STRUTS—THEIR WORKING STRENGTH AND STIFFNESS.

By Professor R. H. Smith.

No. III.

The results calculated and tabulated at the end of Part II. of this paper are represented more intelligibly in a graphic form by the curves of Fig 1.

Twelve curves are drawn out in Fig. 1, corresponding to the 12 values of $\left(\frac{2i}{se}\right)$ of the Table. The curves are extended to $\frac{L}{h} = 500$, because, as said previously, their horizontal ordinates have in use to be reduced in a ratio usually more than 2 and sometimes as much as 10. In each curve of Fig. 1 the value of $\frac{L}{h}$ is co-ordinated with that of $\frac{w}{k}$, each curve being for one special value of $\left(\frac{2i}{se}\right)$. In Fig. 2 the same results are shown in the converse fashion, each curve being for a special value of $\frac{w}{k}$ and in each curve $\frac{L}{h}$ being co-ordinated with the value of $\left(\frac{2i}{se}\right)$. These two sets of curves exhibit graphically in a very complete and clear way the whole theory of the strength of struts of uniform section.

It is to be noted that the curves of Fig 1 show the law according to which the load that can be supported by a given section with a given maximum stress decreases with the length of strut, because with given section the load $L \propto w$ and, therefore, $L \propto \frac{w}{k}$ since k is constant, and also with given section $L \propto \frac{L}{h}$.

These curves may be used in designing by trial and error, but in Fig. 3 a set of curves much more convenient for designing calculations is drawn out.

By help of this other set of curves we can solve the problem *directly* without any trial and error. The necessity for trial and error in using the above curves arises from $\frac{L}{h}$ being one of the ordinates to the curves employed, and this $\frac{L}{h}$ cannot be known until h, the quantity sought, is known. In the following curves $\frac{L}{\sqrt{W}}$ is proportional to one ordinate, and $\frac{k}{w}$ the other. Now, $\frac{L}{\sqrt{W}}$ can be at once found from the known data, and therefore the curve gives by a single direct reading the value of $\frac{k}{w}$. From this, of course, w and $S = \frac{W}{w}$ can be directly calculated. The equations (e) and (g) can be easily thrown into the forms—

$$\frac{s k L}{2\sqrt{W E i}} = \cdot \frac{k}{w} \sec.^{-1}\left\{\frac{2i}{se} \cdot \left(\frac{k}{w} - 1\right)\right\} \quad . \quad . \quad . \quad (e)$$

and

$$\frac{s k L}{\pi \sqrt{W E i}} = \cdot \frac{k}{w} \sqrt{1 - \frac{1}{\frac{2i}{se}\left(\frac{k}{w} - 1\right)}} \quad . \quad . \quad . \quad . \quad (g)$$

The curves in Fig. 3 represent this last form of equation (e). The horizontal ordinates are $\frac{s k L}{2\sqrt{W E i}} =$ say λ, and the vertical ordinates are $\frac{k}{w} =$ say χ. A curve is drawn out for each of a similar but more complete series of values of $\left(\frac{2i}{se}\right) =$ say σ, than those employed for Figs. 2 and 3. The equation represented by the curve is thus, in simple form, $\lambda = \chi \sec.^{-1}\left\{\sigma(\chi - 1)\right\}$ *

On the supposition that the ratio e of excentricity of end thrust to cross-dimension can be fairly guessed, these curves give at once, without any trouble, the solution of the practical problem of strut design, because λ and σ are calculable directly from the data. On the curve in Fig. 3, most nearly corresponding to the given value of σ, take the horizontal ordinate equal to the given value of λ, and read the corresponding vertical ordinate χ. Then, to find the required section S that will secure the occurrence of no greater stress anywhere than the desired k under the load W, all that is needed is the multiplication—

$$S = \chi \frac{W}{k}.$$

All the curves of this diagram are asymptotic, the common asymptote being the straight line $\frac{2}{\pi}\lambda = \chi$ passing through the origin. The different curves approach each other slowly, however, and become very nearly parallel long before they approximately coincide. Beyond the sharp corner, and within the limits of the part of the diagram applicable to common data in practice, each curve coincides with a fair amount of approximation to the straight line

$$\chi = \frac{2}{\pi}\left(\lambda + \frac{1{\cdot}1}{\sigma}\right).$$

* This is the form the author's formula (e) takes. Professor Perry's formula takes the shape $\lambda^1 = \chi\sqrt{1 - \frac{1}{\sigma^1(\chi - 1)}}$, where $\lambda^1 = \frac{s k L}{\pi\sqrt{W E i}}$ and $\sigma^1 = \frac{2i}{se}$.

A little beyond the above limits a close and simple approximation would be

$$\chi = \frac{2}{\pi}\left(\lambda + \frac{1}{\sigma}\right).$$

Each curve starts at the horizontal height $\chi = 1 + \frac{1}{\sigma}$. Thus for each curve may be substituted, without serious error, a couple of straight lines, the first a horizontal one at the height $\left(1 + \frac{1}{\sigma}\right)$, this being continued until it cuts the other line $\chi = \frac{2}{\pi}\left(\lambda + \frac{1{\cdot}1}{\sigma}\right)$. Thus, for calculations that do not aim at much exactitude, it is sufficient to take

$$\chi \geq 1 + \frac{1}{\sigma}$$
$$\geq \frac{2}{\pi}\left(\lambda + \frac{1{\cdot}1}{\sigma}\right),$$

and taking the greater of these two values, apply it to the formula $S = \chi \frac{W}{k}$. It should be remembered, however, that the error of this approximation is in DEFECT, and in using it, therefore, a low value of k should be used. Inserting in $\chi \frac{W}{k}$ the second of these approximations to χ—suitable for long struts—we find the following formula for the section:—

$$S = \frac{s}{\pi\sqrt{i}}\left(L\sqrt{\frac{W}{E}} + 1{\cdot}1\frac{e}{\sqrt{i}}\frac{W}{k}\right).$$

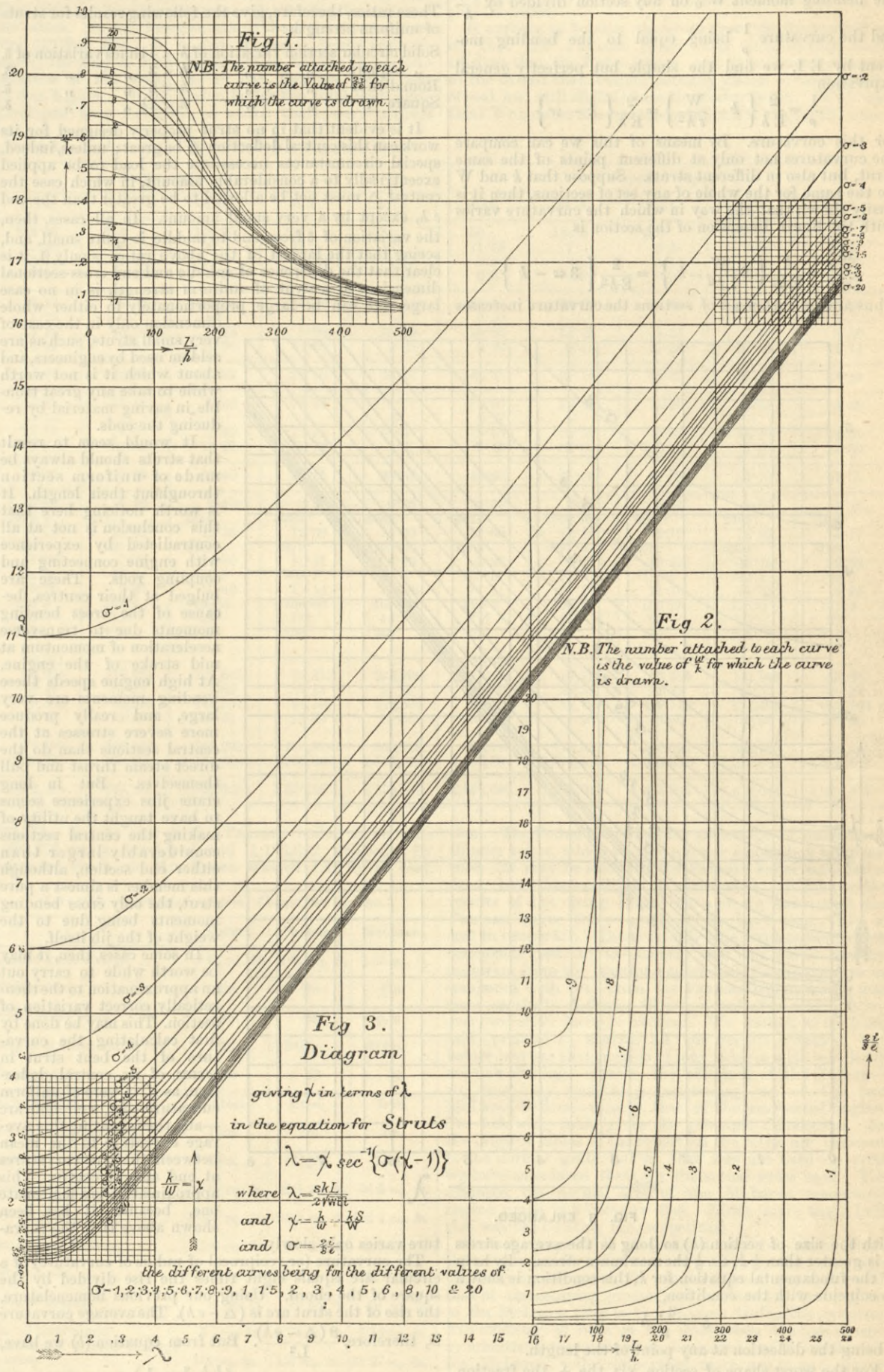
Using these curves, the following solutions of the previously stated examples are obtained:—

$L = 500''$, $w = 10^5$ lbs., $E = 3 \times 10^7$, $k = 10^4$ lbs./in^2, $e = \frac{1}{10}\frac{t}{h} = {\cdot}04$, square tube section.

These data give $\lambda = 1{\cdot}414$ and $\sigma = 3\frac{1}{3}$, and from the curve $\chi = 1{\cdot}53$.

Therefore S = 15·3 square inches, instead of 15, as found before.

The above approximation would, however, give only 13 square inches.



Again, $L = 360''$, W = 120 tons, E = 12,000 tons/in^2, $k = 8$ tons/in^2, $e = \frac{1}{8}$. These data give for

Section I. ▪ $\begin{cases}\lambda = 4{\cdot}157 \quad \sigma = 1\frac{1}{3} \quad \therefore \chi = 3{\cdot}35 \text{ and} \\ S = 15 \times 3{\cdot}35 = 50{\cdot}3 \text{ sq. in.}\end{cases}$

„ VI. ● $\begin{cases}\lambda = 4{\cdot}255 \quad \sigma = 1 \quad \therefore \chi = 3{\cdot}62 \text{ and} \\ S = 54{\cdot}3 \text{ sq. in.}\end{cases}$

„ VIII. ◎ $\begin{cases}\lambda = 2{\cdot}34 \quad \sigma = 2 \quad \therefore \chi = 2{\cdot}12 \text{ and} \\ S = 31{\cdot}8 \text{ sq. in.}\end{cases}$

„ V. □ $\begin{cases}\lambda = 2{\cdot}58 \quad \sigma = 2\frac{2}{3} \quad \therefore \chi = 2{\cdot}12 \text{ and} \\ S = 31{\cdot}8 \text{ sq. in.}\end{cases}$

For the first two of these sections, viz. I. and VI., the approximative formula would give 47·5 and 51·1 sq. in. This approximation is thus seen to be a not very safe guide, unless the strut be a very long one. Its error diminishes as the length increases. Its factor $\frac{2}{\pi}$ could, of course, be modified $\left(\text{to } \frac{2}{3}\right)$, so as to make it safe for

struts of moderate length, but it would then give sections in excess of that required for very long struts.

Struts of Varying Section.

We will now consider struts of varying section, and make an attempt to obtain an approximate rule for designing the variation so as to equalise the maximum compressive stresses in all the sections along the whole length.

$m = (k - w)$, the stress due to bending, being equal to the bending moment W δ on any section divided by $\frac{2\,I}{h}$ and the curvature $\frac{1}{\rho}$ being equal to the bending moment by E I, we find the simple but perfectly general expression

$$\frac{1}{\rho} = \frac{2}{E\,h}\left\{ k - \frac{W}{s\,h^2} \right\} = \frac{2}{E\,h}\left\{ k - w \right\}$$

for this curvature. By means of this we can compare the curvatures not only at different points of the same strut, but also in different struts. Suppose that k and W be the same for the whole of any set of sections, then it is easily shown that the way in which the curvature varies with the linear dimension of the section is

$$\frac{d\frac{1}{\rho}}{d\,h} = \frac{2}{E\,h^2}\left\{ 3\frac{W}{s\,h^2} - k \right\} = \frac{2}{E\,h^2}\left\{ 3\,w - k \right\}$$

Thus among such a set of sections the curvature increases with the size of section (h) so long as the average stress w is greater than $\frac{1}{3}\,k$, *i.e.* $\frac{1}{3}$ the maximum stress. By help of the fundamental equation for k, this condition is shown to coincide with the condition,

$$\delta < \frac{4\,i}{s}\,h$$

δ being the deflection at any point of the length.

For the worst shape of section, viz, the +, the fraction $\frac{4\,i}{s} = \frac{1}{6}$; for the solid circular and square sections it is $\frac{1}{4}$ and $\frac{1}{3}$; for the best sections it equals 1. Clearly, under the most severe working conditions all well designed struts in machines and structures fulfil this condition, so that in them the curvature always increases with the size of section, other things (k and W) being the same. But the rate of increase is very slow, because E is a very large stress (about 30,000,000 lb./in.^{2} for wrought iron) and 2 $(3\,w - k)$ is quite a small stress. In the case of the varying section of a strut of uniform strength at all points of its length, this can be recognised directly from $\frac{1}{\rho} = \frac{2}{E\,h}\left\{ k - w \right\}$. Here the central section is greater than the end section, and therefore, w decreases towards the centre. Thus both $(k - w)$ and h increase towards the centre; and, although their ratio increases, it does so in a comparatively small degree. This same argument might be developed by investigating how δ varies with h when W and k are constant. We find $\frac{d\,h}{d\,\delta} = \frac{1}{\frac{2\,i}{s}\left(\frac{3\,k}{w} - 1\right)}$. For the solid circular section this is $\frac{1}{\frac{3}{8}\frac{k}{w} - \frac{1}{8}}$. For the solid square section it is $\frac{1}{\frac{1}{2}\frac{k}{w} - \frac{1}{6}}$.

For the round tube section it is $\frac{1}{\frac{3}{4}\frac{k}{w} - \frac{1}{4}}$. For the square tube section it is $\frac{1}{\frac{k}{w} - \frac{1}{3}}$. Now, $\frac{k}{w}$ must always be > 1.

These ratios, therefore, give the following results for struts of uniform strength:—

Solid circular section	variation of	$h < 4$	times	variation of	δ.
„ square	„	$h < 3$	„	„	δ.
Round tube	„	$h < 2$	„	„	δ.
Square	„	$h < 1\frac{1}{2}$	„	„	δ.

It is evident that in no strut properly designed for its work can this central deflection $\triangle$ be great; unless, indeed, special circumstances necessitate the load to be applied excentrically to a considerable amount, in which case the central $\triangle$ must not be allowed to be greater than the end $e\,h$, except by a very small amount. In all cases, then, the variation of δ from end to middle is quite small, and, seeing that the largest of the above ratios is only 4, it is clear that the difference of middle and end cross-sectional dimensions of a strut of uniform strength is in no case large. It can be large proportionately to either whole dimension only in the case of very small struts, such as are seldom used by engineers, and about which it is not worth while to take any great trouble in saving material by reducing the ends.

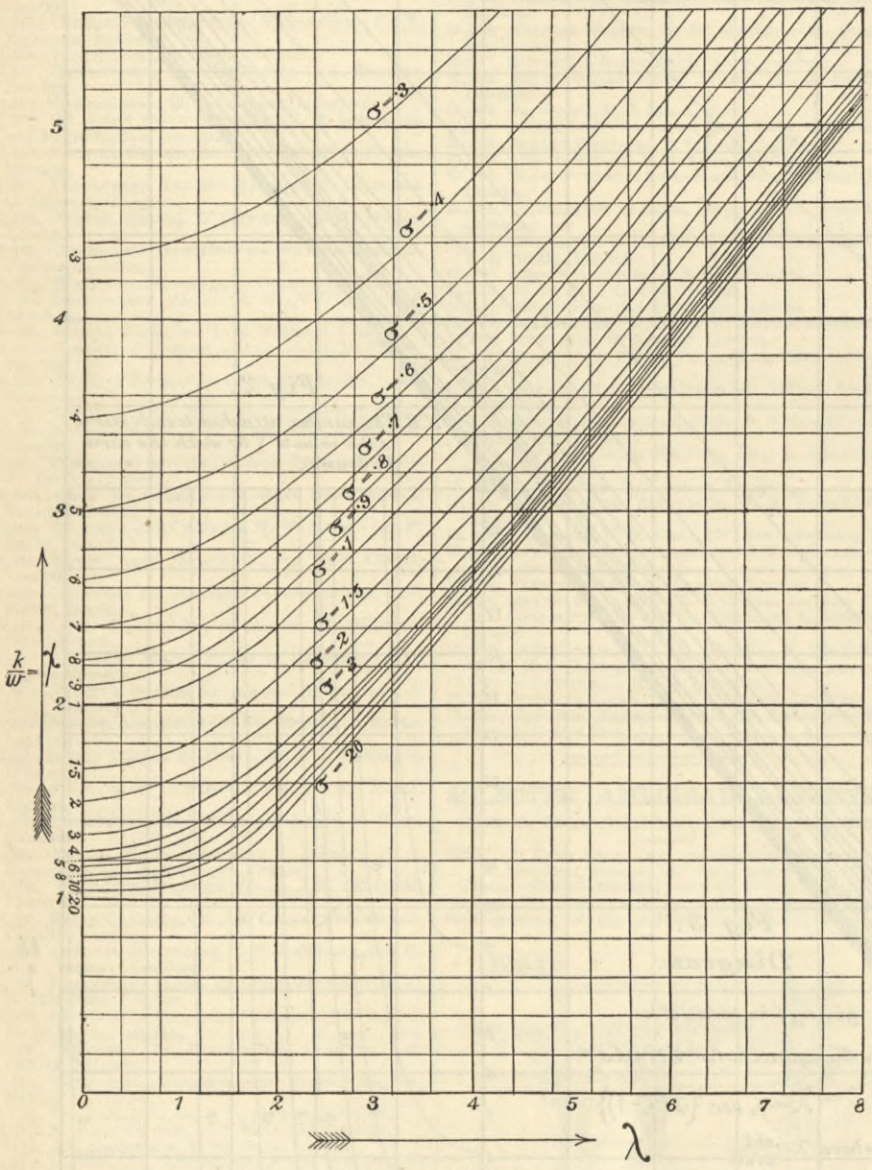


FIG. 3 ENLARGED.

It would seem to result that struts should always be made of uniform section throughout their length. It is worth noticing here that this conclusion is not at all contradicted by experience with engine connecting and coupling rods. These are bulged at their centres, because of the cross bending moments due to transverse acceleration of momentum at mid stroke of the engine. At high engine speeds these bending moments are very large, and really produce more severe stresses at the central sections than do the direct steam thrust and pull themselves. But in long crane jibs experience seems to have taught the utility of making the central sections considerably larger than either end section, although this member is almost a pure strut, the only cross bending moments being due to the weight of the jib itself.

In some cases, then, it may be worth while to carry out an approximation to the theoretically correct variation of section. This may be done by first calculating the curvature of the bent strut in terms of its central deflection, as if it were of uniform curvature—*i.e.*, a circular arc—and then equating this average curvature to the mean between the true curvatures at end and at centre. This approximation is a legitimate one, because it has been shown above that the curvature varies only slowly.

The curvature (or reciprocal of radius of curvature) of a circular arc equals eight times the rise divided by the square of the chord. Using our previous nomenclature, the rise of the strut arc is $(\triangle - e\,h)$. The average curvature is, therefore, $\frac{8\,(\triangle - e\,h)}{L^2}$. But from equation ($b$) we have,

$$\triangle = 2\,i\,h_c\left(\frac{k\,{h_c}^2}{W} - \frac{1}{s}\right)$$

Where h_c is put for the cross dimension of the central section. We have deduced above the value of the true curvature $\frac{1}{\rho}$ at any section. Taking its value at the end (where the cross dimension will be called h_1), and its value at the centre, adding these two and dividing the sum by two, and finally equating this mean to $8\,\frac{(\triangle - e\,h_1)}{L^2}$ with the above value of $\triangle$ inserted; we obtain the following equation in which the only unknown quantity is h_c.

$$2\,i\,h_c\left(\frac{k\,{h_c}^2}{W} - \frac{1}{s}\right) = \frac{L^2}{8\,E}\left\{ k\left(\frac{1}{{h_c}^3} + \frac{1}{{h_1}^3}\right) - \frac{W}{s}\left(\frac{1}{{h_c}^3} + \frac{1}{{h_1}^3}\right)\right\} + e\,h_1 \qquad \text{equation } (j).$$

This is an equation of the sixth degree, but a very little trouble enables one to solve it by the method of trial and error already referred to. In it h_1 is a known quantity. It is to be previously calculated by help of the equation,

$${h_1}^2 = \frac{W}{s\,k}\left\{ 1 + \frac{s\,e}{2\,i} \right\}, \text{ equation } (k).$$

Taking as an example the same data as used before, viz., L = 500″, W = 100,000 lb., K = 10,000 lb./in.^{2}, E = 3×10^7 lb./in.^{2}, square tube section with $\frac{t}{h} = \cdot 04$, and therefore S = ·16 and $i = \frac{4}{300}$, also $e = \cdot 1$; the last equation gives $h_1 = 9$in., and (j) then gives $b_c = 9 \cdot 6$in. This is the same central dimension that equation (g) gave, and equation (e) gave 9·7. This would seem to show that the error involved in the last approximation (j) is *not* in the direction of safety, the dimensions given by it being less than that given by the previous formula. Evidently the central dimensions for a strut of uniform strength should be greater than that for one of uniform section if the end excentricity of thrust be the same in the two cases, because the end sections being diminished, the end portions of the length become more flexible, and the total central deflection must become greater; the central bending moment is thus increased, and a greater section is required for the same maximum stress. But the discrepancy is explained by the fact that in our present example we have taken $e\,h_1$, the end excentricity = ·1 × 9″ = 0″ ·90 whereas in the previous example using equation (e) we took $e\,h = \cdot 1 \times 9 \cdot 7 = 0'' \cdot 97$. In fact, if $e\,h_1$ be taken ·97, the equation (k) gives $h_1 = 9'' \cdot 1$, and then equation (j) gives $h_c = 9'' \cdot 7$. It thus appears that under fairly comparable circumstances the two formulæ give the same central dimension. The struts used in practice require to be so stiff that they bend to a small deflection only, and under this condition it does not much matter whether the central section is calculation from equation (j) or from (e). In either case the end section may be safely found by help of equation (k).

In conclusion, it will be proper to say a few words regarding the factors of safety that should be employed in connection with this method of designing struts. Firstly, so far as concerns k, the maximum stress to be permitted in any part of the material of the strut, there is no reason at all for employing in the above formulas any different k from that that would be considered safe in a short bearing block. That is, no specially large factor of safety is to be applied to the maximum stress considered safe in a long strut. It may, indeed, be remarked that the safe section does not depend on the k chosen to nearly so great a degree as might be imagined, because in $S = \chi\,\frac{W}{k}$ a decrease of k, of course, increases the factor $\frac{W}{k}$, but it at the same time decreases χ since λ is proportional to k This may, perhaps, be seen still more clearly by considering the approximate equation $S = \frac{s}{\pi\sqrt{i}}\left(L\sqrt{\frac{W}{E}} + 1 \cdot 1\,\frac{e}{\sqrt{i}}\,\frac{W}{k}\right)$, in which k influences only the second term inside the brackets.

As regards W, if there be any doubt as to the amount of the load coming on the strut, a liberal estimate of possible excess load must be made in the same way as would be done for a short bearing block or for a tension rod. Here again we should note that the section will not be increased in the full proportion in which we multiply the known load by a factor of safety to get the estimated extreme possible load—inserted as W in the formula. This may be seen from the above approximate equation, or by noting that while $\frac{W}{k}$ is directly proportional to W, still the factor χ decreases as W increases, because $\lambda \propto \frac{1}{\sqrt{W}}$.

There cannot be rational doubt as regards the length of the strut, and therefore although the section varies rapidly with L, there is no reason for inserting a greater L than the known length.

Large struts are usually built up, and even in the case of a plain cast iron column, one cannot depend on the shape of the section being exactly what is intended. Some allowance should be made for inequality in the thickness of the casting for bolt and rivet holes, &c. &c. To make this allowance one may take s a little larger and i a little smaller than correspond to the intended geometrical shape of section.

The safe section depends in an important degree upon the modulus of elasticity, λ being inversely proportional to $\sqrt{E}$. The "known," or intended, modulus should therefore be diminished in a reasonable proportion to allow for possible low elastic quality of the material. From $\frac{7}{10}$ to $\frac{85}{100}$ is probably the range of the factor that should be used for this purpose for cast iron and rolled iron and steel.

It is in choosing the ratio of excentricity e that the most liberal allowance should be made. λ is not affected by the value of e, but $\sigma \propto \frac{1}{e}$. From the curves on Fig. 3 it may be seen that as σ diminishes, the value of χ for a given value of λ increases very rapidly, and thus the section required becomes rapidly larger as e increases. There should therefore be inserted in the formula the most liberal possible estimate of e, or rather an extravagant value of e; what is considered a likely value of the excentricity being multiplied by a factor of safety. It is needless to attempt to define rigorously the proper values of this factor, because the thing itself to which it is to be applied is a matter of intelligent guess-work. Its proper value depends evidently on the style of the end-bearings of the strut and on the quality of the workmanship. It probably varies from 2 to 5 or 6. Owing to the inequalities of the section referred to above, arising from inevitably imperfect manufacture and workmanship, the centres of figure of all the sections do not lie exactly along a straight line. The neutral axes of the sections deviate still more irregularly from the straight line, because

variations of modulus of elasticity from spot to spot in each section throw the neutral axis away slightly from the geometrical centre of figure. For these reasons the deflection from line of thrust to neutral axis varies more or less irregularly along the axis, and not precisely according to the mathematical equations assumed above. It is reasonable to provide against the possibility of these irregularities not tending much to neutralise each other; but on the contrary, on the whole to have rather a cumulative adverse influence in weakening the strut. Allowance for this is to be made in evaluating e; and therefore it seems that for many cases the above suggested factors 5 or 6 may not be too great.

How far the general conclusions of this paper are applicable to struts not free to deflect angularly at both ends, is a subject requiring separate treatment. It is usual to deduce in a somewhat off-hand manner rules for struts "fixed at both ends" and for those "fixed at one end and hinged at the other" from those applicable to struts "hinged at both ends." The writer does not admit that the deduction of the one case from the other can be legitimately made without close and rigorous criticism.

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

No. II.

We may now proceed to compare the boiler of Messrs. Paxman, Davey and Co.'s compound engine with that of Mr. Foden's simple traction engine, with which we dealt in our last impression. The Paxman boiler differs in several important respects from that of Mr. Foden. Its principal dimensions are given in Table II.

It will be seen that the ratio of heating surface to grate area was much less than in Mr. Foden's engine. The tube surface is larger, but Mr. Paxman worked with a grate area of 4·32 square feet, while Mr. Foden worked with a grate area of only 2·63 square feet, or, say a little over 0·6 of the surface used by Mr. Paxman. When we come to compare the grate areas with the indicated power, however, we find that the difference is much smaller. The Foden engine indicated 13·88 horse-power, the Paxman engine 22·77. There was, therefore, omitting minute fractions, ·19 square foot of grate per horse-power in the Foden engine; and again omitting minute fractions, ·19 square foot per horse-power in the Paxman engine. This is a remarkable coincidence. Coming now to the performance of the Paxman boiler, we find that it was on one basis identical with that of the Foden boiler, as far as weight of water per pound of coal was concerned, the evaporative economical efficiency being 12·99 lb. from and at 212 deg., as compared with 12·96 for the Foden boiler. If, however, we compare the actual efficiency, it will be seen that it is considerably in excess of that of Mr. Foden's boiler. The Paxman boiler evaporated 489 lb. of water per hour, or 2·15 lb. per square foot of heating surface per hour, while the Foden boiler evaporated 409 lb. per hour, or 1·93 lb. per sq. foot. The actual heating surface per indicated horse-power was in the Foden engine 15·23 square feet, and in the Paxman 9·44 square feet. The performance of the two boilers was, indeed, very nearly the same, yet the Paxman boiler used nearly twice as much air per pound of coal as did Mr. Foden's. It is very instructive to note the effect this extra admission of air had on the evaporative efficiency of the boiler. Theoretically, it ought to have carried away a large percentage of heat, yet in practice we find that the efficiency of the boiler and its management, assuming the theoretical calorific value of the coal to have been 15·45 lb. of water evaporated from and at 212 deg. per pound of coal was ·840; that of the Foden boiler being ·839, or practically the same. To what is the identical character of the result due? We give here a table of an extremely interesting nature prepared by Mr. Stead. If our readers will turn to The Engineer for July 15th, they will find a full illustrated description of the apparatus used and methods employed by Mr. Stead in dealing with the gases in the smoke-box. The table we reproduce as No. 1, is No. 12 in the Royal Agricultural Society's report. The temperatures are given on the Centigrade scale, and it may be worth while to tell our readers that they can be reduced to the Fahrenheit scale by multiplying the Centigrade by 9, divding the product by 5, and adding 32.

The temperature in the smoke-box of the Foden boiler was 388 deg. Fah.; that of the steam being 350 deg. Fah. That is to say, the former was only 38 deg. in excess of the latter. In the Paxman smoke-box the temperature was 410 deg. Fah., or 44 deg. in excess, being approximately the same as in the Foden boiler, but the excess temperature of the waste gas in the Paxman boiler was 22 deg. higher. In the Foden boiler the total heat units developed were 1,072,565, of which there were utilised 992,775. In the case of the Paxman boiler there were 1,368,705 units developed and 1,172,682 utilised. By using too much air Mr. Foden wasted 1·18 lb. of coal, while Mr. Paxman wasted 12·3 lb. of coal; yet the efficiency of the boilers comes out, as we have shown, practically identical. It remains, of course, to be seen whether by working with smaller air spaces in his grate Mr. Paxman could have secured a higher result. If we deduct the coal wasted in heating excess air from the whole quantity supplied, we have 156 lb. in round numbers, and a simple rule-of-three sum will show that if this weight and no more had been used the boiler would have evaporated 14 lb. of water per pound of coal from and at 212 deg. The Foden boiler cannot be improved in this respect. But of course it is not certain that Mr. Paxman could have kept steam for the power at which he worked with less air, although it is quite probable that he could.

It appears to be clear therefore, from the figures before us, that the Paxman boiler was economically more efficient than the Foden boiler; and it was more efficient to the extent that it could actually afford to waste 12 lb. of coal and still slightly beat the Foden boiler. Why was this? We confess it is extremely difficult to answer the question. The Foden boiler had the advantage of smaller and thinner tubes, which secured a lower smoke-box temperature. It may be said that the Paxman boiler was better fired, but this condition is eliminated. We have the results of the firing before us, and we know that the Paxman boiler threw away, as we have seen, 12 lb. of coal in excess air. There is only one explanation which commends itself to us—namely, that the loss of heat by radiation from the traction engine boiler was excessive as compared with that from the Paxman boiler, which was most carefully clothed. This is a matter to which, however, we shall have to return. We cannot, as we have said, pretend to analyse all the results obtained, but before leaving that portion of our subject with which we are now dealing—namely, the efficiency of the boilers—we must say something concerning one of the two McLaren boilers—namely, that of the compound engine. The following table gives the principal dimensions. In the original tables in the report all the ratios are referred to the normal grate, but as that was not used on trial we have calculated them for the actual grate used. For example, the normal area of the McLaren compound engine grate is 6·7 square feet. Little more than half this was used during the competition.

Certain remarkable deductions can be drawn from these figures. It will, for example, be seen that although the difference between the temperature of the steam and that of the escaping products of combustion was higher in the McLaren than in the Paxman boiler, the evaporative efficiency of both is the same when the loss caused by admitting too much air is eliminated, and this although the McLaren boiler evaporated more water per square foot of heating surface. It was, unfortunately, found to be impossible to take the furnace temperatures; but it seems not unlikely that the fire was hotter in the McLaren than it was in the Paxman boiler. It will be seen that the ratio of the calorimeter was less in the McLaren boiler than it was in the Foden, and much less than it was in the Paxman boiler. The result was, of course, that the gas had to travel faster through the tubes, less time was allowed in the absorption of heat, and the smoke-box temperatures were higher.

We have said that it would take more space than we can spare to deal exhaustively with all the boilers tested. The three which we have selected—namely, that by Mr. Foden, Messrs. Davey Paxman and Co., and Messrs. McLaren—may be regarded as the best, and therefore we have singled them out for comparison. For convenience of reference, we have grouped our calculations, which, as we have said, will not be found in the report of the judges, in one table. They are not carried out to more than two places of decimals, minute fractions being in this case of no consideration.

It must be understood that the weight of steam used per horse-power given in Table II. is calculated, as is the evaporation per hour, on the assumption that the boilers were evaporating from and at 212 deg. As a matter of fact, they were doing nothing of the kind. It is very

Table I.—*Analysis of the Waste Gases Escaping from Boilers.*

		Simple engines.						Compound engines.				
	Catalogue number (see page 720)	3111.	3114.	147.	3108.	3125.	3117.	3115.	3113.	3124.	3107.	3116.
	Total coal charged in lbs.	404·	138·25	113·	199·75	193·	351·	259·	148·5	168·	202·5	249·
2.	Ashes weighed back in lbs.	45·	7·50	21·	6·	10·	16·	11·75	7·	9·5	7·25	19·5
3.	Carbon in ashes in lbs.	32·2	3·12	17·42	—	3·88	4·87	3·54	2·29	3·18	0·83	11·36
4.	Coal minus ashes actually consumed per lb. coal	0·88	0·95	0·81	0·96	0·95	0·95	0·95	0·95	0·94	0·96	0·92
5.	Percentage by volume of the dry gas. Nitrogen	80·15	80·13	80·80	80·92	80·10	80·62	80·15	80·03	80·09	80·67	80·33
6.	Carbonic oxide	0·50	1·25	—	—	—	—	0·30	—	—	—	—
7.	Carbonic acid	7·75	15·75	10·25	7·75	8·90	12·00	10·65	14·25	8·55	7·50	8·50
8.	Oxygen	11·60	2·87	8·95	11·33	11·00	7·38	8·90	5·72	11·36	11·83	11·17
9.	Air	55·24	53·67	42·62	53·95	52·38	35·14	42·38	27·24	54·09	56·33	53·19
10.	Percentage by weight of the dry gas. Nitrogen	75·56	73·23	75·41	76·32	75·10	74·71	74·60	73·45	75·20	76·11	75·46
11.	Carbonic oxide	0·49	1·14	—	—	—	—	0·27	—	—	—	—
12.	Carbonic acid	11·46	22·64	15·04	11·49	13·12	17·48	15·65	20·55	12·61	11·13	12·54
13.	Oxygen	12·49	2·99	9·55	12·21	11·79	7·81	9·48	6·00	12·19	12·76	12·00
14.	Air	53·60	12·82	41·00	52·40	50·55	33·52	40·68	25·74	52·32	54·76	51·50
15.	Carbon in 100 lb. dry gas in lbs.	3·34	6·66	4·10	3·13	3·57	4·76	4·50	5·60	3·44	3·01	3·42
16.	Waste gas, not including excess of air, in lbs.	4467·	1616·6	1177·	2466·	2334·	4282·	3124·	1804·6	2034·	2489·	2932·
17.	Waste gas per lb. of coal charged in lbs.	11·05	11·70	10·42	12·36	12·09	12·20	12·06	12·15	12·10	12·29	11·77
18.	Excess of air, total weight in lbs.	5251·	230·	825·70	2976·	2376·	2165·60	2052·	597·5	2230·	3264·	3169·
19.	Excess of air per lb. of coal charged in lbs.	13·0	1·67	7·31	14·80	12·31	6·19	7·92	4·02	13·27	16·10	12·72
20.	Excess of air in cubic feet per lb. coal	172·9	22·2	97·2	196·8	163·7	82·3	105·3	53·5	176·5	214·1	169·2
21.	Utilised air per lb. of coal charged in lbs.	10·17	10·75	9·60	11·40	11·14	11·245	11·11	11·20	11·16	11·33	10·85
22.	Utilised air in cubic feet per lb. of coal	142·4	150·5	134·4	158·3	156·00	157·30	155·5	156·80	156·25	158·6	151·9
23.	Temperature of air outside	20° C.	20°	17°	24°	18°	18°	18°	24°	20°	20°	20°
24.	Temperature of smoke-box gases	371°	198°	427°	227°	196°	249°	360°	224°	210°	238°	371°
25.	Heat units (Centigrade) lost in escaping carbonic oxide	115,872	50,211	—	—	—	—	28,456	—	—	—	—
26.	Heat units in waste gas, excess of air excluded	381,004	69,924	117,264	121,645	78,315	239,856	259,614	87,723	93,910	131,866	260,087
27.	——— equal to lbs. of coal	*45·9*	*8·42*	*14·13*	*14·65*	*9·43*	*28·89*	*31·72*	*10·57*	*11·31*	*15·89*	*30·13*
28.	Heat units lost in sensible heat in excess of air	444,187	9,866	81,518	145,594	96,199	120,582	169,132	28,799	102,112	171,494	268,164
29.	——— equal to lbs. of coal	*53·5*	*1·18*	*9·82*	*17·54*	*11·59*	*14·52*	*20·37*	*3·47*	*12·30*	*20·66*	*32·30*
30.	Heat units carried away with waste gases and excess of air	825,190	79,790	198,782	267,239	174,514	360,438	428,746	116,522	196,022	303,360	528,251
31.	Heat units used for raising steam, &c.	2,151,962	992,775	599,365	1,390,686	1,396,036	2,513,512	1,663,894	1,097,526	1,172,682	1,370,684	1,446,660
32.	Total heat units developed	2,977,152	1,072,565	797,147	1,657,925	1,570,550	2,873,950	2,092,640	1,214,048	1,368,705	1,674,044	1,974,911

Table II.—*Particulars of three Competitive Boilers.*

	Foden.	Paxman.	McLaren.
Area of grate at trial	2·63 sq. ft.	4·32 sq. ft.	3·39 sq. ft.
Width of bar	$\frac{5}{8}$in.	$\frac{1}{2}$in.	$\frac{5}{8}$in.
Width of air space	$\frac{1}{4}$in.	$\frac{1}{4}$in.	$\frac{3}{16}$in.
Length of tubes out to out	72in.	84$\frac{3}{4}$in.	81$\frac{3}{4}$in.
Number of tubes	76	53	51
Material of do.	Steel	Steel	Iron
Outside diameter of do.	1$\frac{5}{8}$in.	2in.	2in.
Inside do. of do.	1$\frac{1}{2}$in.	1$\frac{13}{16}$in.	1$\frac{1}{2}$in.
Heating surface, fire-box	20·45 sq. ft.	28·1 sq. ft.	34·5 sq. ft.
Do. do., tubes	188·5 sq. ft.	194·2 sq. ft.	180·1 sq. ft.
Do. do., smoke-box	2·6 sq. ft.	4·4 sq. ft.	3·5 sq. ft.
Total do. do.	211·5 sq. ft.	226·7 sq. ft.	218 sq. ft.
Area of chimney	·49 sq. ft.	·49 sq. ft.	·57 sq. ft.
Do. of blast nozzle	3·7 sq. in.	1·76 sq. in.	3·14 sq. in.
Calorimeter or area through tubes	134 sq. in.	137 sq. in.	90·27 sq. in.
Ratio of grate area to calorimeter	2·828 to one	4·54 to one	5·42 to one
Indicated horse-power	13·88	24	22·1
Heating surface per I.H.P.	15·23 sq. ft.	9·44 sq. ft.	9·86 sq. ft.
Do. do. per sq. ft. of grate	80·4	52·4 sq. ft.	64·1 sq. ft.
Coal consumed per hour per sq. ft. of grate	12 lb.	8·7 lb.	13·5 lb.
Total water evaporated per hour	409 lb.	489 lb.	579 lb.
Water evaporated per sq. ft. of heating surface per hour	1·93 lb.	2·15 lb.	2·65 lb.
Water evaporated per lb. of coal	12·96 lb.	12·99 lb.	12·59 lb.
Do. do., if no waste by excess air	13·00 lb.	14 lb.	14 lb.
Water per I.H.P. per hour	26·1 lb.	20·37 lb.	26·3 lb.
Coal wasted by excess air total	1·18 lb.	12·3 lb.	20·66 lb.
Smoke-box temperature	388 deg.	410 deg.	460 deg.
Excess of do. over steam do.	38 deg.	44 deg.	92 deg.

difficult to arrive with precision at the true weight of water evaporated. For reasons fully set forth in the report, the figures in the following table are taken from the report, all but the last, which we have deduced from the others :—

TABLE III.

	Foden.	Paxman.	McLaren.
	lb.	lb.	lb.
Water actually supplied ...	1413	1658	1967
Calculated weight of steam condensed in heating feed...	27	85	51
Condensed in jacket	162	270	280
Total	1602	2013	2298
Water actually evaporated per lb. of coal under the working conditions	11·6	12	11·37

To this must be added the weight of steam condensed in heating the feed and returned to the tub, and that condensed in the jackets. The latter can only be estimated, the former was easily deduced from the rise in temperature in the tub. These quantities are grouped in the preceding table III.; the figures may be compared with those in Table II. It is a very common practice to estimate the efficiency of a boiler as though it evaporated from and at 212 deg.; but it is not quite clear that this gives a true measure of the efficiency of boilers. We see from the figures we have calculated that, although on the 212 deg. basis the Paxman and the Foden boiler were nearly equal, yet that actually the Paxman boiler was more efficient by 0·4 of a pound of water per pound of coal, or say in round numbers, 5 per cent.; and this, as we have before explained, notwithstanding the fact that Mr. Foden wasted no coal in heating excess air, while Mr. Paxman did. Concerning this excess of air the report says:—"The maximum temperature, and consequently the highest duty, will be attained when only the quantity of air theoretically necessary for combustion is used; every addition of air lowers the temperature, and carries off heat wastefully among the hot products of combustion escaping by the chimney. It is obvious from the foregoing that, with a given temperature for the escaping products of combustion, the useful effect will increase as the temperature of the furnace is heightened. The temperature of the chimney, 385 deg., in this case could hardly have been reduced much lower, for the steam temperature was 334 deg., leaving a difference of 52 deg. only. Mr. Foden used less air than any of the other exhibitors. This arose from the precaution he took of closing his chimney damper every time he opened his fire-door. In the peculiar way of managing the furnace always adopted at "trials," namely, of firing very often, laying on small quantities of coal at a time, the fire-doors are open a great deal, and much air enters in that way, never passing through the fuel at all. The effect of this can be easily seen on the thermometer in the smoke-box, for when the door or the ashpan damper is opened, the mercury falls to a considerable extent at once. Had the other exhibitors been as cautious Mr. Foden, still better results might have been attained."

In another impression we shall deal with the efficiency of the engines as distinct from that of the boilers, a subject to which we have not yet referred.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Argentine Republic—Steam communication with Europe.—A concession has been granted by the Argentine Government to Messrs. Houston and Co., of Liverpool, for the establishment of a line of steamers to run from the northern countries of Europe and from the United States to the River Plate. The terms of Messrs. Houston's contract are :—Building ten fast steamers on the most approved principles. The steamers to carry mails, fly the Argentine colours, have a minimum speed of sixteen miles an hour, leave Buenos Ayres and Europe weekly. The first steamer to ply within fifteen months from date of contract, September 30th, 1887, and all the steamers to be finished and at work within two years. Eight naval cadets to be allowed on board each steamer for practical studies, also an Argentine doctor with a diploma ratified by the Republic, an English crew, and a freezing chamber capable of holding 3000 carcases of sheep. The line to be direct, and on the return voyage the steamer may call at other ports. The line to defray the preliminary costs to secure immigration, to consist of Belgians, Danes, Dutch, English, French, Germans, Irish, Norwegians, Swedes, and others to be determined by the Government. Freights for Government cargo to be reduced 40 per cent., except coal and iron, the reduction upon which is to be 20 per cent. In case of war the steamers to be placed at the disposal of the Government, in which case certain arrangements shall be made. The Government, by paying first cost of the steamers, to be allowed to turn them into cruisers or war ships. In return the Government guarantee 5 per cent. per annum on the necessary capital, £1,250,000 for fifteen years. In case of the net receipts reaching 10 per cent., half of that amount is to be handed over to the Government.

Austria-Hungary—Trade of Trieste in 1886.—On the whole, commerce shows the same returns as in the preceding year. There are now many importing houses inland, so that the returns given contain, in addition to the trade of Trieste, that *in transitu*, which increases every year. Added to this, the severe competition between merchants and the usages of the place, which require every transaction to pass through the hands of a broker, considerably reduce the gains, and render it difficult for trade to bring in what it did in former days. The principal articles of British import, among which are chains, coal, hardware, iron, cast, pig, sheet and wrought, machinery, and tinned plates, increased by 12½ per cent. In sewing-machines Great Britain can still compete, though Austria makes a great many, and Germany floods the country with the spurious American article. A new impediment to the import trade consists in the recent Austrian customs tariff, which came into force on June 1st last. Most articles have been taxed higher. This will tell on British imports, especially on cotton seed oil, which was previously admitted duty free, and now pays about 6s. 4d. per cwt. Trieste is continually and quietly seeking new markets, and competes successfully when a footing has been gained. In various articles Trieste maintains her superiority as regards prices in many distant markets, such as Brazil, China, India, and South America. The Austro-Hungarian Lloyd, which has been heavily subsidised by the Government, has done but little towards finding new outlets for Austrian produce and fresh employment for Austrian shipping, as they run no steamers beyond the eastern part of the Mediterranean and the Black Sea, except the Indo-Chinese line, on which the voyages were increased from twelve between Trieste, Bombay, and Hong Kong to twenty-four, to Hong Kong touching at Bombay, Colombo, and Singapore with a branch line between Colombo and Calcutta. The exports to India show a slight increase, which is not in proportion with the larger number of voyages, and still less with the increased tonnage, the reason for which is attributed to heavy competition. It is a pending question whether the Government will continue the subsidy hitherto paid to the Austro-Hungarian Lloyd, or reduce it, either course being a severe loss to the company. Between 1881 and the end of 1885, the Austrian mercantile marine diminished from 581 ships, 280,000 tons, and 6050 men, to 332 ships, 180,960 tons, and 3380 men—decreases of 42·8, 35, and 44·2 per cent. The reason for this is that nowhere has so little been done to replace sailing vessels by steamers, and Austria would have scarcely any were it not for the Adriatic and the Austro-Hungarian Lloyd Companies, who own all the sea-going steamers except two or three. The proposals made to improve the position of shipping in the two parts of the empire differ. Austria continues the yearly bonuses on construction and navigation—including small coasting vessels, even if bought or built abroad. Hungary proposes paying to the shipbuilders the whole amount due on construction at once, as otherwise it would reduce the freights and benefit the shippers; excluding foreign built vessels and overlooking coasters, which they consider insignificant and daily receding before steamships. Another means of communication which has not had time to show the amount of encouragement it will give to Trieste commerce is the Trieste-Herpelje Railway, opened in last July. The distance gained on the journey inland is 8¾ miles, and towards Istria, and the only naval part in Austria, 23½ miles, thus reducing the distance between Trieste and Pola from 92 to 68½ miles. The principal difficulty overcome in the construction of the line is the heavy ascent, the station at Herpelje being 1602ft. above that at Trieste. The medium gradient is 1 in 40, and in some places the slope is 1 in 30·6. The sharpest curve has a radius of 590ft. There are four bridges, four short bridges, over roads, five tunnels, and seven viaducts. The rails weigh 21 and 23 lb. per foot. Many projects for prolonging the Divazza line to Laak, on the Laibach-Tarvis line, have been brought forward, but none has been sanctioned by the Government.

Hayti.—Commercial prospects.—The United States Consul-General at Port au Prince reports:—For the present fiscal year there is a possibility of an augmentation in business, there being every reason to expect a fair coffee crop—the staple export of the country. Agriculture is in a very rudimentary stage, the natives persisting in working on the same principle as in the times of the old French colony, and using for agricultural implements the cutlass, hoe, and indigo knife. The prolificacy of the soil is astonishing. With attention any fruit or vegetable could be raised, and could some enterprising house send out an agent to study the wants of the South American trade, or if parties conversant with them would give attention to this field, a lucrative business might be opened in agricultural implements, especially such as are adaptable to mountainous regions; but they must not be at all complicated, or great results cannot be expected, as they will not be serviceable to people unpractised in their operation. A great many light vehicles are imported and extensively used. Carriages are run for public hire. Buggies are becoming very popular with business and professional men. The roads are very bad and filled with stones, but dogcarts, landaus, and phaetons are making their appearance, the majority of all conveyances coming from the United States. It is lost sight of in preparing catalogues that the language of this country is French, and although Guadaloupe, Hayti, and Martinique, are the only islands where French is universally spoken, it would pay to cater to this trade. As an example of the beneficial results of meeting the wants of the native customers here, the trade in American cotton goods has during the past two or three years considerably increased, and is beginning to take a firmer hold in this market, hitherto monopolised by English goods. This has in a measure been brought about by the untiring efforts of the head of an American house doing business here, who has studied and had goods prepared especially for it. A contract for the construction of a railway from the city of Gonaives to Gros Morne, a distance of about twenty-four miles, with its eventual termination at Port de Paix, and to be completed in twenty-eight months, including laying the rails to the wharves, so as to communicate directly with vessels loading, has been made with a French firm, who some years ago sent engineers exploring into that part of the country, and who evidently found the conditions particularly profitable for the scheme, as ever since they have been striving to get the concession. The only subvention given by the Government is the wood found in a parallel of 6½ miles in the public ground of the State on both sides of the line. It is said that the country through which the line will pass abounds in forests of the finest logwood and mahogany, which, owing to there being no mode of transporting them to the seaports, could not be utilised for exportation. Such an enterprise embodies significant results. If successful, it will be the means of causing similar lines to be laid at available points, and thus open up the exportation of articles such as Brazil wood and other valuable woods having a market value, which are now unavailable for want of roads and means of transportation to the seaboard cities. The need of this country for its certain progress is foreign industry, its indefatigable enterprise and muscle. The island is free from epidemics of all kinds, and there is no appearance of malignant disease, so common during the hot months in the tropics. It should be noted by those contemplating business relations with Hayti that Europeans cannot own real estate there.

Mexico—Port and trade of Veru Cruz.—The merchants of this State exhibit considerable alarm as to the future prospects of the commerce of Vera Cruz, the only considerable port in the Republic, caused chiefly by a reduction in the freight on the northern railways, which are about to carry goods at an average rate of 1½d. per ton per mile, while the rates on the Vera Cruz, Mexico—English—range from 4½d. to 7½d. per ton per mile. Another ground for alarm is the approaching completion of the railway from the port of Tampico, on the north of the State of Vera Cruz, to join the existing line Mexico-El Paso. If this line should be worked on the usual low American rate of 1½d. per ton per mile, it will give Tampico an enormous advantage over Vera Cruz with its costly and solitary line of railway, notwithstanding the Tampico-Mexico line is nearly three times as long as the Vera Cruz-Mexico. A further cause for alarm is the belief prevalent here that a syndicate of American capitalists is about to establish in the Brazos de Santiago, near the frontier of Mexico, a port with bonded warehouses for the express purpose of supplying that country. If this is done the consequences for Vera Cruz will be most serious. Through there being no bonded warehouses and the high rate of import duties, local merchants cannot afford to hold large stocks, and order their goods as they require them from Europe or New York, and consequently their customers have to wait a long time before they get them. The merchants say, if customers can buy goods out of bond just across the frontier and have them quickly delivered by the cheap North railways, they will leave off buying goods *viâ* Vera Cruz from Europe and New York which cannot come quickly nor be delivered cheaply. The remedies proposed by the merchants are :—The substantial reduction of the rates on the Vera Cruz-Mexico Railway, or, failing that, the immediate construction of a rival line *viâ* Jalapa and Puebla ; the energetic prosecution of the breakwater for inclosing and protecting the harbour ; the conversion of Vera Cruz into a free port. The Mexican Railway Company has since the commencement of the agitation made some concession by reducing the freight of heavy goods from 7½d. per ton per mile to 4½d. and 5d., between Vera Cruz and Mexico, on an entire wagon load. The merchants rightly consider that concession altogether inadequate to the situation. A rival line is not so impossible as the Mexican Railway Company thinks. Their line, owing to its being built during political troubles and from both ends at once, cost £8,000,000, or three or four times the cost of building a line *viâ* Jalapa and Puebla from Vera Cruz to Mexico. Sections of such a line have been partially constructed, and now that political troubles are over, the capital for its completion might be obtained with much less difficulty than formerly. In a war of tariffs with the Mexican Railway, the new line, owing to its smaller capital, would be better able to bear the brunt of the battle. Any such war would be short, as the rival line taps districts not served by the Mexican Railway ; the great struggle would be for the through freight Vera Cruz-Mexico, and the cheaper constructed line would doubtless have that. The near or remote future of the completion of this rival line depends upon the policy of the Mexican Railway Company with regard to reducing their rates. The harbour works have been undertaken by Mr. A. Cerdain, a native of Vera Cruz, who is carrying them out with energy, and who may be depended upon for the punctual performance of his contract. The most important of the proposed remedies is that of making Vera Cruz a free port, and the suggestion has been warmly seconded by individuals, the local commercial traders, and press. The advantages claimed for this course are—abolition of smuggling, larger consumption of dutiable goods, more economical collection of customs duties, much shipping attracted that now avoids Mexican ports altogether, rapid communication between the capital and coast. It is contended that the only loss the Federal Government would sustain by adopting the proposed measure would be the import duties on foreign goods consumed by the 22,000 inhabitants of the port, a number insignificant compared with that of the Republic—10,000,000. Looking at the present crisis as a disinterested and impartial observer, it is evident that the prevailing alarm is neither exaggerated nor groundless; and should Vera Cruz fail in getting declared a free port, and in getting much cheaper communication with the capital, her foreign commerce will be diverted to the north, and she will sink into a coasting port. The advantages that would accrue to British and European commerce by the declaration of Vera Cruz as a free port are too obvious to require detailed consideration. It is difficult to estimate accurately the chances of success the proposal may have, but its supporters can adduce very strong arguments in its favour, and have considerable influence with the Federal Government.

Russia—Railway rates.—The Emperor has given his approval to the decree of the Council of the Empire laying down the principle that the State shall, for the future, regulate railway rates; but no project has been elaborated to give effect to the decree.

Russia—Iron and steel direct from ore.—A new process for producing iron and steel direct from the ore has been invented and patented by a Russian engineer, which will create a revolution in the manufacture of charcoal iron. Under the new process iron ore, after being submitted to the ordinary smelting process, is taken direct from the furnace to the rolling-mill and turned into thin sheets of the finest charcoal iron. There are at least three furnaces in this country fired with charcoal-making iron with perfect success. "Whether the process can be applied with equal success when coke is used for fuel I cannot positively assert; but I am assured that an experiment has been made with coke for a fuel which has been equally successful." The secret of the process is in the construction of the furnace, which is inexpensive and simple.

Servia—Hungarian goods in Belgrade.—It has been decided that an attempt in the direction of establishing sample rooms in the eastern parts of Europe, with the view of developing Hungarian trade, should be made at Belgrade. An establishment will shortly be opened there for bringing specimens of Hungarian industry to the notice of the Servian public. Among the goods for which it is mainly hoped to procure a market in Servia are hardware and iron. A superintendent will be appointed to represent the trades interested, and be the medium of dealing with intending purchasers; and it is probable that the scheme will be furthered by a reduced tariff for goods transported on the State railways.

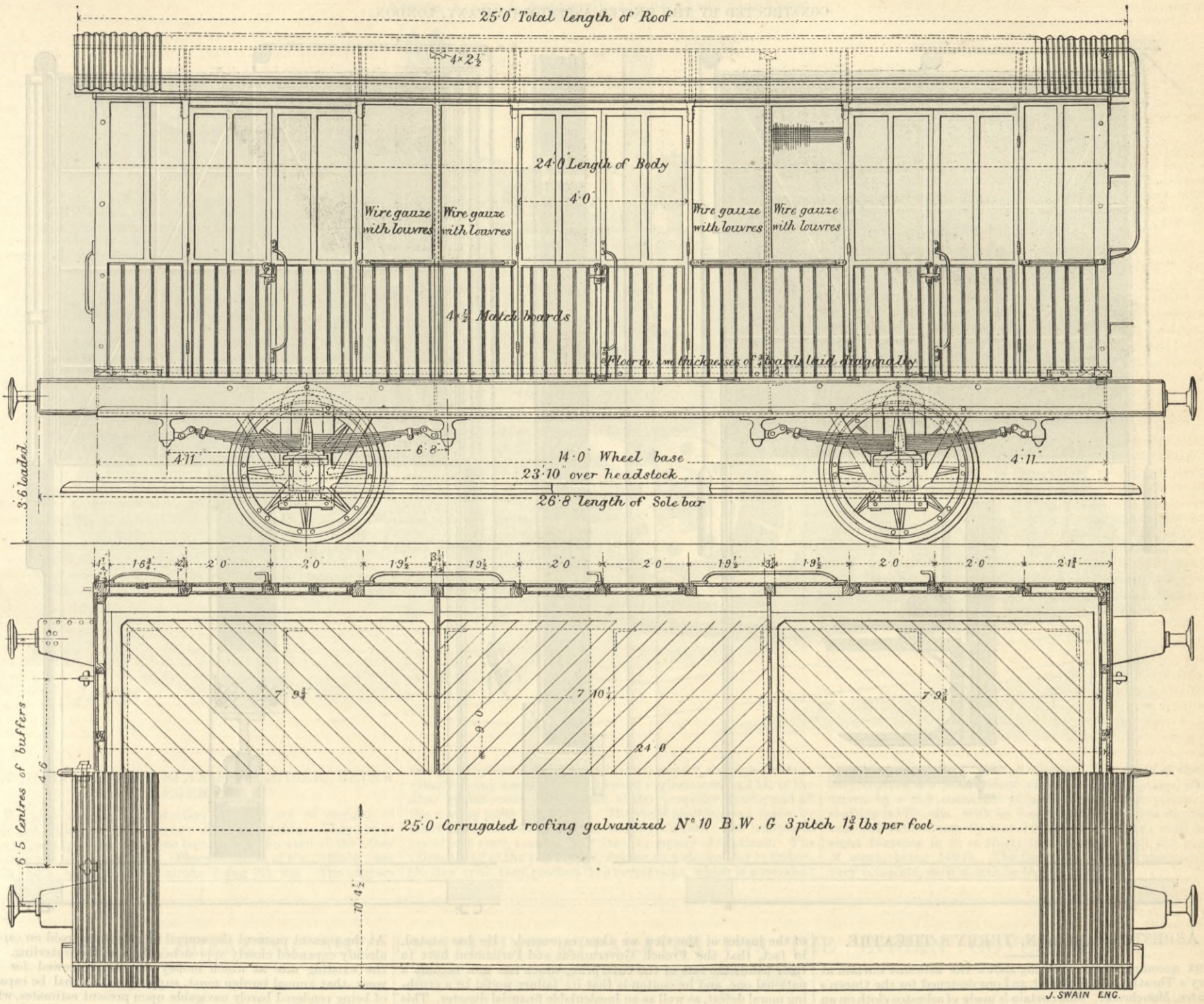
Sweden — General export union. — The funds required for carrying out the objects of the association have been collected and advertisements have been issued asking for agents to go to Australia, the La Plata States, and Spain, to forward in those countries the interests of Swedish firms and manufacturers. The agents will be paid partly by commission and partly by salary.

Sweden—Infusorial earth at Stavanger.—A considerable number of pits of infusorial earth containing from 85 to 95 per cent. of silica, and which are said to be so pure in quality as to be available for most purposes merely after desiccation, have been discovered in the neighbourhood of Stavanger, a seaport town on the Bukkefiord, 100 miles south of Bergen. Capital is being sought for the working of these deposits, which are estimated as being capable of yielding 523,210 cubic yards of that rare product.

ECONOMIC THEORY OF THE LOCATION OF RAILWAYS.—In the notice of this book in our last issue the number of pages is given as 350; this should be 950 pages.

THE EIGHTY-POUND GATLING.—Members of the United States Ordnance Board and United States Treasury officials, November 5th, inspected the newest model of the Gatling gun. The gun exhibited is one designed more especially for use against mobs in cities. It weighs less than 80 lb., and could be transported easily in and fired from police patrol wagons. Dummy cartridges were fired by the operator at the rate of 1200 a minute, and ranges from 500 to 3000 yards have been tried satisfactorily. The gun, while being fired, was lowered and elevated to extreme angles, and also moved in a semi-circle. The action was easy and regular.

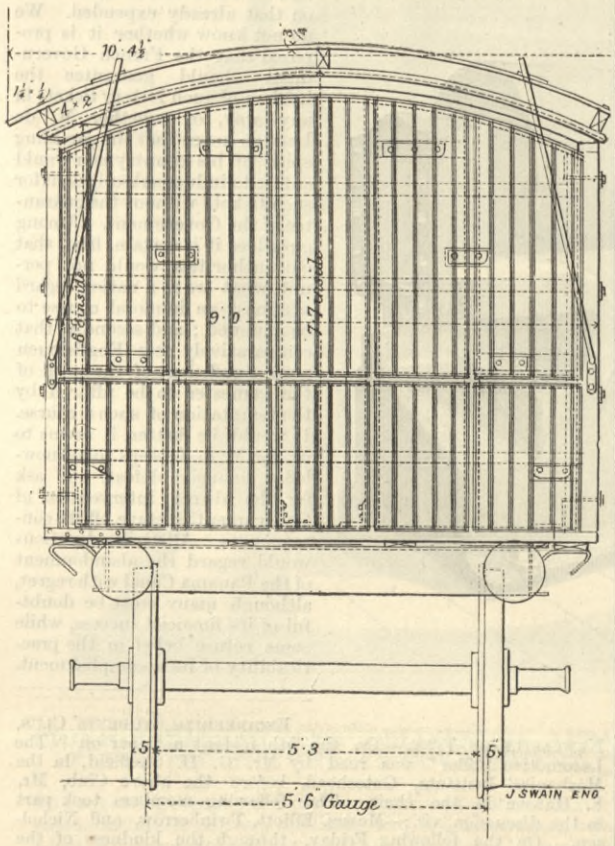
CONTRACTS OPEN—TRANSHIP VANS, INDIAN MIDLAND RAILWAY.



CONTRACTS OPEN.

THE INDIAN MIDLAND RAILWAY COMPANY.—SPECIFICATION OF CARRIAGES, BRAKE-VANS, &c., FOR 5FT. 6IN. GAUGE.

THE contractor is to make and deliver for the above company, in all respects complete except the wheels and axles, springs and axle-



boxes, the following:—Twenty tranship vans to Indian Midland Railway, drawing No. 347; sixteen composite carriages—third and brake compartments—to drawing No. 346, including all timber, steel, and ironwork required, according to the particular terms and conditions herein contained and the contract drawings, copies of which may be had on payment, or according to such modification thereof in form, dimensions, or quantity of any part, or the whole of the work, as the consulting engineer may in writing direct. Every such modification is to be deemed to be within the specification for the purposes of the tender, and in all cases where such modification affects the cost of the work the consulting engineer shall determine whether it adds to or reduces the cost, as well as the amount that shall be added to or deducted from the contract price. The contractor shall supply all parts scheduled or shown on the drawings, or which may be inferred therefrom.

Any plates that require bending, cranking, or working, shall be first brought to a proper heat and then worked to the required form, and any piece which is overheated, strained, distorted, not straight on the edges, or discovered to be in any way unsound or imperfect, will be rejected, and must be replaced at contractor's expense. Bolts and nuts to be of best best Staffordshire iron. All nuts are to be as shown, and must fit so tightly that they cannot be turned by hand, screwed to Whitworth's standand. Every piece of iron or steel is to be made so accurately that it may be used without dressing of any kind in the place for which it is designed in any of the vehicles. The timber, where specified, must be of best Moulmein well-seasoned teak. Parties tendering must be prepared to satisfy the consulting engineer that the scantling and the panels have been seasoned for at least twelve months.

The body of the van is to be as shown on the drawing. It is to be divided into three compartments, each of which are to have folding doors on each side, furnished with iron bolts and necessary fastening as shown. The doors are also to have handles, locks, private locks, and are to be hung on three brass hinges. There are also on each side of each end compartment to be one, and in the middle compartment two, openings, provided with teak louvres covered with copper wire gauze as shown. The upper roof is to be made of corrugated iron, the lower roof and the inside generally is to be similar to the luggage compartment of passenger brake van. The exterior of the van is to be similar in style with the passenger brake van. Commode handles are to be provided as shown. The consulting engineer and the locomotive superintendent in India named in this specification and in the tender shall extend to mean those officers respectively for the time being. All the rest of the specification as usual. Tenders are to be in by noon on the 2nd of December, 1887.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Changing railroad gauge.—The narrow gauge has been recently widened to standard gauge on the Ohio and North-Western Railroad and the Bedford and Bloomfield division of the Louisville, New Albany, and Chicago Railroad; this division extends from Bedford to Switz City, Ind., forty-three miles; the remainder of the narrow-gauge portion of the L., N. A. and C. system will be changed in the spring.

The Westinghouse brake.—The result of the suit between the parties controlling the Westinghouse and Carpenter brakes being an injunction against the latter, an attempt was made to permit Carpenter to give bonds instead of being enjoined, and to continue using his air-brake coupling and filling contracts for the same. This was overruled, and the injunction was issued. This sustains the validity of the Westinghouse patent, and prevents the use by Carpenter of his coupling.

The teredo.—Recently the harbour engineer of San Francisco, Cal., made examinations of piles driven some years ago with anti-teredo coatings. Eucalyptus and cedar piles driven in 1882 were almost destroyed, and a pile driven at the same time, and coated with Pearce's compound—a mixture of paraffine, limestone, kaolin, &c.—was found to be completely honeycombed.

Iron operations in Georgia.—A Pennsylvania syndicate has been purchasing iron ore lands in Georgia, and has secured 20,000 acres, besides having options on several thousand more. A railroad will be built to Chattanooga, furnaces will be erected, and the property developed. Hon. Charles Dougherty, of Florida, is largely interested.

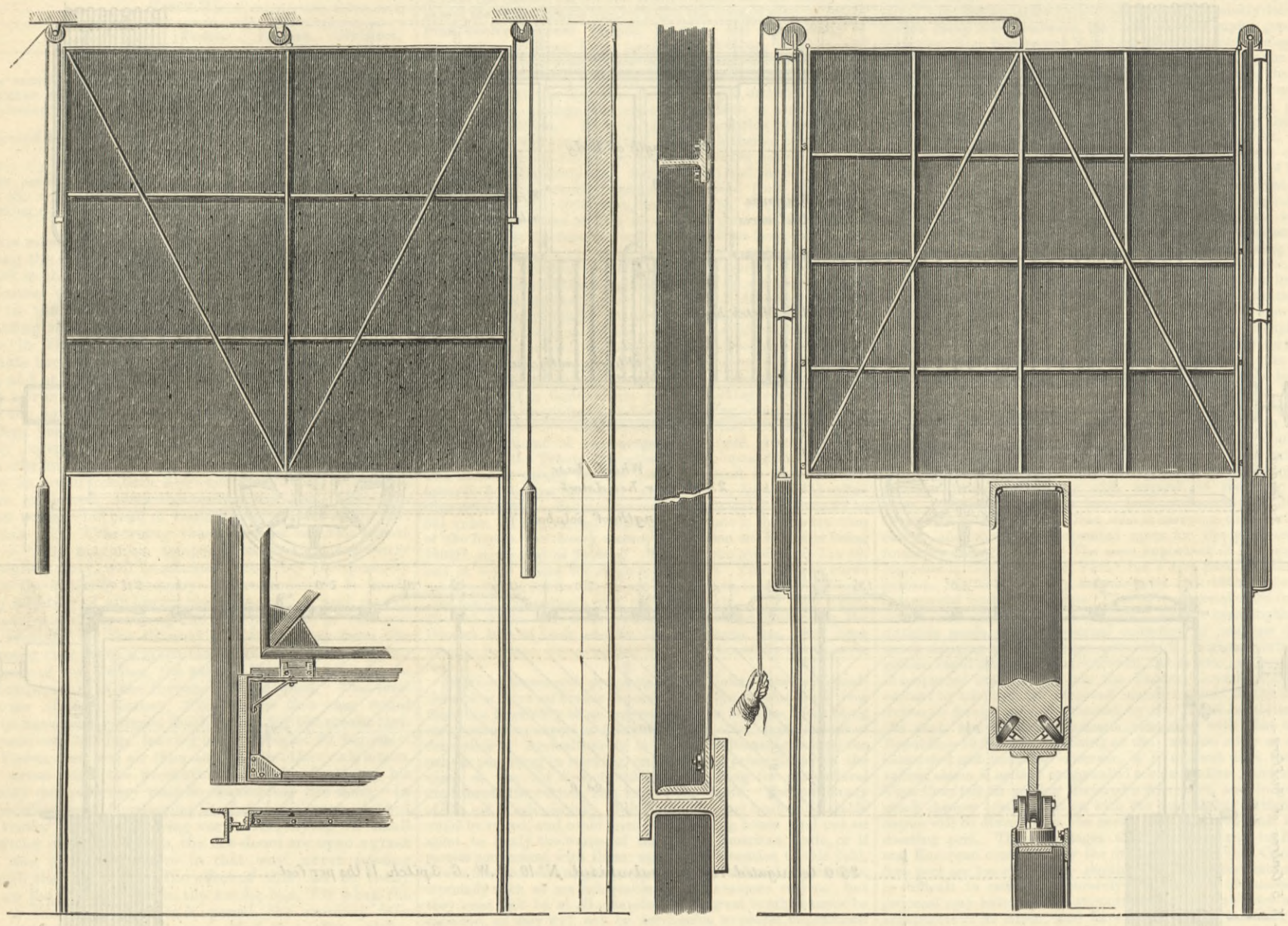
The U.S. Navy.—The bids for the construction of a first-class torpedo boat were from the Herreshoff Company, of Bristol, R.I., 82,750 dols.; Vulcan Ironworks, Chicago, Ill., 84,800 dols. As the former company built the phenomenally fast boats Stiletto and Now-Then, there will be no doubt about their giving the required speed of twenty-two knots per hour. Admiral Porter, in his annual report to the Secretary of the Navy, urges the construction of a squadron of heavy ironclads, and an immediate attention to the matter of coast defences, nearly all the principal ports and harbours being entirely defenceless against a modern ironclad. He also points out the almost impossibility of combining the qualities of an efficient marine engineer and naval officer in one man.

Another Transcontinental railroad system.—A new transcontinental line has been formed by an alliance between several roads, and will be in operation about the beginning of 1888, as soon as the Duluth, South Shore, and Atlantic Railroad completes its extension. The main alliance is between the New York Central and Hudson River Railroad, Michigan Central Railroad, Duluth, South Shore, and Atlantic Railroad, and Northern Pacific Railroad. The Canadian Pacific Railroad will build a line to connect with the Duluth, South Shore, and Atlantic Railroad at Sault St. Marie, Mich.; and the Milwaukee and Northern Railroad will connect with the same line at Republic, Mich.

Omaha and Council Bluffs Bridge.—The new bridge across the Missouri river between Omaha, Neb., and Council Bluffs, Ia., has been opened. The bridge is of steel, and has ten spans; four through trusses of 250ft. span, and six deck spans (three at each end) of 125ft. The width is 54ft.; in the centre are the two railroad tracks, with a 7ft. roadway, and a side-walk on either side. The height above low water is 66ft. The bridge was designed by Mr. Geo. S. Morison, M. Am. Soc. C.E.; and Mr. W. H. Parkhurst, was the engineer in charge of construction; the latter having the misfortune to break his leg soon after the commencement of the work, was succeeded by Mr. G. A. Lederle. In 1866 a bridge was authorised by Congress, and the bonds were sold in England. The contractors were greatly delayed, and finally the Union Pacific Railroad Company annulled the contract and did the work with its own staff, completing the structure in March, 1873. It was an iron, single track railroad bridge, without roadway. Its length was 2752ft., in eleven spans. This structure is replaced by the new bridge, work on which was commenced in October, 1885, and of which the estimated cost is 900,000 dols. At the west end of the bridge is a bronze shield, while the east end is decorated with a massive bronze buffalo head, surmounting a stone arch, which forms the entrance to the bridge proper.

ASBESTOS THEATRE CURTAINS.

CONSTRUCTED BY THE UNITED ASBESTOS COMPANY, LONDON.



ASBESTOS CURTAIN, TERRY'S THEATRE.

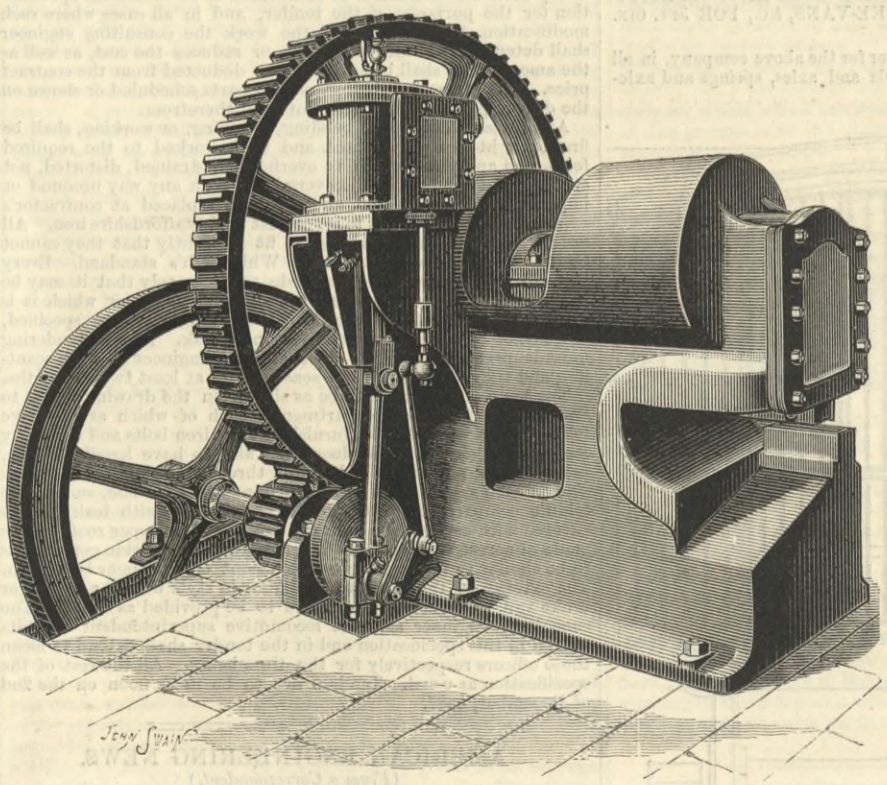
The accompanying engraving shows the asbestos curtain at Terry's Theatre, in the Strand, and one designed for the Queen's Theatre, Manchester. This curtain is made of asbestos cloth on an iron frame. The advantages of this form of curtain, designed and registered by Mr. Lawrence Booth, F.R.I.B.A., are its cheapness, lightness, strength, and ease of manipulation, and it has received the highest commendation of the City Justices of Manchester, and their professional adviser, the City Surveyor. A special method of preventing the iron frame from "bulging" or altering its shape in case of fire or sudden variations of temperature is employed. By using weights not quite sufficient to counterpoise the curtain, the work of raising and lowering is very light. Combustible ropes may be employed, which, on being released by the action of fire or otherwise, will allow the curtain to descend of itself. The pockets are provided to catch the counterbalance weight in case of the breakage of the chain, so as to prevent personal injury. The friction rollers are put on the balance weights to ensure their free action. Friction rollers are also fitted on the curtain frame to give freedom of action in raising and lowering. The hinging of the lower part of the frame, so as to admit of its being raised to the top of the proscenium opening when there is not sufficient room for a curtain of the ordinary make to be raised above the proscenium opening, is a valuable addition. The asbestos cloth is specially strengthened by a fine wire running through each asbestos strand, and is stretched across the whole of the framework, and fastened thereto by means of hoop iron and bolts. A double thickness of asbestos cloth may be used, one thickness on each side of the framework, with an air space between.

RUSHWORTH'S STRONG BAR AND ANGLE IRON SHEARS.

The illustration represents a strong double shearing machine made by Messrs. Rushworth and Co., Sowerby Bridge. The machine is very powerfully geared with a steel pinion driving a large spur wheel shrouded to the pitch line, and driven by a steam engine with a cylinder 12in. diameter. It is arranged to cut angle iron of any length through the centre of the machine 6in. by 6in., with a steel slide, &c., worked from the steel excentric shaft, and is arranged at the end of the machine for cross-cutting bars 8in. wide and 2in. thick; approximate weight 13 tons.

THE PANAMA CANAL.

On several occasions lately we have remarked upon the course of events occurring with regard to the financing of this important project. When we last did so, we stated our conviction that, whether the canal could be ever made to pay or not, it would have to be carried through, because to abandon it would be to produce a great financial crisis; one that might possibly produce almost a revolution among a nation so excitable and yet so thrifty in its habits as are the French. The latest declaration of M. de Lesseps is tantamount to an acknowledgment of the justice of the view we then expressed. He has stated, in fact, that the French Government and Parliament have in their hands the fate of the enterprise, which has now become a national one, and he contends that its failure would be a crushing moral defeat, as well as an incalculable financial disaster. This amounts simply to a demand for that Government aid, the granting of which we predicted could alone save both the scheme and the investors in it. We cannot but think that M. de Lesseps has until now rather studiously concealed this issue, which he must long ago have foreseen. He would doubtless reply to this that it was not until the failure of his last demand upon the public became manifest to him, that doubt became certainty to the extent which has now compelled him to outspokenness. But however late M. de Lesseps may be in speaking, he has now done so after a fashion which is candid enough. He has told the French Government that he is at the end of his financial resources, and that unless Government steps in to back up the enterprise it will have to be abandoned.



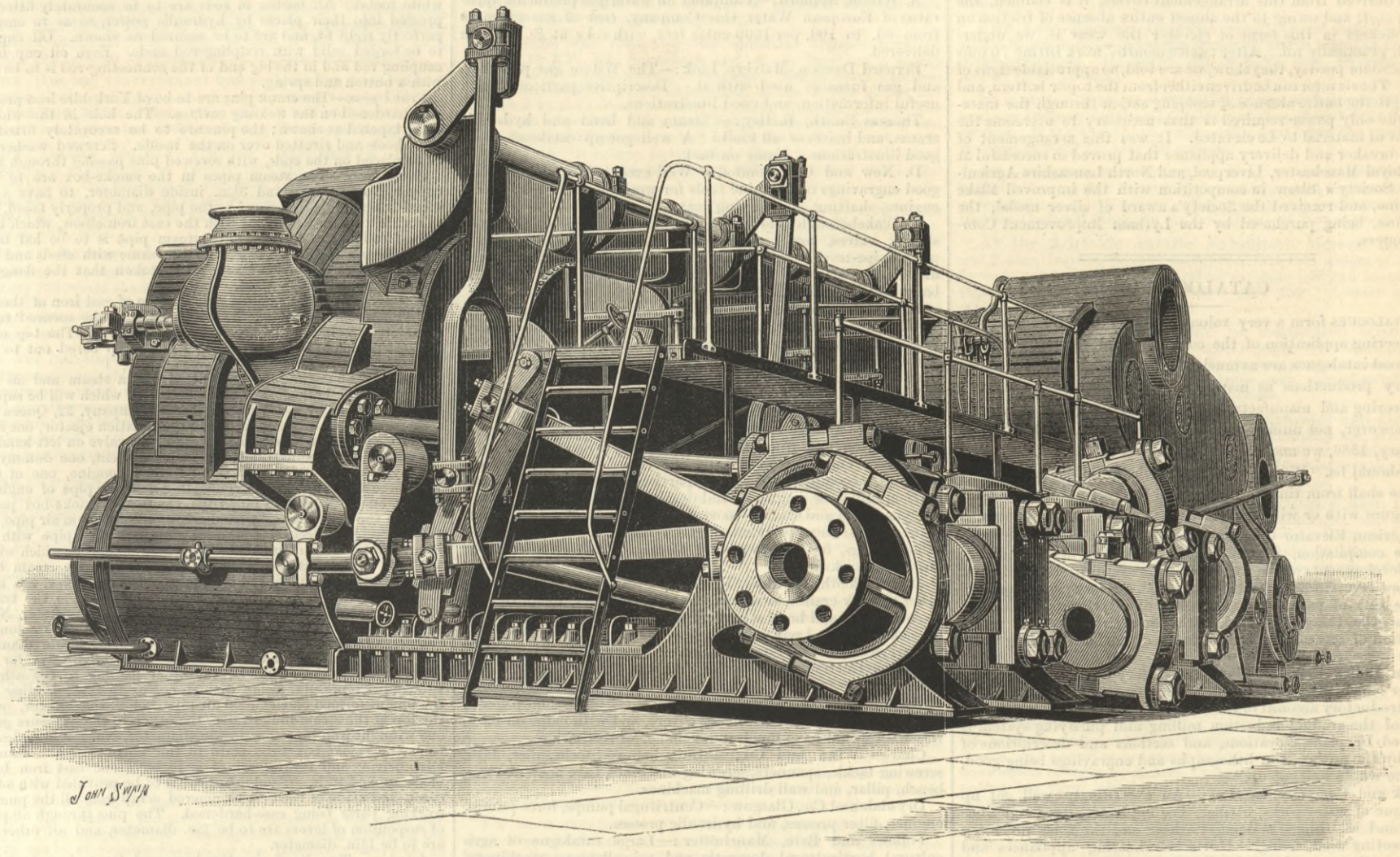
RUSHWORTH'S SHEARS.

At the present moment the annual interest to be paid on capital already expended closely approaches three millions sterling. At the existing rate at which money can be borrowed for the work, that annual burden must, supposing the canal be capable of being rendered barely navigable upon present estimates, when the work is so far completed, be increased to no less than six milions sterling. It is a grave problem, doubtless, therefore that M. de Lesseps seeks to have solved. The solution he proposes is the permission to issue lottery tickets for the raising of the further capital he demands, and the reduction of the interest on that already expended. We do not know whether it is proposed that the French Government should guarantee the holders of such lottery tickets in any way, or whether M. de Lesseps hopes that the gambling spirit of his countrymen would suffice to induce subscriptions for such tickets without the guarantee of the Government. Among ourselves it is certain, first, that our authorities would not permit what we as a nation regard as almost an immoral course to be pursued; and secondly, that comparatively few Englishmen possess sufficient of the spirit of the gamester to be allured by the temptation of such a course. It would be better, it seems to us, for M. de Lesseps to acknowledge financial defeat, and ask for the direct intervention of Government to stave off its consequences. All civilised nations would regard the abandonment of the Panama Canal with regret, although many must be doubtful of its financial success, while some refuse belief in the practicability of its accomplishment.

Engineering Students' Club, Newcastle-on-Tyne.—On the 5th instant a paper on "The Locomotive Boiler" was read by Mr. G. H. Sheffield, in the Mechanics' Institute, Gateshead, before the above Club, Mr. F. Hansen in the chair. The following members took part in the discussion, viz.:—Messrs. Elliott, Twinberrow, and Nicholson. On the following Friday, through the kindness of the locomotive superintendent, Mr. T. W. Worsdell, a large number of the members were shown through the North-Eastern Railway Company's shops at Gateshead. On the 18th instant Mr. G. B. Garvey read a paper at the above-named institute on the "Electric Lighting of the Newcastle Exhibition," Professor Stroud occupying the chair.

COMPOUND ENGINES OF THE REINA REGENTE.

MESSRS. J. AND G. THOMPSON, CLYDE BANK, ENGINEERS.

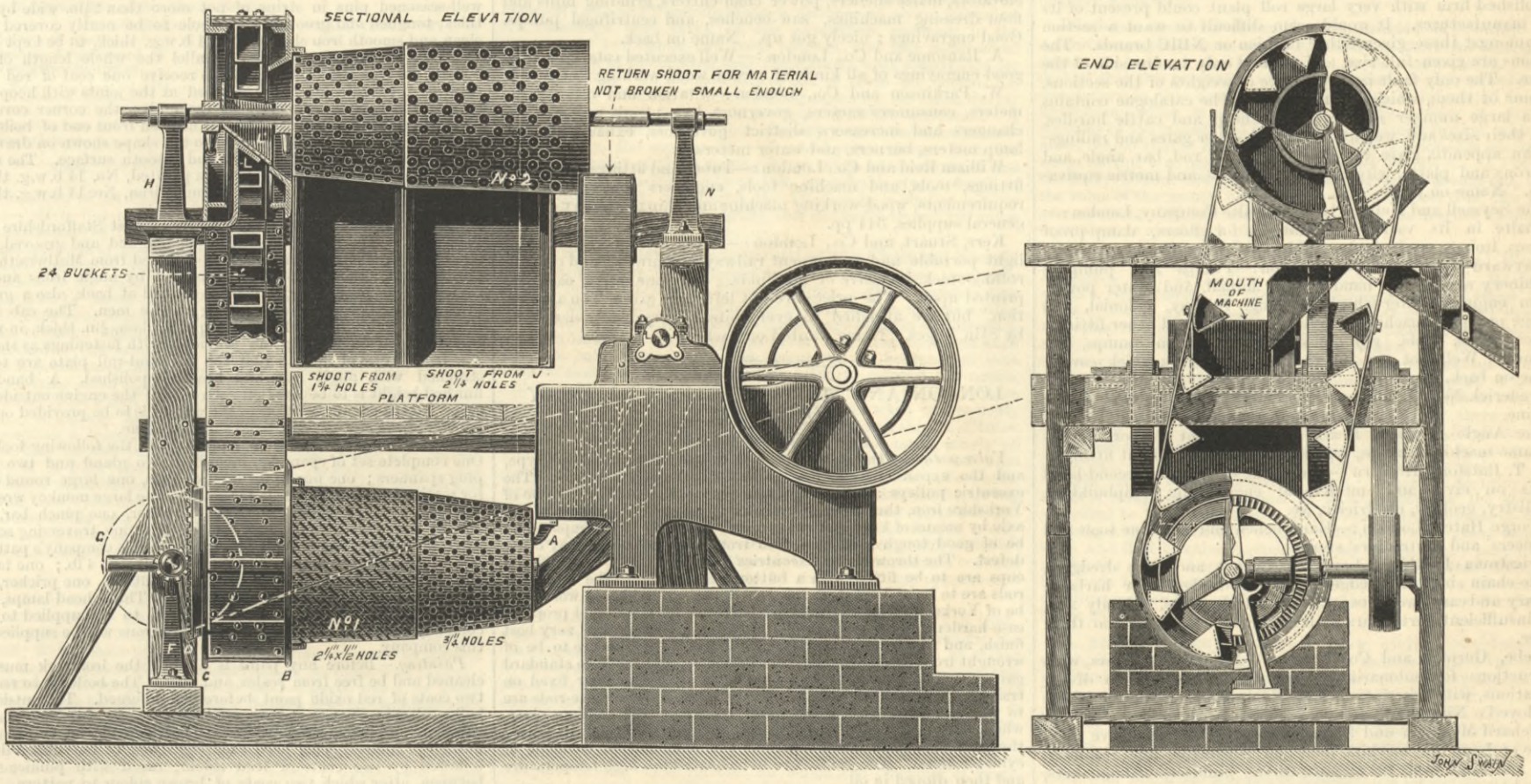


ENGINES OF THE SPANISH CRUISER, REINA REGENTE.

We give above an illustration of one set of engines of this fast cruiser. There are two sets in this ship. They are of the triple expansion type, one being placed forward of the other in separate compartments. The diameters of the cylinders are 40in., 60in., and 92in., the stroke being 3ft. 9in. The engines are exact duplicates of each other in every respect, the high-pressure cylinder being forward in the forward engine-room, and aft in the after engine-room. The crank shafts, propeller shafts, and all the moving parts are of steel. The stern shafting was made by Beardmore, the rest of the shafting by Vickers. The bed-plates are of cast steel, made by the Steel Company of Scotland. The valves are all of the piston type, driven by independent cylinders. On the trial they reached 110 revolutions, which is equivalent to a piston speed of 825ft. a minute. The whole of the auxiliary engines are independent excepting the air pump, which is driven by a rod connected with the low-pressure piston. The shafting is 17in. dia., with an 8in. hole in it. These engines are supplied with steam by four double-ended boilers, each having eight furnaces in it, or thirty-two furnaces in all, the pressure of steam being 140 lb. The forced draught arrangements are very complete, each stokehole having two fans.

STONE-BREAKING AND DELIVERING APPARATUS FOR THE INDIAN GOVERNMENT.

MESSRS. W. H. BAXTER AND CO., ENGINEERS, LEEDS.



STONE-BREAKING AND DELIVERING APPARATUS FOR THE INDIAN GOVERNMENT.

The engraving represents a part-sectional illustration of Baxter's patent automatic delivery appliance, now, we understand, being adopted by corporations, quarry-owners, and others. Its method of working is as follows:—The stone to be broken is put into the mouth of the machine in the ordinary manner, and is then delivered into Screen No. 1, which screens out the gravel. The broken stone is then delivered into the elevator, which—contrary to all former elevators—has the buckets fixed on the inside of the belt. The belt or carrier runs over the two flanged pulleys, the buckets passing in between, so that the material falling from the screen is delivered on to the elevator belt, and as this resumes the perpendicular position the material falls into the buckets, is carried up, and delivered on to a shoot. This conveys the broken stone into screen No. 2, where the two sizes of macadam are taken out and conveyed by means of shoots into carts, barrows, or trucks, as required; that not broken sufficiently small being conveyed by a return shoot, from the end of the screen, back into the machine to be further broken.

The advantages claimed for this arrangement are—First: A saving of labour in shovelling the broken stone from the machine, and wheeling back that not broken to the required size. Second: By regulating the machine so that a larger quantity may pass through that is not at first broken small enough, a great saving in gravel is effected, consequently a larger portion of 2¼in. macadam is produced and a better sample obtained. The jaws being set wide apart, the machine takes less power, the saving thus effected being sufficient to work the elevator, so that the entire arrangement takes no more power than is usually required to work a stone breaker fitted with the ordinary screen. It will be evident from the preceding statement that a stone breaker fitted with this arrangement must effect a saving not only in labour but of waste of stone and also in working ex-

penses, as it is well known that the closer the jaws are set to work the greater will be the liability of breakage to the machine and greater wear on the jaws, driving shaft, and bearings, so that if there was no saving in elevating the broken stone the advantages derived from this arrangement covers, it is claimed, the extra cost; and owing to the almost entire absence of friction on the buckets in this form of elevator the wear is, we understand, practically nil. After twelve months' work lifting 70 tons of macadam per day, they show, we are told, no appreciable signs of wear. The elevator can be driven either from the top or bottom, and owing to the entire absence of scooping action through the material, the only power required is that necessary to overcome the weight of material to be elevated. It was this arrangement of stone-breaker and delivery appliance that proved so successful at the Royal Manchester, Liverpool, and North Lancashire Agricultural Society's Show in competition with the improved Blake machine, and received the Society's award of silver medal, the machine, being purchased by the Lytham Improvement Commissioners.

CATALOGUES.

Catalogues form a very valuable part of manufacturing and engineering application of the compilers and the printers' arts, and good catalogues are as much worthy of being placed amongst literary productions as many of the books turned out with engineering and manufacturing titles. Really good catalogues are, however, not numerous. In our impression of the 22nd of January, 1886, we made some remarks on catalogues, and what they should be. We need not deal with the subject again now, but we shall from time to time record the receipt of engineering catalogues with or without remark, as we do in what follows :—

American Elevator Company, London.—A piece of art work in the compilation, illustration, and printing of a catalogue. The developments of the company's lifts are in particular shown and new forms most perfectly illustrated. Every page is printed on one side of paper only, and each description is illustrated, besides the thing described, with an artistic vignette representation of one of the various forms of ancient hoisting apparatus.

"On Roller Flour Milling," by Henry Simon, C.E., Manchester :—This is something between a treatise and a catalogue. An introductory account of the rise, progress, and modern development of the gradual reduction milling and purifying system is followed by plans, elevations, and sections and descriptions of mills by the author, the lithographs and engravings being good, and the whole well got up.

Beck and Company, London :—An exceedingly well got up catalogue of waterworks, fittings, fire appliances, sewerage ironwork, and all things relating to these and the tools necessary for erecting and fixing. Hot water heating appliances and fittings. Steam engine and boiler fittings, valves, impermeators, injectors, &c. Pumps and pumping machinery for steam, horse, and other power, hydraulic rams, turbines, pipes, and fittings. Sanitary fittings. Engravings good, plenty of sectional illustrations where necessary to show construction. Arrangement and printing good, with prices accompanying each article. The name is on back, which gives it a place on a book-shelf, and makes it easy to find.

Kynoch Gun Factory, Aston, Warwickshire : — Revolvers, pistols, rifles, cartridges.

Shand, Mason, and Co., London: — Fire engines, escapes, hydrants, floating and railway fire engines, force and lift pumps, sluices, ships' pumps, and apparatus and fittings. Well executed, on thin paper and thick covers. Name on back.

The New British Iron Company, Ruabon and Corngreaves Works :—A handsomely got up catalogue of an enormous number of sections of iron and steel, and such as only a long-established firm with very large roll plant could present of its own manufactures. It would seem difficult to want a section not amongst those given either of Lion or NBIC brands. The sections are given full size, and printed only on one side of the paper. The only fault is the absence of weights of the sections, or some of them, which are not given. The catalogue contains also a large number of engravings, sheep and cattle hurdles, with their sizes and weights, farm and other gates and railings; and an appendix gives tables of weights of rod, bar, angle, and tee irons and plates, wire and sheet gauges, and metric equivalents. Name on back.

The Seyssell and Metallic Lava Asphalte Company, London :—Asphalte in its various applications for floors, damp-proof courses, linings, roofs, tanks, stables, pathways, &c.

Hayward Tyler and Co., London:—Pumps and pumping machinery worked by hand, steam, animal, and water power, steam engines, water-wheels, mining, railway, colonial, and sewage pumping machinery, well gear, pump and other fittings, cranes, jacks, tools, gun-metal fittings, garden pumps, fire engines. Well got up, on thin paper and in thick covers. Name on back.

Frederick Nell, London :—Flour-mill machinery and Victor turbine.

The Anglo-American Brush Electric Light Corporation :—Dynamo machines, lamps, regulators, and electric light fittings.

B. T. Batsford, Holborn :—Catalogue of new and second-hand books on civil and mechanical engineering, shipbuilding, chemistry, geology, electricity, &c.

George Hatch, London :—Hand bench and machine tools and engineers' and contractors' stores.

Priestman Brothers, London:—Bucket and grab dredgers, single-chain bucket dredgers, floating dredgers for harbour, estuary and canal work, excavators and elevators. Handy size, but insufficient particulars with illustrations, and on too thick paper.

Siebe, Gorman and Co., London:—Manual for divers, with instructions for submarine operations. A treatise on diving operations, with descriptions and illustrations of the apparatus employed. Nicely got up.

Richard Melhuish and Sons, London:—Comprehensive catalogue of hand and machine tools and apparatus, and ironmongery and brass work for manufacturers, builders, watchmakers, draughtsmen, and for amateurs, and of house and other fittings and materials. Useful and nicely got up.

Ashmore, Benson, and Pease, Stockton-on-Tees:—Gasholders and gas apparatus, retorts, retort houses, scrubbers, purifiers, complete gasworks, pipes, fittings, exhausters, pumps, lamps, and tools for gas-making and gas-using work. A well got-up catalogue with good engravings, clearly described, and photo-prints of gasholders up to 214ft., erected for the South Metropolitan Gas Company, London.

The Pulsometer Engineering Company, London, S.W.:—Special catalogue of filtering machinery and apparatus for filtering large quantities of impure and muddy water, for manufacturing purposes and for baths, and for softening hard water. Compiled for and relating specially to filters for proprietors of laundries, swimming-baths, bleachers, chemical works, steam users, textile manufacturers, water companies, and hydraulic-power companies.

A. Wilson, Stafford:—Pamphlet on water-gas producing apparatus of European Water Gas Company, cost of gas given at from 6d. to 10d. per 1000 cubic feet, with coke at 8s. per ton delivered.

Bernard Dawson, Malvern Link:—The Wilson gas producer, and gas furnaces used with it. Descriptive particulars and useful information, and good illustrations.

Thomas Smith, Rodley:— Steam and hand and hydraulic cranes, and hoists of all kinds. A well got-up catalogue, with good illustrations. Name on back.

D. New and Co., London:—Well-executed catalogue, with good engravings of machine tools for working in metals, steam engines, shafting, and driving gear.

J. Blakeborough and Sons, Brighouse:—Large catalogue of sluices, valves, tower valves, hydrants, water cranes, standposts, pipe-testing apparatus, and other requirements for the distribution of water and gas, and extinction of fire. Name on back. Lithograph illustrations, all on one side of page.

H. J. Coles, Southwark:—Steam, hand, and hydraulic cranes of all kinds, dredgers and excavators, hydraulic machinery, presses and pumps, steam engines, air compressors, rock drills. A thoroughly well got-up catalogue; sufficient letter-press, good illustrations and printing, handy size. Name on back.

Watson, Laidlaw, and Co., Glasgow:—Hydro-extractors. An exceedingly well-executed catalogue of a special class of machinery, but without prices. Handy size. Name on back.

Armington and Sims Engine Company, Providence, U.S.A. Stationary engines. Very fully illustrated with excellent engravings, accompanied by full particulars and tabular information, indicator diagrams, and details.

Dyne, Steel and Co., Newport, Mon. :—Machinery, tools, apparatus, and fittings, corrugated, and other iron roofs, steam and other fittings, fans, blowers, and all requirements for collieries and their workshops.

Joseph Booth, Brothers, Rodley :—Steam locomotive cranes, other railway cranes, overhead travelling cranes, steam Goliath cranes, steam and hand wharf cranes, guy cranes, warehouse and derrick cranes and winches.

Merryweather and Sons, London :—Fire engines, fire escapes, and fire extinction apparatus of all kinds. Attached is a slip of paper, asking that the catalogue might be preserved for reference. If the catalogue, like others of its kind, were printed on pages of about half the size, with thicker covers, and with name on back, this wish would have much more chance of realisation.

Charles Winn and Co., Birmingham :—Stocks, dies, taps, screwing tackle, spanners, screwing machines, tube holders, vices, bench, pillar, and wall drilling machines.

Drysdale and Co., Glasgow :—Centrifugal pumps, force pumps, engines, filter presses, and hydraulic presses.

Follows and Bate, Manchester :—Large catalogue of agricultural, horticultural, domestic, and miscellaneous machinery, tools, appliances, and manufacturing apparatus. Name on back.

J. Miller and Co., London :—Large catalogue of hand and power machine tools, bench tools, apparatus, fittings, materials for various trades and industries.

Charles S. Madan and Co., Manchester :—Injectors, ejectors, and steam jet pumps.

Joseph Evans and Sons, Wolverhampton :—Colonial lift pumps, column, tripod, garden, and rotary lift pumps, water cart and marine pumps, hydraulic rams, deep well pumps with hand and power gear, lift and force pumps, force pumps, wall and plumbers' pumps, fire pumps, wort pumps, well frames and horse and hand gear, ships' pumps, centrifugal pumps, direct-acting pumps, Cornish pumps, steam ram pumps, engines, and vertical boilers. Well arranged. Name on back.

Clayton and Shuttleworth, Lincoln :—Portable, semi-portable, traction, and fixed engines; thrashing machines, straw and chaff elevators, maize shellers, power chaff-cutters, grinding mills and flour-dressing machines, saw-benches, and centrifugal pumps. Good engravings ; nicely got up. Name on back.

A. Ransome and Co., London :—Well executed catalogue with good engravings of all kinds of recent wood-working machinery.

W. Parkinson and Co., London :—Station and other large meters, consumers' meters, governors, bye passes, pressure exchangers and increasers, district governors, exhaust gauges, lamp meters, burners, and water meters.

William Reid and Co., London :—Tubes and fittings, materials, fittings, tools, and machine tools, engineers' and contractors' requirements, wood-working machine and ship machinery cranes, general supplies, 344 pp.

Kerr, Stuart, and Co., London :—A well got-up catalogue of light portable and permanent railways, tramways, and of their rolling stock, inclusive of all kinds. Only one side of each leaf printed upon. The prices are not left to be given "on application," but are attached to everything. Very handy size, 5½in. by 8½in. pages. Name wanted on back.

LONDON AND SOUTH-WESTERN RAILWAY LOCOMOTIVE.

(*Continued from page* 407.)

Valve motion.—The valve motion is to be of the curved link type, and the expansion links are to be hung from the centre. The excentric pulleys are to be in two parts; the smaller is to be of Yorkshire iron, the larger of cylinder metal, to be fastened on the axle by means of keys and set screws. The excentric straps are to be of good tough cast iron, free from honey-comb or any other defect. The throw of the excentrics to be 6in. The excentric oil cups are to be fitted with a button and spring. The excentric rods are to be of Yorkshire iron. All the wrought iron work is to be of Yorkshire iron, the working parts are to be well and properly case-hardened and re-cleaned up, and must be of the very best finish, and free from all marks and defects. All pins are to be of wrought iron, case-hardened, 2in. diameter, and made to standard gauges. The motion is to be reversed by screw gear fixed on trailing splasher on right-hand side of engine. The valve-rods are to work through cast iron guides bolted to the motion plate, which must be bored to the finished size and faced up in its place; the guides are to be bored out to fit the rods, and to be made of cylinder metal. The guides are to be heated to a high temperature and then dipped in oil.

Reversing shaft.—The levers are to be forged solid with the shaft, which is to be placed above the motion and carried by a cast iron bracket with loose cap bolted to the frames with 1in. bolts turned to gauge and made a driving fit ; these brackets to be made of cylinder metal, and to be bored out to 3½in. diameter to take the reversing shaft. The working parts of the shaft are to be properly case-hardened. All pins in the reversing shaft are to be 2in. diameter.

Connecting and coupling rods.—The connecting-rods are to be of Yorkshire iron, forged solid in one length and not welded, 5ft. 10½in. from centre to centre, and are to be fitted with adjustable brasses at small and big ends as shown. All cottars and bolts are to be of mild steel, the cottars are to be accurately fitted, and provided with set screws and cross cottars. The brasses at the big end are to be lined with white metal. Oil cups are to be forged solid with the big ends, at the small end a recess is to be made for lubrication. Each coupling rod is to be of Bessemer steel forged solid in one length and not welded, to be fitted with gun-metal bushes, which will have five grooves ½in. wide and $\frac{5}{16}$in. deep filled in with white metal. All bushes in rods are to be accurately fitted and pressed into their places by hydraulic power, so as to ensure a perfectly tight fit, and are to be secured as shown. Oil cups are to be forged solid with coupling-rod ends. Each oil cup in the coupling rod and in the big end of the connecting-rod is to be fitted with a button and spring.

Crank pins.—The crank pins are to be of Yorkshire iron properly case-hardened on the wearing surface. The hole in the wheel is to be tapered as shown; the pins are to be accurately fitted into the wheels and rivetted over on the inside. Screwed washers are to be placed on the ends, with screwed pins passing through them.

Steam pipes.—The steam pipes in the smoke-box are to be of copper, No. 7 b.w.g., and 3½in. inside diameter, to have a gun-metal flange properly brazed to the pipe, and properly faced, so as to secure a steam-tight joint with the cast iron elbow, which is also to be faced on the flange. Each steam pipe is to be led to the cylinder, and is to be secured to the same with studs and brass cover-ended nuts. Great care must be taken that the flanges on all pipes are properly brazed.

Exhaust pipe.—The exhaust pipe is to be of cast iron of the form and dimensions shown on drawing, and is to be secured to the cylinder with studs and brass cover-ended nuts. The top of the exhaust pipe is to be formed with a loose cap bored out to 4¾in. diameter.

Brake.—The engines are to be fitted with a steam and an automatic vacuum brake. The brake material, which will be supplied for each engine by the Vacuum Brake Company, 32, Queen Victoria-street, E.C., will consist of one combination ejector, one steam cock for ejector, one automatic steam-brake valve on left-hand side of engine, one vacuum gauge, one drip recipient, one dummy, one of Clayton's hose and couplings for front of engine, one of Clayton's hose and couplings for connecting main air pipe of engine to tender, one wrought iron pipe from ejector to smoke-box passing through the boiler on right-hand side of engine, main air pipe, with the necessary T pieces, elbows and clips, one end pipe with cast iron bend for front of engine. The brake material, which will be supplied by the contractor, will be as follows :—One steam brake cylinder with piston and rod complete, one copper pipe, 2in. inside diameter, No. 11 b.w.g., leading from the ejector to the trailing end of the engine, one copper pipe 1¼in. inside diameter, No. 11 b.w.g., leading from the steam cock on the safety-valve column to the top of the ejector, two copper pipes $\frac{9}{16}$in. inside diameter, No. 14 b.w.g., one from the automatic steam-brake valve for supplying steam to the cylinders, the other leading to the ash-pan, two copper pipes ¼in. inside diameter, No. 16 b.w., leading from the unions formed on the main air pipe below the ejector, one to the top of the steam-brake valve, the other to the pressure gauge, one wrought iron pipe 2in. inside diameter, No. 7 b.w.g., leading from the smoke-box tube plate to the bottom of the chimney. Each driving and trailing wheel is to have one cast iron brake-block applied to it. The brake gear is to be provided with adjustment, and made of the best hammered scrap iron, all the pins and working parts being case-hardened. The pins through all points of suspension of levers are to be 2in. diameter, and all other pins are to be 1½in. diameter.

Injectors.—Two No. 8 size Gresham and Craven's patent brass injectors are to be fixed one on each side of engine under footplate, as shown, to deliver into brass clack-boxes placed at front end of boiler. The delivery pipes are to be of copper, 1¾in. outside diameter, No. 8 b.w.g. thick. The suction pipes are to be of copper, 2in. outside diameter, No. 9 b.w.g. thick. The steam pipe is to be of copper, 1½in. outside diameter, No. 8 b.w.g. thick. The overflow pipes are to be of copper 1in. outside diameter, No. 9 b.w.g. thick. Care must be taken that the pipes are so set that the flanges of all joints come fairly to their places without any spring upon them. The pipes are to be solid drawn and perfectly uniform in length, and set so that any pipe will fit into its respective place on any engine equally well. The injectors are to be fitted with Holt's flexible feed-pipe arrangement.

Bolts and nuts.—The bolts and nuts are all to be Whitworth's standard. All are to be finished bright where not otherwise specified. All nuts are to be case-hardened. All nuts inside smoke-box are to be of hard brass with blank ends.

Clothing.—The boiler and fire-box are to be lined with felt and well-seasoned pine in strips of not more than 2½in. wide by ¾in. thick, tongued and grooved, the whole to be neatly covered with clean and smooth iron sheets, No. 14 b.w.g. thick, to be kept 1¼in. above the fire-box and carried parallel the whole length of the boiler ; the iron sheets, which are to receive one coat of red lead paint on the inside, are to be secured at the joints with hoop iron bands with tightening screws at the ends ; the corner covering plate at the back of the fire-box and also on front end of boiler to be of best charcoal iron hammered to the shape shown on drawing, and finished to a perfectly clean and smooth surface. The manhole casing is to be of wrought iron painted, No. 14 b.w.g. thickness. The dome casing to be of wrought iron, No. 14 b.w.g. thickness brazed up solid and painted.

Cab.—The sides and front are to be of best Staffordshire iron $\frac{5}{16}$in. thick. The roof is to be of wood, tongued and grooved, and covered with oilcloth, which is to be obtained from McIlwraith and Co., Glasgow ; the roof is to be supported by angle irons and an iron strip as shown ; a ledge is to be formed at back, also a gutter at each side to prevent water falling on the men. The cab is to have two windows of best polished plate glass, ¼in. thick, in wood frame hinged on the top and provided with fastenings as shown. The front edges of the cab and top of hand-rail plate are to be stiffened with angle iron and beading polished. A hand-rail finished bright is to be fixed on each side of the engine outside the cab. A cord communication to the whistle is to be provided on the outside of the cab on right-hand side of engine.

Tools.—Each engine is to be supplied with the following tools:—One complete set of spanners, including two gland and two mud plug spanners ; one punch for tapered pins, one large round drift for motion pins, one flat drift for cottars, one large monkey wrench, one small monkey wrench, one hand hammer, one pinch bar, two chisels, one pair of tongs, one bunting bar, one traversing screw-jack and ratchet, which must be exactly to this company's pattern; one oil can, 16 lb.; one oil can, 8 lb.; one oil can, 4 lb.; one tallow can, one tallow feeder, two oil feeders to pattern, one pricker, one rake, one fork, one coal-pick, one shovel. Three head lamps, one water-gauge lamp, and one hand lamp are to be supplied to this company's pattern. A sample set of fire irons will be supplied by this company.

Painting.—Before any paint is applied the ironwork must be cleaned and be free from scales and rust. The boiler is to receive two coats of red oxide paint before being lagged. The outside of boiler, clothing-plates, frames, cylinders, wheels, outside of hand-rail plate and cab are to have one coat of lead colour, two coats of filling-up, stopped with hard stopping, then to be rubbed down, followed by two coats of lead colour, faced with pumice-stone between, after which two coats of brown colour to pattern. The picking out and fine lining are to be to pattern panel, which will be supplied by this company. The smoke-box, chimney, back of fire-box, ashpan, footplate, brake work, and side springs are to have one coat of lead colour paint and two coats of Japan black. The insides of frames and cross stays are to have two coats of red oxide paint. Front of buffer plates, life guards, buffer casings, and inside of cab are to be painted vermilion. The axles are to have two coats of white lead. All the painting on the outside of the engine is to have three coats of best hard-drying body varnish. All paint on inside of engine and tender is to have one coat of best hard-drying body varnish. All varnish is to be of the best quality, and is to be obtained from Messrs. Denton and Jutsum, or other approved makers.

(*To be continued.*)

RAILWAY MATTERS.

Mr. M. N. Forney is publishing an enlarged revision of his "Catechism of the Locomotive," in chapters, in the *Railroad and Engineering Journal*, which is published in New York by him.

A rack railway, similar to that up Mount Washington, is being built in the island of Sumatra, by Mr. Augustus Kuntze, a German engineer. The larger portion of the sleepers, rails, engines, and cars has been supplied by German manufacturers.

The Bombay Government has undertaken to construct a portion of the proposed narrow-gauge railway between Hyderabad and Pach Badra. The section which it undertakes to build is that between Hyderabad and Umarkot, a distance of ninety miles.

The Italian *Gazetta Ufficiale* publishes a decree appointing a Committee of Inquiry into the causes of want of punctuality in the running of the train services, so much complained of by the public and in the Italian press since the working of the State Railways there was transferred to two private companies in July, 1885.

Mr. C. Renson, of the Netherlands State Railways, has devised a means of using up old wooden sleepers. Sleepers generally fail where the rail rests, leaving a sound length of about 3ft. in the centre. Two such pieces are joined end to end by a piece of channel iron. The rail rests on the channel iron, which thus prevents it from wearing into the sleeper.

In our last impression some description was given of the Birmingham cable tramway work and the winding station. The engines to which we referred are fitted with Jefferiss's automatic cut-off, and are a fine example of the engine work of the larger sizes of the Messrs. Tangye, of Birmingham. The same firm has also erected for the working of this cable-hauling machinery a pair of barring engines and other machinery and travelling cranes.

The summary of accidents and casualties which have been reported to the Board of Trade as having occurred upon the railways in the United Kingdom during the nine months ending September 30th, 1887, gives first the accidents to trains, rolling stock, permanent way, which caused the death of 32 persons and injury to 538, as against the 11 and 499 in 1886. Of these there were killed, passengers and others, 25; servants of companies, 7. The injured were 450 passengers and 88 servants.

The report of the New South Wales Commissioner of Railways for 1886 shows that at the close of the year 1889½ miles were open for traffic, and that 268 were in course of construction. The earnings amounted to £2,160,070, and the expenses to £1,492,992. The passengers carried numbered nearly 15,000,000. The net earnings yielded 2·901 per cent. on the capital invested in the lines in operation. The net earnings of the tramways amounted to £24,630, compared with £15,345 in the previous year, being a return of 3·32 per cent. compared with 2·17 per cent.

According to M. Ricour, piston valves in locomotives wear at the rate of $\frac{1}{32}$in. for 125,000 miles, while with the slide valve the same extent of wear takes place with one-sixtieth of the mileage. The wear of the valve gear is reduced in the same proportion. The effect in the consumption of fuel is shown by the returns made at Saintes Station for the year 1882, where on all engines worked with slide valves the coal consumed per 1000 tons conveyed one mile was 226 lb., against 234 lb. in the year 1884, when thirty out of forty locomotives had been fitted with cylindrical valves.

According to a recent test made on the Chicago City Railway, it was ascertained that about 36 per cent. of the gross power used in running that road was required to move the empty cable. Figures were made on a day of heavy traffic, and were as follows:—1022-horse power were used to move 300 cars, only 360 of which was required to draw the empty cable. The cars were heavily loaded, perhaps 20 per cent. more than usual, and Secretary Windsor, to whom we are indebted for these facts, assures us that the amount of power required to haul the cable will not exceed 40 per cent. on the average. The *Street Railroad Journal* says the amount of power required per car for additional cars is about as the above figures show, viz., 2-horse power each.

A general classification of the American railway accidents in September shows the following:—

	Collisions.	Derailments.	Other.	Total.	P. c.
Defects of road ..	—	11	—	11	7
Defects of equipment	7	16	2	25	17
Negligence in operating	21	10	1	32	21
Unforeseen obstructions	—	11	—	11	7
Miscellaneous	6	—	1	7	5
Unexplained	49	15	—	64	43
Total	83	63	4	150	100

Speaking of railways, the *Irish Manufacturers' Journal* says:—"It is but natural to hope that the many new lines and new extensions of lines which have lately crept out to hitherto isolated quarters of the country, will exercise no small influence in the development of home industries. If they merely serve to accommodate the travelling agents of foreign houses and accelerate the dispatch of parcel-post packages among the customers of the unfortunate local shopkeepers they cannot be considered an undiluted blessing. There ought not to be a single town at which the screech of the locomotive is heard that should not have its Home Manufactures' Association, which would find good work to do in reviving olden industries or establishing new ones. There is no quarter from which we could not send forth some fruit of our labour. A railway line should be something more to our Irish villages than a huge feeding spoon to metaphorically spill down our throats all the rubbish the rest of the world may refuse. Really it is high time to give up that ancient, harmless, but thoroughly uninteresting performance of opening our mouths and shutting our eyes and taking whatever Brummagem sends us." It is remarkable how often Carlyle's remarks about populations and fools might be appropriately employed. It is useless to try to please those who will not be pleased.

During the first nine months of the year there were reported on the railways of the United Kingdom 24 collisions between passenger trains or parts of passenger trains, by which 25 passengers were killed and 219 passengers and 13 servants were injured; 30 collisions between passenger trains or goods or mineral trains, &c., by which 137 passengers and 37 servants were injured; 11 collisions between goods trains or parts of goods trains, by which 2 servants were killed and 2 cattle dealers and 22 servants were injured; 1 case of a passenger train coming in contact with a projection from a goods train travelling on a parallel line, by which 6 passengers were injured; 37 cases of passenger trains or parts of passenger trains leaving the rails, by which 1 servant was killed and 19 passengers and 4 servants were injured; 6 cases of goods trains or parts of goods trains, engines, &c., leaving the rails, by which 3 servants were killed and 1 was injured; 2 cases of trains travelling in the wrong direction through points, by which 1 servant was injured; 18 cases of trains running into stations or sidings at too high a speed, by which 1 servant was killed and 48 passengers and 4 servants were injured; 93 cases of trains running over cattle or other obstructions on the line, by which 3 servants were injured; 4 failures of engine machinery, by which 2 servants were injured; 1 failure of brake apparatus, by which 15 passengers were injured; 2 failures of couplings, by which 1 passenger was injured; 3 slips in cuttings or embankments, by which 1 passenger and 1 servant were injured; and 1 other accident, by which 2 passengers were injured.

NOTES AND MEMORANDA.

The borings in the Delta of the Nile carried on by the Royal Society have been brought to a standstill by the breaking of the long tube. The depth reached is over 324ft., still without the solid rock being found. It is said to be probable that the work may be recommenced upon a larger scale.

A paper was read on the internal temperature of glaciers, by MM. Ed. Hagenbach and F. A. Forel, at a recent meeting of the Paris Academy of Sciences. The different temperatures determined by careful experiment in the Arolla glacier are explained by the varying pressure to which different parts of the glacier are subjected. The normal temperature below zero is shown to be the effect of pressure, which lowers the melting point of ice, thus verifying in nature facts already theoretically demonstrated by Sir W. Thomson and others, but hitherto studied only in the laboratory.

At a recent meeting of the Paris Academy of Sciences a paper was read on the Gulf Stream, by M. J. Thoulet. Comparing his own observations made on board the Clorinde in 1886 with those of Mr. Buchanan during the Challenger expedition, the author finds that the Gulf Stream is comparable to a river with a greater fall in its upper than in its lower reaches. A relatively steep valley separates it on the left from the United States current setting southwards from Newfoundland, while its more gentle sloping right bank skirting the ocean presents a much broader expanse. Thus is explained the direction of the driftwood carried from America towards the north-west coast of Europe.

In a paper which has just been reprinted from the "Transactions" of the New York Academy of Sciences, Mr. J. S. Newberry maintains that the decorative ideas expressed in the monuments of the ancient inhabitants of Central America have a close resemblance to the carvings executed by the Indians of the north-western coast of America, and by the people of the Pacific Islands. "Hence," says Mr. Newberry, "I am inclined to believe, as has been suggested by Baldwin, that the seeds of this ancient civilisation were brought from the East Indian Archipelago from island to island across the Pacific, and that finally reaching our continent, and prevented by the great and continuous chain of the Cordilleras from further eastward migration, it slowly spread southward to Chili, and northward to our western territories."

MM. Bender and Francken give the following for making agglomerate Leclanche cells:—Manganese peroxide, 40 per cent.; graphite, 44 per cent.; gas-tar, 9 per cent.; sulphur, 0·6 per cent.; water, 6·4 per cent. These substances, says the *Revue Scientifique*, are reduced to a fine powder—gas-tar and water apparently included—they are then carefully mixed, placed in a mould, and strongly compressed. The mixture is then gradually raised to a temperature of 350 deg. C., which not only evaporates the water, but also drives off the volatile elements of the gas-tar. This result is aided by the presence of the sulphur. A portion of the sulphur combines with the gases derived from the tar and disappears, while the remainder is said to combine with the solid ingredients, producing an unassailable compound, by a transformation analogous to that of the vulcanisation of india-rubber.

Up to a comparatively recent date, small parcels of euphorbia rubber have occasionally appeared on the market, but for some time rubber manufacturers could not succeed in satisfactorily making use of it. At last, however, a method has been discovered which renders the gum available for mixing with various kinds of india-rubber to the extent of 50 per cent. A piece of vulcanised rubber containing 50 per cent. of the euphorbia gum has been tested for some time in an exposed position on a roof, and it has kept better than a similarly exposed piece of ordinary pure—vulcanised—rubber. Mixed with gutta-percha, it prevents the latter becoming brittle. Washers made with 30 per cent. of this gum and vulcanised rubber stand well and retain their elasticity. The *Railroad Gazette* says, "Tubing for carrying high-pressures is far less likely to split and crack when a proper quantity of euphorbia gum is employed."

According to Mr. Stallibrass, the history of deep-sea sounding might almost be said to date from the time of the first Atlantic cable scheme in 1858, but proper attention had not been given to the subject until quite recently. The work of surveying with a view to ascertaining the configuration of the ocean-bed previous to laying a submarine cable was of vital importance. Between Cadiz and Teneriffe alone, a distance of about 700 miles, 673 soundings were taken on one expedition, resulting in the discovery of two banks, two coral patches, and four other shoal spots. Some of the inclines near these banks were remarkable for their steepness. On the east side of one of these the bottom fell precipitously for 450ft. On a sounding taken by the Dacia during her survey of the Seine bank, a precipice of 1800ft. was found. A map of the mouth of the Congo showed a most remarkable submarine gully, the contour lines of which were drawn from 202 soundings, many of these having been taken at intervals of less than one mile. In the mouth of this remarkable river a depth of no less than 1452ft. was found, the Thames in a similar locality giving only about 40ft. The gully was distinctly traced 100 miles out at sea.

A note on safety taps was read at the Chemical Society on the 3rd inst. by W. A. Shenstone. The author has previously pointed out—"Methods of Glass Working"—that the safety taps recently introduced are open to the rather serious objection that they offer no special resistance to the passage of air in the direction in which leakage is most likely to occur, and that therefore such taps are only trustworthy when employed in conjunction with suitable mercury traps. But it had hitherto escaped his notice, and probably that of others also, that even when so protected these taps are still of unsatisfactory construction, as when the properly lubricated plug of the tap is brought into position the space below the plug remains full of air. If the tap be well made, nearly all this air will remain there during the exhaustion of any vessel that may be attached to either arm of the tap; but afterwards, especially if the lubrication of the tap becomes imperfect, air will gradually find its way from below the plug into any apparatus that may be attached to the tap. To remove this imperfection a very simple alteration only is required, viz., that the plug shall be drilled so that when the tap is open there is free communication between the space below the plug and the contents of any apparatus of which the tap may form a part.

At a meeting of the Physical Society on the 12th inst., a paper was read "On a Geometrical Method of Determining the Conditions of Maximum Efficiency in the Transmission of Power by Alternating Currents," by Mr. T. H. Blakesley, M.A. In this paper the author confines himself to the consideration of a simple circuit containing generating, conveying, and recipient parts, in which the electro-motive force follows the law of sines. The maximum electro-motive force of both machines is supposed known, together with the resistance and co-efficient of self-induction of the complete circuit. The variable on which the efficiency of transmission depends is the difference of phase of generator and receiver. A geometrical construction is given by which the phase which gives maximum efficiency can be determined. Mr. Kapp thought the construction would not apply where the receiver does mechanical work, owing to the electro-motive force not being a true sine function of the time. He also mentioned an experiment performed on a motor driven successively by alternating and direct currents, in which the apparent power ($\sqrt{\epsilon^2}\ \sqrt{c^2}$) supplied by alternating currents was about five times that required when direct currents were used, the motor giving out the same power in the two cases. From this he inferred that the ratio of power to weight is much greater for a direct than for an alternating current motor. This he considered a serious drawback to the use of alternate currents for transmitting power.

MISCELLANEA.

The Brussels Opera-house, the Theatre Royal de la Monnaie, is now electrically lighted throughout, the current being generated at the Municipal Gasworks, Lacken, 4 kilos. = 2½ miles distant.

The new Russian Imperial yacht to be built at the Baltic Works is to be called the Standard, and is intended only for ocean navigation. Its length will be 314ft. 10in., its beam 46ft., and its speed 17 knots.

It is stated that an influential company intends to erect works at Oldbury for the manufacture of aluminium by the Castner process. It is estimated that when fully established the works will find employment for over 200 persons.

An indignation meeting of Belgian ironmasters was held at Liége, on 20th November, to protest against the Government ordering cannons in Germany, when it has been proved conclusively that the Cockerill Company can turn them out just as good.

At the Adelaide Jubilee Exhibition Messrs. Barnett and Foster, London, have been awarded five first orders of merit, for soda-water machinery, generating carbonic acid gas, ice-making machinery, mineral water bottles, and the "London-made" syphons.

The exhibition of models in connection with the adjourned discussion of Sir F. Abel's paper on "Accidents in Mines," at the Institution of Civil Engineers, proved so successful on Tuesday evening that it is probable such partial exhibitions will be held as frequently as occasion arises.

At the annual meeting of the Manchester and District Association of Trade Union Officials held on Thursday last, Mr. H. R. Slatter, J.P., who is one of what may be termed the working men representative magistrates appointed in Manchester some time back, was re-elected president for the ensuing year.

The Compagnie Générale de Conduites d'Eau, Liége, which casts pipes vertically at the rate of about 25,000 tons yearly, is now executing works for the Bucharest Waterworks and works at Ponta-Delgada in the Azores, and at Loanda, in Africa, and is, in consequence, increasing its capital by a million francs, or £40,000.

The work of clearing out the exhibits from the recent Manchester Exhibition has proceeded with astonishing rapidity, and within a fortnight of the closing the building has been almost entirely cleared, the heavy exhibits in the machinery section having been moved away with almost as much activity as the lighter goods in other sections of the Exhibition.

We understand that the important "compound winding" action on the Brush patent brought by the Anglo-American Brush Electric Light Corporation against Messrs. Crompton and Co. has been settled. Messrs. Crompton have accepted the usual license, and agreed to judgment in favour of the Corporation. The cross action brought by Messrs. Crompton on the Crompton-Kapp patent has been withdrawn, the Brush Corporation taking an assignment of that patent.

At a meeting of the North Staffordshire Chamber of Commerce the Parliamentary Committee last week presented a report on the provisions of the Merchandise Marks Act, in the course of which they drew attention to the fact that there appeared to be some doubt whether it was the intention of the Act to prevent merchants and importers from continuing the practice of marking goods with the name of their firm, such goods bearing no other mark to indicate the place of origin. Until a legal decision of high authority had been given on this point it was difficult to form a definite opinion.

Our Manchester correspondent hears that Messrs. Richard Hornsby and Sons, of Grantham, have obtained the contract for the whole of the engine and boiler power for the electric lighting, heating, and ventilating of the enormous building which is being erected in Manchester for the purposes of Buffalo Bill's Wild West Show. Besides a large number of smaller lamps, there will be twenty-five large arc lamps; and there will be about 8000ft. of steam piping for heating. The Brush Company is supplying the electrical plant, and it has just secured the contract for 500 arc lamps for the Glasgow Exhibition.

We have received from the Committee of Council for Agriculture a programme of the Exhibition of the Fruit-drying Industry to be held at Portici, Italy, in September, 1888. It is desired that this programme should be known to such persons and associations in this country as are likely to be interested in this Exhibition—which is open to all—and with a view of giving a stimulus to the industry of fruit drying in Great Britain, which is much behind that of other countries, and in consequence enormous waste of fruit is entailed. It is mentioned by Mr. C. L. Peel, of the Privy Council-office, by whom the programme is sent out, that the value of the money prizes mentioned in Article 6 of the programme, viz., 500 lire and 200 lire, would in English money be equivalent to about £19 16s. and £7 18s.

At a meeting of the Institute of Iron and Steel Works Managers, held at Dudley on Saturday, Mr. H. W. Harbord, metallurgical chemist, of the Staffordshire Steel and Ingot Iron Works, Bilston, read a paper on "The Basic Open Hearth Process." After describing the operation of the basic Siemens furnaces, one of which has just been put down at the works, Mr. Harbord said that to work the process successfully it was very important to have a suitable pig. Such a pig should contain 2·5 per cent. of phosphorus, 1·25 to 1·5 of manganese, 0·1 or less of sulphur, and not above 1 per cent. of silicon. With reasonable care there should, he thought, be no difficulty in making such a pig in Staffordshire. The question of the most economic relation of pig and scrap was important, but he thought it depended almost entirely on the relative values at the particular place. Generally speaking, the limits of scrap would vary from 20 to 40 per cent. of the charge, according to local conditions. There was another branch of basic working which he thought might ultimately be of great importance, and that was the production of an exceptionally pure material by the use of hematite pig. In some experiments which he had made he produced what was practically carbide of iron, an excellent material for steel castings, as the carbon was not reduced below 1·00.

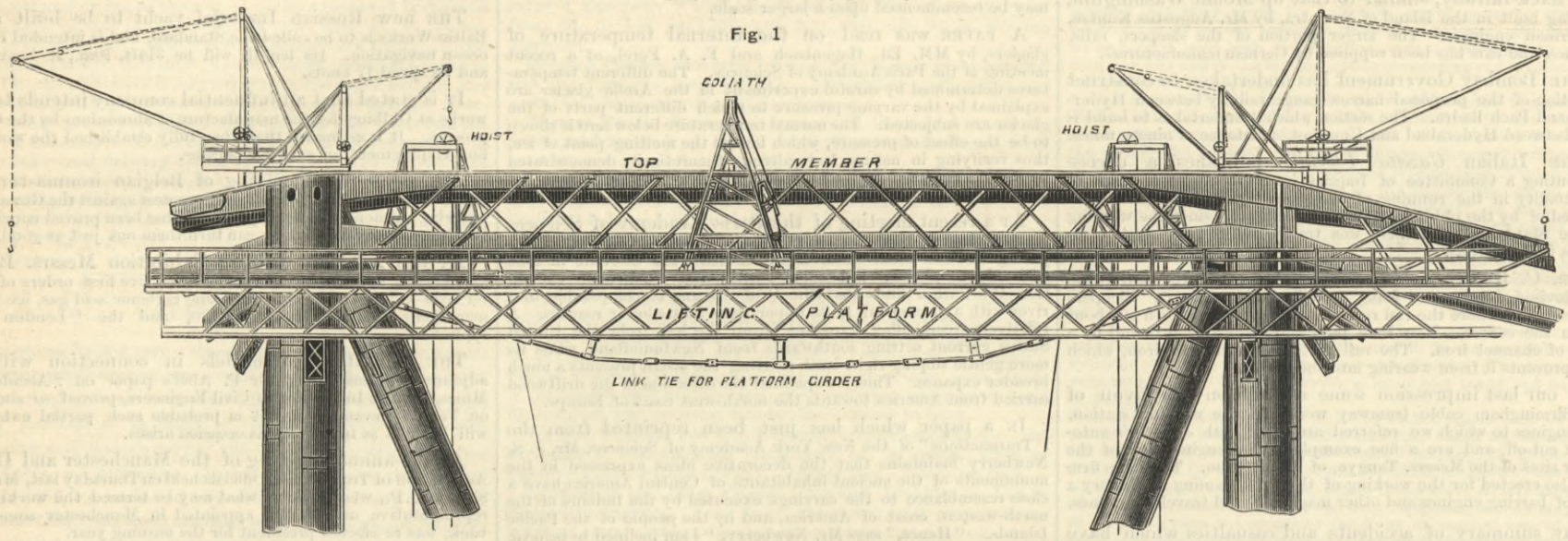
A new waterway scheme is now under consideration which, if carried into effect, would in a measure relieve the trade of Birmingham from sole dependence on the railway companies. The project is to connect Birmingham with the river Trent by means of a short canal, 80ft. wide, and to dredge and widen that river to the point at which the Lower Trent Navigation commences, and then to conduct by means of trains of barges drawn by steam tugs. For twenty miles or so there is a stretch of the Trent over which the Marquis of Anglesey has the navigation right, with toll-free access to the German Ocean. His lordship will make over these rights to a new company which is now being formed to carry out the project. If the scheme succeeds—and no opposition other than that of the railway companies has yet been threatened—Birmingham will have a waterway from 7ft. to 9ft. deep and at least 80ft. wide to the North Sea, with huge trains capable of carrying 400 tons per steam tug. With this waterway the company hope to be able, at an average charge of 8s. per ton, to convey goods to or from the estuary, a distance of 170 miles, in twenty-four hours. By this means there will be a saving of carriage rates upon merchandise and raw material of £300,000 a year. Part of the capital required has been privately subscribed, and is being laid out upon the Marquis of Anglesey's portion, which is already in the hands of contractors.

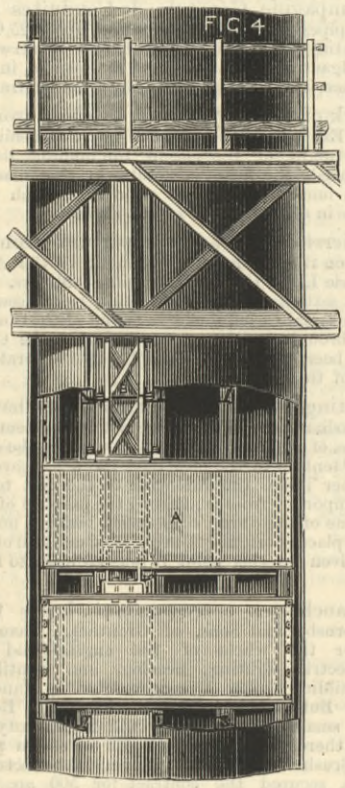
THE ERECTION OF THE FORTH BRIDGE.

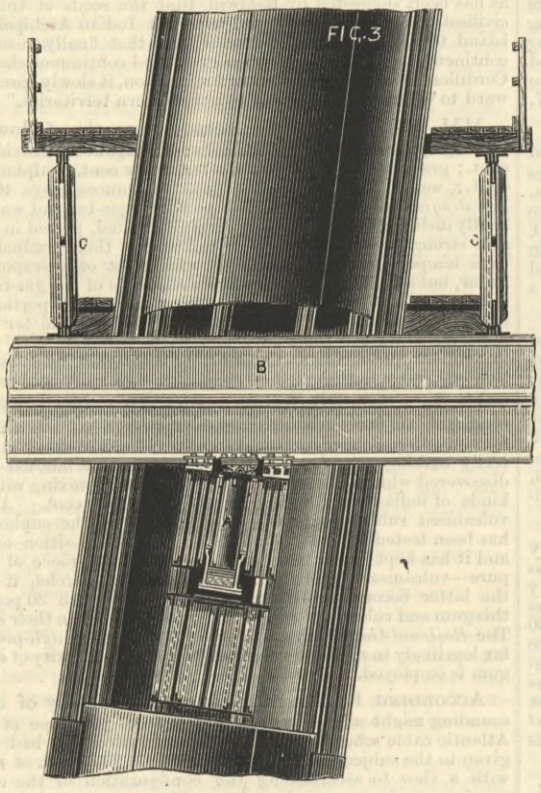
SIR JOHN FOWLER AND MR. B. BAKER, MM. INST. C.E., ENGINEERS.

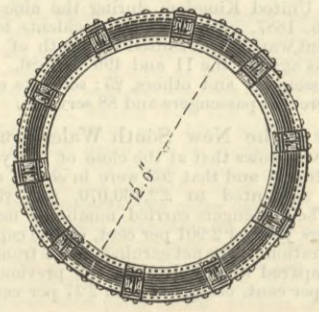
(*For description see page* 438.)

Fig. 1









BOTTOM MEMBER AND MAIN COLUMNS

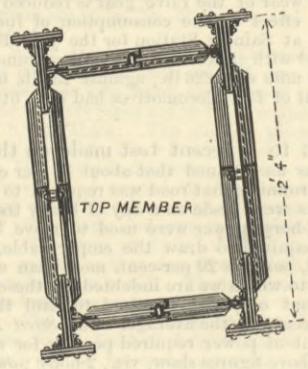
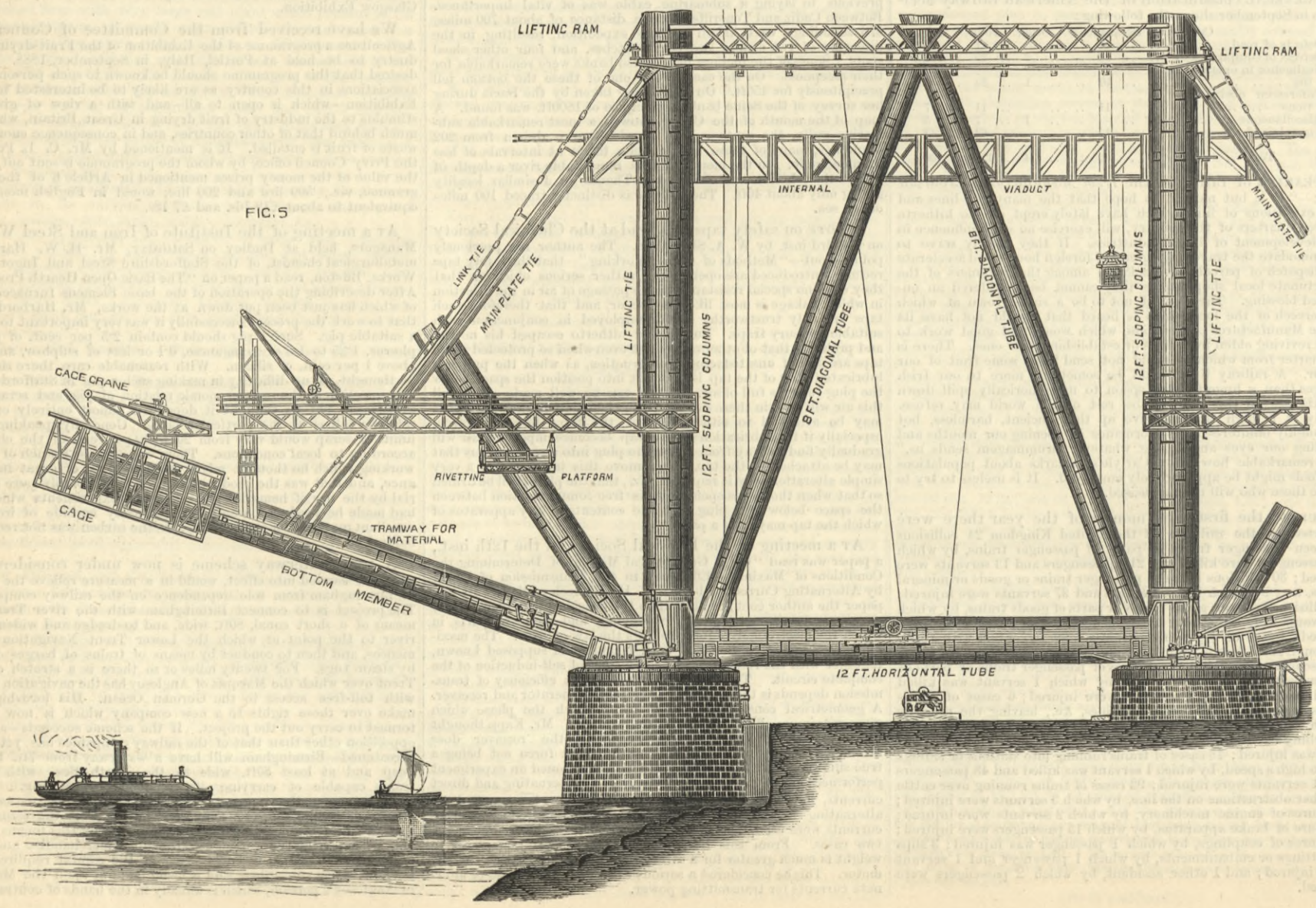


FIG. 5



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CONTENTS.

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J. L. T.—*Gauge.*

C. J. L.—(1) *The Secretary of the Vincennes Exhibition, Vincennes.* (2) *Mr. S. Lee Bapty, Manchester Exhibition offices, Manchester.*

A. H.—*Either in the Electrician's Directory, published by the "Electrician," or in the Local Government Directory, published by Knight, London.*

MATCH-BOX AND MATCH-MAKING MACHINERY.

(To the Editor of The Engineer.)

Sir,—Would some of the readers of The Engineer favour me with the names of a few firms who make machinery for the manufacture of match-boxes and matches?—and oblige, Ulzella.

November 22nd.

AMERICAN TRANSIT THEODOLITES.

(To the Editor of The Engineer.)

Sir,—Will any of your readers kindly inform me whether he has ever seen or used one of Heller and Brightley's standard transits—telescope 10½in., 7in. horizontal limb—and what is his opinion of the merits of this instrument, as compared with the best London-made 6in. transits?

J. M. F.

DRYING GELATINOUS AND PASTY SUBSTANCES.

(To the Editor of The Engineer.)

Sir,—Can you or any of your correspondents inform me of the most economical and rapid mode of drying gelatinous and pasty substances, such as fish and the residue from oil presses? My object is to find something more economical and effective than my present appliances.

November 21st. A. D.

THE GLASGOW INTERNATIONAL EXHIBITION, 1888.

(To the Editor of The Engineer.)

Sir,—Will you kindly permit us to point out an error in your article on above in last week's issue, where you state that the contractors for the girder work are Messrs. Arrol and Co., Glasgow? The fact is, we are the contractors for the whole of the structural ironwork in these buildings. We shall be pleased if you will be so good as make this correction in your next number.

We might add we were contractors for all the steel structural work of the Edinburgh Exhibition, 1886, also. Arrol Bros.

Germiston Works, Glasgow, November 23rd.

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

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

MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, November 29th, at 8 p.m.: Ordinary meeting. Paper to be further discussed:—"Accidents in Mines," by Sir F. A. Abel, C.B., F.R.S., Hon. M. Inst. C.E. Friday, December 2nd, at 7.30 p.m.: Students' meeting. "The Classification of Continuous Railway Brakes," by A. Wharton Metcalfe, Stud. Inst. C.E.; Mr. J. Wolfe Barry, Member of Council, in the chair.

Society of Arts. — Monday, Mr. H. H. Statham will commence a course of four Cantor lectures on "The Elements of Architectural Design." The lectures will be continued weekly on Monday evenings, at eight o'clock.

Chemical Society.—Thursday, December 1st, at 8 p.m. Ballot for the election of Fellows. "On the Supposed Third Nitroethane," by Professor Dunstan and T. S. Dymond. "Researches on the Laws of Substitution in the Naphthalene Series," by Professor H. E. Armstrong, F.R.S.

Society of Architects.—Tuesday, November 29th, at St. James' Hall, Piccadilly, W.: Ordinary meeting. Paper to be read:—"Technical Examinations," by G. A. T. Middleton, A.R.I.B.A., secretary.

THE ENGINEER.

NOVEMBER 25, 1887.

THE W. A. SCHOLTEN DISASTER.

The terrible disaster which on Saturday last befell the Netherland's American Steamship Company's iron screw steamer W. A. Scholten, has directed public attention in the most painful manner to the important subject of ocean passenger carriage, and the question will once more be asked upon all sides whether such wholesale losses of life are among the inevitable risks associated with maritime transport. It appears that the W. A. Scholten—a spar-decked steamer of 2529 tons gross and 1720 tons net register—left Rotterdam, to which port she belongs, on Friday morning last for New York, having on board a general cargo, with passengers and crew amounting to 210 souls, all told. She shortly afterwards encountered foggy weather, so that on Saturday the captain—Mr. G. H. Taat—very properly deemed it advisable to anchor until the weather cleared. The fog having lifted, at about ten o'clock on Saturday night the vessel left her anchorage—which was about ten miles south-east of the South Sands Head lightship—and proceeded on her way. It seems that another steamer—the Rosa Mary—720 tons register, of Hartlepool—had also been detained at anchor by the same fog about five or six miles from Dover, and while in this position had shown only the masthead light which is exhibited under such circumstances. According to one statement the Rosa Mary had never weighed her anchor; whereas by another it is alleged that she had actually got under weigh, but without setting her side lights. Whichever story may prove to be correct, one lamentable fact cannot be disputed, namely, that the two steamers came into collision, with the result that the W. A. Scholten foundered, and about 130 of the passengers and crew, including the captain, were drowned. The Rosa Mary arrived shortly afterwards at Dover with her bow so badly crushed that she was kept afloat by the collision bulkhead. Fortunately the steamer Ebro, 716 tons, of Sunderland, passed the scene of the disaster about the time of its occurrence, and her crew were successful in saving about eighty-seven of the people who were left struggling in the water. Had such help not been forthcoming the disaster would have assumed even greater magnitude, but even as it is we have to go back to the cases of the Strathclyde in 1876 and of the Northfleet in 1873—both of which occurred near Dover—before we find any losses by collision of so direful a character during recent times in British waters. The loss of the Oregon might have been even still more disastrous had it occurred further from land and in a stormy sea, with no help at hand. Thanks to her excellent construction, that vessel remained afloat long after she was run into, and thanks to the favourable circumstances already alluded to, her passengers were saved. With the solitary exception of the proximity of the Ebro, loaded as she was with a deck cargo of deals, which was generously thrown overboard to the assistance of the drowning people—all the conditions associated with this deplorable collision were such as to contribute to wholesale loss of life. The night was dark, the weather far from clear, the water cold, passengers mostly retired for the night, and the ship so designed, as appears by the result, that collision must be followed by speedy sinking.

We have no desire or intention to anticipate the result of any inquiry which may be made into this lamentable occurrence. Our object is merely to comment upon the facts which have so far come to light. The most prominent of these is, that with a hole on her port bow produced by the stem of the Rosa Mary, the W. A. Scholten sank in a few minutes, and that in so doing her bow plunged foremost to the bottom and her stern rose high in the air. Now, the ill-fated vessel was 351ft. in length, and probably had six water-tight transverse bulkheads. Of these one would be situated near each of her extremities, two would form the forward and after boundaries of the machinery compartment, and the other two would divide the forward and after holds each into two water-tight compartments. Whether or not she was actually built with all these six bulkheads remains to be ascertained, but these are the number now usually fitted in cargo vessels of her dimensions. Atlantic passenger steamers are, however, mostly of much larger size, the City of Rome, for instance, being 560ft. in length and 8144 gross tonnage, while the ill-fated Oregon was 501ft. long and 7375 gross tonnage. Such lengths as these admit, of course, of much more considerable subdivision by transverse bulkheads, without unduly cramping the lengths of the several compartments, and spoiling them for stowage. It will be quite clear that the smaller the vessel the greater the interference with stowage by bulkhead subdivision; because with the same number of transverse bulkheads as in a larger vessel, the length of each compartment is so reduced as to shut out certain descriptions of cargo, and in every way interfere with loading and discharging. Hence, while it is quite practicable to so subdivide a large steamer that she shall float with any compartment flooded, the same subdivision in a smaller steamer would render her useless as a cargo carrier. As already remarked, we do not know the actual extent of bulkhead subdivision in the W. A. Scholten; but, having regard to her length, it is very doubtful if either her fore or after holds were in more than two compartments, neglecting, of course, the fore and after peaks. If such was actually the case, one cannot wonder at her foundering when a hole was cut into her side by collision. There are probably very few mercantile steamers afloat which would not behave in the same way. That the space was large into which water was admitted seems evident by the rapidity with which she settled down and by the movement she made in sinking. So far as can be learnt from the evidence yet available, there was nothing in the behaviour of the W. A. Scholten after receiving the colliding blow other than might have been expected, or such as to reflect discredit upon either builders or owners.

But while saying so much, we are far from admitting that the Atlantic passenger trade should necessarily be attended by such risks as are represented by either this or the Oregon disaster. This is a question which should be considered wholly apart from commercial enterprise or shipowners' responsibility. It is one for the Legislature of every civilised country whose subjects are engaged in ocean passenger transport. Such disasters are avoidable, and must be avoided if civilisation is anything more than a name, and naval science anything but a sham. For the safe carriage of passengers on the sea properly designed passenger steamers should be provided. As well might railway passengers be conveyed by mineral trains as ocean passengers be transported in steamers designed principally for cargo-carrying purposes.

The business of the sea in the carriage of merchandise is necessarily attended with danger, however well-built and found a ship may be; and every seaman knows this to be the case when he starts upon a voyage. He faces risks the nature and extent of which he understands. With the carriage of passengers on the sea there must, too, be some danger; just as there is on the railway and in a cab or omnibus. But, when hundreds of human beings are caged on board one vessel, we maintain that the conditions should be rendered as free from risk as our scientific and mechanical knowledge renders possible. Risks which may justifiably be faced by a few seamen in the carrying of a cargo need not, and should not, be presented to hundreds of people, including women and children, cooped up between the decks of a passenger vessel. To render a ship unsinkable through collision is simply a question of dividing her into a sufficient number of compartments, and practically to do so in a vessel which carries a cargo she must be of large size. The conveyance of passengers across the ocean should be limited to vessels properly designed for the purpose. They should be about 500ft. in length, and if fitted with twin screws and divided by longitudinal middle line bulkheads their buoyancy and general safety would be still further assured. Under any circumstances the transverse subdivision should be sufficiently extensive not to leave any compartment of greater length than the vessel's midship breadth. Not only risks by collision, but those due to fire and striking the ground have also to be provided against. In our principal ocean steamers engaged in passenger carrying the arrangements against fire are as complete as at present seems possible, and the cellular system of construction furnishes in itself a good guarantee against loss by striking sunken rocks or reefs. It is the collision danger which chiefly demands attention, and that attention should, we think, be enforced by legislative enactment.

Something might be said about the condition of the boats and their gear on board the W. A. Scholten, but we defer the consideration of that question until further evidence is forthcoming regarding it. Inquiry of some sort must, of course, be made, if only in the coroner's court. It is to be hoped that every detail regarding the bulkhead arrangements in the ill-fated vessel will be determined, and more especially as to whether all the transverse bulkheads extended, unpierced, to the spar deck. The number and positions of the side openings for light, ventilation, coaling, &c., will also be matters of interest. Amid all that is painful and unsatisfactory in connection with this sad event, it is cheering to find that the collision bulkhead of the Rosa Mary was sufficiently strong and tight to keep her afloat after her bow was stove in. Collision bulkheads are not always so trustworthy as in this instance, and very rarely are they strong enough to stand the battering of a sea voyage after the stem is knocked away. Fortunately the Rosa Mary was near a port of shelter, but had the collision occurred in mid-Atlantic the test of her bulkheads efficiency would have been more crucial.

SANITARY SURVEYORS AND INSPECTORS OF NUISANCES.

Some time ago, at a meeting of the Civil and Mechanical Engineers' Society, Mr. G. A. Pryce Cuxson somewhat fluttered the directors of sanitation by publicly proclaiming that the opinion of a sanitary surveyor could be purchased for the price of a pot of beer. The statement was perhaps rather uncomplimentary to the profession, though it did honour to their love of a noble English beverage; but it aroused the ire of most sanitary surveyors who could read, and, having done that, it did nothing more. The ire that had been roused had to subside, and nothing further was heard of the probity of sanitary surveyors, the existence of which no one had previously suspected. This is the curious part of the matter. The law of England makes it incumbent on all local authorities to appoint inspectors of nuisances and sanitary inspectors, whose business it is to watch over the health of the community. The dictum of a sanitary surveyor is taken as final in the very complicated technical question whether a house be in a sanitary condition or not, and yet no care is taken to ensure the appointment of competent men for the post. From the annual reports of the Local Government Board we gather that officials of this kind generally previously held very subordinate positions in the social scale, totally at variance with their present office. Butchers, bakers, old soldiers, and numerous other un-

educated and illiterate people are continually appointed to fill these important posts, without being required to pass any preliminary examination; nor is their salary such as would place them above suspicion. The average pay of a sanitary surveyor or a nuisance inspector seems to be about forty or fifty pounds a-year. With this princely income they are expected to maintain themselves in august respectability, and to frown in scorn at any judicious hints at "palm oil," or pots of beer. The Local Government Board has, indeed, the right to veto the appointment of undesirable persons for these posts, and may—in extreme cases—even appoint such officials itself and compel the local authority to pay them an adequate salary, but we do not believe that any single instance of the Board's exercising this power is on record. The usual method of procedure is typically represented by the following incident, which has recently come to our knowledge. In this case the whole process of the appointment of local sanitary officials is beautifully exemplified.

At the end of last September the Urban Sanitary authority of a southern city advertised for an inspector of nuisances. His salary was stated to be £40 per annum, payable quarterly, and this was to include all expenses except forms, stationery, and postages. It was further stated that the person appointed must be thoroughly acquainted with the district, and, in addition, be prepared practically to devote the whole of his time to the office. He was also required, in addition to obeying all proper directions of the urban authority, to discharge the duties prescribed by the "Public Health Act, 1875," and the regulations "now or from time to time hereafter to be issued by the Local Government Board." In response to this advertisement, fourteen candidates offered themselves for the post, and from among these a certain individual, described as a hotel porter, was selected. The Local Government Board meekly and mildly protested against this appointment in a letter in which they stated that "it does not appear to them that Mr. ———, whose previous occupation is stated in the form to have been that of hotel porter, and who is fifty-six years of age—is likely to have the requisite knowledge and energy for the satisfactory performance of the important duties devolving on an inspector of nuisances," and they requested the Urban Sanitary Authority of this city to reconsider their decision. The mildness of the language, the lame suggestion, will strike every one as a powerful illustration of the utter impotence of the Local Government Board. The result was what was to be expected, the porter was nearly unanimously elected, and the request of the Local Government Board was thus set completely at defiance. Now, it is not for us to say that this individual may not be an exceptionally gifted person, who, while conscientiously discharging his duties as hotel porter, was studying the laws and practice of sanitary science; but we are sufficiently prejudiced to think that a porter who has been accustomed up to the mature age of fifty-six to receive tips from visitors and travellers as he opens the hotel door, is scarcely the man from whom any exalted standard of civic virtue could be reasonably expected. Nor are the opportunities of the ordinary hotel porter such as would prepare them fittingly to perform the duties of a sanitary official. But let us see how the average inspector of nuisances discharges his duties. We have seen how he is elected; our next care will be to behold him in the full glory of office.

At the last Maidstone Assizes an action was brought by a gentleman to recover compensation for loss and damage sustained by him through the act of the defendant, in letting him a house at Beckenham which was in an unsanitary condition. The case was a most interesting one, as all the various sanitary surveyors and medical officers of health who had either reported on this house or were called in to give evidence on one side or the other, flatly contradicted each other, and did not seem to know much about the question in dispute; but the incident of the case to which we wish to direct special attention is the evidence of the inspector of nuisances at Sittingbourne, who was called in as a witness by both parties to the action, and actually gave evidence against himself. The judge took occasion to say that his conduct as a public official was disgraceful. What the mental condition of the inspector must be, and whether people have not been shut up in lunatic asylums on less evidence of insanity than this, we hesitate to say. But sanitary officials similarly situated will rejoice to learn that we have not yet heard that the Local Government Board or any other authority has insisted on his dismissal. The gentleman will probably remain on at his post until death shall remove the nuisance—inspector.

The two instances we have quoted are sufficiently eloquent of themselves, and require no comment. We might go on quoting instances of a similar nature *ad infinitum*, but the above will suffice. What we want to point out is that this state of things cannot be allowed to continue. It is manifestly absurd that the inspection and sanitary condition of our houses should be left in the hands of ignoramuses and imbeciles. These poor creatures defend themselves, and say they are but the slaves of a vicious system, and that if they did their duty honestly they would often have to report against the very people who appoint and dismiss them. But it is not these victims that we are attacking. The system is vicious, and must be radically changed. We are promised some sort of Local Government Bill next session; let us hope that this, perhaps the most important branch of local government, will have the attention of our legislators. In the meantime, the Sanitary Institute of Great Britain has feebly endeavoured to do some good in the interregnum, but we would earnestly request the framers of the new Bill, whatever they do, not to follow in the footsteps of this worthy society. We have seen from what classes the sanitary officials spring, we have seen what salaries they get, and how they perform their duties. Well, the Sanitary Institute of Great Britain has been so good as to imagine that these people are desirous of self-improvement, that the sanitary authorities who appoint them are really sincerely desirous of obtaining high-class men, and that rose-tinted spectacles reproduce accurately and in their true colours the work-a-day world we live in. Starting with these hopeless fallacies, the Sanitary Institute has chivalrously come forward to regenerate sanitary officials by asking them to come and be examined. For this privilege sanitary surveyors are expected to pay a fee of five guineas, and inspectors of nuisances one of three guineas. What is most surprising in all this is that since these examinations were instituted in 1877 as many as nearly three hundred candidates have passed these examinations. Most of these, of course, are never likely to come down so low in the world as to have to apply for an appointment as sanitary surveyor or nuisance inspector; but if they should, the probability is that they would be supplanted by some popular local candidate, in the shape of a cobbler or an hotel porter.

The examinations themselves are of an amusingly severe and rather vague character, to judge by the printed syllabus published by the Institute. The sanitary surveyor is expected to know how to prepare schemes for sewerage works, water works and roads, and how to construct and make them. In other words, he must be a municipal engineer. Some kind of examination is obviously necessary; but would it not be much more advisable to institute competitive examinations for each appointment, or, at any rate, have the examination graduated according to the size and importance of the work? One thing is certain, sanitary authorities—whether rural, urban, or municipal—should be compelled, if they appoint sanitary officials at all, to appoint efficient men, and to pay them salaries on which at least they can support existence. The present state of things is chaotic and disgraceful in the extreme; and the Local Government Board, instead of exercising a proper control, only adds to the chaos by its impotence and weakness, and by countenancing with its official sanction appointments that would be mirth-provoking were they not fraught with such serious consequences.

PIECE-WORK AND TECHNICAL EDUCATION.

In a leader—The Engineer, November 11th—we wrote as follows:—"Perhaps we owe an apology to our readers for once more addressing them on the subject of technical education. Our excuse is that we cannot help dealing with the subject. It is thrust upon us." If we return to the subject again this week, our excuse is that we propose directing attention to a phase of the question that has hitherto escaped notice, viz., the effect of the general adoption of piece-work in our engineering shops, on the training of the apprentices. Down to the year 1875, piece-work, or the system of paying the workmen according to the quantity of work done, had been adopted in very few establishments, but the system has since that date become almost universal. Under the day-work method, or the "come night, come ninepence" system, the apprentices were spread among the journeymen, and as a rule every facility was given to them to pick up all the details of their trade. The journeymen being assured of their day's wages, however small the amount of work they might perform, had therefore no inducement to neglect teaching the boys; and hanging listlessly over "the job," directing the apprentice, was as good a way as any of doing the least they could. Under the piece-work system all this is changed, and there is, we think, far less likelihood of the apprentices being turned out good workmen under the new system.

To bring this point out it is necessary briefly to state here the history of the change from the old to the new system. The course followed in all the works having been pretty much the same, we cannot do better than relate the *modus operandi* carried out at one of the largest engineering and shipbuilding establishments on the Clyde. We have before us a vast mass of data, collected by a very eminent firm, in order to find out the cost of the labour expended in making each of the many thousands of different articles in a shipyard. The hours taken by different workmen, and squads of workmen, were carefully noted, and there is an incredible difference in the cost of the manufacture of duplicate articles by different men. We need only particularise one case, which will serve to indicate hundreds of others equally striking. Here are the facts. Two large engine companion-skylights had to be made for sister ships. A squad of four men and two apprentices were engaged during July and part of August, making the first; and their aggregate wages at the then current rate per hour amounted to £29 4s. Two months later the second skylight was commenced by another squad of men, and the cost of their labour amounted to £44. To arrive at a list of the sums to be paid on piece-work for the various articles, the cost of making everything by day-work was carefully ascertained; and 25 per cent. under the lowest prime cost by the old system was fixed as the price under the new, *i.e.*, the squad who consumed £44 on time-work on the making of the skylight got £22 for the same job on piece-work, and we are able to state that while they were only paid 9d. per hour on day-work, they earned 1s. 4d. per hour by the piece. In other words, the same number of men made the skylight in less than one-third of the time on piece-work that they needed on the day-work system. While the day-work was in force, the apprentices had every attention, and were allowed to do part of the job requiring skill; but it was noticeable under the piece-work method that the boys were put to do all the carrying and machine work, or the "humphing," as the unskilled work is called. Now this has a most important bearing on the training of the apprentices. In France the apprentice is called a "knowledge catcher," and the term is accurately descriptive, for if the boy is to be taught at all he must "catch" knowledge. Under the piece-work system, we have noticed, from close personal observation, that there is much less chance of the apprentices receiving direct instruction from the men, and the run of the shops for five years can only turn them at best into handy labourers. This question seems to have presented itself to the late Mr. Wm. Denny, who was a happy mixture of the eminent expert and far-seeing commercial man; but no step was initiated by him to meet the defect, beyond encouraging mechanics' institutes—but these places have been found a failure. In the large manufacturing towns of the North where they were most encouraged, instead of being schools of practical science, they have become resorts for pleasure-loving audiences, who are amused with panoramas of the Holy Land, the Christy Minstrels, mesmeric or electro-biological quacks; and a miscellany of bad smells and cheap fireworks called chemistry.

We have never concealed our belief in the opinion that the chief school of technical education for artisans in general must be the workshop; but under the piece-work system there are not the same opportunities for the apprentices learning to cut a plank with a saw, boring a hole with a gimlet, or "fitting keys in their seats that will not fall out or require to be wedged in with bits of tin." This knowledge, we think, may be acquired if a part of the work shop be set aside, and a few of the best men are put at the head of the boys and devote themselves to leading them on and bringing out their capabilities. As progress was made the easier portions of the work might be given out to them on piece-work, and by this means not only would they learn their trade, but being paid by results, they would be stimulated into activity, and form the *état major*, or staff of industry. Under such a system as we here indicate the cost of manufacture would not be higher than the prices paid to the squads of journeymen piece-workers, and as the young men became efficient, as a matter of course they would get absorbed among the journeymen, and in this manner the supply of well-trained workmen would be maintained, an end which is hardly possible if the apprentices are left to do only the "humphing," which we are aware is the almost universal practice in the fitting shop at present.

BRITISH MANUFACTURERS AND CONSULAR REPORTS.

In July last year the Foreign-office took into consideration the continuous complaints that the information regarding commercial matters transmitted from abroad by the British consular and diplomatic officers was not of the right kind, came too late, and was not published in an accessible and attractive form, together with the suggestions made for the better promotion of British trade abroad by means of the above officials. These suggestions are so various, adding to the duties of the Consuls those of commercial traveller, debt collector, solicitor, storekeeper, &c., that the Foreign-office declared it should look in vain for men capable of discharging all the duties which its correspondents wished to throw upon the Consuls, and if the men required were discovered, there would remain the difficulty of finding time for such multifarious work. Fresh instructions were issued to the Consuls, conveying to them the substance of the suggestions with regard to their duties, and impressing upon them the value attached to their rendering all such services as they can to British commerce. Arrangements were also made that their reports should be published as received, instead of in parts at long intervals. The rapid publication of these reports—though, owing to their small type and the careless way in which many of them are printed, they are not nearly so attractive in form as their predecessors—has been of the greatest benefit to those contemplating or engaged in business abroad. Though abounding in valuable courteous hints and suggestions, they are often not pleasant reading for the British manufacturer and trader, particularly when drawing attention to his apathy, indifference, neglect, want of tact and the means by which his foreign competitors take away from him a portion or all of his trade. For this reason the consular reports are received with mixed feelings, one section of the commercial classes welcoming and eagerly perusing them in the hope of finding any beneficial information, whilst the other, which was most loud in calling for their publication, denounces the Consuls for their ignorance and incapacity, and decline to be lectured as to their business by men knowing nothing about it. A noticeable instance of this is the case of the Vice-Consul at Santiago, Chili. Early in this year that official, who is unpaid, and carries on a business in the above town, sent a report to the effect that since the Chilian International Exhibition of 1875 British imports of manufactures into Chili had declined, and gave instances. This report was received with the usual chorus of abuse so general when unpleasant facts are set forth. By the ingenious process of comparing the British imports into Chili of the following year, which were exceptionally low, adding to them articles from Australia and India, taking the relative proportions of British imports to the whole in 1876, concealing their actual decline, accusing the Vice-Consul of ignorance of facts, assuming what he did not say, and throwing up a cloud of dust, it was made to appear that British imports into Chili in 1885 exceeded those of 1876 by nearly 3 per cent. Instead of this increase, the Statesman's Year Book gave the return that British imports of home produce into Chili in 1885 were 27¾ per cent. under those of 1876, a much greater falling off than the Vice-Consul's report, which dealt in general terms, suggests. The Foreign-office sent the complaints of inaccuracy to the British Minister at Santiago, requesting him to call upon the Vice-Consul for an explanation. This has been furnished in an elaborate report, replying to the charges and giving details of the trade of the various competing nations in thirty-six articles between 1875 and 1885. The results being that British manufactured imports have decreased during that time by over 8 per cent., while those of France, Germany, and the United States increased by nearly four times the British loss. The British Minister, in forwarding the report, says the Vice-Consul has cleared himself of the charges of ignorance and inaccuracy brought against him, an opinion in which all impartially studying the question, and reading the criticisms and reports, must concur. Shortly afterwards the Consul at Valparaiso sent a report to the effect that England has her fair share—37 per cent,—of the Chilian import trade; and while there are other manufacturing nations it is impossible for her to have it all. In many respects this report corroborates that of the Vice-Consul of Santiago. The do-nothing policy enunciated in the Valparaiso report has found favour in the eyes of a commercial journal, which, for some mysterious reasons, in comparing the two reports, gives that from Valparaiso the preference as a marked improvement over that which shows the decline of British trade, gives reasons for it, and suggests means to obviate it.

COAL MINERS AND RESTRICTION.

One of the most singular features in connection with the proposals of the miners of the kingdom for restriction is the place where the conference is held, and the condition of the trade

there. It is stated that the proposals to restrict the output have been almost solidly voted for by the miners of Northumberland, and that at a time when their trade is feeling the extent of the depression very keenly. Northumberland is one of the coal-yielding counties, which has what may be called a summer trade. It produces good steam coal, and for that it has an especial demand from the Baltic and from the northern counties generally. But its position, the character of its coal, and other circumstances make its trade when winter sets in very small in comparison to that of some other districts—to that of the neighbouring county of Durham, for instance, which has a gas coal trade and a trade in household coal that give it great activity throughout the winter. But Northumberland feels the pinch when winter sets in and the Baltic closes, stopping one of its chief outlets. It is difficult to show by figures the extent of this, because the Tyne, which ships so much steam coal in summer, ships from the other side large quantities of gas and house coal in winter. But as far as can be judged from the figures available, the output of Northumberland is at least 8000 tons per day less in winter than in summer. The effect of this is that the pits which have worked so fully in summer work only part time when winter sets in, and the loss of work means much to the mineowners and to the miners. This state of affairs is now known, nearly all the collieries in Northumberland which produce steam coal chiefly are now working short time—some half-time and some even less. Under these circumstances the decision of the miners is something very much to be wondered at. The dulness of the demand causes the pits to be idle several days in the week, and yet the miners decide that there shall be an additional day lost—that days shall be shorter and that there shall be more idle days. It is very difficult to find the reason for this. It may be that the miners believe that there will be brought about a larger demand of coal, or that the stocks will be so much reduced that they may be able in some measure to dictate their own terms. But they forget that so much of the demand for coal as is for export is chiefly sent in the summer, and that it does to some extent make certain districts independent of the miners in the winter. An example will illustrate this. For months at the beginning of this year the miners of Northumberland were on strike, and it was computed that over 1,500,000 tons of coal which would have been wrought were left untouched. But the market, except in a very limited local area, felt no effect from this, for Durham, Yorkshire, Wales, and Scotland were able to make up the deficiency as far as it was felt, and if the miners restrict in considerable numbers, it yet remains the fact that there are in some of the districts so many men working short time that all that will result from the restrictive movement, after a while, will be a little more equalisation of the production. The coalowners of the North years ago tried the policy of restriction by the "regulation of the vent," as it was called, but the attempts failed time after time, and in the end the laws of supply and demand were left to work their cure; and this is what the miners will have to do; this is what is being in degree done, for the result of the exceptionally dull trade of the last few winters has been to lessen the number of the Northumbrian miners. It is by this, and perhaps by some increased demand in the future rather than by restriction, that the difficulty will be met.

HINDRANCE TO IRRIGATION WORK.

It is a regrettable fact that however well-considered and beneficial in character may be the works of irrigation designed by the authorities of our Indian possessions for the benefit of native agriculture, the main hindrances to their success arise out of the desire of those to be benefitted to throw the whole of the burden of such works upon the general taxpayer. They are inclined always to accept with readiness every proposition made to them the acceptance of which may induce the expenditure of large sums of public money on their behalf; but when once that expenditure has been incurred they prove to be but too ready to repudiate their own part of the bargain. The Indian papers to hand by the last mail record a striking instance of this kind. No sooner had a work of much importance, and costing a large sum of money, been completed, than those benefitted petitioned the Government—even before the water supply had reached them—to permit their ignoring the conditions on which that work has been undertaken. The villagers, to whom the supply was regarded as vital, had engaged to keep the channels through which the water was to be distributed in repair by the contribution of a certain number of days' labour. They have now desired that they should be relieved of this condition. As was to be expected, the petition met with refusal. Judging from our previous experience of such transactions between natives and the Government, we anticipate that the enforcement of the obligation entered into will be met by the refusal on the part of the natives to avail themselves of the supply, and so to escape the labour imposed on them by their agreement. The difficulties in the way of successfully utilising irrigation works in India are indeed endless and most disheartening.

RAILWAY RATES AND CHARGES.

An announcement of great importance to ironmasters concerning the vexed question of the terminal charges imposed by the railway companies is made this week. Lord Henniker, Chairman of the Railway Rates Committee, rightly deems it of extreme interest that two of the great trunk lines of the kingdom should have just refused to contest a claim for the recovery of excess charges brought against them by a Staffordshire ironmaster in the County Court. The companies have, without any fighting, paid the amounts for which they were sued into Court. The railways are the London and North-Western and the Great Western, and they had demanded from a Birmingham iron manufacturer, a member of the Railway Rates Committee, rates for the conveyance of iron which he at first declined to pay on the ground that they were illegal, being in excess of the company's statutory maximum rates. As the company refused to move the iron unless their demands were complied with, the manufacturer paid the rates under protest, and sued both companies to recover the excess. In both instances the companies have now paid the full amounts claimed rather than defend the actions. The rates which this ironmaster declined to pay have been in operation for some time; and, as Lord Henniker points out, it is obvious that the companies have been exceeding their powers in respect of all the traffic of this description. The London and North-Western Company had charged 8s. 4d. per ton for the conveyance of undamageable iron to a Staffordshire town nine and a-half miles distant from Birmingham. The Great Western Company had charged 7s. 4d. per ton for carrying iron from Birmingham to Warwick, a distance of twenty-two miles. In the first case the over-charge was 5s. 4d., or 64 per cent.; and in the latter case 3s., or 41 per cent! The admissions now made by the carriers are of exceeding import, and further urgently evidence the necessity for legislation.

LITERATURE.

Die Bauwerke der Berliner Stadt Eisenbahn Fol., pp. 93, thirty-eight plates. Berlin: Ernst and Korn. 1886.

This imposing folio is a reprint of a series of articles officially communicated by the Minister of Public Works that have appeared in the "Zeitschrift für Bauwesen" descriptive of the structural works on the Stadtbahn or urban line of railway which forms an interior connecting link between the principal terminal stations in the Prussian capital. Berlin, like London and Paris, is most densely populated in its eastern area, and similarly the most important parks and gardens lie on the western side, so that the line may be roughly compared to that of the Metropolitan district between Tower Hill and South Kensington or to the Metropolitan between Paddington and Liverpool-street. Unlike London, however, the principal line of through communication is from west to east—from the Rhine towards Silesia, Poland, and Russia—while the terminal stations of the north and south lines are without any direct short connection. In the words of the text, the Stadtbahn may be regarded as "a great central station" extending from Charlottenburg on the west, to the Silesian terminus on the east. The distance between these points, whose relative positions may be seen in the map illustrating a previous article published in our issue of April 1st, 1887, is nearly 5½ miles, or 12,145 metres, of which 4920 metres are in curves, 2270 metres in inclines, and 1320 metres both in curves and inclines. The radii of curvature vary from 280 to 500 metres, and the inclines from 1 in 500 to 1 in 125. The ten stations cover about one-sixth (1950 metres) of the total length of the line, their individual lengths varying with their importance, from about 130 metres in the simple "halting places" for local trains, to nearly 300 metres in the terminal and central stations, which serve for both local and through traffic. The gradients on the line conform as nearly as possible to the natural surface of the ground, the rails being kept at sufficient height to give a minimum clear headway of 14½ft. at street crossings, in order to avoid as much as possible alterations in the latter. Only in a very few instances has it been found necessary to lower the levels of the street roadway below the bridges.

The line practically is a nearly continuous viaduct, brick arcades alternating with iron bridges at the street and river crossings, while the earthworks are restricted to a short length at either end. The relative proportion of the different parts is as follows:—

	Metres.
Arched viaduct, including the substructure of the stations and stone bridges...	7964
Viaduct with iron superstructure, including road crossings and iron bridges...	1823
Embankment between retaining walls, including the Silesian terminal station	675
Ordinary earthwork, including the Charlottenburg terminal station	1683
Total...	12.145

From the above figures it will readily be seen that the chief objects of engineering interest in the line are its bridges and the arrangements of the stations, and it is to these subjects that the volume is devoted, the different types of brick arching, and the larger bridges in stone and iron, being described with a wealth of illustration which is remarkable even in Prussian official publications. The foundations of the piers seem to have presented few difficulties, as although the ground is of an alluvial character throughout, good sharp sand forming a sufficient bearing surface was found within 10ft. of the surface. In the sections near the river, however, which partly follow old watercourses, the ground is more irregular, the compact sand alternating with masses of peat often of considerable thickness, so that in some cases firm ground was only reached at 56ft. In the deeper foundations, concreting between walls, brick wells and piling were used, the last having been found most advantageous for depths of 22ft. and above, while the other two methods were considered to be of about equal value for depths from 10ft. to 20ft. With less than 9ft. or 10ft. plain walling in brickwork was generally used. The standard spans of the brick viaduct are 8, 10, 12, and 15 metres, costing from £2 12s. to £3 15s. per square metre of ground covered. The bridges over the different branches of the river Spree and the canal harbours are six in number, two being of stone, with three spans of 54ft., 58½ft., and 78ft. respectively, and the remainder in iron.

The most important of the latter are the bridges over the Spree at the Schiffbauerdamm, an elastic arched truss of 160ft. span hinged at the abutments, and that over the Humbolt harbour, which has five V trussed girders of about 100ft. span. Besides the river bridges, detailed particulars are given of eighteen principal street crossings, by bridges of many different types of construction, including arched, latticed, and plate girders; but in almost all cases the principle of flexibility is adopted by the use of pin bearings at abutments and spherical heading where girders are supported on intermediate pillars. Ordinary wrought iron plates and bars have been adopted throughout, as at the time when the works were commenced mild steel had not established its present reputation, neither was it found possible to get steel makers to supply the material.

The stations, which present many interesting points in their arrangements, are mostly somewhat irregular in ground plan, being with few exceptions on curves. The most important one, as being practically the point of arrival and departure of the long distance traffic, is that at the Friedrichstrasse, which adjoins one of the busiest streets in the city. This covers a space of about 3¼ acres, accessible on four sides, of a rather irregular shape, the line being on a curve of 285 metres radius at this place. The building is 520ft. long and 125ft. maximum breadth, the general passenger station and waiting rooms being approached from the south front, while on the north side is a suite of rooms for the use of the Imperial family. Access to the line is obtained by staircases and tunnels through the viaduct, in the manner now generally adopted in Germany, while luggage is raised by direct acting hydraulic lifts capable of lifting a net load of a ton 23ft. in twelve seconds. The station roof is similar in character to that at the Alexander Platz illustrated in our former article, but the arrangement of the principals is somewhat complicated by the annular shape of the station. The Alexander Platz station is nearly 100ft. larger than that at the Friedrichstrasse, and being straight has a more imposing architectural character. Up to the present time, however, the development of the long journey traffic from this point has not been satisfactory, so that part of the station arrangements as originally planned have not been completed.

The eastern end of the line adjoins the old Silesian terminus, the station being covered by an arched lattice truss roof 177ft. span and 670ft. long. The principals are curved to a radius of 130ft., and are put together in halves with a connecting bolt at the summit; the floor ends rest in spherical bearings. In addition to the passenger traffic nearly the whole of the Post-office parcels business is conducted at this station, in which service an average of thirty two parcels vans is despatched daily and a similar number arrive. The number of separate parcels varies from 20,000 to 30,000. At Christmas time the number is increased to about 65,000. Eleven hydraulic lifts are in use for luggage and parcels service, making from 956 to 1506 lifts daily, according to the season.

The line was commenced in the autumn of 1875, and opened for traffic in February, 1882. The cost was £3,754,250, of which £1,994,300 was expended in construction, and £1,759,950 on the purchase of land, the latter item being reduced by £400,000, to be derived from the sale of surplus land. The site of the Friedrichstrasse station, about 3¼ acres, cost about £278,270, and the station as completed £402,840, or about £50 per square yard of surface area covered by the buildings.

It would be impossible to give within the limits possible in these columns any detailed notice of the numerous points of interest touched upon in this volume, which will be of value to many of our readers, even though they may be unable to make use of the text, as the illustrations are models of clearness, and considering their number, the price, 48s., must be regarded as moderate.

JOHN ALGERNON CLARKE.

We announce with great regret the death of Mr. John Algernon Clarke, in his sixtieth year. Mr. Clarke was for many years closely identified with the literature of agriculture, with which he was intimately acquainted. His presence was always looked for and welcomed at the various agricultural shows, and his contributions to the *Times* were remarkable for their impartiality and their acumen. Mr. Clarke was a man of unusual ingenuity, and produced many inventions, which lack of special training as an engineer hindered from coming to much. He suggested to Professor Pepper, of the Polytechnic, a table with which various mechanical feats could be done. This table was to be of glass with tubular legs through which perfectly clear water was to flow and act on mechanism in the table. It was found, however, that air bubbles would intrude and reveal the whole secret. Not content, Mr. Clarke resumed his investigations and conceived an original idea of constructing and actuating trains of wheels without a mechanical power and whilst perfectly insulated. He made several crude experiments without much result, and then took his idea to Mr. Maskelyne, who at once saw the possibility of constructing a dynamic mystery, with proper and very delicate mechanism; and after two years of hard work, Mr. Maskelyne, who is a mechanician of a very high order, succeeded in producing "Psycho," the well-known automaton whist-player, the mystery of whose mode of action has never yet been solved. It is curious yet true that some of the details of this automaton were unknown to Mr. Clarke himself, and he would never permit Mr. Maskelyne to explain them to him. Among other inventions of Mr. Clarke's was a steam hansom. The highway law, however, prevented anything being done in this. Mr. Clarke's health had been indifferent for some time, but his death was quite unexpected. It was due to apoplexy. We add with very deep regret that Mr. Clarke died totally penniless, all his inventions and speculations having been pecuniarily failures, and he leaves a wife and a young son quite unprovided for. The case is one which we commend to the many friends whom Mr. Clarke had among agriculturists and engineers.

South Kensington Museum.—Visitors during the week ending November 19th, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 6787; mercantile marine, Indian section, and other collections, 2805. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m.: Museum, 637; mercantile marine, Indian section, and other collections, free, 1866. Total, 12,095. Average of corresponding week in former years, 12,908. Total from the opening of the Museum, 26,065,107.

Slag Manure.—The development of the manufacture of basic slag manure as an agricultural fertiliser continues to make progress in the Cleveland district. The North-Eastern Steel Company now owns an extensive and very perfect plant for the purpose. The great desideratum appears to be to grind it to an almost impalpable powder, so that it may be the more readily soluble in the rain water charged with carbonic acid, which must be the vehicle whereby the roots of plants are able to assimilate it. To grind a substance of this kind may seem at first sight a simple and easy operation. So it is if a high degree of fineness be not required. But in this case it is the last and not the first step which costs the money. Rapid solubility depends on the area of surface presented by each grain in relation to its weight. The less the size the greater, relatively, is the area of surface exposed. The process of grinding is commenced with edge runners and continued with millstones; those portions which escape without being properly ground being passed again and again through the mills as often as necessary. The manufacture of basic slag manure has been much more developed in Germany than in England. Here the North-Eastern Steel Company has led the way, and the Staffordshire Steel and Ingot Company has done the same in Staffordshire. Now that its utility is generally acknowledged, others are likely to follow. It is certainly absurd, and not very creditable to Great Britain, that raw slag should have been sent to Germany in large quantities to be ground and utilised instead of fertilising our own land with it. The total quantity of basic slag manure at present being manufactured in this country is estimated at above 2000 tons per week. Hitherto not much has been used by British agriculturists except for experimental purposes; but such experiments having been successful, they seemed to have gained confidence, and are ordering in largely increased quantities. The present market price is from 25s. to 30s. per ton, which must yield a handsome profit to producers.

THE ERECTION OF THE FORTH BRIDGE.[1]

By Mr. Andrew S. Biggart.

At the Aberdeen meeting of this Association two years ago, I explained the method proposed to be adopted in the erection of the main steel piers of the Forth Bridge. Since that time this has been accomplished, and we can now take a retrospective view of the completed work. There arose as the work proceeded many points of interest not touched upon at that time, but if taken as a whole, the erection of the piers may be said to have been carried out on the lines then indicated, the only exception requiring notice being the mode adopted for building the internal viaduct. This was done in position, on the overhang system, instead of lifting it from the ground into place complete. While thus there is little further to add to my previous paper, a few remarks on points prominent during the actual erection of the piers should prove of interest. The progress made, as well as the working of the plant, was satisfactory. On some few occasions the piers and the platforms, Fig. 1, were raised as much as 48ft. within eight days. The raising of the platform was done in stages of 16ft., and those were accomplished in some instances within four hours. Frequent delays, more or less protracted, necessarily took place during the erection. For example, when the final adjusting of the columns was being carried out, previous to connecting the various bracings to these members. Before any of the permanent bracing of the piers was fixed to the 12ft. sloping columns, Fig. 2, these had to be about 150ft. high, and owing to their inward batter of 1 in 7½ their tendency was to lie towards the centre of the bridge. This, however, was found to be completely counteracted by the friction at the platform bearings, Fig. 3, preventing the blocks from sliding on the main lifting girders. So long as this lasted these girders acted as effectual struts in keeping the columns apart. The result was also practically the same during the time the weight of the platform rested on the head of the hydraulic rams, Figs. 3 and 4, within the sloping columns, for these lay at all times nearly in the line of the columns themselves. Looking at these conditions, we were not surprised to find some of the columns come a little nearer to, while others went from, their true position in relation to the centre line of the bridge. The columns were individually brought to their true position by means of hydraulic jacks, the platform for the time being resting on the top of the hydraulic rocking rams within the columns, for the purpose of removing the friction between the girders and their bearing blocks, and thus allow the movement to be made more easily. A part of the columns, near the bottom in each case, is left unrivetted for the purpose of relieving any undue initial stress in these members. To make sure that the various members of which the bridge is composed are started at their proper angle, or are at least finally set to such an angle as will, when the bridge is completed, leave only the normal initial stress, is a matter of vital importance. The necessity for this is obvious when we bear in mind that in many members a movement out of the true line of but small amount will at the point of fixture produce in that member an initial stress as great as the whole working stress. Hence, great care is necessary in the setting out to ensure freedom from anything like that indicated. It will readily be seen how that in the setting of nearly the whole of the members many points arise which require to be carefully watched and calculated upon. Thus, the direction of the first bay of the bottom member must be such that when the junction of the permanent tie is made at its outer end the member will be about 1in. high at this point. The stresses at the lower end of the tube will then be the reverse of those at the same point during the time it supported its own weight. These, again, will be reduced to their normal amount if, when the span is completed, the deflection is the same as was calculated upon.

A source of trouble, in the setting out, is the unequal expansion and contraction of the various members, owing to the varying temperature of the parts. The centre line of the upper member of the bridge is sometimes to the east and at other times to the west of the true centre, varying thus according to the sun's position towards the bridge. The bottom members follow the same rule as the piers in regard to horizontal movement—that is, they recede from the sun. The receding is due to the greater expansion of that portion of the tubes facing the sun than the other parts, and this is the more marked if the sun has been shining brightly for a considerable time. Before the piers attained their full height, the erection of the cantilevers was begun, Fig. 5. The first parts started were the bottom members. These consist of tubes, and were built on the overhang system, without support, for a length of over 100ft. At first a crane was employed to build the tubes. It was fixed in front of each skewback, and placed the plates and beams individually in position. As the building proceeded the tubes were rivetted up behind by hydraulic machines, very similar to those employed for rivetting the 12ft. sloping columns. The means adopted to carry the bottom members out further were now brought into use. A rectangular cage, carried at the end of each tube, and within which there is room for the rivetting machine and the men at work, is the plan which has been adopted, Fig. 6. On the top of this cage is placed an hydraulic crane for lifting and placing the plates and beams in position and doing other necessary work. The material is brought within reach of the crane by a tramway running parallel with and fixed to the bottom member. The cage is rectangular in section, and is secured to the tube by strut and tie connections extending from the corners to rings encircling the tube at short intervals. In elevation the cage is composed of six braced rectangular sections securely bolted to each other, while in plan six series of bracings connect the two sides to one another. All the sections are exactly similar, and thus permit the interchange necessary as the work proceeds. This interchanging consists in removing two of the sections, when an advance requires to be made, from the back of the cage, and placing them in front by the hydraulic crane on the top of the cage. The hydraulic crane is of a simple form, and is capable of performing three independent movements—(1) Lifting and lowering the load; (2) turning a complete circle; (3) traversing the full length of the cage.

The tramway consists of a continuous angle, resting on brackets bolted to the bottom member, Fig. 5. On it there is drawn backwards and forwards by means of a steel rope a carriage, to which is hung the material to be run out. The building of the bottom member was, as mentioned, continued without support, till the weight of itself and the plant on the tube raised the stress at the root to about 7½ tons per square inch. Temporary ties were then resorted to to furnish the necessary support. These ties were of two kinds—(1) A light link or carrying tie, and (2) the main plate tie. The link ties were carried from each side of the tubes to the 12ft. sloping columns of the piers. They were attached both to the tubes and columns by gusset plates. So soon as these plates were fixed to the sloping columns the link ties were hung from them in sections, till they had reached their full length. The bottom end was now drawn out by tackle till near its place of junction with the bottom member. Here the tackle gave place to two large steel bolts, the one end of which passed between two channels bolted to the ties, while the other was held by a bracket fixed on the gusset in line with the tie. By these bolts the link ties were pulled up, till a camber of about 20in. was attained, at which point they were attached to the bottom member. A platform formed of cross beams and longitudinal timbers was now secured by hangers to the link ties to permit of progress being made with the main plate ties. These were secured immediately under the link ties and at the ends attached to the columns and tubes by gusset plates. The main plate ties were built from the platform, beginning at the highest point. It is here worthy of notice that the platform and ties were in some cases built in position by means of the cranes placed on the main pier platforms 350ft. above high water. On some other occasions they were lifted by tackle fixed to a temporary carriage on the link ties. In this case the platform for carrying the plate tie was built as the erection of the tie proceeded. So soon as the tie was completed it was connected to the gussets of the bottom member by bolts. It, however, remained free until the member should be raised by hydraulic rams to relieve the initial stress in the tube, and at the same time take up any slackness in the plate ties. The main plate ties between the sloping columns were raised in sections, and rested on platforms hung to the permanent bracing above their position.

As the first-mentioned plate ties were built in position, the stress on the link ties increased, with the result that the bottom member rose. In this way the dip of the link tie became 4ft. To raise the bottom member still further, two angles were bolted to the tie, on each side of the tube. They extended beyond the lower part of the tube, and served to fix a cross girder, on which two hydraulic cylinders were carried. Another girder was placed in front of these cylinders, having its bearings on the tube. On it a pressure of 120 tons was brought to bear, which acting on the tube, raised it, until the whole of the initial stress was practically eliminated in the free cantilevers. In the case of the fixed cantilevers the original stresses at the root of these members were not only relieved, but to a small extent reversed, on account of the tubes being much lighter. The gussets, at the bottom of the main plate ties, were now secured to the bottom member. It is interesting to follow the various vertical movements that take place in these bottom members. These are (1) a gradual fall, due to the weight of the tubes, and of the temporary plant, when being built out; (2) a rise, due to the pull occasioned by the weight of the link ties; (3) a rise, caused by the increased pull on the link ties, when the platforms and main plate ties are placed in position; (4) a rise, as the hydraulic rams raise the member; (5) a gradual fall, on account of the stretching of the main plate ties, as a weight of a portion of the first bays of the cantilevers and plant is transmitted to the ties; (6) a rise, due to a temporary pull, to be put in force before connecting the permanent ties; (7) a gradual fall, as the cantilevers are built out. This is intended to leave the bottom members with only the normal initial stress when the bridge is completed.

A start was made to the erection of the platforms, to be used in building the first bays of the cantilevers, so soon as the main plate ties were connected to the bottom members. They are in form rectangular, and consist of two parallel lattice girders connected together by cross and diagonal bracing, and the timber flooring on the top. These platforms—of which there are two for each cantilever—extend from the 12ft. sloping columns, around which they are built, to the ties at the centre of Bay 1, bottom member. Provision is made for extending them by overhang, so that the building of the struts and other parts may be within range. The erection of the platforms and other temporary parts and placing them in position was a work which occupied a considerable amount of time. The main lifting girders were built on trestles, either in position or immediately in front of the skewbacks, and pulled along the top of the tube on cradles into position. This being accomplished, the platform girders were built immediately over the bottom members, on timbers, resting on the tubes. These were then lifted by tackle, or the hydraulic jacks, until in a horizontal position, over the main lifting girder. The platforms were then completed. The main lifting girders and platforms were now raised high enough to allow the jacks and cross-girders, at the ties in the centre of Bay 1, to be fixed in position. All was now in order for the lifting to proceed, upon which the further raising was performed as described. The hydraulic jacks at the sloping columns each consist of a cylinder, piston, and hollow trunk, through which the upper part of the tie is made to pass. To the top of each cylinder a bow or crosshead is secured, through which also the tie passes. The jacks at the other end of the platforms are of the piston type. While the one end of the platform is supported from underneath, the other end is hung by two light ties, hanging from the hydraulic jacks at each sloping column. These jacks rest on a girder bolted to the main plate tie gussets. The upper part of the ties is composed of single and double bars alternately for a length of about 24ft., and have cotter holes 12in. apart. These bars are rivetted to one another, while the lower end is bolted to the ties. The lower part of the ties, again, is composed of standard lengths of flat bars, joined together by duplicate covers, and secured at the lower end to the platform girders. The aim in having two parts in each tie is to reduce the part through which cotter holes are cut. Cotters pass through these holes and transfer the load to the trunk or bow of the hydraulic jack, as the case may require. The permanent ties at the centre of Bay 1, to which the platform extends, are utilised as lifting columns during the time the platforms are being raised. When raising the platforms, what is done is to remove in single lengths at a time the flats in the lower parts of the ties at the sloping columns. This is effected by securing the ties at a point immediately under the lengths to be removed to temporary hangers underneath the hydraulic jacks, and while so held, to remove the length between this point and the jacks. The upper part is now lowered and secured to the lower part. The platforms are raised 12in. at each stroke of the jacks. To effect this, cotters were inserted over the trunks, and on water being admitted to the jacks these raise both ties and platforms. When the ties are lifted 12in. the upper cotters are withdrawn and inserted 12in. lower down. The water is then exhausted a little, which causes the platform to again rest on the hydraulic jacks. This action continued completes the lift. Simultaneously with the raising of the end of the platform at the main piers, the other end, at the ties in the centre of Bay 1, has to be raised. The mode adopted is, however, wholly different from that just described. The columns at this point are rectangular. In each column, under the main lifting girder, there are placed three cross girders and a hydraulic jack. These cross girders extend from one side of the column to the other at right angles to the main lifting girder, and are secured to the column by steel pins. The jack is secured to the main lifting girder by a sliding block. Immediately underneath the jack, one of the cross girders is fixed to the column, while at the opposite side the other two cross girders are secured also to the column. The jack and the upper of the two cross girders are raised along with the main lifting girder when water is admitted to the jack. The cross girder under the jack serves as the bearing from which to raise the platform. During the time of lifting packing is inserted between the girders as a security against a sudden drop should anything give way. The lower cross girders are now raised, and all is again ready for another lift. The erection of the struts and their bracings, the ties, and the other parts of the permanent structure is now partly proceeding from off these platforms in much the same way as has already been done in the case of the pier platforms. The first section of the bracing between the bottom members has been built out by overhang ties and other supports being brought into requisition to keep the work in position previous to the junction of the ends with the bottom members. As in the case of the piers, so in that of the cantilevers, much of the permanent structure is made use of in the erection, thus with some small additions all the main lifting girders, platform girders, and temporary ties are parts of some of the last required members of the bridge. The weight thus employed will be about 1800 tons.

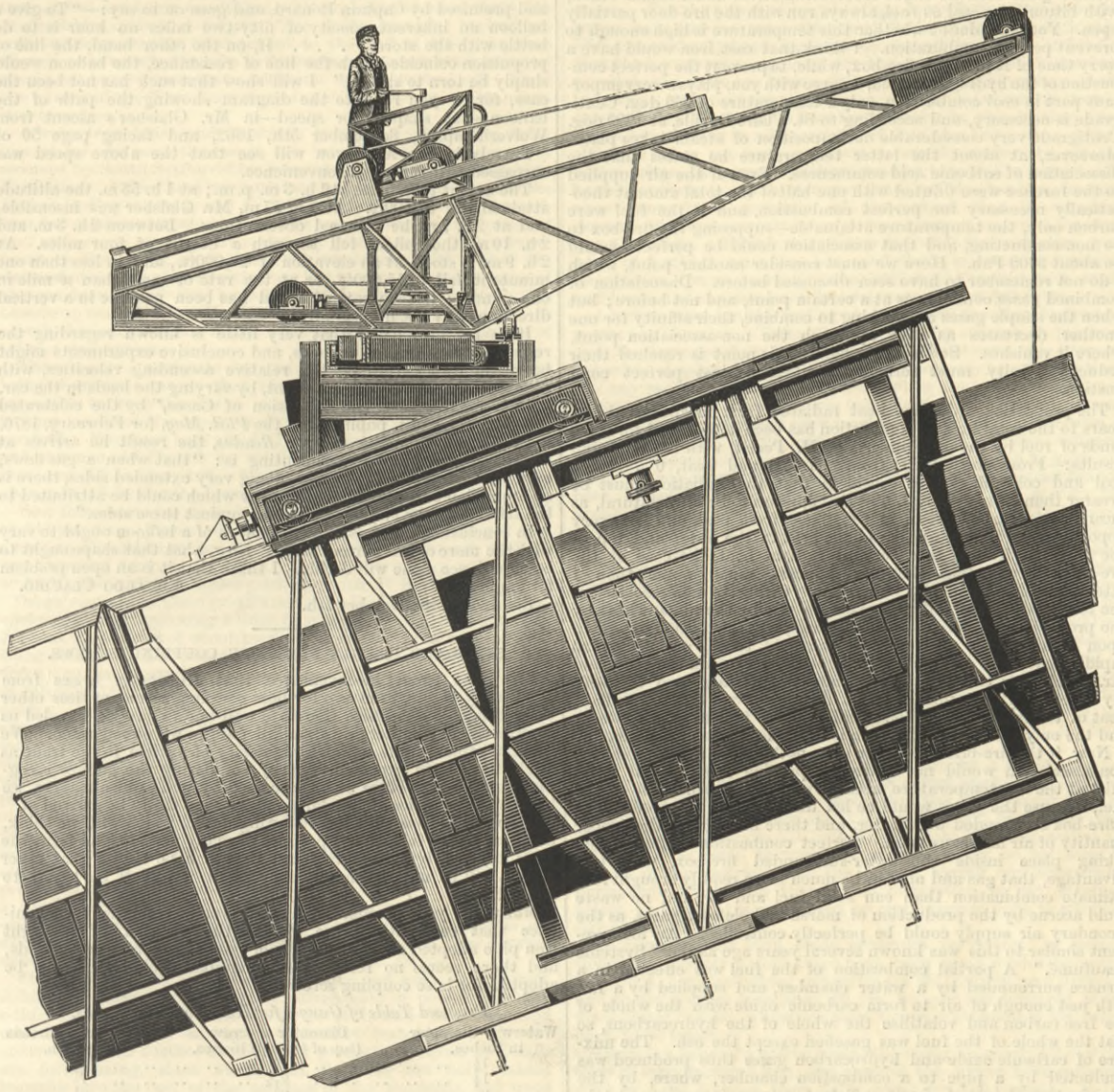
While the foregoing are the lines on which the work has been carried out, it is well to mention that the details of work, similar at each of the three piers, have in a few cases been done differently at each pier. This is due at times to experience gained, in other cases to suit the varying circumstances, at the different piers.

Fig. 2—A MAIN CANTILEVER PIER.

[1] Paper read before the British Association by Mr. Andrew S. Biggart.

ERECTION OF THE FORTH BRIDGE.—RIVETTING CAGE.

Fig. 6



Apart from these causes the same minor plant is used, as much as time will permit, at each pier by transferring it from the one pier to the other, as its use can be dispensed with. From the experience already gained much that will determine the type of plant to be employed in the future work of erection has been learned. Thus, after due consideration, Mr. Arrol has, in consultation with Sir John Fowler and Mr. Baker, settled the principle on which the erection of the next bays of the cantilevers will proceed. This decision has been arrived at after carefully observing the work performed by some of the cranes on the pier platforms, at a height of 300ft. above the work on which they were engaged, and in view of the time and cost taken in the erection of large platforms. It is not my intention to enter into this at present, suffice it to say that cranes and light cages, or platforms, will be the feature of the proposed method. Advantage will also be taken of the internal viaduct, as a position from which much useful work can be carried out. Looking back on the work accomplished since the last time I was before you, and of which I have to-day given you but a faint sketch, everything confirms the opinion, then expressed, that the successful completion of the Forth Bridge will be an event of the near future. The engraving, Fig. 6, is from a drawing by Mr. Neville.

LETTERS TO THE EDITOR.

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

WATER SOFTENING.

Sir,—Suffer me a little space to comment upon the two heated letters in your issue of the 11th inst. from Messrs. Gray and Howatson, who appear sorely wounded by my lifting the veil and disclosing the language of their own prospectus. In my letter in your paper of the 4th inst., I did not make use of your space to advertise the names of those who in the course of ten years have adopted one or other of my systems of water softening and purification. I rather sought, as your readers may have seen, to show that the chemical conditions and reactions are independent of the form of the vessels or apparatus in which they are carried out, their efficacy depending upon the care and attention given to their proportions and qualities.

Messrs. Howatson, Gray, and others have, however, given you the names of several firms at home and abroad in testimony of satisfactory chemical results having been obtained in their respective apparatus; and Messrs. Gray and Co. took you to task for putting the Porter-Clark process so prominently forward in your article of 21st October.

Then I thought it fair to point out that the means described in the prospectus of Messrs. Gray and Howatson, as those by which they secured accuracy in the proportions of water and chemicals, and obtained those results they so repeatedly wrote you about, are identical with what were designed years ago by Sir Frederick Bramwell and employed by me and—as to others—named in my second patent, 1879; and I quoted the red type of their prospectus to the effect that their apparatus "supersedes other previous and similar inventions."

They, angrily, reply that it is being adopted by some clients of mine. It may be, but my clients, like Mr. Howatson, have spared me hitherto the knowledge of it. I dare say Mr. Howatson and Messrs. Gray are aware also that Messrs. Apperley, Curtis, and Co. and Messrs. Hunt and Winterbotham, of Gloucestershire, have preferred to follow the advice of those who have had experience of the Porter-Clark process, and that accordingly their boast of "superseding" similar and previous inventions has exceptions.

Mr. Howatson alludes to the Stanhope as the French apparatus I referred to, and in some confusion of ideas about managers, alludes probably to the introduction of that apparatus at my friend, Mr. Duncan's, sugar refinery. To-day, Mr. Duncan and his chemist and manager, Mr. Newlands, recommend Messrs. Odams and Co., their neighbours, to adopt mine, and they have given orders for it accordingly, recognising, no doubt, the advantage of conducting the work from the ground level instead of having to send the workman aloft to attend the solution tanks; moreover, the outlay is much less, while the structural work is more simple and solid. In this Messrs. Odams and Co. follow Messrs. Francis and Co., the cement manufacturers; Messrs. Fisher, the paper manufacturers, of Tamworth; and Messrs. Ramsden and Bradford; all of whom had the Stanhope, and possibly the Howatson pressed on their notice.

The *Times* of August 23rd, 1877, gave Mr. Bramwell's—now Sir Frederick—paper on the Porter-Clark process as it was for the first time put in operation under his advice. Mr. Duncan then adopted it on a small scale, and the results he obtained from it led to its adoption by the Silvertown India-rubber Company and two other sugar refineries in his neighbourhood, and determined the London and North-Western Railway Company, who now treat 1,000,000 gallons daily by it. Pray pardon my making all this parade, but I think the tone of Messrs. Howatson and Gray provoke it.

London, Nov. 12th. JOHN H. PORTER.

Sir,—Mr. J. H. Porter's letter is far too sweeping in its condemnation of all water-softening apparatus except his own to be allowed to pass without comment. No one denies that the Porter apparatus will do a great deal towards the object in view, but we know of no one who finds or thinks it an advantage to require always to use a considerable amount of engine power, at once troublesome and expensive, the sole object of which is to obtain the necessary pressure to, as he expresses it, "utilise the precipitate produced in the working of the process as the medium of filtration." Mr. Porter states that the advantage of this is to be able to filter continuously day and night, but omits to point out that the engine must also be kept at work day and night. Now one very great advantage attaching to the French apparatus, viz., the Stanhope, which he is so kind as to refer to, is that no power is required at any time, and the system of tanks at which he sneers is so perfectly automatic that it can be left working all night without any attention whatever.

Now working cost is of the most vital importance in all commercial undertakings, while prime cost of an apparatus like ours, which does not depreciate like boilers or engines, is of little moment, and practically reduces itself in most cases to interest on outlay. It is only when the working cost is small that the economy of water softening becomes evident, and we think we are well within the mark in saying that the retention of the antique and costly method of forcing water through filters, instead of the modern and more efficient method of decantation from shelved tanks, does very much harm to the progress of industrial and town water engineering. Water-softening apparatus has been continually improved by gradual simplification, until the present most efficient and economical forms approach strikingly to Dr. Clark's original settling tanks.

It is well to note that the system in use at Canterbury, Caterham, and Bushey is the same as Dr. Clark's original design, which bears no practical resemblance to the so-called Porter-Clark.

We fear that "A. B. C." has failed intimately to acquaint himself with the practical working of surface condensers. The condensed water is never fit for use again, for it invariably contains injurious quantities of grease and oil derived from the cylinders, and no engineer of experience would advise its use in the boilers; there is no economy in doing so, but the reverse. Again, the condensers themselves, being cooled by means of hard water, scale up just as boilers do, so that they afford no real satisfaction in any direction. It is true they are really useful for ship use, but even then they are only the lesser of two evils.

THE STANHOPE COMPANY, Limited.
(JOHN S. SAWREY, Managing Director.)

20, Bucklersbury, London, E.C.,
November 16th.

TECHNICAL EDUCATION AND FOREIGN COMPETITION.

Sir,—Although much has been said and written on this subject, the real cause of our being behind on our merits, in my opinion, seems to be overlooked, except so far as the President of the Civil Engineers touches upon it in his address, viz., the great difference in the number of hours worked by foreign workmen and the low rate of wages paid in proportion. Now, a skilled mechanic should be worth 30s. a week; exceptionally good men a few shillings more; duffers a few shillings less. So it is not the British workman that gets too much; it is the continental workman that gets too little. It is the difference in the hours worked that tells more than the difference in the wages, and I think it would have been better for the trade and for the workmen had they accepted the advance of wages proffered in 1872 instead of standing out for the reduction of hours from 57½ to 54 per week. We have never been fairly settled down to work since that time, and masters have had to economise and cut down wages at intervals to equalise this great change. The advance of wages would have been a more lasting benefit to the men, as the lump sum would have been received every week, and the average rate of wages would have been higher. As it is, he receives his less time—say half-hour less per day—having, as it were, so many bites at the cherry, but he has lost the cherry in the amount of wages that he would have received for the extra time worked, it having been found impossible to eat the cherry and have the cherry.

It appears, then, not to be so much technical education and high-pressure learning that is necessary as application to work, business smartness, and more confidence between masters and men, so that a strike or lock-out may only take place as a last resort. Given the British workman will not part with his fifty-four hours for a week, we must do the greatest amount of work possible in this time to keep the wages from drifting lower. Can those that believe technical education is the cause of our getting behind, explain how it is that the educated foreign workman has to work longer hours and have lower wages to enable him to compete with the uneducated British workman, giving him trade protection in? Again, suppose the British workman gets all this learning into him, will he tackle trade questions with a more open mind, and work longer hours and have lower wages if the facts of the case prove to him that it is necessary it should be so? Business smartness considers well the locality for establishing works of production so as not to be too heavily handicapped with heavy railway rates in receiving material and forwarding finished work to customers, also to consider the rate of wages paid in those districts, as, for instance, the removing of the steel works from Dronfield to Workington, also the removal of the Dowlais works to Cardiff; this will enable the steel master and man to compete with their rivals on more equal terms; the same flank movement may be adopted by other capitalists in the course of time. I fail to see that technical education has brought to bear on these changes. Many of us will remember the palmy days of shipbuilding on the Thames. Was it education that took it from there to the Clyde? Was not the low wages paid and convenience of getting material an important factor in the case? I suppose it is the same reason that is causing the old-established firm of Sharp, Stewart, and Co. to consider the advisability of removing their business from Manchester to Glasgow, unless, indeed, the Glasgow men are better educated, consequently work for lower wages. This is a very important question, and if the British workman gets the impression by following up these facts, that the more educated he becomes the less wages he will get, he will come to the conclusion that "where ignorance is bliss 'tis folly to be wise."

The Whitworth Scholarships were founded to bring to the front the very best men; it would be interesting to know how many of these scholars have forged ahead of other men who have received an ordinary education only; it would give us some idea of what we may expect from the new high-pressure schools. It seems to me they will have a tendency to make a young man Jack-of-all-trades and master of none. GAFFER.

Manchester, November 21st.

FREE TRADE AND NO TRADE.

Sir,—The many letters I have received on this matter seem to show that opinion is more ripe upon it and more ready for action than I thought. Would you allow me to say that I would be glad to to hear from all who are interested in the matter, with a view to some united action being arranged. Letters may be addressed to me here, or to the London Institution, Finsbury-circus, E.C. I would specially like to hear from "Trader." WM. MUIR.

5, Angel-place, Edmonton, November 22nd.

Sir,—I am afraid the point of my letter in your issue of the 4th inst. has been misunderstood by Mr. Ransome. I stated that Mr. Giffen had made the discovery that our Free Trade system frees capital and labour for other industries. Mr. Ransome quotes Mr. Muir, who asserts that Protection would result in a great increase of population, which would be equally beneficial from this new point of view of the blessings of Free Trade. But Mr. Muir also asserts that we should regain many internal industries, and states that increase of population would be the result of what he considers would be our greater psosperity.

Now, if we regained many internal industries it would reduce imports, and as it is an axiom of Free Trade that imports are income and exports expenditure, we should certainly be in a worse position than we are now. Probably "Trader" leans to the old mercantile idea, which is in direct opposition to this axiom; but he has a great deal to unlearn if he imagines that what he finds good for himself as an individual is equally good for a number of individuals forming a nation. That is quite an exploded idea with political economists in this country, and the result is that we foster imports and free numbers of people for other industries. Some of these people are now calling themselves unemployed and giving a great deal of trouble; but they are ignorant of the truths of political economy and must be taught. If they can learn in no other way, it will be knocked into their heads by a policeman's baton, as a large increase in the force has just been decided on for their especial benefit. We can easily defray the cost of the extra police out of our continually increasing imports. JOHN BRETT.

Hounslow, November 21st.

THE PRESTON DOCKS—RIVER RIBBLE FROM PRESTON TO THE IRISH SEA.

Sir,—I have only to-day seen and read your leading article of the 4th inst. I do not wonder at your saying "that nobody in Preston knows very much about the amount of work to be done," and what little they do know I have taught them. The time and money which I have expended on this subject have been enormous. There is now a common expression in Preston and the neighbourhood, "Roberts is right, after all;" and "it is his doing that the town has at last awakened up so as to call in an independent engineer to give an unbiassed opinion."

Allow me again to repeat the facts which I know cannot be disputed. Opinions can be disputed. Facts are facts, and cannot be altered. Opinions may and do vary. (1) From the dock to Lytham the distance is nine miles. (2) From Lytham to the sea—the bar of the river Ribble where it enters the Irish Sea—is eight miles. (3) The bed of the river Ribble from the dock to Lytham is "to be lowered" not deepened, at Lytham from 10ft. to 12ft., at the dock from 18ft. to 20ft., and the difference in level between the two places will be about 2ft.—2ft. of fall in 9 miles—and at Lytham it will be some 2ft. above the level of the bar eight miles off—which bar has on it at low-water spring tides from 3ft. to 4ft. of water. The reason I say the bed of the river Ribble has to be lowered, not deepened, is because to deepen a river is to give more water—greater depth of water—that is exactly what has always been done on all and every other river in the world. Here they propose to take earth out of the river Ribble at Lytham 10ft. to 12ft. deep, at Preston 18ft. to 20ft. deep; length 9 miles. When done, at one end 2ft. above the bar, at Preston 4ft. above the bar; and the bar has on it from 3ft. to 4ft. of water at low-water spring tides, and Lytham eight miles from the bar. (4) From Lytham to the bar is a mass of sand, gravel, mud, and clay, more or less a

little higher than the bar, with holes in the channel. Just before you reach the bar is a long deep hole. About five miles of this eight miles is in the open estuary—that is, land on the north side is thirty miles off, the Irish Sea on the west, and on the south land is thirty miles off. (5) The channel of the river Ribble across these sands is very tortuous and narrow—too narrow for any ocean steamer to navigate. To give you a homely example, it is like a deep ditch with high banks at each side, and every strong south-west wind fills up the ditch, and the river has to find another course to the same outlet. The entrance of the bar of the river Ribble into the Irish Sea has not, I believe, altered its position, but the channel across the sands alters with every south-west wind; and remember that these banks at each side of the channel will be from 9ft. to 12ft. high, in some places higher.

I am of opinion that no man who understands levels, and heights, and depths, the rise and fall of tides, who after reading and carefully considering the above five facts, can come to any other conclusion than of the hopelessness and impracticability of the Preston Dock scheme. I shall be obliged if you will publish the enclosed cutting from a local paper. G. HENRY ROBERTS, C.E.

87, Fishergate Hill, Preston, 18th November.

THE BUOYING OF THE RIBBLE—PROTEST OF SHIPOWNERS.

(*To the Editor of the Preston Guardian.*)

Sir,—We, the owners of the Lady Alice Kenlis, protest against the ignorant management of the buoys in the Ribble Channel below Lytham. We sent our captain down at low water to inspect the channel on Sunday. When going down with the steamer, the weather being rather hazy, he went on in the old channel, and looking for the fifth buoy that was there on Thursday could not find it, and consequently ran aground. We have since ascertained that the buoy was shifted about a mile to the north into another channel.

The river about this place divides into three channels, all going out to sea at low water. Sometimes one is better than the others, but what we complain of is that no notice was given either to us at our office at the Quay, or to our captain. (Signed) JOHN PALEY.
EDWARD PYKE.
THOS. MOUNSEY.
THOMAS JACKSON.

FOREIGN TORPEDO BOATS.

SIR,—In these days of keen competition and constant invention, any information respecting the progress of the foreign shipbuilding trade must be not without interest to many of your readers. We therefore venture to append particulars obtained from ships' logs, which have been sent us from a trustworthy source, respecting eight torpedo boats recently built for the Italian Government by Mr. F. Schichau of Elbing. These boats have been completed and launched during the months from June to October, and under the terms of the contract had to be delivered by the constructor in Italy. They were manned by ordinary merchant sailors, and the following very satisfactory results of their respective voyages bear high testimony to their seaworthiness. The delivery of the boats was accomplished in four voyages, not more than two boats being despatched at the same time.

First voyage.—Boats Nos. 101 and 102 left Pillau 15th June, arrived at Portland 18th June, left Portland 19th June, arrived Cadiz 20th June, thence to Gibraltar in 4 hours, and from Gibralta to Spezzia in 2 days 14 hours. Total time of journey, 8 days 22 hours.

Second voyage.—Boats Nos. 103 and 104 left Pillau 13th July, arrived at Portland 18th July, left 19th July, arrived at Gibraltar 21st July, from Gibraltar to Spezzia 2 days 12 hours. Total time of steaming, 8 days 18 hours.

Third voyage.—Boats Nos. 105 and 106 left Pillau 25th August, arrived Portsmouth 28th August, in dock there ten days on account of storm, left 7th September, arrived Gibraltar 10th September, left 11th September, and reached Spezzia 13th September. Total time under steam, 8 days 20 hours.

Fourth voyage.—Boats 107 and 108 left Pillau 29th September, reached Ramsgate 2nd October, and Portland 5th October, left Portland 5th October, arrived at Gibraltar 8th October, reached Spezzia 12th October. Total time under steam, 8 days 22 hours.

Although the tonnage of these boats is under 70 tons, we find that, estimating the length of the journey from Pillau to Spezzia by the route indicated to be roughly 3600 miles, the average speed maintained during the whole of the voyage by each torpedo boat is about seventeen English statute miles per hour.

BOLLING AND LOWE.

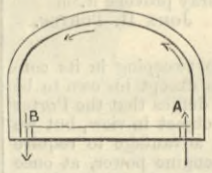
THE CALORIFIC VALUE OF FUEL.

SIR,—I have firstly to thank you for your remarks upon my letter of the 28th ult., and secondly to point out a misprint in the letter itself, which alters the meaning of one sentence. At the end of the second paragraph I am supposed to say, "In fact, the uncombined gases which find their way into the chimney in the former case are in the latter forced by the cooling effect of the water-jacket to *continue* in the fire-box and render up their heat to it;" "continue" should read "combine." In your leader of last week you point out the value of the hydrogen in fuel, and I do not think you over-rate it, if anything, the reverse; for I fail to see why, when the hydrogen and oxygen exist in a compound in the proportion necessary to form water, the hydrogen should be ignored as a heat producer. If only sufficient air be admitted, and the temperature be not allowed to rise too high through the influence of a water casing, all the oxidisable portions of the fuel must be consumed, and render up the total heat due to their combustion, to be afterwards employed usefully or not as the case may be. It cannot matter in what way they are oxidised if only the action be complete. It would be impossible for me to formulate the steps of combustion in a firebrick furnace or locomotive fire-box while the air is passing through the fuel, as everything depends upon the thickness of the fuel and the quantity of air admitted underneath the fire bars. I think, however, it will not be denied that under most circumstances solid fuel should be supplied with two currents of air, one from below and passing through the fuel, and one above it to oxidise that part which has been gasified only. This is of great importance when a chimney draught is employed, as if air be only admitted beneath the fuel, it is found necessary to use as much as double that theoretically necessary for perfect combustion, meaning, of course, that a large amount of air has to be heated up to the chimney temperature, and discharged without performing duty. With forced draught, I think that it would be well worth the while if those engineers who have the means at hand would try the experiment of making the waste gases from the boiler flues pass through a regenerator on their way to the chimney, the air to supply combustion passing through the same regenerator in a reverse direction. There need be no difficulty about it; a set of tubes is all that would be necessary, the products of combustion passing along the outside of the tubes, and the cold air flowing in a reverse direction in their inside. Four-fifths of the waste heat ought to be picked up in this way, and a much less quantity of air would be necessary for the purpose of dilution, as combustion would be more easily perfected. The hot air should be used above the fuel, and not made to pass through it for obvious practical reasons. There is not the slightest doubt that radiant heat plays a most important *rôle* in combustion, and I should imagine that its action follows pretty closely that of light, namely, that *cæteris paribus*, its evaporative effect per unit of heating surface would vary inversely as the square of the distance of the boiler plates from the incandescent material. Furthermore, I am inclined to think that the radiant effect of solid fuel in a state of incandescence is greater than that of gaseous fuel under the same conditions. In the locomotive boiler you refer to the effect of radiation must have been considerably reduced by lowering the fire-bars, thus increasing the distance between the fuel and that part of the fire-box which, above all others, is the most powerful per square foot of heating surface for evaporative purposes, being situated directly over the fuel. The locomotive fire-box of the present day must be considered as a gas generator and furnace combined, as the depth of fuel is great, and the amount of air passing through it small compared with the total amount required for complete combustion. The deficiency is made up by a large quantity entering above the fuel through the fire-door; hence the intense glare seen at night from locomotives under steam which, with bituminous coal as fuel, always run with the fire-door partially open. You, Sir, doubt whether this temperature is high enough to prevent perfect combination. I think that cast iron would have a sorry time of it in such a fire-box, while, to prevent the perfect combustion of the hydrogen, which, I agree with you, plays a very important part in coal combustion, only a temperature of 960 deg. Centigrade is necessary, and according to St. Claire Deville, at 1200 deg. Centigrade very considerable decomposition of steam takes place. Moreover, at about the latter temperature he states that the dissociation of carbonic acid commences. Even if the air supplied to the furnace were diluted with one-half of the total amount theoretically necessary for perfect combustion, and if the fuel were carbon only, the temperature attainable—supposing the fire-box to be non-conducting, and that association could be perfect—would be about 3300 Fah. Here we must consider another point, which I do not remember to have seen discussed before. Dissociation of combined gases commences at a certain point, and not before; but when the simple gases are seeking to combine, their affinity for one another decreases as they approach the non-association point, where it vanishes. So that long before this point is reached their reduced affinity must seriously militate against perfect combustion.

The proportion which the heat radiated from incandescent fuel bears to the total heat of combustion has been determined for some kinds of fuel by the experiments of M. Peclet, with the following results:—From wood, 0·29; from charcoal and peat, 0·5. From coal and coke M. Peclet considers that the radiation must be greater than from charcoal, and this appears to be only natural, as incandescent carbon exists in the flame from coal, and has every opportunity of giving up its radiant heat to the sides and top of the fire-box. Taking into account radiant heat, the case of the fire-brick combustion chamber appears much worse than I attempted to show in my last letter. Owing to non-association, the temperature can only be made to rise by the radiant heat by the production of more dissociated gases, a great portion of which, upon coming into contact with the cold tubes, are cooled so rapidly that I do not believe that they ever again combine, and Mr. Goodman's calorimeter experiments certainly tend to prove my theory. There appears to be no useful way for the radiant heat of the incandescent solid and gaseous fuel to expend itself, and the only thing that it can do is to induce more dissociation.

Now, if the fire-brick chamber were nothing but a gas producer, non-association would not matter, supposing even that it could exist at the low temperature necessary for the gasification of the fuel, because the gases would be led directly from the producer to a fire-box surrounded with water, and there mixed with the proper quantity of air and consumed. Perfect combustion would be then taking place inside the water-surrounded fire-box, with this advantage, that gas and air can be much more readily brought into intimate combination than can solid fuel and air, and no waste could accrue by the production of marsh and olefiant gases, as the secondary air supply could be perfectly controlled. An arrangement similar to this was known several years ago as the "Système Beaufumé." A partial combustion of the fuel was effected in a furnace surrounded by a water chamber, and supplied by a fan with just enough of air to form carbonic oxide with the whole of the free carbon and volatilise the whole of the hydrocarbons, so that the whole of the fuel was gasefied except the ash. The mixture of carbonic oxide and hydrocarbon gases thus produced was conducted by a pipe to a combustion chamber, where, by the introduction of jets of air of sufficient volume, it was completely burned. In the locomotive a great portion of the heat which in a fire-brick furnace is bottled up, so to speak, and can do nothing after a certain point but prevent combination, is abstracted by the fire-box plates; radiation from the solid, and gaseous fuel, and the heat due to conduction all performing useful work instead of being thrown away in the shape of gases in an uncombined state. If there were any thoroughly practicable means of increasing the surface of a fire-box without materially increasing its bulk, I believe that what baneful effect exists in the shape of non-association in the locomotive might be much reduced.

With regard to radiation furnaces, I built one several years ago for the Bower process for coating iron and steel with magnetic oxide to prevent rust, and I believe you illustrated it at the time. I did not, however, intend to heat the articles placed in the chamber designedly by radiation, but I did not wish the products of combustion to strike directly upon any of them. The chamber was D shaped, as shown, and the products of combustion entered through longitudinal ports at A and followed a course shown by the arrows, finally making their exit to the regenerator through other longitudinal ports B. This furnace heats articles placed within very evenly indeed, if care be taken not to allow visible flame above the ports A. If the flame were visible, I found that the articles near it were very liable indeed to be blistered, and if it were caused to wrap round the whole course shown by the arrows, I could melt cast iron without any currents of products of combustion coming into contact with it at all. The furnace was regenerative, but only intended for comparatively low heats, but the effect of radiation was most distinctly marked and noticed by me at the time, but I pursued the matter no farther, having no necessity to employ high heats. ANTHONY J. BOWER.



St. Neots, Hunts, November 15th.

SIR,—Your valuable articles, and the letters in your paper lately, all tend to help on these interesting subjects.

The question of establishing a central station, where any fuel can be tested, is an important one. In this country, unfortunately, there is no coal-testing station similar to that of Dr. Bunte's, in Germany, which he calls very properly a "heat-testing station." Any coals can there be tested for their evaporative power, the gases of combustion analysed, and all the other results very carefully reported upon. This is a most interesting station to visit.

Many years ago several steam boilers were temporarily erected in England, at Wigan, and at other places, for special trials, by colliery owners and others, but the results are not of the same scientific value as those from Germany. Will not one of our institutions or societies, or perhaps a body of coal-sellers or users, help to form a small permanent heat-testing station in England on a really scientific basis?

Many of our institutions have funds, and will they not assist for so useful and practical an object, which might probably be made self-supporting? Millions of tons of coal or heat change hands yearly, and yet how few think of testing such heat by a calorimeter in grains, or by their steam boilers in tons.

To check the different calorimeters now in use, they should, if possible, be experimented upon at the same time, one against the other, with exactly the same sample of coal, as also charcoal, and the result compared with those given by a new standard instrument of, say, Favre and Silbermann.

In steam boiler evaporative experiments, a good basis is to take the cost of fuel for so much water evaporated from a certain temperature — say per thousand gallons: so as to institute a comparison of different results in different districts.

On the Continent the cost of evaporating a cubic metre is often taken as a standard of comparison. It matters little what the steam is used for. We hope for your powerful and continued help in these matters, so that we may keep up with our Continental friends. BRYAN DONKIN, JUN.

Bermondsey, London, S.E.,
November 15th.

AEROSTATION AND AERONAUTICS.

SIR,—A few remarks on your leader of September 2nd will, I believe, throw some light on the subject therein expounded.

The writer of the leader seems surprised at the speed attained and promised by Captain Rénard, and goes on to say:—"To give a balloon an inherent velocity of fifty-two miles an hour is to do battle with the storm. . . . If, on the other hand, the line of propulsion coincided with the line of resistance, the balloon would simply be torn to shreds." I will show that such has not been the case, for, if you refer to the diagram showing the path of the balloon—not shaped for speed—in Mr. Glaisher's ascent from Wolverhampton, September 5th, 1862, and facing page 50 of "Travels in the Air," you will see that the above speed was surpassed without any inconvenience.

The ascent took place at 1 h. 3 m. p.m.; at 1 h. 58 m. the altitude attained was 37,000ft. At 1 h. 57 m. Mr. Glaisher was insensible, and at 2 h. 7 m. he resumed observations. Between 2 h. 3 m. and 2 h. 10 m. the balloon fell through a height of four miles. At 2 h. 9 m. it stood at an elevation of 20,000ft., and in less than one minute it fell to 15,000ft., or at the rate of more than a mile in one minute; if such rate of speed has been possible in a vertical direction, why not horizontally?

It is my firm belief that very little is known regarding the resistance to motion of balloons, and conclusive experiments might be made by ascertaining the relative ascending velocities, with different shapes and displacement, by varying the loads in the car.

In a memoir on "The Expansion of Gases," by the celebrated physicist Régnault, published in the *Phil. Mag.* for February, 1870, a translation from the *Comptes Rendus*, the result he arrives at after twenty years of experimenting is: "that when a gas flows, even with considerable velocity, along very extended sides, there is no appreciable disengagement of heat which could be attributed to the friction of the gaseous molecules against these sides."

In conclusion, the resistance to motion of a balloon ought to vary with the more or less perfect shape. Now, what that shape ought to be experience alone will decide. I think that it is an open problem for engineers. EDUARDO CLAUDIO.

Rio de Janeiro, October 5th.

STANDARD GAUGES FOR HOSE COUPLING SCREWS.

SIR,—The great inconvenience that frequently arises from the variety of gauges in use for hose coupling screws of sizes other than 2¼in., for which size there are well-known gauges, has led us to investigate whether any standard gauges were recognised. We have not found quite so much regularity of system in the trade as might have been expected, but by comparing the gauges recognised by the War-office with those used by well-known makers, we believe that a series of standard gauges may easily be arrived at.

We venture to submit the following table, which will, we think, be found to fall in with the practice of many makers, and be at the same time fairly systematic; but if it can be shown that other gauges will be more generally convenient, we shall be happy to adopt them.

Many of your readers can well remember the inconvenience that constantly arose before the makers of wrought iron pipe adopted a common table of gauges for the screwed ends, and there seems no reason why a similar table should not be adopted for hose coupling screws.

Proposed Table of Gauges for Hose Coupling Screws.

Waterway diameter in inches.	Diameter of screw (top of thread) inches.	Number of threads per inch.
1¼	1¾	7½
1½	2 1/16	7
2	2⅜	6½
2¼	2⅝	6½
2¾	3¼	5

For unions for india-rubber garden hose, of sizes up to 1in. diameter, we believe that the most convenient plan is to screw the unions to iron pipe gauge of the same size. This, of course, involves somewhat contracting the waterway of the swivels; but as these have to pass inside the hose for tying in, it is generally necessary to contract them somewhat for this purpose. The advantage of screwing these unions to iron pipe gauge is evident, as they can then be coupled direct to the pipe, and it is a good standard gauge for the nozzles of cocks. HAYWARD TYLER AND CO.

84 and 85, Whitecross-street, London, 23rd November.

THE ENGLISH FOOT *v.* THE METRE.

SIR,—Referring to your "Notes" in your last edition, I consider the English foot-rule quite as good a measure as can be adopted in place thereof. If differently divided, it would be more easy to tabulate or calculate from. Most two-foot rules are divided on the edge into 100 parts in the foot length. This I would have transferred to the faces, and sub-divided into ten parts or inches, instead of ninety-six parts as at present. This alteration would soon be reconciled to use by the various artificers, and, as it would be a decimal division, facilitate the different calculations, and I have no doubt would come quickly into general use. G. E. CHILD.

Southwold, Suffolk, November 15th.

DRAUGHTMEN'S PROVIDENT SOCIETY.

SIR,—You were good enough to publish a fortnight since that a meeting was to be held at St. James's Hall with the object of starting a society as above, and probably many of your draughtsmen subscribers are anxious to know what took place at the same meeting, and how the matter stands. The committee, of whom I am a member, have requested me to communicate with you craving your insertion of a statement to the effect that the meeting was duly held as advertised, under the chairmanship of Mr. Rt. Walker, C.E., that the subject was discussed and suggestions put forward, and a committee duly appointed to frame rules and put forward the objects and aims of the society. The first meeting of the committee was held to-night, and considerable progress has been made with the rules.

Mr. Middleton, the secretary of the Institute of Architects, has accepted the post of secretary, and will be glad to receive suggestions and names of intending members. Communications should be addressed to Mr. Middleton, secretary of Institute of Architects, St. James's Hall, Piccadilly. It is hoped to get the society started at the commencement of the new year. JOHN ERINDLEY.

62A, Wandsworth-road, S.W.,
November 23rd.

A FRAUD.

SIR,—Taking reference to the anonymous letter published in your issue of November 18th, on page 419, on "A Fraud," I think of being entitled to hear from you the name of the Düsseldorf firm which is said to have written to the Glasgow exporters, as the letter contains a heavy injury to German manufacturers. Otherwise, I would be obliged to characterise the value of this publication in the next issue of *Stahl und Eisen*.

(Die Redaction von *Stahl und Eisen*)

Düsseldorf, Nov. 23rd. E. SCHROITER.

THE SMOKE NUISANCE.—In America the blackest towns have become clean through the use of natural gas. London might have heating gas, but there is not room in the streets for another pipe.

THE HEXTHORPE ACCIDENT.—As a recognition of his services to the employés of the Manchester, Sheffield, and Lincolnshire Railway, they have presented Mr. C. E. Stretton with a handsome clock.

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

(From our own Correspondent.)

OPERATIONS are being conducted with some steadiness at the South Staffordshire mills and forges. The orders recently booked are sufficient to guarantee employment to the end of the year, even though, as is usually the case in December, the work being received should not be commensurate with the orders worked off. Until the advent of the New Year there is not likely to be much accession to orders.

Advices from India and Australia indicate a prospective brisk inquiry for best bars, the result, it is believed, of the good awards received by South Staffordshire firms at the Sydney and Adelaide Exhibition. Prices keep up fairly well at £7 12s. 6d. now for the Earl of Dudley's brand, and £7 for the other list houses. Second-branded qualities remain at £6. The margin between the prices of best and second quality bars is steadily getting less. This is significant to the trade, as showing the persistency with which the demand of second-class descriptions is increasing at the expense of the productions of list houses. This movement, indeed, has become so marked that the list firms are obliged increasingly to curtail the make of their best iron and take up the manufacture of inferior descriptions.

There is only a moderate demand for unmarked iron, the average being about the same as that of the past few weeks. It is found impossible to keep the works in more than partial operation, and in some localities the capacity of the plant is being utilised only one-half. Merchant bars are £5 10s.; ordinary bars, £5 to £5 5s.; and common, £4 17s. 6d. to £4 15s. as the minimum. Puddled bars are £3 5s. per ton. Hoops and strips are without much change at £5 5s. for the former and £5 for the latter.

Best thin sheets for stamping and working-up purposes are £10 to £11 per ton. Tinned sheets are dearer by £2 to £3 per ton, owing to the advance in the value of tin. Plates are without any increased firmness at £6 10s. for tank sorts easy, and £7 10s. to £8 10s. for ordinary boiler qualities, with £9 10s. for best.

The galvanisers on 'Change in Birmingham this, Thursday afternoon, spoke of still experiencing a brisk demand from Australia and New Zealand, on account of which markets more remunerative prices are being obtained. The South American trade is not regarded with favour, as the demand runs chiefly upon the common descriptions of galvanised iron, upon which makers are unable to secure adequate profits. Prices of corrugated sheets of 24-gauge in bundles are named at £10 15s. to £10 17s. 6d., Liverpool, though occasionally less is taken. Delivered in felt-lined cases in the Thames, for shipment to Australia, the price is £12 to £12 2s. 6d., with the usual extras of 20s. to 30s. per ton, according to individual firms, for the thinner gauges.

The heavy requirements of the galvanisers are resulting in the block sheet works still being run to their fullest capacity. This large out-turn of sheets accounts for the increased consumption of pig iron, but this consumption is not wholly satisfactory to the producers of pigs, who would like to see dominant in Staffordshire a heavier branch of the iron trade, which would absorb larger quantities of their material. Prices of single gauge sheets are £6 5s. to £6 7s. 6d.; and double gauge, £6 10s. For forward delivery, makers, being heavily booked, quote £6 15s.

The announcement I was able to make last week, that Messrs. John Lysaght are considering the advisability of possibly erecting a third black ironworks—the site to be at Bristol—has occasioned considerable interest among Staffordshire ironmasters, who are anxious to learn further details. At present, however, no details are forthcoming, since at present the firm are only making inquiries into the cost of the carriage of the materials, and upon other points, with a view to enabling them to more accurately determine whether such a step would be wise.

Messrs. George Adams and Sons, of the Mars Ironworks, are experiencing so good a demand for galvanised sheets that all their make of black sheets is now galvanised by themselves, and as it is insufficient for the demand in their galvanising department, they too are considering the advisability of laying down more black sheet mills.

A good demand is being expressed for all descriptions of steel, and makers anticipate a steady inquiry for the next three or four months at least. Light steel rails for colliery sidings and tramway purposes are £3 7s. 6d. for ordinary and £3 17s. 6d. for superior qualities. Ordinary soft steel sheets are £7 10s. for singles, and cold-rolled and close annealed steel sheets £9 10s. per ton, with the usual extras for doubles and lattens. Steel rounds and squares are £6 to £6 10s. This class of steel is now largely taking the place of iron for rivet-making purposes.

A new make of steel was offered on the Birmingham Exchange to-day in the form of bars, blooms, and billets manufactured by the Aireside Steel and Iron Company, Leeds, which has this week started its important works upon the Bessemer process. Ironmasters here are being invited to give sample orders for the new metal, which should be of excellent quality, seeing that the company has hitherto been known as a producer of first-class hematites from Spanish ores, and that instead of going into the market with their pigs, this same metal is now to be consumed in the steel works. The steel is being offered at favourable rates, and an abundant supply is promised, since the new works will have a capacity of 2000 tons per week.

A rather more confident tone is this week perceptible in pigs, owing to the improved condition of the Northern and West Coast markets, the latter resulting from the restrictive policy which has there been adopted. A curtailment of make of from 5000 to 6000 tons per week, such as is now proposed on the West Coast, is a very large reduction for such a district. But makers here considered that the West Coast firms are wholly justified in taking such a course, and the stronger tone in prices already observed is welcomed. Unless an advance of 5s. is established the effect upon Staffordshire all-mine pig prices will not, however, be very conspicuous. At the present time certain of the Staffordshire all-mine makers are expressing some surprise at being able to command 50s. per ton, when best West-coast forge hematites are quoted at 53s. delivered here.

Best West-coast hematites, such as the Carnforth brand, are quoted at 54s. 6d. for forge sorts, and 57s. 6d. for foundry sorts delivered. Welsh hematites are 51s. 6d. for forge, and 52s. 6d. for foundry, delivered. Imported Midland pigs maintain their values at 37s. for Northamptons, delivered to works here; 38s. for Derbyshires; 40s. 6d. to 41s. for Lincolnshires. Sales are slow, most consumers being well bought forward.

Iron and steelmasters and engineers regard with much favour the news from India and Burmah of the increased attention which is being given to new railway schemes in both countries. All indications are in the direction of a setted extension of the Indian railway system, and it is certain that railway construction must also take place in Burmah. The intelligence tends to increase the confidence of the local iron trade that India will become a much better customer for iron of all kinds than at present.

Additional advances are announced this week by metal goods manufacturers, resulting from the continued rise in metals. Ten per cent. advance is notified by makers of cast and stamped brass mounts for bedsteads and fenders. A further farthing per lb. advance is advised on brass and copper tubes, wires and sheets, and galvanised ironmongery goods, and galvanised nails and spikes are dearer consequent upon the advances in spelter. Cast iron tinned hollow-ware makers anticipate having to again declare a rise, since tin is still going up.

A meeting of operatives was held at Wednesbury on Thursday, when, after an address by Mr. R. Juggins—secretary to the Midland Federation—a resolution was passed, "That this meeting believes that the best and safest means of protecting the interests of the working classes is by federating all branches of labour into one national federation; we therefore pledge ourselves to become members of the Midland Counties Trades Federation forthwith."

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—With the approaching close of the year there has been, as usual, a little extra buying on account of forward requirements. For the principal brands of pig iron offering in this market prices have now for some time past been practically stationary. This has evidently been regarded by consumers as an indication that the lowest price—at least for the present—had at last been touched, and there has been a disposition to take advantage of the low prices, and what seems to be regarded as a favourable time at this period of the year, to buy for delivery in the ensuing year, which has resulted in a fair weight of business being done, which, although it has not been sufficient to enable makers to get any better prices, has given a rather steadier tone to the market. In hematites there is also a stronger tone, but this has been brought about more by a restriction of the output than by increased demand, and can scarcely be said to represent any real improvement in trade. Manufactured iron is—with the exception, perhaps, of a rather easier tone here and there in bars—maintaining its position, forges generally being still well supplied with work, and hoops and sheets especially keep very firm at full rates.

A rather more healthy feeling characterised the Manchester iron market on Tuesday. There was more inquiry stirring in pig iron, and the stronger tone in Glasgow and Middlesbrough warrants helped to steady prices, although it could scarcely be said that there was any really appreciable improvement in the actual condition of trade. So far as Lancashire pig iron is concerned, local makers are still practically out of the open market at their quoted list rates of 38s. 6d. to 39s. 6d., less 2½, for forge and foundry qualities, delivered equal to Manchester, to which they seem determined to hold, and local iron meets with little or no inquiry; but in district brands, both Lincolnshire and Derbyshire, there has been a very fair amount of buying going on. Although there has not been much buying in any great quantity, individually the transactions, taking them all through for the past week or so, have represented a considerable weight of business, principally for deliveries commencing in the New Year. Makers have had to be content with the low rates now current, but for Lincolnshire iron the average basis of the prices that have been got has been about 36s. 6d. for forge and 27s. for foundry, less 2½, and for foundry Derbyshire about 39s. 6d. to 40s., less 2½, delivered equal to Manchester. The considerable fall which has recently taken place in Middlesbrough iron has also brought out a fair amount of buying at prices ranging, according to quality, from about 40s. to 41s. net cash for good named foundry brands delivered equal to Manchester.

For hematites makers are now holding out for a slight advance upon the prices they would have taken a few weeks back, and for good No. 3 foundry qualities delivered in the Manchester district, average quotations are now about 52s. to 52s. 6d., less 2½ per cent. This stiffening in prices has brought out more inquiries, and at old rates business could be readily done, but buyers do not seem to believe in the restriction of the output having any appreciable permanent effect, and there is no disposition to pay advanced prices, and so far there has been no real business done to establish any actual advance.

In manufactured steel, trade continues very quiet; in connection with locomotive work there have been some moderate orders given out, but steel plates generally are still only in poor demand, and do not average more than £6 17s. 6d. per ton delivered in the Manchester district, whilst for steel forgings excessively low prices have to be taken.

There is a generally active trade still doing in nearly all descriptions of manufactured iron, and most of the forges have sufficient work in hand to keep them fully going for the present. In bar iron, however, there would seem to be not quite so much work stirring as in other descriptions, and if anything, there is some indications of weakness, sellers here and there being prepared to book orders at a little under £4 17s. 6d., although this is still the minimum quoted price. There seems to be no present or immediately prospective scarcity of work amongst hoop and sheet makers, and prices are very firm at £5 to £5 7s. 6d. for hoops, and £6 10s. to £6 12s. 6d. for good qualities of sheets delivered in the Manchester district.

The condition of the engineering trade generally can still only be reported as unsatisfactory. With few exceptions machine tool-makers report work to be falling off rather than increasing, and in some instances they are quieter than they have been for a considerable time past. Boiler makers and machinists are kept generally and fairly well supplied with orders, and there has been a little more work stirring amongst locomotive builders and railway carriage builders, both on home and foreign account. Taking engineering works all through, they are, however, but indifferently engaged, and there is the continued complaint to which I have had so often previously to refer, that for the most part work is only obtainable at what are really unremunerative prices.

The report to which I referred last week, of the removal of Messrs. Sharp, Stewart and Co. from Manchester to Glasgow, and which I understand has now been definitely decided upon, has been received with deep and general regret throughout the district, not only because of the serious loss to the industrial interests of Manchester, but equally because a firm universally held in such high repute is severing a connection which has extended over the greater portion of the present century. It is upwards of sixty years since Mr. Thomas Sharp, an iron merchant, in conjunction with Mr. Richard Roberts, the well-known inventor of the mule and of improvements in self-acting tools, first started the works, not on their present site, but more in the centre of the town, as machine makers, and for a long period of years the firm enjoyed a most prosperous career, one noteworthy incident in connection with its history being the introduction to this country of the Giffard injector, which has been the pioneer of the numberless similar appliances of the kind that have since been introduced. With the introduction of locomotive building, for which the firm attained a reputation perhaps second to none in the country, more commodious premises became necessary. The present Atlas Works were started and gradually enlarged, the old works being ultimately given up, and the site on which they stood is now covered with valuable warehouse property. The lease of the land on which the present works stand will shortly expire, and this in conjunction with the more favourable conditions on which their branch of trade can be conducted on the Clyde, where, as I stated last week, the business is to be carried on in conjunction with the Clyde Locomotive Company, would seem to have been the inducements which have led to the transference of the business to Glasgow.

The collection of all the requisite material for vigorously pushing forward the construction of the Manchester Ship Canal is going on apace, and whether the London and North-Western may eventually suffer or not from the competition of the canal, the company is just now reaping a fairly good harvest in the large quantities of contractors' plant that are at present being conveyed over their line to the ship canal works. I referred last week to the orders for locomotives which the contractor had placed in the hands of several Leeds firms, and I may now add that Messrs. Ashbury and Co., of Manchester, have secured a large order for railway tip wagons and other material required for the usual constructive works; whilst in Warrington extensive orders have been given for implements and other material.

I may also add that Messrs. Ashbury are executing some considerable carriage orders for Spain for metre gauge railways, in which an important development seems at present to be taking place in the shape of extending these narrow gauge lines over the less thickly populated districts of the country, to act as feeders for the main lines.

In the coal trade, except that the spell of severe weather during the past week has given a little extra activity to house fire qualities of fuel, there is no improvement to report. Pits are not working more than five days a week, and all descriptions of fuel are plentiful, the inferior sorts for iron-making, steam, and engine purposes being more or less a drug in the market. Prices remain practically unchanged, and at the pit mouth average 9s. for best coals, 7s. to 7s. 6d. seconds, 5s. 6d. to 6s. common house-fire coals, 5s. to 5s. 6d. steam and forge coals, 4s. 6d. to 4s. 9d. burgy, 3s. 6d. to 3s. 9d. best slack, and 2s. 6d. to 2s. 9d. common sorts.

For shipment there has perhaps been a little more doing, but prices are no better, steam coal delivered at the high-level, Liverpool, or the Garston Docks, being still obtainable at 6s. 6d. to 6s. 9d. per ton.

Barrow.—One of the principal features in the shipbuilding trade this week is the acceptance of an order by the Barrow Shipbuilding Company to lengthen the Isle of Man Steam Packet Company's steamer, Mona's Queen, with the view of affording additional space for new boilers, and accelerating her speed. She is fitted with triple-expansion engines, and with increased steam she is expected to travel next season fully 20 knots per hour. A few new orders are in for steamers and sailing vessels, but the outlook in the shipbuilding trade is certainly not cheering. There is a further improvement to note in the hematite pig iron trade, and makers are asking full prices—44s. to 44s. 6d. per ton net, f.o.b., for mixed numbers of Bessemer iron, with 43s. 6d. for No. 3 forge and foundry qualities. These quotations are firm for prompt delivery, and forwards are asked 6d. more. It is true that in some cases needy sales have been made at about 42s. 6d. per ton, and hematite warrants have been done at 42s. to 43s. per ton. Stocks of pig iron are very large, and the determination of makers to restrict the output by fully 5000 tons per week has been forced upon them in order to check the tendency towards lower prices. It is now estimated that fully 250,000 tons of iron are in stock. There is already evidence that the restriction of output is resulting in enabling makers to maintain and improve prices, and it is noticeable that holders of warrants are following the example of makers in keeping up prices. The steel trade is not so brisk as of late, especially in reference to rails, which are in lessened enquiry and at lower prices, £4 per ton being now the quotation for heavy sections of rails. Makers are, however, well able to hold their own, and are not pressing sales, because they fully believe that the growing firmness in the pig iron trade, and the increased enquiry for iron ore at fuller prices, will result in imparting a similar tone to the steel trade. Billets are in good enquiry at £4 per ton. Slabs are in quiet demand. Blooms, which are quoted at £3 15s. to £3 17s. 6d. per ton, are in very quiet demand. Steel for shipbuilding purposes is in slow request. The iron ore trade is still favourably affected by the increase in the freights on Spanish ore, and ordinary qualities of native ore are quoted at from 8s. 9d. to 11s. per ton. There is a firmer tone in the coal and coke trades, and, although the consumption is not increasing, prices are likely to advance. Shipping is not so busy as of late, but the season may now be considered closed.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE usual Parliamentary notices given by local railway companies include several proposals of much interest to this district. The Midland now confirm the statement I was in a position to make some time ago, that it would itself undertake the construction of the Dore and Chinley Railway. This scheme was originally taken up by influential gentlemen, residents and landowners in Derbyshire, chiefly with the view of developing certain districts in which they were greatly interested, and which had been so long shut out from the advantages of railway communication. The capital at first proposed was £1,070,000, of which the Midland covenanted to subscribe £100,000 and agreed to work the line for 50 per cent. of the gross receipts, which they guaranteed should not be less than £60 per mile. After considerable opposition the Act was obtained, but owing to the insufficiency of capital subscribed, it fell through. The Midland Company has now taken up the scheme, and at a meeting of the Dore and Chinley directors, held at Derby last Thursday, they approved of the proposition to transfer their powers and privileges to the Midland, agreeing at the same time to promote an Abandonment Bill which will take effect if the Midland does not succeed in carrying its scheme. The line will begin at the Dore station, on the main line of the Midland, six miles from Sheffield, proceed by Totley Brook, burrowing under the Dore Moor hills, and emerging at Grindleford Bridge, near to Longshawe Lodge, the shooting-box of the Duke of Rutland; thence to the picturesque village of Hathersage, where "Little John" is buried, and his bow can be seen in the parish church; on to Hope, Brough, Bradwell, and Castleton—the site of the famous mines—joining the Midland main line to Manchester at Chinley. It will open up one of the most beautiful and least known districts of Derbyshire, and afford Sheffield an alternative route to Manchester and Liverpool. The Midland also contemplate a new line, to be called the Afreton Branch Railway. This line will begin at the company's Erewash Valley Branch, near Alfreton station, and terminate at the end of the existing branch to the new colliery of the Blackwell Colliery. Another, the Birley Colliery Branch, begins at Beighton and terminates near the existing coal screens of the Birley collieries—Sheffield Coal Company—passing through parts of Beighton and Handsworth, and Aston-cum-Leighton. The proposals of the Manchester, Sheffield, and Lincolnshire Railway Company are also important. Its chief local enterprise is the line to open up the Rother Valley, in which it is estimated that over 2,000,000 tons of coal are raised per annum. This line would begin at Beighton, and passing through parts of Killamarsh, Eckington, Renishaw, Barlborough, Staveley, Brimington, Whittington, Tapton, Newbold, and Dunston, terminate at Chesterfield. Several short lines are projected in connection with this Rother Vale Railway, mainly to afford communication with the pits of the colliery company at Eckington—J. and G. Wells—the Norwood collieries—Sheepbridge Coal and Iron Company—Renishaw Ironworks—Messrs. Appleby and Co.—and the new Markham colliery of the Staveley Coal and Iron Company. The Manchester, Sheffield, and Lincolnshire Company contemplates another new line, beginning in the parish of Wales and terminating at Beighton, to accommodate the parishes of Wales, Langben-en-le-Morthen, and Treeton.

The Miners' Conference at Barnsley has terminated as was anticipated. There were three resolutions submitted—(1) That eight hours in the twenty-four be the maximum day's work for all persons employed underground where the single shift is worked, and seven hours when the double shift is worked, the time to be reckoned from bank to bank; (2) that one general holiday be observed each week, this day to be fixed in each district, and to be strictly observed, even though the men may have been idle on any preceding day that week; (3) that in order to clear off surplus stocks and secure a 10 per cent. advance, one week's holiday to be taken simultaneously all over the United Kingdom, or such other number of holidays as may be necessary to secure these objects. This movement affects 500,000 men and boys. The conference opened at ten o'clock, and continued till two. It was not open to representatives of the press, to whom the results were communicated at the close. The resolutions passed were to the effect that the majority of votes were in favour of these resolutions, and that the conference be adjourned for a fortnight to hear the results of the Newcastle Conference and take action accordingly. The vote for and against the resolutions was not disclosed, but the representatives of the press were informed that the majority for limiting the output and "playing" a week, and one day a week, was considerable. Mr. E. Cowey, President of the Yorkshire Miners' Association, was in the chair, and was supported by the leading officials, with the exception of Mr. Benjamin Pickard, M.P., who is on his return journey from America.

A Glasgow firm, by the publication of a letter which they have received disclose a system of fraudulently-branded steel bars,

which is of special interest to steel centres. A writer, who dates from Düsseldorf, offers to supply steel bars of German make, "stamped all with Swedish brands, and to all practical purposes equal to the real article." "If you like," he adds, "to try the quality, I can send you some samples, and if you decide to buy some afterwards, you need not get the works to stamp any brand which you may decide upon putting on. This you can get done after the bars have left the works, or the works will do this for you." The letter begins by asking if the firm to whom it is addressed are buyers of Swedish steel bars for the India or China markets, and closes by impressing upon the recipients the necessity of regarding the communication as "strictly private," adding, "I shall be glad if you will accordingly treat it as such. Only, some people I know are making these days enormous profits out of this."

The sharp touch of frost last week set the joiners' tool makers at work upon skates. There is no trade so susceptible to the first indication of real winter weather. As soon as ever the ice would bear, the numerous sheets of water in the Sheffield district were covered with people enjoying the seasonable pastime. Though an industry of but brief duration, it was at one time a very important occupation for the makers of joiners' tools. Now-a-days the Germans seem to have got the grip. Two Sheffield houses of merchants have had delivered to them this season no fewer than 40,000 pairs of skates of German make; and these are not of the cheaper kinds in which German houses have been wont to undersell English firms, but of an expensive and well-known skate bearing a familiar name.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THERE was an improved attendance at the Cleveland iron market held at Middlesbrough on Tuesday last. Inquiries were more numerous than for some time past, and prices decidedly firmer than they were at the end of last week. On Friday, the 18th inst., merchants would have sold No. 3 g.m.b. at 31s. 1½d. per ton for prompt delivery, but they have since reverted to 31s. 3d., or the quotation current on the 15th. There is now some inquiry for delivery over the first quarter of next year, and a few sales have been made at 31s. 6d. per ton. Most of the recent transactions, however, have been for delivery over the remainder of the present year. Most makers are now anxious to book fresh orders, and are willing to accept 31s. 6d. for December delivery. Beyond that they decline to go in the meantime. Considerable business in forge iron has lately been done at 30s. per ton, and some lots have been sold at slightly less.

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

Warrants are again in demand to some extent, and quotations have advanced from 30s. 10½d. to 31s. 6d. per ton. This is without doubt a movement in sympathy with the improved tone of the Glasgow market.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store on Monday last was 326,563 tons, representing a further increase of 398 tons.

Pig iron shipment from the Tees had, during the first twenty-one days of the present month, reached only 46,770 tons, or about 4000 tons less than during the corresponding portion of October.

Orders for finished iron have increased during the last few days, but no improvement in prices has taken place.

The Tees Conservancy Commissioners have just issued their report and financial statement for the year ending October 31st, 1887. The results recorded are remarkably satisfactory, indicating as they do a decided improvement in the trade of the river. The total income for the year reached £61,222 8s. 6d., which is £12,130 11s. 11d. more than the revenue for the preceding year. Of this income, £54,126 2s. 6d. was derived from the port of Middlesbrough, and £7096 6s. from the port of Stockton. The total number of vessels which entered and left the river was 5489, amounting to 1,881,658 tons capacity. In other words, more than 100 vessels entered and cleared per week, the average size being 343 tons. The increase over the previous year was 755 ships and 385,700 tons. Of the total number of vessels, 4509 came as far as Middlesbrough, and 664 as far as Stockton.

Encouraged by statistics, it is not surprising that the Commissioners have decided to proceed at once with the deepening of the river between Newport and Stockton, at an estimated cost of £10,000, and to construct a turning-place at the latter port for large ships, at a cost of £600. The extra depth to which the dredging will be carried is 2ft. An amendment moved by the chairman, to the effect that before proceeding with this undertaking Sir James Rendel should be consulted, was lost. Mr. Fowler, engineer to the Commissioners, had given it as his opinion that the wharves and other property upon the banks would not be damaged by dredging to the extent named. But the chairman, and those who sided with him, thought a second opinion ought to be obtained on this point. The Stockton members of the Commission contend that their trade has been actually damaged by the improvements made in the lower reaches of the river, because the tide ebbs more completely than it used to do, and therefore ships take the ground sooner than formerly.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE has been more activity this week in the Glasgow pig iron warrant market, with the result that prices have shown a certain improvement. This has occurred, too, despite the fact that the past week's shipments were unusually small. They amounted to 5000 tons, as against 5899 in the same week of last year. Of this quantity 2140 tons were coastwise shipments; so it will be seen that the exports were very limited. To the United States 550 tons were despatched; Holland, 450; India, 350; Italy, 250; and Russia, 100 tons. There are at present several steamers loading, and others are chartered to convey pig iron to Italy, to which from 8000 to 10,000 tons is expected to be despatched before the close of the year, in order that it may escape the extra duty thereafter to be exacted. The number of furnaces in blast is unchanged, and the week's addition to stocks in Messrs. Connal and Co.'s Glasgow stores is about 2000 tons. These stocks are now about 100,000 tons larger than they were a week ago.

The current quotations of Scotch makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 45s. 6d.; No. 3, 42s.; Coltness, 50s. and 42s. 6d.; Langloan, 47s. and 43s. 6d.; Summerlee, 48s. 6d. and 42s.; Calder, 46s. 6d. and 40s.; Carnbroe, 41s. 6d. and 38s. 6d.; Clyde, 45s. and 40s.; Monkland, 41s. 3d. and 38s. 3d.; Govan, at Broomielaw, 41s. and 38s. 3d.; Shotts, at Leith, 46s. 6d. and 44s. 6d.; Carron, at Grangemouth, 49s. and 43s.; Glengarnock, at Ardrossan, 45s. 3d. and 40s.; Eglinton, 41s. and 38s. 3d.; and Dalmellington, 42s. and 38s. 6d.

The agreement of the Cumberland makers to reduce production has imparted firmness to the hematite market, and the prices have been advancing. They are still, however, much below what they were in recent times. The requirements of the Scotch steel makers are largely met by the production of pigs made at home by imported Spanish ore, but there is a considerable market here for shipment abroad in English hematite. There has also been a certain movement this week in Cleveland warrants, the demand and the prices being improved.

There is a good business in the malleable iron department, but the prices show no improvement. Indeed, the rates are somewhat difficult to maintain. For merchant bars £4 13s. 9d. is the quotation, less 5 per cent., but it is reported that in one or two instances business has been done rather under that rate; for scrap iron the inquiry is very quiet, and there is little doing in old rails.

The steel makers are fairly well supplied with work, but the prices are not at all satisfactory, and it is thought that it will be necessary to reduce wages. Indeed in one instance a notice to terminate contracts has been given, which is interpreted as the preliminary step towards such a reduction.

During the past week there was shipped from Glasgow locomotives to the value of £16,463, of which £10,000 went to Rangoon, £4063 to Africa, and £2400 to Calcutta. A paddle steamer and engines, valued at £9200, and hull and machinery of four barges, £3400, were despatched to Calcutta; and a steamer and two barges, worth £10,625, went to Rangoon. There was shipped besides machinery, worth £3000; sewing machines, £4410; steel goods, £8260; and general iron manufactures, £19,690.

There has been a scarcity of ships for the conveyance of coals, and freights in nearly all directions have been advancing; yet the quantity of coals despatched from Scotch ports in the past week shows a good increase on that got away for several weeks previously. At Glasgow, 24,160 tons were shipped; Greenock, 1953; Ayr, 7570; Irvine, 1610; Troon, 6603; Ardrossan, 2646; Burntisland, 15,926; Leith, 5936; Grangemouth, 11,579; Bo'ness, 2630; Granton, 2174; Port Glasgow, 400; total, 83,187 tons, as against 81,212 in the corresponding week of last year. The inland trade is improving, but so far there is no appreciable improvement in prices.

At a conference of Scotch miners' delegates held in Glasgow on Monday, it was agreed that in pursuance of the resolution of the recent conference at Edinburgh, a week's holiday should be taken by the Scotch miners either on the first or last week of January for the purpose of restricting the output of coals, and allowing time for accumulations to be cleared away from the collieries. The miners of Fife have by a large majority voted in favour of taking a week's holiday, and of working only eight hours a day. In the Kirkintilloch district there is also a great majority in favour of the holiday. Should it be held in the first week of January it will not cause much inconvenience, as the New Year holidays generally extend over two or three days at any rate. But if the men suspend work in the last week of January considerable trouble is likely to result, and the probability is that in Fife, where the colliers work under contract, they may involve themselves in the liability for damages if they suspend work.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE air is thick with rumours about amalgamations of vested interests, removal of ironworks, and the like. With respect to the first, it is only a question of time for important amalgamations to take place in Cardiff railways, in particular, but it is too early yet to be more explicit.

The people living by the sea-shore at Barry, Briton Ferry, and Swansea are making bids for ironworks to be removed to their location. In some places, at the Barrows, Swansea, in particular, it is stated that land can be had for nothing. It is not likely that this will modify present arrangements, or tempt others. Ironmasters will wait, and see with what measure of success the Cardiff experiment of the Dowlais Company will be attended.

The Dowlais Company is well placed in the matter of Bilbao ore, thanks to the prevision of Mr. Jenkins, of Consett, in securing for Dowlais the favourable position it holds with Consett, Ebbw Vale, and a foreign company in a little monopoly at Bilbao. So it will be well to see how Dowlais fares first.

There is little doubt that the great removal of Dowlais is certain, but at first three furnaces, equal to an output of seven of the existing furnaces, are being discussed. All house property has been depreciated 50 per cent. by the proposal to remove so gigantic an establishment, and naturally so. A large proportion of the rates is borne by Dowlais, and the burden that will fall upon others will be very great.

I am told, on excellent authority, that the sea freight being less from Barrow to Swansea than the railway rate from the Welsh works, the latter are suffering considerably by the competition. Cases have been mentioned to me, which I cannot further particularise, showing that the North of England and Scotch ironmasters are running the Welsh ironmasters very hard, and in several instances securing business. This will lead to a strong appeal for a revision of railway charges, and a movement in that direction may be anticipated.

Amongst the novelties sent by Cyfarthfa to the Newcastle Exhibition was a fine block of 4ft. steam coal. This was a subject of considerable discussion at the Exhibition. Coalowners doubted its genuineness; it was of such compact "limestone" character. The fact was that it was genuine enough; but had been carefully sawn out of a larger block, and was almost like ebony or black marble. The perfect 4ft. Cyfarthfa steam coal may be taken as one of the best types of that measure, as within a slight distance, comparatively, to the east it becomes more bituminous, and to the west more anthracite. A few years, and the difficulty will be to find any sample left.

The house coal men have voted strongly against the existing scale. At a meeting at Aberdare on Monday the decision was—For the scale provided six amendments are carried out, 4000; neutral, 300; for the scale as it is, 72.

The coal trade at Cardiff continues sluggish, but prices are firm at Swansea; prices for best steam are varying from 8s. to 9s. 6d., according to quality; bunker's steam as low as 6s. 9d. Rhondda No. 3 is quoted at Cardiff at 8s. 3d. to 8s. 6d.; steam as low as 9s.; best, and small 3s. 6d. Coke is showing better, and sells freely at late quotations. Small bituminous, which is in good demand at the works and at port, sells for 7s. 3d. Lower quotations for Spanish are 12s. at port.

A successful re-start of the Blaina Tin-plate Works and of the Landore blast furnaces is announced.

There is unmistakeable improvement in the iron and steel works, and greater activity and promise in connection with the whole of them from Blaenavon to Swansea.

If railway rates could be adjusted I should have no fear of a good winter's trade. Large quantities of tin bar are now being turned out, and the improvement in the tin-plate trade has been quickly felt.

At the Exchange, Swansea, on Tuesday, it was announced that block tin had been advanced £7 10s. since the last meeting. Copper also had advanced from £47 2s. 6d. to £51 5s.

Tin-plate workers have had a hard time of it in the endeavour to do business in the teeth, so to state, of the great rise in tin, and it is only now that they are showing that they can do it. Plates have been advanced in price proportionate to the advance in tin, and it is either business done at those prices, or no business at all.

The Exchange quotations at Swansea were: Ordinary coke tin, 14s. 3d. to 14s. 6d.; Bessemers, 14s. 6d. to 14s. 9d.; Siemens, 15s. to 15s. 6d.; ternes, 26s. to 28s.; charcoal, 19s. to 21s.; best, 21s. to 23s. 6d.; wasters, 6d. less per box than prices all round.

The iron and steel quotations of the trade are nearly about the same as they have been for some time. Merchant bars, £4 7s. 6d. Heavy steel rails are quoted a little less, £4 to £4 5s.; light sections, £4 17s. 6d. to £5 2s. 6d.; steel sheets up to £8 10s.; blooms, from £4 5s.

Renewed and most successful experiments in firing shots by electricity have taken place at Ynyshir Colliery. In one case, Mr. Abraham, the colliers' M.P. as he is called, fired the shots himself. It is thoroughly believed that a great problem has been solved and an important factor in colliery explosions done away with. In each case the pit was cleared during the discharge, and the failures of shots very few in number.

The freight market is everywhere getting firmer. Operations have been resumed at Llangennech tin-plate works.

NOTES FROM GERMANY.

(From our own Correspondent.)

WHAT little change there is to note this week in either price or demand for iron in these markets is for the better, as in some articles a small rise has taken place. The numerous conventions, and especially the fact that the weighty Saar and Moselle Works have joined the grand wrought iron sales bureau, has given the impulse to this slight improvement where observable. In Silesia pig iron maintains itself well at a slightly enhanced figure, puddle pig being M. 47 and foundry M. 54 to 55 p.t., and the mills and forges are even better employed than during last month; and the same satisfactory state of things pervades the neighbouring markets in Austria, where demand for iron manufactures is most abundant.

In the western districts, specially, is to be noted that iron ores, partly in consequence of the high water freights on Spanish ores and partly through the large contracts which have been made for next year, are a trifle dearer, and now range in the Siegerland from M. 8·80 to 12·50 p.t., according to sort, whilst Nassau hematites are M. 3 dearer, which prices are very firm, as also are those of Luxemburg brand, which are in excellent demand. It is not at all improbable that Westphalian furnaces will have to give up using Spanish ores and return to the native supplies, if the former should not become cheaper, which is scarcely likely, unless new mines near Bilbao are discovered and opened up. Ores any way free from phosphorus are extremely rare—almost unheard of in Germany—which is against the Bessemer steel makers, and will greatly account for the large quantity of basic made in the country. The prices of pig iron, notably in the Siegerland, are very firm, and the demand has been, and still is, so good that the output of twenty-six furnaces did not quite cover the demand last month, and recourse was had to English raw material in some cases, while stocks, including foundry iron, are reduced to 51,570t. for the whole district. In consequence of the rise in sheets, puddle pig has advanced M. 1 p.t., and is now noted M. 46 to 47 p.t.; spiegel of low quality, 10 p.c. Mn., 52; Bessemer, 48 to 49; foundry, 49 to 55, according to the No.; and basic 43 to 44, which in some quarters is in active demand without affecting its price. Forge pig is everywhere in full request, foundry moderately so, and Bessemer remains steady, but without life. The pig iron convention lapsed this last week, and the result of a confidential meeting held on the 16th inst., so far as it has transpired, leads to the belief that it will be prolonged till the end of the year. The future stability of the trade will depend upon the definite result of this meeting, showing upon what a slender thread the whole fabric of the trade here hangs in spite of the wrought iron convention.

The rolling mills have nearly everywhere satisfactory orders in hand, sufficient to insure them regular work for some time to come, in some cases known to me till February next. Since the Saar Works joined the grand convention their prices for bars have been put up to M. 118 p.t. as a basis at Neuenkirchen, whilst girders have been advanced M. 3, and now stand at M. 106 p.t. at Burleuch. These works, with those of Hessen-Nassau forming the S.W. group, produce about a quarter of all the rolled iron sold in the Empire, which is estimated at 600,000 t. per annum. The price for the Rhenish-Westphalian group was fixed at M. 122·50 p.t. for merchant bars within the home radius. Orders for export have improved a little, though the quantity has fallen off for this year as compared to last. The hoop branch is exceedingly animated; prices are firm with a tendency to rise, and are at present noted M. 125 to 127·50 p.t. The business in sheets is very good, all the mills in the Siegerland, and most of those in Westphalia, are very busy, and have work for a considerable time ahead. The price is now M. 142 p.t., though, till old orders are run off, this price is not realisable. Before the approaching meeting at Düsseldorf, little can be said about the course the wire rod trade will take. It is expected, however, that a common sales-bureau will be organised, and then a slight rise in price declared. Meanwhile, wire and wire nails are firm in price, and the works and factories well employed. The price of iron wire rods is M. 110; in steel, 105; wire in either metal, 130; and wire nails, 145 p.t. The convention has lowered the discount on gas tubes 1½ p.c., equivalent to a rise of 5 p.c. on the net price. In steel and railway material and wagon building there is nothing remarkable to note. At a recent tendering for wheels and axles, the lowest offer per set was M. 303 p.t.; for crucible steel tires, 290; in Martin steel, 230; and in fine grain iron, 175; fish-plates were 95 p.t.

The machine shops continue well employed, but no further rise in prices has taken place. The brass foundries, on the other hand, have procured an advance in prices of late, consequent upon the rise in tin and copper, and for the first half of this month have secured abundant work. The prices are for bronze castings M. 1·75, phosphor-bronze 1·85, and for red copper 1·80 p. ko.

Though the Consuls report a good deal concerning German competition in other articles, with the exception of wire rods and wire, England need be in no immediate alarm about its over-sea trade in iron, though a constant sharp look out should not be relaxed by those interested, especially in the far-off Eastern and South American markets. The official report of German exports of iron and steel for September, 1887, is jubilant at the quantity, which was, of iron and steel wire rods and wire 17,620 t., or 1272 t. more than in September, 1886. Of rails there were 12,188 t. Belgium took 3996, or one-third of the total export; America received 159 t., Switzerland 1076 t., Australia shows 4592 t. against 1044 t. for the corresponding month last year. The Netherlands, which used to be a chief customer, took no rails in consequence of Belgian competition. The export in bar iron has fallen off, through more inland demand and less export to Russia, from 16,079 to 12,333 t. Russia took 1170 t., 63 p.c. less than in September last year, which shows that it is not yet independent of foreign sources for some kinds of sectional iron. A good deal of constructional ironwork comes to works in Germany from Dutch export houses for Eastern countries. Now, this work would be cheaper done in England, and it is a pity this field is not better cultivated by English firms. The trade journals here are exasperated at a report, which, it is said, has emanated from Sheffield, that after trial by the Government officials in Japan, English rails should have been found superior to those made in Germany.

An explosion of gas in the Gneisenau coal mine in Westphalia, occurred last week, killing fourteen men and seriously injuring others. In this connection may be mentioned the disastrous explosion of dust in a very large flour mill at Hamelin, on the Weser, when one end of the mill was blown to pieces, overwhelming an adjacent dwelling-house and killing and wounding several persons in both buildings.

The French iron trade is gradually improving, since a common sales bureau for the Nord department has been provisionally agreed upon, and the price-depressing policy of the dealers at Paris has begun to slacken. Makers have raised the price of merchant bars to 130f., and ordinary plates to 165 p.t. The Belgian iron trade is firm as ever, and the works have been obliged to call in to their aid French assistance, from the ores upwards to finished articles, in order to deliver promptly enough, and because native raw materials are getting so dear; but for next year few orders are at present in hand. Nevertheless, there is great confidence in the future, and another furnace is about to be blown in in the Liége district.

A good order for steel rails has just dropped in from Brazil, and another from Spain. Girders for export are 110f. at Antwerp, and prices are very firm indeed, 117·50f., and even 120, being demanded for very prompt delivery. In Belgium it is not calculated upon that English firms will agree to a Belgian-English thin sheet convention.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, Nov. 10th.

STEEL rails have unexpectedly dropped 1 dol., and are now 33 dols., with rumours that they may drop to 32 dols., and even less. Large buyers are still holding out. There are inquiries on the market to-day for nearly 100,000 tons, and offers at 32 dols. for several lots. Buyers fear the syndicate may shut down six weeks or two months, and thereby force them to cover at advancing prices, in consequence of restriction. Large quantities of old material and iron and steel are arriving. Last week's receipts of old rails, 3643 tons; since January 1st, 143,808 tons, against 19,282 tons the same time last year. Receipts of steel rails, 140,000 tons. Prices are strong for all kinds of material. No. 1 foundry, 20 dols. to 21 dols.; mill, 16·15 dols. to 17·50 dols.; English Bessemer, 20 dols. to 20½ dols.; spiegel—20—27 dols. Sales of Lake copper, 750,000 lb., at 11½ to 12½. Exports for week, 60,000 lb.; for year, 9,950,224 refined, and 42,412,936 lbs. matte and ore. The advance in copper and tin helped lead, and during the week 1500 tons sold at 4·30 at the start, to 4·50 at the close.

The iron and steel makers throughout the country are all very busy, and the outlook is excellent for the winter. Trade conditions are favourable. The volume of business is 7 per cent. greater than last year. Railroad earnings show a falling-off. Several natural gas lines are projected for next year, and will aggregate 100 miles. During the past four months fifty million dollars have been added to the country's circulation, and the effect is visible in easy rates and abundant loans. The winter's prospects are excellent, and scarcely any idleness exists.

NEW COMPANIES.

THE following companies have just been registered:—

D. C. Green Compressed Air, Forced Draught, and Ventilating Company, Limited.

Upon terms of an agreement, dated 20th inst., this company proposes to purchase the business and goodwill of the D. C. Green Ventilating and Engineering Company, Limited. It was incorporated on the 10th inst., with a capital of £75,000, in £5 shares. The subscribers are:—

	Shares.
*H. F. Green, 7, South-parade, Bedford Park, engineer	1
J. Adamson, 27, Ashmount-road, Hornsey-lane, engineer	1
J. C. Duke, 37, Nelson-square, Blackfriars, clerk	1
J. F. Blyth, Nayland, Suffolk, engineer	1
E. R. Elsey, Jamaica-buildings, St. Michael's-alley, accountant	1
*J. Tolley, 66, Cannon-street, architect	1
E. C. de Segundo, 2, Aldridge-road Villas, Westbourne Park	1

The number of directors is not to be less than three, nor more than five; qualification, 100 shares. The first are: Major-General Webber, chairman; Henry Francis Green, managing director; James Tolley, and any other person appointed by them. Mr. Hiram S. Maxim, inventor of the "Maxim" gun, is appointed consulting engineer for five years.

Graphite Plumbago Crucible Company, Limited.

On the 15th inst. this company was registered, with a capital of £25,000, in £10 shares, to take over the business of plumbago crucible manufacturers, carried on at Tanners' Hill, Deptford, by Messrs. Ryle Brothers, under style of the Graphite Plumbago Crucible Company. The said business was established in 1857 by the late Mr. John Hyman, and was subsequently carried on by Mr. George Bower. The subscribers are:—

	Shares.
F. V. Hornby, 3, Plowden-buildings, Temple, barrister	1
Jeremiah Lyon, 4, Lombard-street, merchant	1
R. M. Curtis, 29, Rood-lane	1
T. D Gregory, Corn Exchange-chambers	1
D. Mitchell, Leamington, manufacturer	1
N. J. Ryle, 19, Highbury-terrace, N., merchant	1
A. Spencer, 2, Beacon-hill, N., clerk	1

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

J. D. Hickman and Company, Limited.

This company was registered on the 15th inst., with a capital of £2000, in £10 shares, to manufacture and sell "Hickman's patent rudder attachments or fittings." The subscribers are:—

	Shares.
*E. Hart, jun., 14, Moorgate-street, chartered accountant	2
*H. L. Hewitt, 28, Moorgate-street, solicitor	2
*W. T. Hart, 28, Moorgate-street, solicitor	2
A. J. Bowen, 28, Moorgate-street, solicitor	1
C. W. Routledge, 19, Union-road, Walthamstow	1
R. H. Cunningham, 4, Arthur-street, E.C., wine merchant	1
C. Hart, Ewell, Surrey	1

The first three subscribers are appointed directors.

National Exhibition Association, Limited.

This association was registered on the 16th inst., with a capital of £175,000, in £10 shares, to acquire the property of the American Exhibition, Limited, and to prepare and arrange in the United Kingdom, or elsewhere, exhibitions of arts, manufactures, inventions, resources, products, and other matters. The subscribers are:—

	Shares.
John R. Whitley, Director-General Italian Exhibition, Lillie Bridge, S W.	1
Vincent A. Applin, Italian Exhibition, Lillie Bridge, S.W.	1
J. G. Speed, Italian Exhibition, Lillie Bridge, S.W., journalist	1
W. T. Collier, Italian Exhibition, Lillie Bridge, S.W., correspondent	1
F. F. Fuller, Italian Exhibition, Lillie Bridge, S.W., secretary	1
J. Priestman, 137, Cheapside, manager Bradstreet's	1
A. Kirby, J.P., Fairlawn, New-cross	1

The management of the association will be vested in an executive council of not less than five, nor more than nine members; qualification, ten preferred shares. The first members are:—John Robinson Whitley, Sir Alfred Kirby, Victor Vesey, J. Priestmann, V. A. Applin, and J. G. Speed. Mr. Whitley is empowered to nominate three members of the Executive Council. The remuneration of the council will be £1000 per annum. Mr. Whitley is appointed director-general of such exhibitions, and will be entitled to a salary of not less than £2000 per annum. Mr. V. A. Applin is appointed secretary, at a salary of £600 per annum.

Railway Train Telegraphy Company, Limited.

On the 11th inst. this company was registered, with a capital of £3000, in £1 shares, to construct demonstrative lines of railway train telegraph, with all necessary adjuncts, under letters patent granted to Thomas A. Edison, Ezra T. Gilliland, and Lucius J. Phelps. The subscribers are:—

	Shares.
N. H. Wood, 42, Gutter-lane, E C., merchant	1
A. Dix Phelps, 4, Somerset-villas, Wimbledon	1
R. Ponsonby Staples, Hornton-street, Kensington	1
E. Schmolle, 111, Tufnell Park-road, merchant	1
W. G. Rose, 64, Riversdale-road, Highbury New Park	1
R. L. Lomax, 51, Westbourne-street, Chelsea, art agent	1
C. Crisp, 13, Poplars-avenue, Willesden Park, merchant	1

Registered without special articles.

Red Moss Works Company, Limited.

This company was registered on the 12th inst., with a capital of £20,000, in £1 shares, to manufacture peat, charcoal, gas and dye products, and to trade as iron manufacturers and engineers. Certain patents, &c., will be purchased upon terms of an unregistered agreement of the 25th ult. The subscribers are:—

	Shares.
G. Stephenson, 67, St. George's-square, S.W.	1
W. B. Chapin, Lombard House	1
Clarnia Shaw, Fire Brigade, Southwark	1
E. Zohrah, Red Moss, Horwich, Lancaster	1
R. A. Knight, 12, Abchurch-lane, merchant	1
F. J. Dickson, 16, Leadenhall-street, solicitor	1
S. A. Bird, Uxbridge	1

The number of directors is not to be less than three, nor more than seven; qualification, £25 in shares or stock. The first directors will be appointed at the first general meeting, the subscribers acting *ad interim*. The company in general meeting will determine the remuneration of the board.

R. Bell and Company, Limited.

This is the conversion to a company of the business of R. Bell and Company, of South-street, Wandsworth, manufacturers of matches and match-boxes. It was registered on the 10th inst., with a capital of £100,000, in £5 shares, with the following as first subscribers:—

	Shares.
*C. R. E. Bell, Wandsworth, match manufacturer	1
*W. Tarr, Wandsworth, match manufacturer	1
C. A. Bell, 73, Queen Victoria-street	1
E. C. Warren, New Adelphi-chambers, naval architect	1
J. Cosway, 73, Queen Victoria-street, accountant	1
A. Taylor, 49, Honbury-road, S.E , book-keeper	1
H. H. Bardis, 15, Handley-road, Hackney, clerk	1

The number of directors is not to be less than four; qualification, fifty shares, or £250 stock. The first two subscribers, and such other persons as are appointed by the signatories, are the first directors. Remuneration—chairman, £200 per annum; each other director, £150 per annum.

Grassington Waterworks, Limited.

This company was registered on the 8th inst., with a capital of £1000, in £1 shares, to supply the village of Grassington, Yorkshire, with water. There are fourteen signatories to the memorandum of association, who collectively subscribe for 100 shares.

KING'S COLLEGE ENGINEERING SOCIETY.—At a general meeting held on Tuesday, November 15th, Mr. Ranken read a paper on "Photographic Apparatus," comprising the apparatus used in the field and the necessary appliances for the production of negatives and prints. The author commenced by a description of the various forms of lens in use, including Ross's, Dallymere's, Swift's, and Lancaster's, and then passed on to the cameras, of which he stated that there are about 150 varieties. The author explained the peculiarities of some of these, and exhibited some of the different makes of cameras, including Brown's patent camera, which, in the author's opinion, is one of the best. Robinson's detective camera was also shown. Plate-holders, tripods, instantaneous shutters, actinometers, washers, lamps, printing frames, rolling machines, and burnishers were then described and their peculiarities commented upon. At a general meeting held on Tuesday, November 22nd, the president in the chair, Mr. Hewett read a paper on "Submarine Mining." The author commenced by briefly stating the advantages ensuing from the use of a submarine method of attack and the means of performing it by (1) electrical and (2) mechanical mines. Descriptions were then given of the different kinds of mines now used, and the method of laying and then firing them from either a fixed station or by means of a circuit closer. The cross-bearing instrument, for observing when the hostile strip is directly over the mine, was then explained, as well as the mechanism of the circuit closer. The question of mechanical mines was then entered upon, pointing out that although they had their advantages, they are greatly inferior to electrical mines. In connection with mines supplied with motive-power, the Whitehead and Breman torpedoes were described. The author concluded with some formulæ for calculating the force of submarine explosions. In the discussion which followed, Mr. A. H. Preece gave some account of electrical fuses, and after a hearty vote of thanks to Mr. Hewett, the meeting adjourned.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

15th November, 1887.

15,596. ARTIFICIAL PAVEMENTS, J. W. MacKnight, London.
15,597. PIANOFORTES, G. Green and C. Savage, London.
15,598. HYDROCARBON MOTORS, E Butler, London.
15,599. BASSINETTE SPRING, W. Bryan, sen., and W. Bryan, jun., Birmingham.
15,600. ELECTRIC CIRCULAR SWITCH RAILWAY, W. Price and J. Gerrard, Preston.
15,601. HAND CANDLE LANTERN, G. W. Forbes, Bristol.
15,602. APPLYING SHEET STEEL as PANELS for DOORS, W. Wade, Crewe.
15,603. PIVOTTING SWING LOOKING-GLASSES, &c., W. J. Payne, London.
15,604. CLEANING WINDOWS, &c., F. Redmond, Dublin.
15,605. LADIES' HAIR-PINS, M. Goundry, Gosforth.
15,606. HOLDFAST for SECURING HANDLES to BROOMS, &c., A. Taylor, London.
15,607. CUTTING the HAIR of HORSES, &c., W. H. Hillier, Nailsworth.
15,608. TOBACCO, &c., CASINGS, C. Simmons and G. H. Tregaskis, Cardiff.
15,609. AUTOMATIC SALE of CIGARS, &c., F. D. Butler, London.
15,610. FOLDING UP PERAMBULATOR, J. Nutter, Irlam.
15,611. HAY and STRAW TRUSSING MACHINERY, G. Woodville, Manchester.
15,612. FRAME for REAR DRIVING SAFETY BICYCLES, H. J. Brookes and R. Green, Smethwick.
15,613. SKATE BLADES, A. E. Harrison and F. C. Tomkinson, Longport.
15,614. ROUNDABOUTS, T. C. Lidster, Hull.
15,615. FURNACES, F. Goddard, Nottingham.
15,616. TICKET or TABLET, G. B. Baughan, Walthamstow.
15,617. HYDRAULIC RECOIL BRAKES, O. Krell, London.
15,618. PRINTING MACHINES, O. Imray.—(*J. C. Fowler and E. A. Henkle, United States.*)
15,619. PRINTING MACHINES, O. Imray.—(*J. C. Fowler and E. A. Henkle, United States.*)
15,620. JOINING LEATHER BELTING, B. J. Gibney, London.
15,621. STOPPING MOTIONS, W. Rothwell, London.
15,622. ADJUSTABLE CLIPS for MUSIC, &c., STANDS, J. Hornby, London.
15,623. SHUTTLES for LOOMS, F. S. Hamel, Birmingham.
15,624. SOLITAIRES, S. Atkins, Birmingham.
15,625. RESERVOIR PENHOLDER, D. Mason.—(*G. and H. de Lambert, France.*)
15,626. WOOD-WORKING MACHINERY, A. and R. Kerr, Glasgow.
15,627. RAILWAY VEHICLES, H. H. Lake.—(*Pullman's Palace Car Company, United States.*)
15,628. FASTENER and NECKTIE HOLDER, G. H. Couch, London.
15,629. LEVER HALF-GLOBE or GLOBE STOPPER, C. B. Peacock, London.
15,630. AUTOMATIC EXTINGUISHMENT of OIL LAMPS, E. Soutter, Warwickshire.
15,631. POLE CHAIN FITTING for METALLIC HORSE-COLLARS, J. Brindley, London.
15,632. COMMUNICATING MOVEMENT to TOYS, S. F. Martin, London.
15,633. COAL-VASES or BOXES, A. H. Bremner, London.
15,634. FIRE-BRICKS, J. Gay and F. W. Wood, Northfleet.
15,635. LAMPS, R. F. Heath and H. Walker, London.
15,636. FIXING COMB FOUNDATIONS in BEE-HIVES, T. B. Blow, Welwyn.
15,637. COMB FOUNDATION in FRAMES of BEE-HIVES, T. B. Blow, Welwyn.
15,638. REGULATING WATCHES, W. Hardy, jun., London.
15,639. FIXING LETTERS, &c., to GLASS, R. W. and A. J. Willis, London.
15,640. PACKING for HYDRAULIC WORK, J. C. Margetson and R. Blunt, London.
15,641. PREPARING WIRE for GILDING, C. Seiler, London.
15,642. REGULATING the ELECTRO-MOTIVE FORCE of SECONDARY CIRCUITS, W. H. Scott and E. A. Paris, London.
15,643. DOUBLE SEAMING METAL BOXES, S. B. Stevens, London.
15,644. JOINTS of GAS, &c., PIPES, J. B. Petter, London.
15,645. COUPLING SHAFTS to VEHICLES, G. Brownlees, jun., London.
15,646. SIGHT-FEED LUBRICATORS, W. Adams, Manchester.
15,647. COLOURING MATTER for DYEING, G. Tall and W. P. Thompson, Liverpool.
15,648. BILL FILES, W. P. Thompson.—(*The Schlicht and Field Company, United States.*)
15,649. LAMPS, W. P. Thompson.—(*B. J. M. Menge, United States.*)
15,650. OVENS, R. Cornthwaite, Liverpool.
15,651. SECURING HANDLES to DRAWERS, W. R. Lake. (*W. W. Chilton and C. V. Faile, United States.*)
15,652. PRINTING MACHINE, M. F. Dickinson, jun., London.
15,653. ELECTRICAL APPARATUS for SIGNALLING in TRAINS, H. H. Lake.—(*The De Mier Electrical Train Signal Company, United States.*)
15,654. HEDDLES for LOOMS, W. R. Lake.—(*G. V. Morey, United States.*)
15,655. HINGES, F. L. Scheidemann and F. W. Bender, London.
15,656. SECURING COVERINGS of DRESS STEELS, W. Holmes, London.
15,657. HYDRAULIC ENGINES, W. Tee, London.
15,658. GAS ENGINES, C. Davy, London.
15,659. SIGNALLING in TRAINS, J. Lawrence, London.
15,660. ELECTRIC CLOCKS, A. J. Thomas, London
15,661. FEEDING, &c., COMPOSITION FIRE-LIGHTERS, J. H. Glew and J. Hayes, London.
15,662. REMOVING SKIN from LUBRICATORS, W. S. Simpson, London.
15,663. SEWING MACHINES, P. Diehl, United States.
15,664. SEWING MACHINES, P. Diehl, United States.
15,665. GRINDING, &c., PANS, C. Appleby, London.
15,666. CEMENT, G. M. R. Layton, London.
15,667. TESTING the STRENGTH of SOLUTIONS of TANNIN, B. Nicholson and T. Palmer.—(*C. Collin and L. Benoist, France.*)
15,668. ANTISEPTIC or DISINFECTANT, W. J. Cooper, London.
15,669. FACILITATING TRANSPORT of EGGS, T. Bishop, London.
15,670. BURNERS for REGENERATIVE GAS LAMPS, G. Porter, London.
15,671. FITTINGS for ILLUMINATING GAS, G. Porter, London.
15,672. ALCOHOL STOVES, H. Clayton, London.
15,673. DIRECT-ACTING STEAM ENGINES, D. D. Hardy, London.
15,674. ARTIFICIAL TOOTH CROWNS, G. Evans, London.
15,675. GAS, &c., HYDRO-CARBON ENGINES, G. Adam, London.
15,676. TIME CALCULATOR, W. Wood, London.

16th November, 1887.

15,677. SOLITAIRES, &c., G. H. Blackhurst.—(*R. B. Blackhurst, Canada.*)
15,678. TOP PIECE for BOOT HEELS, I. J. Machin, London.
15,679. NAVES for WHEELS of VEHICLES, S. Wilde, Hyde, Cheshire.
15,680. VULCANISATION of WATERPROOF FABRICS, H. H. Waddington, Manchester.
15,681. MOULDING LUMPS of FUEL, J. H. Yeadon and R. Middleton, Leeds.
15,682. CLEANING COTTON SEED, R. S. Baxter and G. D. Macdougald, Dundee.
15,683. SILK COMBS, F. Fleming, Halifax.
15,684. BRAKES of LOOMS, J. Bullough and J. Kirkham, Halifax.
15,685. LABEL PROTECTORS, D. Robertson and C. H. Swift, Greenhead.
15,686. TAKING-UP MOTION in LOOMS, S. Whitaker, London.
15,687. CONCENTRATING SODA LYE, J. Dixon, Sheffield.
15,688. CONSUMING SMOKE, A. Anderson, Monkwearmouth.
15,689. RIVETTING MACHINE, J. Mackenzie, Egglescliffe.
15,690. MANUFACTURE of GLASS, G. Wood, Leeds.
15,691. MAKING KNOBS, &c., W. Phillips, Birmingham.
15,692. COMBINED HOSE CART, &c., W. Cooper and J. Holdsworth, Hull.
15,693. RENDERING FABRICS NON-INFLAMMABLE, T. G. Lee, Manchester.
15,694. STOPPING BOTTLES, D Rylands, Barnsley.
15,695. VALVE BOTTLES, D. Rylands, Barnsley.
15,696. SPRING MATTRESSES, W. Waterhouse and T. W. Blantern, Tyslay.
15,697. IMITATION SEAL SKIN, H. Lister, Halifax.
15,698. VELOCIPEDES SADDLES, G. Salter and C. J. Holdship, Birmingham.
15,699. MANUSCRIPT PRINTER, &c., J. Pumphrey, Birmingham.
15,700. CARD CYLINDERS, J. E. Wadsworth, Manchester.
15,701. CARRIAGE LAMPS, H. Hughes, London.
15,702. TRAWL NETS, G. Duthie, Glasgow.
15,703. GALVANIC BATTERY, J. Court, London.
15,704. VALVES, L. Howard, Liverpool.
15,705. COUPLING, V. Holliday and J. P. Hitchcock, London.
15,706. FASTENING the ENDS of BANDS, V. Holliday and J. P. Hitchcock, London.
15,707. SUBSTAGE SECTION INDEX, W. H. Barrett, Glasgow.
15,708. UNIVERSAL MICROTOME, W. Barrett, Glasgow.
15,709. STEAM BOILERS, E. C. J. Davis, Glasgow.
15,710. HAY KNIVES, G. A. Garfitt and J. Crooks, Sheffield.
15,711. HEATING FLAT-IRONS, T. G. Dorning, London.
15,712. VELOCIPEDES, E. Mushing, Birmingham.
15,713. EXTINGUISHING APPARATUS for LAMPS, T. H. Harvey, London.
15,714. FURNACES, T. Snowdon, London.
15,715. SHIPS' SIDE LIGHTS, T. Brétèché, London.
15,716. BELLOWS, &c., A. Langlois, London.
15,717. ELECTRICAL DATE and TIME STAMP, C. A. Randall, London.
15,718. PUNCHING or CUTTING CHECKS, C. A. Randall, London.
15,719. WATER GAUGES, C. Wells, London.
15,720. ENVELOPE OPENER, C. Wells, London.
15,721. ELECTRICAL MOVEMENT, A. W. Armstrong, London.
15,722. CONVERTING a PHOTOGRAPHIC IMAGE on a GELATINE SURFACE into a RELIEF or INTAGLIO PRINTING SURFACE, H. Sutton, London.
15,723. TAP or VALVE, A. Edwards and G. Stoneham, London.
15,724. HYDRAULIC CAPSTANS, W. Shapton, London.
15,725. CLEANING TOBACCO PIPES, H. Peacey, London.
15,726. CONDUCTORS for ELECTRIC LAMPS, N. K. Cherrill, Shortlands.
15,727. PHOTOGRAPHIC MATERIALS, E. H. Farmer and H. K. Tompkins, London.
15,728. CUTTING, GROOVING, &c., WOOD, G. A. Oncken, London.
15,729. CANDLE EXTINGUISHER, I. D. E. L. Lloyd-Jones, London.
15,730. GALVANIC BATTERIES, J. Vaughan-Sherrin, Ramsgate.
15,731. MOUTHPIECE for BASSOONS, O. Hawkes, London.
15,732. CHECKING APPARATUS, J. R. Ward, London.
15,733. CORD PULLEY and SUPPORT, A. Theyskens, London.
15,734. COOKING VESSELS, H. Fricker, London.
15,735. SIGNALLING APPARATUS, W. R. Lake.—(*C. Grivolas, France.*)

17th November, 1887.

15,736. SECURING the ENDS of TAPES for DRIVING SPINDLES, J. Day, Bradford.
15,737. STEAM BOILERS, T. Beeley, Bradford.
15,738. CLEAVING BLOCKS of FUEL, J. A. Yeadon, R. Middleton, and H. T. Nadin, Leeds.
15,739. CEMENTS, J. W. T. Stephens, Cardiff.
15,740. STEAMSHIP PROPULSION, G. Chapman, Glasgow.
15,741. SPRINGS for CARRIAGES, T. W. Smith, West Brighton.
15,742. STEAM ENGINES, J. Maxwell, Glasgow.
15,743. FIRE-BARS, T. Carter, Sunderland.
15,744. CORRUGATING IRON, W. and T. Blackwood, jun., Port Glasgow.
15,745. KNOTTED LOOP STITCH SEWING MACHINE, F. W. Rawstron and J. Chapman, Manchester.
15,746 MACHINERY for WINDING YARNS, J. Corrigan, Manchester.
15,747. MACHINERY for WINDING YARNS, J. Corrigan, Manchester.
15,748 DESTRUCTION of WEEDS, D. Allport, London.
15,749. BREAKING COAL, G. Lowry, Barnsley.
15,750. WORKING TRAMWAY POINTS, C. H. Cuthbertson, Birmingham.
15,751. PHOTOGRAPHIC DARK SLIDES, W. B. Birch, Dublin.
15,752. CRICKET BATS, A. J. Altman, London.
15,753. STARTING TRAMCARS, H. Bennett, Derby.
15,754. ELECTROLYTES of SECONDARY BATTERIES, W. J. S. Barber-Starkey, Manchester.
15,755. PICKERS, A. Broadbent, J. W. Sykes, and R. Gledhill, Halifax.
15,756. CORNER CUTTING MACHINES, T. Furnival, E. Tudor, jun., C. Preston, and W. Byway, Manchester.
15,757. HOLDERS for PHOTOGRAPHIC PLATES, A. J. Boult. —(*G. Eastman, United States*)
15,758. CAMERA ATTACHMENTS, A. J. Boult.—(*G. Eastman, United States.*)
15,759. COMMUNICATING with TRAINS, A. E. Porte, Dublin.
15,760. TREATMENT of SEWAGE, W. Webster, jun., London.
15,761. TRAVELLING WEBS, FELTS, &c., B. Meinert, Liverpool.
15,762. FIRE-EXTINGUISHING SPRINKLERS, A. A. Tatter sall, London.
15,763. FIREPLACES, &c., A. Haslam and J. Settle, London.
15,764. FASTENING SASHES, &c., J. W. Stevenson, London.
15,765. WICK HOLDERS, T. Hayward, London.
15,766. TREATING SKINS, C. Collin, L. Benoist, B. Nicholson, T. Palmer, London.
15,767. WINDING-UP INDICATOR, L. P. Guignard, London.
15,768. EGG WHISKS for SPONG MACHINES, A. W. Arthurton, London.
15,769 FOLDING ROOF-TRUSSES, &c., R. Bucknall, London.
15,770. INVERSION of CANE SUGAR, J. F. Madocks, Amport.
15,771. VARNISHES, F. Crane.—(*W. D. Field, United States.*)
15,772. GUM RESINS, F. Crane.—(*W. D. Field, United States.*)
15,773. VARNISH, F. Crane.—(*W. D. Field, United States.*)
15,774. PURIFYING COMPOUNDS, &c., C. Williams, London.
15,775. MEANS for SIGNALLING on RAILWAYS, A. Duffin London.
15,776. ROCK DRILLS, C. J. Richards, London.
15,777. AXLES of ELECTRIC TRAM-CARS, A. J. Jarman London.
15,778. ELECTRIC CARS, LOCOMOTIVES, &c., A. J. Jarman, London.
15,779. ELECTRICAL MOTORS, A. J. Jarman, London.
15,780. COP TUBES, J. B., G., and J. B. Swailes, London.

15,781. Wall Ladder and Fire-escape, T. A. Abbot, London.
15,782. Road Cars, G. Clifford, London.
15,783. Wire Nails, J. Nichols, Birmingham.
15,784. Buckles, L. Mayer, London.
15,785. Tickets, J. M. Black, London.—[Received 17th November, 1887. Antedated 20th May, A.D. 1887. Under International Convention.]
15,786. Propelling and Steering Boats, E. Pombas, London.
15,787. Head Gear for Horses, F. A. Thouveuin, London.
15,788. Multiple Expansion Engines, A. Laing, Glasgow.
15,789. Churning, W. Bergh, London.
15,790. Casks, E. Ball, London.
15,791. Alleviating Pain, W. C. Davis, London.
15,792. Artillery Mountings, D. D. T. O'Callaghan, London.
15,793. Refrigerating Machines, R. Matthews, London.
15,794. Warming Pan for Medical Purposes, C. J. Southon, London.
15,795. Steam Engines, A. V. Newton.—(*J. Ericsson, United States.*)
15,796. Winding Threads, W. T. and J. H. Stubbs, Manchester.
15,797. Sewing Machines, J. E. Carver, London.
15,798. Preserving Passengers' Clothing, S. M. y Valdivielso, London.
15,799. Automatic Delivery Boxes, B. Burkin and T. Melville, London.
15,800. Treadle Cranks for Bicycles, F. L. Rödel, London.
15,801. Electric Lamps, W. H. Beck.—(*A. M. Michel, France.*)
15,802. Tooth Brushes, J. Evans and J. F. Golding, London.
15,803. Scissors and other Articles, T. W. Newman, London.

18th November, 1887.

15,804. Sewing Hat Leathers, T. M. Cockroft, Sheffield.
15,805. Memorial Wreath Cases, F. Henderson, Glasgow.
15,806. Preventing Downward Draught in Chimneys, J. Johnson, St. Leonard's-on-Sea.
15,807. Washing Fabrics, D. Mason.—(*N. Reiser, Germany.*)
15,808. Stage Illusion, F. Harvard, London.
15,809. Combing Wool, &c., H. W. and J. H. Whitehead, London.
15,810. Boiler Furnaces, D. McQueen, Glasgow.
15,811. Hydraulic Gas Valve, G. Watson, Birmingham.
15,812. Raising and Lowering Windows, A. Lever, J. T. Pearson, and T. Richmond, London.
15,813. Railway Buffers, J. Mitchell, Sheffield.
15,814. Combined Paste and Size, J. J. Carr, Scarborough.
15,815. Adjustments of Windows, J. A. Macmeikan, London.
15,816. Extermination of Rabbits, &c., A. W. Murray, Dublin.
15,817. Prevention and Cure of the Gapes in Poultry, T. Campbell, Haddingtonshire.
15,818. "Veneering" Felt Hat Bodies, N. L. Hilton, Manchester.
15,819. "Veneering" Felt Hat Bodies, N. L. Hilton, Manchester.
15,820. Interlocking Apparatus for Railways, W. F. Burleigh, London.
15,821. Heating Rooms, &c., F. and A. Craven, W. Pinder, and P. H. Stansfield, Bradford.
15,822. Registering Tap, C. Windust, London.
15,823. Combined Umbrella and Walking-stick, G. Beech, London.
15,824. Velocipedes, S. Miller and W. E. Whitbread, London.
15,825. Spring Lock or Bolt, J. Hudson, Birmingham.
15,826. Imprinting Marks on Goods, J. A. Cundall, Manchester.
15,827. Heating Hollow Rollers for Photographic Rolling Presses, &c, W. E. Moss and J. Mitton, Nottingham.
15,828. Pencil Leads, &c., J. Moseley, Manchester.
15,829. Ball and Roller Bearings, J. Ashworth, Manchester.
15,830. Railway Signalling Apparatus, J. Willey, Rotherham.
15,831. Screw Wrench, T. Shepherd, Richmond.
15,832. Preparing Fruit, &c., R. H. Courtenay, London.
15,833. Shipping Coal, &c., W. Malcolm, Glasgow.
15 834. Shipping Coal, &c., W. Malcolm, Glasgow.
15,835. Enamelled Composition, T. D. Harries, Aberystwith.
15,836. Boots for Football, &c., T. Jones, London.
15,837. Rails for Railways and Tramways, R. Bradshaw, Manchester.
15,838. Attachment of Castors to Bedsteads, &c., S. Sproston, Birmingham.
15,839 Burning Mineral Oil in Stoves, &c., J. M. Anthony.—(*E. G. Marks, United States.*)
15,840. Needle-case, J. Darling, Glasgow.
15,841. Boots and Shoes, W. McDonnell, Limerick.
15,842. Receiving the Thrust of Propeller and other Shafts, W. B. Thompson, Dundee.
15,843. Sounder Screen for Telegraph Purposes, G. Beech and G. Welch, London.
15,844. Combination of Barometer, &c., C. Phillipsbourne, London.
15,845. Vacuum Pumps, &c., F. B. Hill and M. Shearer, London.
15,846. Securing Covers of Jars, F. A. Darton and F. G. Phillips, London.
15,847. Bed Mattresses, D. Mason. —(*A. Florein, France.*)
15,848. Cartridges, T. P. Wood, London.
15,849. Combination of a Watch, &c , L. Weill and H. Harburg, London.
15,850. Oil Lamps, R. F. Heath and H. Walker, London.
15,851. Solution for Unhairing Hides, J. Palmer, London.
15,852. Illuminating Gas, J. H. R. Dinsmore, Liverpool.
15,853. Cloth, A. E. Hudson, London.
15,854. Holding Flat Irons whilst being Heated, B. E. Midgley, London.
15,855. Machinery for Boring, &c., G. Harrison and The Northern Engineering Company, London.
15,856. Knife and Fork Cleaner, E. Cawthra, London.
15,857. Treating Wrought Scrap Iron, R. R. Gubbins, London.
15,858. Dynamo Electric Machines, &c., W. Main, London.
15,859. Rocking-horse, T. H. B. Hitching, London.
15,860. Taps, E. Boyes, London.
15,861. Oil Cans, T. F. Braime, London.
15,862. Horse-clothing, L. Haslam, London.
15,863. Copying Press, E. Nussbaum and S. Netter, London.
15,864. Velocipedes, A. E. Price, London.
15,865. Spinning Machines, J. Hogg and A. H. Robinson, London.
15,866. Ornaments, E. Weis, London.
15,867. Bedsteads, A. Wright, London.
15,868. Drain Pipes, R. N. Shaw, London.
15,869. Ventilators, W. R. Hayes, London.
15,870. Horizontal Drums of Windlasses, H. Fletcher, London.
15,871. Brakes, E. Shaw, London.
15,872. Lever Appliance for Suction Clips, W. S. Simpson, London.
15,873. Spring Clip Knee Cap for Horses, W. S. Simpson, London.
15,874. Ropes, A. T. Cwerdinski, St. Louis, U.S.
15,875. Earthenware, S. Pitt.—(*M. S. Higbie and G. G. Frelinghuysen, United States.*)
15 876 Lathes F. W. Ames, London.
15,877. Telegraphic Apparatus, &c., J. B. Willis, London.
15,878. Utilisation of Compressed Air, V. Popp, London.
15,879. Horseshoes, T. F. R. Herrmann, London.
15,880. Air Propellers for Propelling Ships, H. C. Vogt, London.
15,881. New Alloy for Electro-plating, C. A. Meygret and P. Marino, London.
15,882. Cutting Tubular and Solid Screws, W. Reh, London.
15,883. Electric Safety Lamp Apparatus, W. G. Adams, London.

19th November, 1887.

15,884. Miners' Safety Lamps, J. Ashworth, Manchester.
15,885. Hat Bodies, W. Sidebotham, J. H. Gosling, and F. J. Farmer, Manchester.
15,886. Mills for Grinding Grain, J. and J. Edge, Liverpool.
15,887. Automatic Delivery Box, A. W. Armstrong, London.
15,888. Combined Compass and Scale, J. G. Rollason, Birmingham.
15,889. Double Bar Lock Roofing Tile, T. N. Grimbleby, Hull.
15,890. Lamp Carriers, W. Newton and M. J. Wheatley, South Shields.
15,891. Measuring Electrical Currents, W. H. Douglas, Birmingham.
15,892. Feed Rollers of Carding Engines, G. Eastwood, Rochdale.
15,893. Washing, &c., Clothes, J. Heselwood, Manchester.
15,894. Combing Machines, B. A. Dobson and J. Hill, Manchester.
15,895. Bottle Stoppering, L. T. Plose, London.
15,896. Rendering Fabrics Waterproof, T. F. Wiley, Bradford.
15,897. Drawing Corks, J. A. Yeadon and R. Middleton, Leeds.
15,898. Padlocks, N. Brough and G. H. Austin, Birmingham.
15,899. Rendering Fabrics Waterproof, T. F. Wiley, Bradford.
15,900. Rendering Fabrics Waterproof, T. F. Wiley, Bradford.
15,901. Obtaining Perfect Combustion, J. S. Taylor, and A. Harvey, Grimsby.
15,902. Tool Chest Locks, C. Corbett, Wednesfield.
15,903. Cutting Clay Emitted from Brick Machines, R. Parry, Westcote.
15,904. Ball Valves, J. W. Broadey, London.
15,905. Gas Stoves, A. J. Boult.—(*J. Smith and H. J. Boyd, Canada.*)
15,906. Brick Machines, W. P. Thompson.—(*W. T. Duvall and H. Blunt, United States.*)
15,907. Photometers, G. B. A. Gibbons and C. J. McEwen, Liverpool.
15,908. Non-emiting Smoke in Engines, T. Huard, London.
15,909. Air Gun Toy, J. Sample, Newcastle-on-Tyne.
15,910. Rifle Shooting Scorer, J. McHardy and J. Livingstone, Dollar, N.B.
15,911. Feeding Fuel to Furnaces, A. H. Stott, sen., Oldham.
15,912. Propelling Cycles, W. H. Blessly, Middlesbrough.
15,913. Boards, A. B. Dobbie, Glasgow.
15,914. Lawn Tennis Pole, J. A. Duthie and J. Anderson, Aberdeen.
15,915. Reversing Gear, D. Williams and W. E. Raymond, London.
15,916. Safety Valve, C. Macintosh, London.
15,917. Press for Lawn Tennis Rackets, W. Hawcridge, Bradford.
15,918. Twisting Frames, A. Combe, Belfast.
15,919. Reversing Apparatus for Perambulators, J. Price and H. Nash, London.
15,920. Perambulator Brakes, J. Price and H. Nash, London.
15,921. Hot-air Engine, E. Schlinder and H. W. Thatcher, London.
15,922. Spring Jack, A. Coleman, H. F. Jackson, and E. L. Dudley, London.
15,923. Locks, Latches, &c., T. Burns and J. S. Dumbell, London.
15,924. Steam Traps, J. C. Mewburn.—(*E. H. Nacke, Germany.*)
15,925. Taps or Valves, J. H. Schofield and A. V. G. Worth, London.
15,926. Portland Cement, O. Bowen, London.
15,927. Saucepans to Prevent Overflow while Boiling, W. S. Simpson, London.
15,928. Portable Lavatory and Water-heater, G. Portes, London.
15,929. Easels, J. A. Macmeikan, London.
15,930. Hydraulic Jacks, A. E. Seaton, Sheffield.
15,931. Steel Plates with Thickened Edges, W. Davies, Sheffield.
15,932. Ink-blotters, W. Nagelschmidt, London.
15,933. Bottle-closing Devices, W. Nagelschmidt, London.
15,934. Cloth-raising Machines, J. Schofield, Manchester.
15,935. Turn-buttons, G. Y. Illiffe, Birmingham.
15,936. Articles of Clothing, L. Haslam, London.
15,937. Clearing Yarn and Thread, L. Haslam and C. Marshall, London.
15,938. Filters, R. Morris, London.
15,939. Electrolytic Treatment of Sewage, &c., W. Webster, jun., London.
15,940. Automatically Closing Tap Holes of Casks, F. M. Morgan and C. T. Hulett, London.
15,941. Velocipedes, J. K. Starley, London.
15,942. Mules for Spinning, A. Koechlin, London.
15,943. Galvanic Batteries, O. C. D. Ross, London.
15,944. Working Slide Valves of Duplex Steam Pumps, T. Jefferis and Tangyes, London.
15,945. Graphic Portable Plane for Model, &c., Drawing, J. W. Thomas and G. W. F. Moore, London.
15,946. Tea and Coffee Pots, A. E. and J. E. Furniss, Sheffield.
15,947. Boots, F. Edwards, London.
15,948. Lamps, J. Methven, London.
15,949. Moulds, W. Grasshoff, London.
15,950. Self-lighting Gas Burners, &c., E. Fahrig, London.
15,951. Range-finding Gun, T. Nordenfelt.—(*B. von Matern, Sweden.*)
15,952. Projectiles, H. S. Maxim, London.
15,953. Collapsible Beds, F. H. Street and C. Ellis, London.
15,954. Machine Guns, C. F. Wood, London.

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15,955. Chain, F. Egge, London.
15,956. Reversible Cast Iron Standards, C. Froggatt and J. Briggs, Stockport.
15,957. Weavers' Reed Hook, W. Oldfield and J. Holt, London.
15,958. Decorating Iron Bedsteads, J. Brookes, Smethwick.
15,959. Veneering, W. Nuthall, L. Thornley, and J. Booth, Manchester.
15,960. Travelling Trunk and Bedstead, J. L. Hanman, Birmingham.
15,961. Trap Twisting Frames, A. Ambler, Halifax.
15,962. Camera-obscura as a Toy, W. H. Day and G. Dimmer, West Cowes.
15,963. Water Tap and Boss, W. H. Wallis, Southampton.
15,964. Woven Weft Pile Fabrics, J. Wilkinson, Manchester.
15,965. Erecting Telegraph and other Wires, A. S. Dunn, Glasgow.
15,966. Tool-holder, V. Morris, Ipswich.
15,967. Padlocks, &c., J. Frakes and J. Lowe, Birmingham.
15,968. Stockinette Frames, R. H. Lendrum, Halifax.
15,969. Portable Sewer Flushing Tanks, B. D. Healey, Bamber Bridge
15,970. Accidental Insurance, W. Johnson, Liverpool.
15,971. Cleaning Cotton Seed, R. S. Baxter and G. D. Macdougald, Dundee.
15,972. Dyeing Cotton Velvet, J. Marshall, Walsden, near Todmorden.
15,973. Hodgson's Teazer Grate and Cleaner, T. Hodgson, Yeadon.
15,974. Cutting Sunk Surfaces, W. and T. S. Taylor and H. W. Hobson, London.
15,975. Stopping Bottles, D. Rylands, Barnsley.
15,976. Pumps, J. Reid, Bromley.
15,977. Indicating the Speed of Shafts, R. P. Fuge, London.
15,978. Putting Up Surgical Threads, &c., J. Milne, London.
15,979. Dental Forceps, C. F. Forshaw, London.
15,980. Dress Improver, A. C. Herts, London.
15,981. Double Flush Water Waste Preventing Valves, J. Earsdon, London.
15,982. Pedals for Velocipedes, C. A. E. T. Palmer, London.
15,983. Cooking Utensils, A. J. Dewar, London.
15,984. Coating Glass, W. J. Cox, London.
15,985. Diverting Electrical Currents, E. Bergholt, London.
15,986. Steam Generators, J. J. Tinker, London.
15,987. Micrometer for Optical Instruments, G. Shann, London.
15,988. Transporting Package, J., R., A. M., and W. Milne, London.
15,989. Dry Gas Governor, E. H. Skelton, Leyton.
15,990. Sifting Granular Materials, E. Kreiss, London.
15,991. Velocipedes, W. Lee and D. Wiggins, London.
15,992 Teapots, M. E. Woods, London.
15,993. Signalling Apparatus, W. P. Thompson.—(*A. B. Harford, United States.*)
15,994. Rollers for Grinding Mills, A. Stevenson, Liverpool.
15,995. Wines, C. Billing, Liverpool.
15,996. Preventing the Slamming of Doors, W. R. Lake.—(*H. E. Russell, United States.*)
15,997. Pipes, &c., F. Claustrat, London.
15,998. Making Nicks in Types, J. Y. Johnson.—(*The Thorne Machine Company, United States.*)
15,999. Vapour Burners, W. R. Lake.—(*H. B. Ford, United States.*)
16,000. Domestic Fire-escape, F. St. J. Robinson, London.
16,001. Lock for Safes, W. H. Beck.—(*E. Paublan, France.*)
16,002. Closing Jars, F. H. Palmer and W. H. Bowlsby, London.
16,003. Photo-chemical Printing, W. Willis, London.

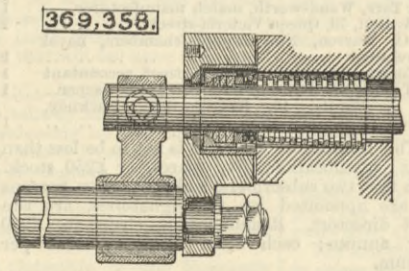
SELECTED AMERICAN PATENTS.

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

369,358. Supporting Mechanism for Valve Stems, *E. P. Monroe, Philadelphia, Pa.—Filed September 30th*, 1886.

Claim.—(1) The combination, with a valve stem or rod, of a carriage for the stem and an adjustable bar or track supporting the weight of the carriage and one end of the stem, substantially as set forth. (2) The combination, with a valve stem or rod, of a carriage for the stem and a vertically adjustable supporting bar or track for the carriage, which bar is also adapted to be rotated more or less to compensate for wear, substantially as set forth. (3) The combination, with a valve stem or rod, of a carriage for the stem and a hollow adjustable supporting bar or track for the carriage, provided with a threaded bolt of a separate piece of metal forming a stem for adjustment of the track, substantially as set forth. (4) The combination,

369,358.

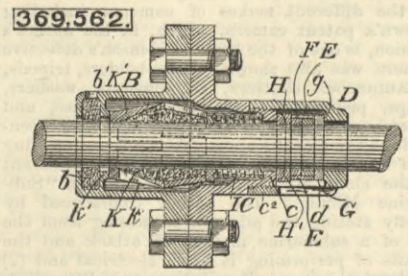


with a valve stem or rod, of a carriage for the stem and a track or supporting bar for the carriage, provided with a shank for supporting and adjusting the track, substantially as set forth. (5) The combination, with a valve stem, of a carriage for the stem and a supporting bar or track for the carriage, the carriage composed of two parts bolted together adjustably between the track and valve stem, substantially as set forth. (6) The combination, with a valve stem, of a hollow carriage and a hollow supporting bar or track, substantially as set forth. (7) The combination of the valve stem and its packing and the carriage and adjustable track at one end with the yoke and its horn and a carriage and adjustable track for the horn, substantially as set forth.

369,562. Piston-rod Packing, *W. T. Small and H. H. Warner, Tacoma, Wash.—Filed April 27th*, 1887.

Claim.—(1) In a stuffing-box, the combination of the frames standing in opposite positions within the said box around the rod reciprocating therein and provided with fingers diverging from their bases, with the fingers of each facing those of the other, the light packing material between the rod and said fingers, and the coiled spring bearing against the base of the inner frame and against a fixed support within the

369,562.

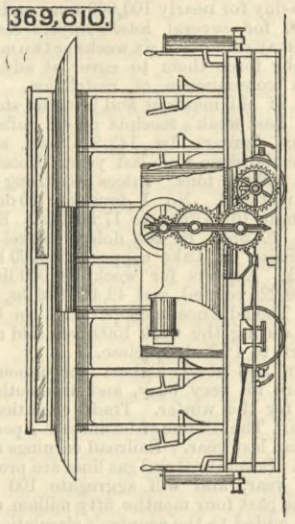


stuffing-box, substantially as specified. (2) The herein-described packing-box, composed of the outer section B provided with the recess *b* and diaphragm k^1, the inner section C provided with the flange *c* and the shoulder c^2, the cage D, provided with the openings *d* and flange *g*, the frames K K^1, provided with the fingers *k*, the coiled spring I, the closed ring G, H, and H^1, and the cut rings E E and F, all constructed and arranged substantially as and for the purpose specified.

369,610. Power-driven Street Car, *J. Noble, St. Louis, Mo.—Filed April 28th*, 1886.

Claim.—(1) The combination, with a street car and a motor for propelling the same, of driving gear suspended from the power shaft of the motor, and a device for preserving the mesh of the driving gear with the pinion on the car axle, substantially as and for the purposes specified. (2) The combination, with a street car and a motor thereon, of a frame suspended from the power shaft of the motor, and a series of driving pinions having their journals or bearings on the suspended frame, substantially as and for the purposes specified. (3) The combination, with the power shaft of the motor, of the suspended loop frame, two sets of pinions journalled therein, and pinions on the power shaft, which mesh with the trains of gearing supported by the suspended loop frame, substantially as and for the purposes specified. (4) The combination, with a street car, of a motor, two trains of gearing having an unequal number of idlers, so as to obtain reverse

369,610.

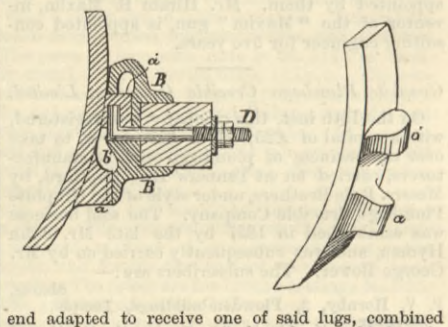


motion, said gearing suspended from the power shaft, and an interposed shifting clutch gear, substantially as and for the purpose specified. (5) The combination, with a street car, of a motor, a train of driving gearing suspended from the power shaft, a pinion on the axle, and radius bars which connect the axles of the driving pinions and the driven axle, substantially as and for the purposes specified. (6) The combination, with a street car, of a motor, two trains of driving gearing suspended from the power shaft of the motor, an interposed shifting clutch gear wheel, a shipper, and a rod for actuating the shipper from either end of the car, substantially as and for the purpose specified. (7) The combination, with a street car, of a gas motor, driving gearing actuated by the motor for propelling the car, and a muffler and a waste tank for receiving the exhaust of the motor, substantially as and for the purpose specified. (8) The combination, with a street car, of a gas motor, driving gear actuated thereby for propelling the car, a waste tank for receiving the exhaust of the motor, and spray or jet pipes for delivering the tank water on the track, substantially as and for the purposes specified. (9) The combination with a power driven street car, of a brake system consisting of brake-rods 37 and 38, pivotted lever 34, connected to the brake beams by rods or chains, fixed pulley 36, rope or chain 42, and shifting friction clutch 27 on the driven axle, substantially as and for the purpose specified.

369,736. Brake Shoe and Head, *J. P. Race, St. Paul, Minn.—Filed April 19th*, 1887.

Claim.—(1) A brake shoe having the convex bearing points *a a*^{1}, combined with the brake head B, provided with a lug b^1, and L-shaped bolt D, upon which the brake shoe is pivotted, substantially as set forth. (2) A brake shoe provided with convex-faced lugs and a brake head having a concave depression at its lower

369,736

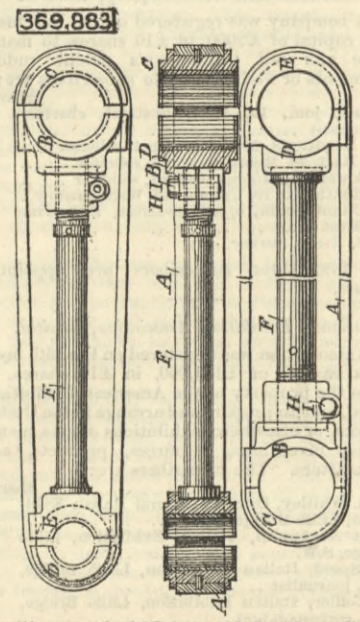


end adapted to receive one of said lugs, combined with a brake beam and an L-shaped pivotal bolt, substantially as described. (3) A brake shoe combined with a brake head and a vertical pivot for uniting the shoe and head having engaging lugs for preventing the upward riding of the shoe, substantially as set forth.

369,883. Connecting-rod, *J. Richards, San Francisco, Cal.—Filed April 14th*, 1887.

Claim.—(1) In a connecting-rod, the combination, with the embracing strap, of the strut and the divided collar and its clamping means, substantially as described. (2) In a connecting-rod, the embracing strap, in combination with a strut having enlarged ex-

369,883.



tremities, one of which is provided with a split screw collar having clamping means, substantially as described. (3) The combination, with the embracing strap and the boxes for receiving the pins, of an interposed expanding strut having a divided collar provided with clamping means, substantially as described. (4) The combination of the strap A, boxes B C and D E, strut F, and screw collar H, having clamping screw I, substantially as described.