDRAULIC CASTINGS.

(*To the Editor of The Engineer.*)

SIR,—Would any of your readers kindly name the best brands of pig iron to use in the production of castings for hydraulic purposes; such castings being subject to heavy internal pressure, are therefore required to be very close and strong? Any suggestion that will assist me in securing good results will be appreciated by HYDRAULIC.

September 10th.

TAPERED SLUICE VALVES.

(*To the Editor of The Engineer.*)

SIR,—I have to specify for a number of tapered sluice valves for use under a considerable hydraulic pressure. I am in doubt as to the amount of taper to be given. If the incline is too steep they will leak, if too small they will stick by their wedge-like action. Can any reader tell me where I can obtain information as to the wedging action of metals?

London, September 14th. C. E.

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

THE ENGINEER.

SEPTEMBER 17, 1886.

THE TRADES CONGRESS.

SINCE our last impression was published, the members of the Trades Congress at Hull have supplied us with more matter for consideration. It is impossible to read the report of their deliberations without regret, showing as they do how entirely ignorant the speakers are of some of the rudiments of political economy, and we might even add of common sense. Some of the motions put before the meeting were sufficiently reasonable; such, for example, as that of Mr. Howlett, that "in the opinion of this Congress, the number of sanitary inspectors be largely increased, but that no man be appointed without previously passing a thoroughly practical examination." This was intended, no doubt, to attack certain factories and shops in which unhealthy trades are carried on under unfavourable conditions. It may be worth mentioning in connection with this question, that the workmen themselves have, over and over again, protested against interference—as, for example, the needle grinders of Redditch, who would not permit fans to be erected to carry away the murderous dust which killed men off before they were thirty with grinder's asthma, the reason given being that if the trade was less unhealthy the wages would be smaller. It is pleasant to find more enlightenment among the men now-a-days. But it is to be noticed that Mr. Howlett was opposed by Mr. McIntyre, of Glasgow, and Mr. Stradley, of London, and that a respectable minority voted against the motion. We also find that the members voted against the opening of museums and parks on Sunday, so that the men appear to desire that the public-houses shall not suffer from competition. The most astounding resolution carried was that of Mr. Bloor, of Burslem, "That the large number of unemployed in this country calls for practical and immediate legislation, and that this Congress refers the question to the serious consideration of the Parliamentary Committee." The notion that legislation can improve trade would be amusing if it did not supply deplorable evidence of gross ignorance. Mr. Bloor did not attempt to go into details; possibly if he had done this the weakness of his resolution would have been made sufficiently manifest to lead to its immediate rejection. As it was, the resolution was unanimously carried. We shall await with curiosity the publication of the scheme for carrying it into practice.

What shall we say of Mr. Maudslay's proposition, "A minimum rate of wages to be settled by law which will enable workmen to live decently and rear their families?" It is impossible, we venture to say, to name any scheme more flatly opposed to the teachings of political economy than this. The amount available for wages in any country is derived entirely from the goods sold and from nothing else. It may happen that for a time the goods sold will not suffice to pay the wages spent on their production, but if the wages are still paid, they are paid out of capital, or, in other words, as we explained last week, out of savings accumulated previously; and the result of a continuance of the practice will be the bankruptcy of the individual, the firm, or the nation. Wages fixed by law must ostensibly be higher than those which would be paid under the ordinary conditions of supply and demand, for if they were not higher, legislation would be unnecessary. If they are higher, then the price of commodities must go up; and, as we have already pointed out last week, the working man will be no better off than he is now. Let us suppose, for example, that wages in the boot and shoe trade go up. The immediate result will be that fitters, tailors, masons, joiners, will all have to pay more for their boots than they did before. All attempts to fix wages by any other law than that of supply and demand of commodity and of labour, are based on an entire ignorance of the source from which wages are derived. The popular opinion with men of Mr. Maudslay's type seems to be that wages come out of the pocket of the Bloated Capitalist. If he could realise that they really come out of the pockets of working men he might, perhaps, modify his views. Wages are paid by the consumers, and all over the world men who work with their hands or their brains constitute by far the greatest number of consumers. The employer is after all only the intermediary or middle man between the producer or workman, and the consumer. We speak now of the manufacturer as an employer, not as a capitalist. There is another objection to Mr. Maudslay's scheme which he has, as a matter of course, passed over. If wages were fixed by law at a point too high—and any point higher than that fixed by the operation of natural laws must be too high—capital would seek other investments; works would be closed; blast furnaces put out; coal mines shut up, and the last state of the British workman would be worse than the first. As it is now, capital seeks investments abroad, where wages are lower than they are here. If Parliament fixed a minimum rate of wages, foreign competition would ruin the English working man. If, on the other hand, all the Governments of the world united to fix the rates of wages, then, as we have explained, there would be a corresponding rise in the value of all commodities, and the wages earner would be not one bit better off than he is now. We record with pleasure that Mr. Maudslay's resolution was based on one put before the International Congress at Paris, and it proved to be too strong for his hearers. English working men are not universally idiotic, and the motion was not carried.

As we read the report of the proceedings of the Congress, we come time after time on motions which incline us to doubt whether the delegates are really working men at all. They display so absolute an ignorance of subjects with which they ought to be familiar, that we rub our eyes as we read, and ask ourselves, Can such things be? Here, for example, is a resolution, moved by Mr. Swift, of Manchester, "That in the opinion of this Congress the systematic working of overtime in many of the trades of the country is an evil to the large body of the unemployed, and ought to be discouraged." We should like to ask Mr. Swift if he ever came across an employer who liked overtime or regarded it as anything but a nuisance. Overtime is always paid for at the rate of time and a-quarter to time and a-half, according to the extra number of hours worked. It is notorious that work done in overtime is usually inferior, both in quantity and quality, to that done during the regular day. From the capitalist's point of view, there is nothing to recommend it; and Mr. Swift ought to know that it is only adopted from necessity. There are two or three ways by which it may be avoided. Thus, for example, a firm may refuse to take work to be delivered complete on a given day provided the fulfilment of the contract renders overtime necessary. We doubt that Mr. Swift would go so far as to suggest that a firm should refuse an order under any circumstances just now. The second way out of the difficulty is to employ two gangs of men, one set to come on at 6 p.m., when the day men leave off. Thus the night shift, if we may so call them, would have about two hours work per day. As all the cost and trouble of time-keeping, to say nothing of the inconvenience of one set of men taking up the jobs of another set of men, would be incurred, we fear that the scheme would be highly impracticable, and excessively unpopular with the regular hands of the firm. In fact the scheme would not work at all, save in a very few trades indeed. This would in very many ways, be it observed, be quite different from the regular system of working day and night shifts, as carried on in the iron trade, for example. A third way out of the difficulty would be to put more hands on in the daytime. If this could be done, the employer would gladly do it without solicitation. We need not explain to our readers that it is just because it cannot be done for want of room and tools, that the worry and expense of overtime are incurred.

In this, as in far too many of the resolutions passed, we find ample evidence that the members of the Congress have not given due thought to the subjects they undertake to discuss. There can, indeed, be little harm done by bringing forward a lot of abstract propositions; but they can do no good. We imagine that the working men represented at the Congress desire to have practical questions practically discussed. We have no doubt that if any one had put a resolution to the meeting to the effect that it was highly desirable that working men should all find plenty of employment at high wages, it would be carried unanimously. But such a resolution would do no good. We believe we are correct in saying that the delegates in Hull have their expenses paid. The passing of a couple of dozen abstract resolutions seems to us to be a poor return for the outlay. It would be much better to take one resolution and put it into a practical shape, and discuss it thoroughly, than to send floating about the world a quantity of intangible—shall we say nonsense?—so vague that it cannot be agreed with or combatted, recommended as good or dismissed as evil, save in a very unsatisfactory way. May we suggest, for example, that Mr. Maudslay should have drafted at least the general heads of an Act of Parliament fixing the minimum rate of wages to be paid in different places, and that he should have read this draft, explaining and illustrating as he went how it would, in his opinion, work. Again Mr. Swift, not content with saying that overtime was objectionable, which everyone admits, should have put forward a well-considered, definite working scheme for superseding it. If Mr. Maudslay and Mr. Swift are not equal to such tasks, then they have no business at the Hull Congress; and what we say of Mr. Maudslay and Mr. Swift we can also say of a good many other delegates.

RAILWAY GAUGE IN CEYLON.

DURING the last thirty years the Government of Ceylon has carried out the construction of railways within the colony on the Indian gauge of 5ft. 6in., the main consideration which induced its adoption being the possibility of ultimate junction with the Indian system of railways by a line to be carried across a series of reefs known as "Adam's Bridge," which practically unite the island with the main continent. The local railways have received gradual extension until an altitude of fully 5000ft. has been attained in the tea and coffee planting districts, and but comparatively recently a trace has been completed and estimates prepared for a further extension desired to meet the wants of the most outlying of those districts. The Governor of the colony and the most influential of its public bodies have warmly advocated immediate procedure with this extension on the present gauge, and successive commissions have reported that not only would the existing traffic make the extension remunerative, but that its transference from the road lines, which it at present greatly follows, to the already constructed railways, would very materially add to the general income derived from them.

Under such conditions it would seem natural to presume that sanction to immediate undertaking of the work would at once be given. But the Colonial-office has shown reluctance to increase the public indebtedness of the colony by the amount required for continuing the line on the present broad gauge, and consequently an alternative has been proposed to adopt one of extreme narrowness—only 2ft.—the estimate for which it is believed will be so low as to remove all cause for the hesitation felt by the authorities in Downing-street on the score named. It is not within our province to discuss this question in its financial aspect, but it is manifest that when it is proposed, within a comparatively small area, such as that of Ceylon, to commence a break of gauge, there are many important questions of an engineering character to be considered. It will be conceded, we believe, that under any conditions a break of gauge must always be productive of inconvenience. We do not say that it can never be justified, but the reasons for its adoption must be exceedingly strong to warrant it. It has generally been held that at some time or other such a course *must* be followed in Ceylon. The vast extent of plain country which must eventually be traversed to unite the chief trading centres of the colony must, it has been held, be served by lines of the lightest construction, and therefore that the continuance of the present broad gauge would in such a case have to be abandoned. On this ground those who now desire to break the gauge at once urge that it may as well be broken now as at some later period. This argument has, however, given rise to fuller consideration being given to the question of railways in the low country than it has hitherto received, and there is no doubt that the present decision should be made largely dependent upon the needs of the future.

It may well be doubted if in a country where neither severe gradients, curves, or embankments, are required, and where the cost of land is *nil*, a narrow gauge line offers any material gain in the matter of first cost, its character in other respects being equal; while few will be found to dispute that the working expenses, as compared with paying load, increase in direct proportion to the narrowness of the gauge. Further, in the opening-up of districts almost entirely covered with fine forests, the carriage of timber must be looked to as one of the most paying items of traffic. It is certain that logs of 40ft. or 50ft. can hardly be safely carried upon a very narrow gauge, for reasons which it is not necessary to detail to the readers of THE ENGINEER. The broader the gauge to be employed on such lines the greater will be the facilities for utilising profitably the vast areas of forest through which the lines of railway must be carried in the low country of Ceylon. If, therefore, it can be shown that there can be no advantage, but rather a disadvantage, in reducing the gauge when the development of the plain country is undertaken, the argument now made use of for breaking gauge while still within the hilly ranges becomes materially weakened.

But independently of this point there remains the important question as to whether it will be possible to carry the traffic required on lines destined to serve the tea and coffee estates on any such very narrow gauge as that contemplated, viz., 2ft. The case of a line now in full work within the Darjeeling district in India has been cited as affording an affirmative reply to such a query, and an influential deputation recently waited upon the Secretary of State for the Colonies with the request that a report should be obtained to determine the capacity of a line of that character to serve the requirements of Ceylon. Until we are in possession of the facts to be shown by that report, we must suspend final judgment as to whether it can be advisable to construct some forty miles of railway in continuation of the main system on a broken gauge, when it is, to say the least, extremely doubtful, for the reasons above given, whether it may not form the single instance of such a break throughout the present and prospective system of the island.

It has certainly hitherto been held that on such a gauge as 2ft. the demands of first-class traffic, such as that which is carried by the present railways of Ceylon, cannot be met. Advocates of such a gauge for that colony say, however, that this opinion is due solely to the fact that such diminutive railways have, until this Darjeeling line was constructed, been given only the character of light lines. They advance the theory that if all the attributes of an ordinary type of railway in heavy metal and sufficient sleeper base were given to it, the very narrow gauge proposed would be as equal to the carriage and wear and tear of heavy traffic as the wider gauges are. Very careful estimating has demonstrated that between the cost of a railway of 5ft. 6in. gauge and one of 3ft. 6in., or of metre gauge, in the hill country of Ceylon, there is only a margin of £1000 per mile, and it is admitted that to secure such a limited saving the break of gauge is not desirable. But it is contended that when the reduction in gauge is brought as low as to 2ft. the difference in first cost will approximate to £10,000 per mile. We find it impossible to realise the grounds for such an assumption. We must admit, of course, that an extremely narrow gauge lends itself freely to the rounding of very sharp curves such as have to be dealt with in all mountainous countries; but there is the difficulty of obtaining sufficient haulage power with any class of engine adapted to a 2ft. gauge competent to deal with the equally sharp gradients which have to be surmounted in such a country. Then, again, how is the question of the increased sleeper base, which it is admitted is a necessity, to be met? Longitudinal, or continuous sleepers, can hardly, we should say, be adopted upon a very narrow gauge exposed to the exigencies of a traffic of first-class character. No system of tying at present known to us could preserve the gauge under such a trial round the exceptionally sharp curves imposed. Equally difficult must it prove to preserve the relative elevation of the rails under such conditions. If, therefore, it must prove necessary to increase the length of the sleepers themselves, what becomes of the economy to be gained in constructive cost? For if the length of the sleepers has to be made equal—say, to those required for a 3ft. 6in. gauge—the roadway must be made equivalent, and, as we have said above, it has been shown that for such a gauge a saving of but £1000 per mile can be anticipated. We have stated enough to show that a further interesting problem in the matter of gauges is about to receive attempted solution, and our readers will, we feel sure, watch the course of such an attempt with particular interest.

HIGH AND LOW LOCOMOTIVES.

IF the question were asked, "Given two vehicles, both having wheels the same distance apart laterally, but the height of the centre of gravity of one greater than that of the other—which would be most likely to overturn in use?" the answer would be, in most cases, the vehicle with the narrower base in proportion to the height of its centre of gravity. The adage that circumstances alter cases applies here, however, with more force than many persons are aware of. The locomotive engine supplies an example of this. For many years engineers held the opinion that the lower the centre of gravity of a locomotive could be kept, the steadier it would run; and the relative merits of engines with outside cylinders, in this respect, as compared with those having inside cylinders, formed subject for debate. The inside-cylinder engine necessitates a higher placed boiler than does an outside-cylinder arrangement, because of leaving clearance for the big ends of the connecting rods, and room generally for the parts of the motion, and to give access to them. On the other hand, as an offset against the greater height could be put the action of the steam in the cylinders.

It is well known that the alternate pressure of the steam on the ends of the cylinders tends naturally to rotate the entire engine horizontally round a centre or a turning point situate in the longitudinal middle line of the engine, the force being measurable by the total pressure on the lid or bottom of the cylinder, multiplied by the distance of the centre of the cylinder from the turning point. The distance is a fixed measurement in any given engine, but the loads or stresses are constantly altering both in direction and magnitude. Thus, when both pistons are moving forwards, each crank being at an angle of 45 deg. with the horizon, the turning stress about the central point is equal to the difference between the steam pressures in the respective cylinders, which difference will depend upon the grade of expansion in use at the time. When, however, one piston is coming back towards the fire-box, while the other is still going forwards, the cranks being again at an angle of 45 deg., the strain or steam pressures both act to turn the engine in the same direction; therefore the stress at the turning point will equal the sum of the stresses for each cylinder. A little reflection will show that inasmuch as the centres of outside cylinders are considerably further from the engine centre than are those of inside cylinders, the stresses on the cylinder ends act with proportionately greater leverage, and therefore with enhanced stress. The vibratory or "boxing" movement of small outside cylinder tank engines when running fast is very perceptible. The advocates of outside cylinders, however, claimed that this action, so far as danger of derailment was concerned, was, as we have observed above, compensated for by the lower centre of gravity obtained. In the earlier days of railways locomotive engineers did not discern apparently so clearly as is now done the difference between strains causing an engine to overturn and those tending to make it leave the rails. The risk of an engine overturning while running is very slight, even when going round sharp curves. Indeed, we cannot call to mind any instance of an engine overturning when running while still on the rails and nothing broken. The danger of derailment, so far as the engine action is concerned, is to be found in horizontal lateral strains, such as hammer or grind the flanges against the rails, tending of necessity to break flanges, wheels, axles, or rails; and here we may incidentally comment on the dearth of information extant about broken rails, as to the nature of the various examples of fracture. Did a rail break vertically or horizontally? Did it snap like sealing-wax without any previous permanent set bending? Information on the behaviour of rails in this way would be both interesting and instructive.

It is gradually becoming admitted by locomotive superintendents that high engines run easier and with less jar and shock than low engines, and we venture to say that there are at this moment locomotive superintendents who, if they had to build their last set of engines over again, would set their boilers higher. The reason why the high engine is the steadier is this—the gauge of the rails represents the base of a triangle, and the centre of gravity of the engine represents its apex. Now if a side strain be caused to act on the apex of the triangle, it can be resolved into two other forces on the triangle, if we regard it for the moment as a truss or as a solid body. One of these forces will create a rotating strain, resembling in effect the action on a crank, if we regard the lower corner of the triangle farthest from the pushing strain as the shaft, and the apex or point where the strain is applied as the crank pin. The lower corner of the triangle is the turning point of the strain; the purely rotary force being equal to the amount of the applied strain multiplied by the sine of the angle at the turning point. But as we have pointed out, there is a lateral strain also, tending to simply push the triangular body sideways; and the magnitude of this stress will be equal to that of the applied force multiplied by the sine of half the top angle of the triangle or half its base. From this it will be obvious that the greater the lower angle and its natural sine, as compared with half the apex angle and its natural sine, the greater will be the oversetting or rotating force, and the less will be the lateral strain on the rail. The high engine complies better with these conditions than the low. Consequently, the bursting action on the rails is proportionately reduced, while the margin of safety against the high engine oversetting is so great as to render the risk of danger from that cause altogether insignificant. For example, a body cannot overturn until its centre of gravity overhangs its base. Before this could take place with an engine of 4ft. 8½in. gauge, and whose centre of gravity is 6ft. from the rails, the engine must be inclined to an angle exceeding 22 deg. Besides this, other elements of safety attend the high engine. For example, as it strikes the outer rail of a curve with less force than does the low engine, there is less tripping action operating to cause an upset. The high engine, just as with the old high, narrow mail coaches, having their piles of luggage on the roof, and generally high centre of gravity, has a long, gentle, easy swing, coming slowly into motion and slowly coming to rest again, without those jars and shocks strongly perceptible with low engines. Then as regards ease of traction or propulsion, as well as the diminished risks of broken axles, wheels, and rails, and the reduced vibration influences on all parts of the engine, and their attendant evils in shaking nuts and joints loose, and causing crystallisation, everything is in favour of the high engine. There may be men still alive who prefer the low engine, but we venture to think that they do so more from early impressions than from any specific reason, and that when they really study the matter carefully they will change their views.

It must not be forgotten that our reasoning is based on the fact that the locomotive is carried on springs. The effect of the high centre of gravity is to produce an augmented stress on the outer springs and a diminished stress on the inner springs, and the higher the centre of gravity the greater will this downward thrust be. If it was possible for the centre of gravity to be at the same level as the rails, then the effect of the engine in passing round a curve would be wholly lateral, no vertical component being existent; and the elastic action of the springs would be eliminated. The high engine runs more easily than the low, because it makes better use of the elasticity of the springs on which it is carried.

THE ALKALI MANUFACTURE.

THE makers of alkali by the older process seem to have again united to force up the price by a species of combination. But there is still a competition between the alkali makers by the older and newer process which is not so easily overcome, and which shows itself in effect on the exports. In the first seven months of the present year the exports of alkali are officially reported as 4,104,453 cwt., which is about 360,000 cwt. less than the quantity for the corresponding months of the past year; and the exports of bleaching materials, separately given, are also less. The imports of alkali, which are not important in point of quantity, show a significant increase, so that it is apparent that the chemical trade does not retain its importance either in the home or the foreign markets. The reason chiefly is that the makers here adhere to the older process, and that some makers abroad are adopting the newer process, and in some countries are to a certain extent driving our chemical products out of the field. It is important in this connection to learn in what countries the substitution of other alkali for our own is taking place; and an inspection of the official returns of exports, showing that it is to Russia, Germany, and Holland that the decline is mainly due—exports of alkali to these countries showing a falling off month after month of most marked extent; so that it may be not unfairly deduced that the loss of trade is largely attributable to the increased production on the continent, where the ammonia process has of late grown. It may be added that to the United States of late there has been a large and satisfactory increase in the amount of alkali sent—the increase last month, for instance, being over 25 per cent. on the quantity for the corresponding period of last year. But the falling in the demand of the Continent is very important, and it has its teaching as to the duty of chemical makers here. Any forced advance of the prices of soda crystals would only result in the use of the foreign product, because it would not advance in proportion. On the other side the fact remains that the producers of soda crystals by the older method lose by the sale of the article at present prices, and thus there is some justification for the attempt to force up those rates. Still, the difficulty remains that the tendency is to crush out the Leblanc soda manufacture, except so far as it is necessary for the production of bleaching powder. The situation of this old industry, and especially on the Tyne, is one of interest of a painful character, for it is growing more and more critical owing to the increased and increasing competition with the alkali made by the ammonia process at home and abroad. The makers have the advantage of very cheap raw materials, and on the Tyne they have the benefit of the proximity of the salt in South Durham, which is now reducing the price of that article to the chemical makers on the Tyne by at least 2s. 6d. per ton. If by any means the brine could be brought from the Tees to the Tyne, the difficulty would be solved, and the cheap ammonia soda of the latter would rule the chemical markets of the world as its Leblanc soda long did.

ENGINES IN THE NAVY.

ANOTHER failure is recorded of that machinery on which so much depends. H. M. corvette Pylades went out for her trial trip on Tuesday. The trip was brought to an abrupt conclusion because, it is said, of the "failure of her safety valves." This is a very remarkable species of failure. We may say, indeed, that it is unprecedented. Concerning the nature of the failure there is, of course, manifested the usual official reticence. Until the statement is confirmed, we shall regard "safety valves" as a misprint for something else. The Pylades is quite a new vessel of 1420 tons displacement; estimated speed, with forced draught, 13 knots; cost, £80,000. She is under orders to proceed to the North American station.

ROWLAND MASON ORDISH.

WE regret to announce the death, on the 12th inst., at his residence in London, of Mr. Rowland Mason Ordish, an engineer well known to many of our readers, and whose reputation will live in the numerous important works he has carried out. Mr. Ordish was born near Derby, at a village where his father practised as a land agent and surveyor; but excepting what he saw of building operations incidental to his father's business, the son had no special education as an engineer. Coming to London about the year 1847, when he was twenty years old, Mr. Ordish, after a few months in the office of an architect, was engaged as an assistant by Mr. R. E. Brounger, an engineer then well known in London, and who is now in the Public Works Department of Cape Colony. While with Mr. Brounger Mr. Ordish was sent to Denmark on a survey connected with a projected railway. On his return to England he was engaged on structural work, and at a time when bridges and buildings of new types were needed for the earlier railways. He soon showed conspicuous talent, there being no lack of opportunity in those days for draughtsmen of capacity. The Victoria Bridge, over the Thames at Windsor, was the first work of the kind that Mr. Ordish was connected with, and in designing the details of this structure he had a considerable share. It was about this time that the sinking of bridge cylinders and caissons by pneumatic processes was first introduced; and in the application and development of these he thenceforth took a leading part. In 1850 Messrs. Fox and Henderson, of Birmingham, undertook the construction of the Hyde Park Exhibition building, and Mr. Ordish, having been lent as an assistant draughtsman to Mr.—afterwards Sir Charles—Fox, proved so efficient that the important work gradually fell to him; and he with Mr. Fox made at the office in Westminster the whole of the detail drawings for execution at the Soho Foundry, Birmingham. The use of cast iron for trellis girders, the bracing of columns in numerous tiers, and the framing of the whole so as to allow safe and rapid erection, had then to be thought out for the first time, and the building then designed has been followed as a type to the present day. Before the Exhibition was opened, in May, 1851, Mr. Ordish was called to Birmingham to assist in making the working drawings of the New-street Station roof, then the largest that had been made of iron, and when this was finished he was engaged on the Crystal Palace at Sydenham. Although the re-erection there, with large additions, of the Hyde Park building, was successfully carried out, Mr. Ordish never was of opinion that such light structures of iron and glass were the most suitable for permanent purposes, and the endurance until now of the Crystal Palace is mainly due to the admirable skill with which the columns and girders are arranged and braced to transmit the various strains to which they are subjected. From this time forward Mr. Ordish was a trusted friend and coadjutor in the numerous works on which Sir Charles Fox was engaged. The widening of the Victoria Railway Bridge over the Thames at Chelsea, and the numerous bridges at Battersea by which the railways approach the river, were among the works then carried out. Another was a bridge with three spans of 120ft. for the Queensland Railway, in which the upper or compression members of the girders were of cast iron tubes, the use of these, and the skilful connections which render them trustworthy, exemplifying in a very able way the opinion which Mr. Ordish shared with Sir C. Fox, probably against most of the profession, that cast iron properly applied might be thoroughly depended on for such a purpose. He carried out the same idea later on in his design for the Amsterdam station, erected in 1863 for the Dutch-Rhenish Railway, where roof trusses of 120ft. span were made with tubular cast iron compression members. Mr. Ordish was for a time chief draughtsman at the Works Department of the Admiralty, but having become fully established on his own account, he carried out during the following years works of various kinds, confining himself, however, mainly to iron structures and their foundations. His work at the Crystal Palace had brought him into contact with Mr. Owen Jones, the distinguished art designer and colourist, and they carried out several works together. Among these was a Kiosk for India, designed in a Moorish style, but including the roof, entirely of cast iron. It was in this building that Mr. Ordish first applied the plan of giving stability to columns against the outward thrust of an arched roof where no abutments were available, by attaching them to foundation plates or girders running inwards from the bases of the columns. He applied somewhat the same principle later in 1876, when he designed the roof over the Enoch-square Station in Glasgow with a span of 198ft. Between 1860 and 1875 Mr. Ordish constructed the Amsterdam Crystal Palace, the Dublin Exhibition building—lately re-erected at Battersea as the Albert Palace—Watson's Building in Bombay, and several others with novel and interesting features of design. Among these was an iron and glass building designed in 1868 for Sir G. Gilbert Scott to serve as a winter garden at the new Leeds Infirmary. Here, without abutments or tie rods, a lofty roof was constructed as a rectangular dome. From this time till his death Sir G. G. Scott consulted Mr. Ordish on all important questions of structure. An interesting case was that of the octagonal Chapter House at Westminster Abbey, where the ancient and beautiful vaulted roof, having shown signs of failing, is now, while apparently resting on a light central marble column, really suspended from an unseen polygonal iron roof above, designed by Mr. Ordish.

In 1868 Mr. Ordish constructed the Francis-Josef suspension bridge over the river Moldau at Prague, with a central span of 500ft. on his principle, for the first time applied, of rigid suspension. Working drawings of this bridge have appeared in our "portfolio." The catenary chain is of steel link bars. The beauty of this structure and its stability under severe test loads gained for its author from the Emperor of Austria the gold medal of Arts and Sciences, the highest honour of the kind in the country. A second bridge over the same river was built by Mr. Ordish soon after, and again later, another on the same principle at Singapore. In 1872 a scheme for the Albert Bridge at Chelsea was before Parliament, and was authorised only on the condition that Mr. Ordish should design it. Constructed on his rigid suspension system, the design was unfortunately marred by the owners of the bridge insisting on having a steel wire rope instead of the link chain that Mr. Ordish desired—correctly desired as has been since proved, for the rope having been insufficiently protected is at the present time being removed by the Metropolitan Board of Works, and chain links substituted. Mr. W. H. Barlow, past president of the Institution of Civil Engineers, had full confidence in Mr. Ordish's ability, and entrusted him with many works of importance for the Midland Railway and elsewhere. At the opening of the St. Pancras station Mr. Barlow stated publicly that the design of this roof was Mr. Ordish's. A few years later the Glasgow station above referred to was built somewhat on the same lines. Not only in the design of these roofs, but in the appropriate symmetry of the connections and other details, is Mr. Ordish's skill apparent. Mr. Ordish designed for Mr. J. Heywood, the engineer of the City of London, the bridge over Farringdon-street, which forms part of the Holborn Viaduct. This bridge is entirely of cast iron, the roadway being formed of corrugated cast iron plates, with caulked joints like a tank. For a heavy dead load of concrete and granite, and the traffic of a London street, cast iron may be deemed the best and most durable material.

Another of Mr. Ordish's important works is the roof over the Albert Hall at South Kensington, which he designed with the co-operation of Mr. Max am Ende, who was at that time his chief assistant. This roof, which presented many difficulties, is constructed as a dome elliptical in plan, the outward thrust of the ribs, which act also partly as girders, being taken by a horizontal iron ring on the walls.

During the later years of his life Mr. Ordish has suffered from ill-health, but has at all times been fully engaged in advising architects and others on important questions of foundations and iron structures. One of his recent works was a design made, in conjunction with Mr. Ewing Matheson, for the Tower Bridge, as an alternative to the design of the City Architect which is now being carried out, and about which we not long ago expressed our opinion freely. Mr. Ordish was, as it were, born to his profession. With a marvellous feeling for strength and proportion in the materials he handled, he was a man of fertile resource, hardly ever repeating himself, and able to solve difficult engineering problems where no one else could see a way of doing so. One of the most interesting incidents in his career is the number of pupils, foreign as well as English, who have passed through his office, and the majority of whom have since made their mark in positions of trust and importance. Mr. Ordish was ever ready to impart his knowledge to others, and would give full credit to his youngest pupils for what they could do or suggest. The numerous engineers in all parts of the world who have served under him will hear with regret of his death, and will gratefully give credit to their old master for the solid principles of construction which they gained from his precepts and example. Mr. Ordish was little known outside the profession, but those who were acquainted with him appreciated him as pre-eminently "a man who knew," and in structural designs, and various ingenious details, now often repeated and even hackneyed as the common property of engineers everywhere, they recognise his original handiwork. In no spirit of exaggeration we venture to say that during the last twenty years R. M. Ordish has been the ablest and most original engineer in this country for all matters of structure. Mr. Ordish was in his sixty-second year. The cause of death was heart disease. The funeral takes place to-day—Friday—at Highgate Cemetery.

THE EDINBURGH INTERNATIONAL EXHIBITION.

No. IX.

THE advantages which wall engines possess both in the matter of saving in first cost and of economy in space and fitting would lead one to expect for such a description of engine a greater demand than evidently exists, in Scotland at least. One of the very few firms exhibiting engines of this kind in the Exhibition is that of Messrs. Thomas Aimers and Sons, of Waverley Ironworks, Galashiels, whose productions in this line are already pretty well known to the Scotch millowners, &c. The engine shown in motion at their stand in the machinery section is of 4-horse power, having 6in cylinder with 12in. stroke, designed to run at 150 revolutions per minute. The illustration, page 235, sufficiently shows the arrangement adopted, the engine requiring no foundation, is bolted vertically—or where there is insufficiency of height diagonally—to any ordinary wall. With the view of demonstrating that the engine is well balanced and free from vibration such as might tend to injure buildings, the example under notice has been attached to a wooden partition of very light construction. Although slightly to the disadvantage of the engine in running, this severe mode of fitting has little or no effect on the partition. A special feature of the engine is the high-speed governor with which it is fitted, this being the patent of Mr. Aimers. The balls are fitted on the arms of a fly-wheel, thereby securing perfect steadiness of motion, while at the same time the wheel acts as a guard to the balls. The direct attachment of the springs to the balls without the intervention of levers and joints tends to greater sensitiveness. The balls are connected direct to the valve rod. The governor can be made to work in any position.

We illustrate a steam hammer exhibited by Messrs. Davis and Primrose, Leith. It is what they call a 2 cwt. hammer—that is, the piston-rod with hammer head weighs 2 cwt. The diameter of the cylinder is 7in., and the cylinder allows a maximum stroke of 14in. The anvil block is cast with the frame, as is a common plan in these very small hammers; one which the makers do not adopt for those of larger size and power. This style and size of hammer is made for small shops, where the work done does not exceed pieces of 4in. diameter, and they are useful for even the lightest work, as the stroke may be reduced to less than 1in. in length. It can be worked by the hand lever A when single dead blows, or a succession of such, are required. When the operator lets go the handle A the self-acting motion comes into operation, and a continual series of equal blows will be given. The handle B is used for regulating the length of the stroke. Thus, if this handle is moved to the lowest notch of the quadrant, the length of stroke of piston will be less than 1in., or the shortest stroke possible is given; and if the handle B be moved to the highest notch in the quadrant the longest stroke will be given. In addition to these methods of working the hammer, there is a motion by use of which the smith can dispense with an attendant or hammer driver. The movements are all effected by the foot of the smith acting on the short lever seen projecting from the slot in front of the hammer near the treadle plate. The smith places his foot on this treadle plate and depresses it until steam enters the cylinder and the hammer starts into motion. If the smith wants a single heavy blow he depresses the short lever, the hammer falls with increased force, and will remain on the forging or anvil until the smith relieves the pressure of his foot somewhat, when the hammer resumes making blows of ordinary force. By another movement of his foot on this lever he can suspend the hammer as above stated.

Messrs. Blake, Barclay, and Co., of Greenock, exhibit combined engine and centrifugal separating machine, which we illustrate by the engravings on page 235. The centrifugal machine is of the kind made for general purposes. The drums are of steel throughout, with cast iron centre cone. The spindle is of steel, running in hard bronze adjustable bearings. The internal lining is composed of wire cloth and perforated metal fixed to the periphery with detachable brass segments, allowing patching or re-lining of lining without having recourse to soldering. The arrangement of the combination is one which commends itself, and needs no further description.

We also illustrate the engines of the steel screw yacht Sareea, constructed for the Egyptian Government by Messrs. Ross and Duncan, Whitefield Works, Govan. The cylinders are 10in. and 20in. diameter, with piston stroke of 14in. The valve gear is Bremme's patent—the best development of the old Hackworth gear—and is applied in a rather interesting manner, so as to give the greatest durability and most satisfactory details of mechanism. In its elementary form, as is well known, the Bremme gear consists of an excentric with a stiff arm projecting from the excentric strap, guided at an intermediate point by a swinging link or radius-rod, which latter is carried by a bracket which can be turned around a centre, this centre coinciding with the axis of the joint of the guided point of the radius arm when the crank is on its dead points. By changing the angle of the bracket the engine is made to go forward or backwards, and at intermediate positions any desired degree of expansion is given with uniform lead. In the engine of the Sareea the radius-rod or swinging link is carried by a double bar supported by a lever at one end and by a curved slot at the other, the radius of each of these being equal to the length of the radius-rod, and the line joining their centres passing through the centre of the joint of the excentric arm and radius arm when the crank is on either dead point. This arrangement gives the best distribution of stresses and proportion of parts. By the use of double rods to the valve spindle a long radius arm is obtainable, with correspondingly small variation of angle and stress on the joints. It will be noticed that the bars are only moved in reversing or varying the expansion. In ordinary working they are at rest. A well-constructed link motion for one cylinder has two excentrics, four double joints, and one single joint constantly working, or eleven parts in all; whereas a Bremme gear for one cylinder in its best form has one excentric and four single joints constantly working, or five in all. The simplicity, durability, and beauty of mechanism of the Bremme gear are now leading to its extensive adoption. The cut-off in the up and down strokes can either be equal or unequal as desired, uniformity of lead being kept at all grades of expansion. The Sareea is a handsome steel screw yacht, 68ft. long over all by 12ft. beam by 7ft. moulded depth, with elegantly fitted cabin and very complete fittings, and has been ordered on account of the Government of Egypt, through Messrs. Bastin and Lawson of London.

ZINC PRODUCTION IN EUROPE AND THE UNITED STATES.

THE Oppeln—Silesia—Chamber of Commerce has just published a report concerning the production of zinc in the above-named countries, out of which the following is extracted. The weights are in English tons:—

	1884.	1883.	1882.	1881.
Rhenish and Belgian districts	130,522	123,891	119,193	110,989
Silesian do.	76,116	70,405	63,811	66,497
English do.	29,259	28,661	25,581	24,419
French and Spanish do.	15,341	14,671	18,075	18,358*
Polish do.	4 164	3,733	4,400	4,000*
Austrian do.	2,365	2,867	3,199	2,520*
	257,767	244,228	239,259	226,783
American do.	30,000*	34,790	33,765	30,000*
Total	287,767	279,018	273,024	256,783

* The figures marked with an asterisk are estimated.

In the year 1885 the prices, owing to over-production, became lower than they ever had been since 1849, and in consequence negotiations were set on foot to form a coalition. In August this was consummated, the basis of which was that the Rhenish, Westphalian, and Belgian zinc smelters bound themselves from the year 1886 to limit their production to that of 1884. All the English and some of the French works joined the combination, which to begin with was to remain in force three years, beginning in 1886. In the year 1885 the works belonging to the combination produced:—

	Tons.
French and Belgian district	102,215
Silesian do.	80,680
Rhenish do.	37,321
English do.	21,628
	241,844

The Silesian smelters have the right at some of the works to increase the production by 5 and in some cases by 7 per cent. According to the report the good effect of the combination was very speedily felt. The prices immediately rose, and by the close of the year it became apparent that the existence of the Silesian zinc works had been secured, although the price then stood much below the average of the last ten years. It is now to be hoped that the comparatively small stocks will soon be absorbed, when, if the demand keeps up, a rise in prices must follow.

TENDERS.

NORTHWICH LOCAL BOARD.—WATERWORKS—LAYING OF MAINS.

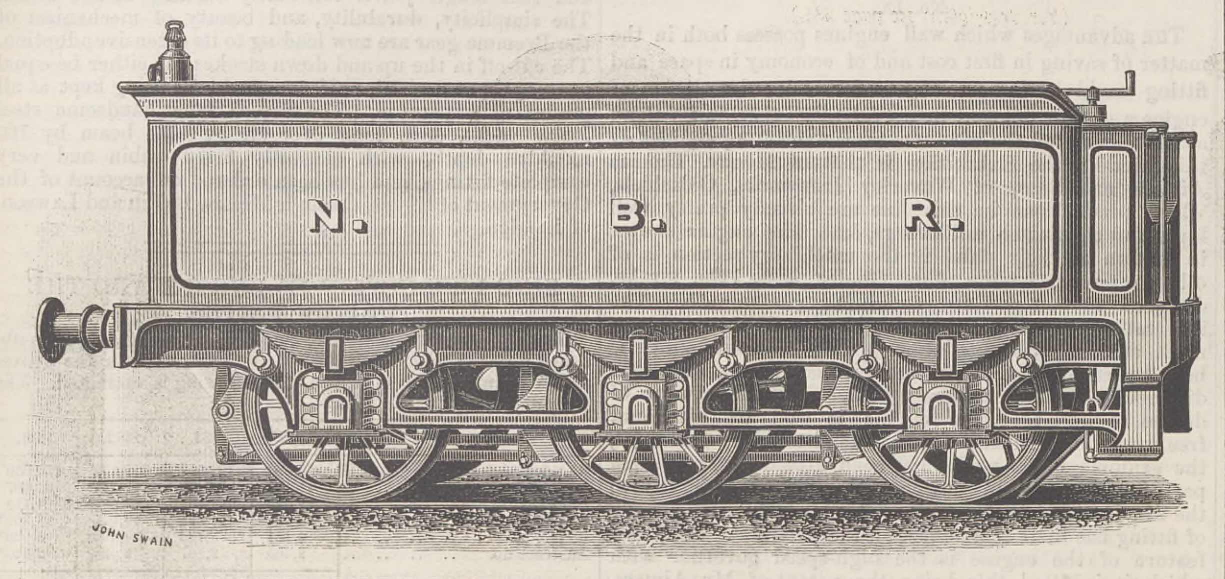
FOR laying pipes, &c., from Cote Crook to Heywood Reservoir.

	£	s.	d.
J. B. Mather, Hull—withdrawn	3,026	11	8
H. W. Gould and Co., Southampton—accepted ..	4,280	16	0
J. W. Pickthall, Yeovil and Southampton	4,572	13	6
W. Winnard, Wigan	4,458	4	4
William Drewitt, Alsager	4,525	1	11
C. F. McCulloch, Manchester	4,837	7	6
Innes and Wood, Handsworth	4,994	16	3
James Holland, Castle-Northwich	5,241	5	2
James Bush, Preston	5,687	1	0
John Brigg, Bingley	5,781	13	3
Small and Sons, Handsworth	5,880	17	2
Pickthall and Sons, Merthyr Tydvil	5,951	4	6
John Jowett, Rainhill	6,0[illegible]0	2	11
James Dyson, Ellesmere, Shropshire	7,004	9	3
George Law, Kidderminster	7,161	0	0
Frank Dawson, Bury	7,[illegible]04	9	6
Walmsley and Co., Crumpsall	8,794	14	0
Josiah Dale, Northwich	9,346	0	0
Walmsley and Co., Preston	10,500	0	0
Holmes and Kershaw, Bradford	11,889	11	11
John Mackay, Stoke-upon-Trent	12,287	8	10
Oliver Norris, Heaton, Bolton-le-Moor	24,473	12	5

UNIVERSITY COLLEGE, LONDON, ENGINEERING DEPARTMENT.—We notice from the prospectus of this Department that the examination for the Gilchrist—entrance—Engineering Scholarship of £35 per annum is to be held on the 28th and 29th inst. Candidates must be under nineteen, and the subjects of examination are:—I. Mathematics; II. any two or more of the following: (a) mechanics; (b) mechanical drawing; (c) examination on some subject connected with engineering; (d) French or German; (e) the use of tools. The examination is intended to be of such a standard as can be passed by lads from school, who have begun to acquire some knowledge of mechanical pursuits. The appliances of the engineering laboratory—under Professor Alex. B. W. Kennedy—have been very much extended during the past year, mainly through a grant from the Gilchrist Trustees, and are now very complete in the direction both of experiments in elasticity and the strength of materials, and in the economic work of engines and boilers. Laboratory work is so arranged that students go through a systematic course of experiments in these and other connected subjects during the session.

THE RUSSIAN ARMY.—From official returns which have just been published in Russia it appears that the effective strength of the Russian army during the year 1884 amounted to 30,889 officers and 798,908 men. The number of officers on January 1st, 1885, showed a decrease of close upon 500 on that of the preceding year, principally owing to the introduction of revised regulations for the officers of the higher ranks on account of age or physical unfitness. The following figures show the strength of the regular army on January 1st, 1885, viz.:—Infantry, 954 battalions, 513,861 men; cavalry, 330 squadrons, 59,262 men; artillery, 368 batteries, 1640 guns, $57\frac{1}{2}$ parks, 77,571 men; engineers, $30\frac{1}{2}$ battalions, 22 parks, 20,533 men; total, 671,227 men. In addition to these must be added the peace strength of the Cossacks forming part of the standing army, viz.:—285 mounted and 50 dismounted sotnias, with 96 guns, giving a total of 2169 officers and 44,920 men, out of a total war strength of 158,000 officers and men. The most striking feature in these returns is the large amount of sickness and the excessive number of deaths which occur in the Russian army, the number of deaths during the year being no less than 6327, or 7·29 per cent. of the effective strength, a formidable percentage when it is considered that the men are in the flower of their youth. The most fatal diseases are consumption, typhus, and inflammation of the bowels.

TENDER—NORTH BRITISH RAILWAY.



EXPRESS ENGINE—NORTH BRITISH RAILWAY.

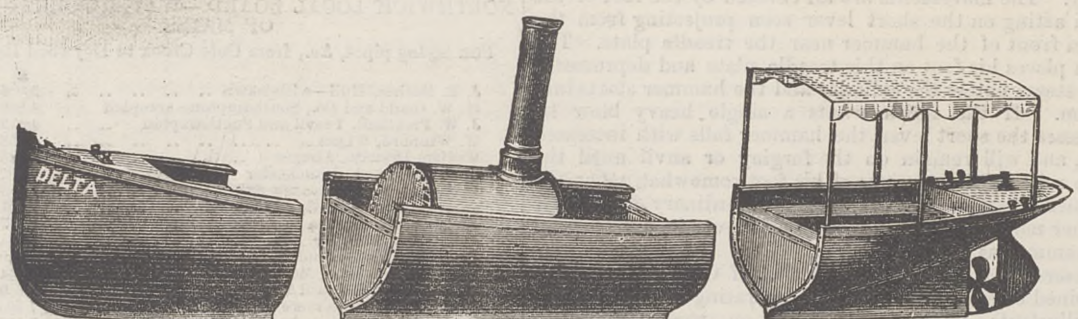
We illustrate above and on page 230 a very fine locomotive designed and constructed at Cowlairs Works by Mr. M. Holmes, locomotive superintendent of the North British Railway, and exhibited at Edinburgh.

This engine is one of six now being built at Cowlairs and intended to work the passenger service between Glasgow, Dundee, and the North, *viâ* the Tay Bridge, which it is hoped will be opened for traffic next summer.

The following are the principal dimensions of the engine:—

	ft.	in.
Boiler:—		
Diameter of barrel, outside, at fire-box end	4	4
Length of barrel	10	$3\frac{1}{2}$
Thickness of plates, Yorkshire iron	0	$0\frac{1}{2}$
Fire-box Shell:—		
Length outside	6	6
Breadth outside at bottom	4	1
Copper Fire-box:—		
Length of fire-box inside, top	5	$7\frac{13}{16}$
„ „ bottom	5	$11\frac{5}{8}$
Breadth of fire-box inside top	3	$7\frac{7}{8}$
„ „ bottom	3	[illegible]$\frac{5}{8}$
Depth at front end	5	$10\frac{3}{4}$
„ back end	5	$10\frac{3}{4}$
Tubes:—		
Material—brass	—	
Diameter outside	0	$1\frac{3}{4}$
Length between tube plates	10	$7\frac{5}{8}$
Heating surface:—		
Fire-box	119 sq. ft.	
Tubes	983 sq. ft	
Total	1102 sq. ft.	
Grate area	21 sq. ft.	
Cylinders:—		
Inside diameter of cylinders	1	6
Stroke of piston	2	2
Length of ports	1	4
Width of steam ports	0	$1\frac{5}{8}$
„ exhaust ports	0	$3\frac{1}{4}$
Centre to centre of cylinders	2	3
„ „ of valve spindles	0	4
Excentrics:—		
Throw	0	$6\frac{1}{2}$
Diameter	1	$4\frac{1}{4}$
Rods:—		
Length of excentric rods	4	7
Length of connecting rods	6	6
Wheels:—		
Diameter of coupled wheels on tread	7	0
„ bogie „ „	3	6
Thickness of all tires when finished	0	3
Width „ „	0	$5\frac{1}{2}$
Wheel base:—		
From centre to centre of bogie axles	6	6
„ of bogie to driving axle	9	10
„ of driving to trailing	9	3
Total wheel base	22	4
Axles:—		
Bogie, diameter of journals	0	6
„ length „	0	9
Driving, diameter of crank pin journals	0	8
„ length „ „	0	4
„ diameter of journals	0	8
„ length „	0	$7\frac{1}{2}$
Trailing, diameter „ (conical) ..$7\frac{1}{2}$in. at centre, $8\frac{1}{4}$in at outside.		
„ length „	0	$7\frac{1}{2}$
Weight of engine:—40 tons 15 cwt.		
Tender:—		
Water capacity of tank	2550 gals.	
Coal capacity	5 tons.	
Total weight of tender	3[illegible] tons.	

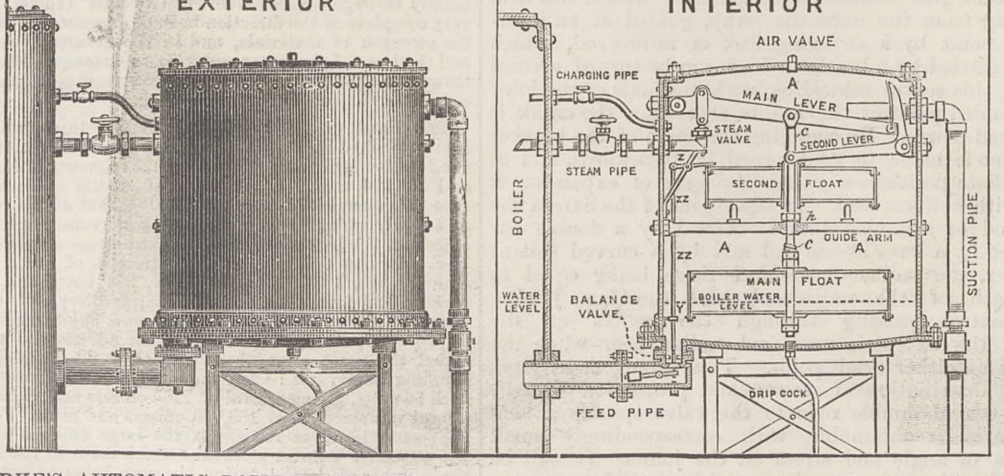
DELTA METAL STEAM LAUNCH.



DELTA METAL STEAM LAUNCH.

The *Hamburgische Correspondent* contains an interesting notice on Delta metal steam launches, of which Herr Holtz, Harburg, is making a speciality. Above we give an illustration of one of these launches, destined for the German colony in Central Africa. The plates and angles are of rolled Delta metal, and the stern, keel, and propeller are forged of the same material; and in order to facilitate the transport, it is constructed to take to pieces and to be easily put together again. Another large launch is now being built, which can also be taken to pieces, it being specified that no piece should weigh more than sixty pounds. The advantage gained by using Delta metal instead of steel in the construction of these launches is that whilst it possesses the same strength as the latter, and can thus be made of same thickness of material, it is practically incorrodible, which becomes of great importance in countries where skilled labour is out of all question, and where steel and iron hulls rust through in a very short time unless continually painted. The price of the finished launches is about twenty to twenty-five per cent. more than of similar launches built of steel; but taking into consideration that Delta always retains its value, it is maintained that the Delta launches are the cheaper. The editor of the Hamburg paper jokingly observes that the navigators of the Dark Continent need never be "hard up," as they can always cut off a piece of Delta metal and thus replenish their purse.

THE CLARKE AUTOMATIC BOILER CLEANER.



CLARKE'S AUTOMATIC BOILER CLEANER.

We illustrate above a machine recently invented and patented by Mr. Thomas Clarke, of Meldrum, Kilbeggan, West-Meath, Ireland. It is designed by him for the purpose of automatically feeding steam boilers with water. We give a short description of the machine, from which it will be readily understood how it works. The exterior view shows the machine as it is attached to the boiler, and the interior view shows its construction. It consists of a suitable closed-in chamber, and is fitted with a suction pipe, steam pipe, charging pipe, and a boiler-feed pipe. To start the machine, steam is admitted through the charging pipe, and is allowed to flow out through the drip cock. When the machine is worn these cocks are shut; a vacuum then takes place, and water is drawn up through the suction pipe, and flows down through the machine, so filling it. The suction pipe is fitted with a non-return valve. As the water rises in the machine it supports the main float, and consequently the rod and lever which are attached to it, but it cannot lift them, as the main lever is held down by the tail-piece of the second lever. When the second float and its lever is lifted, the main one is released, and rises; at the same time the lever Z is lifted. The end of this lever works in a slot in the rod Z Z, and thus allows the rod Z Z to rest on the top of the balance valve. The main lever in lifting opens the steam valve, and steam flows into the machine. When the pressure is equalised with the boiler, the balance valve opens, which it is assisted in doing by the weight of the rod Z Z, and the water then flows into the boiler. As the water lowers, the second float is not supported, but cannot return to its place, as the tail-piece of its lever presses against the up-raised arm of the main lever. When the water falls low enough the main float sinks, thus shutting the steam valve, allowing the second float to fall into its place, lifting the rod Z Z. A vacuum now takes place and the mahine continues in the same manner working automatically. Should the water in the boiler be to the full level, the main float does not fall, and it is obvious therefore that the machine will be dormant until the water falls low enough for it to resume working. C is a spring to prevent a jar when the main lever lifts. H is a stop to support the weight of the main float; there are also stops to support the weight of the second float. The air valve in the top is to let out uncondensed vapour. A machine has been working some months on the boiler in the factory of Mr. John Donfield, Sir John Rogerson's Quay, Dublin, and we understand it gives every satisfaction. The feeders will deliver feed hot, and will work either hot or cold water, and will, we are told, lift water 28ft. In addition to their other advantages they can be used as a pump. If well made they ought not to be liable to get out of order, and they should be a great safeguard against low water.

THE RUGGIERI FUSE.

Messrs. John Davis and Co., of Newgate-street, E.C., are now introducing the Ruggieri mine fuse into this country. It is composed of a small tube of pasteboard A, Fig. 1, of conical shape, enclosing a fuse or filament B, a bit of spun cotton coated with a powder paste. The large end of the tube is stopped by an electric detonator—a mixture of chlorate of potash, saltpetre, sul-

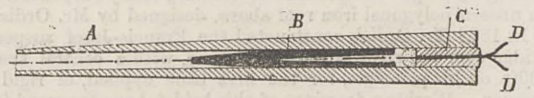


Fig. 1.—The Ruggieri Fuse or Projectile Igniter.

phate of ammonia, and finely-granulated carbon—C, solidly fixed, on which is a wire, the ends of which, D D, remain outside. This tube is placed in the cavity left by the boring instrument, being solidly secured after the manner of a spigot in a cask on account of its conical form. The wires D D are attached to a cable with two conductors communicating with an induction machine—from which the current is obtained—the detonator is ignited, fires the

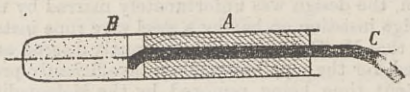


Fig. 2.—Dynamite Cap furnished with a small Wooden Cylinder containing the Filament.

fuse contained in the tube, which is blown through the tube into the charge. If the fuse although burnt does not reach the bottom of the bore, as it is composed of an insignificant quantity of material—two or three grains—it is claimed that it is consumed on the way, and leaves only an ash, quite cold in five or six seconds at the most.

In mines charged with dynamite, where there is no need for tamping, the process undergoes a slight modification. In the dynamite cap B A, Fig. 2, are placed a few pieces of wick or filament C,

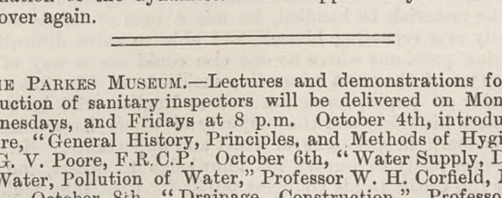


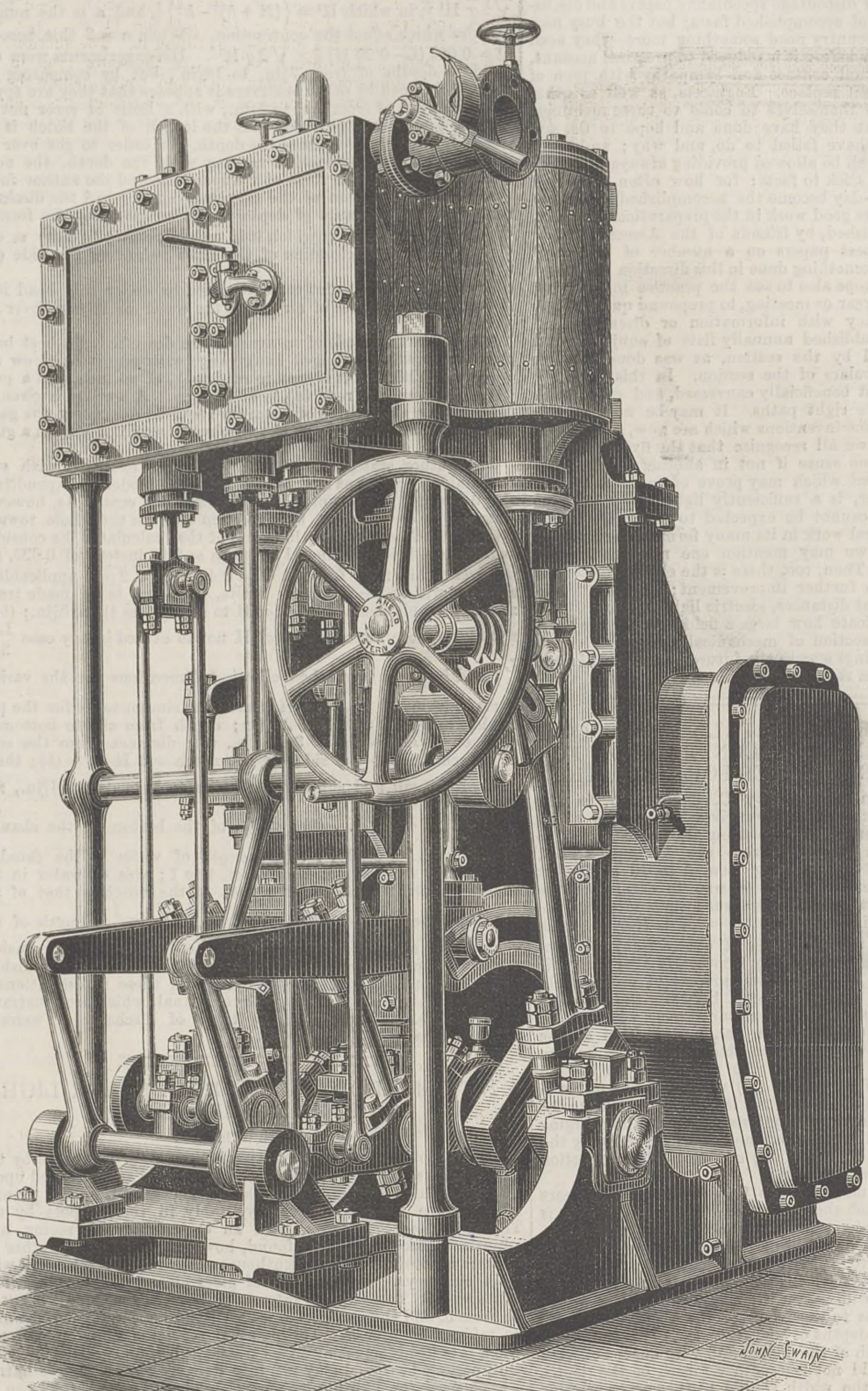
Fig. 3.—Dynamite Cartridge and Cap.

leaving one or two centimetres projecting; the top of the copper mounting is flattened, and then the cap is placed in the dynamite cartridge D, Fig. 3, which is pushed to the bottom of the hole. There is placed at the mouth of the latter a large stopper of cork or of wood, pierced so that there is an orifice to permit of the admission of the Ruggieri fuse. The wires are attached and the shot is fired. When the fuse ignites it shoots right to the bottom of the bore, on to the filament of the cap, which causes the detonation of the dynamite. The stoppers may be used over and over again.

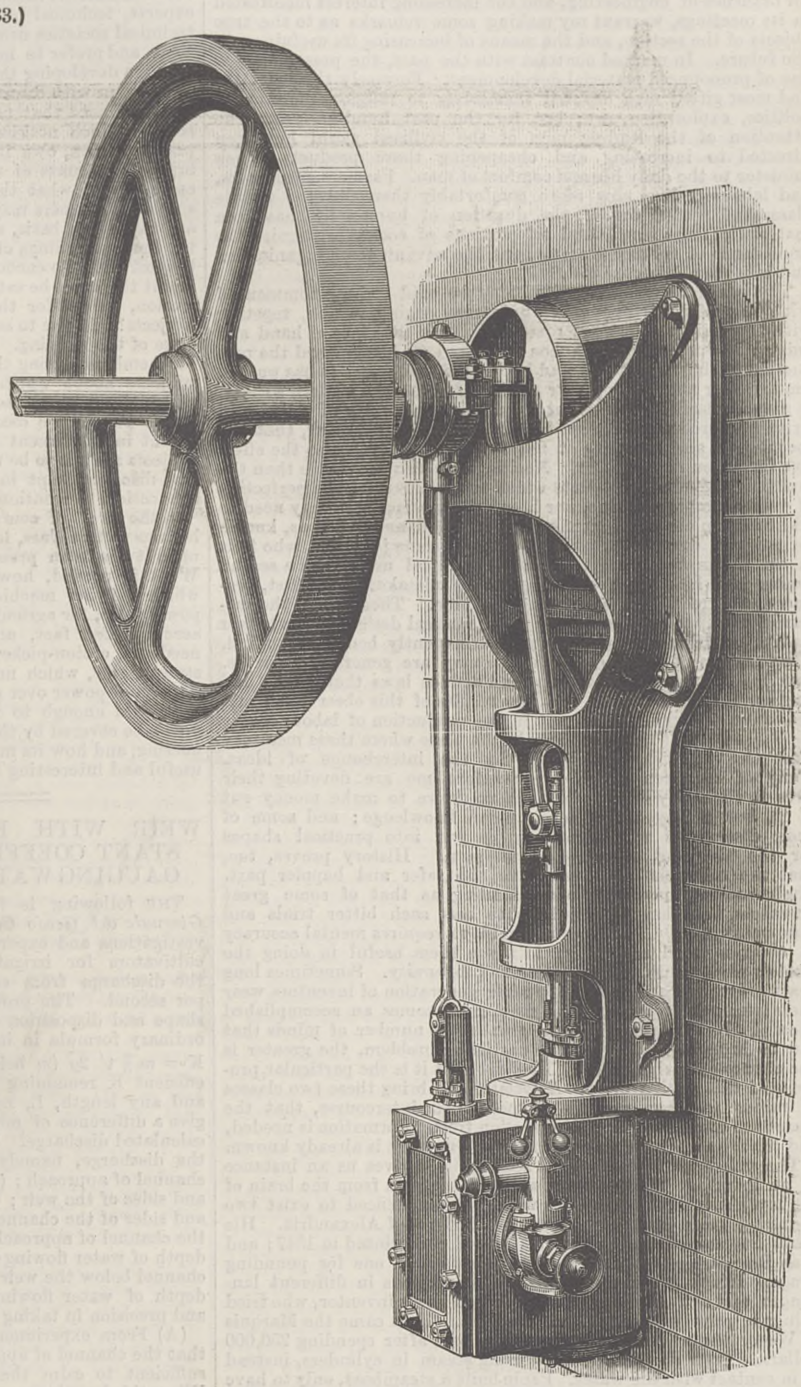
The Parkes Museum.—Lectures and demonstrations for the instruction of sanitary inspectors will be delivered on Mondays, Wednesdays, and Fridays at 8 p.m. October 4th, introductory lecture, "General History, Principles, and Methods of Hygiene," Dr. G. V. Poore, F.R.C.P. October 6th, "Water Supply, Drinking Water, Pollution of Water," Professor W. H. Corfield, M.A., M.D. October 8th, "Drainage, Construction," Professor H. Robinson, M. Inst. C.E. October 11th, "Sanitary Appliances," Mr. Percival Gordon Smith, F.R.I.B.A. October 13th, "Ventilation, Measurement of Pubic Space, &c.," Professor M. de Chaumont, M.D., F.R.S. October 15th, "Scavenging and Disposal of Refuse," Mr. H. Percy Boulnois, M. Inst. C.E. October 18th, "Food, Good and Bad, Milk, Sale of Food and Drugs Act," Mr. C. E. Cassal, F.C.S., F.I.C. October 20th, "Infectious Diseases and Methods of Disinfection," Dr. R. Thorne Thorne. October 22nd, "General Powers and Duties of Inspectors of Nuisances, Methods of Inspection," Mr. J. F. J. Sykes, B.Sc., M.R.C.S. October 25th, "Nature of Nuisances, including Nuisances, the Abatement of which is Difficult," Mr. J. F. J. Sykes, B.Sc., M.R.C.S. October 27th, "Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws," Dr. Charles Kelly. October 29th, "Metropolitan Acts, Bye-Laws of Metropolitan Board of Works," Mr. A. Wynter Blyth, M.R.C.S., I.S.A.

EXHIBITS AT THE EDINBURGH EXHIBITION.

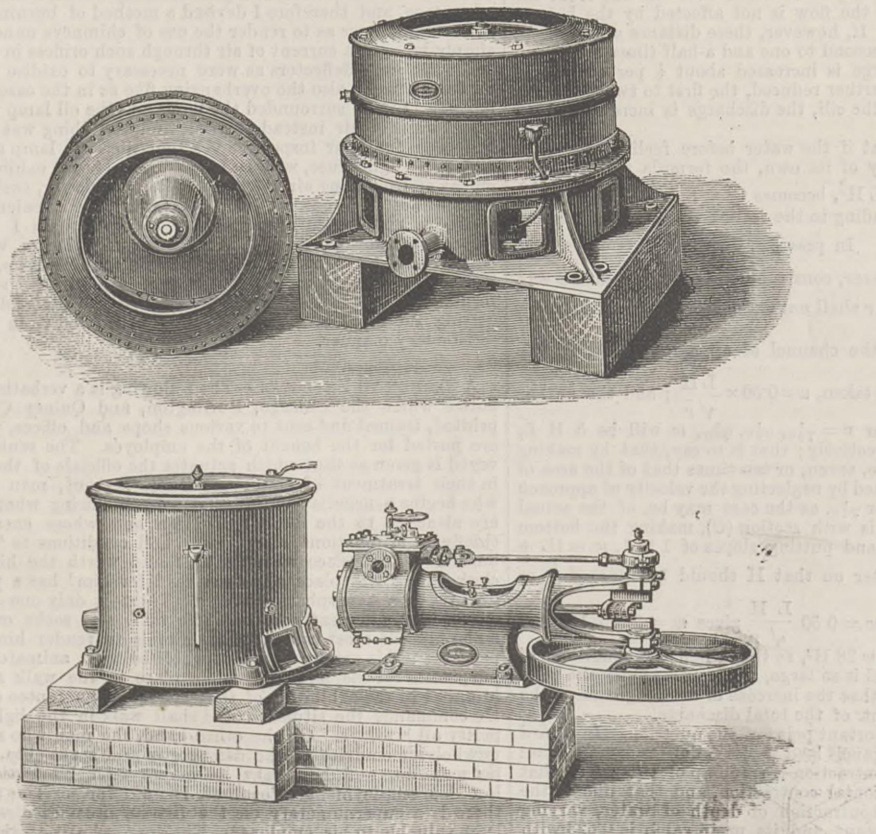
(*For description see page 233.*)



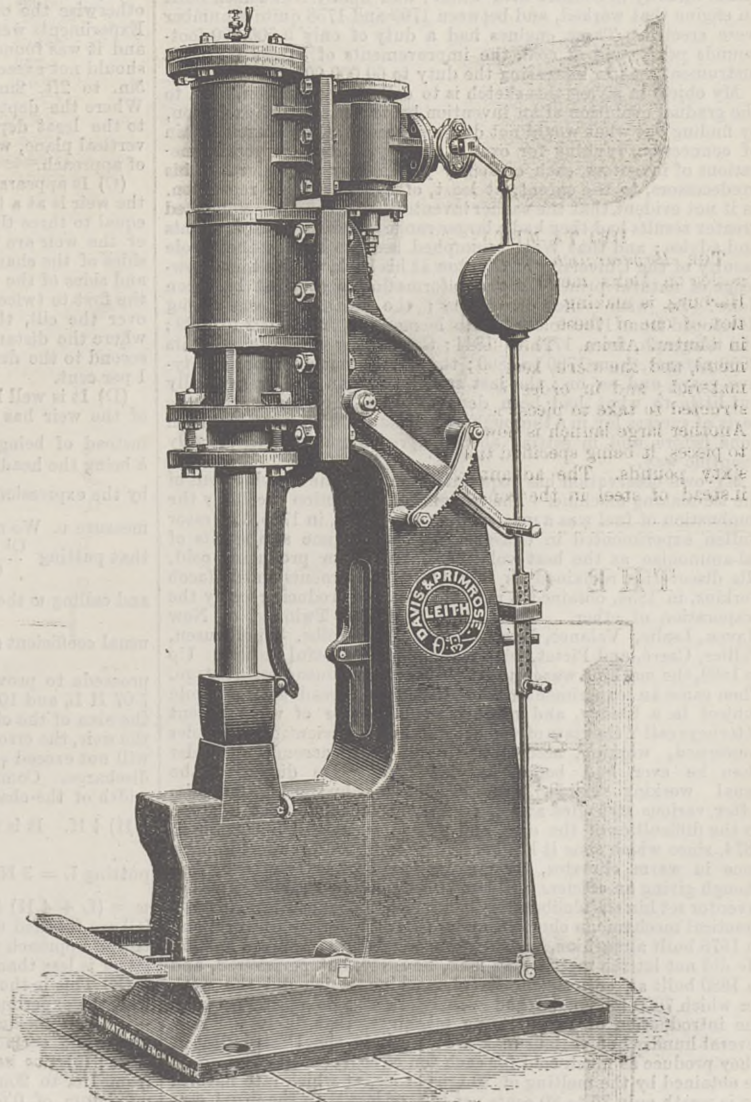
ENGINES OF THE STEEL SCREW YACHT SAREEA FOR THE EGYPTIAN GOVERNMENT.



WALL ENGINE.



CENTRIFUGAL DRYING MACHINE.



STEAM HAMMER.

PROGRESS OF MECHANICAL SCIENCE.[1]

By Mr. O. Chanute, C.E.

The recent enlargement of the scope of this section to include all branches of engineering, and the increasing interest manifested in its meetings, warrant my making some remarks as to the true objects of the section, and the means of increasing its usefulness in the future. In marked contrast with the past, the present age is one of pronounced material development. Formerly the brightest and most gifted men devoted themselves to religion, philosophy, politics, exploration, art; but for the past hundred years the attention of the leading men of the civilised world has been directed to increasing and cheapening those products which minister to the daily life and comfort of man. Farmers, mechanics, and labourers live now more comfortably than did the middle classes of feudal times; the duration of human life has been materially lengthened, and all portions of society recognise the importance of further progress, and the advantage of organisation and invention in securing it.

This era of material progress may be said to have commenced with the final perfecting of the steam engine, which, together with the various attendant machines, takes the place of hand and animal labour, and which has increased and cheapened the production of the necessaries and luxuries of life; and it has pushed the inventor and the engineer to the front rank in modern society. It may be useful to point out the absolute necessity of verbal and written intercourse between investigators and inventors, that the speculation and curiosity of the former may ripen into the effective invention of the latter. Nothing is more remarkable than the multitude of minds and facts which are required for the perfecting of even a simple machine, nor how little the last man may need to add to complete the invention. Facts and natural laws, known for years as curiosities, are taken up by some inventor, who fails in the attempt to render them of practical use; then a second genius lays hold, and, profiting by the mistakes of the first, produces, at great cost, a working machine. Then comes the successful man, who works out the final practical design, and, whether making or losing a fortune, he yet permanently benefits mankind. The faculties of invention and discovery are generally separate. One set of men observe facts, and deduce laws therefrom; and another set endeavour to turn the results of this observation and deduction to practical account in the production of labour-saving appliances. This section should be the place where these men may meet one another, and profit by the interchange of ideas. Many of the men whom I see before me are devoting their lives to the study of nature, with no desire to make money out of it, but simply to increase human knowledge; and some of their discoveries will eventually be put into practical shapes for the use and convenience of man. History proves, too, that the scientific observers have the safer and happier part. Their success may not be so dazzling as that of some great inventors, but they do not have to bear such bitter trials and disappointments. To deduce natural laws requires mental accuracy in observing and reasoning; to make them useful in doing the world's work requires imagination and ingenuity. Sometimes long years must pass, and generation after generation of inventors wear their lives out, before a needed machine becomes an accomplished success. Evidently, then, the greater the number of minds that can be brought to bear upon a particular problem, the greater is the chance of early success. I believe that it is the particular province of this section of the Association to bring these two classes of minds together, and to promote their intercourse, that the discoverer may learn in what direction fresh information is needed, and that the inventor may be advised as to what is already known.

The well-worn history of the steam engine gives us an instance of an invention which did not spring full-grown from the brain of the inventor. History informs us that it commenced to exist two thousand years ago, in the eolipile of Hero of Alexandria. His treatise remained hidden until translated and printed in 1547; and then Branca, the Italian architect, constructed one for pounding drugs. Hero's book ran through eight editions in different languages, and attracted the attention of a French inventor, who tried vainly to raise water by steam pressure. Then came the Marquis of Worcester, who died a disappointed man after spending 250,000 dollars. Then de Morland tried using steam in cylinders, instead of in contact with the water. Papin built a steamboat, only to have it seized and destroyed while on its way to England; and he, too, died broken hearted and poor. Savory went back to using the steam directly in contact with water; and finally Newcomen built an engine that worked, and between 1705 and 1758 quite a number were erected. These engines had a duty of only 5,500,000 foot-pounds per pound of coal, the improvements of James Watt, an instrument maker, increasing the duty to 60,000,000.

My object in giving this sketch is to call your attention, first, to the gradual evolution of an invention by the process of exclusion, by finding out what would not do; and second, the apparent chain of connection, running for over a century, through several generations of inventors, each evidently profiting by the failures of his predecessors, to the extent, at least, of avoiding their repetition. Is it not evident that the earlier inventors would have accomplished greater results had they had a larger range of scientific experiments and advice; and that Watt triumphed because he had the whole faculty of the University of Glasgow at his back, to give him knowledge of natural principles, and information as to what had been done? So with other inventions; the steamboat was being developed from 1760 to 1807; the locomotive, from 1802 to 1829; the telegraph, from 1729 to 1844; the sewing machine, with its 2000 patents, from 1790 to 1860; the reaping machine, for seventy-five years, and so on; the last successful man adding generally but little to what had been done before. The rule is, that the basis of success lay in a thorough acquaintance with what had been done before, and in setting about improvement in a thoroughly scientific way.

My own observation has acquainted me with the development of the ice-making machine. The economical production of cold by the combustion of fuel was a matter of theory when, in 1755, Professor Cullen experimented in Glasgow with quick-lime and spirits of sal-ammoniac as the best volatile substance for producing cold. His discoveries remained as laboratory experiments until Jacob Perkins, in 1834, obtained a partial success in producing ice by the evaporation of ether. Then came Professor Twining, of New Haven, Leslie, Valance, Harrison, Pontifex, Seibe, Windhausen, Tellier, Carré, and Pictet, with more or less doubtful success. Up to 1869, the machine was in the experimental or unsuccessful stage. Then came an experimenter who deliberately read up the whole subject in a library, and made himself master of what patent attorneys call "the state of the art," and of the scientific principles concerned, working, according to his own account, "harder than he ever had before in his life." He discarded the usual working fluids, and adopted anhydrous ammonia. After various struggles and successes, the machine was adapted to the difficulties of the case, and put in successful operation in 1874, since which time it has become of immense practical importance in warm climates, for making ice, cooling breweries, &c., though giving an efficiency of but 70 per cent. In 1877, another inventor set himself deliberately to improve the machine. He put a practical mechanic, a chemist, and a patent attorney to work, and in 1878 built a machine, which, however, gave no improved results. He did not let the matter rest here, however, but persevered, and in 1880 built an entirely successful machine, which did the work for which 7000 tons of ice had been required. So rapid has been the introduction of refrigerating machines, that there are now several hundred of various makes at work in the United States. They produce as much cold for each ton of coal consumed as would be obtained by the melting of 20 tons of ice, at which rate natural ice is worth only 75 to 80 cents per ton, or less than the usual cost of harvesting and storing it.

In comparing this development with that of the steam engine, we see the difference between the scientific way of working out an invention and the former disjointed way, when each man had to rely chiefly upon his own experiments; and also the difference between ancient facilities and the modern advantages offered by experts, technical publications, scientific societies, &c. Ordinary technical societies usually discourage speculative papers and discussions, and prefer to hear of accomplished facts; but the busy men who are developing this country need something more—they need to keep up with discovery before it is reduced to practical account, and they need that personal contact and sympathy with men of science which nothing can replace. Engineers, as well as other practical men, owe it to themselves to come to these meetings, bringing accounts of what they have done and hope to do, and especially of what they have failed to do, and why; and some speculative papers may well be allowed providing always that they are on a sound basis, and stick to facts; for how often is it that the imagined things of to-day become the accomplished results of to-morrow? To encourage good work in the preparation of papers, might there not be established, by friends of the Association and section, prizes for the best papers on a number of important subjects? I hope to see something done in this direction before the close of the meeting. I hope also to see the practice inaugurated for members, during the year or meeting, to propound queries upon subjects about which they wish information or discussion. I should like also to see published annually lists of subjects upon which papers are desired by the section, as was done to some extent in the recent circulars of the section. In this way, live subjects are apt to be most beneficially canvassed, and experiment and discovery kept in the right paths. It may be well, in this connection, to mention some inventions which are now, so to speak, "in the air;" of course, we all recognise that the flying-machine belongs to this class, in one sense if not in another, and a paper upon it has been presented which may prove of interest to you. What is needed, however, is a sufficiently light motor, without which a flying machine cannot be expected to succeed. Steam power, also, for agricultural work in its many forms, is not yet an accomplished fact, and we may mention one machine greatly needed, a cotton-picker. Then, too, there is the electric motor for street traffic, which needs further improvement; also the transmission of power over great distances, electric lighting, &c. But I have said enough to indicate how large a field may, in my judgment, be covered by this section of mechanical science and engineering, and how its meetings may in the future be made still more useful and interesting than they have been in the past.

[1] Abstract of an address read before the Section of Mechanical Science of the American Association for the Advancement of Science at Buffalo, August 19th, 1886.

WEIR WITH FREE OVERFALL AND CONSTANT COEFFICIENT OF CONTRACTION FOR GAUGING WATER SUPPLIED FOR IRRIGATION.[1]

The following is from a paper by C. Cipolletti, in the *Giornale del Genio Civile*:—This paper gives the results of investigations and experiments for measuring water delivered to cultivators for irrigation purposes from the Villoresi Canal, the discharge from each gauge being from 5 to 10 cubic feet per second. The problem to be solved was to determine the shape and disposition of a gauging weir such that adopting the ordinary formula in its simplest form, $Q = K\,L\,H^{\frac{3}{2}}$, in which $K = m\,\frac{2}{3}\,\sqrt{2g}$ (m being the coefficient of contraction), the coefficient K remaining constant for any depth, H, over the weir and any length, L, none of the various sources of error would give a difference of more than ½ per cent. between the real and calculated discharge. There are eight circumstances which affect the discharge, namely:—(A) The form and disposition of the channel of approach; (B) the shape and thickness of the bottom and sides of the weir; (C) distance of the weir from the bottom and sides of the channel of approach; (D) velocity of the water in the channel of approach; (E) ratio of the length of the weir to the depth of water flowing over it; (F) conformation of the discharging channel below the weir; (G) place and method of determining the depth of water flowing over weir; (H) accuracy of construction and precision in taking measurements.

(A) From experiments made on the Cavour Canal it appears that the channel of approach should be 66ft. long, and that this is sufficient to calm the water entering even with a fall of 19in. When this length cannot be obtained perforated diaphragms should be inserted in the channel to still the water.

(B) The water should approach the weir freely from all sides, as otherwise the coefficient will vary with the depth of the water. Experiments were made as to the effect of the width of the cill, and it was found that for depths of water less than 5in. the width should not exceed one-tenth of the depth, and with depths of from 5in. to 2ft. 2in. it should not exceed one-fourth of the depth. Where the depth varies, the width should be that corresponding to the least depth. The upstream face of the weir must be in a vertical plane, which extends to the sides and bottom of the channel of approach.

(C) It appears from the experiments of Francis, when the cill of the weir is at a height above the bottom of the channel of approach equal to three times the depth of water over the cill, and the sides of the weir are twice the depth of water over the cill from the sides of the channel, then the flow is not affected by the bottom and sides of the channel. If, however, these distance are reduced, the first to twice and the second to one and a-half times the depth over the cill, the discharge is increased about ½ per cent.; and where the distances are further reduced, the first to twice and the second to the depth over the cill, the discharge is increased about 1 per cent.

(D) It is well known that if the water before feeling the effect of the weir has a velocity of its own, the formula for discharge instead of being $Q = K\,L\,H^{\frac{3}{2}}$, becomes $Q^1 = K\,L\left\{(H+h)^{\frac{3}{2}} - h^{\frac{3}{2}}\right\}$ h being the head corresponding to the initial velocity v and found by the expression $h = \frac{v^2}{2\,g}$. In practice, however, it is difficult to measure v. We may, however, construct the channel in such a way that putting $\frac{Q^1 - Q}{Q} = r$, r shall not exceed any required fraction, and calling w the area of the channel of approach $= \frac{Q}{v}$, if the usual coefficient $m = 0{\cdot}62$ is taken, $w = 0{\cdot}50 \times \frac{L\,H}{\sqrt{r}}$; and the author proceeds to prove that for $r = \frac{1}{100}, \frac{1}{200}, \frac{1}{400}$, w will be 5 H L, 7 07 H L, and 10 H L respectively; that is to say, that by making the area of the channel five, seven, or ten times that of the area of the weir, the error occasioned by neglecting the velocity of approach will not exceed $\frac{1}{100}$, $\frac{1}{200}$, or $\frac{1}{400}$, as the case may be, of the actual discharge. Comparing this with section (C), making the bottom width of the channel 3 H and putting slopes of 1 to 1, $w = (L + 4\,H)\,4\,H$. It is shown later on that H should not exceed $\frac{L}{3}$, or putting $L = 3\,H$, we find $w = 0{\cdot}50\,\frac{L\,H}{\sqrt{r}}$ gives $w = 21{\cdot}21\,H^2$, and $w = (L + 4\,H)\,4\,H$ gives $w = 28\,H^2$, so that when the conditions of (C) are fulfilled the channel is so large, and consequently the velocity of approach so small, that the increase of discharge due to the latter is less than ½ per cent. of the total discharge.

(E) This is the most important point of the question. In regard to it the experiments of Francis lead to the following conclusions:—(*a*) The coefficient of contraction is made up of two parts, that due to the surface or horizontal contraction, and that due to the sides; (*b*) the horizontal contraction of depth of water, varying from 1in. to 20in., is constant, and its mean value is 0·623 with maximum of 0 624, and minimum 0·62, so that the possible error is less than 1 per cent.; (*c*) the lateral contraction is also constant, provided that the length of the weir is at least three or four times the depth of the water; for shorter lengths the lateral contraction becomes less because the contractions from the two sides interfere with one another; (*d*) in long weirs the side contraction is proportional to the depths of the water, and serves to diminish the effective length by a mean value approximately equal to $\frac{1}{10}$ of this depth. Francis' formula is $Q = 0{\cdot}623\,(L - 0{\cdot}10\,n\,H)\,\frac{2}{3}\,\sqrt{2g}\,H^{1\,\frac{3}{2}}$, in which $H^1 = \left\{(H+h)^{\frac{3}{2}} - h^{\frac{3}{2}}\right\}^{\frac{2}{3}}$, and n is the number of sides which affect the contraction. When $n = 2$ this becomes $Q = 0{\cdot}623\,(L - 0{\cdot}20\,H)\,\frac{2}{3} \times \sqrt{2\,g}\,H^{1\frac{3}{2}}$. His experiments were confined to depths of from 7½in. to 18¾in., but by comparing the results obtained by other observers it appears that they are applicable to depths of from 3in. to 24in., with a limit of error not exceeding ½ per cent., provided that the length of the notch is not less than three or four times the depth. In order to get over the difficulty of the contraction varying with the depth, the notch should be made in the form of a trapezium; and the author found that if the inclination of the sides was made ¼ to 1 the discharge within the above limits of depth would be given by the formula $Q = m\,L\,\frac{2}{3}\,\sqrt{2\,g}\,H^{\frac{3}{2}}$, in which it is only necessary to take m constant $= 0{\cdot}623$, the inclination of the sides balancing the side contraction.

(F) The principal point to be attended to under this head is to ensure the free access of air under the water as it falls over the weir.

(G) Several methods of measuring are described, the best being that by a suitably-arranged hook gauge with adjusting screw and vernier. With this it is easy to read to $\frac{1}{50}$ of an inch, and a practised observer can read to $\frac{1}{500}$ of an inch. A method is given for ascertaining the degree of accuracy required in reading the gauge in order that the error in the discharge may not exceed a given ratio.

The author states that if the works are executed with such reasonable accuracy as may be obtained for a moderate expenditure, the discharge may be measured within ½ per cent. As, however, the various errors which may creep in tend on the whole towards giving a discharge slightly in excess of that calculated, he considers that the coefficient m should be taken as 0·63 instead of 0 623, and he gives as his final formula $Q = 0{\cdot}42\,L\,H\,\sqrt{2\,g\,H}$ applicable to all cases within the following limits, the notch being made trapezoidal, as explained above:—(*a*) H to be not less than 3¼in.; (*b*) H not to be more than 24in.; (*c*) H not to exceed in any case $\frac{L}{3}$ or $\frac{L}{4}$; and he then gives the following dimensions for the various parts in terms of H, when H is at its maximum value for the particular weir:—$L = 3\,H$ . . . (1); depth from cill to bottom of channel of approach $= 3\,H$ . . . (1); distance from the sides of the channel to the sides of the notch $= 2\,H$ . . . (1); thickness of the cill and sides of the notch $= \frac{H}{10}$ if $H < 4\frac{3}{4}$in., and $\frac{H}{4}$ if $H > 4\frac{3}{4}$in. . . . (2); width of the bottom of the channel of approach $= 3\,H$ . . . (1); depth of water in the canal of approach $= 4\,H$; slopes of channel, 1 to 1; area of water in the channel $= 28\,H^2$; ratio of the area of the notch to that of the water in the channel of approach $= \frac{3\,H^2}{28\,H^2} < \frac{1}{9}$; length of the channel of approach = from 30 H to 60 H. The dimensions marked (1) may be increased; those marked (2) may be diminished.

The author then gives the application of these investigations to the case of the gauges of the Villoresi Canal, which are illustrated by drawings. There is also a table of discharge of weirs in metrical measures.

[1] Proc. Inst. Civil Engineers.

A NEW METHOD OF BURNING OIL FOR LIGHTHOUSE ILLUMINATION.[1]

By J. R. Wigham.

At the South Foreland experiments recently conducted by the Trinity House several new oil lamps were tried and reported upon. Those patented by Sir James Douglas, engineer to the Trinity House, were spoken of very favourably in their report by the Trinity House. I myself had an opportunity of seeing and admiring these burners. I found, however, that, like all other oil burners heretofore used in lighthouses, they require to be used with glass chimneys. Now, the use of glass chimneys has these disadvantages—(1) The chimney intercepts the light; and (2) it is apt to be broken, and thus, until a new chimney be applied, the light may be said to be useless. The delay in replacing a broken chimney when it is hot is sometimes very considerable, and during the time thus occupied a vessel may run into danger. With the gas-burner I have used for lighthouses no such difficulty occurs, for I use no glass chimney, but place over—not in front of—the flame, at such a height as not to interpose any obstacle to the light, a flue, which sucks in the oxygen of the air, and thus renders smokeless and intensely white the flame of the gas lamp. There are, as we all know, many positions in which, for want of room, it is almost impossible to apply gas at lighthouses, and in such cases oil must be used. To use it without a glass chimney would, I felt, be a great advantage, and therefore I devised a method of burning oil lamps in such a manner as to render the use of chimneys unnecessary. I simply brought a current of air through such orifices in the burner, and with such deflectors as were necessary to oxidise the smoky oil flames, using also the overhanging flue as in the case of my gas-burner. I thus surrounded the flames of the oil lamp with cylindrical walls of air instead of glass, and the thing was done. On the table for your inspection is a four-wick oil lamp as used in a first-order lighthouse, with its air casings. [Lamp exhibited.] Any means of propelling air may be adopted; a blower, such as is used with atmospheric gas, worked by weight, is a convenient arrangement, or an electric motor similar to that which I have here. [Electric motor exhibited.] But, of course, larger will answer equally well. I think it right to mention that Mr. Ross, of Dublin, has also designed a lamp on this principle. I have seen its performance, and I believe it will accomplish the desirable object of getting rid of glass chimneys for great oil lights in a perfectly satisfactory manner.

[1] British Association—Section G

A Sermon to Employes.—The following is a verbatim copy of a notice which the Chicago, Burlington, and Quincy Co. has had printed, framed and sent to various shops and offices, where they are posted for the benefit of the employés. The sentiment conveyed is given as that which actuates the officials of the company in their treatment of employés: "The servant, man or woman who begins a negotiation for service by inquiring what privileges are attached to the offered situation and whose energy is put chiefly in stipulations, reservations, and conditions to 'lessen the burden' of the place will not be found worth the hiring. The clerk whose last place was 'too hard for him' has a poor introduction to a new sphere of duty. There is only one spirit that ever achieves a great success. The man who seeks only how to make himself most useful, whose aim is to render himself indispensable to his employer, whose whole being is animated with the purpose to fill the largest possible place in the walk assigned to him, has in the exhibition of that spirit the guarantee of success. He commands the situation and shall walk in the light of prosperity all his days. On the other hand, the man who accepts the unwholesome advice of the demagogue and seeks only how little he may do, and how easy he may render his place and not lose his employment altogether, is unfit for service; as soon as there is a supernumerary on the list he becomes disengaged as least valuable to his employer. The man who is afraid of doing too much is near of kin to him who seeks to do nothing and was begot in the same family; they are neither of them in the remotest degree a relation to the man whose willingness to do everything possible to his touch places him at the head of the active list."

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

(*From our own Correspondent.*)

A moderate degree of steadiness—not, however, developing into any large extent of activity—marks operations at the mills and forges this week. Shipping and country orders combined provide sufficient material to keep the works mostly running, but ironmasters are dependent generally upon specifications obtained week by week, and are unable to guarantee employment far ahead.

The sheet works are likely to be fully employed for the rest of the quarter upon specifications from the galvanisers, and prices are well maintained at the former level. In some directions there is a reluctance to book orders for forward delivery at the current rates. The principal shipping orders at date are for galvanised corrugated sheets for the Colonies, plain sheets for Russia, nail rods for the Eastern market, and tin-plates for the United States and Canada. None of the specifications are very large, but they represent in the aggregate a considerable volume of business.

Satisfaction is expressed that the revival in the United States is well upheld, and gives indications of assuming increased importance as winter comes on. The Canadian demand is steady. Prospects of the Colonial and South American trade are further improved by the continued advance in wools and some other descriptions of produce. Ironmasters doing business with the East are rather more hopeful, by reason of the slightly improved value of silver, though the recent rapid rise has not been maintained.

A few of the makers of marked descriptions of finished iron continue well engaged on Government and other work, though most of them seem now to be no better off as regards current business than the makers of lower class iron. Short times continues the rule at most of the best bar works, and orders are not to be got without a good deal of energy. Marked bars remain at £7 per ton, the price fixed last May.

Messrs. Wm. Barrows and Sons quote: Bars round, square, and flat, £7; best bars suitable for chain making and other purposes, £8 10s.; double best, suitable for superior chains, bars, and the like, £9 10s.; plating bars, £7 10s.; best angle, tee, and rivet iron, £9; and double best £10. Boiler plates the firm quote £8 10s., £9 10s., £10 10s., and £14 10s., according to quality; and sheets, £8 10s. for 20 gauge; £10 for 24 gauge; and £11 10s. for 27 gauge. Hoops they quote £7 10s.; best, £9; and wide strips, £8 10s.

The New British Iron Company occupies a somewhat exceptional position as follows:—Best Corngreaves bars, £6 5s.; composite bars, £8 15s.; best Corngreaves rods, £6; best Corngreaves plates, £7 15s.; tank plates, £7; best Corngreaves angles, £6 15s.; best Corngreaves tees, £6 15s.; and best Corngreaves hoops, £6 15s. per ton.

Ordinary merchant bars are quoted at £5 10s. to £6; and common, £4 10s. to £5. Common sheets are worth about £6, though various buyers seek to obtain their supplies at £5 17s. 6d. Galvanised sheets of 24 gauge are about £10 per ton f.o.b. Liverpool. Common tank plates are £6 10s.; and tank plates to bend, £6 15s. Boiler plates are £7 10s. to £8 for common qualities, and superior sorts £9 to £10.

Scotch, as well as Northern competition, has now to be reckoned with in the sheet trade, so, too, in the wide strip trade for gas tube purposes. After paying 15s. per ton carriage, the Scotch ironmasters are delivering this latter class of iron into this district at £6 per ton, which is sensibly below the price which native makers can accept. For narrow tube strips local prices are £4 15s. per ton upwards. Certain of the Scotch millmen are, it is understood here, working for 25 per cent. less than Staffordshire millmen, which would largely account for the low competitive prices of the Scotch makers. Common angles and tees are about £5 to £5 5s.; and hoops, £5 5s. to £5 10s. per ton.

The well-known tin-plate making firm of Messrs. E. P. Baldwin and Co., of Dudley and Kidderminster, intend, it is understood, to gradually remove the bulk of their tin-plate business from the last-named place to their newly erected works at Newport, Mon. This step has been rendered necessary, not only to avoid excessive railway rates, but also to provide facilities for obtaining supplies of steel. The Wilden works will be still kept in partial operation upon best black sheets, but the number of hands will be considerably lessened. The Swindon works of the firm will be kept on fully as heretofore on best sheets.

A brisk demand is finding expression for steel blooms, billets, tin bars, and similar sections, for rolling down in the iron mills, at £4 5s. to £4 6s. 3d. and £4 7s. 6d. for billets. The best sheet and tin-plate makers are large consumers. Steel masters, however, do not yet seem to be able to produce metal of perfect uniformity. Consumers are this week here and there complaining of this circumstance, and of the impediment which it affords to a still wider adoption of the metal by them. The attention of the steel masters concerned has been again called to the defects, and they reply that the metal which they are now supplying is made with the utmost possible care. It is clear, therefore, that steel masters have still something to do in perfecting their processes.

Best foundry pig iron is rather firmer owing to better orders from the engineers, but other native sorts are in quiet demand through slackness of work at the pipe-making foundries. Deliveries from the furnaces are not going away rapidly, and it is estimated that stocks in makers' hands have increased about 20 per cent. during the past six months. Best all-mine hot-blast forge pig goes off in limited parcels at 55s., and less excellent makes at 52s. 6d. and 50s. Medium makes of pig realise about 35s. to 42s. 6d., according to mixtures; and common pigs, 27s. 6d. to 32s. 6d.

Business between sellers and consumers of Derbyshire, Northampton, Leicestershire, and similar makes of pigs is the subject of much negotiation. Sellers are doing their best to keep up the market, but it is not an easy matter to convince consumers that the stronger prices quoted are justified by the state of the market. The amount of business doing is therefore only small. Vendors are quoting 36s. 3d. per ton delivered to works for Derbyshires, and 35s. 9d. for good Northamptons. Buyers will not give more than 35s. 6d. to 35s. 9d. for Derbyshires, and 34s. 6d. to 35s. for Northamptons. Lincolnshire pigs are quoted 38s. per ton, but it is impossible to get the figure. Buyers mostly decline to give much more for them than for Derbyshires. Hematites are pretty firm, but they have not advanced so much as was a few weeks ago expected. Tredegar brand may still be had at 50s., West Cumberland forge numbers are 52s. delivered, and foundry numbers 52s. 6d. per ton.

Coal is in a stagnant condition. Forge coal ranges from 6s. for best qualities down to 4s. 6d. per ton. Good mill coal is 6s. to 7s.; new mine furnace, 7s.; and furnace, 8s. to 9s. 6d. per ton. Business in coke and iron stones is slow. Ordinary Derbyshire cokes are 13s. per ton delivered; North Staffordshire cokes, 12s. 3d.; South Wales superior qualities, 15s. to 16s.; and Durham foundry cokes, 20s. to 21s. 6d. delivered. Native ironstone is about 9s. to 10s. per ton for gubbin qualities, and 8s. for common new mine sorts, while Northampton stone is selling at from 5s. to 5s. 6d. delivered in this district, and makers would book forward two years at present prices.

The boiler, tank, and gasometer makers are moderately engaged, and pretty satisfactory orders, as regards extent, are held by the bridge builders; but contract prices are very unsatisfactory. Engineering and machinery castings are ordered in irregular quantities. There are some good inquiries for heating appliances. Galvanised iron roofing is in good request by shipping houses, and the orders in hand furnish steady occupation. Wrought iron tubes for gas purposes are on order to a slightly better extent.

The light ironfounders are only moderately engaged, but at the town of Willenhall splendid work in artistic light ornamental castings is just now being turned out, which has no superior even in America. The result is the receipt of increased orders from home makers, and enlarged export to the colonies and other shipping markets of goods which, only a few years ago, it was impossible to obtain from this country. Importations of German and French hardwares are also leading to improvements and advances in local manufactures.

The chain-makers of Old Hill and Cradley Heath are still holding out for an advance. They have become more confident of success, many masters having conceded their demands, and others having shown practical sympathy with their cause. So determined are they in their agitation, that rather than submit to a reduction they state their readiness to leave the trade altogether.

A dispute is pending in Walsall between the chainmakers and their "link" men. Some of the employers have been compelled to reduce their workmen's wages to 5d. a gross, which is a penny less than the previous list. The men resent this, and they have consequently come out on strike.

The leading employers in the horse nail trade have agreed to an advance in the wages of their operatives of 3d. per thousand. This is only half of the increase required by the men, but they have accepted the concession, and will resume work. This advance increases the workmen's list to 2s. 3d.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The condition of the iron trade in this district remains without material change. Makers of pig iron, although perhaps not adhering firmly to the full rates which have recently been quoted, still hold out for a substantial advance upon the minimum prices which were being taken a month or so back, and although not much business is practicable at the prices they are now asking, they show little or no disposition to meet buyers, who are prepared to give out orders if they can get prices back to something like old rates. Hematites remain firm in price, but meet with only a poor demand in this district. Manufactured iron makers are getting some increased weight of business, and are not cutting quite so low in their prices; but except that one or two Staffordshire brands have been put up 2s. 6d. per ton as the result of the diminished make in that district, prices do not show any actual upward movement.

There was only a slow business doing on the Manchester iron market on Tuesday. For local and district brands of pig iron delivered equal to Manchester the average price was about 36s. 6d., less 2½, for foundry qualities delivered equal to Manchester, with forge qualities ranging from 34s. 6d., less 2½, for some district brands, to 35s. 6d., with 36s. 6d. as a nominal quotation in one instance for delivery here. In foundry qualities there are a few orders stirring, but forge iron meets with very little inquiry, manufactured iron makers in most cases being pretty well covered for the present, and as they are not able to get any appreciable advance on finished iron, they are not disposed to pay any higher price for the raw material until they are absolutely compelled to place out orders. In outside brands there is considerable underselling, and both Scotch and Middlesbrough iron can be bought in this market without difficulty at under makers' prices.

Hematites still meet with only a slow demand here, and in some instances orders are reported to have been taken at very low figures, but the average quoted prices remain at about 51s. to 51s. 6d., less 2½, delivered into this district.

There have been some moderate orders given out in the manufactured iron trade, but I understand they have been keenly competed for and have been taken at very low figures. One or two of the Staffordshire makers are now quoting £5 per ton for bars delivered here; but £4 17s. 6d. is still the average current price, with hoops to be got at £5 5s., and sheets at £6 10s. per ton.

In the steel trade prices are being cut excessively low, and I have heard of cast steel cylinders, with bored and turned ends, and tested, being delivered here as low as 17s. per cwt., whilst steel sheets and plates delivered here can be got readily at under £7 per ton, £6 15s. being quoted in some instances.

The condition of the engineering trades remains about stationary. As regards employment, the reports of the leading trades union societies show no appreciable change as compared with last month. The returns issued this month by the Amalgamated Society of Engineers show, in the total for the whole of the districts connected with the Society, a slight reduction in the number on the books in receipt of out-of-work support; but the reduction is spread over so wide an area that it does not represent any real improvement of trade in any particular district, and does not appreciably reduce the high percentage of donation or out-of-work members returned in the last report. The reports as to the condition of trade received from all the important industrial centres continue very unsatisfactory, "bad," or only "moderate," being the general return; whilst in the important engineering district of which Manchester and Salford form the centre, even as regards the number of unemployed, which seems to be above the average of most other districts, no improvement whatever is reported, and at many of the large engineering concerns old contracts as they run out are being barely replaced with the new work coming forward. The report of the Steam Engine Makers' Society states that there has been no change from last month; there has been no further decline in the number of unemployed, and no improvement of any note in the condition of trade. The numbers in receipt of out-of-work donation still average about 4 per cent. of the total membership, and the district returns as to the state of trade still show it to be only moderate throughout the country generally. The last report of the Boiler Makers' Society shows some slight improvement in the condition of trade, several of the large firms having secured moderate orders, which have put them into moderate work.

Mr. James Swift, general secretary of the Steam Engine Makers' Society, has been elected as a representative of the engineering trades to fill the vacancy on the Parliamentary Committee of the Trades Union Congress caused by the resignation of Mr. John Burnett, general secretary of the Amalgamated Society of Engineers, owing to his acceptance of an office under Government as correspondent of the new Labour Bureau, the salary in connection with which office will, I understand, be £300 per annum.

The letting of the contract for the erection of the Manchester Exhibition building to Messrs. R. Neill and Sons, of Manchester, for the sum of £34,350, gives a definite start to this project, which will form one of the several important attractions which Manchester will present during the ensuing Jubilee Year of her Majesty's reign. The contractors are losing no time, and already they have a large staff of workmen on the ground. Mr. Samuel Lee Bapty, the general superintendent of the present Liverpool Exhibition, has been appointed to a similar post in connection with the Manchester Exhibition. It is to be hoped that in his official capacity on the Manchester Exhibition he will strenuously eliminate from it some of the objectionable features which have been a very serious ground of complaint against the management of the Exhibition at Liverpool. The mere shop element must as much as possible be eliminated, and if the Exhibition is to aim at being a means of instruction to the visitors, efforts must be made to secure a large and a complete display not only of machinery in motion, but of various manufacturing processes in full working operation. One special feature will be a collection of handicrafts, under the management of a committee, of which Mr. Alderman W. H. Bailey is the chairman, and which it is intended shall occupy rooms in the structures which will represent Old Manchester and Salford. It is intended that some space shall be devoted to the historical development of ancient handicrafts, especially those which illustrate the trades of the district of the South of Lancashire, whilst modern handicrafts will also be exhibited at work. At the first meeting of the committee held on Monday, Mr. Bailey very pertinently pointed out that if they were able to exhibit in operation any old craft or obsolete manual art which might be profitably revived in this district, or if they could import simple handicrafts from other districts or from abroad which might be carried on by cottagers in their own homes, such methods of work would not only be highly interesting as exhibits, but they might further be of very great value and possible benefit to the whole district by affording a means of employment to people who now found it difficult to secure work through the ordinary channels. At the meeting on Saturday of the Manchester Engineers' Society, of which Mr. Bailey is the president, he also brought the matter forward, and asked the members to assist in every way they could to make the section of handicrafts as complete and interesting as possible. He said, engineers and machinists, and those engaged in the development of labour and the economical use of energy, had driven out many old handicrafts, and the committee would be very glad to have the benefit of any suggestions which would enable them to make their special department a success. As regards the general engineering section, of course in an important centre like Manchester this may be looked forward to as one of the leading features of the Exhibition, and I understand the matter is being very energetically taken up by the principal firms in the district.

With regard to the Manchester Ship Canal project, the independent committee recently appointed are actively engaged on the new scheme to be submitted to the public, but until the holidays are over nothing definite will be done. At a gathering of the workpeople employed by Messrs. Daniel Adamson and Co., held at Hyde on Sunday, Mr. Digby Seymour, Q.C., threw out some suggestions as to working men taking up a large interest in the share capital, and expressed the belief that if five millions of the share capital were once raised the remaining three millions would be taken up at a handsome premium. As to raising the five millions, he had the assurance of leading financial men in London that if the public could be relied on for half the amount they would undertake in the course of a day or two to underwrite and provide the rest. As a practical outcome of Mr. Digby Seymour's address, the men at Messrs. Adamson's works have arranged to work at least two extra hours per week, the amount earned during that time to be deducted by the firm and invested for the men in the capital of the Ship Canal. At a moderate computation it is estimated that the annual amount to be raised for the Ship Canal from this source will be £1000 as the minimum, and depending upon the state of trade, it may run up to £3000. It is urged that if the employés of a thousand other firms of equal magnitude could be induced to follow this example scarcely any other subscriptions would be wanted.

In the condition of the coal trade there is comparatively little or no change to report, either as regards prices or demand; all descriptions of fuel still move off only slowly, with, if anything, a tendency to stiffen in price in anticipation of the approaching winter demand, and the possibility of some advance next month.

Barrow.—No alteration of material moment can be noted in connection with the staple trades of this town and district. Orders for pig iron are pretty freely offered, and the improved tone in the demand reported about a fortnight ago is fully maintained. The demand for Bessemer samples especially is good, and it is noticeable that forge and foundry qualities required for general use are also in more favour. The output of pig iron has not, however, been increased, as some of the large sales for early delivery have been completed out of stocks. The latter, as a consequence, have been somewhat reduced. There is a steady production, however, of about 26,000 tons per week, all of which is going into consumption. This iron is made by forty-nine furnaces, but fifty-six are out of blast, so that the production is not half what it would be if there was the work to do. Prices show no variation. Mixed Bessemer samples are quoted at 42s. to 42s. 6d. per ton, and the makers that are best off for orders are asking 43s. per ton. Forge No. 3 and foundry iron of the same number is offered at 41s. to 41s. 6d. per ton net. Makers, generally speaking, are sold forward for three months. The steel trade is well employed, and there is a large production of rails which are not only well ordered forward, but they are still in fair request for both home and foreign markets. Prices are steady at about £3 15s. per ton net at makers' works for ordinary heavy sections, other weights and sections are at proportionate prices. The tin-plate trade is fairly employed, but in other departments of the steel trade there is not much life, although a better trade is doing all round than was the case a short time ago. Shipbuilders are no better off for orders; some are being negotiated for, but there are not indications of large contracts coming to hand which would furnish anything like adequate employment for the large yards in this district. Engineers are still busy in the marine department only. Iron ore finds a better market; but the large banks of raw material which have accumulated at mines will not necessitate any increased activity except in the filling of wagons. Coal and coke are in steady consumption, and prices remain at late rates. There is a brisk trade in shipping, so far as exports are concerned, and freights are better. An attempt is being made in this district to get a reduction in railway freights corresponding with that on the East Coast recently made by the North-Eastern Railway Company. It is contended that such a concessiou would be of great advantage to the traders of this district.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The improvement in several markets for unwrought steel has excited hopes of a general revival in that branch of industry, but as yet the additional "call" has not been felt in the high-class crucible steels, though a considerable amount of business has latterly been done in costly grades of steel for the States. During August unwrought steel was exported to all markets to the value of £135,285, against £80,248 for August of 1885, and £82,239 for the similar month of 1884. France has been a gradually declining market, the values for August, 1884-5-6, being respectively £8394, £7974, and £6875. The United States, for the corresponding months, took values of £17,488, £17,808, and £55,268; other countries figuring for £56,387, £54,466, and £73,143. For the eight months each year the figures were—1884, £763,515; 1885, £647,636; 1886, £839,139.

Some interest has been excited by a reference made the other night in Parliament by Mr. Woodall, the late Surveyor-General of Ordnance. "If the Government," he said, "could induce one of the great Sheffield houses to compete for the making of guns, the ordnance of the country would be benefitted, for it was well-known that there were in the town many capable manufacturers who might be induced to enter into competition." Messrs. Thomas Firth and Sons, Norfolk Works, have been engaged in the production of steel ordnance for many years, and laid down a most costly plant which has been greatly extended of late. Messrs. Charles Cammell and Co., Cyclops Steel and Iron Works, have also produced the great ingots needed for the guns, and make a speciality of gun carriages. Sheffield manufacturers produced the immense ingots ordered for the 100-ton guns of the Duilio and Dandolo, and the still heavier guns for the British Navy. The boring of the ordnance for the Government is undoubtedly done at Woolwich; but there is no reason why Sheffield enterprise should be confined to the core. What local people, however, have to contend with is this: they lay down a very expensive plant, and sometime after find themselves threatened with Government competition. If the chief customer becomes a business competitor of course there is an end of profitable work. With some understanding as to a likelihood of the machinery being adequately employed, and no fear of Government competition, there would soon be a vigorous "rush" into ordnance manufacture by our most capable firms, who would only be too glad to add another department to their establishments; but the directors would scarcely feel themselves justified in recommending serious outlay of capital by their shareholders without some prospect of its being wrought at a gain.

A Sheffield mannfacturer, who recently returned from an extended tour in Canada and the States, expressed his opinion that it was not Germany England had to fear, but the United States. A Sheffield artisan writes to me strongly confirming the manufacturer's views. He says he spent some years in America, and adduces some examples of the difference between the two countries as regards enterprise. "Some years ago," he says, "I received a letter from a prominent silver-plate and Britannia manufacturers in Sheffield, stating that the Americans were selling over them in Australia; and as one large firm was getting out a new and fine catalogue, they would esteem it a very great favour if I could procure one for them. After some trouble I did so, and this was the result. A large stock of goods and patterns were made and forwarded to the Australian market, the result being they could not sell them, saying, 'that style had gone out, and something newer was wanted.' That ended the enterprise as regards trying to beat the Americans. Here are the reasons why they did not sell: The first time a pattern is made in the American's works a large stock is made and sold before drawings or photograph are sent out. That is, all the large towns and best shops are supplied, then photos. are sent out, and they do not get in the catalogue until the second year, so that by the time the Sheffield manufacturer gets his goods in the market they have been sold for four seasons. Was he likely to sell anything? So much for Sheffield enterprise. This is how the American firm in question regard an enterprising way of doing things. Last June the head of the firm came to England, France, Germany, and Austria, bringing with him his manager and designer. They visited all the large towns to see what they could find that would be of any advantage to them. They went through most of the silver and plate shops in Sheffield, Birmingham, and London—all expenses being paid by the firm. The remark they left was that "they did not need to fear English competition." A very interesting question was asked me by the American. How many Sheffield firms keep a designer, *i.e.*, a man to do nothing but make drawings for the firm. Can you inform him? Well, in the silver and electro-plated trades, the Sheffield firms employ many designers, and some of the principals have themselves produced many beautiful works which were exclusively their own design.

Is there any insurmountable obstacle to making an iron and glass roof water-tight? Within ten days I have been under two great structures, and both failed to keep out rain. On Saturday, the 4th of September, between 8 and 9 a.m., in the flower market at Covent Garden, London, it suddenly became very dark; then thunder and lightning with excessive rains. Without any warningthe rain poured into the building, chiefly I noticed down the iron columns, and causing the stallkeepers to get away their choice wares as rapidly as possibly. I observed that part of what appeared to be the ventilators were open, but the rain did not appear to be coming through them. On Monday, September 13th, in the Edinburgh Exhibition there was a "Scotch mist," a miserable drizzle. The string and military band from Woolwich were playing, and it was amusing to see one of the "violins" feeling the "drops" patting down on his carefully frizzed head. Some of the listeners, finding the wet percolate through the roof, left their chairs, which were immediately occupied by others. These, in their turn, vacated them without affording explanation to fresh victims. The rain fell on the musical and the unmusical.

The production of large steel forgings, &c., into which Messrs. John Brown and Co. have entered with characteristic energy, has induced them to issue a further £30,000 of the company's £10 five per cent. preference shares, in order to meet the outlay necessary for introducing this new manufacture.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUT little business was done at the Cleveland iron market held at Middlesbrough on Tuesday last. Merchant sellers seemed hopeful as to their future prospects, and adhered to the prices which they quoted last week. They do not anticipate that any further advance will take place so long as stocks continue to increase. Makers were firm at 30s. to 30s. 6d. per ton, and are likely to remain so until they know the effect of the restriction when in full force. The prevailing quotation for No. 3 g.m.b. for prompt delivery was 30s. per ton. Buyers offered 29s. 9d., and some small lots changed hands at 29s. 10½d.; grey forge iron could not be bought for less than 29s. per ton.

Warrants are considered worth 30s. per ton, but there are no buyers at the moment.

Nothwithstanding the reduction of make which is now in progress, and the heavier shipments which have recently been made, Messrs. Connal and Co.'s stocks at Middlesbrough and Glasgow continue to increase. On Monday last their Middlesbrough stock stood at 298,722 tons, being an increase of 3014 tons for the week, and their Glasgow stock was 819,232 tons, or an increase of 2296 tons.

The shipments of pig iron from Middlesbrough have certainly improved. Up to Monday last 36,403 tons had been exported since the 1st inst. This is about 6000 tons more than was shipped in the corresponding portion of August, and nearly 12,000 tons more than in July last.

Large quantities of railway material are leaving Middlesbrough for India. On Saturday last the s.s. Rothsay sailed for Bombay with 1100 tons of rails, 1280 tons of sleepers, 20 tons of keys, and 100 tons of fish-plates, all being of steel. The s.s. Stella left the day before with 3164 tons of iron railway material and 16 tons of steel switches.

Nothing of a favourable nature can be said with respect to the finished iron trade. The demand does not improve, and the competition for the few orders which appear in the market is exceeding keen. Prices remain exactly the same as quoted last week.

The Trades' Union Congress, which held its concluding meeting at Hull on Saturday last, was fruitful of interest to all who watched for the signs of the times. The intellectual activity and the tone of patient self-reliance exhibited by the assembled representatives of labour were most noticeable. The Durham and North Yorkshire delegates came, as might have been foreseen, a good deal to the front—a circumstance which will probably not escape the observation of their constituents. Every now and then when one individual differed in opinion from another, he relieved his feelings by imputing unworthy motives, and an unseemly squabble of course ensued. But looking at the meeting as a whole, it may fairly be said that unparliamentary language was not indulged in much more frequently, or more freely, than it is in the House of Commons, whilst in rapidity in making up its mind, and in putting its mind into intelligible words, the National Representative Assembly might well follow the example of the Trades' Union Congress. On some of the burning questions of the day, especially those which specially concern the industrial classes, the delegates seem to have very clear and decided views, and their resolutions thereon were usually passed by such large majorities as to indicate virtual unanimity. The value of education was fully recognised, and although it was forcibly pointed out that free elementary education meant substituting rates to which their class would have largely to contribute for subscriptions now paid by the upper classes, still they were for it almost to a man. On the difficult question of finding work for the unemployed, they decided unanimously that something in the way of legislation ought to be done, but what that something should be they did not even suggest. Of their prudence in taking so cautious a course there can be no manner of doubt, but it is equally clear that their decision was of no more assistance to our legislators than if they had been entirely silent. They were all of one mind that blast furnaces should not be worked on Sundays, but they ignored the fact that besides the danger of explosions entailed by such temporary stoppages, this additional "straw on the camel's back" would throw more of them out of work altogether. On the question of the Sunday opening of museums, it was amusingly shown that national sentiment is stronger than class interests. The English wanted them opened, but the Scotch would not have it so, and the latter ultimately prevailed. As might be expected they were all against the employment of female labour and the systematic working of overtime, the diminution of competition against themselves being apparently at least as prominent a motive as benefitting to the parties immediately concerned. Their not very courteous reproof to Judge Grantham would probably astonish his lordship. Perhaps it would have been a safer course for him had he attributed the case of attempted murder which he tried to "trades unionism" rather than to the "curse" of trades unionism. Lastly, the Congress did not hesitate in deciding without a dissentient voice that working men should sit on the bench as magistrates; and that with that object in view the property qualification should be abolished. But there remains something more than a doubt as to whether the decisions of a bench so constituted would be accepted, say in such cases as trade outrages, by the condemned, if those decisions were really fair ones. At all events it is certain the position of a working man justice of the peace would not be the bed of roses which he possibly now imagines it.

Messrs. E. Withy and Co., of West Hartlepool, are reported to have obtained an order from a London firm for a vessel of 3200 tons capacity. Mr. Edward Withy, the founder of the firm, but who retired two or three years since, and emigrated to New Zealand, is now on a visit to this country. He will, however, return to the land of his adoption next month.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Scotch pig iron market has been inclined to firmness this week, in consequence mainly of the determined attitude of the colliers on the wages question. Considering their poverty, the miners are supporting their newly-formed organisations in a way that was quite unexpected. They are doing their very utmost by restricting the hours of labour generally, and by strikes at particular collieries, to reduce the supply of coals available for smelting purposes, hoping in this way to force the ironmasters into granting them an advance of wages. Whether they will succeed is at present doubtful. The shipments of pig iron from Scottish ports in the week ending Saturday last amounted to 7928 tons, as compared with 9192 in the preceding week, and 7557 in the corresponding week of 1885. The shipments coastwise were 1832 tons, the remainder of the 7928 tons going abroad. Scotland is at present the chief market for Cleveland iron, which can be placed in the works of the consumer several shillings a ton cheaper than they can obtain Scotch No. 3. In fact, we are just now importing more iron from the Tees than we are exporting to all parts of the world. At present there is rather less Scotch iron going into the warrant stores than has been usual for some time, the quantity added in Messrs. Connal and Co.'s stores in the course of the past week being 2287 tons.

Business was done in the warrant market on Friday at 39s. 6d. cash. On Monday transactions occurred at 39s. 6d. to 39s. 4d. Tuesday's market was firmer, closing with buyers at 39s. 7d. cash. Transactions occurred on Wednesday at 39s. 7½d. to 39s. 8½d. cash. To-day—Thursday—business was done at 39s. 9½d. cash, closing cash sellers at latter quotation, and buyers ½d. per ton less.

The current values of makers' pig iron are:—Gartsherrie, f.o.b. at Glasgow, No. 1, 43s. 9d. per ton; No. 3, 41s.; Coltness, 47s. and 42s. 6d.; Langloan, 43s. and 41s.; Summerlee, 45s. and 41s.; Calder, 45s. 3d. and 41s.; Carnbroe, 41s. and 39s.; Clyde, 42s. 6d. and 39s.; Monkland, 40s. 6d. and 36s. 6d.; Govan, at Broomielaw, 41s. and 36s. 6d.; Shotts, at Leith, 43s. 6d. and 43s; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 42s. and 39s. 9d.; Eglinton, 39s. 6d. and 36s. 3d.; Dalmellington, 40s. 6d. and 38s.

Sir Charles Tennant gave it as his opinion at the annual meeting of the Steel Company of Scotland, held in Glasgow a few days ago, that they had come to this state of things in the steel trade, that unless the element of labour assisted them to some considerable extent in reducing costs, they should not get expenses much lower. The shipbuilders were not busy and not likely soon to be so, he was afraid; and until they got a change in that respect, they could hardly expect a much improved demand for their manufacture. He was, however, very glad to say that they had a fair order book, and they had laid in a heavy stock of raw material, principally hematite, at the lowest prices that were current, because they thought it prudent to keep well ahead of their orders in this respect. The dividend is 4 per cent. £14,708 had been spent in rendering the works still more efficient, £15,000 had been written off for depreciation, and £1243 carried to next account.

During the past fortnight the iron and steel goods shipped from Glasgow, in addition to pig iron, embraced the iron hull of a steamer, with boilers, &c., for Rangoon, valued at £21,950; locomotives, £12,000 worth for Huelva and £6750 for Kurrachee; machinery, £24,950, of which £12,000 went to Cuba and £3777 to Trinidad; sewing machines, £6301; steel goods, £9700; and general iron manufactures, £42,300.

The ironmasters, or a majority of them, are still disposed to resist the demands of the miners for increased wages, and it is expected that if the men carry out their proposal not to raise coals for the blast furnaces, that a number of the latter will be put out of blast.

The past week's shipments of coals from Glasgow were 21,174 tons, as compared with 19,310 in the corresponding week of 1885; Greenock, 1465, against 437; Ayr, 8709, against 8477; Irvine, 1473, against 2914; Troon, 5002, against 6765; Burntisland, 17,900, against 18,233; Grangemouth, 11,426, against 16,979; and Bo'ness, 7715, against 3492 tons.

The dispute between the colliers and their employers, as to the advance requested in wages, is apparently not yet near a settlement. In Lanarkshire the men have generally received back the last 6d. that was deducted from their pay; but in Ayrshire the advance is by no means general, and in Fife and Clackmannan it has been refused. In the last-named counties a lock-out is threatened unless the colliers adhere to the rule of working at least eleven days a fortnight. The enginemen employed at the collieries in the Baillieston district are also moving for an increase of wages, considering it unjust that they should not receive it as well as the colliers.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE returns for August, which have just been completed, show that an improvement has really set in with regard to the coal trade. February was the lowest total of the year. June showed a slight improvement over April, and since then the increase has continued, though the difference between January total and August is very slight. For instance, in January the total foreign coal shipments from Cardiff amounted to 559,095 tons, and the August total 578,298 tons. Newport showed better. In January the coal total was 123,750 tons, in August 183,697. Llanelly was also better, January total 5651 tons, August 9720; but Swansea showed a decrease, January 76,278 tons, August 34,000 tons. The returns also show that Swansea must do its best to retain its old superiority in the patent fuel trade. Formerly its averages were double that of Cardiff. Last March and April the Cardiff totals were only about 9000 tons, while Swansea showed 21,000 and 22,000 tons. August totals are about on a par, Swansea showing 20,791 tons, Cardiff 20,027 tons.

A little consolation can be gleaned from returns in the matter of iron and steel, for though Cardiff exported 8296 tons in January and only 2837 tons in August, yet the export for the year so far has amounted to 32,457 tons.

Newport, which is fed by Blaenavon, Tredegar, Ebbw Vale, and Rhymney, shows better. May and June months totalled up 30,000 tons; and the total for the year so far is 88,248 tons.

The steel rail business is yet far from satisfactory, and full activity in many of the principal works is rarely known. Prices are low, too low for the makers' good, steel rails being quoted at £3 10s.; and steel billets, which now form a leading future, at about £3 15s. The cause of these low figures for billets is that minor industries, wireworks, &c., are stagnant. If tin-plate workers were desirous of going in for steel bar they would find it cheaper to buy than to make.

Tin-plate has indicated a slight turn for the better, and holders of stock have not shown the usual anxiety to get rid of accumulations. For best brands there has been a manifest hardening of price, makers being firm at from 13s. 3d. to 13s. 6d. I.C., but business has been done for ordinary brands for as low as 12s. 6d. The close character of the trade is shown by the fact that sales have been effected for 12s. 7½d., 12s. 9d., and even 12s. 10d. Formerly the custom was a drop or a rise of 3d., and "splitting hairs" was not resorted to.

On the whole, though notices remain out at several large establishments, and a reduction generally is imminent, a survey of the condition of things is not altogether unsatisfactory. There cannot be any fault found as regards quantity. January to August shows an increase in export of over half a million boxes.

The total number of boxes shipped during August, 1885, was 494,000, value £338,000. The total number in August, 1886, was 522,000, value £353,000. For the last three years the shipments have been on the progressive scale, and the uses to which plates have been applied, both foreign and home, are on the increase. Still, with it all, there is a greater make than can obtain a fair remuneration, and makers having tried restriction of make, and failed, have now no other alternative than to keep on working until the weak ones go to the wall.

There is not much that is new moving this week in the coal trade. Ironworks collieries, Plymouth, Cyfarthfa, and Dowlais, are moderately employed, and the Rhondda and other principal collieries are somewhat better.

Ynysfeio is working again, but not up to its full complement of men. Cardiff shipped 120,000 tons last week, Swansea 28,000 tons. Newport Mon., showed less activity, the house-coal trade being very dull. Monmouthshire coals sufficiently low to tempt, varying from 7s. to 7s. 9d. at port. Rhondda coal is firm with 8s. 6d. to 8s. 9d. quotations, and owners say that an advance may be regarded as a certainty. Small coal is stiff at 5s. Pitwood is falling again in price. Iron ore remains at 9s. 6d. to 9s. 9d. The freight from Bilbao to Cardiff is 3s. 7½d., so deducting cost and labour in shipping, the margin of profit must be amongst the fractions.

The audit is now at work upon coalowners' books, and appearances justify the belief that another reduction of wages is imminent. Fortunately the lot of the collier is better. If he earned more money in 1874 he spent it recklessly to the injury of health and of wife and family. With lessened means he is becoming more home-loving and steadier, and small savings still go on.

The Miners' Provident Fund Society had their quarterly meeting on Saturday, Sir W. T. Lewis in the chair. The report showed that £255 had been paid during the quarter as funeral allowances on the death of members, £544 paid to widows, £556 to children, and £4157 to disabled members. At the end of June 172 widows and 342 children were receiving weekly payments from the society. This is most encouraging, as showing the substantial good done where formerly only a tithe was performed by charitable appeals and poor law doles; but it is incumbent upon ratepayers to subscribe to the fund, and upon the wealthy to give donations. The colliers' periodical payments should be supplemented. It will be seen that the item "disabled members" is a large one. This is the weak joint in the harness. A hearty vote of thanks was given to the chairman—the founder of the fund.

An explosion in the Bedminster Colliery, Bristol, a fiery vein, has been attended with ten deaths. This is the largest total known for this colliery. A rigid investigation is to take place.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

FROM Silesia the news is a little more favourable this week, as both domestic and export orders have been received sufficient to keep the rolling mills pretty well going; but there is no change for the better in prices. Best forge pig has got down to M. 38 p.t., and smelters are complaining of not being able to produce more cheaply, on account of having to pay so highly for their coking coal and their ores being of so lean a quality, and foreign ores too expensive, because of the long freight. Ship plates are better inquired after, but at prices lower than ever; M. 131·50 is the list price, but that is no criterion when real business is to be done. Bar iron and girders stand at M. 87·50 list price. Zinc at Breslau is quiet at M. 270 lowest price. The consumption has not been very great this season. During the week the market in Rhineland-Westphalia has not changed materially. In some branches the outlook appears a little brighter, whilst others remain depressed. The restriction of make in England has worked favourably over here, for since that occurence the buyers in Belgium have freely paid the prices fixed by their combination, and this will in due course cast its reflection over into these parts. The French market is also very firm. Ores are as neglected as ever. The pig iron trade is, if anything, more contracted than last week, but hopes are entertained of somewhat better sales soon, as the thin sheet works have now plenty of orders on their books. Prices, on the whole, though not higher, are firmer. The same may be said of the bar mills. For wire rods, on the other hand, there is very little demand, and drawn wire and wire nails are selling below cost of production. A few very trifling orders for rails have been given out by the State Railways. The Union of Dortmund took one at M. 120 p.t. Points and crossings, 190 tons, were taken by another firm at M. 115 p.t. At Carlsruhe the Belgians underbid the German firms 6 and 7½ M. for 1500 tons of rails. Many Bessemer works are only working five to six turns per week, instead of the customary thirteen. The constructive workshops are in the same stagnant position as last reported.

The brassfounders have not done quite so well last month, and have had to lower prices in consequence somewhat, so that brass now costs M. 1·65; phosphor bronze, M. 1·75; red brass, M. 1·70 p. kilo.

The house coal trade is beginning to be brisker, but in anticipation of cessation of the coke combination on October 1st, contracts have been taken at ruinously low prices—as for instance, for ironworks in the Siegen and Nassau districts at M. 6·20; for some Luxemburg works, at M. 5·60, and indeed, at M. 5·40; and for the Longwy works—France—at M. 5·30 p.t. for 40 tons daily.

The first hydraulic coal tip on the Continent, constructed by Armstrong, Mitchell, and Co., has lately been inaugurated with ceremony at Rotterdam, by the loading of a barque with 1000 tons of Westphalian coal for Java. The enterprise of the Dutchmen in having established this accommodation at a cost of 60,000 florins has set the coalowners in Westphalia in great glee. It appears that most of the sea-going vessels entering Rotterdam have to go out again in ballast to seek an outward cargo elsewhere, so now it is believed they will load coal in preference to that kind of work.

A fortnight ago the somewhat extraordinary announcement was made that a syndicate of Englishmen and Belgians had been formed, with a capital of £500,000, to establish a coal trade between Belgium and England. Knowing from experience that Belgium imports about 600,000 tons of coal alone from Germany, that the Belgian coals cost a great deal to get, that in a cold winter house coal is somewhat scarce there, and that the quality of the coal, as a rule, is of a leanish description, it looked so very like a *canard* that it was not reported at the time. Now the news is published that the Railway Minister has lowered the freights on coal from the Charleroi basin to Ostend and Bruges, which are to be the shipping ports to England; so it now becomes a necessity to mention the matter. Whether this is intended as a scare to induce the railways in England to lower their freights and charges on coals to London, or whether the scheme can ever pay, time must show. It is also remarked that this plan has been arranged with the object of forestalling the Germans sending coals to England. Thus the old adage of "sending coals to Newcastle" between the two seemed likely to be verified.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, Sept. 4th.

THE advices from the interior as far as Chicago and St. Louis indicate a strengthened demand for nails, hardware, agricultural implements, and small shop machinery, such as wood-working machinery, lathes, presses, &c. A great deal of new machinery is also being put into New England textile mills, and considerable orders have been received from two or three of the Southern States for additional textile machinery, to be shipped there within ninety days. The earthquake disturbances have had no effect whatever upon trade, being felt only in the Southern States. The movement of merchandise of all kinds, from dry goods to hardware, is heavier this week, partly because of the fact that the railroad companies have come to terms with shippers. Shipments have been held back for some time on account of the unfair classification by the trunk lines. These complaints have been removed. Railway traffic has increased remarkably within two weeks. Large contracts are being made between railway managers and shippers on more reasonable terms. There is very little danger of a disagreement between pool roads, and this fact opens the way for the closing of freight contracts between large shippers and railroad companies. Steel rail blooms will be wanted to the extent of about 20,000 tons to fill requirements in hand. Quotations are 24 dols. to 24 dols. 50c. Several large lots of good Bessemer iron can be sold here at a price equal to 18 dols. 50c., c.i.f. The rush for steel rails is over for the present because of the unwillingness of makers to accept contracts for delivery before January. Some capacity yet remains unsold, amounting to perhaps 150,000 tons in all, but the managers prefer to keep this capacity open in order to meet the urgent requirements of small buyers, who might be willing to pay higher prices for prompt accommodation. On large lots prices are not likely to advance beyond 34 dols. or 34 dols. 50c. There is a great scarcity of old material of all kinds, and brokers in this city are acting under urgent orders for immediate shipments at current prices. The bar mills throughout Pennsylvania and Ohio are making more iron than they have at any time for three years. Refined is selling at 1 dol. 60c. to 1 dol. 90c.; tank iron is 2 dols. 10c.; plate the same; angles, 1 dol. 90c.; girders, 3c. Wrought iron pipe is extremely active for natural gas purposes. Since the earthquake the wells in Western Pennsylvania have been acting rather strangely; in some cases the pressure is increased while in others it has fallen off, leaving some mills with scarcely any supply of gas. This is regarded as inexplicable, because of the fact that the shock was barely perceptible there, and Pittsburgh is 1000 miles removed from the scenes of disturbance.

NEW COMPANIES.

THE following companies have just been registered:—

George Price's Safe, Lock, and Engineering Company, Limited.

This is the conversion to a company of the business of iron safe manufacturer and patentee carried on by Mr. George Price, of Cleveland-street, Wolverhampton. It was registered on the 3rd inst. with a capital of £35,000, in £10 shares, with the following as first subscribers:—

	Shares.
*Herbert Price Lavendar, Wolverhampton, engineer	10
Thomas Fisher, 17, Temple road, Birmingham, solicitor	10
C. Stroud, Penn Fields, Wolverhampton, secretary	10
F. Lavendar, Walsall, manufacturer	10
G. L. Lavendar, Walsall, manager Eldon Works	10
George Price, Wolverhampton, manufacturer	10
*W. Benson, 46, Corporation-street, Manchester, manager	10

The number of directors is not to be less than three nor more than five; qualification, £200 in shares or stock; the first are the subscribers denoted by an asterisk and J. N. Lester and John Thompson. The ordinary directors will be entitled to a commission of 5 per cent. upon the amount of dividend whenever not less than 10 per cent. is declared.

Continental Oxygen Company, Limited.

This company was registered on the 8th inst. with a capital of £150,000, in £100 shares, to purchase certain patent rights (particulars of which are not given in the memorandum of association) upon terms of an unregistered agreement between Arthur Brin and Leon Quentin Brin of the first part, S. W. Cragg of the second part, Henry Sharp of the third part, and the company of the fourth part. The subscribers are:—

	Shares.
*E. Elias, 15, Great Winchester-street, merchant	1
*Henry Sharpe, Poole, manufacturer	1
*Arthur Brin, 59, Brompton-crescent, engineer	1
*J. D. Dewhurst, Manchester, merchant	1
L. Q. Brin, 59, Brompton-crescent, engineer, &c.	1
J. Sharp, Chilworth, Surrey, electrician	1
W. Sharp, 9, Walbrook, solicitor	1

The number of directors is not to be less than three nor more than seven; qualification, fifteen shares; remuneration, £500 per annum for the chairman, and £200 per annum for each other director. The first four subscribers are directors.

Blakey, Emmott, and Co., Limited.

This company proposes to carry on the business of electrical and general engineers. It was registered on the 8th inst. with a capital of £35,500, in £100 shares, with the following as first subscribers:—

	Shares.
E. Blakey, Halifax, electrical engineer	1
W. Emmott, Halifax, electrical engineer	1
J. Lakeman, Leeds, chartered accountant	1
E. H. Fowle, Penkridge, Stafford	1
E. Butler, Leeds, solicitor	1
S. Wilson, Leeds, worsted manufacturer	1
C. P. Spink, Leeds, medical student	1

The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first and act *ad interim*. Directors residing within ninety miles of the place of meeting will be entitled to two guineas to each meeting attended, and those residing beyond ninety miles will receive four guineas. Each director will also be entitled to a further sum of £20 for each 1 per cent. dividend upon the ordinary shares above 10 per cent. per annum, but so that such further sums shall not exceed in the aggregate the sum of £1000 per annum each director. Messrs. E. Blakey and Walter Emmott are appointed managing directors at salaries of £600 per annum each.

Eclipse Button-hole Worker, Limited.

This company proposes to acquire and work the English patent, No. 10,192, of 1884, granted for a self-guiding button-hole attachment to sewing machines. It was registered on the 8th inst. with a capital of £60,000, in £1 shares. An agreement of 7th inst. with the City and Provincial Contract Corporation, of 11, Queen Victoria-street, regulates the purchase. The subscribers are:—

	Shares.
D. C. Laughton, 21, Queen Victoria-street, agent	1
W. H. Chappell, 6, Herne-hill-road, printers' manager	1
C. F. Hinton, 132, Upper Thames-street, agent	1
A. G. Jeakins, 9, Charles-street, Walworth, managing clerk	1
F. G. Dawson, Lower Broughton, Manchester, clerk	1
W. Northcott, 13, Philbrick-terrace, Nunhead, traveller	1
A. Kissam, 37, Walbrook	1

The number of directors is not to be less than two nor more than seven; qualification, £100 in shares; the subscribers are to appoint the first; minimum remuneration, £500 per annum.

Northern Sheet Iron and Steel Company, Limited.

This company proposes, with a capital of £5000, in £10 shares, to carry on, in all branches, the business of ironmasters, iron and steel manufacturers, engineers, machinists, and general contractors. It was registered on the 2nd inst., with the following as first subscribers:—

	Shares.
*C. F. Jackson, Newcastle-on-Tyne, iron merchant	1
*Lieut.-Col. F. F. Sheppee, Chester-le-street, Durham	1
*B. W. Raine, Newcastle-on-Tyne, iron merchant	1
T. Heppell, Bentley, Durham, engineer	1
W. M. Angus, Newcastle-on-Tyne, leather merchant	1
J. E. Lee, Newcastle-on-Tyne, chemical manufacturer	1
F. Goddard, Newcastle-on-Tyne, accountant	1

The number of directors is not to be less than three nor more than seven; qualification, ten shares; the first are the subscribers denoted by an asterisk. Messrs. Richard Carl Cook and John Mowbray Scott are appointed managers. The company in general meeting will appoint the remuneration of the board.

Isle of Man, Liverpool, and Manchester Steamship Company, Limited.

This company was registered on the 4th inst. with a capital of £200,000, in £1 shares, to acquire ships for the conveyance of goods and passengers to and from the Isle of Man. The subscribers are:—

	Shares.
T. Bell, Rumford-street, Liverpool, shipowner	1
C. J. Wise, West Kirby, book-keeper	1
J. S. Russell, 40, Tyrwhitt-road, St. John's, book-keeper	1
J. C. Dixon, 27, Washington-street, Liverpool, master mariner	1
F. Aspinall, 30, Brunswick-street, Liverpool, marine engineer	1
C. Bradburn, 53, Lord-street, Liverpool, chartered accountant	1
J. M. Simpson, 53, Lord-street, Liverpool	1

The board is to consist of two managing and three ordinary directors; qualification, shares of the nominal value of £100. Messrs. T. Bell and F. Aspinall are appointed managing directors, and for their remuneration will be entitled to 2½ per cent. on the gross earnings. Mr. Henry Kelsall Aspinall is appointed general traffic agent at a salary of £250 per annum.

City Steam Laundry, Dyeing, and Carpet Beating Company, Limited.

This company was registered on the 4th inst. with a capital of £5000, in £1 shares, to take over and carry on the cleaning and dyeing business of Mary Simons, late of 65, Brunswick-road, Liverpool. The subscribers are:—

	Shares.
*B. Stream, 73, Berkeley-street, Liverpool, journalist	1
T. J. Rushton, 16, Danbey-street, Liverpool, accountant	1
*W. Thurme, Gleston-place, Liverpool	1
*R. Leach, 4, Johnston-street, Liverpool, joiner	1
*W. A. Brignal, 50, West Derby-street, Liverpool, journalist	1
*F. H. Ropes, Princes-avenue, Liverpool, ice merchant	1
*J. Ansonia, Seymour-street, Liverpool, advertising agent	1

The subscribers denoted by an asterisk are the first directors; remuneration, 5s. each for every meeting attended.

Needles and Alum Bay Pier Company, Limited.

This company proposes to construct a pier or jetty at Alum Bay, Freshwater, Isle of Wight. It was registered on the 7th inst. with a capital of £3000, in £1 shares. The subscribers are:—

	Shares.
J. J. Burnett, Southampton, chartered accountant	50
T. Morgan, Southampton, timber merchant	50
A. Paris, Southampton	50
T. J. Phillips, Southampton	50
C. B. Sheppard, East Cowes Park, Isle of Wight	50
A. W. White, Portsmouth	50
G. J. Tilling, Southampton, rope manufacturer	50

Registered without special articles.

Victorian Cable Traction Company, Limited.

This company proposes to purchase the interests of Andrew Smith Hallèdie and Wm. Eppelsheimer in connection with patent rights for cable traction in Victoria, Australia. It was registered on the 4th inst. with a capital of £5000, in £1 shares, with power to increase. The subscribers are:—

	Shares.
W. H. M. Smith, 2, Victoria Mansions	30
G. Kitson, Weekfield, Windsor	10
E. C. Wickes, 50, Mervan-road, Brixton, manager	1
W. Jackson, 2, Octavia-street, Battersea, clerk	1
W. H. Richard, 201, Great Portland-street, clerk	1
D. McMillan, 2, Victoria Mansions, solicitor	1
W. E. Hinde, Heswell, Cheshire, iron merchant	1

The subscribers are to appoint the first directors, the number of which is to be three.

Steel Frame Carriage Company, Limited.

This company was registered on the 4th inst. with a capital of £50,000, in £100 shares, to trade as carriage builders. The subscribers are:—

	Shares.
J. Garden, 8, Pembury-avenue, Tottenham, secretary to a company	1
N. G. Paterson, 19, Bedford-road, Tottenham	1
R. R. Edmunds, F.C.A., 2, Warwick Villas, Wood-green	1
J. J. B. Campling, Lower Tottenham	1
W. H. Walker, Newcomen-road, Finchley	1
R. Finlayson, 20, St. Augustine-road, Camden-square	1
C. Stuart, 26, Manor-road, St. John's, clerk	1

The number of directors is not to be less than three nor more than seven; qualification, £1000 of capital; the subscribers are to appoint the first and act *ad interim*; the company in general meeting will determine remuneration.

Kidwelly R. Dinas Fire-brick Company, Limited.

This company proposes to acquire and carry on the business of the R. Dinas Fire-brick and Silicate Works, Kidwelly, Carmarthen. It was registered on the 3rd inst. with a capital of £20,000, in £1 shares. The subscribers are:—

	Shares.
A. T. Hughes, 31, The Grove, Camberwell, clerk	1
G. P. Pulling, 17, Fenchurch-street, merchant	1
W. J. Barton, 15, Walbrook, merchant	1
B. Townsend, Chaucer-road, Herne-hill, stationer	1
E. T. Gregory, 18, Walbrook, commission agent	1
A. C. Hubert, Northumberland-avenue, Charing-cross, engineer	1
J. Cartwright, 20, Leyton Park-road, E., clerk	1

The number of directors is not to be less than three nor more than seven. Most of the regulations of Table A are adopted.

ECONOMICAL QUAY WALLS.[1]

THE following is from a paper by E. Pontzen, in the "Nouvelles Annals de la Construction."

"Though the cost of foundations by means of compressed air has been greatly reduced within recent years, there are cases where pile-work foundations are still advantageous. As quay walls must be accessible for vessels, it is impossible to strengthen them like ordinary retaining walls by a large batter on the face, by widening out the foundation at the outer toe, or by a mound of rubble in front. Accordingly, as far back as 1837, the plan of pushing forward the foundation by means of sloping piles was adopted at the Glasgow quays. A similar system, with improvements, has been adopted for the new Rouen quay walls. The bed of the Seine, at Rouen, is about 32ft. below the required quay-level, and a layer of silty sand overlies the hard chalk, which is found at about 25ft. below the river bed. Instead of building a quay wall, 33ft. high, on an unstable foundation, or carrying it down to the solid chalk, a wall, only 18ft. high, has been built upon piles sloping forward towards the front, and reaching down to the chalk. The thrust of the filling for the quay is kept off from the back of the wall by a mound of rubble stone, and by a layer of rubble stone resting upon a platform supported on piles, carried back far enough for the natural slope of the filling behind, going between the foundation piles under the wall, not to protrude in front of the face of the wall. The wall rests upon four rows of piles, of which the three front rows have a batter of 1 in 8; whilst the back row, and the four rows supporting the platform behind, are vertical. The lower part of the wall, for a height of 5⅝ft., is composed of concrete, and is 11ft. wide, and the upper portion is built of rubble masonry, and has a width of 6½ft. at the bottom. The wall has a batter of 1 in 8, and is faced with brickwork. The cost of this wall was about £24 per lineal foot. The latest design of quay wall, which is being now built at Rouen for extending the quays, is similar in construction, but has been carried 3¼ft. lower down, owing to the increasing draught of vessels coming up to Rouen, and in order to allow heavier weights to be placed near the edge of the quay. The concrete is deposited within watertight caissons of beech, 68ft. long, on the top of the piles. The wall is strengthened by iron tie-rods, at intervals of 35ft., bolted to large blocks of masonry, placed about 66ft. back from the face of the wall. The last type of wall costs £25 8s. per lineal foot, exclusive of the dredging for placing the toe of the slope low enough for the anticipated deepening of the channel. The author then compares the Rouen quay wall with the New York quay wall along the Hudson River, as executed since 1876. The New York wall is similar in type, being a slight wall of concrete and masonry, backed with rubble, and resting upon long vertical and sloping piles; but the piles are surrounded by a rubble mound which projects in front of the wall, and the wall, though higher than the Rouen wall, is much thinner at the base, and its lower portion has been built with grooved concrete blocks. The top of the wall is about 35ft. above the bed of the channel, or about the same as at Rouen; but the piles are driven about 20ft. deeper at New York than at Rouen. The cost of the New York wall, after deducting expenses incurred in the removal of old works, was £39 18s. per lineal foot. It is suggested that the experience of Rouen shows that the rubble surrounding the piles at New York might have been safely dispensed with, that the projection of the rubble mound in front of the face of the wall is prejudicial to vessels, and that the cheaper wall of the Rouen type would have been better for New York than the type adopted.[2] It is considered, however, that for a long length of quay the concrete block foundation employed at New York would be more economical than the concrete in mass deposited in frames. The above quay walls are less durable than the Antwerp quay wall, founded on firm ground, at a depth of about 60ft. below quay-level, or intermediate between the depth reached by the foundation piles at Rouen and New York. The Antwerp quay wall, founded by aid of compressed air,[3] is strong enough to resist the thrust of the filling at the back, and also a surcharge of 5 tons per square yard on the quay; but it cost about £93 3s. per lineal foot, or nearly two and a half times the cost of the New York wall, and more than three and a-half times the cost of the Rouen wall. The quay wall at Ghent, founded on firm ground met with at a small depth, cost only £31 9s. per lineal foot. The concrete well foundations of the Ninth Dock at Havre[4] proved an economical system under the special conditions of the site, having cost £34 13s. per lineal foot. Different systems are, accordingly, advisable under varying conditions; but the Rouen type of quay wall has the advantage of enabling quay walls to be extended at ports which, through want of resources, have hitherto possessed inadequate quay accommodation."

1 "Proceedings," Institution of Civil Engineers.

2 The type referred to was adopted, at New York, in places where the piles could not reach a firm stratum. —"Harbours and Docks," L. F. Vernon-Harcourt, p. 427.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

7th September, 1886.

11,340. LOCKS, H. J. Allison.—(*G. P. Whittlesey and D. P. Wright, United States.*)
11,341. JACQUARDS, J. Wild, Halifax.
11,342. PROOFING or STIFFENING HATS, J. and W. E. Webb, Edgeley.
11,343. SAFETY LETTER-BOX, &c., D. T. Ratcliffe, Salford.
11,344. TRAMWAY GRIPPER SLOT POINTS, N. Stretton, Liverpool.
11,345. RETORTS or FURNACES, J. A. Yeadon and R. Middleton, Leeds.
11,346. CARD WINDING MACHINES, F. and T. Brailsford, Leicester.
11,347. VALVE MOTION for DIRECT-ACTING PUMPS, &c., J. E. Hainsworth, A. T. Winn, and W. E. Hainsworth, Dewsbury.
11,348. FASTENING BLINDS to ROLLERS, J. Tennyson, Chester.
11,349. STEAM or other ENGINES, L. Cooper and A. Holt, Ardwick.
11,350. POWER EJECTOR VENTILATORS, J. Hall, Manchester.
11,351. PICTURE HANGING APPLIANCES, &c., E. Coldwell, Huddersfield.
11,352. WOOD COVER for CLAY TOBACCO-PIPE, W. Jenkins, London.
11,353. TIES, BOWS, CRAVATS, &c., J. Ferguson, Bowdon.
11,354. WASHING CLOTHES, &c., C. M. Linley and J. Biggs, London.
11,355. INSULATING CONDUCTORS, O. Imray.—(*W. W. Averell, United States.*)
11,356. RESORCINE BLUE, O. Imray.—(*H. M. Baker, United States.*)
11,357. WEFT FORK and MECHANISM for STOPPING LOOMS for WEAVING, W. C. Priestley, Halifax.
11,358. UTILISING LIGHT and HEAT ARISING from the COMBUSTION of GASES, J. Orchard and H. Lane, London.
11,359. SAVING LIFE from FIRE, H. G. Powell, London.
11,360. HANGING SASHES to admit of CLEANING, &c., G. J. Soper, London.
11,361. STARTING TRAM-CARS, &c., R. O. Gercke, London.
11,362. PADLOCKS, W. J. Richards, London.
11,363. GUNS and PROJECTILES for THROWING LIFE-SAVING LINES, N. C. Pond, M. O. West, and E. Simons, London.
11,364. CRICKET BATS, J. O'Connor, London.
11,365. PORTABLE PHOTOGRAPHIC APPARATUS, H. J. Cooke.—(*J. F. Fetler, France.*)
11,366. DRYING OFFAL and the like, W. P. Thompson.—(*V. D. Anderson, United States.*)
11,367. CAR COUPLINGS, S. A. Kilmer and E. J. Crandell, London.
11,368. JACQUARD LOOMS, W. P. Uhlinger, London.
11,369. RAILWAY CHAIRS, A. J. Boult.—(*H. C. Sintzenich, Canada.*)
11,370. WASHING WOOL, E. Tremsal and A. Dicktus, London.
11,371. VENEERING, H. J. Haddan.—(*C. W. Spurr, United States.*)
11,372. GRAIN CLEANERS, H. J. Haddan.—(*H. Collyer and M. Crawford, United States.*)
11,373. VICES, H. J. Haddan.—(*W. R. Baird, United States.*)
11,374. SPINNING MACHINERY, H. E. Leetham and J. Jones, London.
11,375. CONSTRUCTION of FOLDING, &c, TRICYCLES, G. D. Needham and W. Smith, London.
11,376. ENEMAS and PUMPS, J. Arnold, London.
11,377. TILES for ROOFING, &c., W. Bull, London.
11,378. METALLIC BOXES for STORING FOOD, &c., W. B. Williamson and G. H. Williamson, London.
11,379. VICE PROP, R. Gay, London.
11,380. MANUFACTURE of RIBS, &c., for UMBRELLAS, W. Corder, London.
11,381. PENDULUM COMPENSATOR, R. D. Sanders, London.
11,382. SUPPLYING PREPAID QUANTITIES of LIQUID, G. W. S. Lennox, London.
11,383. SMOKE CONSUMING FURNACE, J. L. Peslin, London.
11,384. CUTTING, &c., FINGER and TOE-NAILS, H. Morrison, London.
11,385. UTILISING the EXPANSION of METALS, F. E. Hainley, London.
11,386. PAPER BOXES, &c., H. H. Lake.—(*G. A. Wilkins, United States.*)
11,387. MANUFACTURE of AXES, &c., E. G. Odelstjerna, London.
11,388. SAFETY RAZORS, H. H. Lake.—(*W. H. Murphy, United States.*)
11,389. SCREWS and NAILS, H. E. Russell, London.
11,390. SONOROUS ALARM, G. Bapst and L. Falize, London.
11,391. ELECTRIC CURRENTS and CABLES, F. Wynne, London.
11,392. MUZZLE, J. G. Trott, London.
11,393. CIGARETTE, &c., CASES, F. Hewson, London.
11,394. MATTRESSES, J. Read, London.
11,395. PORTABLE BED or COUCH, J. Read, London.
11,396. DISTANCE INDICATORS, H. Moon and W. Morgan, Birmingham.
11,397. RAPIDLY BORING and SINKING WELLS or SHAFTS, O. Terp, London.
11,398. SELF-ACTING EXTINGUISHER, P. H. Sherratt, London.

8th September, 1886.

11,399. DRIVING CONNECTIONS for BICYCLES, &c., H. Dalgety, Catford Bridge.
11,400. FASTENER or CLIP, F. W. Martin, Edgbaston.
11,401. VACUUM AIR PUMPS, A. B. Worth, Manchester.

3 "Harbours and Docks," p. 407, and plates 8 and 14.

4 "Minutes of Proceedings," Inst. C.E. vol. lxxxi. p. 361.

11,402. Moving Buffer for Weaving Loom, W. Craven and J. Fielden, Todmorden and Walsden.
11,403. Adjusting the Shafts of Two-wheeled Vehicles, W. Fenn, Northampton.
11,404. Rotary Tip and Heel for Boots and Shoes, H. Williams, Birmingham.
11,405. Connecting, &c., Parts of Velocipedes, P. W. Blackstaffe, Birmingham.
11,406. Removing Obstructions from the Front of Tramway Engines, J. Smith, Birmingham.
11,407. Automatic Fire-extinguishing Sprinklers, J. H. and J. W. Galloway, London.
11,408. Igniting Mixed Air and Gas in Gas Engines, T. Sturgeon, London.
11,409. Drying and Powdering Blood, &c., A. Forrest and W. Welsh, Manchester.
11,410. Automatic Sprinklers for Fire-extinguishing Apparatus, R. Hargraves, Bolton.
11,411. Mats and Hearthrugs, G. H. Seddon, Huddersfield.
11,412. Safety Lamp, R. L., J., and J. B. Short, West Hartlepool.
11,413. Electric Safety Lamps, M. Settle, Manchester.
11,414. Torpedoes, L. Sanderson, London.
11,415. Foot-cycles, A. W. Foster and L. Oxford, Nantwich.
11,416. Furnaces, R. Scott, Newcastle-on-Tyne.
11,417. Automatic Couplings for Railways, J. Bancroft and H. Shuttleworth, Manchester.
11,418. Pattern Mechanism of Looms, T. H. Chadwick, Manchester.
11,419. Propelling, &c., Vessels, G. Chapman, Glasgow.
11,420. Warp Beams for Looms, T. Burns, J. Fowler, and A. Akeroyd, Bradford.
11,421. Seat Adjuster for Two Wheeled Vehicles, W. Howes, Norwich.
11,422. Lengthening, &c., Shafts on Dog Carts, &c., W. Howes, Norwich.
11,423. Cooking Meat in Ovens, A. C. Critchell, London.
11,424. Gas-heated Soldering Irons, R. A. Gilson and W. J. Booer, London.
11,425. Spindles for Preparing, &c., Fibrous Materials, T. Rothwell, London.
11,426. Extinguishing Apparatus for Oil, &c., Lamps, E. Philips, London.
11,427. Waterproofing Cloth, &c., R. Punshon, London.
11,428. Automatic In and Out Gear for Reapers, J. E. Brown, Saxilby.
11,429. Working Slides in Magic Lanterns, C. Lever, London.
11,430. Water-motors, A. Norman and G. L. Pearson, London.
11,431. Transmitting Messages by Magnetism, J. Holloway, London.
11,432. Stoppers for Bottles, &c., H. Barrett, London.
11,433. Engines Actuated by the Explosion of mixed Hydrocarbon Vapour and Air, G. F. Redfern.—(*G. Smyers, Belgium.*)
11,434. Safety Bit for Horses, H. Pfandner, London.
11,435. Constructing Walls, &c., of Temporary Buildings, R. Bucknall, London.
11,436. Holding Together Loose Documents, &c., J. Asten and F. E. Morris, London.
11,437. Applying Igniting Material to Match Sticks, W. Holmström, London.
11,438. Lock Nuts for Srew Bolts, A. B. Ibbotson, London.
11,439. Domestic Fire-blower and Fireguard, G. R. J. Comont, London.

9th September, 1886.

11,440. Tin Funnel for Filling Bottles Rapidly, G. McFarlane, Bangor.
11,441. Smoke Consumer for Gas Globes, F. H. Hardisty, Nottingham.
11,442. Screw Neck Bottles and Stoppers, D. W. Blaxter and S. G. Page, London.
11,443. Oil Cans, H. Lucas, Birmingham.
11,444. Match Boxes, L. A. White, Manchester.
11,445. Binder for Securing Loose India-rubber Tires to Wheels, W. Cook, Headless Cross.
11,446. Dobbies in Looms for Weaving, W. H. Teague and J. Eccles, Halifax.
11,447. Metallic Pistons, R. Tonge, Manchester.
11,448. Furniture Castors, E. French, Birmingham.
11,449. Siphon or Bend Traps, J. Shanks, Glasgow.
11,450. Producing an Optical Illusion, W. Weber and J. Winson, Waterloo.
11,451. Making Lump Sugar, S. Vickess, Liverpool.
11,452. Drying Gelatine Plates, W. Tully, Glastonbury.
11,453. Joiners' Drilling and Boring Braces, W. P. Fox, Sheffield.
11,454. Kitchen Ranges, R. Hunter and J. Turnbull, Glasgow.
11,455. Airing and Beetling Starched Fabrics, D. Macfarlane, Glasgow.
11,456. Vent in Cigars, G. Adie, Newcastle-on-Tyne.
11,457. Repeating or Digital Recording Work in Watches, J. Eshelby, Dublin.
11,458. Automatic Fire-alarm Apparatus, J. H. Lynde, Manchester.
11,459. Fire-lighter, W. Anderson and S. E. Pearse, Gosforth.
11,460. Window Frames and Sashes, T. Robson, London.
11,461. Extraction of the Water Liquid from Sewage, &c., V. L. E. Miller, London.
11,462. "Gradus'" Towel Rack, H. Schooling, jun., London.
11,463. Ratchet Box Spanner, J. Moore, Newcastle-on-Tyne.
11,464. Making Sodium, H. C. Bull, Liverpool.
11,465. Sharpening Card Teeth, C. Roberts and S. Wood, Halifax.
11,466. Regenerative Gas Lamps, J. E. Lewis, London.
11,467. Doubling or Twisting Yarns or Threads, C. Holdsworth, T. Barnes, and J. Hardy, Halifax.
11,468. Clasp for Fastening Shoes, W. H. Munns.—(*J. Heilmann, France.*)
11,469. Stoves or Fireplaces, T. Derichs, F. Weber, and E. Bender, London.
11,470. Pumps, T. Derichs, London.
11,471. Portable Umbrella, A. S. Owen, London.
11,472. Bisulphate of Soda, G. E. Vaughan.—(*A. E. Schuwirth, France.*)
11,473. Brackets for Cable Railways, A. J. Boult.—(*E. D. Dougherty, United States.*)
11,474. Spinning and Doubling Frames, J. Garth, R. Allen, and A. Ferguson, London.
11,475. Paper Bag-making Machinery, A. G. Brookes.—(*C. O. Stearns, United States.*)
11,476. Tobacco Pipe to avoid Nicotine, H. S. Liesching.—(*L. O. Liesching, Ceylon.*)
11,477. Valves and Cocks, W. P. Singleton, London.
11,478. Apparatus for Washing, &c., Linen, J. Eaton, London.
11,479. Coating Pills, &c., W. F. Norman, London.
11,480. Fixing Standards for Dressing Bags, &c., E. T. Wilkins and P. C. Wilkins, London.
11,481. Dyeing Worsted, &c., Fabrics, C. H. Hopps, London.
11,482. Barbed Wire for Fences, H. Dalgety, London.
11,483. Window Sash Fastenings, C. Groombridge and J. P. Rickman, London.
11,484. Cooking Utensil, F. Plaister, London.
11,485. Braces for Trousers, G. R. Holding, London.
11,486. Washable, &c., Wall Hangings, F. H. E. Shipton and J. R. Thame, London.
11,487. Positive Pole Plates for Secondary Batteries, S. Farbaky and S. Schenek, London.
11,488. Horseshoe Nails, C. Gibbs, London.
11,489. Automatic Coupling of Railway Vehicles, W. Tipple, London.
11,490. Combined Looking Glass, Toilet Box, &c., T. Marns, London.
11,491. Preventing Falsification of Bills, &c., A. Schlumberger, London.
11,492. Union Smoker, J. Sykes, Golcar.
11,493. Preparing Colours, A. McLean and R. Smith, London.
11,494. Making Pigments, A. McLean and R. Smith, London.
11,495. Motive-power Engines, J. F. Schnell, Manchester.
11,496. Charging Air with Vapour, &c., J. F. Schnell, Manchester.
11,497. Charging Air with Vapour, &c., J. F. Schnell, Manchester.
11,498. Feeding Bees, F. Shorten.—(*O. Kunert, Germany.*)
11,499. Telephonic Apparatus, H. H. Lake.—(*D. Drawbaugh, United States.*)
11,500. Lockstitch Sewing Machine, A. F. Wileman, London.
11,501. Urinals, &c., G. and S. Jennings, London.
11,502. Water-closets, G. and S. Jennings, London.
11,503. Meat Cutting Machines, T. and W. P. Green, London.
11,504. Staiths for Shipment of Coal, G. Taylor, London.
11,505. Crimping Strips for Boots, &c., J. M., J., A. J., and S. A. Gimson and J. Craig, Leicester.
11,506. Switches for Electric Currents, R. A. Scott, London.

10th September, 1886.

11,507. Joints of Railway Plates, &c., B. Hoyland, Sheffield.
11,508. Shaping Collars and Cuffs, C. H. Felton, London.
11,509. Double-action Air and Smoke Extractor, T. Whitehead, Liverpool.
11,510. Fustians and Cords, W. Wilcock, Halifax.
11,511. Open and Close Arrangement for Kitchen Ranges, W. Nicol and J. Hercus, Edinburgh.
11,512. Collectors or Brushes used in Electrical Locomotion, H. Barcroft, Belfast.
11,513. Ornamentation of Parts of Metallic Bedsteads, F. R. Baker, Birmingham.
11,514. Van Boxes or Cases, D. Rylands, Barnsley.
11,515. Culinary Utensils, R. H. Fletcher and W. Fletcher, Birmingham.
11,516. Looms for Weaving, W. Warrington, Manchester.
11,517. Picture Rods or Rails, T. Pulling, Walmer.
11,518. Sodium Sulphites, J. M. Collett, Gloucester.
11,519. Scoring or Creasing Card or Paper, L. W. Stone, Banbury.
11,520. Miners' Safety Lamp, W. Banks, London.
11,521. Counters, A. Paget and E. L. Paget, London.
11,522. Potable Malt Liquor, J. E. Guild.—(*D. R. S. Galbraith, New Zealand.*)
11,523. Opening Mineral Water Bottles, T. P. Greene, London.
11 524. Combined Hay Drier and Fence, T. S. Winter, London.
11,525. Cleaning Boots and Shoes, E. Buck, London.
11,526. Supports for Candles, &c., B. T. Newnham, London.
11,527. Sewing Machine, F. N. Cookson, London.
11,528. Combined Umbrella or Walking Stick Handle and Box, E. W. Furrell, United States.
11,529. Electric Apparatus for Curing Special Impotence in Males, F. Borsodi, London.
11,530. Notation of Music, A. White, London.
11,531. Stive Rooms, J. Higginbottom and O. Stuart, Liverpool.
11,532. Iron Lasts for Boots, &c., H. Davey, London.
11,533. Grooved Pulleys, E. P. Baville, Liverpool.
11,534. Hollow Wire Springs, &c., W. Sturcke, London.
11,535. Shearing Machine, A. McShain, London.
11,536. Anvils, A. McShain, London.
11,537. Cricket Stump, J. T. Ford, Southsea.
11,538. Burning Mineral Oils, &c., in Furnaces, J. Neil, Glasgow.
11,539. Fastenings for Baskets, &c., E. A. Renaudin, London.
11,540. Nut-locks, S. L. Shellenberger, London.
11,541. Wheels for Carriages, W. Hillman, W. H. Herbert, G. B. Cooper, R. A. Dalton, G. F. Twist, and A. Rotherham, London.
11,542. Ornamentation of Wood, &c., B. Ludwig, London.
11,543. Taps for Measuring Wines, &c., H. Curwen, London.

11th September, 1886.

11,544. Clips or Shears, F. Frielinghaus, Manchester.
11,545. Preparing, &c., Cotton, &c., H. Stevenson, J. Webb, and S. Hallam, Manchester.
11,546. Taps or Cocks, J. Clingan, Glasgow.
11,547. Spinning and Doubling Cotton, T. Ashworth, Manchester.
11,548. Tobacco Pipes, C. Hind and W. Gordon, Southampton.
11,549. Occasional or Folding Bedsteads, F. Hoskins, Birmingham.
11,550. Loading Cartridges for Breech-loading Fire-arms, R. Barker, Whitehaven.
11,551. Telegraphy, W. Lucas and T. A. Garrett, London.
11,552. Trip Expansion Gear of Steam Engines, W. Cameron, Maryport.
11,553. Hall Lamps or Lanterns, H. H. Wright and E. Sarjeant, Birmingham.
11,554. Homogeneous Steel, &c., J. Morley and W. Gaskill, London.
11,555. Vanishing a Living Person from a Chair, J. L. Graydon and H. Hermann, London.
11,556. Moistening Postage Stamps, &c., A. H. Kuhlmann, London.
11,557. Liquid Gum, E. M. Knight, Halifax.
11,558. Coupling for Railway, &c., Vehicles, C. Buckley, Manchester.
11,559. Raising and Forcing Beer, &c., J. Crawford, Glasgow.
11,560. Washing Powder, J. E. Quayle, Liverpool.
11,561. Window-sash Fasteners, W. J. Gibbons and W. Sabell, Birmingham.
11,562. Circular Knitting Machines, E. Newton and A. C. Smith, London.
11,563. Lid Guard, W. Storer, London.
11,564. Packing Cases, W. R. Watson, London.
11,565. Machinery for Paring Hats, &c., H. Polak, London.
11,566. Preventing Tampering with Cheques, W. H. Howorth, Halifax.
11,567. Castors, E. Smith, Blackburn.
11,568. Binocular Glasses, J. J. Wood, Liverpool.
11,569. Construction of Coffer Dams, &c., S. Fox, London.
11,570. Repeating Ball-trap for Shooting Practice, G. H. Hockey, London.
11,571. Musical Notation, A. Galbraith, Glasgow.
11,572. Paper Trimming Machine, F. M. Edmunds, London.
11,573. Fire Engines, A. G. Melhuish, London.
11,574. Electric Gas Lighters, J. Stevenson.—(*M. Dick, Bavaria.*)
11,575. Appliance for Use in Lacing Boots, &c., W. J. Payne, London.
11,576. Gas Engines, A. J. Boult.—(*Count V. de Nydprück and J. D heyne, Belgium.*)
11,577. Appliance for Throwing Life-buoys, &c., C. E. Thompson, Liverpool.
11,578. Scraper for Clearing the Rails of Tramways, B. Treeton, London.
11,579. Manufacture of Crucibles, M. Slade and E. J. T. Digby, London.
11,580. Railway Materials and Stock, P. Dietrich, London.
11,581. Mordant for Dyeing Cotton, W. G. Young, London.
11,582. Stopping Supply of Oil to Lamp Burners, W. and G. Camp, London.
11,583. Purifying Air for Ventilating Rooms, C. H. Jolliffe, London.
11,584. Mechanical Retorts for Destroying Animal Matter, &c., T. Rouet, London.
11,585. Apparatus for Checking the Amount Taken, &c., S. Firth, London.
11,586. Stopping Bottles, A. S. Tanner, London.
11,587. Pair of Suspenders, C. A. Smith and R. P. Marble, London.
11,588. Producing Carbonic Acid, N. Harris.—(*I. Ferinaux, France.*)
11,589. Filter Presses, D. K. Clark, London.

13th September, 1886.

11,590. Indicating Apparatus for Water-closets, E. Banfield, Hove.
11,591. Inhaler, J. F. Boyes, Brighton.
11,592. Self-indicating Weighing Machines, W. Hodgson, Salford.
11,593. Stoppering Bottles, &c., W. Anderson and W. Witham, Manchester.
11,594. Kettle for Quickly Heating Water, A. Ashby and W. Street, Boscombe.
11,595. Raising and Lowering Lamp Galleries, F. R. Baker, Birmingham.
11,596. Lavatories, &c., J. Deeley, Birmingham.
11,597. Frames for Holding Transparent Photographs, &c., R. Mander, Birmingham.
11,598. Curing Bacon, A. W. Shaw, Limerick.
11,599. Leathers of Hats, J. W. Thompson and J. Minshall, Manchester.
11,600. Linings of Copper, &c., Furnaces, A. E. Tucker, Smethwick.
11,601. Oven for Drying Raw Cotton, &c., D. Hall, J. H. Kay, and T. Wagstaffe, Manchester.
11,602. Domestic Weighing Machine, I. and P. Roberts, Bootle.
11,603. Bicycles and Tricycles, W. Andrews, Birmingham.
11,604. Advertising, A. R. Waddell and F. G. Redman, Kidderminster.
11,605. Winches for Sailing Vessels, J. Shaw and J. Hastie, Glasgow.
11,606. Dark Roller Slide for Photographic Cameras, A. Gache, London.
11,607. Fastenings for Window Sashes, R. Lindsay, Glasgow.
11,608. Victor Patent Drawers Suspender, A. Kahn, Liverpool.
11,609. Fore-end for Breech-loading Small-arms, J. Middleton, Birmingham.
11,610. Indicating Speed of Machinery, T. F. Walker and J. G. W. Fairbairn, London.
11,611. Connecting Parts of Electrical Conductors, T. F. Walker and J. G. W. Fairbairn, London.
11,612. Electrical Switches, T. F. Walker and J. G. W. Fairbairn, London.
11,613. Burning of Portland Cement, H. Macevoy, H. Holt, and W. Wilders, Northfleet.
11,614. Ankle-supporting Boots, H. Bradley, London.
11,615. Boxes for Photographic Plates, S. D. Arundel, London.
11,616. Stoppering Bottles, F. Gelder, Sheffield.
11,617. Running the Castings in Steel, C. Shaw, Sheffield.
11,618. Muzzles for Dogs, W. E. Nichols, Birmingham.
11,619. Nest Appliance, J. Chilvers, London.
11,620. Treatment of Excreta for Manure, W. H. Nevill, London.
11,621. Telescopic Ladders, W. W. Popplewell.—(*F. W. Hofele, United States.*)
11,622. Roller Bearings, G., E., and N. Smith, jun., London.
11,623. Safety Oil Cans, T. S. Lyon, London.
11,624. Preventing Diseases, &c., J. G. Claud-Mantle, London.
11,625. Suspending Lamps, D. Deckers, London.
11,626. Faucet Bungs, H. E. Newton.—(*The Marshall Manufacturing Company, United States.*)
11,627. Utilising Waste Heat of Water, E. F. Daniel, London.
11,628. Water or Fluid Meters, &c., J. H. Strang.—(*A. Bonna, France.*)
11,629. Ornamental Cloisonne Work, C. J. Heaton, London.
11,630. Box Striking Plate for Mortise Locks, H. Taylor, London.
11,631. Optometer, L. Courlander, London.
11,632. Compounds for use as Fuel, E. Eich, H. Sepulchre, and J. Pasque, London.
11,633. Automatic Air Valves, D. J. R. Duncan and W. S. Welton, London.
11,634. Measuring Electric Currents, J. C. Serjeant and R. E. George, London.

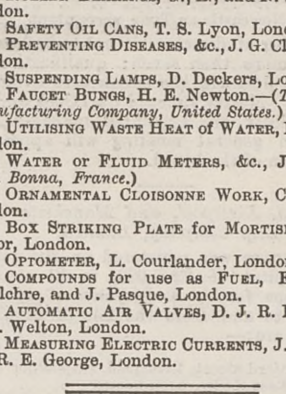
SELECTED AMERICAN PATENTS.

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

344,364. Crank Pin Lubricating Device, *J. Herbert Emery, Charlestown, Mass.—Filed September 19th*, 1885.

Claim.—(1) The combination, with a crank pin and its arms, of a hollow or recessed ring D, and a pipe E extending from the ring D, and communicating with

344,364



an opening in the crank arm, the latter being provided with an exit opening, substantially as and for the purpose specified. (2) The combination, with the recessed ring D and the pipe E, of a valve H, as and for the purpose set forth.

344,806. Alarm Lock, *William G. Bennett, Sharpsburg, Pa.—Filed March 20th*, 1886.

Claim.—(1) In a combined door lock and burglar alarm, the combination, consisting of the shell *a* and bolts *e f*, operated as described, the hammer *p*, actuated by the spring *t*, and a means for setting or securing the same above the receptacle *c* for the cap or cartridge *d*, the receptacle *c* formed at the rear of the lock,

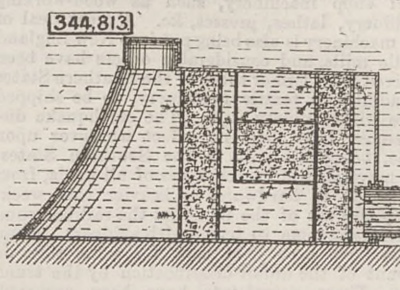
344,806

and recess communicating with the receptacle from the outside of the lock, the vertical projection *i* on the bolt *h*, for closing the key-hole, the inclined surfaces *s r* on the bar *m* and bolt *h*, for releasing the hammer *p*, the projection *o* on the bolt *f*, and corresponding depression *n*, in the bar *m*, as a means for releasing the hammer *p* when the bolt *f* is disturbed, substantially as set forth and described. (2) In combination with a combined door lock and burglar alarm provided with a hammer *p*, and spring *t*, and a means for operating the same by the action of the lock, a thimble t^1, provided with a screw thread, in which the cap or cartridge *d* is placed, and a recess *v*, formed in the rear of the lock, provided with a corresponding screw thread for securing the thimble t^1 therein, as and for the purpose set forth.

344,813. Method of Constructing Waterworks, *Richard H. Bull, New York, and Hayden H. Hall, New Hamburg, N. Y.—Filed February 25th*, 1886.

Claim.—The method hereinbefore described of constructing waterworks, which method consists of laying

344,813

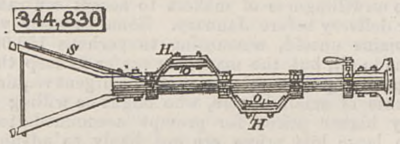


a submarine tube by means of a travelling caisson, which is moved ahead as the tube is built therein, of then fitting the interior of said caisson with a filtering device, and of then admitting water, substantially as described.

344,830 Gang Plough, *Peder Hansen, Fresno, Cal.—Filed March 12th*, 1886.

Claim—(1) The combination of the plough beam, the lateral arms having the section clamps bolted together on opposite sides of the beam, and having the ears projecting from the upper and lower sides of the beam, the plough standards bolted to the lateral arms, the braces R, bolted to the plough standards and to the depending ears, the plough handles bolted to the rear end of the beam, and the brace rod S, connecting the

344,830

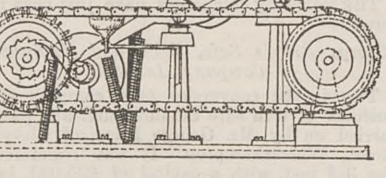


said handles with the upwardly projecting ears of the rearward section clamp, substantially as described. (2) The combination of the hollow tubular plough beam, the lateral arms H, having the curved section, clamping arms provided with the vertically projecting ears bolted together on opposite sides of the beam, the plough standards bolted to the lateral arms, and the clamp plates O, bolted to the said standards and to the lateral arms, substantially as described.

344,837. Safety-pin Machine, *Joel Jenkins, Montclair, N.J., and Elam H. Gaylord, Waterbury.—Filed November 27th*, 1885.

Claim.—(1) The machine organised substantially as described, comprising a device delivering intermittently bits of solder, a reservoir and tube delivering drops of acid, and burner or heating device for melting the bits of solder, in combination with conveying mechanism, substantially as described, for carrying forward and momentarily detaining in reach of each said devices the headed ends of safety-pins placed upon said conveying mechanism, whereby a bit of solder and a drop of acid are automatically delivered upon each pin head, and the solder thereafter fused

344,837

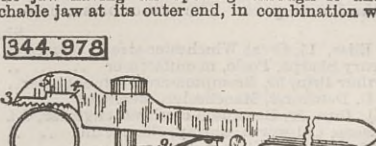


thereon, substantially in the manner and for the purpose herein set forth. (2) The combination, with a solder-feeding device, an acid-feeding device, and a heating device, each constructed to operate substantially as described, of an endless carrier chain constructed of a double set of flat links whose upper edges are notched to receive and retain the wire blanks for safety-pins, and which is made to revolve intermittently in line parallel with the solder device and burner, substantially in the manner and for the purpose herein set forth.

344,978. Pipe Wrench, *Ira Morse, Danbury, Conn.—Filed April 22nd*, 1886.

Claim.—(1) A wrench consisting, essentially, of a bar having a handle at one end and a jaw at the other in line with the bar, in combination with an arm pivotted to said bar, and having at its outer end a pivotted jaw, a threaded pin or bolt adapted to pass through openings in said bar or arm, and a nut adapted to engage the threaded pin or bolt. (2) The bar having a jaw at its outer end, and an opening, 16, through it, in combination with an arm pivotted to said bar and having a similar opening through it, a pivotted jaw at the outer end of said arm, a spring, 12, acting to hold said pivotted jaw in its opened position, and a bolt adapted to pass through the openings in the bar and arm and provided with a nut, whereby the jaws may be adjusted for different classes of work. (3) The bar having a recess 4, jaw 3, having shoulder 5, adapted to engage such recess, and a screw for holding said jaw in position, in combination with an arm pivotted to the bar, and having at its outer end a pivotted jaw, and a bolt and nut, whereby the arm may be closed upon the jaw to adjust the wrench. (4) The jaw having an opening through it and a detachable jaw at its outer end, in combination with

344,978



an arm pivotted to said bar and carrying at its outer end a pivotted jaw, a bolt and nut for compressing said arm upon the bar, and a spring, 9, whereby the arm is held at its farthest open position. (5) The bar having a jaw at its outer end, arm 7, pivotted to said bar, and having at its outer end a pivotted jaw, 10, and a spring, 12, for holding said pivotted jaw to its operative position, in combination with a threaded pin or bolt adapted to pass through openings in the bar and arm, a nut engaging said pin or bolt to move the arm inward, and a spring, 9, adapted to hold the arm against the nut. (6) The bar having a jaw at its outer end whose teeth lie parellel to the plane of the bar, and an arm pivotted to the bar and having a pivotted jaw at its outer end, the plane of said pivotted jaw being at an acute angle to the plane of the upper jaw, in combination with the bolt having a head made angular to prevent it from turning, and adapted to pass through openings in said bar and arm, and a nut engaging said bolt, whereby the arm is moved inward.