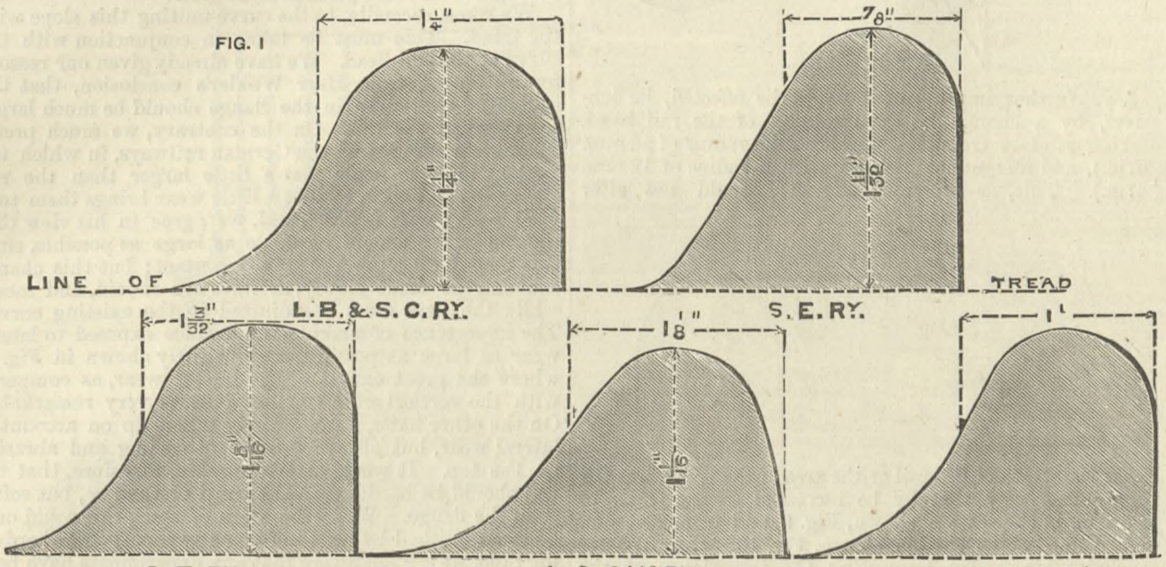
TIRE SECTIONS AND RAIL SECTIONS.

On the 11th of March, 1881, we published a short article on "The Flanges of Leading-wheel Tires," and gave full-size sections—reproduced in Fig. 1—of the flanges used by five of our leading railways. This article seems to have attracted the notice of Herr Wöhler, the well-known German experimentalist; and in the *Centralblatt der Bauverwaltung* for August 20th, 1881, issued by the Minister of Public Works, Berlin, he published a paper with substantially the same title as that with which we have headed this article. He begins by referring to a remark in THE ENGINEER with respect to the material difference between the tire sections used on different railways, and observes that the same diversity exists in Germany. When the German Railway Union collected statistics on the subject, twelve different sections were submitted, coming from thirty-four different railways, and the radii to which the fillets, or curves between the flange and the, tread, were struck, varied from 14 to 29 mm. (0·55in. to 1·14in.).

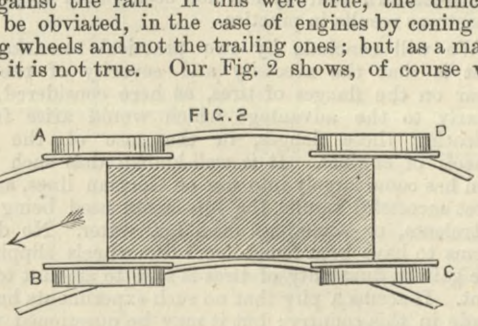
It is evident that the continual wear between the flange of the tire and the head of the rail must tend, more or less, to bring the shape of the two into correspondence. If they be made of materials differing in hardness, the softer of the two will assume the shape of the harder; but if the hardness be about the same, something like a compromise will be arrived at. Again, the greater the area in contact at any moment the less will be the unit pressure, and the less consequently the wear and tear. Hence it would seem at first sight correct to make the tire and rail sections exactly similar to each other; and this would indeed be all that is needed if a railway were a perfectly straight and even line. But the effect of curves introduces a new element into the question. In the first place, the tread of a tire is not turned to a cylinder, as would appear natural, but to the frustum of a cone. This, indeed, is not resorted to purely on account of curves. Even on the straight, accidental inequalities, making use of the necessary play between tires and rails, may throw a pair of wheels to one side, thus causing uneven going, and allowing one of the flanges to grind against the side of the rail-head. If the wheels are cylindrical there is nothing to counteract this evil; but if they are conical, the axle is canted upwards, and the cones, rolling in a curvilinear line on the rails, bring back the wheels to a symmetrical position. It is on curves, however, that the chief advantage is claimed for the conical form; since by that means the outside wheel, which has the greater distance to traverse, is also made to revolve on a larger circle of contact, so that the speed of revolution is approximately equalised, and the grinding of the outside wheel on the rail is prevented. In Germany the coning of tires appears to be universal, and the slope of the tread varies from 1 in 20 to 1 in 15, or, in the single case of the Saxon railways, 1 in 13.

FIG. 1



It is singular that, with all our experience in railways, any doubt should yet remain on such a question as this. Yet, at a recent meeting of the Institution of Mechanical Engineers—"Proceedings, 1880," p. 71—Mr. Crampton laid down the dictum that coning was an entire mistake, and further stated that Mr. Haswell, of Vienna, having at his suggestion adopted the cylindrical form, had found this produce a saving, in wear and tear of tires, of not less than 20 per cent. It was stated in the same discussion that Mr. Charles Brown, of Winterthur, now makes all his tramway engines—in which department he has great experience—with cylindrical wheels. Mr. Crampton's theory is that, when a vehicle is on a curve, it is only in the front pair of wheels that the tire flange is grinding against the rail. If this were true, the difficulty could be obviated, in the case of engines by coning the leading wheels and not the trailing ones; but as a matter of fact it is not true. Our Fig. 2 shows, of course with

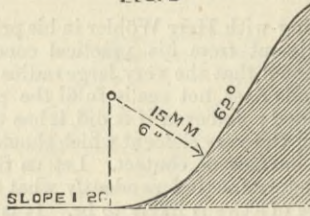
FIG. 2



great exaggeration, the passage of a rigid four-wheeled truck round a sharp curve. It is clear that the outside leading wheel A, on which the main stress comes, will strive to put itself in the direction of a tangent to the curve at its point of contact, but that, if it did so, it would throw the outside trailing wheel D beyond the outer rail altogether. All that it can do, therefore, is to keep the flange of D pressed up against the inside of the outer rail, exactly as is its own flange; and, therefore, if coning is of any advantage for the one pair, it will be for the other pair also. As far as curves are concerned, therefore, the value set upon coning would appear to be well founded. With regard to its action on the straight, Herr Wöhler states that several railways have increased the angle of coning of their wheels, specially to give more even going on the straight, and have derived benefit therefrom. It would seem, therefore, that both experience and theory point, on the whole, to the coning of wheels as the true course to adopt, while at the same time the adverse verdicts of Mr. Haswell, Mr. Brown, and others, seem to show that there is still something in the matter which requires further and closer investigation.

With regard to the proper angle of coning, Herr Wöhler considers that it should not be too great, otherwise when in the straight a wheel gets accidentally to one side, the inequality in the circumferences of contact may cause serious grinding before the conical form brings it back to the symmetrical position. He also points out that with rigid axles the coning is quite incompetent to prevent what is probably the worst wearing effect upon curves, namely, that due to the axle not being normal to the rails. The wear thus brought upon the flange requires, as he observes, a close investigation. On the whole Germans appear to prefer 1 in 20 to any other inclination or coning for the tire. This is used for the flange section shown in Fig. 3, which is that agreed upon by the State railways of

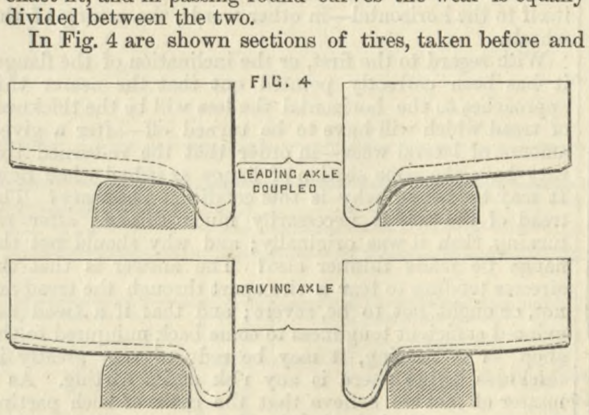
FIG. 3



Prussia, and by several other German companies. Here the fillet of the flange has a radius of 15 mm., while that of the rail head curve is 13 to 14 mm. The result is that after a very short time the flange and rail get to an exact fit, and in passing round curves the wear is equally divided between the two.

In Fig. 4 are shown sections of tires, taken before and

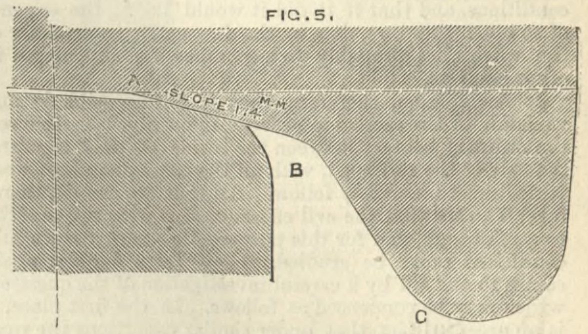
FIG. 4



after wear, from two engines, Schlei and Bigge, having this flange section, the rail head being as in the shaded section. The effect of the mutual action of the two in producing lateral wear is well illustrated, and also its very unfavourable results for the duration of the tire, owing to the great thickness of material which has to be removed in turning down, to bring the flange back to its original section. The thickness thus wasted in the leading wheels is at least three times that removed by direct wear; and this thickness will be greater the nearer the original slope of the flange was to the vertical—assuming the depth of wear to be the same. There is no doubt an equal wear upon the rail heads, but as this is distributed over a great length of way it is not so visible.

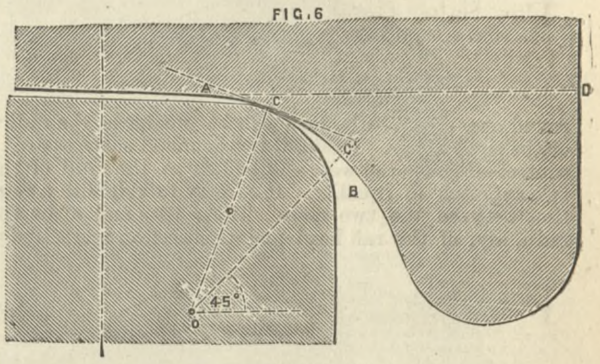
We have now to consider whether this section can be improved. What is needed is to add to the coning—which is apparently all which is needed for the conditions of the straight track—some additional improvement in section which shall respond to the conditions on curves. Herr Wöhler's way of dealing with the problem is as follows. An obvious suggestion, he remarks, is that represented in Fig. 5, namely, to terminate the ordinary inclination of the tread towards the flange by a short slope A B at a much higher angle, here taken as 1 in 4. In that case, when the leading wheels entered a curve, and the flange of the outer wheel began to approach the inside of the rail, the rise of the wheel on the rail would be so marked as alone to compensate for the increased distance this wheel has to travel, and also to give a sideways pressure sufficient to guide the wheel round the curve, without the actual edge of the flange B C coming in contact with the rail at all. This simple arrangement would require, however, a similar sloping off of the rail head, as represented

FIG. 5.



in Fig. 5, otherwise the wear would be so concentrated as to be excessive. It is, therefore, inapplicable to the present rounded form of head. The principle may, however, be adapted to that form by giving the fillet A B a much larger radius than is now usual, as shown in Fig. 6. The wheel, as it enters a curve, will then mount upon the rail much as before; and the tangent drawn at C, Fig. 6, shows

FIG. 6



the virtual slope thereby given to the circumference of contact, which, as will be seen, is quite as steep as that shown in Fig. 5. The higher the wheel mounts the steeper will this slope become, and therefore the more powerful will be the sideways thrust tending to push the wheel back again and to guide it round the curve. This Herr Wöhler offers as a satisfactory solution of the problem; and it remains to ask whether it may really be accepted as such.

The amount by which the wheel will rise on the rail can be easily calculated in any particular case, of which the conditions are known. Let O be the centre from which the curve of the tire section is struck, and let i be the angle which the radius O C, Fig. 6, makes with the vertical. Let W be the weight on the wheel, f the coefficient of friction between wheel and rail, P the normal pressure along O C, and T the horizontal thrust. Then, resolving vertically and horizontally,

$$P \cos. i - f P \sin. i = W$$
$$P \sin. i + f P \cos. i = T.$$

Hence,
$$W \frac{\sin. i + f \cos. i}{\cos. i - f \sin. i}$$

is clearly the net sideways thrust—allowing for friction—which guides the wheel round the curve. Let n W be the total weight of the vehicle—so that $n = 4$, in the case of an ordinary four-wheeled truck—v its velocity, and r the radius of the curve. Then, the sideways thrust found above has to counteract the centrifugal force due to the passage of the weight n W, at velocity v, round a curve of radius r. The resulting equation will thus be

$$\frac{\sin. i + f \cos. i}{\cos. i - f \sin. i} = \frac{n}{g} \frac{v^2}{r}$$

from which the value of i can easily be found.

It will be well to test the effect of this arrangement in a particular case. Let us suppose that $r = 1000$ft., that $f = {\cdot}15$, and that $n = 4$. Then the equation is

$$\frac{\tan. i + {\cdot}15}{1 - {\cdot}15 \tan. i} = \frac{4 v^2}{32{,}200}$$

Suppose $i = 45$ deg., then $\tan i = 1$, and we have—

$$v^2 = \frac{32{,}200}{4} \times \frac{1{\cdot}15}{{\cdot}85}, \text{ or } v = 105.$$

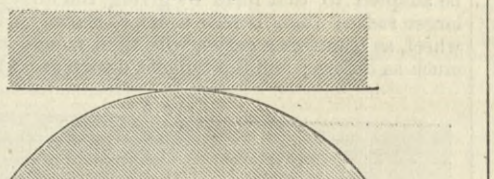
Hence it appears that a velocity of 105ft. per second, or about seventy miles an hour, would be sufficient to make the wheel mount on the rail until the angle made by C O with the vertical was not less than 45 deg., so that C assumes the new position C[1]. But at this angle it will be seen that the distance of C[1] from the horizontal A D—in other words, the difference between the radii of the circles of contact in the two wheels—is not less than ¼in. Assuming the wheels to be 3ft. 3in. diameter, this makes the ratio between the distances travelled by the two wheels in each revolution—supposing there is no slipping—to be $\frac{39{\cdot}5}{39}$ or 1·013. But the ratio between the lengths of the outer and inner rail, on a curve of 1000ft. radius—assuming the standard gauge—is $\frac{1004{\cdot}7}{1000}$ or 1·0047 only. The effect due to the mounting of the wheel in this case is therefore shown to be nearly three times as great as is required to make the two wheels run round the curve; and the grinding will therefore be much worse than if the circles of contact were simply allowed to remain the same. Moreover, as will be seen by Fig. 6, the fillet at the point

C, is just about to merge into the general slope of the inside of the flange, and any advantage as to wear, due to its presence, is therefore reduced to insignificance.

It would, therefore, appear that Herr Wöhler has neglected to examine the true effect of his suggestion, when he proposed this very wide fillet between the tread and flange of the tire. He may possibly object that seventy miles an hour is beyond the speed even of express trains; but it must be remembered on the other side that many lines have curves with radii less than 1000ft. The conclusion remains, therefore, that the large fillet here suggested does not produce the amount of sideways thrust that is required to guide an engine round a curve under ordinary conditions, and that if it did it would be at the expense of so much grinding, due to the inequality in diameter of the wheels, as probably to neutralise its advantages in other respects.

It would seem, therefore, that it is impossible by any variation of tire section to prevent, in passing round curves, the ordinary contact between the inside of the flange and the side of the rail head, with all the consequences of wear which must inevitably follow. All that we can do, therefore, is to see that the evil effects of this wear are reduced to a minimum, and for this purpose its exact nature and conditions must be studied. Here Herr Wöhler again comes to our aid by a careful investigation of the question, which may be condensed as follows. In the first place, it is an accepted fact that under similar conditions the wear is greater as the pressure per unit of surface in contact is less. Thus, where a plane surface is in contact with a

FIG. 7.



round one—Fig. 7—the wear will be greater as the radius of the circle is less. Again, if two rounded surfaces are in contact—Fig. 8—the wear will be less as the radii of the two approach to equality. It is easy to establish a relation between the two cases. Thus, let r and r^1 be the radii, say, of the rail head and tire section respectively,

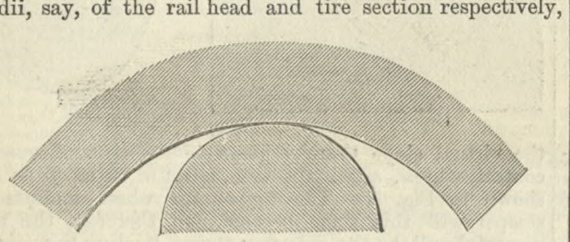


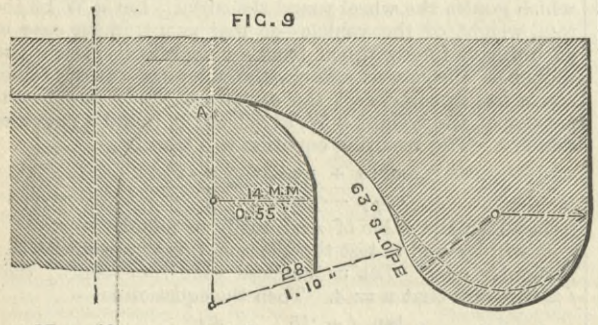
FIG. 8

and R the radius of the circle which, if in contact with a plane, would have the same length of arc in contact as there is between rail and tire. Then, by the ordinary rules of curvature,

$$R = \frac{r^1 \, r}{r^1 - r}.$$

Now, in the direction of motion the rail is straight, whereas the tire is circular, and this makes a great difference in the pressure per unit of surface in contact. This pressure does not vary inversely as R, but in a much smaller ratio, which, according to Herr Wöhler, is about as the fourth power of R inversely. Again, where the pressure per unit of surface is so high as in this case, and where there is always a certain amount of slipping, the wear will not vary directly as the pressure, but probably in a higher proportion. Thus everything points to the desirability of making R as great as possible.

FIG. 9



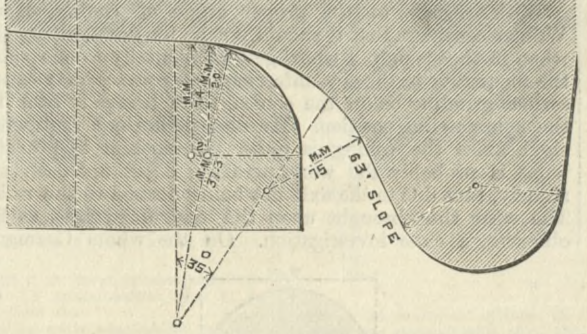
Now, if we suppose the curvature of the rail head and the tire fillet to start from the same point of contact A, Fig. 9, the difference between their radii will be fixed by the play which it is decided to allow between the tire and the rail. Let this fixed difference be e; then we have

$$R = \frac{(r + e)\, r}{e}.$$

Hence R will be greater as r is greater; in other words, the wear will be less as the radius to which the rail-head is rounded is greater.

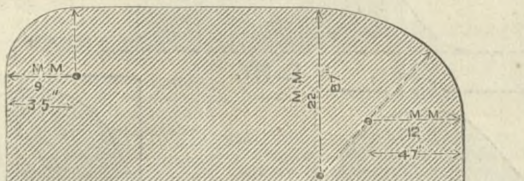
On German railways the established radius for the rail-head is 14 mm. (0·55in.), and the total play between rail and tire—or the difference in the gauge—must not be less than 10 mm. (·39in.) or more than 25 mm. (·98in.). This gives ·2in. and ·5in. as the limits of the play at each rail. We must not make e so great that the superior limit of this play shall be reached by a slight amount of wear; but short of this it should be as large as possible, because this enables us to give the largest possible value to r^1, the radius of the flange. This is based, however, upon Herr Wöhler's view that a large value for this radius is desirable—a view which we have shown above to be at best doubtful. On the whole he considers that a radius of 28 mm. (1·1in.), or double that of the rail head, is the best for the flange. This is represented in Fig. 9. It merges into the general slope of the flange, which is about 60 deg.; this, he states, is the best angle for an ordinary four-wheeled goods wagon, with a rigid frame, passing round a curve of 1000ft. radius. On the same figure is marked in dotted lines the outline of the London and South-Western section taken from Fig. 1, and it will be seen that they are very closely coincident. Still following his leading idea, Herr Wöhler suggests that this might yet be improved by giving the fillet, from its junction with the flange, a much larger radius—37·3 mm.—and then uniting it with the tread—which it would meet at a slope of about 1 in 5—by a short arc of the same radius as the rail head. This section is represented in Fig. 10.

FIG. 10



A yet further improvement might be effected, he considers, by a change in the rounding of the rail head, making it start from the tread with a radius of 22 mm. (·87in.), and merge into the side with a radius of 12 mm. (·47in.). This, as shown in Fig. 11, would not alter

FIG. 11



either the width of the rail or the area of the tread, but the value of R may thereby be increased from 28 mm. to 56·5 mm. in the section shown, Fig. 9, and from 22·4 mm. to 42·8 mm. in the section shown, Fig. 10. Herr Wöhler concludes his paper by urging the importance of the subject, not only with regard to fixed, but also to radial axles, the full advantage of which will never be realised until the section of the flanges and rails is so proportioned as to reduce to the minimum the wear which accrues from the different distances which the two wheels have to traverse.

While fully agreeing with Herr Wöhler in his principles, we are bound to dissent from his practical conclusions. We have already shown that the very large radius of fillet which he recommends does not really fulfil the purposes for which it is intended; and even if it did, it has the fatal defect of diminishing the very element which should be the largest, namely, the surface of contact. Let us therefore make an effort to determine independently what the best section for the flange of a tire is likely to be. It is evident that there are three main questions to be decided: first, the slope or angle of inclination to the horizontal of the inside face of the flange; secondly, the form of the curve or fillet, by which this slope is made to merge into the tread of the tire; and thirdly, the inclination of this tread itself to the horizontal—in other words, the coning of the wheels.

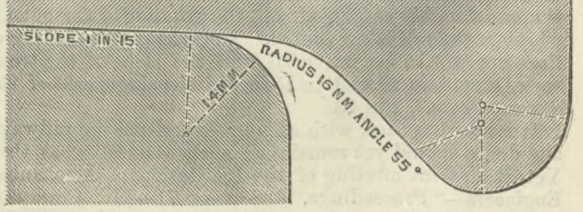
With regard to the first, or the inclination of the flange, it has been correctly pointed out that the nearer this approaches to the horizontal the less will be the thickness of tread which will have to be turned off—after a given amount of lateral wear—in order that the re-turned tire may have the same section of flange as it had when new. It may be asked, why is this condition necessary? The tread of the tire is necessarily much thinner, after re-turning, than it was originally; and why should not the flange be made thinner also? The answer is that the stresses tending to tear a tire apart through the tread are not, or ought not to be, severe; and that if a tread has evinced sufficient toughness to come back uninjured to the shop for re-turning, it may be reduced very greatly in thickness before there is any risk of its parting. As a matter of fact we believe that the cases of such parting occur very rarely indeed with old and re-turned tires; they are almost very always with comparatively new tires, which have been somehow made too hard. On the other hand the stresses and shocks to which tire flanges are subjected by the sideways action of vehicles, particularly on sharp curves and in passing over points, are most severe, and always require a very large allowance of strength. Moreover the results of failure in the former case are much less to be feared than in the latter. Wheels with cracked tires, if these are properly secured, have run for many miles, even hundreds of miles, with safety; but a wheel from which a portion of a tire-flange has flown off is certain to "jump the rail" almost immediately, and thereby to bring about an accident more or less severe. We think, therefore, that engineers are right to insist on keeping up the full thickness of their tire flanges; and, this being so, it follows, as mentioned above, that the slope of the flange face to the horizontal should be as small as possible. On the other hand, it clearly must not be so small as to cause any danger that a vehicle, when entering a sharp curve at a high speed, may mount too far, and actually pass over the rail. This limit, therefore, has to be fixed. Now, if we recur to our previous investigation as to the sideways thrust due to the pressure of the flange upon the rail an angle i, we shall see that if $\cos. i - f \sin. i$ is zero, then the value of this thrust is infinite—in other words, the flange would not rise over the rail, even if the velocity were indefinitely great, or the radius of the curve indefinitely small. If, as before, we take $f = {}·15$, this gives a value for i of $81\frac{1}{2}$ deg.; in other words, a slope of this steepness would make it absolutely impossible for a wheel to mount, even under such conditions. It is obvious that in practice a much lower angle will be admissible. If we assume that $i = 60$ deg., we shall find that the speed required to make the wheel mount against such an inclination on a curve of 1000ft. radius is about 100 miles an hour. This would appear sufficient to allow, especially as, in such extreme cases, the coefficient of friction would no doubt rise above the low value of ·15, which we have assumed for it; and it appears that this is about the angle which experience has shown to be the best. Roughly measured, the angles of slope for the various sections figured in this article are as follows:—London, Brighton, and South Coast Railway, 66 deg.; Great Eastern Railway, 66 deg.; South-Eastern Railway, 58 deg.; London and South-Western Railway, 55 deg.; London, Chatham, and Dover Railway, 63 deg.; German State Railway—Fig. 3—62 deg.; Herr Wöhler's section—Fig. 9—63 deg. It will be seen that the engineers of the London and South-Western Railway are content with an angle of 55 deg.; and we may fairly assume this to be sufficient, unless, perhaps, in the case of express engines running on a line with sharp curves, for which 60 deg. or 65 deg. would seem perhaps to be safer.

We come, secondly, to the curve uniting this slope with the tread. This must be taken in conjunction with the curve of the rail head. We have already given our reasons for dissenting from Herr Wöhler's conclusion, that the radius of the curve in the flange should be much larger than that in the rail. On the contrary, we much prefer the system adopted by the German railways, in which the flange radius is made just a little larger than the rail radius to start with, so that a little wear brings them to a good fit. On the other hand, we agree in his view that the rail radius should be made as large as possible, since this tends to increase the area in contact; but this change can only be made slowly, as lines are re-laid, and meanwhile the tires must be adjusted to the existing curves. The importance of making the surface exposed to lateral wear as large as possible is sufficiently shown in Fig. 4, where the great extent of the lateral wear, as compared with the vertical wear on the tread, is very remarkable. On the other hand, a rail is never taken up on account of lateral wear, but always because of scaling and abrasion on the top. It would seem desirable, therefore, that the rail should be harder than the tread of the tire, but softer than the flange. Where both are of steel, this could only be accomplished by means of some system of case-hardening; but we are not aware that any experiments have been tried in that direction.

Thirdly, we have to consider the coning or inclination of the tread. We have already seen that with a standard gauge, and a curve of 1000ft. radius, the difference between the diameters of the circles of contact in the two wheels should be ·0047 of the diameter, or, say, for ordinary diameters ·18in. Since the shifting laterally of the wheels decreases the contact circle of the one as much as it increases that of the other, we must divide this by 4 to get the actual increase or decrease of the radius, which has to be provided by the effect of the coning, which will thus be ·045. If the slope of the tread be 1 in 20, it will require a lateral shifting of about ·9in. to give this amount of elevation or depression. This is very nearly equal to the extreme limit of play allowed between wheels and rails; and therefore it would seem better to adopt the slope of 1 in 15, which, with a lateral play of about $\frac{1}{2}$in., would seem to answer well to the radius of curves most commonly met with on first-class lines.

The tire section thus arrived is shown in Fig. 12 in its

FIG. 12

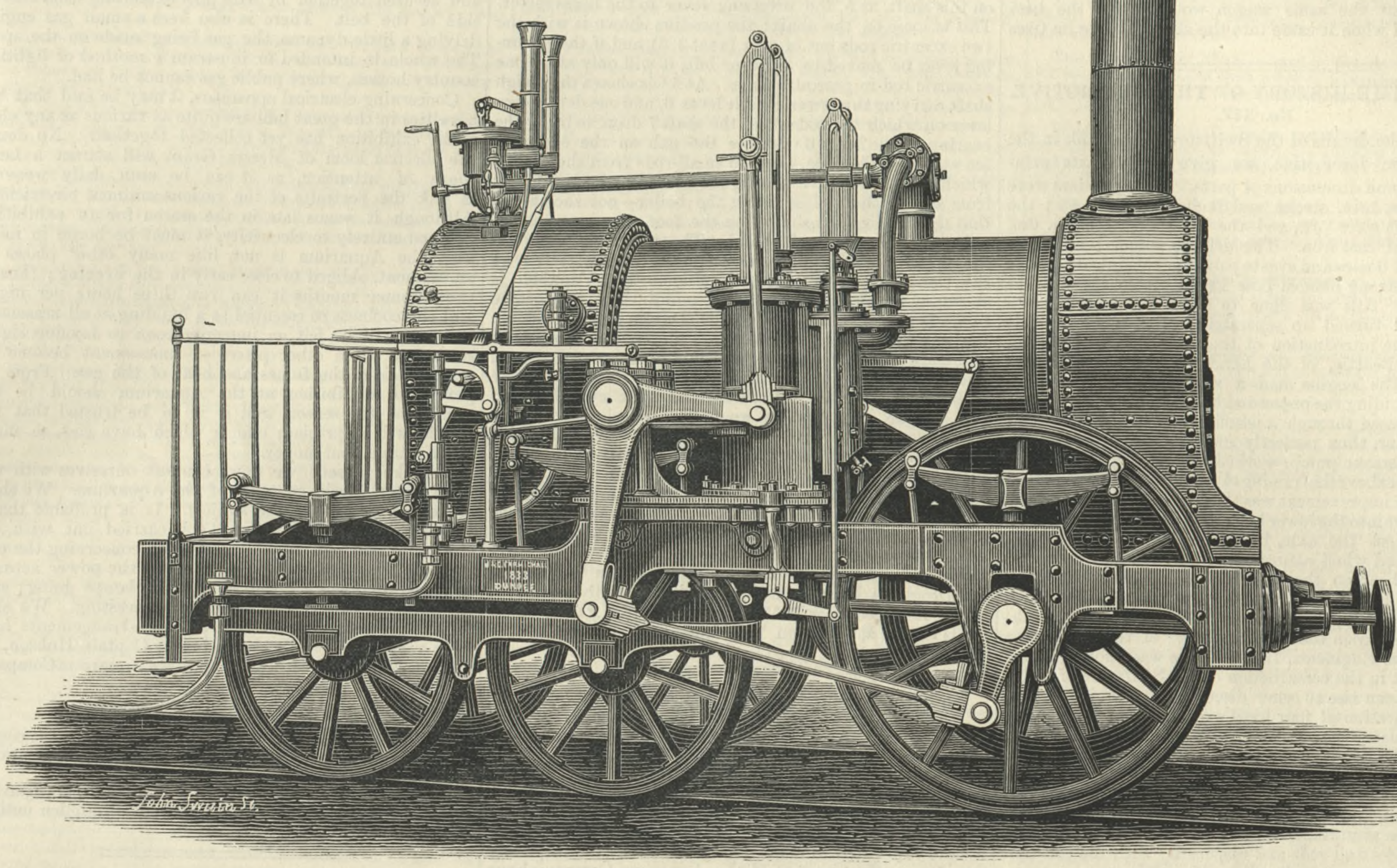


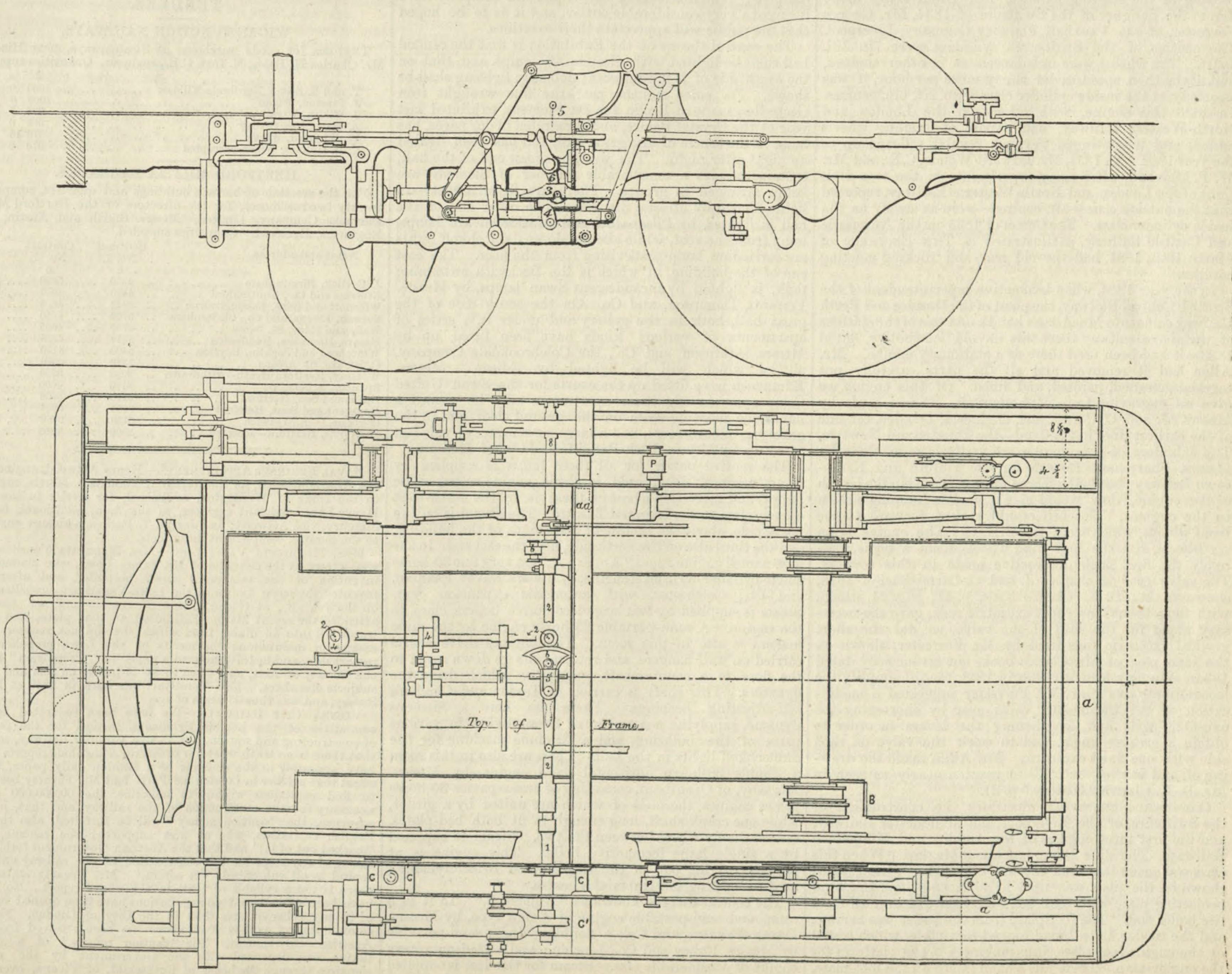
symmetrical position, and as arranged for the rail section of the German railways, and thus made comparable with the section recommended by Herr Wöhler, and that used by the London and North-Western Railway, as shown in Fig. 9. It will be seen that it differs from these mainly in having a much smaller radius for the fillet of the flange. This radius is, however, not far from being a mean of the radii used by the five railways represented in Fig. 1; and it is to be presumed that even the very small radius of the South-Eastern Railway has not been found to yield any disastrous results in practice.

We will conclude by two practical remarks. The first is that the necessity and severity of the lateral wear on the flanges of tires, as here considered, points clearly to the advantage which would arise from lubricating these flanges, in the case of the leading wheels of engines. It is well-known that such lubrication has come largely into use on German lines, and with most successful results, the lubricants used being grease, petroleum, or sometimes even hot water. No difficulty seems to have been found from the wheels slipping, and the gain in durability of tires is said to amount to 50 per cent. It seems a pity that no such experiments have been made in this country; but it may be questioned whether in such a case the angle of the flange should not be increased somewhat, say from 55 deg. to 65 deg. The other remark is as to the means of testing the various forms of section used, or proposed, as to which is really the most favourable for durability. There would seem to be a very simple method of doing this, without waiting for the tardy and always intricate results of actual experience in work-

LOCOMOTIVE, DUNDEE AND NEWTYLE RAILWAY, 1833.

(*For description see page 160.*)





VALVE GEAR OF SWIFTSURE, 1834

ing. Let several wagons be prepared alike in weight, state of lubrication, material of tires, &c., but with the flanges made each to one of the sections proposed to be tested. Let these wagons be launched successively at the same speed upon some sharp curve. The speed should be high enough to approach to the conditions of practice. Then the wagon which ran furthest round the curve before coming to a standstill would clearly be running with the least resistance; and as decreased resistance means decreased wear and tear, it would be tolerably safe to assume that the same wagon would show the best mileage record when it came into the shop to have its tires re-turned.

LINKS IN THE HISTORY OF THE LOCOMOTIVE.

No. XIV.

As some of the details of the Swiftsure form a link in the history of the locomotive, we give some of its principal features and dimensions of parts. The cylinders were 11in. diameter, 18in. stroke, and it had four wheels; the driving wheels were 5ft., and the leading wheels 3ft. 6in. in diameter, of cast iron. The driving wheels were made with enlarged bosses and eyes to pass over the outside cranks and on to a strong flanged boss keyed on to the straight driving axle. This was done to allow the wheels to be taken off and turned up separately in a face lathe; this was before the introduction of the double-wheel lathes of Mr. Joseph Beattie, of the London and South-Western Railway. The engine had a vibrating pillar parallel motion for guiding the piston-rod head; and the lengthened piston-rod passed through a stuffing-box in the front end of the cylinder, thus perfectly guiding the piston in it. It had short stroke pumps worked from a lever suspended from a bracket above the framing to the crosshead, as shown on page 159. An improvement was the introduction of a narrow piece of sponge into the lower half of the axle-boxes; it gently pressed against the axle, by its elasticity absorbed the surplus oil, and when saturated, by its capillary property, gave the oil back on the underside of the axle bearings. For further information we may refer our readers to a description of the axle-boxes on the London and North-Western Railway in the "Proceedings" of the Institution of Mechanical Engineers, 1853. There was another detail improvement in the construction of the Swiftsure of 1834, which has given rise to some discussion as to its author, *i.e.*, the application of four fixed excentrics on the driving axle to actuate the valves by four, separate, gab end excentric rods, two of them for forward gear and two for back gear. This improvement removed the constant rocking movement of the starting handles near to the engine-man's position, and avoided the rough starting and shunting of engines at stations. The credit of first using the four fixed excentrics and rods and dispensing with the constant rocking of the starting handles, Mr. Allan states to be due to the designer of the Swiftsure of 1834, Mr. George Forrester, of the Vauxhall Foundry Company, Liverpool. The centres of the Swiftsure's cylinders were 7ft. 1in. apart. The wheels were unbalanced as in other engines, and at the then speed under thirty miles per hour, it was as steady as the inside cylinder class with 2ft. 6in. centres. In 1836 this engine, with others on the London and North-Western Railway, had a pair of trailing wheels added, and it continued to run a regular mileage up to the year 1842. In 1851, Mr. Edward Woods, C.E., and Mr. W. P. Marshall, after many experiments on the two divisions of the London and North-Western Railway, reported that the outside class—6ft. centres—were as steady as the inside cylinder class. The Comet of 1835 on the Newcastle and Carlisle Railway, as illustrated in THE ENGINEER of March 18th, 1881, had the old gear and rocking starting handles.

In the year 1854, when locomotive superintendent of the Scottish Central Railway, the plant of the Dundee and Perth Railway came into Mr. Allan's hands. At one of the stations of the above railway there was an old locomotive, dated 1833—it had been used there as a stationary engine. Mr. Allan had it removed and all the parts carefully put together, cleaned, painted, and lined. Of this engine we give an engraving from a photograph. It was made by Messrs. J. and C. Carmichael, engineers, Dundee, for one of the earliest lines in Scotland—the Dundee and Newtyle. The cylinders of this engine are vertical, as in those by Messrs. Sharp and Roberts for the Dublin and Kingstown Railway; but being placed more centrally in the length of the engine, they would give a smaller jumping motion to the engines. The bell crank worked forward to the front wheels, which were the drivers. The engine is on six wheels, and the four hind wheels form a bogie, probably the first bogie locomotive made in this country. The valve gear is that of J. and C. Carmichael of 1818, shown in Mr. D. K. Clark's book, p. 21, Fig. 24, which, with long levers and short excentric rods, gave the necessary angle for the lead of the valve, as did the short vertical excentric rods used by Mr. Forrester, shown on the same page of Mr. Clark's book, but erroneously dated 1834. We may mention that in 1848, to still simplify the locomotive valve gear, Mr. Forrester suggested a modification of the Carmichael valve gear by shortening the excentric rods and lengthening the levers in order to obtain a greater angle, and to work the valve on each side with one fixed excentric. Mr. Allan made the drawing of, and worked out this suggestion nearly as seen in Mr. D. K. Clark's "History," p. 21.

Our outline engraving illustrates the construction of the Swiftsure, of the Liverpool and Manchester Railway, and the first three engines of the Dublin and Kingstown Railway. The slide valves had about ½in. lap. When this class was made into tank engines, the spring arrangement shown on the plan was used at both ends, and the hind projecting plate with coke-box was about 4ft. over all from the boiler end. The foot-plate from the boiler was narrow, and the tender had a broad hinged foot-plate, which rested on the engine foot-plate, thus making a broad platform for the engine-man. There was a hand pump on the foot-plate, so that if water got low it could be filled by hand, but this was seldom used. B B on the plan is the outline of the boiler; *a a a* angle-irons on the frame for the foot-plate to be rivetted to, some pieces being omitted on the outside plates; C cast iron ferules between the frame-plates for long bolts passing through to screw up the outer plates of the frames; C^1, cast frame, had an opening for the connecting rod and for the three long bolts to pass through to *a a* from the outside, shown in line similar to the three at cylinder end bolts; 1 on plan is the valve rocking shaft with the top lever to the valve spindle, dotted at 5; 6 shows the lower double lever and shaft for two excentric rods, and on this shaft, at 5, the reversing lever to the brass sector. This is loose on the shaft; the position shown is with the two excentric rods out of gear (as at 3, 4), and if the reversing lever be moved to right or left, it will only allow one excentric rod in gear at a time. At 1^1 is shown the weigh shaft carrying the lower double lever 6, and one double jaw lever on which the rods from the shaft 7 drop, to bring the bearing of the lever 6 opposite the gab on the excentric for work. This done, the two small rods from the shaft 7 which move the valve shafts, are lifted out by two levers from a small shaft close under the boiler—not shown—so that the handles on shaft 7 on the foot-plate have seldom to be moved by gear or by hand. The two excentric rods on the right, 3, are held up by a cam 4 on the cam shaft; 2 shows the cam shaft with a toothed pinion. The Vauxhall is shown on the side with the hand pump; the large centre buffer is shown, which was on the Dublin and Kingstown Railway stock. All other parts are the same as those of the Swiftsure of 1834, for the London and Manchester Railway. The Hibernia of 1834, by Messrs Sharp, Roberts, for the Dublin and Kingstown Railway, had 11in. cylinder, and 16in. stroke, and was, as we have said, similar to the Experiment, 1833, on the Liverpool and Manchester Railway, by the same makers, and described by Mr. D. K. Clark.

We have to acknowledge our indebtedness to Mr. Allan for the trouble he has taken to supply us with these "Links in the History of the Locomotive," and we would once more ask any of our readers who are in a position to do thus, to follow Mr. Allan's example. We want now particulars of some of the first engines used on the Dublin and Drogheda Railway, and the Midland Railway of Ireland. As recently as 1855 there was a large four-wheeled goods engine at work on that line—probably the last of its race.

THE ELECTRICAL EXHIBITION AT THE WESTMINSTER AQUARIUM.

No. I.

THE long promised electrical exhibition at the Royal Aquarium may be said to at last have an existence. To-morrow—Saturday night—the building will be fully lighted by electricity, and it is to be hoped that little will remain to be done to make the Exhibition in every way complete. The directors of the Aquarium Company have incurred a very considerable outlay, and it is to be hoped that the public will appreciate their exertions.

The general theory of the Exhibition is that the central hall shall be lighted with electric arc lamps, and that on the south side of it incandescent domestic lighting shall be shown. For some months past the fine wrought iron electrolier, made at Berlin for Dr. Siemens, exhibited last year at the Crystal Palace, and illustrated in our pages, has hung in the centre of the great hall, and has been lighted up night after night. The west, or organ end of the hall, contains besides a considerable number of Siemens' arc lamps arranged in groups. There are in all twenty-six lights, shown by Messrs. Siemens. The other end of the hall is lighted by Pilsen-Joel and Mathiesen arc lamps, hung from the roof, while about a dozen Jablochkoff lights are carried on lamp-posts rising from the floor. The east end of the building, in which is the Beckwith swimming tank, is lighted by incandescent Swan lamps, by Messrs. Ferranti, Thompson, and Co. On the south side of the great hall, both in the gallery and under it, a series of apartments of various kinds have been fitted up by Messrs. Atkinson and Co., the Colebrookdale Company, all of which will be lighted by Edison. Messrs. Edmunson have fitted up the courts for the Swan United Company. Among these apartments may be named a handsome drawing-room on the ground floor, and in the gallery a billiard-room, and a large conservatory; this last fitted up by Messrs. Dick Ratcliffe and Co., of Holborn

The motive power for all these lights is supplied by steam engines, distributed in three engine-rooms. The largest and most important of these is in the north-west corner, close to the Imperial Theatre. The second is on the north side, about the middle of the length of the building, and the third also on the north side, near the east end. In the first-named engine-room, "Annexe A," is a very fine 30-horse single-cylinder horizontal engine, by Messrs. Davey, Paxman, and Co., Colchester, with automatic expansion gear. Steam is supplied by two large locomotive boilers close to the engine. A semi-portable 25-horse engine by the same makers is also in this room. The engines drive shafts carried on wall hangers, and return belts go down again to the floor to a countershaft, pulleys on which drive the dynamos. This shaft is carried in Taylor and Challen's self-adjusting bearings. There are here a Siemens dynamo, supplying a number of Swan lights in various parts of the building, and a Gramme machine for the Jablochkoff lights in the hall. There are also in this room a double 30-horse horizontal fixed engine by Messrs. Hornsby, of Grantham, consisting of two separate 30-horse power engines, the beds of which are united by a girder, while one crank shaft, long enough to fit both bed-plates, carries the fly-wheel between the two. Steam is supplied by a single large locomotive boiler. This engine is at present driving one of the largest-sized Brush dynamos, used in lighting the Imperial Theatre.

The central room is known as "Annexe B." In it is a compound semi-portable engine of a new type, by Messrs. Davey, Paxman, and Co.; a double-cylinder semi-portable by Messrs. Robey and Co., Lincoln; and a Hodson rotary engine of considerable size. Steam for this last is supplied by two semi-portable boilers standing in an out-building. The Paxman engine drives the first motion shaft with three ropes instead of a belt. This is an experiment, and so far as we are aware, ropes have never before been used for driving dynamos.

In the third engine-room, known as Annexe C, there will be found one 25-horse double-cylinder semi-portable engine, by Messrs. Davey, Paxman, and Co. This engine drives one Ferranti dynamo and two Edison dynamos by means of Oldfield and Walton's patent leather chain belts, which appear to be earning golden opinions. This belt is made up of links of leather about 1½in. long, laid on edge and secured together by wire pins extending from side to side of the belt. There is also here a small gas engine driving a little dynamo, the gas being made on the spot. The whole is intended to illustrate a method of lighting country houses, where public gas cannot be had.

Concerning electrical apparatus, it may be said that the novelties in the great hall are quite as various as any electrical exhibition has yet collected together. No doubt the electric loom of Messrs. Grant will attract a large share of attention, as it can be seen daily weaving in silk the portraits of the various eminent electricians. Although it seems late in the season for an exhibition devoted entirely to electricity, it must be borne in mind that the Aquarium is not, like many other places of amusement, obliged to close early in the evening; thus in the summer months it can run three hours per night, and the coolness so essential to a building at all seasons of the year will be felt an immense boon to London sight-seers just when other places of amusement become intolerable from the fumes and heat of the gas. From all points an exhibition at the Aquarium should be the success of the season, and it is to be trusted that the public will appreciate efforts which have cost so much labour, time, and money.

For the present we must content ourselves with this brief notice of the contents of the Aquarium. We shall, of course, return to the subject. It is probable that a valuable series of trials will be carried out with the engines which will supply information concerning the consumption of fuel per horse-power, and the power actually required to keep a given number of lamps going; such experiments cannot fail to prove interesting. We shall for the present only add that all the arrangements have been very satisfactorily carried out by Captain Hobson, the manager, and Mr. Gooch, engineer to the Aquarium Company.

WHITWOOD SEWAGE WORKS.

WE illustrate this week on page 166, a pair of pumping engines constructed by Mr. J. Horne, of the Providence Ironworks, Castleford, for pumping sewage at Whitwood.

In our next impression we shall publish additional engravings illustrating these works, and we reserve our description until we give these engravings.

TENDERS.

WIGAN JUNCTION NAILWAYS.

TENDERS for goods warehouse at Strangeways, near Hindley. Mr. Charles H. Beloe, M. Inst. C.E., engineer. Quantities supplied.

	£	s.	d.
T. and R. Stone, Newton-le-Willows	1053	0	0
J. Preston, Wigan	1000	0	0
J. Wilson, Wigan	998	7	6
A. Haughton, Godley	980	0	0
W. Winnard, Wigan	976	13	0
C. B. Holmes, Wigan—accepted	970	0	0

HERTFORD MILITIA BARRACKS.

FOR the erection of barrack buildings and quarters, comprising twenty-two residences, for the directors of the Hertford Militia Barracks Company, Limited. Messrs. Smith and Austin, Civil Engineers, Hertford. Quantities supplied.

Name and address.	Contract No. 1. £	Contract No. 2. £	Total. £
J. Garlick, Birmingham	4850	5620	10,470
Gibbons and Co., Buntingford	4430	4970	9,400
Willmott and Sons, Bassingbourne	4043	4375	8,418
Vernon, Ewens, and Co., Cheltenham	3700	4350	8,050
Wade and Edey, St. Neots	3750	4035	7,785
Messrs. Hampton, Hoddesdon	3372	4298	7,670
Whitehead and Jacklin, Royston	3400	4110	7,510
C. Miskin, St. Albans	3320	4000	7,320
W. Gray, Hertford Heath—withdrawn	3930	3250	7,180
Spencer, Atherstone	3120	4000	7,120
Ekins and Son, Hertford	3200	3900	7,100
Rayment and Sons, Hertford	3104	3935	7,039
Gibbons, O. E., Ipswich	3150	3850	7,000
H. Norris, Hertford—accepted	2900	3680	6,580

NAVAL ENGINEER APPOINTMENTS.—Henry Attwood, engineer, to the Asia, additional, for the Neptune; Thomas A. Morris, engineer, to the Duke of Wellington, additional, for service in the Ant; Henry Lane, assistant engineer, to the Asia, additional, for the Mercury, vice Attwood; and Joseph T. Parkes, assistant engineer, to the Serapis, complement incomplete.

MRS. HENRIETTA VANSITTART.—Mrs. Henrietta Vansittart, so well-known as the daughter of Mr. James Lowe, who claimed the invention of the submerged screw propeller, and afterwards invented the screw known as the Lowe-Vansittart propeller, died on the 7th ult., at Gosforth, near Newcastle-on-Tyne. She had attended the recent Marine Exhibition at that place, and afterwards fell into an illness from which she did not recover. Her energy in maintaining the merits of the Lowe propeller was remarkable, and in 1876 she read a paper on "Propulsion" before the Society of Arts, and often spoke in public on this and other subjects elsewhere. Mrs. Vansittart was born in 1840 at Ewell, Surrey, and was thus 43 years of age.

VIENNA CITY RAILWAYS.—We have been requested by the committee of the London Syndicate, formed for the purpose of constructing and working the Vienna Circular Railway, to state that there is no truth whatever in certain scandalous reports which have appeared in the columns of a London daily paper, to the effect that neither in London nor Paris had Mr. Fogarty been able to find capitalists willing to subscribe the 60,000,000 florins necessary for the construction of the railway, and that, in consequence, the "caution money" will be forfeited, also that the English capitalists, who at first supported the scheme, have "backed out of it;" and that the Austrian Government forbids the taking of any steps for the construction of the railway until the capital is all subscribed, "et cetera." Mr. Fogarty states that there is not a syllable of truth in the above report. No shares have been offered, and no negotiations have been opened in Paris or in any other quarter than in the City of London. No such communication as that given above has been received from the Austrian Government. The "caution money" of a million florins was deposited with the Government by the concessionaires through the house of Rothschild, of Vienna, over eight months ago, and could not be forfeited except under the terms of the concession, which will, however, be strictly fulfilled.

RAILWAY MATTERS.

OF the railway accidents in America during December last, 148—half were at night.

A NEW YORK telegram of yesterday states that three carriages of a Dakota train on the Chicago and North-Western Railway had been precipitated over an embankment near Palatine, Illinois.

THE half-yearly meeting of the South London Tramways Company was held on the 27th ult. The chairman stated that the traffic receipts were almost double those of the previous half-year.

AT a public meeting of the ratepayers and owners of property at Birkenhead, on the 21st inst., the Town Council were authorised to oppose in Parliament the Mersey Railway Bill and the Manchester Ship Canal Bill.

A MOVEMENT has been initiated at Devonport for constructing a submarine tunnel from that town to Torpoint, on the Cornish side of the mouth of the Tamar, which at that point is about a mile wide. The cost is estimated at £75,000.

THE Portuguese Government has submitted to the Chamber of Deputies a Bill for authorising the construction of the Beira-Baira Railway, which is to connect the Abrantics station of the Portuguese Railway Company's line with that of Guarda on the Upper Beira Railway.

THE arrival of the special train, direct from Calais, of three Pullman sleeping carriages, sent from England for service on the Southern line from Rome to Reggio di Calabria, attracted a good deal of attention in Rome. The carriages, which are of the same kind as those running on the Great Northern and Midland lines, were the objects of considerable curiosity.

THE report of Colonel Yolland on the collision that occurred on the 6th November last, at Wandsworth Common station, on the London, Brighton, and South Coast Railway, between a light engine belonging to that company and a passenger train belonging to the London and North-Western Railway Company, shows that the original cause of the collision was the failure in the block working, owing to the signalman at Balham junction having forgotten that he had admitted a light engine into Balham station, and had neglected by mistake to signal it forward to Wandsworth Common before he permitted the London and North-Western up passenger train to pass the Balham junction up signals, and to signal it forward to Wandsworth Common. Colonel Yolland says: "This failure in the system of block working could not have occurred if the union of the lock and block system (Hodson's patent) of working, as established on some of the company's lines, had been in operation on this portion of line."

ON Saturday afternoon a special meeting of the Board of Works for the Westminster district was held to protest against the action of the Metropolitan District Railway in constructing ventilating shafts in the principal thoroughfares of the district and on the Thames Embankment. Mr. Wheeler, the surveyor, said that he had received notice of the intention of the company to make openings and construct shafts in the Broad Sanctuary, opposite to the north entrance of Westminster Abbey, and in Tothill-street, near to the Aquarium, and opposite the Westminster Palace Hotel. Mr. Aston stated that the shaft would almost ruin the latter property, as the noxious fumes from the railway tunnel would be wafted into the windows of the hotel. The chairman said the worst feature in the whole matter was the circumstance that the District Railway had done away with the ventilators on their own ground so as to enable them to make marketable use of it, and they now desired to avail themselves of the public highways.

A CASE illustrating the inestimable value of an automatic brake occurred on the 11th December last at Essendine station, on the Great Northern Railway. In this case, as the up East Coast Scotch express train, due to pass Essendine at about 6.10 a.m., and due at King's-cross at 8.15 a.m., was passing the south end of Essendine station at a speed of about fifty miles an hour, the engine and the left sides of the tender and of most of the vehicles composing the train came into collision with a brake van attached to the engine of the 5 a.m. down goods train from Peterborough to Colwick, which engine and van were supposed to have been in a siding joining the main up line. The driver of the express, who had not at first realised the nature of the collision, but had thought his engine had struck a crossing, after reducing speed and finding nothing apparently wrong, was again proceeding, when he felt the vacuum brake being applied from the train, upon which he stopped about half a mile south of Essendine, when the train was examined, then taken on slowly to Peterborough, and the damaged vehicles removed. The buffer beam of the engine and one axle-box of the Pullman car were broken.

THE estimates of great railways for rolling stock, form one of the chief of the tests of the appreciation that they have of the needs of the districts committed to them. In the past half-year there have been large sums spent in this way—the Midland Railway spending no less than £345,000, but of this nearly two-thirds was expended in the purchase of coal wagons from private owners. About £45,000 were spent on new locomotives, and £65,000 on wagons, additional to those already referred to. The Midland Railway does not give figures to show the amount intended to be spent on additional rolling stock during the current half-year, though some of the other railway companies do. The Lancashire and Yorkshire proposes to expend £100,000 in the six months now in progress; the Great Northern, £50,000; the London and North-Western, £45,000; the London, Brighton, and South Coast, £15,000; and the North-Eastern, £130,000. It is thus evident that the railway companies have before them, according to these estimates, a period of prosperity and of need of rolling stock; and it is thus evident that there is, so far as they can see, a continued period of good trade that will employ at least the locomotive builder very fully for some time to come. Branches and works that have been long in course of construction are now approaching completion so far that the provision of rolling stock for them is now required, and the companies have come into the market with orders that are large even in comparison to those that have been of late given out, and that must further stimulate the revival in trade that has given birth to these orders.

ALTHOUGH the opening of the St. Gothard Railway took place only little more than six months ago, it has already been the means of causing an important development of the corn trade with and through Switzerland. In June last 285,255 kilogrammes of grain were carried through the great tunnel; in July, 759,300; August, 1,333,335; September, 650,310. The *Times* Genoa correspondent says: The new line is developing the Italian egg trade in a way altogether unexpected. Italy's exports of eggs amounted last year to 250,969 quintals, the estimated value of which, at 140 lire a quintal, is 35,135,660 lire. A few years ago this trade did not exist. Through the opening of the St. Gothard Railway, Genoa has become the most convenient seaport for North and Central Switzerland. The distance from Zurich to Genoa is 458 kilometres as compared with 696 to Antwerp; and from Milan the distance to Zurich is only 382 kilometres—216 miles—little further than from London to Liverpool. The geographical situation of Genoa is, moreover, very favourable for trade between the Levant, the South of Russia, and Central Europe. Great efforts are being made to provide increased accommodation for shipping and commerce in the North Italian port. The harbour, for the improvement of which the late Duke of Galliera left a bequest of 20,000,000 lire, is now seven kilometres long, and as it is computed that a kilometre of quay-length is capable of accommodating 280,000 tons of merchandise, the capacity of Genoa in this regard is equal to a total of 2,000,000 tons. Antwerp, which after Marseilles, is Genoa's most formidable rival, possesses 20 kilometres of landing room. The trade of the northern port is growing with great rapidity. In 1881 more than 1,000,000 railway wagons arrived at Antwerp laden with merchandise for shipment to various parts of the world.

NOTES AND MEMORANDA.

AT a recent meeting of the Académie des Sciences the perpetual secretary reported that M. Mauser had succeeded in transmitting a message through a hundred telephone wires to as many destinations at once.

IN water containing caustic soda and air free from carbonic acid, lead, tin, Britannia metal, and zinc suffer a very considerable loss; brass and German silver an inconsiderable loss; copper none. A good deal of lead, tin, Britannia metal, and zinc are dissolved; only a little brass and German silver, and no copper.

M. MANGIN lately demonstrated the safety of his miners' electric lamp by placing it in the middle of a balloon filled with hydrogen. The appliance consists of a Swan incandescent lamp, immersed in a glass globe containing water. The light is further intensified by a copper casing silvered inside, and one or more strong lenses.

AT the annual meeting of the Telegraph Construction and Maintenance Company on Tuesday, Sir Daniel Gooch, Bart, M.P., who presided, said that last year extensive repairs were effected in the Anglo-American Telegraph Company's French Atlantic cable between Brest and St. Pierre, in depths up to 2000 fathoms after a submergence of thirteen years. That cable was in good order, and therefore the idea was dispelled that the life of a cable was only ten years.

As a fire-proof paint MM. Vildé and Schambeck made a varnish, described by a French contemporary as of twenty parts of very finely powdered glass, twenty parts porcelain, twenty parts stone of any kind, ten parts calcined lime, thirty parts soluble soda glass. Silicate of potash may be substituted for the silicate of soda. The first coating soon hardens and a second coat may be applied from six to twelve hours afterwards. Two coats are sufficient. The varnish may be employed as a preservative against rust.

ACCORDING to experiments on the effects on metals of different solutions with air free from and with carbonic acid, made by Professor A. Wagner, in lime water, with air free from carbonic acid passed into it, lead lost considerably in weight; zinc and brass an inconsiderable quantity; copper, tin, Britannia metal, and German silver none at all. A perceptible quantity of lead was dissolved, but only traces of zinc and brass. It was impossible to perform the experiment in the presence of carbonic acid, as this would form carbonate of lime.

HYDROGEN is completely absorbed by palladium sponge at 100 deg., and Mr. W. Hempel has used this as a means of separating hydrogen from a mixture of gases. In order to test the applicability of this property to the estimation of hydrogen evolved in sealed tubes, Herr Tschirikow treated zinc with hydrochloric acid in a sealed glass tube containing a palladium spiral. The proportions of acid and zinc were such as to produce a pressure of twenty-five atmospheres if no hydrogen were absorbed by the palladium. The absorption was found to be complete. A small portion of the hydrogen had united with the oxygen of the air remaining in the tube. Nearly the calculated amount of hydrogen was obtained from the palladium spiral by heating to 350 deg. The evolution of the gas was so regular that Tschirikow suggests the heating of palladium-hydrogen as a means of obtaining chemically pure hydrogen.

SOME substances possess the property of reducing silver salts and thus producing an adhesive layer of brilliant metallic silver on the walls of the tubes which are used in the experiment, but the mirror which is thus obtained is not perfect. Prof. Palmieri employed glycerine, which seems likely to open a new future to the art of silvering. When glycerine is added to an ammoniacal solution of nitrate of silver, after a while the liquid becomes brown, then it deposits a black substance and becomes limpid and colourless. If the mixture is re-heated it takes a gradually deepening brownish hue; at the boiling temperature it becomes black and leaves upon the tube a metallic deposit of a steel-gray colour. *Les Mondes* says:—The best result is obtained with caustic potash, when the mixture is between 60 deg. and 70 deg.—140 deg. and 158 deg. Fah.—with potash and ether, between 30 deg. and 35 deg.—86 deg. and 95 deg. Fah.—with potash and alcohol, between 40 deg. and 45 deg.—104 deg. and 113 deg. The reaction is complete in eight or ten minutes.

DR. HERTZ lately described and exhibited before the Physical Society, Berlin, an apparatus he had constructed for demonstration of such weak electric currents as change their direction very often, several thousand times in a second. He called attention to the defects of the electro-dynamometers previously employed for the purpose, and showed that the electric heat effect could most fitly be used in this case. The new dynamometer consists of an extremely thin horizontally stretched silver wire, the extension of which by heat, produced by the alternating currents, is observed. To this end the wire is, at its middle, wound round a vertical cylinder of steel capable of rotation about its axis, by turning of which the wire is stretched. Each extension of the wire through electric heating turns the cylinder the opposite way to this torsion, and its rotation is observed by means of a mirror and telescope. This dynamometer, as Herr Hertz showed, is only applicable when the currents are weak, and the current reversals are very frequent; that is, precisely in cases where other measuring instruments fail.

FROM statistics recently published it appears that Great Britain has, at present, twenty-three metallurgical works producing steel, with 115 converters, and a productive capacity of 1,460,000 tons per annum; Belgium has four steel works, with eighteen converters, and a productive capacity of 380,000 tons; Austria, fourteen works, thirty-six converters, 632,000 tons; Germany, twenty-three works, eighty converters, 1,300,000 tons; Russia, five works, ten converters, 100,000 tons; Sweden, thirty-five converters, 80,000 tons; the United States, thirty-four converters, 1,500,000 tons. This applies to Bessemer steel. As regards the Thomas-Gilchrist method, there was produced by it, in October last, in Germany, 25,170 tons of steel from eight firms; in England, the works of Bolckow, Vaughan, and Co., the only one using this process, produced 2500 tons; Belgium produced 1687 tons; Russia, 1279 tons; France, 1240 tons—the last three have each, like England, only one steel works using the process. This gives a total, for October, of 46,537 tons of basic steel produced in fifteen works.

THE results of some experiments on influence of temperature on magnetisation, by M. Bersen, have been given in the *Annales Industrielle*. He investigated the influence of temperature on the magnetisation of iron, steel, nickel, and cobalt. He places the bar to be experimented on in a constant magnetic field, at different temperatures, and compares its magnetic moments. Some of the results obtained are as follows:—As regards iron, magnetisation is nearly independent of temperature. The total and temporary magnetisations increase up to 260 deg., then they decrease, while the permanent magnetisation diminishes very slightly. With steel, the total magnetisation increases at first, attains a maximum at 260 deg., and then decreases; the permanent magnetisation attains its maximum toward 240 deg. Variations of temperature during the experiment exercise an influence on the magnetisation, which increases under these conditions. If the temperature of a bar magnetised when cold be raised, its magnetisation diminishes; the same occurs if a bar, which has been magnetised when hot, is cooled. If, now, the bar is tempered, it retains a greater magnetic moment than if it had been worked at a low temperature, a result confirmed by Professor Hughes' experiments. With nickel, the total magnetisation slowly increases up to 240 deg., and after reaching 280 deg. decreases very rapidly, becoming *nil* at about 330 deg. Nickel magnetised at a low temperature and heated to 320 deg. loses all magnetisation; if, on the other hand, it has been magnetised at 280 deg., and subsequently slowly cooled, its magnetic moment begins at first to increase, then decreases at about the ordinary temperature, but finally remains greater than at the temperature of magnetisation. Cobalt behaves like steel.

MISCELLANEA.

ALL applications for space in the Cork Exhibition must be sent in before 1st March, to Mr. L. A. Beamish, Cork.

WE understand that the Board of Trade has granted the usual certificate for the protection of inventions that may be exhibited at the Cork Exhibition.

A STRIKE is impending amongst the colliers in the Forest of Dean. They are asked to submit to a reduction of 10 per cent., and a strike is much feared.

THE Volta prize of £2000, offered by the Académie des Sciences for the best economical application of electricity, will be awarded in December, 1887. The competition, open to foreigners, closes on 30th June, 1887.

IT is now considered almost certain that the Tyne steamer Bywell Castle, which ran down the Princess Alice off Woolwich in the autumn of 1878, causing terrible loss of life, has foundered in the Bay of Biscay.

THE directors of the firm of Messrs. Armstrong, Mitchell, and Co., have acquired the well-known London Ordnance Works, belonging to Mr. Vavasseur, and Mr. Vavasseur has been elected a director of the company.

SEVERAL correspondents have written us respecting a process which has been spoken of as in use for obtaining turpentine from sawdust and other saw-mill refuse. We shall be glad to hear from any one who has tried the process.

THE Telegraph Construction and Maintenance Company is seeking parliamentary powers by a Bill to enable it to utilise electricity in every form in which it could be made available, including powers to carry out lighting arrangements.

THE first great Russian ironclad on the Black Sea, now building at Nicolaieff, will have 18in. armour, six 12in. and seven rifled 6in. guns. It is of the type of the Peter the Great, but larger; its length being 320ft. by 69ft., and the depth 25ft., with 9000-horse power.

THE Crystal Palace District Gas Company has recently completed a new gasholder, the cost of which, with the inlet and outlet pipes and valves, has been £17,608 12s. 8d. The capacity of the gasholder is 1,604,000 cubic feet, showing the low cost of £10 19s. 8d. per 1000 cubic feet of capacity.

THERE has recently been found at Baildon Green, near Shipley, an extensive bed of stone, technically known as "ganister." This stone is of a very refractory nature, and has been found, on analysis, to contain 97½ per cent. of silica, thus making it of the greatest value as a substitute in ironworks.

THE steamer Normandie, which has just been built by the Barrow Shipbuilding Company for the Compagnie Générale Transatlantique, has made a remarkable passage from the Clyde to the Lizard on her way to Havre, having completed the distance in twenty-six hours, which gives an average speed of 16¾ knots per hour. The Normandie has a carrying capacity of 6500 tons.

THE French gas companies have instituted at their common expense, *Nature* says, a laboratory for testing the several inventions reported in electric lighting, and proving whether they are valuable or not. After alluding to this foundation, and the much-spoken-of experiments tried at the French Great Northern Railway Station, a French scientific periodical says: "Mieux vaut un sage ennemi qu'un imprudent ami."

IN testing lubricants, blue litmus paper will become red in melted acid fats or oils, such as stearic acid, as well as in acid watery solutions. But oil may be tested for free acid by pouring it over a layer of cuprous oxide contained in a glass. If the oil contains either the free, fatty, or resinous acid, they will attack the oxide and colour the oil green in a very short time. Slightly heating accelerates the action.

THE annual report of the American Commissioner of Patents for the year ending December 31st, 1882, shows that the balance in the Treasury on account of the Patent Fund was increased during the year from 1,880,119.32 dols. to 2,205,471.10 dols. The business done was largely in excess of that of the previous year and more than double that of 1866, as shown by the fees received and the number of patents issued, evidence enough of the rapid development of the service.

THE report of the Crystal Palace District Gas Company for the half-year ending 31st December, 1882, shows that the coal carbonised during the half-year was: Common, 28,475 tons; cannel, 1001 tons; total, 29,476 tons. The gas made was 294,757,000 cubic feet, quantity not accounted for 21,074,700 cubic feet, or no less than one-fourteenth of the whole made. The company makes its ammoniacal liquor into sulphate of ammonia; 589,520 gals. were made, and 544,802 gals. were thus used in making 223½ tons of sulphate of ammonia.

THREE separate sets of staging, each about 100ft. in height, have been erected under the central tower of Peterborough Cathedral, on which a crane and steam engine for taking down the condemned structure will be worked. It will still be some time before the actual demolition of the tower can commence. The shoring of the adjacent windows and arches, which must inevitably come down with it, is not yet complete. A tramway is being laid to run from the cathedral, underneath the tower, to a space enclosed on the north-eastern side of the minster graveyard, for the reception of the stonework and masonry as it is removed.

M. RAOUL PICTET has recently tried a specimen of his "rapid vessel," and illustrates it in *Archives des Sciences* for January. With a length of about 67ft., and a width of 13ft., this vessel is peculiar chiefly in having a bottom of parabolic form lengthwise, the concavity downwards; transversely the bottom is nearly straight; the sides are vertical. A keel, reaching from about the middle of the length, incloses a screw shaft. M. Pictet shows that the force of traction is always less than that of an ordinary vessel going at the same rate. The advantages of the parabolic curve only become apparent at a certain speed, depending on the width, length and tonnage, and the parameters of the parabolic curve. The force of traction passes through a maximum, at a certain velocity for each vessel; beyond that point it diminishes, though the speed increases. Experiment has yet to decide the limits of this second period. The emergence of the vessel, very small for small velocity, grows very quickly when a speed of 5 metres per second has been reached; and it converges rapidly towards an upper limit.

THE American Navy Department appears to be well pleased with the behaviour of the lately launched monitor Miantonomoh while on her trial trip from Philadelphia to Washington. It is reported that while in the Chesapeake Bay she made 10½ knots per hour. There are two other monitors of the class of the Miantonomoh, exactly alike, which, says the *American Manufacturer*, up to the present time have been considered the best that have been launched. They are the Solimoes and the Javary, built at Bordeaux, France, for the Brazilian Government. The Solimoes was launched in 1875, and the Javary in 1881. They are of 3700 tons displacement, the Miantonomoh being 3800 tons. Their length of beam and draught measurements are the same as in the case of the American monitor, and like her they are double-turreted and low freeboard ships. The Solimoes, on a trial trip in September, 1881, in Brazil, just outside of Rio, developed with half revolutions of the screw a maximum speed of 10½ knots, the same as the Miantonomoh. It is claimed also that the frames of the Miantonomoh are stronger for ramming than those of any monitor of her class constructed up to the present time. The officials of the department predict that when properly armed and finished she will be able to cope with any vessel of her size afloat.

METROPOLITAN RAILWAYS.—THE INNER CIRCLE COMPLETION LINK.

MR. J. WOLFE BARRY AND MR. J. TOMLINSON, MM.I.C.E., ENGINEERS.

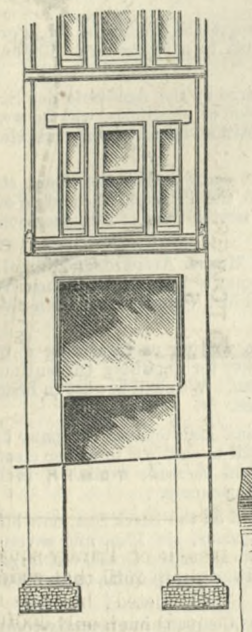


FIG. 9

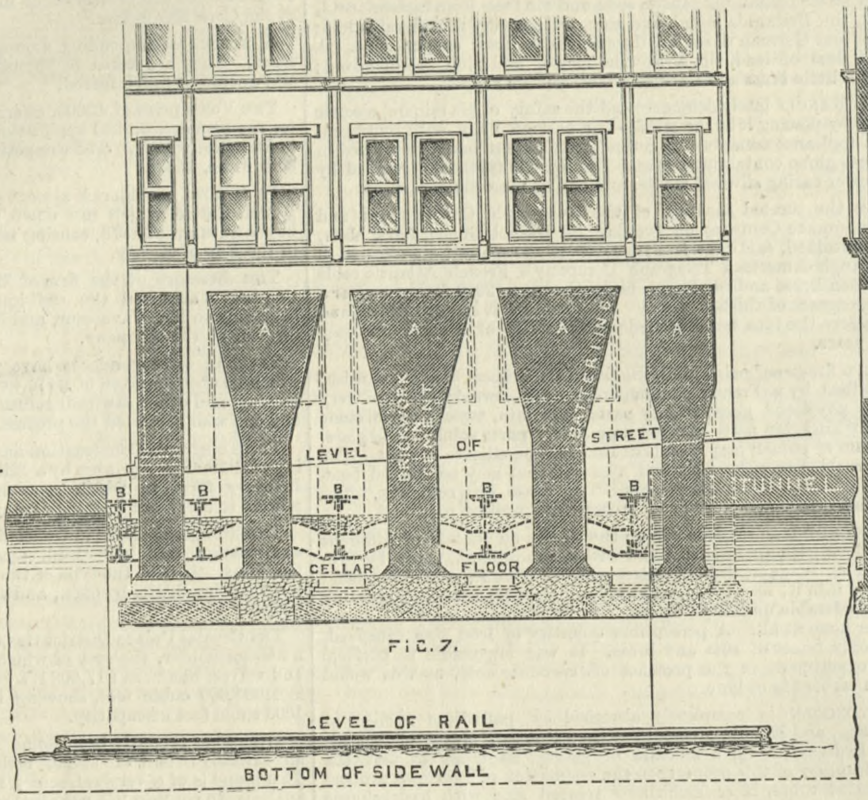


FIG. 7.

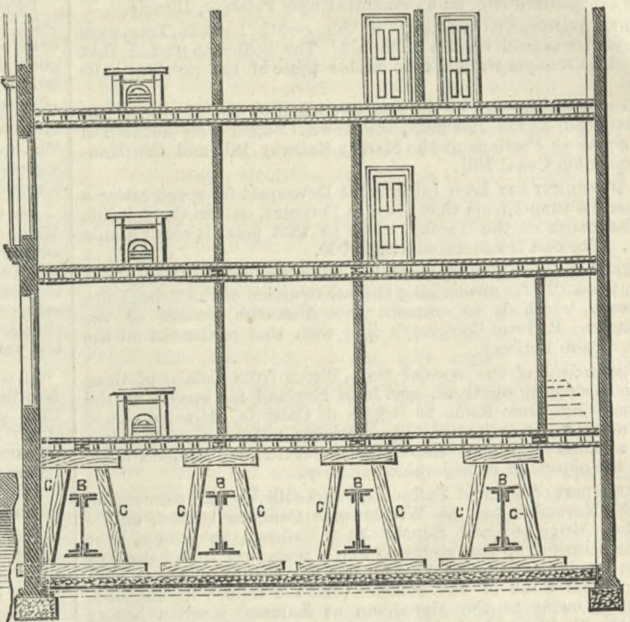
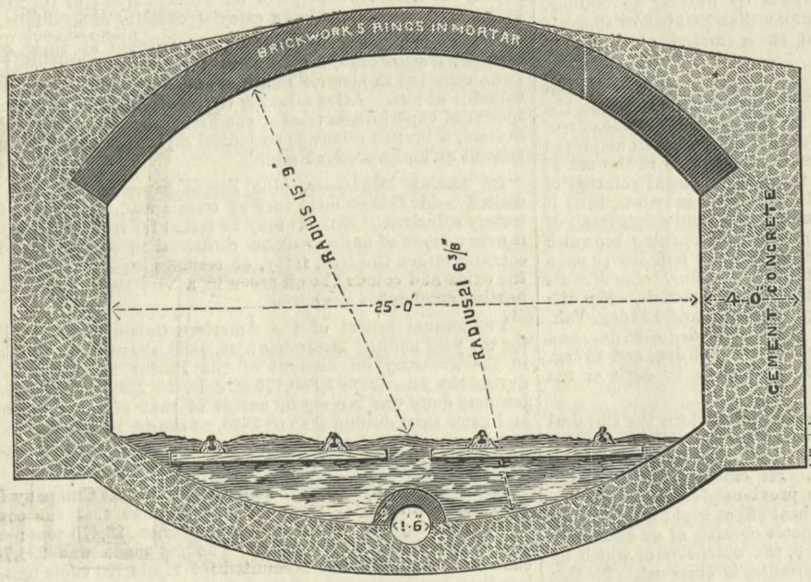


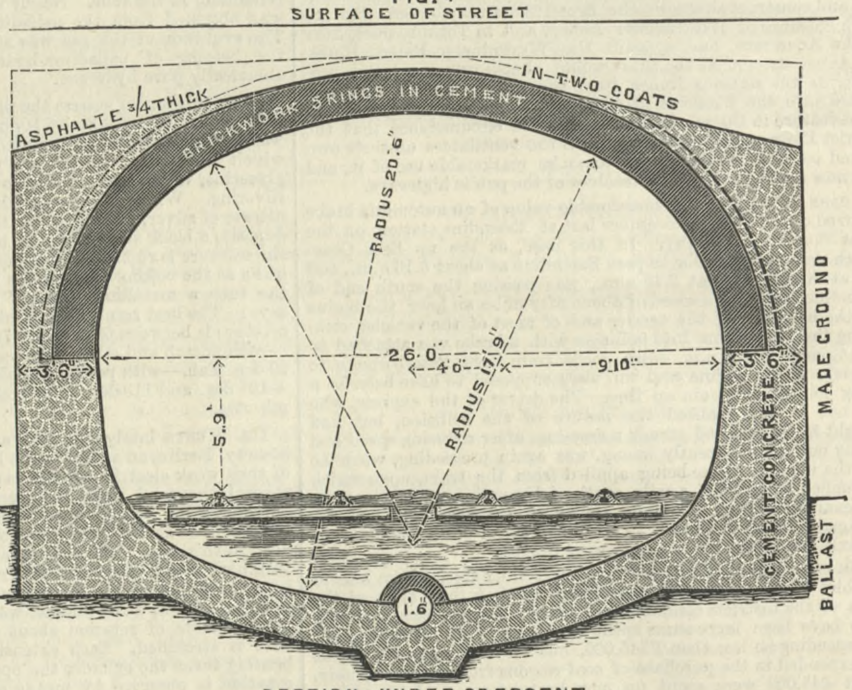
FIG. 8.

FIG. 5.



SECTION UNDER TRINITY SQUARE

FIG. 4



SECTION UNDER CRESCENT

SECTION UNDER MINORIES

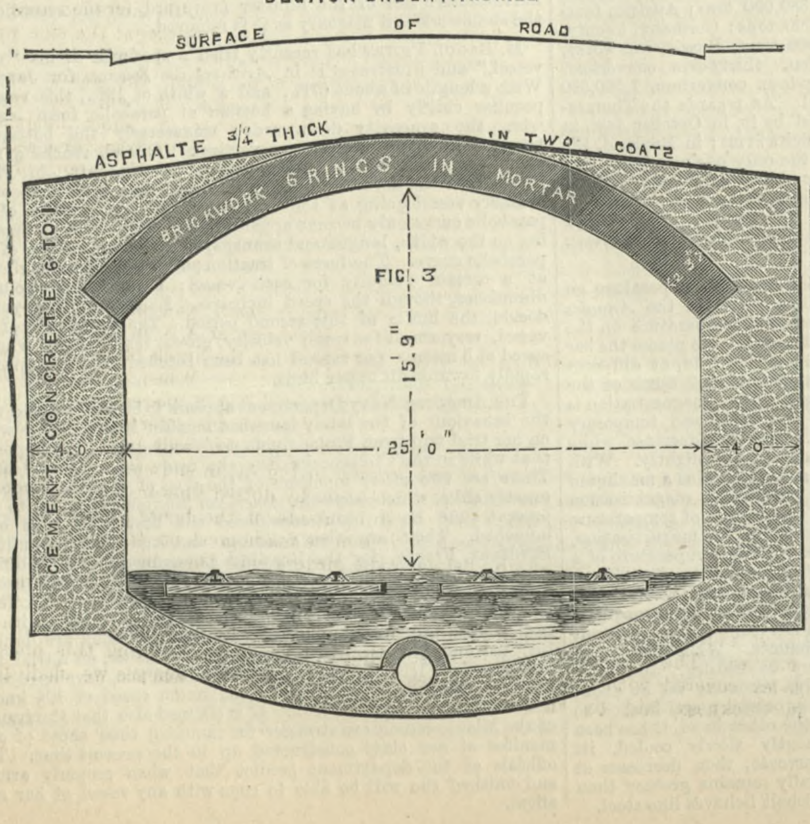


FIG. 3

SECTION UNDER HOUSES AT A

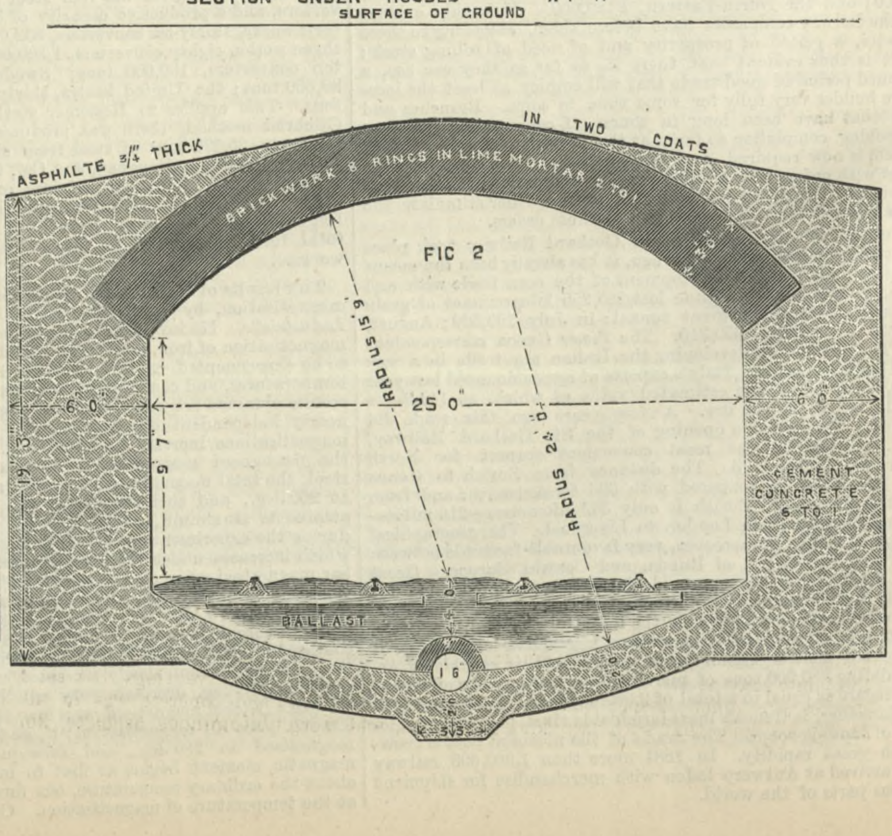


FIG. 2

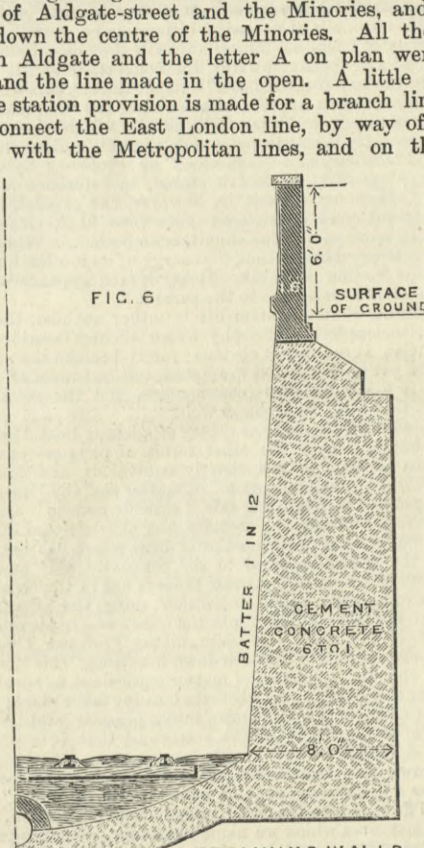
THE INNER CIRCLE COMPLETION RAILWAY.

No. I.

As we mentioned in our impression of the 5th January, great progress is being made with this important and interesting piece of railway, and work involving many difficulties calling forth the exercise of great care and judgment, is being carried out.

This completing link of the underground railways, as most of our readers are aware, extends from Aldgate station to the Mansion House, thus connecting that which was until September last the terminus eastward of the Metropolitan Railway with the terminus of the District Railway. The direction of the line commencing at the Mansion House, is directly eastward to the front of the Cannon-street station of the South-Eastern Railway, where a station will be constructed; thence dipping southwards a little, the line passes down Cannon-street to a spot between the north end of Fish-street-hill and King William-street, where there will be another station. Thence the line passes slightly northward, and again southward along Eastcheap and Great Tower-street, across Trinity-square, turning thence, by a curve of 10 chains, northward to Aldgate Station, passing under the Blackwall Railway from Fenchurch-street and along under the Minories. A general idea of the route may be gathered from the accompanying plan. In our impression for the 29th September last we gave a short account of the part of the line completed by the Metropolitan Company from Aldgate to what is at present known as the Tower Hill Station, which is on the east end of Trinity-square, and not as marked on the map, the latter mark showing the site of the station which will be constructed by the District Company. We now propose to give some further account of the engineering work on this line.

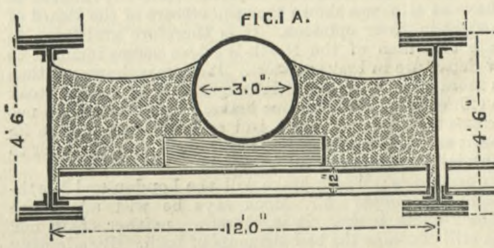
On leaving Aldgate station the line passes under the corner of Aldgate-street and the Minories, and thence passes down the centre of the Minories. All the houses between Aldgate and the letter A on plan were taken down, and the line made in the open. A little south of Aldgate station provision is made for a branch line which is to connect the East London line, by way of Whitechapel, with the Metropolitan lines, and on the other



RETAINING WALLS

hand, by way of the Thames Tunnel, with the lines south-east of London. The East London Railway is at present a thankless possession, and much friction is caused by the persistent pushing of financial and working propositions which are strongly asserted to be to the advantage of the District Railway. This branch, it will be seen, will leave a three-cornered space, with Aldgate station nearly in its centre; but communication for passengers from the East London will have to be by tunnel between the lines.

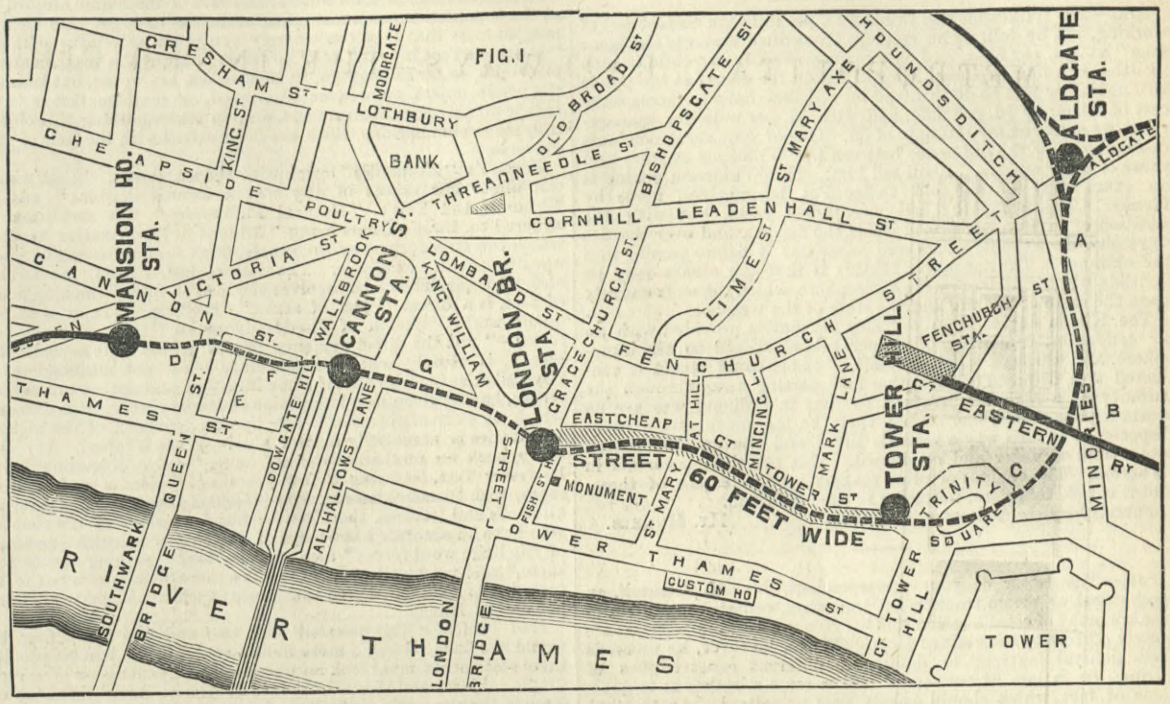
From a little above the point A, the line was built in tunnel, but in passing under Aldgate-street, each half the width of the street had to be stopped alternately for some



time, because some large gas mains had to be supported. These mains consist of two 36in. mains and one 24in. main, the latter being charged under a pressure, said to reach 84 lb. for passing gas on to Westminster, the 24in. main emptying into a 36in. main further on, and the pressure being there reduced. Besides these large mains running along Aldgate there were a 10in. and a 4in. water main, and a 4in. gas main beside the sewers. These made it necessary to carry Aldgate-street on short heavy girders supported by columns, the mains being carried between some of the pairs of girders thus—

Flat plates on transverse girders 12in. deep, as shown in Fig. 1A, were laid from girder to girder, and the mains laid in wooden saddles, one being placed close behind a joint and the other about 2ft. 6in. from the front, so that the joints may at any time be got out for caulking. The saddles are much deeper than shown above. It need hardly be said that with two 36in. gas mains, and with

THE INNER CIRCLE COMPLETION RAILWAY.

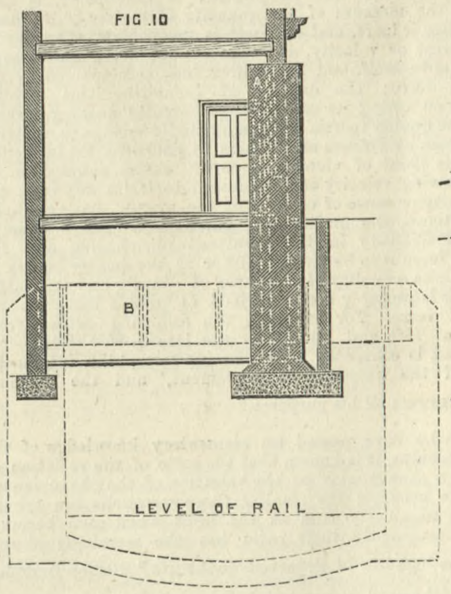


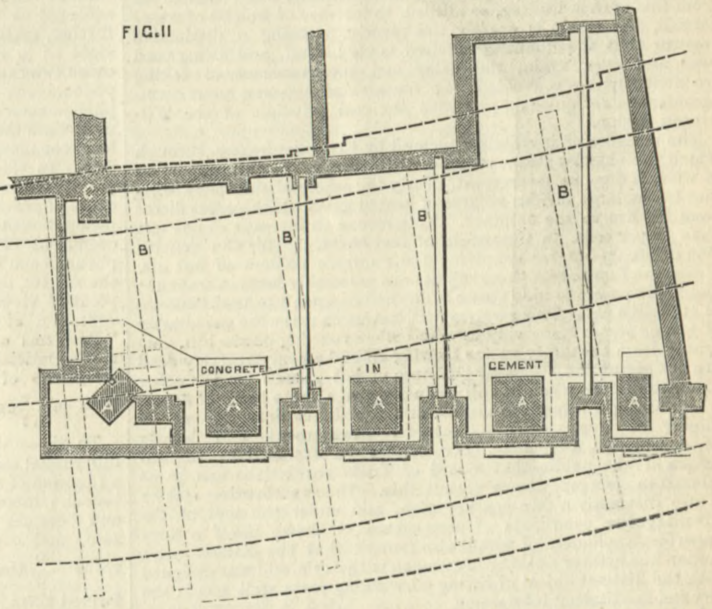
the 24in. gas main charged at a very high pressure per square inch, taking the ground away, getting in supports, and finally getting in the very strong girders which carry the street, was a ticklish job, and one which needed no little caution and judgment for its successful execution. Where these girders carry houses they are reckoned to carry 2·5 cwt. per square foot of plan. Just before passing under the Great Eastern Blackwall Railway, the line again passes under the sites of houses which were removed, and the rest of the line made in the open. In passing under this railway a difficult piece of work had to be accomplished—namely, the underpinning of the arch, which is almost continuously traversed by trains, and to which no interruption could be permitted. This, however, was successfully accomplished, and at the same time the extension of the bridge for carrying another pair of lines was carried out, the footings of the piers being carried down to the side walls of the tunnel. As already mentioned, the line is open from Aldgate to a little north of the point A on the map, and in this and other parts the retaining

coats. The station on the east side of Trinity-square was constructed as a temporary station until that which is to be built on the next side is completed; but it is not improbable that both stations will be, though only 400ft. apart, used when the line is finished. The last part of the length of tunnel under Trinity-square was keyed on the 13th May, 1882, and completed the part to be carried out by the Metropolitan Company. It was carried out under Mr. J. Tomlinson, jun., the engineer to the company; Mr. E. P. Seaton, A.M.I.C.E., was the resident engineer, and Mr. T. A. Walker contractor.

It may be mentioned that at the Tower station an excellent specimen of the old Roman wall is to be seen.

In describing the works on that part of the railway now being constructed by the District Railway Company, it will be convenient to commence at the Mansion House end. The first part is constructed partly open and part under houses, one of which—29, Queen-street—is a new building of great weight, and offering considerable difficulty. The work here to be carried out is illustrated by





wall is of the section shown in the annexed engraving—Fig. 6. The wall is of concrete, consisting of one of Portland cement to six of washed gravel, an invert of the same material, with a drain in the centre, being carried across from wall to wall, and thus effectually preventing any sliding of the walls into the cutting. From the point a little north of A, the tunnel commences which runs under the Minories, and from that point to where it is fairly clear of the houses which will be built over it, or, in other words, until it is fairly under the road, the tunnel is of the section shown at Fig. 2, page 162, the side walls being 6ft. in thickness, and the arch having eight rings of bricks. Under the Minories the tunnel has the section shown at Fig. 3, page 162, the side walls being 4ft. in thickness, and the arch having six rings. In both these sections the arch has a segmental form, the dimensions and radii of arch and invert being given at the sections. To carry the Minories during the construction of the tunnel a temporary bridge of heavy cross deals supported on whole balks was made, the whole length being constructed between the nights of January 9th and 14th, 1882. On passing the Blackwall Railway the line passes under the Crescent, and here the tunnel has an elliptic section, as shown in Fig. 4, page 162. This section was not, however, repeated in any other part, as, though stronger, it cost a good deal more to construct, while the same strength was secured by a comparatively small extra quantity of material, as used in the next section under Trinity-square, shown at Fig. 5, the side walls being 4ft. instead of 3ft. 6in., and the concrete carried up higher. Under the Crescent the elliptic arch had five rings of bricks set in cement, six rings being used under the houses. The segmental arch under Trinity-square had also five rings, but set in mortar. The top of the arch and concrete was in all places covered with a layer of bituminous asphalte, 3in. in thickness, laid on in two

Figs. 7, 8, 9, 10, and 11. The house is five stories in height, but we only show part of the height. The railway runs quite under this house, so that the whole has to be supported. This is being done as follows:—Referring to the plan of the house Fig. 11, the curved dotted lines running along from end to end represent the side walls of the tunnel and the centre line. It will be seen that one wall, the south, runs under the main wall of the house. To support this, it will be underpinned by excavating down below in short lengths, namely, of 5ft., to the depth shown in the transverse section of the house and tunnel at Fig. 10. A 5ft. length of the tunnel side wall will then be built of brickwork in the excavation and made good to the house wall footings. When short lengths are thus completed, the intervening pieces will be excavated and the wall completed. The cellar of the house is floored with a bed of concrete, and on this, to support the outside main wall of the house, temporary brickwork piers—shown at A A, in Figs. 7, 10, 11—will be built and carried up to the lintels of the lower windows, as shown in Figs. 7 and 10. When these have been built, and timber trestles C, Fig. 8, placed to carry the floor and party walls, trenches for the outer side wall of the tunnel will be excavated and the wall built. The girders B B, shown in plan in Fig 11, in end elevation in Figs. 7 and 8, and in elevation by dotted lines in Fig. 10, will be passed in from the outside of the house and fixed. The house wall will then be made good on the girders. The spaces between the girders will then be arched in, as shown in Fig. 7, forming the top of the tunnel. The temporary piers A A, and the cellar floor, will be removed and the tunnel invert made. The cellar of the house will thus be almost wholly taken away. From this house the line crosses under Queen-street, whence we shall follow it in another impression.

LETTERS TO THE EDITOR.

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

STEAM ON TRAMWAYS.

SIR,—Mr. Wilkinson still thinks $3\frac{3}{4}$d. per mile the correct cost of working, but he tells us he employs "unskilled and unintelligent men" at $3\frac{1}{2}$d. per hour, and only manages to kill one child in nine months with four engines. He will find in the end that the public will not allow him to do this, and he will then have to increase the cost of labour by $\frac{3}{4}$d. per mile, and with $\frac{1}{2}$d. per mile for management we arrive at my estimate of 5d. One of your correspondents desires to know the difference between the Wilkinson engines and those of other makers. I will tell him. The Wilkinson engine is an exact copy of the old Coffee Pot locomotives, made by Messrs. Chaplin for the last twenty-five years, but with the addition of an iron box placed inside the fire-box and over the fire to receive the exhaust steam and superheat it before passing into the chimney. The intention of this is that the steam may be invisible when it arrives in the atmosphere, which depends entirely upon the state of the fire and the state of the weather.

The Kitson engine is an ordinary locomotive provided with an air condenser, consisting of copper tubes exposed to the atmosphere, and through which one half of the exhaust steam is conducted and disposed of, the other half passing away through the chimney at a high temperature, so that in ordinary weather no steam is perceptible; but should there be too much steam to be disposed of in this way a valve is lifted and the exhaust passed into a tank of water and condensed. This principle is certain in its action. The engines of other makers are but copies of these, and it is not, therefore, necessary to describe them.

Foundry-square, Leicester, Feb. 27th. HY. HUGHES.

SIR,—The letter of your correspondent, Mr. H. Conradi, on mechanical or steam traction on tramways, contains many statements worthy of consideration, and his views on working expenses are closely correct to ascertained facts. When, however, he proceeds from general matters to details of different constructions of engines, he is less at home, and makes some mistakes as to questions of fact which should hardly pass unnoticed. As to what constitute "neatness and correct proportions" opinions will necessarily differ, but when we are informed that as regards "the shortness of wheel-base necessary for the existing sharp curves," only the Wilkinson and Hughes Paris-type engines correspond to the requirements of such a service," it must be noted that the reverse is the fact, the Wilkinson engines having a wheel-base of 5ft. 6in., whereas the Merryweather engines are 12in. less, and none of the Kitson engines, of which some eighty have been built, exceed 4ft. 6in. With curves frequently not exceeding 40ft. radius, the latter dimension has everything to recommend it, as regards freedom of working, power of starting on curves, freedom from derailment, absence of wear on tire flanges and damage to points and crossings. Indeed, with the longer spread of wheels, the flange wear will involve renewal of tires before any reasonable lifetime has been secured from the tread, and this indicates with sufficient clearness a measure of injury to permanent way that should not be tolerated.

Your correspondent's statements as to the important and difficult matter of condensation also need correction. He appears to have in view ordinary water condensation and superheating, and pronounces the latter the more perfect system. The former was, indeed, a feature in the Hughes engines, but exists at present in none but the Manning and Wardle, 13 to 15 tons locomotives, rather misnamed tram engines. The Kitson engines have always had air condensation, and of late years the Merryweather also; and so far from this system leading, as alleged, to increase of weight of water carried, the result is exactly the reverse, it being a distinctive feature that the quantity required is very small, and being used over and over again, the delay and inconvenience of taking frequent supplies is avoided. So far also as appears, your correspondent is not quite *au fait* with the real principle of the Wilkinson engine.

The measure of invisibility secured by the superheater through which the exhaust steam passes constitutes a very small proportion of what is done in this respect, nearly the whole of the effect being due to the large surplus volume of heated gases which passes direct from the fire to the chimney. This means an increase of not less than 50 per cent. in the weight of fuel burnt, not for the generation of steam but for supplying the requisite volume of hot air. Hence the fumes from these engines are noticeably large in amount; and their power to hide steam is dependent upon the maintenance of an active fire. This receives an illustration from the peculiarity of visible steam being very frequent when running down hill, this arising from the safety valves blowing off and a comparatively dead fire not giving the necessary quantum of hot gases. On the other hand, the latter when in full quantity give a large body of flame, which at night is but too visible, and the direct draught emits a shower of live sparks. Such an arrangement can hardly be considered a finality, nor can it be expected in the interests of the public that Board of Trade regulations can be so relaxed in stringency as to permit this. The superheating system is also distinctly a fair-weather plan, and under the test of disadvantageous conditions of atmosphere it shows itself a very imperfect appliance. I would also remark that the Kitson valve motion has little or nothing in common with Joy's, and was designed with the distinct object of lifting all working parts well out of the dirt and facilitating lubrication. JNO. S. BATCHELOR.

Leeds, February 28th.

THE PRINCIPLES OF MODERN PHYSICS.

SIR,—With some curiosity I have glanced at discussions on "Foundations of Mechanics," "Principles of Physics," &c. &c., in your own and other periodicals, for a long time having held the opinion that every fresh generation of students in mechanics, in a measure, were forced to wade through that ancient puddle, the "measure of force," with mathematicians doing their best to "magnify their office," as guides through that slough of despond, by continually enlarging it by explanations which have no real warrant from mathematical principles and with an avowed contempt of any need of reference to physical ones!

Nigh two centuries gone, thinkers had come to the conclusion that motion could not be lost in the universe, and also held an opinion that *vis viva* was the "cause of motion." Our old mathematicians immediately came down upon them with demonstration "apparent to every reader, of the malignity and falsehood of the absurd opinion that motion could not be lost in the world . . . *vis viva*, that obscure, precarious law or force founded upon no certain principles," was then explained, in a fashion. "See my Mechanics . . . where the nature of it is unravelled," quoth Emerson; and other learned men who unfortunately laboured under the impression that mechanics was an adjunct of "gerund grinding," and that they perfectly understood what they were writing about, with mistaken zeal corrected Smeaton's mistakes!

Assuredly there were many difficulties and impotent conclusions on both sides. Take one illustration: A bowl of water was stirred, and having speedily come to rest, it was demanded, what had become of the motion? Whereon ensued much wrangling, mathematics excellent in quality and copious in quantity, triumphant chuckling on one side, and mistaken explanations on the other, with the result of the subject of dispute left in the same stage for a century or so; when the consideration of many minds, and finally Dr. Joule and a delicate thermometer, conjointly arrived at the solution of the enigma, namely, after stirring and coming to rest, so much heat as had actually been expended in stirring the water, neither more nor less, was to be found in the water! Properly understood, this was a physical phenomenon, and in the statement of the laws which govern such, and in their numerical relations, mathematics are invaluable as an ally and assistant; but the pretensions of mathematicians to be lords paramount in physical science in virtue of their science of abstractions, are unfounded, absurd, and ought to be sternly challenged.

It seems to me, in the fundamental fact of mechanics alluded to at the commencement, most mathematicians have got into such a tangled mess that they can scarcely venture a statement without "putting a foot into it," not, however, because the mathematical principles, so far as they go, in themselves, are wrong, but because the whole object, avowed or disavowed, of mathematicians is to reduce all things to abstractions, and in accomplishing this object they make assumptions which are inconsistent with the facts of the universe.

Poisson's "Mechanics" opens with the statement, "That which can affect our senses in any way is termed matter;" and in Thomson and Tait's "Natural Philosophy" this definition is adhered to, these authors being "content to know matter as that which can be perceived by the senses, or as that which can be acted upon by or can exert force. The latter, and, indeed, the former also, of these definitions involves the idea of force, which, in point of fact, is a direct object of sense." Professor Tait, in a subsequent work, "Sketch of Thermo-dynamics," 1877, writes as follows:—"But the direct evidence of our senses, uninterpreted by reason, is usually wholly misleading, when not meaningless, in physical science;" so that if some intuition, and not our misleading senses, having given us a knowledge of matter, what, then, is force, which, as a direct object of sense, by this definition of the highest authorities is necessarily matter also? What is force? Any and every book on mechanics defines force, "cause of motion;" yet Professor Tait, lecturing a few years ago before a sanhedrim of sages, with Bismarckian sincerity informed them, as "the result of all books and lectures, there can be but few people in this country who have an accurate knowledge of the proper scientific meaning of the little word force;" also, that he had "nothing new to tell them," and yet he alleged, "force is a mere name—it is not to be regarded as a thing. Force is the rate at which an agent does work per unit of length."

Had Professor Tait asserted that two and two made four, he would not have uttered a more necessary truth, yet, to most people, these statements must look an uncalled-for mystification of a very simple subject; and if we substitute Professor Tait's definition of force in the alternative definition of matter, it then reads: "Matter is that which can be acted upon by or can exert the rate at which an agent does work per unit of length." This undoubtedly sounds strange. Suppose it tried on a rough subject by way of illustration:—An able-bodied railway "ganger" is certainly acted upon by the rate at which one of his "navvies" does work per unit of length; and, if needful, stripping off his coat, not only could exert the same rate, but in many cases could show how it ought to be accelerated somewhat. Only if, on that account, anyone ventured to stigmatise the said "ganger" as matter, he would require to lay his account to being answered with the retort, "you're another," and possibly, having "a half brick," heaved it at him as a reminder that very comprehensive definitions are not well understood, and might be considered offensive.

No doubt in this universe we find things very much mixed, and we can only in an ineffective and illogical way reason out the separate items of the concrete phenomena of existence; and I believe it is usual to consider matter as a definite existence, incapable of change as to absolute quantity, and exhibiting the primary qualities of impenetrability, gravitation, and inertia. By which is meant, matter is extended in three directions and occupies space, so that no two portions of matter can simultaneously occupy the same space; matter is also subject to the aggregating action named gravitation, the amount of which, under the same circumstances, is known as the weight of the matter, and when the variable circumstance due to position is eliminated, is then accepted as the measure of the quantity of matter or its mass; further, matter is inert, and of itself is incapable of changing its state as to rest or velocity, any such change being due to some cause external to itself, and being invariably accompanied by the phenomenon force; the quality of exhibiting this sensible phenomenon on having its state changed—really meaning nothing more than the quality inertia which admittedly belongs to matter—has been chosen by Poisson and others as sufficient for its definition. In this point of view, a piece of matter acted upon by gravity or having velocity communicated to it, in any way; the cause of gravity or cause of velocity in the matter, have an independent existence, the matter only enters as a passive agent or coefficient of quantity in the resultant phenomena, and the phenomenon force is to be viewed, either as the quality inertia of the matter, or as a quality of the cause of change, and this latter point of view is probably better arrived at from a mathematical definition of force. For example, the following extract from "Problems of Life and Mind," by the late J. H. Lewes:—"A mathematician is contented with defining force, 'the differential coefficient of the quantity of movement,' and the formula $F = m\frac{dv}{dt}$ answers all his purposes."

To those who have passed an elementary knowledge of the differential calculus, it is known that the ratio of the variation of a function of a phenomenon to the variation of the phenomenon, becomes more accurate the smaller these variations are taken, and becomes absolutely true at the limit when each becomes zero, and consequently, their ratio has the seemingly absurd value $\frac{0}{0}$, the "ghosts of departed quantities" Bishop Berkeley termed them, the good bishop not believing in this description of ghosts. Nevertheless, a slight consideration of the nature of vanishing fractions leads to the knowledge that such expressions have definite values, and a further vital consideration can also be arrived at: a differential coefficient no longer expresses the thing differentiated, but only an abstract ratio derived therefrom!

I would here observe, it is a very usual but inaccurate custom to use the terms motion and movement in the sense of velocity of matter, when in strictness these terms express the concrete quantity, the product of the mass and the velocity. Thus the assumed *rationale* of the statement, force is the cause of motion, is as follows:—A force F acting during the time $d\,t$ upon the mass m, generates the quantity of motion $m\,d\,v$, and hence, $F\,d\,t = m\,d\,v$, or, as it may be written, $F = m\frac{d\,v}{d\,t}$.

Also, when for simplicity the mass is assumed constant, the statement that force is the differential coefficient of the quantity of movement involves that $F = d\frac{m\,v}{d\,t} = m\frac{dv}{dt}$, as before, and we have now to consider Professor Tait's definition of force, "the rate at which an agent does work per unit of length," which had its origin in the casual use by Newton of the physical basis of mechanics to illustrate the mathematical "laws of motion."

Newton wrote of the *actio agentis*, action of the agent in machines, a quantity which, however varied might be the phenomenon force, and corresponding velocity of the parts of a machine in movement, the product of these was invariable. Now the machine itself is only so much matter, a passive agent; and the "action of the agent," or as defined by Smeaton, the power, which before being developed in the machine, to the extent of this action, existed as the capability of doing work; in the antecedent state, or as being developed, is the mechanical potential which stated as a function of the phenomena of development, and differentiated in any direction, the first differential coefficient is the force in that direction.

Hence w, denoting the *actio agentis* at a moving point, and s the space which, at the same rate, would be described in a unit of time, mathematically expressed, Professor Tait's statement is $F = \frac{d\,w}{d\,s}$, and, in any case, the force having two values, from the mathematician's point of view, being the differential coefficient of the quantity of motion, in respect to time; and from the mechanician's, as the differential coefficient of the cause of velocity in respect to space; on equating these we have, $\frac{d\,w}{d\,s} = m\frac{d\,v}{d\,t}$, which, since $v = \frac{d\,s}{d\,t}$, can be charged into, $d\,w = m\,v, d\,v$; and, taking the simplest case, by integrating, $w = \frac{m}{2}v^2$.

Hence the *actio agentis*, quantity of action, power, potential, or as it is now usual to name it, the energy involved in communicating the velocity v to the mass m, is definitely expressed by the function $\frac{m}{2}v^2$, and is then no other thing than the *vis viva* or living force of Leibnitz; which function being differentiated in reference to velocity or space described, the differential coefficient is force, the phenomenon which to the mathematician and sense-misled mortals, the change of velocity seems due; and the first class having defined force as the cause of motion, both have unhesitatingly accepted it as the cause of change of velocity in matter; thereby elevating a mere abstraction and quality of an entity into the definite measure of the more important and entirely different entity, the cause of physical change in the universe!*

Albeit, neither great mathematician nor mechanician, the thoughtful man of genius, Richter, states as a general rule, "great mathematicians are poor philosophers. Malebranche says rightly, the geometrician does not love truth but the discernment of it; or, to express it more clearly, not its existence but its proportion. Philosophy, on the contrary, will search into existence; it places itself and the mathematician . . . the whole world within, around and above, before its gaze." In illustration of which I may refer to the following statement, written by the late Professor Rankine, in 1852, in which there is certainly more philosophy than mathematics:—"The experimental evidence is every day accumulating of a law which has long been conjectured to exist, that all the different kinds of physical energy in the universe are mutually convertible; that the amount of physical energy, whether in the form of sensible motion and mechanical power, or of heat, light, magnetism, electricity, or chemical agency, or in other forms not yet understood, is unchangeable; the transformation of its different portions from one of these forms of power into another, and their transference from one portion of matter into another, constituting the phenomena which are the objects of experimental physics." . . "All visible motion is of necessity ultimately converted into heat by the agency of friction. There is thus in the present state of the known world a tendency towards the conversion of all physical energy into the sole form of heat." In the thirty years which have elapsed since this was written, what advance has been made in the philosophy of physics? Take up the branch which more than any other has recently been occupying men's minds, and in the recent work on "Electricity and Magnetism," by Professor Sylvanus P. Thompson, at p. 328, we find it stated, in reference to electric currents, "Whatever current is, however, not expended in this way in external work is frittered down into heat, either in the battery or in some part of the circuit, or in both. . . When matter in motion is stopped by friction, the energy of its motion is frittered down by this friction into heat. Heat, in fact, appears whenever the circuit offers a resistance to the current."

In these and similar statements by other authors, the inconsequential, incomplete philosophy which Richter ascribes to the mathematician is somewhat obvious; for if heat be the omega of the protean, yet unchangeable in amount, substratum of all physical change, is it not a necessary consequence, and the result of all experience, that it is the alpha as well?

Further, what is the sense or utility of naming heat "a form of physical energy," when the other forms of physical energy are either forms of heat or are strictly equivalent and convertible thereto? Thus "sensible motion" of matter and the "mechanical power" expended in producing this "sensible motion" are simply a definite effect ascribed to a definite but conventional cause, the real cause being the definite amount of heat which has vanished in producing the effects ascribed to the conventional "mechanical power;" and the equality between these is not in the sense of one thing the cause, being equal to another thing, the effect; but in the sense of the cause passing into the effect as a mode or manner of existence of the cause. Or again, taking Professor Thompson's statement, the current "frittered down into heat," this has had its source in a changed condition of matter equivalent to burning, but with little or no heat apparent where the burning takes place; we have a connected chain of matter thrown into a peculiar state, which is supposed to be explained by the statement that it is a "closed circuit of electrical energy" with less or more of the current frittered down into heat; but would be much more accurately described as a definite amount of heat "frittered down" into a current and flowing into the æther, an indefinite proportion, according to circumstances which we name resistance, remaining as heat in the matter of the circuit. ROBERT MANSEL.

White Inch, Glasgow, February 20th.

* There is also another point of view in which the issue with the mathematician is, whether the differential coefficient of an entity or the entity itself ought to have precedence?—R. M.

CONTINUOUS BRAKES.

SIR,—Mr. Moon's remarks in regard to continuous brakes at the last half-yearly meeting of the London and North-Western Railway Company are of great interest to the travelling public. When a gentleman in the position of Mr. Moon announces that his company has decided to take a certain course on a much debated question, his words will very properly receive more than ordinary attention; all the more so when, as in this case, the question referred to is of importance not only to the public and his own company, but also to the companies which interchange traffic with it. It will be remembered that although Mr. Moon has for years frequently alluded to the chain brake as a satisfactory one, the Board of Trade has even more frequently condemned it in the strongest terms, and the accidents which have resulted from the failures of this brake have at all times shown that the officers of the Board of Trade were right in their opinions. It is therefore gratifying to hear that the chairman of the North-Western seems inclined to make a new departure in brake matters. It appears, however, that he attaches more importance to interchangeability of rolling stock than to the efficiency of a continuous brake. Mr. Moon does not say that because the chain brake is a bad and unsafe appliance he will abandon it and take another, but that he will do so in order to secure the interchangeability of rolling-stock.

The next question is: Which brake will the London and North-Western Company adopt? Mr. Moon says he will adapt the vacuum to their chain brake. It is, therefore, neither chain nor vacuum, but still contains the bad elements of both. By adopting a form of hose-pipe Mr. Moon appears to think the question of interchangeability in continuous brakes is solved. That such is totally incorrect, is at once made clear by explaining that three of the companies mentioned use different automatic vacuum brakes, and the others a non-automatic vacuum brake. These automatic and non-automatic vacuum brakes work on exactly opposite principles, and, of course, cannot be operated together on the same train; and further, the one prevents the other from being worked —hence interchangeability of rolling stock is impossible. As to the vacuum brakes on the lines referred to by Mr. Moon, it need hardly be pointed out that they have been condemned by the Board of Trade as strongly as the chain brake. The Great Northern and North Staffordshire companies use the non-automatic vacuum brake, which is in direct opposition to the recommendations laid down by the Board of Trade. The Lancashire and Yorkshire has introduced several forms of automatic vacuum brakes, and it seems yet uncertain which one it will finally adopt. The Midland

and Great Western companies use a modification of the Sanders and Bolitho system, generally known as the "two-minute brake," which, although supposed to be automatic, is so constructed as to make it often worse than useless, and in accidents it has been reported on by the officers of the Board of Trade as a dangerous and unreliable system. Recent letters which have appeared in THE ENGINEER have called special attention to the dangers of this "two-minute" leaking-off brake; for instance, the collisions at Portskewet Pier, Liverpool, and Bradford, the case of a train running from Market Harborough to Desborough hanging by side chains only, of another running from Bedford to Leicester with the hose pipe not properly placed upon the stop plug, and also the numerous instances of trains running past stations. It cannot therefore be expected that much good can result from a mixture of such bad elements as the "chain," "non-automatic vacuum," and the automatic "two-minute" systems, and it is feared that the North-Western Company, which has already spent such enormous sums of money on its chain brake, will make another serious mistake, which will increase the existing confusion in brake matters, and push the much-desired uniformity and interchangeability of rolling stock further off than ever.

The most important through trains on the North-Western are those running in connection with the West Coast route; an enormous amount of rolling stock is exchanged at Carlisle. I will therefore for a moment consider the brakes used by companies running into that station. Here we see the trains of the Glasgow and South-Western, Caledonian, North British, North-Eastern and Midland, also the through vehicles belonging to the Lancashire and Yorkshire, *viâ* Hellifield, and the Midland Scotch Joint-Stock, all fitted with the Westinghouse automatic brake. Now, it will be seen that if the North-Western Company adopt the vacuum, either automatic or non-automatic, its vehicles will not be interchangeable with those of any of the other companies. The chain brake can be worked in a section, but the vacuum will, of course, be no use unless connected to the engine.

Mr. Moon says he thinks all the companies will in a little while adopt the vacuum, but others very much doubt this, and on very good grounds. The Westinghouse brake, which fulfils all the conditions of the Board of Trade, has been adopted by six large companies, and is used by many others—altogether in the kingdom 1370 engines and 10,390 carriages are now working or in course of being fitted with it—and it is not at all likely, notwithstanding Mr. Moon's assertions, that the English companies will adopt the vacuum brake.

In conclusion, it may be observed that Mr. Moon's remarks upon continuous brakes are not at all clear, but they seem to indicate that the next step of the London and North-Western Company in the matter will be one which is not in the interest of the public or the shareholders, and will most likely retard the solution of the problem of uniformity in continuous brakes which is so very much desired and needed in this country. One thing is at all events quite certain, that the vacuum system will never become the universal brake in England. It is to be hoped that Parliament will find time to deal with the subject, and compel companies to adopt efficient automatic brakes fulfilling all the conditions of the Board of Trade.

CLEMENT E. STRETTON.

Saxe Coburg-street, Leicester, Feb. 27th.

THE EFFICIENCY OF TURBINES.

SIR,—I have read Mr. Turnbull's paper on "Water Wheels and Turbines," and examined the accompanying diagram of efficiency with great interest. The latter would give the casual reader the impression that the "Hercules" turbine gives 10 per cent more power than the "American" when working under similar conditions.

By the aid of Mr. James Emerson's very practical work on turbines, and one of his letters, I find that this is by no means the case. First, with regard to the line of efficiency given for the American. In November, 1872, Mr. Emerson certified that the American gave 80·4 per cent. at ⅞-gate, against about 77 per cent. on Mr. Turnbull's diagram. Whether the Hercules line, excepting as representing an isolated experiment, is valueless or not your readers may judge, if you will kindly publish the following extract—which I have made *verbatim*—from Emerson's "Hydro-dynamics," page 121, and the accompanying diagram:—

Holyoke Machine Company, Holyoke, Mass.

This company built the Boyden and Hercules turbines, the latter invented by John B. McCormick, of Brookville, Pa. Of the former it is unnecessary to say anything here, as its merits are given on several other pages of this work.

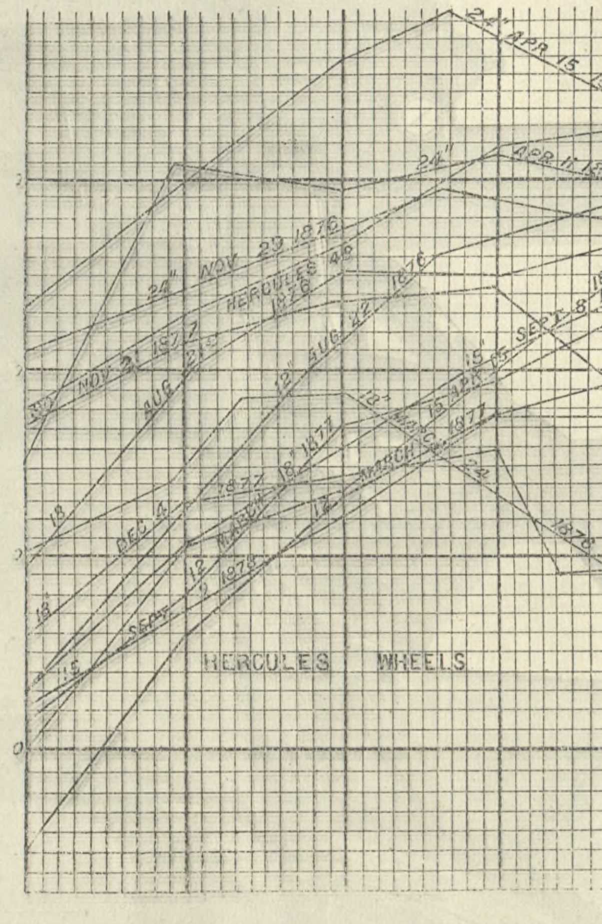
Hercules.

In March, 1876, several of the above-named wheels—24in. in diameter, each differing somewhat from the others—were brought to Holyoke to be tested. All gave remarkable results: one 87 per cent. useful effect, and a power so extraordinary that the wheel was taken up and examined. A few changes were made, then it was reset and again tested, when the following results were obtained:—

Gate opened.	Head.	Rev. per minute	Horse power.	Cubic feet.	Per cent.
Whole gate	18·02	217	70·58	2478·60	·8361
Whole gate	18·04	206	70·52	2460·04	·8386
Part gate..	18·06	214	70·03	2391·04	·8579
Part gate..	18·17	214·5	64·35	2167·29	·8644
Part gate..	18·23	213·5	64·05	2083·25	·8922
Part gate..	18·26	212	57·81	1944·50	·8612
Part gate..	18·34	210	53·45	1800·13	·8470
Part gate..	18·38	209·5	48·56	1690·89	·8267
Part gate..	18·57	211	32·12	1250·50	·7291

As high useful effect has been obtained by several builders, but no such average at all stages of gate opening. In capacity, however, the Hercules took a stand so entirely above that of any turbine ever before produced, that it seemed a good starting point for bringing all builders into harmony for their own and the public good. I immediately opened a correspondence with the best builders of the country, urging the abandonment of inferior wheels and the advantage of uniting upon the plans of the Hercules, paying the patentees a small royalty, and each builder trying to excel. The idea was favourably received. In the meantime the patentees hastily disposed of their right to build for the Western States. This, of course, ended the chance for a union of builders. The contract, however, was soon cancelled; then the patentees offered the Holyoke Machine Company certain exclusive rights in their patent. I opposed the negotiations, because I believed then, and continue to believe, that it would be better for all to have a union of the best builders, instead of a continuance of the ruinous competition of the past upon inferior plans, which only serves to hinder the perfection of the best. Turbine building is not sufficiently understood to allow of its being considered a science; it is simply "cut and try." I know of no builder that with certainty can make two turbines that will give the same results even made from the same pattern. Until that can be done the manufacturing interest must suffer, unless manufacturers use the greatest care in the selection of turbines. What is almost invariably needed is a wheel that will economise water at any stage of gate opening, and when such can be produced with certainty, then turbine building may properly be considered a science, and not before, for such wheels are possible. Our rivers and streams are extremely variable in supply of water; that of the summer months often being less than one-fourth of what it is for the rest of the year, and three-fourths of the larger quantity is almost invariably allowed to run to waste, because wheels of sufficient capacity to utilise the maximum have generally proved to be incapable of transmitting any power from the use of the minimum supply.

I have tested about eighty of these wheels, and as may be seen by the diagrams, the variations have been great, and there is no good reason for believing that they will be less so in future. Many of them are sent to purchasers without flanges on gate. In such case, in my opinion, the Victor would be preferable. That the company desire to do an honourable business may be seen from the following extract, taken from the second edition of this work:—"From our experience we are satisfied the interest of the purchaser requires that wheels should be tested before acceptance, and hereafter we shall furnish tested wheels when desired to do so; and if a purchaser desires to have his wheel tested after it is set in his mill, we will make the test there, if the purchaser will pay the extra expense incurred thereby. And we believe the safest and most economical way to furnish mills with power is to first ascertain exactly what is required, and we will send an engineer, at the expense of the purchaser, to any mill, who will consult with the proprietor, make examinations, using suitable instruments where deemed necessary, ascertain the quantity of water available, &c. &c., and then furnish wheels that we will guarantee to do the work in an economical manner, and to give the maximum of power promised by us, but it must be plainly understood that we do not promise to furnish a given amount of power with a less quantity of water than fixed upon at the time of making the



examination, or that our wheel or wheels will run the mill if additional machinery is added.—Holyoke Machine Company, November 20th, 1875."

The constant variation of the wheels and a lack of appreciation of purchasers caused an abandonment of the plan suggested in this card, and now the wheels are sent away without any knowledge of their efficiency.

After examining the sketches accompanying Mr. Turnbull's paper, it is a matter of surprise to me that any turbine with buckets so nearly flat could have given a very good result, and one is apt almost to doubt whether the turbines, which have done well at the testing flume, had buckets of the form delineated.

Ancholme Foundry, Brigg, February 21st. CHAS. L. HETT.

SIR,—The following may interest your readers, *re* Victor turbine. Two 20in. Victors, made entirely of bronze in heavy iron flumes, are now being set at Rochester, New York, under 96ft. head, to drive the Brush Electric Light plant in that city. Each wheel is warranted to produce 575-horse power, which I believe to be very much the largest power ever developed by wheels of that size. We are also building two 48in. wheels to work under 50ft. head, developing over 2000-horse power, for compressing air, which will be carried over 2½ miles though iron pipes, for use in iron mines for driving mining machinery instead of steam.

26, Mark-lane London, February 23rd. FREDERIC NELL.

PATENT LAW AMENDMENT.

SIR,—Your article of last week, on the subject of "Patent Law Amendment," appearing to invite the opinions of your readers, and as correspondents seem generally to assume that the interests of patentees and patent agents—mostly the latter—are the only ones to be considered, I venture to advocate the claim of the general constructive mechanical engineer to some little protection; for if it would be impossible for leisurely Government officials to decide the question of novelty, how can he, who must be at once ready to take up the construction of almost any class of mill, engine, or machine work which may fall in his way, keep himself posted up in the endless trivialities which, flowing freely under the existing patent charges, may be expected to appear in torrents under reduced ones?

This man, having little time for inquiry, must use the details with which he has, without knowing exactly how, or when, become acquainted, generally feeling sure they are "as old as the hills," and quite unsuspicious that they have become the subjects of patents; but finds, when too late, that he must either submit to a costly lawsuit or to be mulcted in an amount altogether disproportionate to any advantage he has derived, for there is undoubtedly a terrorism exercised by poor patentees—or their agents—as well as by rich ones. Many manufacturers think the present cost of patents sufficiently low and the term of protection sufficiently long, but if the weight of opinion should incline the other way, then the new law ought certainly to limit the amount of penalty which could be demanded for any unintentional infringement made before notice has been served upon the transgressor by the patentee to a very moderate percentage upon the cost of manufacturing the appliance infringed upon, and so prevent the patent laws being used as instruments of extortion.

February 27th. MILLWRIGHT.

SIR,—In your able article on this subject in your last impression I notice one statement which deserves special attention, and to which I hope you will return. I allude to the recommendation that the declaration that a man is "the first and true inventor" should be dispensed with in future.

It is well known that this declaration is commonly regarded in the light of a legal fiction, and that the *possessor* of an invention is regarded as quite justified in making the declaration in question. Indeed, it is difficult to see what possible object is gained by it, for it is simply impossible to prosecute; nor have I ever heard of a single instance in which any one was prosecuted or convicted. No one can prove a negative; and unless the person making the declaration convicts himself out of his own mouth, no one else can, for no one can prove that the man did not, when he made the declaration, believe that he was the first and true inventor. The value of the declaration is *nil*, because if it is true the patentee gains nothing by making it, and the public care nothing; and if it is not true no one suffers any harm save the man from whom the invention was stolen—if it be stolen; and he has a far more efficient and attractive remedy than a criminal prosecution.

The subject presents itself in various ways. Thus, for example, it is well known that it is the practice of all the members of a firm to associate themselves with one of them who invents something worth patenting. Again, the capitalist constantly associates himself with the inventor in taking out a patent, for his own protection. I know at this moment two gentlemen, one is the head of a firm of engineers, the other is the manager of the works of this firm; the first mentioned gentleman is not an engineer, but he is a first-rate commercial man. He never invented anything in his life, and can scarcely tell one end of a locomotive from the other. His manager is a very clever engineer, and very ingenious. He and his employer have between them taken out dozens of patents, from some of which large profits have been made. I know that one was sold for £9000, when it was about two years old. The principal always appears as one of the patentees, and makes the declaration as a matter of course. In short, the thing is done daily. It is morally wrong, perhaps, but the law is in this case to blame. It is the cause of offence, being entirely unnecessary and a hindrance to commercial transactions.

Again, it is known that very few inventions come complete from the brain of one man. The process is very often like this:—A hits upon an idea and begins to work it out. Then a difficulty is encountered; he speaks of this to his confidential friend B. This friend makes a suggestion, which may be good in itself, or may merely serve to turn the current of A's thoughts in the proper direction, so that difficulty is got over; another is settled by C, and so on. At last the thing comes to be made, and then the drawing-office scheming begins, every bit of it inventing. Can A be declared, in such a case, to be the true and original inventor? I think not.

Furthermore, many men now make inventions which they would gladly dispose of, while they refuse to be worried with a patent and, probably, a lot of law costs for the assignment of it. Thus I know clever men who would gladly sell inventions for £10 or £20 each, and who could sell them too, if it were not that this declaration affair stands in the way; but that sales of the kind are effected daily is a matter of notoriety. A manufacturer wants a certain machine to produce a given result; he goes to the proper party, who designs the machine for him, and pockets his fee for the design, and the other goes and patents it as his own. No one, so far as I can see, is defrauded. Why should not a man become purchaser of an invention as well as of a patent? Why should not the patent issue to the possessor of the invention? It would be comparatively easy to show that he had stolen it if such was the case—far easier than to prove that he had perjured himself.

It is to be hoped that in any Patent Bill that may be passed this declaration clause will be either expunged or modified, and I hope you and my brother patent agents will take up the pen to carry out this reform. INVENTOR.

Chancery-lane, February 27th.

[We hope that it is *not* "well known" that a statutory declaration can either legally or morally be trifled with as "Inventor" suggests.—ED. E.]

SIR,—Noticing in your concluding remarks in the article on the above subject as to what your "readers may say," will you kindly allow me an expression of opinion as to the probable requirements of a certain class of inventors in the matter of protection for invented improvements? The desire seems to be the cheapening of the process of obtaining a patent and in making an invention public for the public good, the inventor receiving for this a protection for the use and working of his invention.

Now, it seems that there are different degrees of inventors, viz., the large and wealthy manufacturer, the middle-class inventor, and the working-man inventor. A modification of the existing laws for the reduction of the cost of obtaining a patent might be brought about without any undue alteration, by so classing and dividing the payments into three different heads, thus: 3rd class patent: A patent granted for a period of three years at a cost or charge of £5; 2nd class: For say a term of ten years at a cost of £25; and 1st class: For say a term of twenty-one years for the sum of £100. Each of the second and third class patents to be eligible to be raised at any period of their term to the first and second class or grade respectively upon the payment of the extra cost for the complete term of the patent. This would give the young inventor and the poor patentee an opportunity of patenting at a cheap rate, and give time for the introduction and to test the novelty and validity of the patent, and the power of raising the patent to the second or first grades or degrees as thought fit or required. The second class patentees would be those who think a longer term more suitable to the chances of their patent, and for them there would be an extension of the time of the third class upon a payment equal to the existing three years' term. The lower grades would have equal power and rights with the greater during their term. It being only optional with the patentee, and the value he may attach to his invention and the probable chances of successful introduction, and the class in which he may feel disposed to commence patenting.

With respect to the examination of an invention before the grant of the patent, it does not seem to be quite clear how any one person or committee, or council of persons, however acquainted they may be with the theories, technicalities, and practices embodied in the various industries, can be able to anticipate the nature or value of an invention of an intending patentee, and as often a real invention must be almost in its infancy at the commencement of the patent, the examination would seem to be likely to give rise to dissatisfaction, and might act as a deterrent to many intending patentees. If having patented a supposed improvement, it is afterwards found out to have been anticipated, used, or previously patented, or of no practical value, the charge of £5 for a three years' term would not be a considerable loss or injury to any inventor, and at least the time and publicity given to the invention would bring out and test the real value and worth of the patent, whereas hampering it in its first stages, when it can hardly be known what is actually intended, would impede and throw back many very useful inventions and improvements.

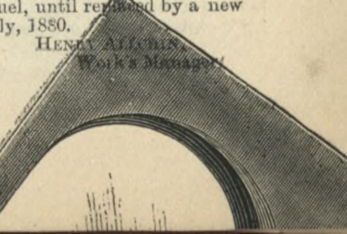
The scheme of the first, second, and third class grades will give opportunities at a cheap rate for a long term for all classes to enter their improvements and to test them publicly, and then to raise them to the second and first grades, thus securing practically all we want—the cheapening of patents in their first stages, and gradually enhancing their value as they mature and come out, and giving to the State a fair return for the privileges granted. A SMALL PATENTEE.

Charlton, February 27th.

GOSLING'S FUEL ECONOMISER.

SIR,—I was pleased to see the report of the trials of Gosling's fuel economiser at the Beckton Gas Works in last week's ENGINEER giving such good results. The idea is not new. I had two baffle plates placed in the tube of an old Cornish boiler, 16-horse power, at the Wests Gas Improvement Company's Works, in December, 1878, which proved a great saving in fuel, until re[illegible] by a new Galloway boiler with cross tubes in July, 1880.

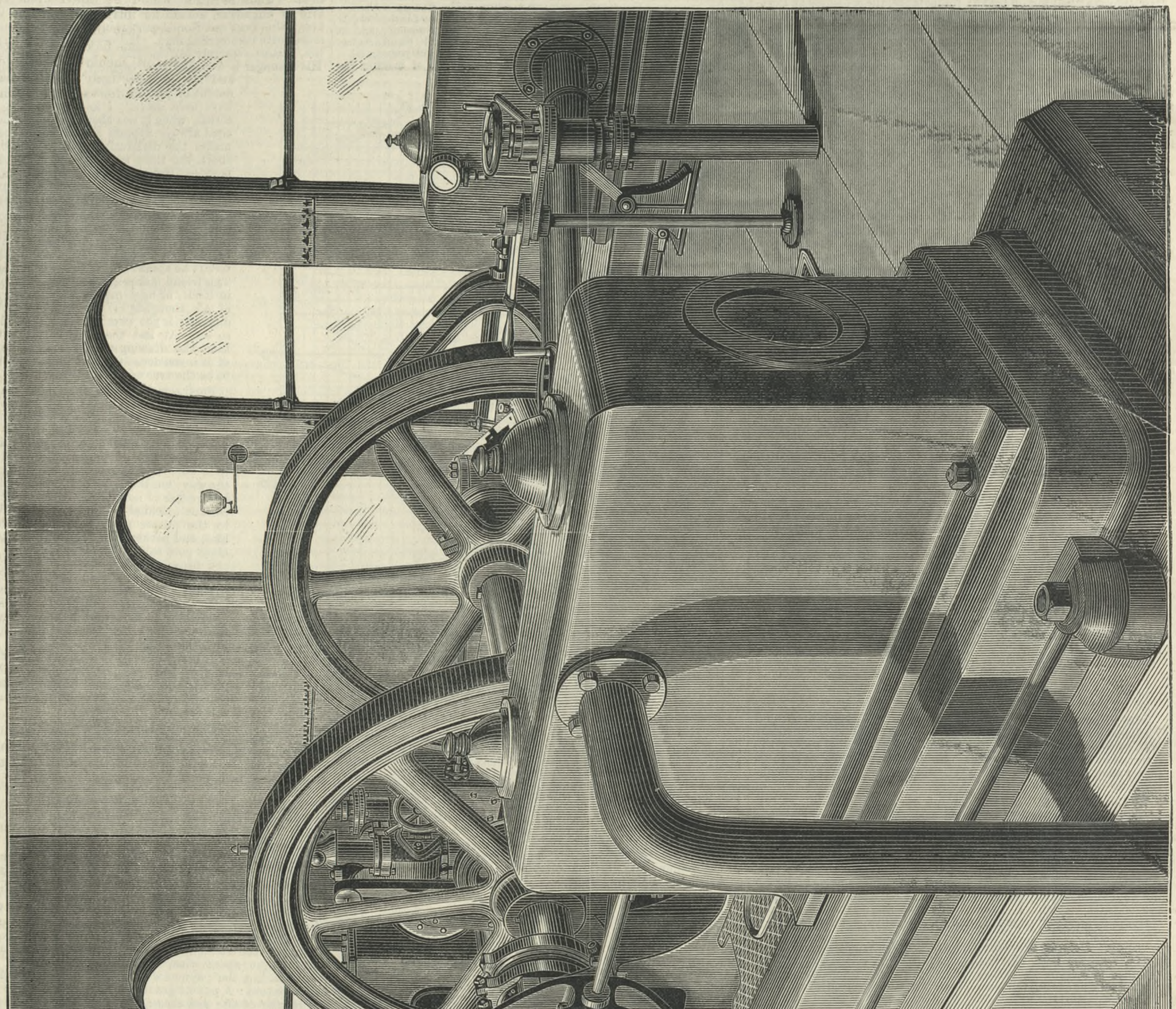
Maidstone, February 27th. HEN[illegible], Work's Manager.



PUMPING ENGINES.—WHITWOOD SEWAGE WORKS.

MR. JOSHUA HORNE, CASTLEFORD, ENGINEER.

(For description see page 160.)



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TO CORRESPONDENTS.

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

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

PATTERN BOOK.—*See the address given at page* 63 *of* THE ENGINEER, 26*th January*, 1883, *col.* 3.

CHIPS (Sunderland)—*There is no book published on the management of donkey engines and boilers.*

AN EMBRYO DRAUGHTSMAN.—*You can obtain sensitised paper for photracing from several well-known London stationers.*

N. S. (St. Petersburg).—*We do not consider your idea impracticable. Messrs. Siemens and Halske, of Berlin, might be disposed to aid you.*

ENGINEER.—*In order to become a civil engineer you must be educated just as you would be for any other profession. You may take a degree at several colleges. For example, the London University, Glasgow University, and Trinity College, Dublin; or you may be articled to a civil engineer for five years, paying a premium of from* £300 *to* £1000.

C. F. C. (Lincoln).—*If you employ two field magnets* 9in. *long by* 3 *by* $\frac{3}{8}$ *thick, the approximate quantity of wire required to excite them would be* 900*ft. of No.* 20 *B.W.G. cotton-covered wire. This will have a resistance of about* 9 *ohms, or rather more; but as you seem only to require to light one* 16 *or* 20 *candle-power lamp, which would have when hot but a resistance of about* 40 *ohms, you can afford to have the internal resistance of the dynamo fairly high. You can obtain your wire from Phillips Brothers, Mackintosh-lane, Homerton, London. The above quantity would be rather over* 4 *lb.*

CASTING CART WHEEL BUSHES.

(*To the Editor of The Engineer.*)

SIR,—Could any of your readers tell me the best method of putting names on cart bushes which are cast vertically on chills, and also the best place to get the stamps?
INQUIRER.

TRAMWAY STATISTICS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers oblige with the name of a reliable work giving statistics of cost of construction and maintenance of horse tramways and running stock?
F. T.

CHARCOAL MILLS.

(*To the Editor of The Engineer.*)

SIR,—Will any of your readers favour me with the names and addresses of manufacturers of animal charcoal mills?
CHARCOAL.
London, E.C., February 26th.

CONDENSATION ON INSIDE OF GALVANISED IRON ROOFS.

(*To the Editor of The Engineer.*)

SIR,—Could any of your readers tell me the best thing to put on galvanised corrugated sheets to prevent their sweating inside? I find great trouble from the drops falling on the machines.
INQUIRER.

WOODLEY'S HARVESTER.

(*To the Editor of The Engineer.*)

SIR,—I shall be glad if any of your correspondents will send me the name and address of "Woodley" or "Uttley," or some such name, who is a maker of Woodley's harvester.
HARVESTER.
Lincoln, February 26th.

PHOSPHOR BRONZE.

(*To the Editor of The Engineer.*)

SIR,—In your issue of 23rd inst., containing a description of my new alloy, Delta metal, I notice my name erroneously mentioned as being also the inventor of phosphor bronze. I originally introduced this latter alloy into this country, but the inventors are my late friends Dr. Künzel, of Dresden, and Mr. Montefiore, of Brussels, to whose labours all its merits are due.
ALEXANDER DICK.
110, Cannon-street, London, E.C., February 26th.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 6th, at 8 p.m.: Papers to be read with a view to discussion:—(1) "The Productive Power and Efficiency of Machine Tools and other Labour-saving Appliances Worked by Hydraulic Pressure," by Mr. Ralph Hart Tweddell, M. Inst. C.E. (2) "Stamping and Welding under the Steam Hammer," by Mr. Alexander McDonnell, M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, March 5th, at 7.30 p.m., a paper will be read, entitled "A New System of Treating Fœcal Matter," by Mr. Harry Olrick, the leading features of which are as follows:—A description of apparatus designed to manufacture manure, with a minimum expenditure of fuel, and without danger to health. The results of working such apparatus at Augsburg, Bavaria.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, March 8th, at 8 p.m., a paper will be read "On Some New Forms of Telephone Transmitters, with a Note on the Action of the Microphone," by Mr. John Munro, Associate.

SOCIETY OF ARTS.—Monday, March 5th, at 8 p.m.: Cantor Lectures, "Solid and Liquid Illuminating Agents," by Mr. Leopold Field, F.C.S., A.S.T.E. Lecture VI.—Ozokerit, and other mineral sources of light. Manufacture of candles. Survey of the candle trade and the various inventions and industries excited hereby. Conclusion. Wednesday, March 7th, at 8 p.m.: Fourteenth ordinary meeting, "The History of the Pianoforte," by Mr. J. Hipkins. Mr. John Stainer, M.A., Mus. Doc., will preside. Thursday, March 8th, at 8 p.m.: Applied Chemistry and Physics Section, "Self-Purification of River Waters," by Mr. W. N. Hartley, F.R.S.E. Professor F. A. Abel, C.B., F.R.S., will preside.

THE ENGINEER.

MARCH 2, 1883.

PATENT-OFFICE FEES.

IN our last impression we indicated the direction which any amendment of the existing patent law should take, and it will be remembered that we suggested three important modifications of existing rules, namely, the substitution of a fee of £1 for the present fee of £5 paid for a provisional protection; the substitution of twelve months for the six months during which provisional protection now lasts; and the payment of Patent-office fees yearly instead of at the end of four months, six months, three years, and seven years, as is now the practice. We propose here to consider more fully than we could do last week the last of these three suggestions. With the initial fee of £1 we need not further concern ourselves at this moment. We shall assume that the inventor has got his protection for twelve months. This protection would be to all intents and purposes as useful as a patent, from which it would differ indeed in few respects. The inventor could, with this in his pocket, exhibit his invention as he pleased; could negotiate for its sale; could enlist the help of capitalists; could make his arrangements to supply the demands of purchasers. The total probable expense would be to him about £5, including drawings and patent agents' fees; for complete detailed drawings would not be needed, and the preliminary specification would not have to be drawn quite so carefully as the complete specification, which would have to be lodged further on. At the end of the year a further sum of, say, £3 would have to be paid, and the patentee would then be in possession of a patent; but the duration of the patent would be only one year. However, counting the year of provisional protection, and the first year of patent, the inventor would obtain absolute protection for his invention for the sum of £5 paid in Patent-office fees. What his other expenses would be can only be matter of conjecture, and it is not needful to consider the question of their amount here, because it is not contemplated that the new patent Bill should in any way regulate the sums that might be charged by the patent agent. Two years elapsed, the inventor would find himself called upon either to drop his patent or pay a further fee of, let us say, £5, and so at the end of each year the patent might be renewable on payment of an annual fee, increasing steadily in amount with the age of the patent. What the total amount should be we have already suggested, namely, £200 to £250; but the annual amounts should be so arranged that the total cost for the first five years should not exceed £25. After that period fees might increase rapidly, because it may be taken as a proved fact that any patent which it would be worth while to keep going more than five years would represent a good deal of value. It is not easy, indeed, to imagine the case of a patent which had lasted five years, and on which the payment of £25 would be a heavy burthen. If its owner did not feel justified in paying such a sum, then the patent could be worth nothing, and ought to be dropped. We hold that as the age of a patent augments, it represents more and more value. We can cite a case in point, in which a patent for a manufacturing process dragged on a miserable existence for three years, during which the patentee was endeavouring to place his goods in the market. He had no hesitation in paying the £50, however. About the end of the fourth year his goods began to find their way into favour with the public, and about this time he sold his American patent for a few hundred pounds. The success of the invention became assured; and in the United States it was so great that he found it worth his while to buy up the last two years of the American patent for more than eleven times the sum for which he had sold it when it had fourteen years to run. It will be seen that in such a case as this the payment of a final fee of £50 for the last year would have been no hardship at all, and such cases are by no means unusual. In point of fact, they are of every-day occurrence. It is not too much, perhaps, to assert that a patent six or eight years old, under the new *régime*, which could not pay a fee of even £50, would have no existence.

The advantages conferred by the annual fee system would be two-fold. In the first place, the pocket of the inventor would be spared, and patents would be placed within the reach of the poor man. But there is a more important consideration than this to be borne in mind. We are not underrating the first advantage; but the subject must be regarded by Parliament from more points of view than that of the inventor. The direct result of reducing the cost of patents will be a rush of applicants for them. About twenty-four thousand patents are taken out every year in the United States, and it is by no means improbable that as many will be taken out here. The vast number taken out at the other side of the Atlantic is, however, due in great measure to the rule of American patent law that only one invention shall be included in each patent. In this country a hundred modifications of the same ruling idea may be patented; but each modification must be patented in the United States. For example, Edison not long since took out no fewer than fourteen patents for improvements in apparatus for generating and using electricity. The whole of these improvements could have been covered in this country by probably one, certainly by two patents. Thus so many patents will not be needed here as are required in the United States to protect a given number of inventions; but on the other hand the initial fee, being much less than that paid in the United States, more inventions will be patented. Now the great argument against cheap patents is that their numbers would be so great as to seriously hamper trade; at every turn the manufacturer would be called upon to pay a royalty or stand an action for infringement. As we have previously stated, we believe that this argument has not nearly so much weight as some folks fancy. It is, however, highly desirable that it should be deprived of all weight, and nothing will so effectively dispose of it as the annual fee system. Not long since we heard of a case in which a particular form of pump valve was used by an engineering firm. It was invented, if we may use the term, by one of the principals, who never considered it worth a patent; but he was subsequently sued for a royalty by an inventor, whose patent was running the last of its three years, and who had actually never made a single valve of the kind, or taken any step whatever to work his patent, after he had paid the first £25. He regarded it as commercially worthless, and had let his invention drop. It will be seen in a moment that under the annual payment system such a case could not occur, as the patent would have only run one year. In a word, the effect of the annual system would be to kill off with the utmost certainty and celerity a vast multitude of useless patents, which will be called into existence by the small initial fee, and thus the ground would be kept clear. But it may be argued, Would it not be better to keep the fees high, and so prevent the birth of patents, rather than kill them afterwards? To which we reply, certainly not. Under the proposed system scores of inventors will be enabled to test the value of their inventions who cannot test them now. Patenting an invention has been compared to putting into a lottery. It need not necessarily be anything of the kind; but it very often is. By the new system the price of the tickets will be, so to speak, reduced, and in so far the great public of inventors will be benefitted; but the annual fee would act as the guard to protect the manufacturer from being overwhelmed by a torrent of patents. The life of that which is worth prolonging will be prolonged, the rubbish, after a year or two years' trial, would be swept away and would trouble us no more.

It may be urged that the collection of annual fees will be very troublesome. Just the same thing may be said of the income-tax, or the licence on metropolitan stage carriages, or a hundred other things. It will not be so troublesome but that hundreds of men will be found quite willing to undertake the work in return for moderate salaries. Of course a staff of clerks would have to be appointed for the purpose of receiving the fees and indorsing the receipts on the patents; but this is a matter of pure routine, office, detail, demanding no consideration at all in the Act of Parliament. Let it be stated that patentees must pay fees every year or lose their patents, and the money will be paid. A comparatively moderate addition to the staff would enable the practice of insurance companies to be followed, and a notice to be sent to every patentee that his fee—with its amount—would fall due on such and such a day. It will be urged, probably, that as premiums mostly fall due on a particular day, there is little trouble in this, and that there is no true parallel between patents and insurances. If such an argument were pressed, we could cite the case of season ticket holders on railways as strictly analagous to that of patentees. Season tickets expire at all sorts of times, unless they are renewed; but railway companies make no difficulty about notifying the holders three or four days before the money falls due. It may be said that there will be more patentees than season ticket holders. This we doubt; but even if they numbered three or four to one, the illustration would still hold good, because season ticket holders pay, as a rule, either four times a year or three times a year, and thus each of them must get either three or four notices every year, while the patentee would need but one. This difficulty, if it deserves the name, needs only to be grasped to shrink into approximate nothingness.

THE PROBLEM OF FLIGHT.

IN another page will be found a paper on the hovering of certain American birds, sent us by Mr. Lancaster. We have published this paper because its author has evidently given much thought to a very puzzling question; a question, too, which has exercised many minds in all parts of the civilised world for centuries. The statements made by Mr. Lancaster are, however, so remarkable that either of two things must be taken for granted—namely, Mr. Lancaster is mistaken, or there is some peculiarity in the action of wind currents on inclined surfaces which is at present unexplained. The conditions do not, we think, warrant us in adopting the first hypothesis without question. Mr. Lancaster asserts that he has watched certain birds for comparatively long periods of time, during which they remained suspended in a current of air without moving a wing; and he postulates from certain other observations that this phenomenon of suspension is unattended by any muscular effort on the part of the bird. There can be no mistake concerning Mr. Lancaster's assertions. He evidently watched closely, and he no doubt fully believes all that he has said. It will be observed that there is a nearly uniform basis of agreement between him and Professor Hele Shaw, of Bristol, whose letters on flight have recently appeared in our pages; and the testimony of Mr. Lancaster does not stand alone, many writers on the natural history of birds have stated nearly what Mr. Lancaster has stated in very similar words. In short, there is a considerable amount of reputable evidence that some birds can remain suspended—hovering—in the air for minutes, if not hours, without moving their wings, and without changing their places.

It is not, perhaps, unkind to say that up to the present the whole question of aerial navigation has remained in the hands of the amateur. There are, of course, a few exceptions. What we wish to convey is that careful observations concerning the flight of birds are lacking, and that crude theories abound in plenty. There is the skilled professional observer of natural phenomena, and there is the amateur observer. The latter has, up to the present, written and said and done nearly all that has been said, written, or done concerning flight. Now an essential difference between the highly trained scientific observer and the improperly trained amateur, is this:—The first understands that we know nothing of a great many causes save what is taught us by their effects, and that we can never be quite sure that a given effect is produced by a cause which has already produced a somewhat similar effect; while the untrained observer is apt to mistake effects for causes, and to assume that when certain facts have been acquired by observation, enough has been done to enable the nature of the cause which has produced these effects to be ascertained, constantly forgetting that the addition of one more fact might suffice to show that the assumed cause could either have no existence at all, or that it did not operate in the particular case stated. For example, in the case cited by Mr. Lancaster, it is evident that if he had succeeded in detecting any motion in the wings of even one of the buzzards of which he speaks, the edifice of theory which he has constructed must fall to the ground. Of course he will say that no such motion takes place, but this is just the point at issue. Mr. Lancaster seems to have trusted entirely to his unaided eyesight; and he probably formed a theory concerning the sailing of birds at an early stage. This theory would be sufficient to render every observation he subsequently made doubtful as to accuracy. Let us suppose that some trained observer, without any theory or prepossession, provides himself with a powerful binocular telescope, and watches the proceedings of the buzzards referred to by Mr. Lancaster. It is clear that a statement made by him must possess more value as evidence than a statement made by a man who had a preconceived theory and had not a telescope. We do not reject Mr. Lancaster's evidence, however, but we do say that however consistent it may be with the hovering performances of buzzards, it is not consistent with the laws of mechanics as taught daily in this and other countries. It is not to be denied, however, that these laws may be based in some instances on insufficient evidence, and that the announcement of some new fact is not to be rejected with scorn simply because it seems to be or really is opposed to text-book teachings. To assert that it ought to be rejected would be to say that nothing more remained to be learned concerning nature or natural laws.

Mr. Lancaster would have us believe that a bird can remain at rest in a current of air moving at the velocity of five or ten miles an hour, and this without effort of any kind, save just so much as required to maintain equilibrium, prevent oversetting, and preserve the general inclination of the wings to the wind at the proper angle. We concede at once that *if* the bird can remain over one spot on the earth's surface while the air moves beneath it, a powerful lifting effect will be produced. There is no doubt about this. If the bird is light enough, and the force of the breeze be strong enough, and the inclination of the wings be sufficient, the bird will be carried upward, the horizontal path of each molecule of air being deflected downwards. If the bird does not rise at all, then the deflection will be represented by the sine of the angle made by the wing with the horizon. If the bird rose through a distance equal to this sine, while a molecule of air swept from the front to the back of the wing, then there would be no deflection of the air current; but neither would there be any upward impulse derived from the wind. If the bird fell, the deflection would be magnified; when it is at rest then the molecular deflection will be something between the other two. All this is well known, and only needs to be mentioned. The whole question at issue is, What prevents the bird from being carried away horizontally by the current? A kite supplies a case in point. We have in it sustained flight due to the pressure of the wind on the under side of an inclined surface. But kites cannot be flown without strings. The question is, Can birds do without the equivalent of strings? and apparently the reply made by all those who have given much attention to the subject is that they can. If they can, then there is a great deal about the action of wind currents not yet explained, and apparently wholly inexplicable. It has been gravely advanced that birds are able to divest themselves of weight—in other words, neutralise the action of gravity—when they think proper. The proposition is startling, to say the least of it; but we confess that to us it is not more startling than the assertion that a large bird can remain at rest in a breeze without effort of any kind.

The surface of a bird resting in the air with inclined wings, may be divided into two portions—a horizontal and a vertical component. The vertical component will be small, but it is none the less real, and on it the current must operate to carry the bird away. By what means is this neutralised? Again, let us take the head and neck and breast of the bird; on these the wind must act. What resists this force? The only way out of the difficulty is either to imagine that the air exerts no horizontal pressure at all, or that some peculiar eddy action takes place on the upper side of the bird which operates to propel it forward. It is conceivable, for example, that if a wedge-shaped body were immersed in a current of elastic fluid, the base being directed towards the current, the pressure closing in behind on the inclined sides of the wedge would cause it to advance base first. We say that this is conceivable, but Mr. Lancaster asserts that he has made models which prove that it is a fact. There are, moreover, two circumstances bearing on the hypothesis, which tend to demonstrate its possibility. One is that if a flat, triangular board be towed through still water, it will offer less resistance if towed base first than if towed point first. The second is that Mr. Froude has demonstrated that a body immersed in a perfectly frictionless liquid would experience no resistance whatever to motion, provided eddies were not formed; and on the other hand, an immersed body at rest could not be put in motion by the moving liquid. Now the wing of a bird is thicker toward the front than toward the rear, and we have here a wedge presented base first to the current; but it does not appear that the shape of the bird as a whole is just what is wanted to attain the required conditions. If it can be shown, first, that Mr. Lancaster is right in his observations, and if, further, the cause of the phenomena of sailing or hovering can be explained, then will human flight perhaps become possible, and we would direct the attention of observers to the settlement of this point before they trouble themselves with any other. As we have already pointed out, given muscular force enough, or in other words, power enough, with a stated limited weight, and almost any wing will suffice for flight. But the buzzards and cranes apparently do without muscular effort very nearly altogether; if man can learn this secret, then all the rest becomes possible; but before any progress can be made let us have accumulations of facts instead of groups of theories. It ought to be in the power of others to verify or disprove Mr. Lancaster's statements. Nay, Mr. Lancaster can himself, with the aid of a powerful glass, do much to confirm or overthrow what he has written.

LONDON FIRES.

The statistics of London fires have been carefully treated in our columns from time to time, and the subject, at the present moment, is one which engages considerable attention, consequent on certain proceedings at the Metropolitan Board. We have also the benefit of Captain Shaw's report for the year 1882. The number of fires in that year was 1926, which, compared with the mean population of the year, shows 49·47 fires per 100,000 of the population. This is what has been called, in our previous discussions of the subject, the "fire rate," and affords a convenient mode of comparing the prevalence of fires in different years, while making due allowance for the continual increase in the number of the inhabitants. Houses and other buildings, we may presume, are multiplied nearly in the same proportion as the population; and hence, it might be expected that the census of the metropolis and the outbreaks of fire would preserve something like a fixed ratio to each other. The early statistics of London fires are doubtless defective; but it has been pointed out that the growth of the fire rate in the later years has been so great that a large amount of the increase must be considered due to a real augmentation of the ratio. In the sixteen years ending with 1848, the average annual fire rate was 33·26. In the next sixteen years it became 40·82, and in the next, which ended with 1880, it was 48·36. The present series of statistics, recorded by Captain Shaw, commenced in 1866. In that year the fire rate was 44·3, and it will be observed that the figure for last year is much higher. But there are large fluctuations in the ratio. In 1870 it was as high as 60·7, dropping to 45·3 in 1872. The year before last it became 51·96. Taking quinquennial periods, we find the fire rate rising persistently from 1836-40 down to 1866-70, when it became 50·8. In 1871-75 it fell to 47·76, and in 1876-80 it became 46·3. It will be seen that the ratio has been greater than this during the last two years. The population per fire last year was 2021, as compared with 1924 in the year preceding.

In order to test the efficiency of the Fire Brigade, we ought rather to consider the subject of serious fires. The absolute number of fires is a matter which the Brigade cannot control, although it is an important element in determining the degree of danger which has to be guarded against. If we take what may be called the "serious fire rate," that is to say, the number of serious fires per 100,000 of the population, we may consider that we are going to the core of the subject. In doing this, we are limited to the period during which the Brigade has been an institution appertaining to the Metropolitan Board. In 1866, when the task of protecting the metropolis from fire first devolved on that body, the serious fires were as high as 25 per cent. of the total, and we may accept this as a somewhat striking proof that the Brigade at that period was altogether insufficient for the work it had to perform. The state of the case is very palpable when we observe that the serious fires in 1866 were as many as 326, or double the number they were last year, although the actual number of fires was 588 more at the later date than at the former. The fire rate was much higher last year than in 1866, but the serious fire rate was lower in a very marked degree. In the five years 1866-70, the serious fires averaged 256 per annum, whereas in the two next quinquennial periods they averaged 162 and 163 respectively. This brings the comparison down to the close of 1880, and we find that the average of the last two years is 165. If we compare the serious fires with the population, the best year is seen to be in 1872, when the rate per 100,000 of the population was only 3·6. During the last six years the rate has slightly exceeded 4. Last year it was 4·21. The highest fire rate, independent of magnitude, was in 1870, when it reached 60·7. The serious fire rate was also high in that year, but was not at its maximum, that being found in the year 1866. The lowest fire rate was in 1877, being 42·7; but we have already observed that the serious fire rate was lowest in 1872.

We have shown on a previous occasion that the number of fires in the metropolis, relative to the extent of population year by year, exhibits signs of improvement from a period dating about the year 1870. The quinquennial periods show this very distinctly, ending with 1880. The two subsequent years have a higher ratio, but before the current period is complete this may undergo correction, especially as 1882 has a decidedly lower ratio than 1881. It will be an encouraging fact if the total number of fires occurring annually should persistently decline in their ratio to the population. If this point becomes clearly established, it may be held to indicate that there was a considerable amount of "fire raising" in former days, as also that there is more carefulness, as well as, perhaps, more sobriety among people now than formerly. Concerning the magnitude of fires, we should like to see the low rate of 1872 maintained. For the present the Brigade appears to have gone as far as it can go in this direction. But with the improved appliances which are now coming into use, in the shape of fire hydrants, numerous hose carts, and an increased number of "watches," associated with the introduction of electric fire alarm circuits, we may hope that further impression will soon be made on the domain of fire. In a recent debate at the Metropolitan Board, Mr. Selway claimed that the Building Acts, as administered by that authority, had been of great service in restraining the spread of fire in London. How far the Building Acts have really operated to this end may be a matter of dispute. But it would seem inevitable that the law must have been of service for this particular purpose. Yet the style of building in this era is rather favourable to the production of big fires. The use of lifts is fraught with peril in the event of a fire getting any hold of a building, and such contrivances are almost indispensable in the lofty structures which are specially characteristic of commercial enterprise. The erection of these Alpine edifices where the streets are little better than alleys in respect to their width is an ominous circumstance. The City abounds in instances of this kind, and the great fire which raged in Wood-street a short time back indicated the mischief likely to arise from such a crowding together of colossal warehouses. Twenty-five fire-engines were battling with that conflagration, and it is said that there was no room for any more. This is the more likely to be true, seeing that the Watling-street steam fire-engine was absent. In fact we hear it stated that this particular engine never attended a single City fire all last year—a circumstance which may be attributed to the success which has attended the use of the fire hydrants and the hose carts.

It is evident that a call which has long been put forth, demanding a more liberal development of the Fire Brigade, is about to be answered. The Metropolitan Board have so far exceeded their resources for the sustentation of the fire department, that they are compelled to ask for power to go beyond the narrow limits of the halfpenny rate. By the end of the present year the expenditure on the current account for the Fire Brigade will have overrun the income by £21,000. This excess is not due to any extravagance, the fault being rather on the other side. More funds must be found. It by no means follows that the Board require a rate of a penny in the pound because a halfpenny is not sufficient. But the Board should be at liberty to spend what is necessary for the protection of London against fire. The Government contribution to the Brigade, amounting to £10,000 a year, is not likely to be enlarged, and there is no very strong reason to urge why it should be. The argument for an advance in the rate of contribution from the Fire Offices rests on a very different footing, and there ought to be no serious objection in that quarter to an increase in the scale. Their £35 per million insured has been an admirable investment, and falls decidedly short of the 30 per cent. of the amount raised by the ratepayers, to which they were willing to submit in 1864. The insurance offices may fear that London is likely to be over-protected. It may not be to their interest that every fire should be put out as soon as the flame shows itself. If "serious fires" cease, or nearly so, people may conclude that it is scarcely worth while to insure. The "tariff" may have to fall, and the enormous profits which have been reaped by the fire insurance companies during recent years may decline. But the people of London are not content to be burned in their beds to please the Fire Offices, or to have their costly merchandise consumed, so that everybody may be scared into taking out a policy. Neither is it fair that the insurance offices should leave the ratepayers to bear the whole cost of the improved and extended arrangements now coming to pass for the protection of London against the ravages of fire, and for excluding the possibility of an overwhelming conflagration. After all, as we are bound to assume, in justice to the insurance companies, that they really wish to see a reduction in the extent of metropolitan fires, there is the more reason why they should consent to a revision of the bargain made in former days, when, as we have shown, the Brigade was obviously far too weak for its work.

The Metropolitan Board must be considered as promoting the interests of the Fire Offices, as well as those of the public, by the recommendation which they have recently made to the Home Secretary in favour of establishing a Court of Inquiry to investigate the origin of fires in certain cases. Such a system, if adopted, would tend to diminish the practice of incendiarism, and would also aid in detecting unknown sources of danger, besides assisting in the discovery of improved methods for restricting the ravages of fire. It is to be hoped that the Fire Offices will take an enlightened view of the situation, and will co-operate with the Metropolitan Board in any reasonable measure calculated to make fires less frequent and disastrous. Some valuable facts connected with the pecuniary part of the question have just been given by Mr. G. B. Richardson, in a debate at the Metropolitan Board. One significant item is that the market value of the shares of four of the Fire Offices has increased by nearly £4,000,000 since the Board took possession of the Brigade in 1866. The insured property in the metropolis—in reference to all the companies—has risen from £315,000,000 in 1865, to £678,000,000 in 1882. The amount contributed to the income of the Brigade by the Fire Offices last year was £23,000. We think the insurance companies can hardly be said to groan under the weight of the burden thus imposed upon them. In 1865 their contribution was £10,000, while the ratepayers contributed £30,000. Last year the ratepayers furnished more than £86,000, and that amount left a deficiency which has to be met. The burden of the rates may be said to have increased threefold, and the Fire Offices could not be held to have a grievance if their contributions were to advance *pro rata*. One little fire in place of one big one would save them a sum of money far exceeding their entire contribution for a year.

BASIC FURNACE-LININGS FOR DEPHOSPHORISING PIG-IRON.

It appears from a recent paper, issued by Jungbaug and Uelsmann, in *Dingler's Polytechniches Journal*, that soda and potash carbonates are used instead of the corresponding chlorides of those metals, and that the durability of the lining is said to be increased by the addition of cryolite. The following modification of the usual method of preparing the lining has been found to answer admirably:—The raw or calcined masses of lime, dolomite, or magnesite are ground and mixed with the flux; the mixture is then burnt to dust and worked up into bricks, the dust being rendered plastic with tar treated with 3 per cent. of flux. When the flux is made up of alkaline carbonates, ground calcined phosphate or bone-black, with the addition of a few per cent. of the alkaline carbonates, are used in the preparation of basic bricks, muffles, &c. André states that the basic masses are to be burnt at a high temperature, then pounded and ground, and the powder thus obtained is formed into bricks by the addition of freshly prepared lime sulphate. Two per cent. of the lime sulphate suffices to form a plastic material. Borsig proposes to mix dolomitic limestone, either in a crude, calcined, or finely divided form, with from 2 to 2·5 per cent. of crude boracic acid, or 3 per cent. of fused and pounded borax. The mixture is used in a dry or wet condition for lining furnaces or for the preparation of bricks. According to the Society of Mines of Hörde, and the Rhenish Steel Works at Ruhrort, limestone free from magnesia, containing not more than from 15 to 20 per cent. of silicic acid, alumina, iron oxide, and manganese oxide, may be used for the preparation of basic linings. The quantity of iron oxide present should not exceed 6 per cent. It was, further, found that phosphorus can be got away in the slag without the after blow, by the use of fluor spar equivalent to one-tenth part of the tribasic lime phosphate formed. Instead of fluor spar, alkalies, alkaline earths, or cryolite may be used. The dephosphorisation is also effected by blowing air into a reverberatory furnace having a basic hearth. Immediately before the introduction of the metal into the converter lined with basic bricks, it is recommended to add lime or a mixture of eight parts of lime and one of ferric oxide. The mass is heated and air blown in for from six to ten minutes when the converter is emptied, and the metal treated with a mixture of from two to three parts of lime and one part of ferric oxide free from silicic acid. The quantity of flux in the first blowing amounts to twice the weight of silicium and phosphorus contained in the original charge, while the quantity used in the second operation depends on the durability of the converter. The object of the addition of the second flux is to obtain a slag containing more than 36 per cent. of lime and magnesia. The basic flux may be replaced partially or wholly by manganese ores, cryolite, fluor spar, and caustic or carbonated alkalies, whilst phosphorite or bone-black, mixed with clay or asphalte, is used as a lining. After the decarburation of the iron bath the oxidation of the remaining phosphorus is effected by the introduction of oxidising agents, as ferric and manganic oxides, into the iron. This operation takes the place of the after blow.

PREPARATION OF STEEL FROM PHOSPHORISED CAST IRON AT CREUSOT.

A PAPER by M. Delafond has recently appeared in the *Annales des Mines* on the preparation of steel from iron of this kind, and he finds that the problem is completely solved, both in the Bessemer converter as well as in the ordinary furnace, when basic linings of magnesian lime are employed. The removal of phosphorus is as satisfactory as could be desired, and the silicium is almost entirely removed, while the sulphur is also to a great degree separated. The basic steel is found to be purer and more uniform in texture than acid steel. The soundness of basic steel is more uniform than that of acid steel. Tires of both are found to be statically and dynamically alike. The formation of bubbles and blisters in the basic ingots has been avoided by raising the temperature before casting. In the furnace the basic process goes on more easily than in the converter, and the removal of phosphorus is likewise more complete. Metallurgists have then at the present time two different processes of forming steel, either in the converter or in the furnace; in the one pure kinds of cast iron are treated in the apparatus with acid lining, in the other impure products are subjected to basic linings. The question then arises, if, under otherwise equal conditions, a complete refining follows as well with a basic lining as with an acid, why should not the basic lining be simply employed, so that the steel of greater purity, furnished by that method, be obtained? To this it may be replied that when the furnace is used, it would in many cases be advisable to replace the acid lining with a basic one, whereby, in fact, the work would offer no obstacle. It is quite otherwise where the converter is employed. Here the cast iron cannot be worked with a basic lining so advantageously as when the acid lining is employed. It is rich in silicium, which introduces great difficulties when the basic lining is employed. If, however, it be possible so to regulate the smelting furnace that the iron contains less silicium, the inter-molecular combustion may be so regulated that no sufficient heat shall be developed to maintain the metal and slag in a liquid state. Thus it is that the preparation of pure cast iron in basic converters presents difficulties. A mixed process may, it is true, be employed; the scorification, first in an acid converter, and then a further refining in a basic converter; only this process would be costly and complicated. The future will decide what is best to be done in this respect. The white raw iron employed at Creusot in the basic process has the average composition:— 3 = C; 1·30 = Si; 1·50 – 2·0 = Mn; 2·50 – 300 P; and 0·20 S, while the basic (1) and acid (2) steel contain:—

	1	2
Carbon	0·43	0·40
Silicium	trace	0.30
Manganese	0·76	0 66
Phosphorus	0·06	0·075
Sulphur	0·029	0·04

The basic lining, consisting of dolomite treated with tar, has the composition, $CaO = 53$; $MgO = 35{\cdot}8$; and $SiO_2 = 7{\cdot}7$, while the slags at the end of the decarburation (1) and dephosphorisation (2) have the following constitution:—

	1	2
Silicic acid	22	12
Lime and magnesia	47	54
Iron and manganese oxides	11	11
Phosphoric acid	12	16
Alumina and chromium sulphates	5	5

PROFITS AND WAGES.

BETWEEN these there is just now a disproportion which is telling to employers' disadvantage, and of which complaints are loud upon the trading exchanges. These complaints are nowhere heard with more distinctness than in the mining and the iron-making centres. At this there need be no surprise, since it is declared to be capable of proof that, as to colliers' wages, they are in Staffordshire, it may be, 30 per cent. above the minimum rate of about three years ago, whilst the prices realisable for the bulk of the coal sold is but little more than sixpence above the minimum prices of that time. The wages of the ironworkers in the same part of the kingdom are 20 per cent. higher than at the earlier date, while the prices which can alone be secured for much of the iron now being sold there show a relatively corresponding disadvantage compared with those cited in respect of the coal trade. Whether the cause be to be found in the depreciation of gold as our standard of currency, or in the adverse climatic influences, or in the unsettled condition of legislation upon the United States Tariff, or all combined, it is beyond dispute that the profits of trade show a decided decline by the necessity for reducing quotations. Those prices alone are procurable for ship-plates in the North of England, which have led to drop after drop in makers' terms; and the shipbuilders assert that only by terms which such reductions render possible can they obtain new orders; and this week it is made known that the chief implement firms are dropping prices of mowers, and reapers, and binders, and the like 15 per cent.; ploughs 10 per cent.; and castings 5 per cent. All this time operative engineers' wages, like those of colliers and ironworkers, have remained unaltered from the late considerable advance. If, under such circumstances, the operatives carry out their expressed resolve to oppose any step calculated to lower the scale upon which they are now remunerated, the tension in the relation between employer and employed which is beginning to appear will develope issues in which the operative must be the heaviest sufferer.

AN APPALLING FEATURE IN BANKRUPTCY.

A NEW terror will be added to death should Mr. Chamberlain's Bankruptcy Bill become law. By the 56th section it will be enacted that when the estate of a deceased person is insufficient for the payment of his debts, he shall be deemed to have committed an act of bankruptcy by the act of his dying! Thus disproving the truth of the old saying that "a man cannot do two things, satisfactorily, at once." Thereupon, the Court may upon petition make an order for the administration of his estate as though he had been declared a bankrupt during his life-time. Nothing is said in the Bill as to the bankrupt's discharge, but that will clearly be a matter of secondary importance to him, though the omission is an illustration of the truth of another old saying that "the absent have no friends."

PROVISIONAL ORDERS FOR ELECTRIC LIGHTING.

A SHORT time ago we called attention to a draft provisional order prepared by Mr. J. F. Moulton, as an example of the draft order that had been lodged with the Board of Trade. The provisional orders have drawn adverse criticism upon some points; but the main features of Mr. Moulton's draft seems to be recognised as satisfactory. The Board of Trade has just issued some draft clauses which they propose should be inserted in the provisional order. These clauses deal with certain points only, and do not attempt to give the framework of a complete order. A careful comparison of these clauses with the draft orders prepared by Mr. Moulton will show that generally his ideas have been followed. His terms "main," "service line," "charging main," "distributing main," &c., are adopted by the Board of Trade, and what is more important to the public and the undertakers, draft clauses apply to the area to be supplied. Electric lighting is in its infancy, and work on a large scale will be somewhat experimental. Hence the orders generally specify two areas, A and B, which the undertakers have marked out for supply. Section or area A is comparatively small, but large enough to enable the undertakers and the public to decide whether the lighting is successful. If it is successful the undertakers may proceed to light the larger area B. In other words, they undertake to experiment with A, and either give place to someone else, or in due time to proceed with B. Two years may elapse before the undertakers can be compelled to light part or whole of area B; then "any fifty owners or occupiers of premises situate in any part of the area included in B, which may be comprised within a radius of a quarter of a mile, and may not, for the time being, be included in the area of supply, may serve a notice signed by them upon the undertakers, requiring them to apply to the Board of Trade to direct that such part as particularly specified in such notice shall be added to the area of supply." Three months' grace are given to the undertakers to do the work, which may otherwise be removed and given to other parties.

Other clauses have reference to capital. The undertakers are to set apart within six months and secure a sum equal to "one-half the amount required to execute the works necessary for the supply" of area A, which supply is to be made within two years. The supply may be by the "parallel system," "series system," or any other system approved of by the Board of Trade, and two weeks' notice is to be given before the commencement of the supply. Distributing boxes may be erected and used, but must be of an approved pattern. A number of clauses specially relate to the operations of a company. In this case the undertakers have to give certain notices and follow certain regulations as regards the local authorities. With regard to the supply on the parallel system—which really seems the only one contemplated—the current is to be sufficient, at a constant pressure, and continuous, except by permission of the Board of Trade. The pressure is not to vary more than 5 per cent. from the standard pressure adopted. This standard pressure "may be different for different points of any main, and for different hours during the period of supply, but it shall in all cases be within the fixed limits"—in the case of continuous currents, not less than thirty and not more than 200 volts; in the case of alternate currents, not less than 50 and not more than 100 volts, the difference of potential in the latter case being measured by its maximum value during a complete alternation. The number of alternations per minute is not to be less than 600, unless by permission. The supply is delivered to two poles on the consumer's premises, past which points the undertaker's liabilities cease, and the resistance of the consumer's lines is to be such as will not degrade the pressure more than 2·5 per cent. A number of clauses refer to the appointment of inspectors and testing operations, as well as to compulsory supply. Three methods by which the charge is to be made are mentioned: (1) By the quantity of energy contained in the supply; (2) by the actual quantity of electricity supplied; (3) by the number of hours the consumer uses the supply and the maximum current supplied. Other methods may be used by permission. The meters used to measure the supply must be approved and certified. They may be hired from the undertaker or purchased outright, and must not be disconnected without due notice. The consumer is to keep his own meter in order; but, if hired, this work falls to the undertaker. The mains are to be well insulated with an insulation resistance of not less than 1000 ohms per mile run. The conductors are not to be connected to earth except by permission; nor is the current to exceed a fixed value per square inch of section of pure copper of equal conductivity, and the supply is capable of being turned off at some point outside the building. Safety cut outs must be used—easily accessible—to cut off the supply when the current increases more than 100 per cent. over the maximum intended current. If the supply to a consumer exceeds 50 Ampères it is to be taken from more than one pair of poles. Other clauses relate to the maximum potential allowance between points in the conductors, and between the conductors and earth, all framed with a due regard to safety from personal injury and from fire.

The Board of Trade clauses are as follows:—

(1) *The choice of the area of supply.*—The clauses with regard to this are framed on the supposition that a fair area should be included in Schedule A, in which the undertakers may make an experiment, and to which, if they find that experiment not sufficiently remunerative to induce them to extend their operations, they may be allowed to confine themselves; at the same time it is proposed that a further area should be included in Schedule B, to which the undertakers may, after feeling their way by their first experiment, extend their operations by degrees, subject to the right of the local authority, or, where the local authority are themselves the undertakers, of certain inhabitants, at any time to require the undertakers to forthwith extend their operations over any part of such area, or to resign their rights over such part. It is therefore suggested that local authorities in whose districts companies are seeking powers would do well to take care that the area proposed to be included in Schedules A and B respectively are such as may fairly be included therein, having regard to the future development of the supply of electricity within the district. If, owing to local circumstances, as, for instance, in the case of small towns, they deem it necessary to allow the undertakers to include in Schedule A all the most remunerative part of the district, it will be for them to consider whether they should not propose clauses for withdrawing some part of the area included in Schedule A from the area of supply if the undertakers decline to extend their operations beyond it in order to encourage other undertakers to come in and supply a larger area.

(2) *The question of capital.*—The clauses on this subject are only applicable in the case of companies. In such a case it is proposed that the undertakers should be required within six months to set aside and appropriate as a separate capital, for the purposes of the particular undertaking, such a sum as would appear reasonably sufficient to enable them to meet all probable demands for a supply in the area included in Schedule A; and in addition to this, and as a part of such separate capital, to deposit or secure to the satisfaction of the Board of Trade within the same period a sum of not less than one-half the amount which may be reasonably calculated as the capital necessary to enable them to execute the works which they are required to execute within two years in certain specified streets in Schedule A, and to supply electricity therein. Similarly, in the case of Schedule B, additional sums are from time to time to be added to the separate capital of the undertaking, and fresh sums to be deposited or secured in respect thereof as separate parts of the area included in Schedule B are added to the area of supply to such amounts respectively as the Board of Trade upon directing such additions to be made may prescribe.

(3) *As to the modes of supply.*—The parallel system is the system of supply adopted as the standard system in these clauses, and it is not proposed at first to give a right either to the local authority or to private consumers to demand a supply for public or private lighting on any other system; the provision is made that with the approval of the Board of Trade any other system may be substituted. Of course, by agreement any system whatever may be employed, provided that it complies with the regulations as to safety and otherwise, special provision being made in the clauses that if it is desired to supply at high tension for arc lighting or other purposes this may be done under special regulations.

(4) *As to time of supply.*—It is proposed that this should be continuous, subject to six months' grace upon first commencing supply, when the undertakers need only supply between sunset and sunrise, and to a power on the part of the Board of Trade to permit special intermissions for the purposes of testing or otherwise. It may, however, be well for local authorities to consider in every case how far continuous supply is desirable for their district; as, however necessary it may be thought in crowded cities, where artificial light may probably be in constant demand, where there is only a slight demand in the daytime, as in country towns, the small additional convenience may not improbably be more than counterbalanced by the much higher price which must almost of necessity be charged for electricity where there is a continuous instead of an intermittent supply.

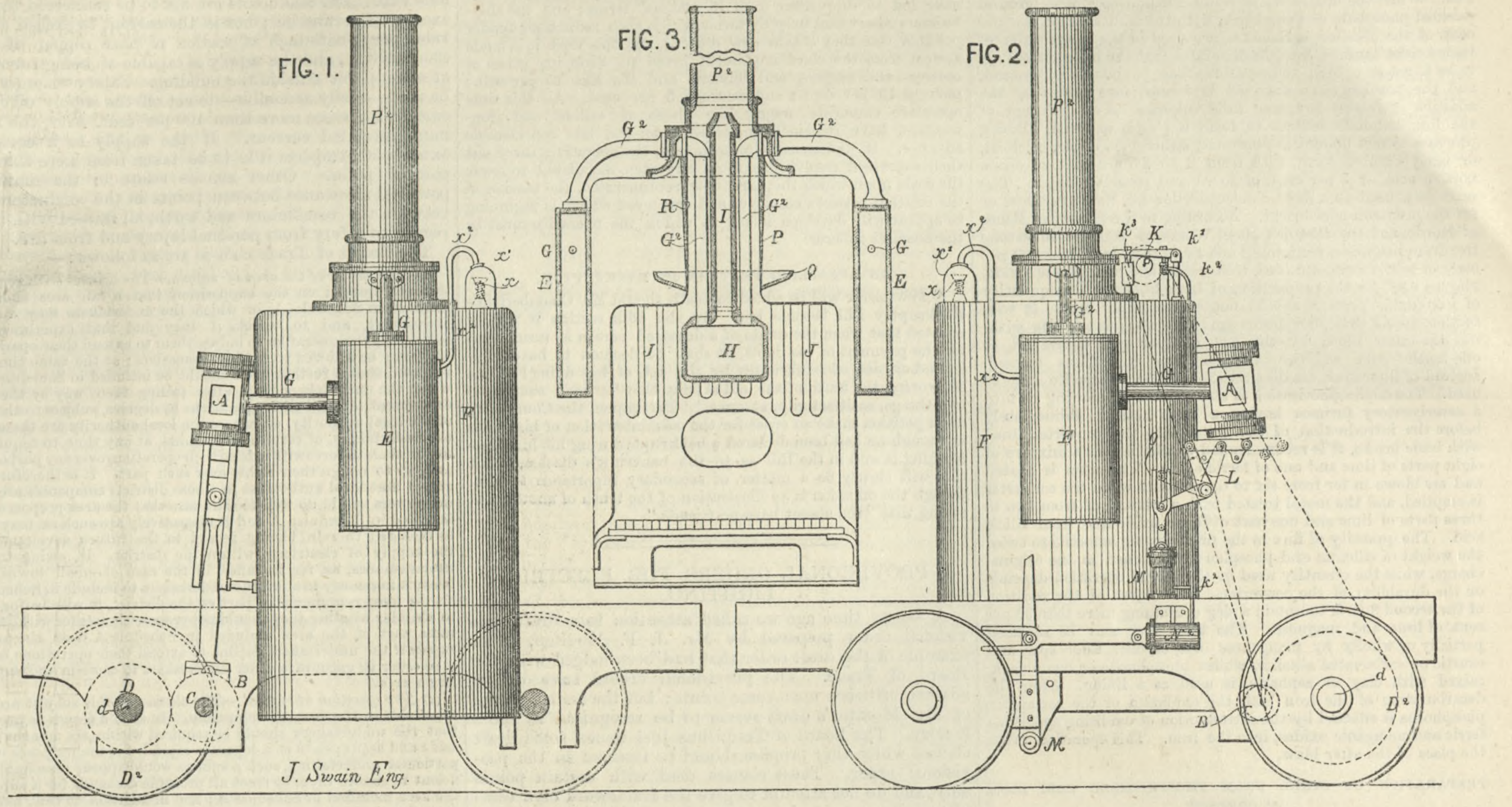
(5) *As to price.*—It is proposed that electricity should in all cases be charged for by meter, but as at present it seems doubtful whether there is any reliable meter for quantity or energy, a power is given to the undertakers to charge for the present, and until the Board of Trade otherwise direct, by the maximum current required, and the number of hours during which electricity is used. The latter, however, does not seem a very satisfactory mode of charging, and it is hoped it may soon be dispensed with, as there seems to be no doubt that meters for quantity and energy will soon be perfected for practical use.

(6) *As to limitation of profits, revision of prices, monopoly, &c.*—No clauses are inserted dealing with the above subjects. In the case of companies, the undertaking can be purchased by the local authority at farthest at the end of twenty-one years, at the then value of the plant. In the meantime, there is, in the first place, the competition with gas, which is likely to be very severe; and in the second place, the potential competition with other undertakers to keep down prices, as the Board of Trade see no reason whatever why such last-mentioned competition should not be an active and potent force. The accounts of the uudertakers are open to all. No monopoly is, under the Act or the Provisional Order, granted or intended to be granted to them; and should they neglect their duties in the district, or charge exorbitant prices, there is nothing to prevent the immediate grant of a licence or Provisional Order to a competing set of undertakers in the same district. In the case of local authorities there will be not only competition to look to, but also public opinion, and the Board of Trade prefer to rely upon the above considerations rather than to attempt to impose artificial restrictions, which in other cases have not proved too successful.

It will not escape notice that the rules appear to be specially framed in the interests of the makers of low tension dynamos. They would practically exclude such machines as those of Gordon and Ferranti. There is not as yet a highly efficient low tension machine in the market, though we may say that good machines, with an electro-motive force of but 64 volts, are being made. Possibly the framers of the rules had these machines in their minds when they were drawing them up. The lower limit, 30 volts, is simply an absurd superfluity, as a machine of such low tension is practically useless, save for limited incandescent lighting. Of course, the rules can only be regarded as provisional in more senses than one, and will probably be regarded as evidences of absurd ignorance in about five years.

THE WILKINSON TRAMWAY LOCOMOTIVE.

FIG. 1. FIG. 3. FIG. 2.



A GOOD deal of attention has recently been called to the performance of the Wilkinson tramway locomotive, and we illustrate it above. It will be understood, of course, that the boiler and machinery are housed in the usual way. Fig. 1 is a one side elevation, and Fig. 2 the other side. Fig. 3 is a vertical section, the framing and wheels being omitted. The engine has a vertical Field boiler. The engines have two inverted direct-acting vertical cylinders A, the piston-rods of which drive two cranks on the shaft B. The crank shaft is fitted with a spur wheel *c* gearing into a second spur wheel D keyed on the driving axle *d*, on which are also keyed the driving wheels D^2. These wheels are coupled to the trailing wheels. It is claimed that by this method of connection of the engines to the driving wheels, the galloping or jumping action of the engine on the road that would take place if the engines were attached direct to the driving wheel axle without the intervention of spur wheel gearing is obviated.

The steam from the cylinders is exhausted through the pipes G into two jackets E, fixed one on each side of the boiler F, as shown in Fig. 3, so as to be heated to the same temperature as the boiler. These chambers serve to superheat the steam after it is exhausted from the cylinders, thereby intercepting and partially evaporating any water that may pass with the exhaust steam into the jackets. From these jackets are led two pipes G 2, passing down and into the inside of the uptake P to the chimney P^2 of the furnace into a vessel H, made of cast iron or other suitable material, and suspended inside of the furnace by convenient stays or supports at any convenient distance below the foot of the uptake P, this chamber H acting also as a distributor of the heated gases amongst the tubes *j*. From this vessel a blast pipe I opens into the lower part of the chimney, thereby directing the exhaust steam which has passed into the chamber H up the chimney in, it is said, a perfectly dry, superheated, and invisible condition. The vessel H is exposed to the greatest heat of the furnace, and it is claimed effectually superheats and dries the exhaust steam, so that no water can be emitted from the chimney to the annoyance of passengers, and owing to the steam being expanded in separate vessels after leaving the cylinders of the engine, the pressure of the exhaust steam is thereby so much reduced as to minimise the noise of exhaust on reaching the chimney. The safety valves indicated at *x* are inclosed in a box x^1, from which pipes x^2 are led into one or each of the before-mentioned jackets, which reduces to a minimum the noise made when steam is blowing off from overpressure in the boiler. The waste water pipes from the cylinders are also led into the side jackets. All water caused by condensation is led from side jackets into a steam and water-tight tank.

A governor is employed, of the class known as "Allen's Paddle Governor," to reverse the valve gear of the engine, and to apply the brakes when a speed is attained higher than is allowed by the authorities. This is effected by means of an excentric cam K fixed to the shaft of the governor, so that the cam is turned by the governor, when a certain speed is attained, into such a position that it presses up a lever against the adjustable spring balance k^3, and opens a valve at k^1 against the pressure in the boiler, and allows water or steam from the boiler to pass up the pipe k^2 to the underside of a piston or hydraulic ram in the cylinder N, which is in direct connection with the lever of the reversing shaft L, and also admits steam or water to the underside of a piston or hydraulic ram in the cylinder N^2, in connection with the brake shaft M, thereby reversing the engine and applying the brake at one and the same time.

In the ordinary Field boiler the portion of the uptake or chimney which passes through the steam space at and above the water-line inside the boiler is liable to have loose scale and hard mud formed upon it by reason of the scum floating on the surface of the water becoming baked and attached thereto, and at times dropping off and choking or fouling the circulating tubes, and so interfering with the effectual circulation of the water, and thereby causing the tubes to burn out. To prevent this there is fitted on to the uptake inside the boiler, immediately over the tubes, a removable dish Q, made of iron, copper, or other suitable material, so as to catch and intercept any scale that may have been formed on and drop from the uptake, and prevent it from falling upon and into the tubes.

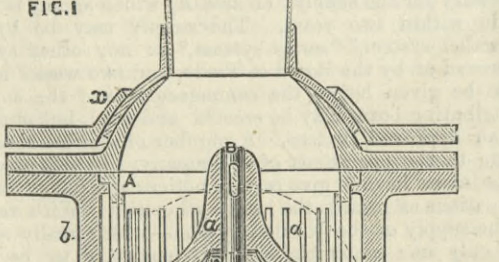
The uptake P, or lower part of the chimney passing through the steam space of the boiler, being subjected to a very high temperature in ordinary boilers, wastes away very much more rapidly at this point than any other portion of the boiler. To prevent this it is protected by fitting a casing preferably of wrought or cast iron inside the uptake, where the same passes through and above the water line of boiler, as shown at R, between which casing and the uptake P an annular space is formed, which is filled with fire-clay.

It will be seen that this invention is, like many others, a combination of old devices. Thus vertical boilers have been used in road locomotives by Chaplin, Thompson, and others. Vertical geared engines have also been used by many inventors. The getting rid of exhaust steam by superheating it has been practised for many years. An example will be found in Moreland's steam roller, working in St. James's Park. The employment of quieting chambers to keep down the noise of exhaust steam is old. The novelty consists in the combination. The idea of using geared tramway engines is, of course, not new; but it has much to recommend it, and the system of disposing of the steam by superheating it is, it is said, much to be preferred to the plan of condensing it in water tanks.

FOG-SIGNALLING APPARATUS.

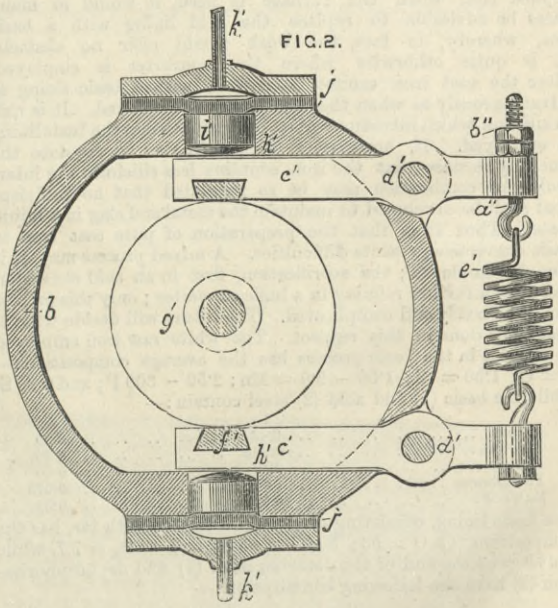
WE gave in our issue for 16th February an illustration showing a perspective view of Prof. F. H. Holmes' patent "Siren" fog signal apparatus, and the machinery for operating it, as constructed by the Caloric Engine and Siren Fog Signal Company, of London; we also gave a brief description of the use and objects of the invention, and promised some details in a future number.

FIG. 1



The apparatus consists essentially of (1) a pair of "Buckett" caloric engines, having pumps for compressing air; (2) a large vessel for receiving the compressed air; (3) automatic gearing for opening the valves at given periods of time, and sounding the signal; and (4) Professor Holmes' patent double note "Siren" fog horn. We understand the company is in negotiation with the Commissioners of the Great International Fisheries Exhibition for the erection of a special building in the grounds of the late Horticultural Society, at South Kensington, in which to place a complete set of apparatus of this description, so that our readers may have an opportunity not only of seeing the machinery in operation, but of having undoubted proof of the power of the Siren as a sound-producing instrument, for it is capable in calm weather of being heard at a distance of twenty miles. The arrangement of apparatus we illustrated is for light ship or signal station use, where the Siren can be placed in proximity to the engines, but there are many places in which it is necessary to separate them by a considerable distance, in which case other means than those we have to describe are adopted for operating the Siren automatically. We are informed that the Commissioners of the Northern Lighthouses propose to place a powerful fog signal on each side of the well-known Ailsa Craig in the Firth of Clyde. The Craig is a precipitous rock, having at one point only a small strip of land upon which it would be possible to erect machinery, but this is separated by about three-fourths of a mile from either of the points where the proposed signals are to be erected, some doubt consequently arose as to the possibility of conveying compressed air through two pipes, each three-quarters of a mile long, and automatically sounding the Siren. Before, therefore, the Board of Trade would authorise the work to be commenced, they required proof that it could be done, and the company's engineer, Mr. Charles Ingrey, undertook to supply it, by conducting a full-sized experiment at the Isle of Pladda, near Arran, where there happen to be caloric engines and air pumps suitable for the purpose. The pipes were laid around the rocks

FIG. 2.



of this little island, and in less than a fortnight were complete, and proved to the satisfaction of the inspecting engineers. The importance of the establishment of these fog signals at Ailsa Craig cannot be overrated, and when erected will be an inestimable boon to navigators. We hope at some future time to be able to give a description of the manner in which this difficult piece of work is carried out, but we will now proceed to describe the apparatus at present referred to, which is intended to give a signal consisting of three sounds repeated in quick succession after an interval of 115 seconds; that is to say, the three notes, and their periods of rest, are given once in every two minutes—this arrangement of time can, of course, be varied as required. The Siren is made to produce a high, shrill note, somewhat similar to, but much stronger than a whistle, also a low note, such as from a deep and powerful horn. The three notes constituting the signal consist of two low notes and one high, or two high and one low, arranged to sound in the requisite order to produce the desired signal, which is intended to be not only quite distinctive from the signals emitted by Professor Holmes' Sirens on board men-of-war, but also to make known to the mariner the particular station from whence the signal emanates.

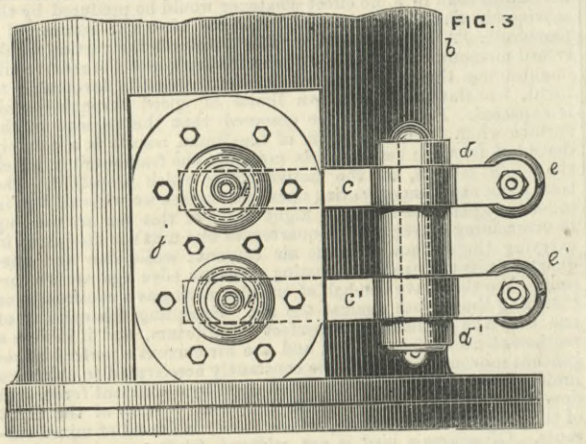
This will be better understood by assuming a series of stations around a coast, each series being consecutively numbered or termed respectively *a*, *b*, *c*, *d*, *e*, *f*, and supplied with the double note apparatus. The following might, therefore, be taken as an example of how each station of the series might, by using a different combination of the three soundings, give forth a signal of a distinctive character, thus :—

Station			
a.—High note.	High note.	Low note.
b.—High	Low	High
c.—High	Low	Low
d.—Low	Low	High
e.—Low	High	Low
f.—Low	High	High

The next series would commence again at *a*, but the distance between it and the preceding station *a* would be so great as to quite prevent any confusion, for the mariner would have to be a very long way out of his reckoning if he mistook one for the other.

The Siren produces its powerful sound by means of two slotted cylinders, one fixed, the other revolving within it. The slots as they pass one another stop, or cut off the passage, of compressed air or steam, and thereby cause a series of vibrations, and consequently a musical note, the pitch of which is determined by the speed of revolving slotted cylinders. In order, therefore, to vary the note it is only necessary to govern its velocity. To accomplish this, Professor Holmes by one of his arrangements, forms his double-note Siren as shown in the sectional elevation, Fig. 1 :—*b* is the casing; A, the fixed

FIG. 3



slotted cylinder, and *a* the revolving slotted cylinder, which has attached to it the spindle B, carrying two discs *g* and g^1. The air or steam enters by the ports E and passes through the slots of the cylinders to the horn, in the direction shown by arrows. The slots are cut in each cylinder at opposite inclined angles, so that the motive fluid impinging against a number of inclined planes causes the inner cylinder to revolve with great rapidity.

As the cylinder *a* revolves, it also turns the two discs *g* and g^1 upon the peripheries of which the bearing surfaces of levers $c\ c\ c^1\ c^1$, Fig. 2, press, under the action of the small pistons $i\ i\ i^1\ i^1$. These pistons are operated by diagrams, to the outer side of which compressed air is admitted to the spaces — — — —. When the high note is required, only one brake is put into operation, but when the low note is to be sounded both brakes are to be used, by which means the speed of the revolving cylinder is reduced. When the notes are being sounded, the pressure of air in the air receiver, of course, diminishes, but as the air for operating the diaphragms comes from the same source, the force exerted on the brakes lessens in the same ratio, and the friction on the discs $g\ g^1$ being reduced, the cylinder continues to revolve at a uniform speed; the pitch of the note is therefore maintained. This is of great importance. The ball-and-socket joint *x* at the top of the Siren is for enabling the horn F to be turned in various directions and set at any required angle.

The automatic arrangement by which the Siren is operated is shown in the engravings, Fig. 3, 4, 5, 6, and 7:—The end of the crank shaft of the engine is formed with a screw P, which engages with a worm wheel *o*. Upon this worm wheel is bolted a cam q^2 having short and long projections—that shown has one long and two short. The short projection opens the small valve R and the long projections open not only valve R, but a second valve R^1. The valve R is connected by a copper tube with the starting valve box *t* of the Siren, which in its turn is connected by a pipe with the diaphragms of the first brake A. When, therefore, the cam opens the small valve R, air from the receiver *m* passes to a diaphragm on the top of the starting valve box *t*, and the area being greater than the starting valve, the pressure at once opens the latter and admits a volume of compressed air into the Siren, at the same time also allowing a small quantity of air to pass to the brake A. The Siren, therefore, having only the resistance of one brake to overcome, revolves at the requisite speed to produce the high note. When the long projection in the cam strikes the second valve R^1, air passes by the pipe k^1, and operates the second brake, so that the extra friction reduces the speed of the revolving part of the Siren and produces the low note. It will, therefore, be understood that according to the shape of the cam, or, *i.e.*, according to the order in which the long or short projections are used, see forms in Fig. 7, so is the high or low note formed, the spaces between the projections giving the period of rest between each note, and the time occupied in the revolution of the worm wheel, giving the interval of silence between each signal. The caloric engines which are used to operate the apparatus are of great interest, embodying, as they appear to do, improvements in this system of obtaining motive power of a remarkable character.

The "Buckett" engine has been used for some time in connection with Professor Holmes' apparatus, but it is only now being brought before the public as an engine for general purposes, by the company which has been lately formed to develope it. The engines in this particular instance are of horizontal construction, this form being necessary for light ships where the height 'tween decks would not allow of the vertical form.

Fig. 8 below shows the general arrangement of the engine: *a* is a wrought iron generator lined with fire-bricks, between the outer sides of which and the inner sides of the generator is an annular space, *b* is a door through which the fire is lighted in the first instance, and *c* a door from which the ashes are removed before starting the next day. Air is forced into the generator

FIG. 5.

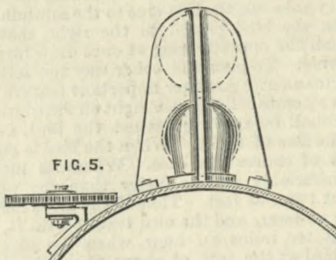
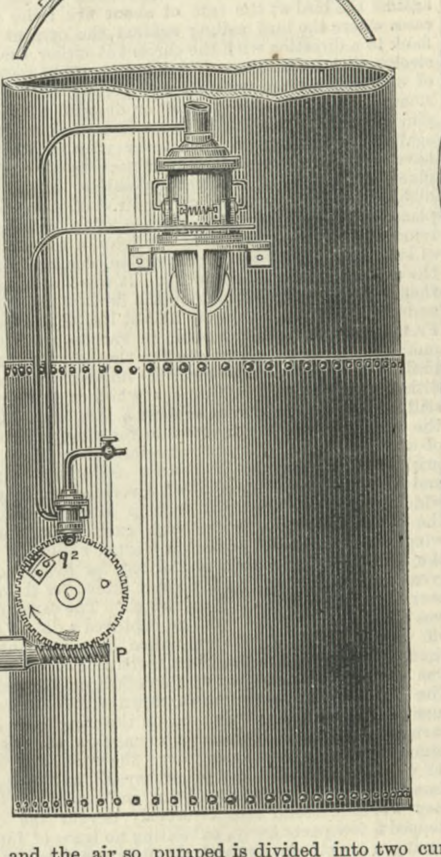


FIG. 6



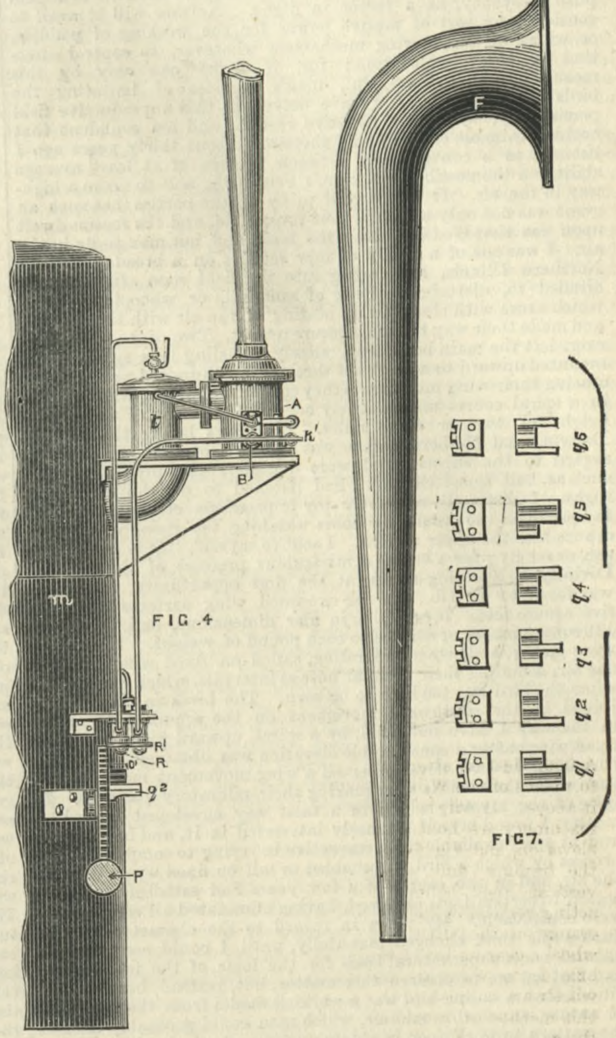


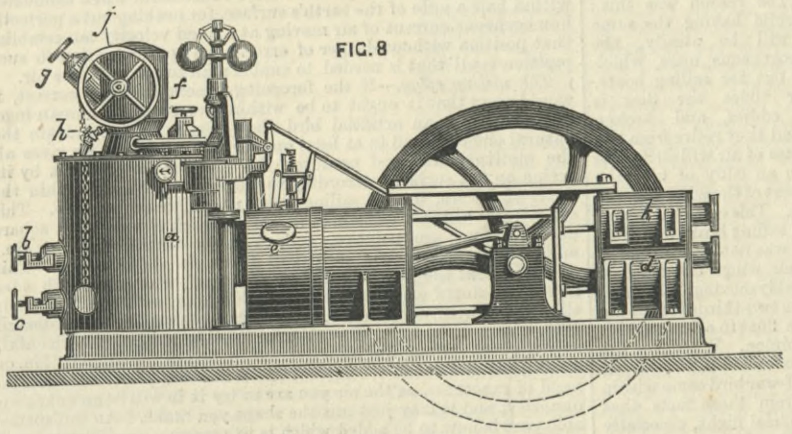
FIG. 4

FIG. 7.

by a pump *d*, and the air so pumped is divided into two currents, one passing into the annular space referred to, whence it descends beneath the fire bars, and so through the fire, the other passing into the upper part of the generator above the fire, where the oxygen enters into instantaneous combustion with the carbonic oxide formed by the air which had previously passed through the fire. The intense heat causes expansion, or rather compression of the air, and a valve allows a portion of it to enter the cylinder *e*, where it expands and operates the piston, and so gives motion to the engine, a second valve opening at the proper time to allow of the escape of the hot air on the return stroke. The governor of the engine is so arranged that it determines the quantity of air to be admitted below or above the fire, so that according to the force being given out by the engine, the rate of consumption of fuel is regulated and the speed maintained. The generator is charged with fuel from time to time, without interference with the running of the engine, and with but a very trifling loss of pressure. The upper part of the generator *a* supports a fuel chamber *f*, into which coke is passed through the door *g*. After the fuel has been introduced, this door is closed, and a small cock *h* is turned on; this allows a small quantity of compressed air to pass from the generator into the fuel chamber, and to create an equilibrium of pressure upon the top and bottom of a conical feed valve which depends from a chain connected to a pulley inside the fuel chamber. When, therefore the wheel *j* is turned round, the cone descends over the fire, and the coke is free to fall.

The cone being drawn up, the cock *h* is turned off and the door *g* removed, when the pressure in the generator keeps the cone tight up to its seating, and prevents escape of pressure. The pump *k* is for supplying the compressed air to the receiver for operating the Siren.

FIG. 8



THE "BUCKETT" CALORIC ENGINE.

AN AMERICAN RIVER STEAMBOAT.

ON the 15th instant a new steamboat, claimed to be the largest cargo boat in the United States, arrived in New York, from Fall River, on her trial trip. We learn from an American contemporary that in her design and build and in the application of her propelling power, together with many other essential appliances for her navigation, there has been a radical departure made from the conventional system of river steamboat construction. Her hull was built at Chelsea, Mass., and her machinery at the North River Ironworks, New York. This steamboat has been constructed especially for the transportation of freight.

The hull is built of wood—oak and hackmatack frame, with oak planking, clamps, stringers, &c. It is 260ft. long—273ft. over all—42ft. 4in. beam—73ft. wide across the sponsons—and 17ft. depth of hold. Her register tonnage is 2533 gross, 1723 net. A novelty in her construction is the absence of the conventional hog frame. In its place, however, and to obtain the requisite longitudinal vertical rigidity, a Howe truss—bridge frame—has been built in her hold, in which there is room to spare, as only the engines and boilers are intended to occupy the major portion of its capacity. The upper chord of this truss, which is about 200ft. long, fore and aft, supports the deck beams, and the lower chord is bolted to each frame. Additional longitudinal strength is supplied, too, by a network of iron cross strappings on the inside of her frame. These diagonal straps are of flat iron, 4 × $\frac{5}{8}$, and are connected to an iron belt plate 6 × $\frac{3}{4}$, which extends clear fore and aft parallel to and behind the clamp strake. This cross bracing runs downward to and is fastened in the floor timber heads. The interstices between her frames are filled in with white pine, navy fashion, and the joints caulked, thus making her floor solid from stem to stern. Her ceiling is caulked also, that her compartments, of which she has four, may be truly watertight. She has three watertight bulkheads, the first, or the collision bulkhead, being 20ft. abaft the stem; the next one going aft, just forward of the forward boiler; the next just abaft of the after boiler. Her main deck, or freight deck, is laid in yellow pine caulked, and sheathed over with $1\frac{3}{4}$ spruce. Between this deck and the upper deck is where all the freight will be carried, and its capacity in bulk is estimated at eighty large car loads, all of which is secured and isolated from every other portion of the boat, and, as all "working ship" will be done on the upper deck, she is, in fact, a floating warehouse.

She is propelled by a compound vertical beam engine with a surface condenser. Its two cylinders stand fore-and-aft in a line with its beam, and at one end, while the connecting-rod and the air-pump are attached to the other. The low-pressure cylinder, being the farther out, has the longer stroke, and the connections between the two have been so arranged that, should the engine not prove as is desired, the high-pressure cylinder can be removed, and steam taken directly from the boiler by the low-pressure cylinder. The cylinders are—low pressure, 68in. in diameter; high pressure, 44in. The strokes are 12ft. and 8ft. respectively. She is fitted also with an independent donkey steam pump and boiler, which combination can either "pump ship" or be used as a fire-engine, throwing four large streams of water. When carrying 65 lb. of steam pressure the main engine was run up to 30 revolutions, and its working was a revelation to old steamboat engineers, who had never seen beam engines of so long a stroke (12ft.) go faster than some 16 or 17 revolutions per minute. Its indicated horse-power is 2400, and at the present time it is the only marine engine of its type now afloat.

The boilers are of the Redfield return tubular type, of which a few are in use now on the Hudson. There are two of them, one placed forward and one aft of the engine. They were built of steel $\frac{1}{2}$in. thick, and have been tested at 150 lb. hydrostatic pressure per square inch. Their intended working pressure is 80 lb. per square inch. They have double shells, and are $17\frac{1}{2}$ft. wide and 15ft. long, the inside shells being $7\frac{1}{2}$ft. diameter. Each shell contains 110 $3\frac{1}{2}$in. tubes 12ft. long. The superheater to each boiler is 12ft. high, with 8ft. outside diameter and 4ft. 8in. diameter inside. This type of boiler we understand is in high repute in New York.

Feathering paddle-wheels are turned by this novel engine, of which a few only are in use now in the States in Southern waters. The floats are 3ft. 4in. wide by 10ft. long. They have been built with extra strength, to withstand the ice and rough water of the winter season. The maximum speed obtained already, when the boat was light, was $17\frac{3}{10}$ knots per hour, and her average speed in all kinds of trim is calculated to be not less than $15\frac{9}{10}$ knots an hour. Speed is required in her special trade. She is fitted with a steam windlass and capstan, and steam steering gear, the invention of Mr. F. E. Sickles. The estimated cost of the City of Fall River is 250,000 dols., or over £50,000.

TORPEDO BOATS.—Messrs. Yarrow and Co., of Poplar, have just completed four second-class torpedo boats for the Admiralty, the last of which was tried on Thursday at Long Reach, on the Thames, in the presence of Mr. Allington and Mr. Andrews, of the Admiralty, and Mr. Maiston, of Portsmouth. Formerly the conditions of trial were that these small craft should be put through six runs at the measured mile, but as this test of endurance was not considered a sufficient guarantee against subsequent breakdowns, they were afterwards required, previous to acceptance, to pass through an ordeal of two hours' continuous full power steaming, loaded, during which the customary runs were to be made upon the mile. At the trial of Thursday a speed of 17·27 knots was realised, the greatest which has yet been recorded of any second-class boats under the new conditions. The boats are provided with forward steam impulse gear, for discharging Whitehead torpedoes from the bows, as originally proposed by the firm in conjunction with Captain Gordon, of the Vernon, and are to be despatched forthwith to Portsmouth for trial of their torpedo fittings.

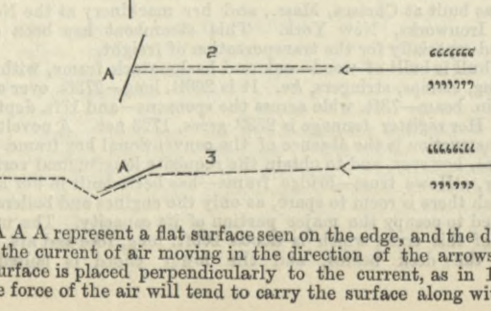
THE FLIGHT OF BIRDS.

The following paper on the flight of birds has been sent us by the author, Mr. J. Lancaster, of Wabash-avenue, Chicago, U.S.A. It contains several statements concerning the flight of birds which deserve the attention of those—and they are numerous—who are interested in an unusually attractive mechanical problem :—

The theory of flight here given stands upon its own merits. It is based upon a multitude of facts, any of which can be verified without difficulty; and until these are shown to be unreliable, the theory seems to me to be impregnable, as it explains them all. I wish the reader to dismiss from his mind all notions of balloon-supported weights, or the use of any gas lighter than air to accomplish buoyancy, as a factor in flight. Neither will it avail to consider any sort of motive power for the working of paddles, or wings, or any moving mechanism whatever, to control direction or effect translation; for, if flight can only by this means be made successful, man's chances of imitating the birds is indeed small. I have delved in this unproductive field persistently, with only negative results, and am confident that nothing valuable can be found therein. About thirty years ago I listened to a conversation between persons of at least average ability on the possibility of man's ever being able to make a highway in the air. It was agreed to by all the parties that such an event was not only unlikely, but impossible, and the reason dwelt upon was that God had made the birds and not man to fly in the air. I was one of a family of new settlers on a broad prairie in Northern Illinois, and, going into the field soon after the talk alluded to, disturbed a flock of sand-bill, or whooping cranes, which arose with slow, steady beating of the air with their wings, and made their way to a more secure retreat. Two of the flock, however, left the main body, and, slowly wheeling in a spiral flight, mounted upward to a height of three or four hundred yards, when, ceasing their wing movements they continued their upward motion in a spiral course until entirely beyond the limits of vision at a height of two or three miles. This was before the time of Darwin, and Herbert Spencer was unheard of, and my views in regard to the supernatural were doubtless the prevailing ones, such as had toned the talk I had listened to on the subject of flight. I distinctly remember my impressions of the scene as I lay prone on the ground for hours watching the rising of the two cranes into the upper regions. I said to myself, "It is true; man can never fly; for a bird is a miraculous product of the hand of Divinity." Shooting a crane at the first opportunity, its weight was found to be 9 lb., and its extended wing surfaces measured five square feet. It was 6ft. in alar dimensions, and there was 110 square inches of surface to each pound of weight. The cranes were plenty, and, when migrating, sailed on fixed wings high in the air, sounding their peculiar note at intervals, which was audible when the bird was too high to be seen. The birds in the vicinity joined in the southward movement on the approach of winter in the way I have indicated, by a spiral, upward flight, made on fixed wings after a considerable elevation was obtained by beating the air, and I have never observed a wing movement made at any time while these birds were making their migratory passages. In spite of the mystery which in a tacit way enveloped the whole matter, I found myself intensely interested in it, and in all ways, and at every available time, was active in trying to comprehend the process by which a bird was enabled to sail on fixed wings through the air, and in the course of a few years had satisfied myself in regard to certain facts observed, having eliminated all errors which were conceivable. My views in regard to the character of flight during this time changed materially, until I could see neither a natural nor a supernatural basis for the logic of the talkers who had first set me to observe this matter, but, instead, became convinced that a sailing bird was a working model from the workshop of nature launched in mid-air, which man could profitably take as the pattern to work upon in obtaining atmospheric dominion. It is needless to recount my experiments, as they were overshadowed in importance by what followed, and I simply indicate that I succeeded in establishing to my own satisfaction

These propositions :—(1) Sailing birds can maintain themselves on rigid wings for any length of time in the air, either in a calm or moving condition of the atmosphere, and translate themselves at will, either with or against the current, or obliquely to it, or either up or down. (2) They do this without fatigue. They travel with great velocity through the air with no more effort than sitting on a chair requires of a man, or perching on a tree demands of a bird. (3) Throwing the observed facts into a mechanical statement, they assume this form—viz.: that a given weight, say 9 lb., distributed in a nucleus flanked by flat surfaces, the whole in the shape of a sandhill crane, may be sustained in free air by means of some relation existing between itself and the atmosphere independently of any motive power exerted by itself whatever. Now the vital question, how is this done, if answered, will, *à priori*, give to man dominion of the air. I say *à priori*, for it is possible that there may be a change in the rule of operation after a certain limit of weight and extent of wing surface was reached which would bar the ponderous body of man from the benefit of the causes which make possible the flight of the crane. It is hard to imagine any such condition of things; still the reservation is a pertinent one, and must be made. I progressed no further than this point for twenty-five years. That the bird could move against, or with, or obliquely to a current of free air on immovable wings, totally unsupported from without, was a fact continually before my eyes. How it was done was a conundrum only to be given up. For myself, it was useless to attempt any direct experiment to accomplish flight, for if a model set before my eyes, which appeared perfectly to perform all that could be wished for, having complete dominion of the airy kingdom, was still so far beyond my comprehension as to present no clue as to how the thing was done, it would be absurd to endeavour to effect my object by a trial of chances without I had an infinite amount of time to work in. It is true I carved cranes out of wood and launched them in air only to see them go to swift destruction. I killed, and skinned, and stuffed the actual bird; with great care weighted the effigy as I found it in life, only to see it made a toy of by every breath of wind; but was not at all disappointed by these results, for I had fully anticipated them, and until some sort of explanation as to how the actual bird could perform its feats was obtained, I did not expect to make the first step towards success. About seven years ago I found myself without an occupation and without a family, when it seemed that my duties to others presented no objection to giving my time to the solution of this problem. I went to the gulf coast of south Florida, well down toward the capes, and resided there for five years continually, in the very paradise of sailing birds, where their habits the whole year round are well adapted to observation. The climate of this part of the country is very mild and delightful, summer and winter, and the perfect sterility of the soil and insular position warrant a healthy condition of things, so that one can live very closely to nature and not suffer. The cranes are plentiful, but their habits are not suited to observation; the carrion vulture, widely known as the turkey buzzard, and the man-of-war bird, being the best for the purpose. The buzzards exist in great numbers, are not alarmed at man's approach, and are a much finer bird than the same species further north. They run to feathers more, and are more cleanly in their habits and much larger. They will stand over the beaches of the mainland at heights of from 30ft. to 100ft. for days together on motionless wings, and a steady breeze of from five to fifteen miles an hour blowing against them. At intervals they will wheel on either flank and pass for a mile either up or down the beach, or rise to an equal height and return, with no other object than to enjoy existence. These birds weigh from 4 lb. to 6 lb., and have a wing surface of about four square feet. The man-of-war bird is the most stylish of any of the sailing varieties. They weigh about 4 lb., and are from 6ft. to 8ft. in alar dimensions, with about four square feet of wing surface. Their pinions are longer and more narrow than either the buzzard's or crane's, and they have a power of translation through the air which far transcends the buzzard's utmost effort. They float at heights of half a mile or more, and only when the wind is very high or unsteady do they stoop to the level of the buzzard. Now what do these birds reveal? I asked of myself. That they can stand motionless in moving air can be seen at once, for one can lie prone on the ground and gaze at the buzzards for days, at a distance of 30ft., and many times I have touched them by suddenly stretching out my hand. They are from 5ft. to 7ft. from tip to tip of wings, and their slightest movement can be detected. I here made several new discoveries, which it was not possible to make further north, where the habits of the birds are different. The movements required to change the direction were among the most important of these, as they gave me the first clue to the solution of the main question. When the bird passed to the right, that wing was flexed slightly, when the opposite wing at once drew forward, wheeling on the flexed wing. To pass the other way the left wing was flexed, in a similar manner. Another important feature I have found to hold good in all cases. To sustain flight on flexed wings, it is required that the air shall be moving against the bird, *i.e.*, in a direction opposite to its line of flight. When the bird is moving against the wind this is of course the case. When its motion is with the current, it invariably travels faster than the wind is blowing—usually about twice as fast. Thus if the air is moving at the rate of five miles an hour, and the bird travels with it, its rate of speed will be about ten miles an hour, when the air will be blowing against the bird at the rate of about five miles an hour. In all cases where the bird sailing against the current wheels on either flank to a direction with the current it either beats the air a few strokes with its wings or descends to a lower level at the moment of making the turn, until a speed greater than the moving air is attained, when it can ascend or descend at will on motionless pinions. When the air is calm it is obvious that it will blow against the moving bird, whatever may be its line of flight. I have never seen a bird stand in motionless air on fixed wings in one place, and believe such a feat impossible. A sailing bird can attain high speed in perfectly calm air. On one occasion I had placed a barrel over the carcase of a catamount, which was removed the next morning at daylight in expectation of an arrival of buzzards. They were soon visible, coming from every point of the compass with great velocity. It was a dead calm, and I timed them from their appearance on the limit of vision till their arrival, and estimated their velocity at not less than two miles a minute. From many observations made in various parts of the country a motionless state of air seems far the best for the flight of sailing birds, yet, practically, to meet the imperative demands of the conditions of flight, it is indifferent whether the bird moves against still air, or the air moves against a still bird. It is seldom that the conditions are all favourable for close observation of a man-of-war bird, yet on one occasion everything was right. A brisk westerly breeze of twenty miles an hour was blowing, and a splendid specimen stood overhead at fifty feet distance, which was certainly eight feet in alar dimensions. Suddenly the bird seemed to quiver with excitement, and extending its wings to their fullest extent it darted obliquely upward against the wind over the waters of the bay for five hundred yards with great velocity—how fast I do not know, for the whole affair was over before I could consult my watch. The cause of the escapade was apparent. A fish-hawk had captured a dinner and was making off with it, when it was overtaken in a moment, and the booty changed owners. I noticed in a multitude of cases that this flight was attended with no discoverable effort on the part of the bird. The buzzard would retire at sundown to an old tree and keep up a turmoil half the night and be on the wing again at daylight. I have seen a hundred buzzards remain on the wing for fourteen hours continuously hovering over the carcass of a dead fish, in the vicinity of which I had placed myself, and facing for the whole time a breeze of ten miles an hour, and after their long day's work they would descend and vigorously devour the carcass when I stepped a few paces away, exhibiting no trace of fatigue, thus confirming a conclusion arrived at many years before that flight of this kind was attended by no exertion on the part of the bird. It was sometimes the case that the buzzards, after enjoying themselves in the air the greater part of the day, would gradually become restless—flexing and extending their wings, elevating and depressing their tails, passing up and down the beach, and finally upward for a thousand feet as if they were very much disturbed. Finally one by one they wheeled inland and disappeared until not one was visible in any direction. On looking above to the level where the man-of-war bird was used to disport itself, the space was likewise tenantless, and not a sailing bird of any species was seen within the limits of vision. There appeared no cause for this. The breeze was still blowing seemingly unchanged in character. The sun shone in a cloudless sky as usual; the temperature was delightful, and the warm glow made existence a pleasure. Why this escapade on the part of the birds? The reason was this: Moving air differs greatly in character while having the same general velocity. At times the flow will be steady, the whole body moving alike, as one homogeneous mass, which is the best condition not only for birds, but for sailing boats, as I afterwards discovered. At other times the flow is made up of innumerable whirls, and eddies, and broken currents, which fill the birds with disgust, and they retire from the field. A whirl of twice the velocity of the mass of air will strike one of extended wings while the other will be in an eddy of half the velocity, and if it were not for quick adjustment of the wing surfaces by the bird it would in an instant be capsized. This enforced labour is distasteful to the do-nothing habits of the sailing birds, and they quickly retire and wait for better times. It was noticeable that in light, easy-flowing winds the birds keep their wings extended to greater tension than when the air was more briskly moving. The man-of-war bird habitually floated with no more than two-thirds of its wing surface utilised, and the buzzards would often float in a breeze with half of their wing surface folded in a flexed pinion. Whenever the birds wished to move rapidly the wing was extended to its utmost, which could be readily seen whenever a man-of-war bird came within range of close vision. It is presumable from these facts that balancing will be the difficult region of artificial flight, especially the retaining of equilibrium in broken currents of air. As I have here intimated, the experiments up to this time, excepting those made to verify observed facts, were barren of direct results, and the only valuable materials obtained were made by direct observations of the living birds themselves in their native element. From the facts thus obtained I framed the following theory of flight, and there is no movement of sailing birds which I have ever observed that can not be fully explained by it.

Theory of flight.—To present properly the subject a diagram will be required. The theory is based upon the action of moving air upon flat surfaces.



Let A A A represent a flat surface seen on the edge, and the dotted lines the current of air moving in the direction of the arrows. If the surface is placed perpendicularly to the current, as in 1, the whole force of the air will tend to carry the surface along with it. If it is placed at an angle of 45 deg., as in 2, half the force will carry it along with it, and half will raise it in opposition to gravity. If placed as in 3, a very much greater amount of force will be exerted to carry it against gravity than to carry it along with the current of air, and the forward thrust along the rear edge of the surface made by the air in returning to the path from which it was deflected by the surface will be greater than the whole force with which it is urged along with the current. The consequence is that the surface will be sustained in the air and move against the current. There are various conditions to be observed to produce this result. Within certain limits the width of surface must be properly related to its length, and both to the weight of the surface. There is also a certain angle of inclination of surface to the air current which, with a given width and length of surface and weight, will produce the maximum results of upward and forward movement. There are, however, no exact conditions required. There is a generous surplusage of upward and forward thrusting which is ample for all the purposes of practical air navigation. The whole business of flight on fixed wings is thus explained. The darting forward of the man-of-war bird at the extension of its long wing surfaces; the wheeling of the buzzard on its flexed wing; the tense extension of the wings when rapid flight was produced, and the lack of fatigue in the flying bird, are all explained by this theory. The entire motive power is given by the air. The bird is called upon to make the slight motions to control direction and maintain equilibrium, and nothing more. Mark how perfectly adapted the surface is to the requirements of flight. If it is inclined a trifle more to the horizontal than in 3, no effect whatever would be produced by the moving air, and the weight would descend after the manner of a parachute. A slight inclination from 3 towards the vertical would retard momentum at once and throw the surface to the rear; while maintaining the inclination of maximum results favourable to flight, translation to unknown limits of speed through the air is expected. For it is to be observed that the passage of the surface when in the position of maximum results is absolutely devoid of friction; for the air is not only the framework in which the weight is held, but the motive power which propels it. The total amount of energy acting upon the surface we will call ten, in order to explain the matter. Eight units of this ten are used up in overcoming gravity; three-quarters of one unit are dissipated in carrying the surface with the air current; while one and one-quarter units are used in thrusting the rear edge against the current. We thus have one-half of one unit acting as a constant force thrusting the surface against the air. Excepting this one-half of one unit the surface is in perfect equilibrium, and if it were a mathematical surface indeed, and the air current a perfect homogeneous movement, it would be constantly accelerated to unknown limits, for it would be a body acted upon by a constant force, and devoid of friction. This explains the great velocity of the flight of the salling birds in a calm, where the air is devoid of mixed currents. Of course a bird is not without friction, as parts of the head and beak must produce it as well as the thick front edges of the wings. Yet their shape is well adapted to deflect the air-current into one of the differential factors concerned in flight. The disturbed character of moving air is, however, the great impediment to perfect flight. I have witnessed portions of days when the measured velocity of wind would not be over ten miles an hour, in which it was clearly impossible for a sailing bird to maintain itself in the air. The position of maximum results was so greatly interfered with by the necessity of incessantly changing the extent and inclination of the surfaces to maintain equilibrium in the agitated and conflicting whirls and eddies which composed the body of moving air, that flight became too difficult even for a bird. I think it reasonable to suppose that man would long since have penetrated the secret of flight had it not been for this peculiarity. In the numberless chance trials that he has made, the clue would have been seized had not the conflicting currents so obscured the real issue as to keep it invisible and prevent all fruitful thought. Certain it is that the wind at or near the surface of the earth is ill-fitted for sailing birds to travel on fixed wings, and artificially-produced currents are totally unfit to experiment with in any manner whatever. I procured a steam engine during my Florida experience in order to determine the rule of maximum results of the action of air on flat surfaces, but found that the current when utilised, either on the exhaust or pressure side of the fan, was unfit for the purpose. It did not resemble a current of air at all, and a bird could no more maintain flight in it than in a vacuum. The only position that I found available was the top of a pine tree standing near the coast, or the roof of a building similarly situated, where the flow of a steady breeze was uninterrupted by any obstacle, and the further I succeeded in getting from the ground the better was the condition of the air. I never satisfied myself in regard to what the position of maximum results was, and believe that no experiments intended to establish that position can be successful when conducted within half a mile of the earth's surface, for nothing but a perfectly homogeneous current of air moving at a fixed velocity can establish that position without danger of error. An approximation to such position is all that is needed to enable man to navigate the air.

The sailing effigy.—If the foregoing conclusions are correct, it would seem that it ought to be within the scope of human ingenuity to make an artificial bird that would so far imitate the natural one as to sail in at least one direction. If the air gives all the motive power and produces the phenomena of flight by its action on flat surfaces, according to fixed rules entirely within the order of nature, then a sailing effigy ought to be possible. This can readily be made as follows :—Take a stick of wood 1in. square and 18in. long, and point one end. Slit the other end 3in. or 4in., and insert a piece of stiff cardboard 6in. wide and 1ft. long. This will represent the body and tail of the bird. Fasten on both sides near the pointed end a tapering stick 2ft. long, with the outer ends slightly elevated, and fasten to these and the body a piece of cardboard 10in. wide and 2ft. long. Have the tail vertical instead of horizontal, as in the bird. Round off the outer rear corners of the wings for 3in. or 4in. The imitation of the natural bird is now complete. There is no need of exactness, as the air you are to try it in will be an unknown quantity, and it may just suit the shape you make. An indispensable part is now to be added which is to preserve equilibrium, and is not used by the natural bird. A tapering stick, say 1½in. wide, three-eighths of an inch thick at the top, three-eighths of an inch square at the other end, and 18in. long, is used. This piece is to be securely fastened by a small bolt through the upper end of the body piece, about 5in. from the front end. It must be capable of adjustment by allowing the lower end to swing front and back through, say, 40 deg. To the lower end is fastened a muslin bag which will hold 2 lb. of shot. Expose the effigy to a breeze of from three to twenty miles an hour, from as high a situation as it is possible for you to obtain, by holding it by the pendant stick near the body. Adjust the weighted stick forward or back, and add or subtract shot, until the effigy has a tendency to spring from your hand against the current of air, when it may be released at a moment of greatest steadiness of breeze. I have made hundreds of these toys with all kinds of success, but have never yet succeeded in getting one to travel beyond the limits of vision. They have proceeded directly against the breeze for 500 yards, and obliquely, up or down, or to right or left, within these limits, when they would lose their balance and come down. Sometimes almost any kind of one that was presented to the air would float creditably, while at others none would succeed. The pendant weight for maintaining equilibrium, though the best I have ever devised, is far too sluggish for perfect work. The momentum of this weight prevents the best results, for if a succession of puffs of wind upon the same wing should occur quickly together, the weight would swing far enough in obedience to the impulse given to capsize the effigy. Such a succession of puffs is sure to occur sooner or later at each trial. These toys operate long enough, however, to prove the purely mechanical character of flight, and serve to materially strengthen the theory.

Romance of the birds.—There has always been a sort of romance connected with the idea of a bird, and a man-of-war bird floating high in the air somewhere between yourself and the constellations has a tendency to inspire sentimental feelings in the beholder. There has been a good deal of pathos employed on skylarks, doves, and other denizens of the air, and yet the bird, though soaring skyward, is still earth born. It must seek some "coign of vantage" in which to place its cradle and rear its young, when its wings must be flexed and nicely folded to the body, in which condition it is altogether a creature of the earth. There has also been much sentiment expended on a feather. Why was a feather selected for a bird? Because by its lightness and strength it made the best possible surface for that purpose, or because of its narrowness and adaptability for being placed in layers, and of sliding together, it was the best possible thing to be nicely folded away on the creature's body when it came to earth for food, or shelter, or to rear its young. Had the only object been to facilitate flight, no feather would have been likely to appear in the economy of nature. It is not required that man shall imitate a bird in all respects in order to make a highway of the atmosphere as the bird does. It seems to me that the great task was not to accomplish the flying alone, but to make a creature who could command such a great area of flat surface and at the same time survive. For if the wing, in order to be a wing, should be always stretched, the animal must become the prey of any beast seeking food the moment it came to earth. It would get tangled in the bushes of the forest and come to destruction in various ways speedily. This necessity for flexing and folding the pinions has doubtless been a far more potent factor in determining the character of a bird than the requirements of flight. In this repect man has a vast advantage over the bird. He will use the surface only in flying, and then detatch it from his person, a feat impossible in the latter. He will use shapes which his experience teaches will give the best results, entirely free from the necessity of using only those which could be folded upon his own body. He will employ a wing, the character of which is controlled by the condition of his pocket-book, and not by the conditions of his existence.

The way to success.—Hitherto, if history is trustworthy, the attempts to imitate the birds have been mere trials of chances, with no well-defined basis of operation to work upon, and certainly no plausible theory of flight underlying the whole scheme. It is not the best way to make a flying apparatus and trust one's life to it at the first trial. Such a method has always been productive of failure. To obtain skilful control of a pair of wings, or any other description of surface which could maintain a man's weight in the air, might be supposed to demand at least as much skill and experience as to properly use a pair of skates, or to ride a bicycle, even after the mechanism of flight has been perfected. It is to be expected, therefore, that many trials and changes must be gone through with by the first successful experimenter before the proper mechanical appliances are discovered; and I will indicate the course to be pursued which, in my judgment, will give the best results. No attention should be given to beating the air with the wing surfaces. To get a start in a calm a tower should be used, from which a short descent could be made obliquely to obtain the initial speed requisite for light in still air. In a breeze no difficulty would be found in starting from the surface of the earth. I should use bamboo of the finest quality for the construction of the mechanism, putting it together after the manner of the best fishing-rods, and should take a sandhill crane or buzzard for a model to work by. The case to contain the person, corresponding to the body of the bird, and the surfaces on each side, say for six feet, should be made rigid, without joint or movable part. From this case to the extremity of the wings would be located the appliances to control direction and rate of speed. The normal status of all the parts should be the position of maximum results. To decrease speed or change direction this position would have to be modified by breaking the rear edge of the wing, by reducing or increasing its extent, or by changing the inclination of the surface, or by breaking the continuity of the surface, or in any other ways which would suggest themselves. No great pains need be taken before a trial in free air is obtained, as the operator will then doubtless get valuable hints how to proceed. The mechanism should be constructed so that the person could lie prone, face downward, in a nicely-fitting case well upholstered, and with his hands grasping handles controlling the devices for changing or maintaining direction, so that very small impulses of moving air could be felt. The feet should control the movements of the tail by elevating or depressing it, if it should be found that such a surface was required.

To make a trial.—Two posts should be planted in some open space each 100ft. or more in height, and, say, 100 yards apart, from the tops of which should be stretched a stout rope with a pulley fastened in the centre. Through this pulley a rope should lead to the ground and be fastened to the back of the body of the device, while assistants hoisted it into the breeze. I estimate that 200ft. of surface would be ample to maintain 300 lb. in the atmosphere. The first new idea the operator would be likely to get would be concerning the tremendous energy there was in moving air. He would have no fear from that time that weight was going to seriously interfere with his success, and he would probably find that he was constructing his wing surfaces in too weak a manner. After this, if there was any of the inventor's pluck about him, he would make steady progress to the final solution of the problem. It is likely that the perils of locomotion in the air would be attended with less danger than that of any other kind whatever. When it is remembered that space of only two dimensions suffices to accommodate all the movements going on at the surface of the earth, while space of three dimensions is utilised the moment you launch into air, it seems that there is room enough to maintain the entire population of the globe on the wing with very small danger of collision. There being no working mechanism in the case vital to maintaining positions against gravity, all the movable parts of the entire device might become deranged, and still the person could descend in safety, while the perfect manner in which control of direction and speed is secured, coupled with the nature of the devices required to do it, reduces dangers from accident to the lowest possible point. Loss of consciousness on the part of the operator might prove fatal, but, otherwise, the exercise of ordinary common sense would guard against all dangers. There is one obvious criticism of the theory here set forth which might be made with entire justice and sincerity, viz., that it invades the great law of the conservation of energy. The flight of a bird on fixed wings in a dead calm does seem to combat that rule; and for a short time I was perplexed at what seemed the necessity of either doubting the fact of such flight, or of the validity of such a law. The latter alternative was not possible, and to doubt the former was to discredit my senses in a very violent manner, which I could in nowise do. The difficulty in a great measure disappears when a clear idea is had upon what the theory attempts to do. For, observe, that it does not pretend to detail the exact manner in which the particles of air impinge upon the surface to counteract gravity. Neither does it follow those particles in their effort to escape from the pressure of the rear edge of the surface, and by their reaction urge forward the surface upon the moving air. It does not explain the manner in which the particles of air are grouped or associated nor the difference between still air and air in motion in regard to the arrangement of its particles. I have many reasons for believing that still air away from the surface of the earth rests in a tension which the passage of a body through it liberates, seemingly thereby making more air than there was before. On several occasions I have noticed phenomena of refraction immediately in the wake of a passing bird difficult to explain on other hypothesis than a change in the character of the air by the flitting body. The theory is a generalisation of a multitude of facts, and is a proximate explanation of the phenomena of flight. What the ultimate explanation may be would require a longer season of experiment and observation to determine, and that knowledge, when obtained, would throw no further light on the problem of man's accomplishing the navigation of the air.

The geological evidence.—That there is no peculiarity in the rule of the action of air on surfaces which would bar the weighty body of man from imitating the birds, seems to be suggested by the geological record. Air-navigating creatures, as ponderous as an average man, were certainly at one time in existence when the nature of the atmosphere was nearly similar to its present condition. Their modern representatives still inhabit the air, showing that modification of bulk was produced by other causes than impossibility of flight. The ancient giants among the birds became extinct, doubtless from the same requirements which evolved the other natural monsters to extinction, viz., that the conditions of existence favoured less ponderous forms. But, as I have noticed elsewhere, the conditions of man's existence are not involved in any manner in artificial flight. No lesson can, however, be learned from the geological birds at all to be compared in importance with the present existing forms of bird life, and the only reason for alluding to it is to show that man's bulk will prove no impediment to his success. In fact, it seems that nature has found no obstacle in her path to prevent the occupancy of the atmosphere by any form of life, however ponderous, which arises from the exigencies of flight—the difficulty being to endow the creature with the wing surfaces and at the same time preserve its life. From my standpoint, the wonder will be in the near future, not that man has at length made a conquest of the air, but that he did not do it centuries ago.

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THE INSTITUTION OF CIVIL ENGINEERS.

THE PROGRESS OF TELEGRAPHY.

THE first of the series of six lectures on the applications of electricity was delivered on Thursday evening, the 15th of February. This was on "The Progress of Telegraphy," by Mr. W. H. Preece, F.R.S., M. Inst. C.E., of which the following is an abstract:—

Telegraphy is the oldest practical application of electricity. It grew about the railway system, and was rendered a practical agent by the foresight of Robert Stephenson, I. K. Brunel, Joseph Locke, and G. P. Bidder, who were its godfathers in England. Electric currents are, as a rule, maintained for telegraphic purposes by the combustion of zinc, and in the innumerable forms of batteries, the conversion of zinc into sulphate of zinc is the root of the transformation of energy into that form which was utilised as electric currents. There are three forms of battery in use in the British post-office telegraph system, and in the following numbers: —Daniell, 87,221 cells; Leclanché, 56,420 cells; bichromate, 21,846. Every administration has its own adopted form, differing in design, but based on one or other of these types. Magneto-electricity is applied for some forms of apparatus, and dynamo machines are occasionally utilised to supplement batteries. The various terms, electro-motive force, resistance, induction, and current, though measureable in definite units, have not yet become household words; but, having been admitted into commercial, legal, and parliamentary lore, they will soon be as familiar as feet, gallons, or pounds. Electric currents are conveyed from place to place either overground, underground, or submarine.

Overground.—Wooden poles, preserved in creosote, are employed in England, but iron poles are extensively used in the Colonies. The conducting wire is almost universally of iron, but copper wire is much used through smoky places where iron is liable to rapid decay. Phosphor bronze wire is under trial, and is a very promising material, as it possesses the conductivity of copper with the strength of iron. The improvements made in the quality of iron wire have been very great, and it conducts now fully 50 per cent. better than it did a few years ago. Electric tests have had a marvellous effect upon the production of pure metallic conductors; copper has improved in a greater ratio than iron, and samples have been produced better even than the standard of purity. The insulators remain principally of porcelain, and their forms vary nearly with the number of individuals who use them; the only improvement of any value recently made is one which facilitates the very necessary process of cleansing.

Underground.—Wires are almost invariably carried underground through towns. Copper wire, insulated with gutta-percha, incased in iron pipes, is the material used. There are 12,000 miles of underground wire in the United Kingdom. There is a great outcry for more underground work in England, owing to the destruction to open lines by gales and snowstorms; but underground telegraphs, wire for wire, cost at present about four times as much as overground lines, and their capacity for the conveyance of messages is only one-fourth; so that overground are, commercially, sixteen times better than underground wires. To lay the whole of the Post-office system underground would mean an expenditure of about £20,000,000. Hence there is no desire to put wires underground except in towns. Besides snowstorms are few and far between, and their effects are much exaggerated. Of the numerous materials and compounds that have been resorted to for insulating purposes, gutta-percha remains the oldest and the best for underground purposes. It, like all other materials used for telegraphy, has been improved vastly through the searching power that the current gives the engineer.

Submarine.—The past ten years has seen the globe covered with a network of cables. Submarine telegraphs have become a solid property. They are laid with facility and recovered with certainty even in the deepest oceans. Thanks to such expeditions as that of H.M.S. Challenger, the floor of the ocean is becoming more familiar than the surface of many continents. There are at present 80,000 miles of cable at work, and £30,000,000 have been embarked in their establishment. A fleet of twenty-nine ships is employed in laying, watching, and repairing the cables. The Atlantic is spanned by nine cables in working order. The type of cable has been but very little varied from the first made and laid between Dover and Calais; but the character of the materials, the quality of the copper and the gutta-percha, the breaking strain of the homogeneous iron wire, which has reached 90 tons to the square inch, and the machinery for laying have received such great advances, that the Telegraph Construction and Maintenance Company laid a cable across the Atlantic last year in twelve days without a hitch or stoppage.

Ideas are conveyed to the mind by electric signals, and, in telegraphy, these signals are produced at distant places by two simple electric effects:—(1) That a magnetic needle tends to place itself at right angles to a wire when an electric current passes through it; and, (2) that a piece of iron becomes a magnet when a current of electricity circulates around it. An innumerable quantity of tunes can be played on these two strings. Various companies were established at different times to work certain systems, but when the telegraphs were absorbed by the State, the fittest were selected to survive, and their number consequently declined.

The A B C instrument is the simplest to read, for it indicates the letters of the alphabet, by causing a pointer to dwell opposite the desired letter. There are 4398 in use. Its mechanism is, however, complicated and expensive, and it is being rapidly supplanted by the telephone. The needle instrument is the simplest in construction, but it requires training to work it. There are 3791 employed by the Post-office, and 15,702 among different railway companies. As a railway instrument it is the simplest, cheapest, and most efficient ever devised. The Morse instrument, of which the Post-office possesses 1330, records its letters in ink, in dots and dashes on paper tape, and like the needle and A B C appeals to the consciousness through the eye; it also indicates the letters of the alphabet by sound, and thus utilises the organ of hearing. Sound reading is gaining ground in England with great rapidity. There are now 2000 sounders, while in 1869 there were none. In America scarcely any other instrument is used, but on the continent of Europe there is scarcely one. Acoustic reading attains great perfection in Bright's bell instrument, where beats of different sound replace the dot and dash of the Morse alphabet. Sound reading is more rapid and more accurate than any system of visual signals or permanent record. In fact, no record is kept in England, for the paper tape is now destroyed as soon as it has been read. Errors are of course inherent to all systems of telegraphy. A telegraphist cannot see what he writes, nor hear what he says, and who is there that does not make mistakes, whose eye follows his pen, and whose ear takes in his own words? The Hughes type instrument, which prints messages in bold Roman characters, is much used on the Continent; it is in fact recognised as the international instrument, but it has had to give way in England to a more rapid system of telegraphy. It is, however, solely employed for the continental circuits by the Submarine Telegraph Company. All long cables are worked by Sir William Thomson's beautiful siphon recorder.

In ordinary working only one message can be sent in one direction at one time; but by a simple and ingenious contrivance, by which the neutrality of opposite currents is utilised to convey signals, duplex telegraphy is rendered possible, so that two messages can be sent on the same wire at the same time; and, by a still further improvement, where currents of different strength are utilised, four messages are sent on one wire—two simultaneously in opposite directions—at the same time. There are in England 319 duplex and thirteen quadruplex circuits at work. The acme of efficiency in telegraphy is attained in the automatic system, in which manual labour is supplanted by mechanism in transmitting the messages. There are seventy-one circuits worked by these instruments, and 224 instruments in use, and a speed of working of 200 words per minute is easily maintained upon them. With the hand alone from thirty to forty words per minute is the maximum rate attained, but by automatic means the limit is scarcely known. Since this system can be duplexed, and in many cases is so, 400 words per minute on one wire are easily sent. By the use of high-speed repeaters, the length of circuit for automatic working is scarcely limited; it would be easy to send 100 words per minute to India.

The growth of business since the telegraphs have been acquired by the State is enormous; 126,000 messages per week have grown to an average of 603,000; but the mileage of wire has not increased in anything like the same proportion, the excess of traffic having been provided for by the great improvements made in the working capacity of the apparatus. In 1873 the average number of messages per mile of wire was 147, it is now 256. It is in press work that the greatest increase has taken place, 5000 words per day at the time of the companies have grown to 934,154 words per day now. 340,966,344 words of press matter were delivered in the year ending 31st March, 1882.

The development of railways has necessitated a corresponding increase in the telegraphs required to ensure the safety of the travelling public, and while 27,000 miles of wire in England, Scotland, and Wales were used for that purpose in 1869, at the end of December, 1882, the total had increased to 69,000 miles, equipped with 15,702 instruments, against 4423 in 1869. The growth of business is equally discernible in the great cable companies. In 1871 the number of messages dealt with by the Eastern Telegraph Company was 186,000; in 1881 it was 720,000. This growth is equally striking in all civilised countries, and even in Japan 2,223,214 messages were despatched, of which 98 per cent. were in the native tongue. The mode of transacting the trade of the world has been revolutionised, and while wars have been rendered less possible their conduct has been expedited, and their penalties alleviated.

PATENTS FOR INVENTIONS No. 3 BILL.

THERE are now three Patent Bills before Parliament, namely, the Government Bill, the Society of Arts Bill, and the Bill of which we reproduce the more important clauses below. The Bill is being introduced by Mr. Anderson, Mr. Brown, Mr. Broadhurst, Mr. Jackson, and Mr. Hinde Palmer.

(1) This Act shall come into operation on the first day of January, one thousand eight hundred and eighty-four.

(2) Her Majesty may from time to time, by warrant under her sign manual, on the recommendation of the Lord Chancellor, appoint an officer to be called the Chief Commissioner of Patents for Inventions, and on the recommendation of the President of the Board of Trade two officers to be called respectively Second and Third Commissioners of Patents for Inventions; and these officers shall hold their offices during Her Majesty's pleasure.

(3) The Treasury may fix the salaries of these three Commissioners at such annual sums as it deems proper, but not exceeding, for the first Commissioner fifteen hundred pounds, for the Second Commissioner twelve hundred pounds, and for the Third Commissioner one thousand pounds; and the Treasury may also provide such further moderately paid assistance as may be found necessary for carrying on the work of the office, but as far as possible continuing those now employed. All payments under this section to be out of moneys to be provided by Parliament.

(4) It shall be the function of these three paid Commissioners to do all the duty hitherto performed by the unpaid Commissioners and the Law Officers, whose duties shall thereupon cease, to take over the establishment from them, and to manage all the business of the Patents for Invention Office of the United Kingdom, and to perfect its organisation; more particularly in the matter of a library of records and registers, so indexed and arranged as to facilitate searches, and to be easily accessible to the public under such reasonable regulations and small fees as the Chief Commissioner, with approval of the Lord Chancellor, may from time to time prescribe. On receiving a petition for grant of Letters Patent, they shall cause the registers to be searched for prior inventions on the same subject, and if any are found that seem to bar the claim to novelty, the petitioner shall be referred to these for consideration before any further fee is demanded; and if the petitioner asks to be heard, the Commissioners, or one of them, shall hear him and may advise him as to further procedure.

(5) Letters Patent for Inventions shall be granted for the period of twenty-one years from the date of application, subject to a payment at the end of the seventh, and at the end of the twelfth, and at the end of the seventeenth years respectively, as prescribed in the Schedules appended to this Act; and the provisions of this section shall apply also and equally to inventions—including foreign inventions—that may have been previously patented abroad.

(6) Letters Patent for Inventions granted prior to the commencement of this Act, and then in force, shall be exempted from the payments formerly prescribed at the end of the third year and at the end of the seventh year, so far as those payments have not become due at the commencement of this Act, and shall thereafter be liable only to the payments prescribed in the Schedules appended to this Act, and at the end of the twelfth year may be extended to twenty-one years, subject to payment of the sums prescribed in said Schedules.

(7) After a patent shall have been sealed, the failure to pay the stipulated duty at any of the subsequent terms when due shall not invalidate the patent, provided at some period before the expiry of twelve calendar months after such due date the duty shall have been paid, together with such amount of fine as is specified in the appended schedule of fines for postponed payments, but failing that the patent becomes void.

(8) There shall be paid to and for the use of the Crown on the several instruments described in the Appended Schedules the duties and fines mentioned in those Schedules, and no others.

(9) The term for provisional protection shall henceforth be extended to twelve months, and the patent when sealed shall date as of the day on which the petition for Letters Patent was left at the Office of Patents for Inventions by the applicant.

(10) At any time subsequent to the sealing of a patent it shall be in the power of its owner to add to it such improvements as he may desire unless the Chief Commissioner shall decide that the improvement proposed is not a legitimate addition to the patent, but is more properly the subject for a new patent. For every such addition to a patent, or procedure connected with such addition,

there shall be paid one half of the initial stamp duties, and subsequently one half of each stamp duty still remaining to be paid, as these may fall due on the original patent, or with proportionate fines for postponed payment. Any such addition to a patent shall expire along with the original patent.

(11) A patent shall have to all intents the like effect as against her Majesty the Queen, her heirs and successors, as it has as against a subject, but the Secretary of State of any Department may, with the consent of the Treasury, use for the public service any patented article, or any patented manufacturing process, on such terms as may be agreed on with the owner of the patent, or, failing such agreement, the Treasury and owner shall each appoint an arbitrator, and the arbitrators shall appoint an umpire in the event of disagreement, and the terms so arrived at shall be binding on both parties.

(12) Employment in the public service shall not preclude any person from taking out or owning a patent, or from any participation in the privileges of a patentee, but this provision shall not apply to any person employed in the Office of Patents for Inventions.

(13) The short title of this Act shall be the Patents for Invention Act, 1883.

Schedule of Stamp Duties.

	£	s.	d.
On petition for grant of Letters Patent	1	10	0
On certificate of record of notice to proceed	1	0	0
On the sealing of Letters Patent..	1	0	0
On the Specification	1	0	0
On Letters Patent at the end of seven years	20	0	0
On Letters Patent at the end of twelve years	20	0	0
On Letters Patent at the end of seventeen years.. ..	20	0	0
On certificate of record of notice of objections	1	0	0
On certificate of every search and inspection..	0	1	0
On certificate of entry of assignment or licence	0	5	0
On certificate of assignment or licence	0	5	0
On application for disclaimer	1	0	0
On caveat against disclaimer	1	0	0
On office copies of documents for every 90 words ..	0	0	2

On every addition to a patent one-half of the above stamp duties.

Schedule of fines for postponed payments.—If paid within three months after due date, 25 per cent. on the duty then due. If paid not within three, but within six months after due date, 50 per cent. on the duty then due. If paid not within six but within nine months after due date, 75 per cent. on the duty then due. If paid not within nine, but within twelve months after due date, 100 per cent. on the duty then due. On every addition to a patent, one half the above fines.

THE S.S. OREGON.

In our annual article we referred at some length to the Guion steamer Oregon, being built by Messrs. John Elder and Co. The following additional particulars, authorised by Messrs. Elder, will be found interesting.

The principal dimensions of the Oregon are as follows:—Length over all, 520ft.; breadth, 54ft.; depth, 40·9 to upper deck, or 48·10 to promenade deck. The gross tonnage is about 7500 tons. The vessel has five decks. The first or promenade deck, extending the whole length and breadth of the vessel, is—with the exception of the parts forming the turtle decks at the ends—reserved for the use of the first-class passengers only. On this deck, amidships, is placed the ladies' boudoir, a fine spacious apartment, which will be fitted up and decorated in a most tasteful manner. On the second or upper deck are the cabins for the officers and engineers, the smoking saloon and saloon entrances, also the kitchens, bakeries, sculleries, and other offices. These are chiefly contained in a large central deck house, 220ft. long by 32ft. broad. The extremities of the upper deck are well protected by extensive turtle decks, that at the forward part extending about 100ft. aft from the stem. On the third or main deck are the cabins for the passengers with their dining-saloons, ladies' retiring rooms and other accommodations. On this deck accommodation is provided for 340 first-class, 92 second-class, and 110 third-class passengers. The first-class staterooms are replete with all fittings usual in the highest class of passenger steamers. The first-class dining-saloon which is placed in the midship part of the vessel, forward of the machinery space, is an exceedingly large and magnificent apartment, 65ft. long by 54ft. wide and 9ft. in height, and is so arranged that all the first-class passengers can dine together. Ample light and ventilation are given to the saloon by a large well 25ft. long by 15ft. wide, extending up to a large skylight placed on the promenade deck, thus allowing the skylight to be kept open even in the stormiest weather. The total height in the saloon at the cupola is over 20ft. Numerous large lights are also fitted along the sides of the saloon. The second-class saloon and accommodation is situated abaft the engine room, and will be fitted up in a neat style, complete with all fittings tending to the comfort of the passengers. The whole of the after part abaft the jigger-mast will be fitted up in a substantial manner for the steerage passengers. The greatest care has been taken in the lighting, ventilation, and sanitary arrangements throughout. The fourth or lower deck can be almost entirely used for steerage passengers, or for cargo as required. On this deck alone accommodation can, if necessary, be provided for 1000 passengers. The fifth or orlop deck is used entirely for cargo. The vessel has four iron masts with yards on the two foremost ones. A complete installation of the electric light on the incandescent principle will be made, adding greatly to the general effect of the tasteful decorations throughout.

Steam-steering gear of the best type is placed in the wheel-house under the after turtle deck, with connections for steering from the bridge amidships. Powerful hand-steering gear with double wheels is also fitted in the after wheel-house. A steam capstan windlass is fitted forward for the efficient working of the vessel. Five large steam winches are fitted at the cargo hatches for the prompt loading and unloading of cargo. Ten large boats are arranged on the promenade deck as far as possible beyond the risk of damage from the sea. In fact, the vessel is provided with all the most approved appliances for navigating her, and for promoting the comfort and safety of the passengers.

The engines for this vessel are of 12,000 I.H.P.; they are compound, having three inverted cylinders, one high-pressure, 70in. diameter, and two low-pressure, each 104in. diameter. The high-pressure cylinder is placed between the two low-pressure cylinders, and all are adapted for a stroke of 6ft. The valves, which are of the equilibrium piston type, are placed between the cylinders, the high-pressure cylinder having one single piston valve, while each of the low-pressure cylinders have two piston valves connected by a crosshead. The valves are worked by the usual double excentrics and link motion. The reversing of the engines is effected by a steam and hydraulic reversing engine. The crank shaft is built and made of Vicker's crucible cast steel. The diameter of the journals is 24½in. The tunnel and propeller shafting is also of Vicker's steel.

The surface condenser is placed at the back of the engines; it is divided into two parts, each of which forms an independent condenser for the corresponding low-pressure cylinder. The water is supplied to the condenser by two large centrifugal pumps having pipes 20in. in diameter, and capable of discharging fully 4100 tons of water per hour. The propeller boss is of Vicker's steel with manganese bronze blades.

The boilers for supplying steam to the engines are entirely made of steel plates, and are nine in number. They are double-ended and arranged in three groups with athwartship stokeholes. Each boiler is 16ft. 6in. in diameter and 16ft. 9in. long, having eight Fox's patent corrugated furnaces 3ft. 6in. mean diameter, making the total number of furnaces for the nine boilers seventy-two.

She will carry, when full, 1542 passengers, and with a full complement of officers and crew, nearly 1800 persons.

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

(From our own Correspondent.)

The iron trade continues to benefit by the finer weather, but the market still lacks vitality. Merchants decline to buy largely for export, and actual consumers mostly confine their purchases to hand-to-mouth lots. On 'Change in Birmingham to-day prices were fairly upheld on the basis of former quotations. Most strength was seen in the rates for "marked" iron, since the competition is less severe in this branch than in second and third-class irons. Prices of these latter were very varied.

The Earl of Dudley's bars were quoted:—Lowest quality, £8 2s. 6d.; single best, £9 10s.; double best, £11; and treble best, £13. His lordship's rivet and Tee-iron was:—Single best, £10 10s.; double best, £12; and treble best, £14. Hoops and strips of the Round Oak brand were:—Lowest quality, £8 12s. 6d.; single best, £10; double best, £11 10s.; and treble best, £13 10s.

The second leading house in the trade, Messrs. William Barrows and Sons, quoted:—Common bars, £7 10s.; best, £9; and double best, £10; plating bars, £8; best plating ditto, £9 10s. Their best angle, T, and rivet iron were £9 10s.; and double best, £10 10s. Hoops, if ordinary quality, £8; and best ditto, £9 10s.

Makers of sheets for galvanising might have done an increased business if they would have accepted the prices which galvanisers offered. Certain of the prices which are being here and there accepted for singles delivered in London are very low, and it would be scarcely fair to quote them in the open market. For doubles £8 5s. to £8 15s. was asked to-day; and for trebles £9 5s. to £9 15s., but galvanisers declined to give these rates.

The galvanised iron trade is without improvement. I have the best authority, however, for the statement that more galvanised iron was manufactured and shipped last year than in any previous twelvemonth. Prices for sheets of 24 w.g. bundled, delivered London, are £13 10s. to £14 10s per ton according to brand.

Second-class bars are selling in good parcels at from £7 to £6 10s. Common bars are tame at £6 to £5 17s. 6d.—prices which leave but little profit. Hoops for cotton tie making are rather more active, and some makers of nail rods and strips have pretty good orders. Hoops are £6 10s. to £7, and gas strip £6 12s. 6d. upwards.

The Monmoor brand of hoops, rolled by E. T. Wright and Sons, was quoted at 16 to 19 w.g., £7 10s.; 20 w.g., of ⅝in., £8 5s.; and 20 w.g., of ⅝in., £9.

Proprietors of mills and forges in Shropshire, no less than Staffordshire, complained to-day of the scarcity of orders. Bars, wire rods, fencing wire, and plates and sheets, were all offered from Shropshire at figures slightly below those which would alone have been accepted three weeks ago. Makers were, however, compelled to adhere very nearly to the quotations which followed upon the reduction, after the quarterly meetings, of 10s. in the top quotation for marked bars, because of the firmness of best pigs and the stringency of the wages scale.

Cold-blast all-mine pigs were again quoted £4 7s. 6d. to £4 5s., and hot-blast £3 5s. Even the lowest figure was, however, with difficulty secured. Part-mines were £2 10s. upwards, and common cinder pigs a little within £2. Hematites were not pressed upon the market, and such lots as were sold went mainly to the standing sheet firms. The Barrow brand was quoted £3 7s. 6d.; Tredegar, £3 5s.; and Blaina, £3 2s. 6d.

Derbyshire and Wiltshire pigs were slightly stronger. For good brands nothing under 48s. delivered would be accepted.

In the coal trade a sale of 10,000 tons of forge quality took place at 6s. 6d. per ton at the pits, long weight.

There is about being placed in this district a contract for a galvanised corrugated iron roof, for erection on an Indian sugar plantation. Some 100 tons of columns and wrought iron will be consumed on the job, which will be of the value of about £2000.

Machinists who manufacture corrugating and other machinery for the galvanisers report that the demand is quieter, but that there have recently been good inquiries on Australian, Russian, and other foreign account, which it is hoped will result in business.

Engine builders complain of the severity of competition, and of the low prices which have to be quoted if orders are to be secured.

The manufacture of electric lighting machinery is proceeding satisfactorily, though quietly, in Wolverhampton. The Electric Light Storage and Engineering Company are turning out chiefly storage batteries. Wherever these have been shown they have obtained a good name, and one battery now being manufactured for private lighting in the metropolis upon the Edison system contains fifty cells. The company's batteries for the Swan system mostly contain twenty-two cells. High-speed steam engines, of from 3-horse power to 9-horse power, some of which will run 1000 revolutions per minute, and are practically noiseless, are being manufactured for driving electric machinery and wood-working machinery, and for use on shipboard, &c.

An important advance in ironfoundry has been accomplished by Messrs. Thomas Perry and Sons, engineers, Bilston. They have succeeded in casting wheels and pinions with helical teeth. The advantages, in the shape of increased strength and smoothness of action, which in the case of large wheel gearing are conferred by helical teeth, have long been recognised by engineers. Hooke made important investigations in this direction, and in 1808, a Mr. White, of Manchester, took out a patent on this principle. But the extreme difficulty of casting prevented the adoption of the process. Two or three years ago the manufacture was taken up by a German engineering firm, but there the wheels are being made out of cast steel; and it has remained for Messrs. Perry to cast them successfully in iron. After overcoming numerous difficulties, this firm are now making them out of best cold blast pigs. For six months past a pair of such wheels made by Messrs. Perry have been in operation at an ironworks in Cheshire, and they have given no signs of breaking down, notwithstanding that the circumferential speed at which they are run is upwards of 3000ft. per minute.

The demand for mill and forge ironfoundry, whether as new work or repairs, is very quiet; but dies for stamping purposes are here and there in better request.

Dealers in agricultural machinery are this week in receipt of circulars from certain of the leading implement makers in various parts of the kingdom announcing important reductions in prices. On mowers and reapers the drop by some firms is 15 per cent., on ploughshares 10 per cent., and on agricultural castings a good 5 per cent. One of the chief harvesting machinery firms states the drop is "due to their desire to aid in some measure the efforts of farmers to reduce their outgoings," added to their "diminution in establishment charges, due to the great increase of trade last season, with at least equal promise for the present one."

A new list of prices has been prepared by the operatives in the factory chain trade in the Old Hill, Cradley Heath, and Halesowen districts, who recently gave notice for a rise, and it will be submitted to the employers.

At the half-yearly meeting of the Wolverhampton Gas Company, on Tuesday, the chairman announced that the profits had amounted to £7559, which would enable the declaration of a 5 per cent. dividend for the six months. With the beginning of April the price of gas would be reduced from 2s. 6d. to 2s. 4d. per 1000 cubic feet. The electric light had not yet affected the company.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—A depressed tone continues throughout the iron trade of this district, and although a few moderately large sales of pig iron have been made during the week, orders have only been secured by coming down pretty near to buyers' terms. On the basis of late quoted rates business has been impracticable, but as orders have been given out by pretty keen buyers at about 1s. per ton under what makers have been asking, it may be taken as some indication that the market is believed to have touched its lowest point.

Tuesday's 'Change meeting at Manchester was well attended, but the market was dull. Lancashire makers of pig iron were holding for late rates, and although they are not able to get orders on the basis of their list quotations of 46s. 6d. to 47s., less 2½ delivered equal to Manchester, fair offers made during the week at about 1s. per ton less have been declined. Local makers have still fairly good deliveries going on against old contracts, but the absence of new orders is necessitating some portion of the present output going into stock. For district brands prices are irregular; some makers are still holding for their late quotations of 45s. 10d. to 47s. 10d. for Lincolnshire, and 48s. to 50s. for Derbyshire, less 2½ per cent., delivered equal to Manchester; but these figures are out of the market, and to meet buyers some of the makers have been willing to give way 1s. per ton. This has resulted in moderately large orders, which buyers had been holding back, being placed out for Lincolnshire forge iron, on the basis of 44s. 10d. per ton, less 2½, delivered.

For hematites there are some fairly large offers in the market, at a little under 60s. per ton, less 2½ per cent., delivered here. At present, however, sellers are not disposed to entertain offers on so low a basis, and for odd sales of small quantities, good foundry qualities have realised about 63s. to 64s., less 2½.

The finished iron trade continues extremely quiet, and some of the local forges are only kept partially going, owing to the want of orders. Prices are weak, and there is a great deal of underselling on the part of dealers. Some of the makers still quote £6 7s. 6d. for bars delivered into the Manchester district, but for actual sales it is exceptional where more than £6 5s. is realised, and hoops are offered at £6 15s. Shipping inquiries do not, as yet, develope any weight of business, and where offers are made they are for long delivery at very low prices.

Messrs. Barningham and Co., of Salford, have secured the order for the whole of the fish-plates, points and crossings, and bolts and spikes for the Southport and Cheshire Lines Extension.

Ironfounders, except a few firms who are engaged on fireproof work for mill construction, report that very few orders are being given out, and in a large number of cases they are only kept going with greatly reduced staffs of men. Builders' castings are competed for at extremely low figures, and I have heard of work being taken in the Manchester district at £5 per ton delivered, whilst the ordinary quotations do not average more than £5 10s. to £6 per ton. For ordinary straight lengths of pipe castings, quotations average £4 12s. 6d. to £4 15s. per ton delivered into the Manchester district.

Visiting one of the foundries in the district, I came across a novelty in ranges which is being introduced by Messrs. W. and A. C. Russell and Co., of Salford, and which will illustrate the constant improvements going on in heating and cooking apparatus to which gas is applied. The combination ranges, in which gas and coal can be used in separate ovens, are a somewhat new feature; but Messrs. Russell have just patented a range in which gas and coal can be used either combined or separately in the same oven, and which will be a decided step in advance of the ranges so far brought out.

The actual present condition of the engineering trades of this district shows no material change upon what I have previously reported, but in several quarters I hear that new inquiries show a decided falling off, and that the weight of new work in prospect is not by any means large.

There appears to be a growing demand for hot-air engines in the Colonies and India, where they are being largely used to work in connection with pumps for irrigation purposes. Messrs. W. H. Bailey and Co., of Salford, who have extended their works specially for the manufacture of this class of motor, have at present a considerable number on order, and as these engines are handy for distributing the driving power as required, they are seldom made to exceed 1-horse.

I have received this week a copy of the fifty-eighth annual report of the Steam Engine Makers' Society, whose head offices are in Manchester. Mr. James Swift, the general secretary, issues with it a very interesting address, from which at present I can, however, only briefly summarise few particulars. The cash balance at the end of 1882 amounted to £8771 1s. 3d., and the income from all sources during the year has amounted to £9238 7s. 8d., making a total of £18,009 8s. 11d. The expenditure during the year has been £7941 4s. 10½d., leaving a balance on the year's operations of £10,068 4s. 0½d., which represents an increase of capital of £1297 2s. 9½d. The number of members has increased by 204, the number on the books being now 4951. A satisfactory feature of the past year has been the reduced amount paid out as donation to unemployed members, which has been £1472 18s. 2d., as compared with £2492 12s. 8d. in 1881. This is, of course, an indication of a decided improvement in trade, with regard to which the report states that future prospects are equally cheerful. The prosperity so far has been such as to enable the members to secure an improvement in their wages and trade privileges, which has made their earnings equal to what they were previous to the reduction in 1878, and this had been obtained without any serious disputes with the employers, which in previous years had caused an enormous drain upon the resources of the society.

Ring-spinning is a question which has long occupied the attention of machinists and engineers in this district; but although the system has been largely adopted in America, several attempts which have been made to introduce it into the cotton mills of Lancashire have so far met with very little success. The question gave rise to an animated discussion at a meeting of the Manchester Association of Employers, Foremen, and Draughtsmen, held on Saturday, when a paper on "The Ring Spinning Machine" was read by Mr. W. H. Beastow. He briefly stated that the only practical difference between the flyer frame and the ring frame consists in dispensing with the flyer and substituting a ring in the lifting frame, and Mr. Beastow urged a whole series of advantages that could be secured by the adoption of the ring spinning machine. Stronger and more even yarn from the same roving and with the same twist could be obtained; the loss from waste was almost obliterated; practically unskilled labour could be employed; from 50 to 75 per cent. more spindles could be put in the same space; the production per spindle was at least 25 per cent. greater and the cost of spinning from 15 to 30 per cent. less; whilst the machine itself was more simple in construction and gearing, and had fewer parts to get out of repair. From the various patents which were being taken out in connection with ring and continuous spinning, it was evident that it was exciting more attention and being more carefully studied than any other machine connected with cotton spinning, and he regarded it as the spinning machine of the future. The discussion did not take a very favourable turn with regard to the ring spinning machine, and the arguments against it were pretty well set forth by Mr. John Nasmith, who is connected with one of the leading machine-making firms in Lancashire. Mr. Nasmith said he could mention men in Lancashire who asserted that they could spin better yarn in a mule than in either a throstle frame or a ring frame, and they might depend upon it there was some good reason why the Oldham spinners did not adopt the ring frame, because although mills were being constantly built they were all constructed for mule spinning. The exigencies of the market necessitated a very large proportion of their manufactures going abroad in "cop," and this was one of the greatest disadvantages with regard to the use of the ring frame; spinning on weft was right enough so long as the yarn was spun where it was woven; it was when they had to export that their difficulties began. Mr. Nasmith added that he had just returned from the United States, and he might, without boasting, assert that America could not compare with Lancashire in regard to spinning.

The late Manchester Scientific and Mechanical Society, which was dissolved about two years back, has been revived under a new title—"The Joule Club"—which has been suggested by the name of a well-known local scientist. The present members consist entirely of gentlemen who were connected with the old society, and Mr. G. E. Davis, F.C.S., has been elected the first president.

The Corporation of Preston, who are carrying out the scheme for the development of the navigation of the river Ribble for which a bill is now before Parliament, have bought up the Ribble Navigation Company for the sum of £72,000.

I understand that Mr. John Pearson, of Liverpool, of the well-known firm of Pearson and Knowles, the large colliery owners and ironmasters of Lancashire, has been appointed the new chairman of the Board of Directors of the Lancashire and Yorkshire Railway Company.

Except that house fire coals are not moving off quite so briskly, there is no material change in the condition of the coal trade. Although the demand for round coals is only moderate, there is still an absence of any great pressure of supplies in the market, and prices were maintained at last month's rates. Engine fuel is generally in good demand, with the better sorts of slack getting scarce. Prices at the pit mouth remain as under:—Best coal, 9s. 6d. to 10s.; seconds, 7s. 6d. to 8s.; common house coal, 6s. 6d. to 7s.; steam and forge coal, 5s. 6d. to 6s. 3d.; burgy, 5s.; and good slack, 3s. 6d. to 4s. 3d. per ton.

Shipping is fairly good, but low prices are taken, and delivered at Garston or Liverpool, good steam coal can be bought at 7s. 6d. to 7s. 9d., with seconds house coal at 9s. to 9s. 6d. per ton.

A conference of miners' delegates has been sitting in Manchester this week to consider the restriction of the output, and reports have been received, the nature of which has, however, not been allowed to transpire, as to the progress of the movement in various districts.

The Miners' Conference were engaged all yesterday—Thursday—discussing the questions of the restriction of the output, but did not come to any decision, and the subject was adjourned for further consideration to-day, when it is expected some resolutions for the guidance of the colliers will be passed.

Barrow.—There is no material change in the hematite pig iron market, but sales have been brisker and prices are steadier. There seems a probability that values may go up a trifle if prices are only maintained. There does not seem much reason to despair on this account, as home and foreign consumers are showing a disposition to do business, and appear to be feeling their way for placing out contracts for the opening up of the shipping season. Prices are not quotably changed, 52s. 6d. being still quoted for mixed samples of Bessemer. Stocks are increasing, as the output is fully maintained. Shipments, of course, are comparatively light, owing to the season. But a large tonnage of metal will be exported so soon as ports are open. The steel industry is brisk, and very fair contracts are being secured. The value of steel rails is unchanged, being £4 12s. 6d. to £5 5s. per ton. Iron ore is 10s. to 12s. 6d. per ton at the mines. Iron shipbuilding is unchanged, but there is every likelihood of this industry being busy in a short time, as it is roumoured that a few good orders have been secured. Other industries in steady employment.

THE SHEFFIELD DISTRICT

(*From Our Own Correspondent.*)

THE official returns of coal sent to London from the South Yorkshire and Derbyshire coal-fields for January, show that Messrs. Newton, Chambers, and Co. are at the head, having sent by far the largest tonnage by rail. By the Great Northern line alone they sent 10,444 tons, and the total quantity they delivered in the metropolis was 20,662 tons. Clay Cross comes next with 16,908 tons; then Grassmoor, 16,214; Eckington, 13,674; Langley Mill, 12,909; Hucknall, 12,437; Blackwell, 11,959; Birley—the Sheffield Coal Company—11,421; Annesley, 8119; Staveley, 7930; Aberdare, 7339; Aldwarke, 3769; Wharncliffe, 3321.

The Nunnery collieries at Sheffield have been seriously flooded this week. For years these pits have been very troublesome to work on account of their liability to inundation, but the pumping machinery having been very largely increased seemed to be equal to the work up till last Friday, when the water was found to be within ten yards of the surface, or 30ft. higher than any previously known depth. This alarming state of affairs caused inquiry to be made in the Manor pit, where the flood had occurred. Mr. Emerson Bainbridge, the managing director, whose knowledge of coal mines is exceedingly complete, conducted a search party along the arches, on which part of the present Midland station rests. When the station was erected it was built over the river Sheaf. The supposition is that in obtaining a foundation for one of the archways, the workmen came to a point just above where the coal crops out, and that the shaking of the ground by the constant passing to and fro of trains had shaken down a portion of what was the roof of an old working. Whatever the cause, it was found that through a large aperture the river Sheaf was pouring into it at the rate of 2500 gallons a minute. Prompt measures were taken, and the inflow of water prevented; but in spite of the most vigorous pumping, the water standing in the Manor pit level had increased on Monday to 800 yards. The week before the discovery no less than twenty-five million gallons were pumped out, and this quantity will have to be greatly increased if work is to be continued. The Manor pit has not been working since Christmas in consequence of the water in the workings.

According to the advance sheets of the statistical report of the British Iron Trade Association, the whole of the works in this country produced last year 1,673,649 tons of Bessemer ingots—an increase of nearly a quarter of a million tons over the production of the preceding year; and from the ingots there were rolled 1,235,785 tons of steel rails, or an increase of over 212,000 tons. In the Sheffield district—which includes the Atlas, Stocksbridge, Phœnix Bessemer, Cyclops, Grimesthorpe, Penistone, Dronfield, Sheffield Steel and Ironworks—there are thirty-two Bessemer converters, of which twenty-six were in operation at the end of the year. In 1882 there were produced in the Sheffield district 420,000 tons of Bessemer ingots, and 310,000 tons of steel rails, as compared with 392,812 and 285,469 tons respectively for 1881. This increase, though considerable, is not equal to the growth of the business in South Wales, and Cleveland and Durham; of steel made by the Siemens or open hearth process during the past year the production in the Sheffield district in 1882 rose to 42,000 tons, an increase of 8000 tons over 1881. Scotland shows the largest increase. The total for last year was 436,000 tons, an increase of 98,000 tons in 1881. Of these two classes of steel—Bessemer and Siemens—the Sheffield district still produces more than a fifth of the product of the kingdom.

A very old Sheffield trade, the manufacture of combs, is gradually dying out, owing to the Scotch and continental competition. The leading establishment in the town—Messrs. J. and J. Stevenson, Arundel Comb Works, Arundel-street—is about to be closed.

An unpleasant reminder of darker days was given us this week in the rattening of a respectable file-grinder, named James Beatson, who works at the Upper Cut Wheel, in the Rivelin Valley. Beatson left the Union a year ago by ceasing to pay his "natty" money, *i.e.*, his weekly subscriptions, and he refused to rejoin the Union ranks. He was also believed to be willing to concede something to the file manufacturers in regard to their request for a 10 per cent. reduction in wages. Hence, his "hull" was visited, and his bands removed, with twelve dozen of files. The bands have since been recovered, and part of the files, and Beatson has resumed working.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

AT the Cleveland iron market held at Middlesbrough on Tuesday last pig iron was offered at 3d. to 6d. per ton lower than the week previous. A little more animation among buyers was noticeable. Inquiries were not lacking, and consumers seemed not averse to consider the advisability of covering other requirements at the prices now current. The price asked and obtained by merchants and some of the makers for No. 3 g.m.b. was 40s. per ton, f.o.b. The majority of the latter, however, demanded 40s. 6d. for the same quality. The shipments of the last few days show a decided improvement, and it is expected that they will be still better next month, when the navigation season opens. This may strengthen the market. On the other hand, it is thought that an addition of between 20,000 and 30,000 tons will be made to the stocks for February, a result tending towards additional weakness.

The demand for warrants has improved somewhat, and as much as 40s. per ton has been obtained by some holders for No. 3 warrants delivered f.o.b.

The stock of Cleveland iron in Messrs. Connal's Middlesbrough store on Monday night was 85,288 tons, being a decrease of 384 tons since last report.

During the week ending Monday last 16,394 tons of pig iron were shipped from the Tees. The quantity for the month up to the same date was 47,203 tons. In the corresponding period of January this quantity was exceeded by 3400 tons, and by 11,600 tons in February last year.

The finished iron trade has not improved. Prices remain about the same, and the competition continues very keen. The inquiries for plates are a little more numerous, but the angle and bar manufacturers complain of a lack both of new contracts and of specifications against old ones. Ship plates are quoted at from £6 to £6 5s. per ton; angles for shipbuilding at £5 2s. 6d. to £5 7s. 6d.; and common bars at £5 10s. to £5 15s.—all f.o.t. at works, less 2½ per cent.

The directors of Messrs. Palmer's Shipbuilding and Iron Company, Limited, have decided to pay an interim dividend of 3½ per cent. for the half-year ending December 31st last. The dividend for the half-year ending June 30th was also 3½ per cent.

At a meeting of the directors of Messrs. Bolckow, Vaughan, and Co., Limited, held in London on the 23rd February, it was decided to recommend a dividend of 7½ per cent. per annum for the year ending December 31st, 1882. It is intended to write off £40,000 from capital expenditure, and carry forward £36,000.

Messrs. J. L. Thompson and Sons, shipbuilders, of Sunderland, have just put to work four of Tweddell's hydraulic rivetters, and a new rivet heating furnace. The apparatus is giving entire satisfaction.

Messrs. Allhusen and Son, of Newcastle, have purchased a large site of land on the Durham side of the Tees for the purpose of erecting salt works similar to those of Messrs. Bell Bros. Messrs. Allhusen have acquired the salt royalty under the land, and intend to obtain brine in the same way as Messrs. Bell Bros. procure theirs. It is possible that Messrs. Allhusen and Son may build chemical works after a time, but at first they will use the salt they obtain at their Gateshead Works. Messrs. Bell Bros. are making satisfactory progress with their salt works at Port Clarence, and have decided to put down a second bore-hole. They have also drawn up plans for a complete chemical works.

An interesting exhibition of models, sketches, and photographs showing the results of boiler explosions, was held at Middlesbrough on Saturday evening last, under the auspices of the Cleveland Iron Trade Foremen's Association. The whole of the exhibits were lent by the Midland Steam Boiler Inspection and Assurance Company, by whom they have been collected during the past twenty years. The chief engineer to the company, Mr. E. B. Marten, was present, and spoke on the best means of preventing boiler explosions. The President of the Cleveland Foremen's Association said that in the Cleveland district there were no less than 4000 boilers under steam daily, giving out 200,000-horse power.

The employers connected with the North of England Iron Manufacturers' Association held a meeting on February 21st, and among others passed the following resolution:—"Having agreed mutually with the operatives for the reconstruction and strengthening of the action of the Board of Arbitration, it is resolved that the employers give a month's notice for the revival of Mr. Dale's sliding scale of 1880, for deciding the rate of wages, from March 31st next, and for a period hereafter to be arranged." This resolution was discussed by the Council of the Ironworkers' Association at a meeting held at Manchester on Saturday last, and the following resolutions were unanimously adopted:—(1) "That this Council, having fully considered the North of England Employers' notice for the adoption of a sliding scale to regulate wages after March 31st next, are of opinion that sliding scales cannot be beneficial or give justice to the workman, no matter on what basis they may be arranged, unless means are adopted to prevent the glutting of the market by excessive over-production, the reckless competition, and unnecessary and uncalled-for reductions in prices made by some firms or their agents." (2) "That to prevent the continuance of this reckless policy, a meeting of representatives from each lodge of the association in the North of England be convened for the purpose of considering this question, and adopting such united action as will check reckless underselling, which means a reduction in the wages of the workmen, bankruptcy to the employers, and injury to the whole trade of the district." Lodge meetings will be held on Monday next to discuss the matter, and elect delegates, and the delegates will meet at Darlington on Saturday, March 10th.

Mr. J. W. Willans called a meeting on Monday last of the chief members of the Cleveland iron trade, to consider improved arrangements which he has devised for systematically taking slag and other refuse to sea. The most perfect system at present in use is that adopted by Mr. Edwin Jones, of the Normanby Ironworks. By this the entire cost, including 10 per cent. interest upon all the movable plant employed, has been reduced to 7d. per ton of pig iron. The cost of tipping upon elevated slag tips, including redemption of the land used and a similar allowance for interest upon the value of movable plant, is estimated at 11¼d. per ton of pig iron by Mr. Willans. Messrs. Samuelson and Co., however, put the latter cost at 8d. There is no doubt but that the right way to dispose of slag in Cleveland is to take it to sea, and tip it there. To do this systematically and cheaply is the question which week by week is forcing itself upon the ironmasters. Hitherto it has only been done partially. One voyage per tide is now being made. If suitable slag receivers were constructed overhanging the river quays, of sufficient height to allow access below for the barges from half tide to half tide, and of sufficient capacity to hold 300 tons, then two voyages per tide could be made, and the cost of disposal would be greatly lessened. It is to be hoped Mr. Willans' efforts will tend to forward the final solution of the difficulty.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow warrant market has been very flat in the course of the past week, there being a still further decline in prices. The transactions of a speculative nature that have taken place have been upon a very limited scale, being in most cases confined to small lots which were being turned over amongst jobbers. But while the condition of the warrant market has been unsatisfactory, and the speculative demand for iron poor, ironmasters are doing a fair business in the better classes of iron, and they have been endeavouring this week to keep up their quotations. It is only in the case of very good orders that a slight abatement has been made, so that makers' prices may be described as practically unchanged. The past week's shipments of Scotch pig iron show a marked improvement in bulk over those of the preceding week, and the quantities being despatched this week are likewise upon a satisfactory scale. It is with the Continent that the extra shipping business is now doing, the inquiries from the United States being at the moment somewhat backward. The stock of pig iron in Messrs. Connal and Co.'s Glasgow stores has been reduced by 15,000 tons since last week.

Business was done in the warrant market on Friday morning at from 47s. 6d. to 47s. 4½d. cash, the quotations in the afternoon being 47s. 4d. to 47s. 8d. cash, and 47s. 5d. one month. On Monday forenoon transactions were effected at 47s. 6½d. to 47s. 3d. cash, and 47s. 6d. to 47s. 5½d. one month, the quotations in the afternoon exhibiting little change. The forenoon business on Tuesday was at 47s. 1½d. and 47s. 2d. cash, and 47s. 4d. to 47s. 4½d. one month, the afternoon business being at 47s. 2½d. to 47s. 3d. cash, and 47s. 5d. to 47s. 5½d. one month. The market was firmer on Wednesday at 47s. 2d. and 47s. 5d. cash, and 47s. 7½d. one month. To-day—Thursday—transactions took place up to 47s. 7½d. cash, and 47s. 10½d. one month.

The demand for makers' special brands is pretty well maintained, and the quotations are as follows:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 62s.; No. 3, 54s.; Coltness, 65s. and 54s. 6d.; Langloan, 65s. 6d. and 55s. 6d.; Summerlee, 62s. and 52s.; Chapelhall, 61s. and 52s.; Calder, 62s. 6d. and 51s.; Carnbroe, 56s. and 50s.; Clyde, 52s. and 50s.; Monkland, 49s. and 47s. 6d.; Quarter, 48s. 6d. and 46s. 6d.; Govan, at Broomielaw, 49s. and 47s. 6d.; Shotts, at Leith, 64s. 6d. and 56s.; Carron, at Grangemouth, 53s. (specially selected, 57s. 6d.) and 52s.; Kinneil, at Bo'ness, 48s. 6d. and 47s. 6d.; Glengarnock, at Ardrossan, 55s. 6d. and 49s 6d.; Eglinton, 50s. and 47s. 6d.; and Dalmellington, 50s. 6d. and 49s.

The imports of iron ore from Spain have only been moderate in quantity, but they were heavy in the preceding week, and this trade has of late assumed large proportions. The demand for hematite is slack, and prices continue low.

The quantities of Cleveland iron being imported into Scotland have of late been comparatively limited, and there is a total decrease in the arrivals since the 1st January of 12,560 tons. The past week's shipments, however, exhibit a considerable improvement, amounting to 7586 tons, against 4897 in the corresponding week of 1882.

The malleable iron trade is quiet, with a good business doing, all the works being kept busy, and the prospects are, on the whole, not unsatisfactory. At the same time the prices are too low to yield a satisfactory profit, except, perhaps, in connection with orders for the shipbuilding trade.

There is a gratifying amount of activity in the engineering and machinery trade. Locomotive engineers are well supplied with work, and it is reported that a new firm is about to start operations in this department in the northern district of Glasgow.

The coal trade is still very dull in Fifeshire. There is a fair inland consumption at low rates, but the export department is very slack. No doubt the shipping demand will improve by and by. In the meantime, the reduction of 4½d. per day in the miners' wages has taken effect. The colliers are much dissatisfied, and threaten to restrict their labour to five days per week; but as they are under obligation to work eleven days a fortnight, under the special rules, the employers are expected to prevent the restriction being put in operation. There has been rather more doing in coal shipments at some of the ports on the south side of the Firth of Forth. There is likewise a good trade being done at the Clyde and Ayrshire ports, where the prices show very little alteration.

In the course of the past month the new shipping turned out on the Clyde was much larger than in any previous corresponding period. There were twenty-one vessels with an aggregate tonnage of 33,560 launched, as compared with eighteen vessels of 28,300 tons in February, 1882.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

AT the threshold of parliamentary inquiries, and rival dock and railway contests, a few facts relative to Cardiff may not be out of place, and to these I add a fact or two with regard to the great coal source—Rhondda.

With reference to the minor elements of the port—imports—600,000 tons of foreign ore came in last year, 335,000 loads of hewn timber, and in all, 1,245,000 tons. The dock area is composed of 78 acres belonging to the Marquis of Bute, 21 acres to the Penarth Dock Company, and 12 acres to the Glamorgan Canal Company. The new Bute Dock now in progress extends over 35 acres, and in addition there is a timber float of 18 acres. Material additions will be made in the course of the year by the Glamorgan Canal and Penarth Dock companies, which will still further increase the acreage.

The growth of the docks and of Cardiff trade, and the Welsh coal trade generally, may be gleaned from the following statistics, for which I am indebted to the "Cardiff Tide Tables":—In the year 1842 the total exports amounted to 220,000 tons only. This may be regarded as the starting point, as by 1852 they increased to 933,000 tons; by 1862, to 2,304,700 tons; by 1872, to 2,921,300 tons; by 1882, to 6,109,000 tons. Even this large total for 1882 does not show anything like the immense coal clearance from the Rhondda Valley. The official lists are not yet compiled, but it is estimated that last year the total quantity of all coals sent for shipment and to various destinations by land amounted to 9,000,000 tons.

An important company has been formed lately, called the Garth Merthyr Steam Navigation Company, Llangynyd, Glamorgan. The estimate of the area is 16 million tons of coal, and an output of 750 tons daily for fifty years. The concern is a going one. The coal can be put into Cardiff at a cost of 8s. f.o.b.

Two new ship companies are announced—the Ferncliffe, principally a Newport Company, and the Castanos, Penarth, and Cardiff.

The coal trade maintains undiminished vigour, and not only are prices stiff, but inquiries are on the increase. At Cardiff the block on the lines was very great last week, and this was cited as strong proof for a new line and a new dock. The charge against defective railway service cannot, I imagine, be substantiated, considering the rolling stock of the Taff, and the admirable arrangements of its traffic service, but I expect that deficient sidings at the docks and want of more dock room may be the cause of the block, and this will all be remedied by the extensions and sidings of the new bills brought in by the Marquis of Bute.

It was thought that the site of Penydarran Works—cleared off as old iron last week—would have been seized upon for tin-plate, wire, or kindred industry; but these trades are too dull to admit of it. I visited the sale last week, and saw the clearances after. There was quite a little fortune sunk underground. To anyone building steel works, and adopting modern appliances, the utter waste and extravagance in arranging plant must have been at once apparent. This was done from fifty to seventy years ago at least. The pillars were solid; the plates immensely thick, covering the earth like a pavement. Some little bit of modern addition on a simpler form could be seen. This was in the time of Mr. Forthergill, who put a good many thousand pounds sterling into the renovations, but all went, as I said, for old iron. The dearest "bargain" was a lot of the old iron rails, made when iron was good. These fetched £6 per ton.

Welsh steel rails are being made freely, and are evidently approved. During the week the mills have been very active, and some large cargoes have been sent to port. One of these for the Cape Town Railway, which is being carried out by Government, amounted to 2500 tons, to Calcutta another of 2800 tons was forwarded, and the whole *viâ* Newport and Cardiff came to 9000 tons. This, I expect, was almost the largest of the old contracts that we shall see. Ironmasters are now looking forward to the spring business, and if it should turn out anything like the autumn and winter trade no one will complain.

Tin-plates are very quiet. Cokes are at 16s. to 16s. 6d. Liverpool and London, and charcoals do not exceed 19s.

KING'S COLLEGE ENGINEERING SOCIETY.—At a general meeting held on Tuesday last, the 27th ult., a discussion was held on 'Motive Power for Tramways." The discussion, which was opened by Mr. W. C. Fellowes Stewart, was ably taken up by Messrs. Douglass, Home, and Atkinson. Professor Robinson, M.I.C.E. occupied the chair.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

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

20th February, 1883.

915. Utilising Vegetable Fats for Alimentary Purposes, C. A. Meinert and P. Jeserich, Berlin.
916. Producing Gases, W. Arthur.—(*J. Gill, N. York.*)
917. Bread Loaf Cutter, D. M. Ford, Bristol.
918. Steam, &c., Joints, E. D. Penning, London.
919. Water-waste Preventers, F. G. Fleury.
920. Assisting Combustion in Grates, H. W. Davidson and J. Speir, London.
921. Water-gauges, J. Holden, Swindon.
922. Forming Pipes of Concrete, &c., C. A. Day.—(*W. M. Campbell, Michigan; E. W. Bond, Massachusetts; R. Brown, R. D. Radcliffe, and C. Detrick, New York, U.S.*)
923. Sash Fasteners, T. J. Mullings, London.
924. Electric Meter, A. S. Butler, St. Andrews.
925. Button Fastenings, J. Imray.—(*A. McKevit, U.S.*)
926. Appliances for Carriage Wheels, J. A. Turner, Manchester.
927. Secondary Batteries, &c., O. J. Lodge and J. S. Pattinson, Liverpool.
928. Pointing, &c., Guns, H. J. Haddan.—(*A. Pouilly, Saumur, France.*)
929. Muffs, H. J. Haddan.—(*F. Hüsgen, Belgium.*)
930. Taps, &c., W. I. Welsh, Wells.
931. Printing Telegraphs, H. J. Allison.—(*S. D. Field, New York, U.S.*)
932. Carding Engines, R. Tatham, Rochdale, and R. Sellers, Cleckheaton.
933. Arranging Frames, &c., Suitable for Building Structures, W. Lee and D. F. Beale, Maidstone.
934. Making Steel, &c., A. Armitage, Sheffield.
935. Railway Permanent Way, P. M. Justice.—(*S. G. Thomas, Calcutta.*)
936. Sewing Machines, E. P. Alexander.—(*C. H. Crawford, New York, U.S.*)
937. Wheels, W. Eyre, Sheffield.
938. Steam Engines, &c., J. Hall, Manchester.
939. Manufacturing Tiles, &c., E. Edwards.—(*P. A. Sazerac, Peruzet, France.*)
940. Electric Cables, &c., A. M. Clark.—(*A. Fortin-Herrmann, Paris.*)
941. Making Uninflammable Products, A. M. Clark.—(*G. Meyer, Paris.*)
942. Metallic Ores, &c., J. H. Johnson.—(*A. D. Ancel and J. M. A. Thiollier, Paris.*)
943. Drying Animal, &c., Substances, W. R. Lake.—(*L. Maiche, Paris.*)
944. Separating Metals from their Ores, A. E. Scott, London.
945. Tanning Leather, L. Gaulard, London.
946. Spinning-tops, W. R. Lake.—(*C. Kimball, Ohio.*)
947. Life-saving Mattresses, &c., W. R. Lake.—(*L. Heath, Boston, U.S.*)

21st February, 1883.

948. Sewing Machines, W. Jones, Guide Bridge, and H. Gamwell, Liverpool.
949. Ink, A. A. Nesbit, London.
950. Knitting Machines, W. Morgan-Brown.—(*G. A. Leighton and S. C. Forsaith, Manchester, U.S.*)
951. Electric Arc Lamp, H. Trott, Battersea, and C. F. Fenton, Twickenham.
952. Horseshoes, J. Ferris, Athlone.
953. Dense Metal Castings, C. M. Pielsticker, London.—(*Partly a communication from F. C. G. Müller, Germany.*)
954. Card, &c., Can Rings, J. Rothwell and G. McMillan, Farnworth.
955. Machinery for Cleaning Wool, J. C. Walker and S. Beaumont, Leeds.
956. Producing the Bases of Colouring Matters, E. G. Brewer.—(*The Chemische Fabrik auf Actien—vormals E. Schering—Berlin.*)
957. Brewing Process, E. P. Alexander.—(*C. Zimmer, Frankfort-on-the-Main, Germany.*)
958. Ingots, D. Davies, Crumlin.
959. Harness, &c., J. G. Tongue.—(*D. Curtis, U.S.*)
960. Governors, F. M. Rogers.—(*J. M. Gorham, Roumania.*)
961. Miners' Safety Lamps, G. Timmis, Stourbridge.
962. Machines for Morticing Wood, J. H. Johnson.—(*J. B. Alexandre, Paris.*)
963. Guard for Forks, A. Clark.—(*T. F. Curley, U.S.*)
964. Producing Designs on Wood, A. Guattari, Paddington.
965. Transmitting Audible Signals, A. F. St. George, London.
966. Railway Carriage Lamps, W. Blakeley, Bournemouth.

22nd February, 1883.

967. Extracting Sugar from Molasses, &c., C. Steffen, Vienna.
968. Measuring, &c., Liquids or Fluids, J. J. Tylor, London.
969. Making Precipitated Phosphate of Lime, &c., W. Weldon.—(*E. Lombard, Marseilles.*)
970. Coal-cutting Machinery, T. C. Fawcett and F. H. Stubbs, Leeds.
971. Window Fasteners, T. H. Collins, Winchester.
972. Separating Liquids from Solids, H. J. Haddan.—(*Gaillet and Huet, Lille, France.*)
973. Dynamo-electric Machines, J. Hopkinson, London.
974. Railway Signalling, W. W. Linscott, London.
975. Preparing Steel for Springs, E. de Pass.—(*A. H. Elliott, New York, U.S.*)
976. Spring for Watches, E. de Pass.—(*A. Elliott, U.S.*)
977. Weighing Machines, E. Wölner, Liverpool.
978. Effecting Illumination by means of Hydrocarbons, C. D. Abel.—(*J. Pintsch, Berlin.*)
979. Working Railway Signals, H. Fisher, Cardiff.
980. Treating Steel Ingots, G. Snelus, Workington.

23rd February, 1883.

981. Lifts, &c., A. B. Dansken, Glasgow.
982. Furnaces, G. Taylor, Middleton.
983. Knitting Machinery, F. Johnson, Nottingham.
984. Chimney-pots, &c., F. Hammond, London.
985. Forming Letters at a Distance, M. T. Neale, Bayswater.
986. Pirn and Spool Winding Machines, P. H. Marriott, and J. Hall, Stockport.
987. Tip Vans, &c., E. Burton, London.
988. Heating by Hot Water, H. and C. F. Longden, Sheffield.
989. Mathematical Instruments, A. Leo and P. S. Marks, London.
990. Cradles, &c., J. Brown, Montrose.
991. Furnaces, W. E. Gedge.—(*L. A. Perrin and J. E. A. Servel, Loire, France.*)
992. Furnaces, P. W. Willans, Thames Ditton.
993. Spider Wheels, J. Orme, London.
994. Floating Docks, G. B. Rennie, London.
995. Purifying Coal Gas, J. T. McDougall, London.
996. Apparatus for Sinking Shafts, &c., A. J. Boult.—(*I. Quinet and A. Denis, Denaine, France.*)
997. Distributing Type, W. L. Wise.—(*F. C. Wyvill, Westphalia, Germany.*)
998. Boots and Shoes, W. R. Lake.—(*E. Le Gay, Paris.*)
999. Gas, &c., Engines, A. M. Clark.—(*N. de Kabath, Paris.*)

24th February, 1883.

1000. Crank, &c., Shafts, A. Jack and H. McCall, Liverpool.
1001. Mechanical Relay Apparatus, D. J. Dunlop, Port Glasgow, N.B.
1002. Fixing the Blades of Screw Propellers to the Bosses, E. P. Timmins and J. Rose, Cardiff.
1003. Ironing Stone, L. A. Groth.—(*L. v. Dulcken, Stuttgart, Germany.*)
1004. Operating on Fibrous Substances, C. Court, Rotherhithe.
1005. Fastener-buttons, E. Colton.—(*E. Wuerfel, U.S.*)
1006. Machines for Warping, &c., Yarn, &c., W. McGee and T. Watson, Paisley.
1007. Supplying Sensitive Plates in Cameras, J. H. Hare and H. J. Dale, London.
1008. Saddles, J. A. Lamplugh, Birmingham.
1009. Sewing Machines, J. Warwick, Manchester.
1010. Gas Engines, C. H. Andrew, Stockport.
1011. Canton Crape, N. Kumagaya, Blackburn.
1012. Lubricating Axles, R. Cunliffe, Manchester.
1013. Costume Stands, B. Sigrist, London.
1014. Propelling Tram-cars, M. H. Smith, Halifax.
1015. Galvanic Batteries, O. C. D. Ross, London.
1016. Secondary, Batteries, R. Courtenay, London.
1017. Furnaces, I. S. McDougall, Manchester.
1018. Apparatus for Damping Fabrics, J. B. Jackson and G. Bentley, Bury.
1019. Operating Electrical Generators, T. J. Handford.—(*T. A. Edison, Menlo Park, U.S.*)
1020. Applying Variable Resistance to Electric Currents without Commutator, L. Gaulard and J. D. Gibbs, London.
1021. Bottle-stoppers, &c., W. R. Lake.—(*S. A. Bull, London.*)
1022. Electrical Railways, T. J. Handford.—(*T. A. Edison, Menlo Park, U.S.*)
1023. Apparatus for Measuring Liquids, R. Jobling, London.
1024. Cribs for Children, A. Clark.—(*I. Opdyke, U.S.*)
1025. Hydraulic Machinery, W. R. Lake.—(*C. Jouffray, Vienne, France.*)
1026. Actuating Cross-cut Saws, R. Richmond and W. Whiting, London.

26th February, 1883.

1027. Tramway, &c., Engines, I. W. Boulton, Ashton-under-Lyne.
1028. Furniture, &c., W. Shepherd, London.
1029. Hoops, &c., for Securing Tools to their Shafts, T. Brown, Sheffield.
1030. Self-acting Grabs, &c., W. D. and S. Priestman, Kingston-upon-Hull.
1031. Jacquard Pegs, E. O. Taylor, Huddersfield.
1032. Scraping Ships' Bottoms Under Water, G. W. Mallett, West Greenwich.
1033. Apparatus for Rolling Metallic Tubes, P. M. Parsons, Blackheath.
1034. Steering Apparatus, J. L. Cathcart, U.S.
1035. Lanterns, &c., J. Rogers, London.
1036. Cartridges, T. Nordenfelt, London.
1037. Generating Electricity, A. M. Clark.—(*H. A. Archereau, Paris.*)
1038. Treating Peat, J. Kendall, Kingston Hill.

Inventions Protected for Six Months on Deposit of Complete Specifications.

876. Lockstitch Sewing Machines, L. Silverman, London.—*17th February, 1883.*
945. Tanning Leather by Electricity, L. Gaulard, London.—*20th February, 1883.*
950. Knitting Machines, W. Morgan-Brown, London.—A communication from G. A. Leighton and S. C. Forsaith, Manchester, U.S.—*21st February, 1883.*

Patents on which the Stamp Duty of £50 has been paid.

733. Kitchen Ranges, W. H. Hughes, Worcester.—*19th February, 1880.*
762. Expanding Basket, N. Kraillsheimer, London.—*20th February, 1880.*
770. Anti-fouling Compound, J. B. Hannay, Glasgow.—*21st February, 1880.*
781. Navigational Sounding Apparatus, W. Thomson, Glasgow.—*23rd February, 1880.*
938. Bleaching, &c., Straw, F. C. Glaser, Berlin.—*3rd March, 1880.*
1220. Gas Generators, &c., C. Pieper, Berlin.—*22nd March, 1880.*
1244. Regulating Electro-magnetic Motors, J. H. Johnson, London.—*23rd March, 1880.*
1259. Electro-magnetic Motors, J. H. Johnson, London.—*24th March, 1880.*
750. Steam Steering Engines, C. G. Y. King, Liverpool.—*20th February, 1880.*
760. Motive Power Engines, E. Edwards, London.—*20th February, 1880.*
865. Metal Moulds, E. H. Waldenstrom and W. Sumner, Manchester.—*27th February, 1880.*
765. Checking Workmen's Time, F. Sage, London.—*21st February, 1880.*
800. Furnace Fronts, &c., T. Henderson, Higher Tranmere.—*24th February, 1880.*
841. Boots and Shoes, W. R. Lake, London.—*25th February, 1880.*
790. Tile for Roofing, T. Hughes, Birmingham.—*23rd February, 1880.*
809. Service Valves, W. Ross, Glasgow.—*24th February, 1880.*
835. Washing Bottles, &c., W. W. Horner, London.—*25th February, 1880.*
864. Making Types, J. M. Hepburn, London.—*27th February, 1880.*
926. Introducing Liquids into Bottles, R. L. Howard, Luton.—*2nd March, 1880.*
966. Changing Shuttles in Looms, J. Imray, London.—*5th March, 1880.*
979. Breech-loading Fire-arms, P. T. Godsal, 52nd Regiment Light Infantry.—*6th March, 1880.*
1007. Lamps for Burning Fluids, A. E. Rugg, Bebington.—*9th March, 1880.*
791. Making Gas, A. P. Chamberlain, London.—*23rd February, 1880.*
815. Apparatus for Moulding Sugar, W. Morgan-Brown, London.—*24th February, 1880.*
821. Sheaf-binding Mechanism, J. Howard and E. T. Bousfield, Bedford.—*24th February, 1880.*
846. Communicating Fluid Pressure to Work Movable Machinery, C. A. Parsons and W. Cross, Elswick.—*26th February, 1880.*
1178. Dynamo-electric, &c., Machine, J. Perry, London.—*18th March, 1880.*
823. Jacquard and Clipping Apparatus, J. Bettney, South Nottingham.—*25th February, 1880.*
842. Producing Electric Light, A. M. Clark, London.—*25th February, 1880.*

Patents on which the Stamp Duty of £100 has been paid.

751. Preventing, &c., Escape of Gas, W. J. Warner, South Shields.—*23rd February, 1876.*
810. Middlings Separators, J. Walworth, Bradford.—*26th February, 1876.*
940. Gas-burners, G. Bray, Leeds.—*4th March, 1876.*
977. Converting Hides into Leather, W. R. Lake, London.—*6th March, 1876.*
1088. Steam Ferry Boats, &c., W. Simons, Renfrew.—*13th March, 1876.*
783. Mowing, &c., Machines, W. McI. Cranston, London.—*24th February, 1876.*

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition, 16th March, 1883.*)

4940. Millstone Balance, A. J. Boult, London.—A communication from J. C. E. Thierrion.—*17th October, 1882.*
4974. Reducing Iron Ore, W. E. Gedge, London.—A communication from L. Durand and D. H. Walker.—*19th October, 1882.*
4985. Motive-power Apparatus for Actuating Sewing Machines, J. Templeton and J. Hilson, London.—*19th October, 1882.*
4987. Obtaining the Salts Contained in Mineral Waters, A. J. Boult, London.—A communication from E. Kuhn.—*19th October, 1882.*
4988. Electric Arc Lamps, A. Serrailler, London.—*19th October, 1882.*
4998. Lamps or Lanterns, A. W. Kershaw, Lancaster.—*20th October, 1882.*
5002. Fittings for Incandescent Electric Lamps, M. Evans, Wemyss Bay.—*20th October, 1882.*
5022. Harrows, A. Clarke, Stevenage.—*21st October, 1882.*
5023. Carbons for Incandescent Electric Lamps, M. Bailey, London.—*21st October, 1882.*
5025. Separating Copper from Matt or Regulus Containing Copper, J. Plaisted, London.—*21st October, 1882.*
5038. Permanent Way of Railways, J. Morrison and R. Armstrong, Newbattle.—*23rd October, 1882.*
5050. Electric Lighting Apparatus, H. H. Lake, London.—A communication from S. F. V. Choate.—*23rd October, 1882.*
5051. Automatic Registering Apparatus for Carriages, W. H. Beck, London.—A communication from X. Portafax.—*23rd October, 1882.*
5068. Liquid Meters, J. C. Mewburn, London.—Com. from A. S. St. Albin.—*24th October, 1882.*
5104. Compounds of Materials for use in Place of Leather for Electrical Insulation, M. Bauer, L. Brougard, and J. Ancel, Paris.—*26th October, 1882.*
5152. Making Paper Tubes, J. C. Mewburn, London.—Com. from M. Schaffhauser.—*30th October, 1882.*
5157. Winding Yarn and Thread, J. Liddell, J. S. and S. H. Brierly, F. W. Hirst, and D. Hamer, Huddersfield.—*30th October, 1882.*
5234. Bicycles, &c., G. Singer, Coventry, and W. R. Davies, Abergavenny.—*2nd November, 1882.*
5276. Utilising Motive Force of Waves, W. R. Lake, London.—A communication from A. de Souza.—*4th November, 1882.*
5357. Folding or Collapsible Boxes, A. M. Clark, London.—A communication from W. H. H. Rogers.—*9th November, 1882.*
5487. Slaying Warps, R. L. Hattersley and W. Greenwood, Keighley.—*18th November, 1882.*
5713. Distillation of Coal, W. J. Cooper, London.—*30th November, 1882.*
5796. Electric Lamps or Lighting Apparatus, W. R. Lake, London.—A communication from R. H. Mather.—*5th December, 1882.*
5918. Dynamo Electric Machines, H. H. Lake, London.—A communication from R. H. Mather.—*12th December, 1882.*
5980. Making Bottles, H. E. Newton, London.—A communication from Messrs. de Poilly, de Fitz-James, and de Brigode.—*14th December, 1882.*
6135. Combing Wool, W. Terry and J. Scott, Bradford.—*22nd December, 1882.*
6212. Making Boots and Shoes, T. Laycock, Northampton.—*29th December, 1882.*
117. Sharpening Drills, J. H. Johnson, London.—A communication from J. S. Bancroft and W. H. Thorne.—*9th January, 1883.*
118. Surface Condensing Engines, J. Chapman, Leith.—*9th January, 1883.*
123. Spark Arresters, A. J. Boult, London.—Com. from J. A. Sterling.—*9th January, 1883.*
155. Pen for Fountain Penholders, G. S. Rayson, Balham.—*10th January, 1883.*
203. Making Iron Hand-rail Stanchions, W. Rockliffe, Sunderland.—*13th January, 1883.*
409. Sewing Machines, I. Nasch, London.—*25th January, 1883.*
415. Raising and Lowering Weights, J. and J. T. Pickering, Stockton-on-Tees.—*25th January, 1883.*
462. Binding Sheaves or Trusses, J. Howard and E. T. Bousfield, Bedford.—*27th January, 1883.*
470. Governors for Steam, &c., Engines, C. J. Galloway and J. H. Beckwith, Manchester.—*29th January, 1883.*
540. Distilling, &c., Mineral Oils, N. M. Henderson, Broxburn.—*1st February, 1883.*
589. Producing Combustible Gas for Steel Making, &c., W. Crossley, Glasgow.—*3rd February, 1883.*
876. Lock stitch Sewing Machines, L. Silverman, London.—*17th February, 1883.*

(*Last day for filing opposition, 20th March, 1883.*)

5012. Ploughs, E. Edwards, London.—A communication from P. P. Jacotot.—*21st October, 1882.*
5026. Tips for Heels and Toes of Boots, G. Chambers, London.—*21st October, 1882.*
5032. Dry Distillation, J. Jameson, Newcastle-on-Tyne.—*23rd October, 1882.*
5041. Sewage Trap, &c., E. Green, Halifax.—*23rd October, 1882.*
5043. Brushes for Painting, &c., J. Culmner, London.—*23rd October, 1882.*
5046. Carriage Bodies, J. S. G. F. Hörcher, Prussia.—*23rd October, 1882.*
5053. Bedsteads, M. Lawson, Ayr, N.B.—*24th October, 1882.*
5056. Liquor Stands or Frames, J. Hall, Sheffield.—*24th October, 1882.*
5058. Bathing and Promenade Piers, G. G. Page, London, and R. Nunn, Salisbury.—*24th October, 1882.*
5066. Ratchet Wrenches, L. Bagger, Washington, U.S.—A communication from G. W. Hight and D. Bailey.—*24th October, 1882.*
5069. Combination Shoe-horn and Button-hook, S. Pulzer, London.—*24th October, 1882.*
5076. Coke, J. Jameson, Newcastle-on-Tyne.—*24th October, 1882.*
5081. Railway Signalling Apparatus, J. Boustead and H. Neville, London, and J. Holt, Essex.—*24th October, 1882.*
5082. Bit Stocks, G. F. Redfern, London.—A communication from J. P. Lawrence.—*24th October, 1882.*
5090. Discharging Oil, &c., upon Waves, R. Rose, London.—*25th October, 1882.*
5095. Governor or Regulator, H. and T. A. Greene, London.—*26th October, 1882.*
5096. Tilting Casks, E. Hogg, Gateshead-on-Tyne.—*27th October, 1882.*
5129. Insulating Conductors of Electricity, C. W. Tott, Birmingham.—*27th October, 1882.*
5132. Kilns, E. de la G. Williams, Birmingham.—*27th October, 1882.*
5150. Drawing Corks from Bottles, A. Olsson, Sandviken.—*30th October, 1882.*
5178. Folding Tables, F. F. Atkinson, New York, U.S.—*31st October, 1882.*
5219. Refrigerating, &c., Rooms, J. Y. Johnson, London.—A communication from J. B. J. Mignon and S. H. Rouart.—*1st November, 1882.*
5226. Stoppering Bottles, &c., J. Airey, Darlington.—*2nd November, 1882.*
5244. Elevators for Grain, &c., H. Garland, West Kirby, and R. Bennett, Liverpool.—*3rd November, 1882.*
5249. Wicks of Railway Carriage Lamps, H. Defries, London.—*3rd November, 1882.*
5430. Bottles for Containing Liquid Blacking, &c., S. M. Bixby, New York, U.S.—*14th November, 1882.*
5432. Musical Instruments, W. Booth, Rochdale.—*14th November, 1882.*
5452. Preventing Displacement of Keys or Wedges, L. Williams and D. Edwards, Cardiff.—*15th November, 1882.*
5476. Ships' Hatches, R. T. Pawley, Cardiff.—*17th November, 1882.*
5601. Secondary Batteries, A. Tribe, London.—*24th November, 1882.*
5633. Telephonic Apparatus, H. H. Lake, London.—Com. from C. A. Randall.—*27th November, 1882.*
5679. Ships of War, J. D. Barker, Somerset.—*29th November, 1882.*
5768. Steam Engines, C. Ridealgh, Sunderland.—*4th December, 1882.*
23. Breech-loading Fowling Pieces and Fire-arms, H. W. Holland and J. Robertson, London.—*1st January, 1883.*
220. Chimney Cowls, G. Davis, Aberystwith, W. Jones, Llannon, and R. Girdwood, Edinburgh.—*15th January, 1883.*
297. Automatic Locking Devices, G. Macaulay-Cruikshank, Glasgow.—Com. from S. H. Raymond and C. N. Shepherd.—*18th January, 1883.*
352. Fire-resisting Doors, J. M. Hart, London.—*22nd January, 1883.*
353. Locks and Latches, J. M. Hart, London.—*22nd January, 1883.*
360. Moulding Socketted Pipes, G. Smith, Leicester.—*22nd January, 1883.*
445. Folding Lattice Shutter, P. Born, London.—*27th January, 1883.*

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 23rd February, 1883.*)

4051. Preserving Meat, &c., W. H. Northcott, London.—*24th August, 1882.*
4063. Apparatus for Retaining Heat, &c., J. Cavargna, Manchester.—*24th August, 1882.*
4071. Apparatus for Printing, W. C. Haigh, Manchester.—*25th August, 1882.*
4074. Heating Baths, D. Jones, Walton.—*25th August, 1882.*
4086. Railway, &c., Carriages, W. J. Bennett and C. H. Rosher, London.—*26th August, 1882.*
4087. Lighting Trains by Electricity, H. E. Newton, London.—*26th August, 1882.*
4106. Printing Ink, C. F. Claus, London.—*28th August, 1882.*
4107. White Pigments, &c., C. F. Claus, London.—*28th August, 1882.*
4108. Preparing, &c., Porous Siliceous Materials, C. F. Claus, London.—*28th August, 1882.*
4119. Propelling Ships, &c., G. F. Harrington, Ryde.—*29th August, 1882.*
4125. Roasting Coffee, W. T. Sugg, London.—*29th August, 1882.*
4131. Silicate of Zinc, C. F. Claus, London.—*29th August, 1882.*
4136. Indicator for Cabs, &c., J. Finney, Manchester.—*30th August, 1882.*
4145. Marine and Fluvial Structures, J. G. Tongue, London.—*30th August, 1882.*
4148. Generating, &c., Electrical Energy, P. de Villiers, London.—*30th August, 1882.*
4150. Steering Gear, J. Granroth, Greenock.—*31st August, 1882.*
4158. Measuring, &c., Electric Currents, A. L. Lineff, London.—*31st August, 1882.*
4180. Carbons for Incandescent Electric Lamps, J. Jameson, Newcastle-on-Tyne.—*1st September, 1882.*
4181. Producing High Vacuum, J. Jameson, Newcastle-upon-Tyne.—*1st September, 1882.*
4193. Cutting Linings of Hats, W. H. Beck, London.—*2nd September, 1882.*
4199. Hopper, &c., Dredgers, W. R. Kinipple, Greenock.—*4th September, 1882.*
4200. Handles for Bicycles, G. S. Kelsey, Birmingham.—*4th September, 1882.*
4209. Starch and Food for Animals, H. H. Lake, London.—*4th September, 1882.*
4216. Rolling Wire Rods, W. Morris, Oakengates.—*5th September, 1882.*
4224. Starch, W. R. Lake, London.—*5th September, 1882.*
4228. Shuttle-box Shifting Mechanism for Looms, D. Anderson, Glasgow.—*5th September, 1882.*
4233. Holding Cords for Venetian Blinds, &c., J. Hudson, Bolton.—*6th September, 1882.*
4254. Voltaic Batteries, F. W. Durham, New Barnet.—*7th September, 1882.*
4264. Boxes or Trunks, C. H. Stanbury, London.—*7th September, 1882.*
4285. Cutting, &c., Glass, W. R. Lake, London.—*8th September, 1882.*
4298. Keyboard Instruments, A. W. L. Reddie, London.—*9th September, 1882.*
4358. Coupling and Uncoupling Railway Trucks, &c., G. Fenwick, Gateshead-on-Tyne.—*13th September, 1882.*
4376. Dynamo-electric Machines, M. Deprez, Paris.—*14th September, 1882.*
4380. Suspending Horizontal Bars, G. Welling, London.—*14th September, 1882.*
4395. Stocks and Dies, C. Neil, Sheffield.—*15th September, 1882.*
4436. Base Material for Paint or Covering, G. E. Church, Providence, U.S.—*18th September, 1882.*
4492. Producing Electric Currents, A. R. Sennett, Worthing.—*20th September, 1882.*
4494. Grape Sugar or Glucose, W. R. Lake, London.—*20th September, 1882.*
4510. Lamps Burning Mineral Oils, J. Imray, London.—*21st September, 1882.*
4578. Dredging Buckets, W. Clark, London.—*26th September, 1882.*
4591. Pasting Labels to Bottles, &c., F. Foster, London.—*27th September, 1882.*
4887. Vehicles Propelled by Human Force, C. Truman, Birmingham.—*11th October, 1882.*
4854. Transmitting Heat to Fluids, W. L. Wise, London.—*12th October, 1882.*
4909. Screw-neck Bottles, &c., F. Foster, London.—*16th October, 1882.*
5105. Electric Lighting Apparatus, P. Cardew, Chatham.—*26th October, 1882.*
5264. Coal Gas, H. E. Newton, London.—*4th November, 1882.*
5363. Treatment of Compressed Air, T. A. English and J. Sturgeon, London.
5384. Composition of Journal, &c., Bearings, A. M. Clark, London.—*11th November, 1882.*
6008. Obtaining Ammonia, F. Lorenz, Prussia.—*16th December, 1882.*
6015. Blasting Powder, J. Polkinghorne, Cornwall.—*16th December, 1882.*
6019. Dynamo-electric Machines, W. S. Horry, London.—*16th December, 1882.*
6154. Bedsteads, G. Gentle, London.—*23rd December, 1882.*

(*List of Letters Patent which passed the Great Seal on the 27th February, 1883.*)

4098. Balloons, J. A. Fisher and C. G. Spencer, London.—*28th August, 1882.*
4104. Portable Folding or Collapsible Boats, L. W. Jelf, London.—*28th August, 1882.*
4105. Looms for Weaving, J. Dawson, Dukinfield.—*28th August, 1882.*
4121. Fastenings for Scythes, A. J. Boult, London.—*29th August, 1882.*
4122. Safety Stirrups, A. J. Boult, London.—*29th August, 1882.*
4139. Pressing Woollen, &c., Fabrics, J. Burras and W. Renton, Leeds.—*30th August, 1882.*
4140. Spinning Flax and Hemp, J. S. Coey and J. McArthur, Leeds.—*30th August, 1882.*
4153. Carpet Fastener, E. Edwards, London.—*31st August, 1882.*
4165. Steam and Hot-water Apparatus, W. R. Lake, London.—*31st August, 1882.*
4175. Securing Heads of Brooms to Handles, W. J. Sage, London.—*1st September, 1882.*
4178. Secondary, &c., Batteries, D. G. Fitz-Gerald and T. J. Jones, London.—*1st September, 1882.*
4195. Paper Bags, T. Coates, Carlisle, and N. Chandler, Hednesford.—*2nd September, 1882.*
4196. Recording Votes, J. Lazenby, Darnall.—*2nd September, 1882.*
4239. Holders for Wire Ropes, T. Archer, jun., Gateshead.—*6th September, 1882.*
4243. Sprit Sails, W. Rowden, Whitstable, and C. E. Doughty, Margate.—*6th September, 1882.*
4252. Paper-cutting Machines, W. H. and F. C. W. Latham, Bolton.—*7th September, 1882.*
4277. Treating Starchy Substances, W. Lawrence, London.—*8th September, 1882.*

4293. MULTIPLE CYLINDER ENGINES, F. Wynne, London.—9th September, 1882.
4301. DISTRIBUTING WATER, &c., in GARDENS, J. T. Foot, London.—9th September, 1882.
4316. SECONDARY, &c., BATTERIES, F. J. Cheesbrough, Liverpool.—11th September, 1882.
4317. SECONDARY, &c., BATTERIES, F. J. Cheesbrough, Liverpool.—11th September, 1882.
4345. LANTERNS, A. J. Boult, London.—12th September, 1882.
4369. WINDOW SASH FASTENERS, W. A. MacLeod, Birkenhead.—14th September, 1882.
4392. UMBRELLA, &c., FRAMES, H. J. Haddan, London.—15th September, 1882.
4422. TELEPHONIC TELEGRAPHY, C. A. McEvoy and J. Mathieson, London.—16th September, 1882.
4522. SPRING MATTRESSES, J. Lokie, Glasgow.—22nd September, 1882.
4552. PAINTS FOR COATING SHIPS' BOTTOMS, A. B. Rodyk, London.—25th September, 1882.
4605. MAKING PAPER, J. A. Johnson, London.—28th September, 1882.
4972. BRAKES, E. C. and T. Blackmore, Cardiff.—19th October, 1882.
5309. ENVELOPES, W. R. Lake, London.—7th November, 1882.
5448. ANCHORS, J. H. Kidd, Wrexham.—15th November, 1882.
5957. TABLES, A. Thomson, Glasgow.—13th December, 1882.
5978. ACTUATING RAILWAY POINTS, H. Johnson, Eccles.—14th December, 1882.
6048. SEWING STRAW PLAITS, &c., into HATS, J. H. Johnson, London.—19th December, 1882.
6220. LOOMS for WEAVING, W. Smith, Heywood.—29th December, 1882.

List of Specifications published during the week ending February 24th, 1883.

2881, 2d.; 2965, 2d.; 3019, 2d.; 3083, 2d.; 3125, 6d.; 3136, 6d.; 3152, 4d.; 3171, 6d.; 3172, 6d.; 3174, 6d.; 3182, 6d.; 3190, 8d.; 3193, 2d.; 3197, 6d.; 3198, 6d.; 3202, 6d.; 3204, 1s. 4d.; 3212, 6d.; 3213, 6d.; 3226, 6d.; 3229, 6d.; 3230, 10d.; 3231, 6d.; 3232, 6d.; 3233, 6d.; 3234, 4d.; 3235, 6d.; 3236, 6d.; 3239, 8d.; 3242, 6d.; 3244, 2d.; 3245, 6d.; 3247, 6d.; 3249, 8d.; 3253, 2d.; 3254, 6d.; 3255, 6d.; 3257, 6d.; 3258, 6d.; 3262, 4d.; 3263, 2d.; 3264, 2d.; 3266, 2d.; 3267, 6d.; 3269, 2d.; 3270, 2d.; 3271, 6d.; 3273, 2d.; 3274, 6d.; 3280, 2d.; 3284, 6d.; 3286, 2d.; 3287, 6d.; 3289, 2d.; 3297, 6d.; 3298, 2d.; 3299, 2d.; 3300, 2d.; 3301, 4d.; 3302, 4d.; 3303, 4d.; 3304, 2d.; 3305, 6d.; 3306, 6d.; 3309, 4d.; 3310, 2d.; 3318, 6d.; 3321, 4d.; 3422, 10d.; 3325, 6d.; 3326, 2d.; 3327, 2d.; 3329, 4d.; 3331, 2d.; 3332, 6d.; 3333, 4d.; 3336, 2d.; 3338, 6d.; 3340, 6d.; 3342, 4d.; 3344, 6d.; 3345, 6d.; 3358, 2d.; 3369, 2d.; 3378, 2d.; 3379, 2d.; 3384, 6d.; 3386, 2d.; 3389, 2d.; 3392, 2d.; 3397, 2d.; 3398, 4d.; 3399, 2d.; 3401, 2d.; 3402, 4d.; 3303, 2d.; 3406, 2d.; 3407, 2d.; 3409, 2d.; 3413, 2d.; 3433, 2d.; 3444, 6d.; 3447, 4d.; 3541, 2d.; 3574, 6d.; 3783, 6d.; 5280, 6d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for THE ENGINEER *at th office of Her Majesty's Commissioners of Patents.*

2881. MEASURING DRAPERY, &c., *J. Scruby, Romford, Essex.—19th June,* 1882.—*(Provisional protection not allowed.)* 2d.
This relates to a measure for measuring long lengths of cloth.

2965. MANUFACTURE OF FUEL MADE FROM COAL SCREENINGS, &c., *B. E. W. Siffken, Buckhurst Hill.—22nd June,* 1882.—*(A communication from W. C. Siffken, Victoria, Canada.)—(Provisional protection not allowed.)* 2d.
This consists in the manufacture of fuel from coal screenings and other materials by moulding the same into blocks and piercing the said blocks with upright conical perforations.

3011. LAMPS, &c., *S. Grafton, Birmingham.—26th June,* 1882.—*(Provisional protection not allowed.)* 2d.
This relates to means for trimming the wick, extinguishing the flame, and carrying matches.

3019. ELECTRIC SOCK FOR BOOTS AND SHOES, *F. W. Woodman, Brixton, and T. W. Aylesbury, Sutton, Surrey.—26th June,* 1882.—*(Not proceeded with.)* 2d.
This relates to a sock to be placed in the boot, which generates currents of electricity when excited by the moisture of the foot.

3083. WRITING INK, *E. Detmold, Putney.—30th June,* 1883.—*(Provisional protection not allowed.)* 2d.
This relates to compositions, each of which when mixed will produce ink possessing the property of drying instantaneously on contact with the paper or other substance.

3125. MANUFACTURE OF CARBONATE OF SODA, &c., *C. Wigg, Liverpool.—3rd July,* 1882. 6d.
This relates to the manufacture of carbonate of soda by the ammonia process—that is to say, the process in which free ammonia and carbonic acid gas re-act upon brine.

3136. SHACKLES, *R. M. Ruck, Chatham.—3rd July,* 1882. 6d.
This relates partly to securing shackle pins or bolts by washers of flexible elastic material.

3152. MANUFACTURE OF BOOTS AND SHOES, *T. Morgan, Charing-cross.—4th July,* 1882.—*(A communication from F. A. Schmider, Tell, Baden.)* 4d.
This consists in making soles and heels durable by many perforations of the sole and the bottom piece of the heel, and by putting and pressing in conical tinned steel blocks in such a manner that the smallest surfaces of the said blocks will be the exterior, so that they are kept in the sole, and offer continually greater surfaces against wear and tear.

3171. APPARATUS FOR GOVERNING MARINE ENGINES BY ELECTRICITY, *W. W. Girdwoods, Poplar.—5th July,* 1882. 6d.
This relates to a combination of a float placed in a tube close to the propeller of a steamship and connected by chains with a wheel placed in close proximity to an electro-magnet, the armature of which is connected with the throttle valve of the engine to be controlled. The action of the wheel causes the circuit of the electro-magnet to be broken or closed, and the armature attracted or not, according to whether the float descends or ascends, owing to the motion of the sea. When the float descends it closes the circuit, and by means of the electro-magnet, armature, and gearing, the throttle valve, but when it ascends the circuit is broken and the valve opened.

3172. VOLTAIC BATTERIES, *J. Imray, Chancery-lane.—5th July,* 1882.—*(A communication from P. Jablochkoff, Paris.)* 6d.
This consists in the employment of sodium or potassium as the negative element in a battery, the voltaic action being by this means produced by air alone, in place of the acid usually employed. The other element is either carbon, or spongy platinum, or metal gauze, the porosity of which is necessary to admit air to act on the oxidisable metal, a porous material, such as thin paper, being interposed between the two elements.

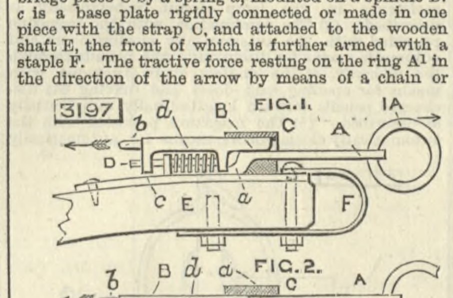
3174. HORSESHOES, *M. Bauer, Paris.—5th July,* 1882.—*(A communication from J. R. Caucis, Sol, Spain.)* 6d.
This consists of a horseshoe having fixed or detachable side straps, which are secured to recesses of the shoe, and applied by articulated fastening bands or links to the body of the hoof.

3182. SECURING, SEALING, AND LABELLING MAIL BAGS, &c., *A. M. Clark, London.—5th July,* 1882.—*(A communication from T. A. Platt and W. Man, New York, and W. G. Platt, Elizabeth, New Jersey.)* 6d.
This relates to a device which consists in a label frame, a cup for holding sealing wax, and a strap for tying the bag.

3190. ELECTRIC AND OTHER TELL-TALES FOR INDICATING AND REGISTERING, *A. Schweitzer and T. Lawrie, London.—6th July,* 1882. 8d.
This relates, First, to an electric self-printing telltale for recording by automatic printing in plain figures the exact time of visits to certain places by night watchmen and others. It consists of two rollers, between which a band of paper is being continually wound by clockwork. The periphery of one of the rollers has the numbers 1 to 12 engraved on it, representing the hours, and these are printed on to the paper. When the circuit is closed by the watchman at any appointed place, the current acts on an electro-magnet which draws down a lever, at the end of which is a letter or figure, and this is printed on the paper. The second part of the invention relates to an electric tell-tale money till, in which the coins when dropped in close an electric circuit, and register themselves by means of an indicator and bell.

3193. INSTRUMENT FOR OPENING AERATED WATER BOTTLES, &c., *J. Parton and D. G. Stansbie, Birmingham.—6th July,* 1882.—*(Not proceeded with.)* 2d.
This relates to an instrument for regulating and controlling the flow of aërated beverages.

3197. TENSION COUPLINGS, *J. T. Mitchell, Mere, Wilts.—6th July,* 1882. 6d.
Fig. 1 is a vertical section of a traction coupling, with the releasing bolt in action. The points of application for the tractive force and resistance are respectively the ring A^1 and the wooden shaft E, of which only the front part is shown. A is the releasing bolt provided at the front end with a ring A^1 and at the back with a tongue *a*. B is a sliding wedge connected with a ring *b*, and pushed forward under the strap or bridge piece C by a spring *d*, mounted on a spindle D. *c* is a base plate rigidly connected or made in one piece with the strap C, and attached to the wooden shaft E, the front of which is further armed with a staple F. The tractive force resting on the ring A^1 in the direction of the arrow by means of a chain or



equivalent appliance, tends to draw the shaft E forward as long as the oblique front surface a^1 of the tongue *a* is held down against the corresponding abutment a^2 by the wedge B, under the influence of the spring *d*. But as soon as the ring *b* is pulled back in the direction of the arrow by a small releasing chain attached to it, the wedge B recedes and allows the tongue *a* to slide upward into the position represented by Fig. 2 and out of the strap C, whereby the connection between A and E is broken.

3198. WALLS OF HOUSES AND BRICKS FOR SAME, *T. N. Sully, Wellington.—6th July,* 1882. 6d.
This relates to improvements in walls of houses, &c.; consisting in constructing them of bricks or blocks having perforations, grooves, or channels therein, the said bricks or blocks being so placed together that a circulation of air is maintained through the walls or like structure.

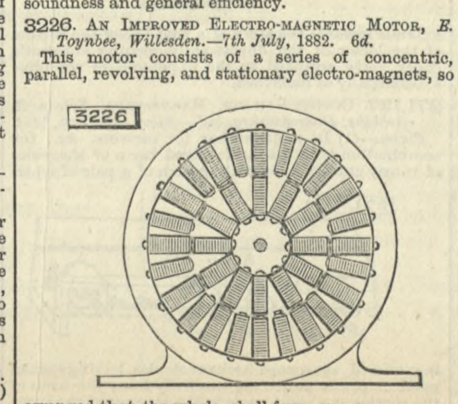
3202. MACHINES FOR COMBING WOOL, &c., *F. Fairbank and J. Robertshaw, Allerton, Yorks.—6th July,* 1882. 6d.
The object is to dispense with the dabbing brushes, and use mechanical means by which the wool is efficiently pressed between the teeth of the combs, and the machine run at an increased speed.

3204. GENERATION, REGULATION, AND UTILISATION OF ELECTRIC CURRENTS, *W. R. Lake, London.—6th July,* 1882.—*(A communication from E. Thomson, New Britain, Connecticut, U.S.)* 1s. 4d.
This relates to the construction of electric generators, which the inventor claims to be able to work up to an electro-motive force of 1500 to 3000 volts, with one commutator of three segments, by means of an air jet attachment, to insure insulation at the slots between the commutator segments, oil being also freely used as a lubricant for its surface. The brushes are automatically adjusted by an electro-magnetic attachment, so as to regulate the strength of the current according to the resistance. The invention also relates to an arc and incandescent lamp. In the latter a frame is provided inside the exhausted glass globe, with a sliding yoke pressed upwards by a spring. The yoke sustaining a small block of carbon, a similar block being pressed against the top of the frame by a carbon pencil interposed between the two blocks. This pencil is rendered incandescent. Pieces of anhydrous sodium or other similar material are placed in the exhausted globe.

3212. APPARATUS USED IN THE MANUFACTURE OF GAS, *J. Thomas, Bodmin, [Cornwall, and C. J. Ennor, Oporto, Portugal.—7th July,* 1882. 6d.
This relates to the construction of apparatus for entirely relieving the retorts from pressure, while it allows of their being worked with any desired depth of seal if preferred.

3213. VALVES, *J. Thomas, Bodmin, Cornwall, and C. J. Ennor, Oporto, Portugal.—7th July,* 1882. 6d.
This refers to hydraulic gas valves to be used in many situations, but especially adapted for connection with purifiers, and has for its object the construction of such valves in such a manner as to admit of the requisite changes of the direction of the gas being made, and at the same time ensure perfect soundness and general efficiency.

3226. AN IMPROVED ELECTRO-MAGNETIC MOTOR, *E. Toynbee, Willesden.—7th July,* 1882. 6d.
This motor consists of a series of concentric, parallel, revolving, and stationary electro-magnets, so



arranged that the whole shall form one or more continuous rings of magnetic poles, enclosing the whole, or nearly so, of the magnetic lines of force. The whole of the revolving or stationary magnets are commutated at each segment of the circle, thus producing a maximum and uniformly continuous rotary motion. Great velocity can be obtained, the inventor states, with no heating, and without much wear and tear. The apparatus is shown in end view in the accompanying illustration.

3229. CISTERNS OR FLUSHING APPARATUS FOR WATER-CLOSETS, &c., *U. Bromley, G. Crowe and W. James, Chester.—7th July,* 1882. 6d.
This relates to a syphon arrangement for flushing.

3230. TRICYCLES, BICYCLES, &c., *W. T. Shaw, Surbiton, and W. Sydenham, London.—7th July,* 1882. 10d.
This consists in the method of applying gearing to the driving parts of tricycles, bicycles, and other velocipedes, whereby increased power is obtained or applied in an advantageous manner to the propulsion of such machines.

3231. BUNDLING AND FASTENING LETTERS, &c., *F. A. R. Russell, Piccadilly.—7th July,* 1882. 6d.
This consists in the construction and combination of wires or strips of copper (or alloy) and labels constituting the respective arrangements of ligatures for bundling papers, and the mode of applying and fastening or securing the same.

3232. STAND FOR PHOTOGRAPHIC CAMERAS, *J. F. Plücker, Antwerp.—7th July,* 1882. 6d.
This relates to the construction of a telescopic folding tripod stand for photographic cameras.

3233. ELECTRIC CLOCKS, *J. P. A. Schlaefli, Soleure, Switzerland.—7th July,* 1882. 6d.
This relates to an improved secondary electric clock to be actuated by a weight raised periodically by a current sent at frequent intervals from a central station.

3234. BOTTLES AND STOPPERS, *O. G. Abbott, Huddersfield.—7th July,* 1882. 4d.
This relates to the construction of a valve.

3235. AGRICULTURAL COLLECTORS, *J. T. Mitchell, Mere, Wilts.—7th July,* 1882. 6d.
The collector consists chiefly of a parallel series of tines secured to a cross beam carried on wheels, drawn by horses or other power and guided by hand.

3236. ARC ELECTRIC LAMPS, *F. M. Rogers, London.—7th July,* 1882. 6d.
This relates to the regulation of arc lamps by means of a clip arrangement actuated by the core of a solenoid in the lamp circuit. The clip acts on the upper carbon, and consists of a block of metal divided lengthwise, centrally, to one side, or diagonally. This block is clamped together and bored so as to exactly fit the upper carbon rod, which passes through it and the hollow core of the solenoid. One-half of the clip is attached to the core, the other half is loosely attached to the first half by links. The weight of this half enables it to embrace the rod tightly, and it is so fixed that when holding the rod it hangs lower than the other half, it is thus lifted up and releases the rod as soon as it touches the lamp-frame.

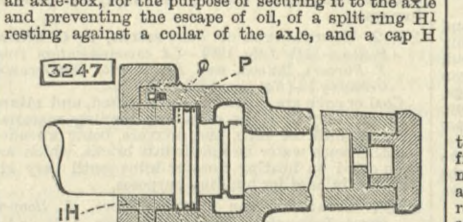
3239. MACHINES FOR TENTERING, STRETCHING, &c., FABRICS, *J. Ashworth, Rochdale.—8th July,* 1882. 8d.
This relates, First, to arrangements for opening, spreading, and stretching fabrics from a state of "rope" to their full width; Secondly, to arrangements and mechanism for squeezing or wringing and drawing away or removing the moisture from the cloth or other material as it passes along; Thirdly, to means and apparatus for spreading and keeping fabrics central when being fed forward for tentering and other purposes; Fourthly, to improvements upon the selvage guiders. Other improvements are described.

3242. TAPE LADDERS, *J. Carr, Manchester.—8th July,* 1882. 6d.
This relates to the method of producing tape ladders by employment of suitably strong yarns, braids, or tapes which are woven in with the main tapes, and float from one tape to the other to form cross sustainers for the blind laths, but are not woven together at the parts which so float or cross from one tape to the other.

3244. INCANDESCING ELECTRIC LAMPS, *T. J. Handford, Southampton-buildings.—8th July,* 1882.—*(A communication from C. A. van Cleve, Metuchen, Middlesex County, New Jersey, U.S.)—(Void.)* 2d.
To remove the aqueous vapour remaining in the globes of incandescing lamps after being exhausted of air by the mercury pump, the inventor introduces and seals in the globe phosphorus anhydride or some such compounds.

3245. SEPARATING TAR FROM AMMONIACAL LIQUOR, &c., *J. and R. Dempster, Elland, Yorks.—8th July,* 1882. 6d.
The object is to provide for the separation of the two bodies more effectually than is the case at present, and this is accomplished by fixing to the opening out of which the liquor or tar passes a suitably shaped box having a vertical pipe screwed therein, which can be raised and lowered by means of the screw to suit the height of liquor in the vessel, so that it can flow over the edge of the cup down the screwed pipe into the box and out at the outlet.

3247. AXLES AND AXLE-BOXES, *H. J. Haddan, Kensington.—8th July,* 1882.—*(A communication from E. Mers, Bruxelles.)* 6d.
The inventor claims, First, the combination with an axle-box, for the purpose of securing it to the axle and preventing the escape of oil, of a split ring H^1 resting against a collar of the axle, and a cap H



secured to the axle-box; Secondly, the combination of an axle-box with a split ring H^1 projecting into the mouth of the axle-box against a collar P, Q, P^1, Q^1 of the axle, and forming a cover over the mouth of the axle-box, and a nut H screwed to the axle-box.

3249. LOOMS FOR WEAVING, *C. Thompson, Halifax.—8th July,* 1882. 8d.
This relates, First, to mechanism in connection with fast and loose reed looms, the apparatus comprising mechanism whereby the reed is held securely when beating up; but when the shuttle is trapped or does not box properly the reed is set free, the brake is applied, and the loom knocked off or stopped automatically and instantly; Secondly, to an improved adjustable box front; Thirdly, to an improved attachment for the warp beam ropes; Fourthly, to improvements in loom temples.

3253. SMELTING "PURPLE ORE," &c., *R. Parry, Hoole, Cheshire.—8th July,* 1882.—*(Not proceeded with.)* 2d.
The ore is reduced to powder and injected into a bath of molten metal. To this, with the ore dust, is introduced fuel and flux.

3254. KNIFE-CLEANING AND POLISHING MACHINES, *G. Kent, Holborn.—8th July,* 1882. 6d.
This relates, First, to the employment of rollers of elastic material for the knife handles to rest against whilst the blades are being cleaned; Secondly, to a stop of elastic material for the back of knife handles to rest against; Thirdly, to means for preventing knives from being drawn into rotary knife-cleaning machines should the revolving discs of the machine be turned in the wrong direction.

3255. INCANDESCENT ELECTRIC LAMPS, *J. H. Gardiner, Camberwell.—8th July,* 1882. 6d.
This relates to a blow lamp for constructing the glass globes of incandescent lamps, by means of which either a large roaring, covering a large area, or a pointed flame, to strike one spot only, can be obtained at will, thus obviating the use of two such lamps; also to a new pump for exhausting the globes of air, which operates by the continual reproduction of the Toricellian vacuum; and lastly, to a new method of mounting the lamps in sockets for use.

3257. INTERNAL STOPPERS FOR BOTTLES, *A. T. King, Nottingham.—10th July,* 1882. 6d.
This consists in employing a surrounding fixed or sliding collar of block tin, glass, china, or other suitable material, on the upper portion of stoppers for bottles.

3258. RETAINING STOCKINGS, &c., IN POSITION ON THE WEARER WITHOUT INJURIOUS PRESSURE, *J. Parry, London.—10th July,* 1882. 6d.
The garter can be made in one or two pieces with elastic webbing or other material. It is fastened on to the sides of the stocking and passed round the front of the leg, when the back part of the stocking forms a wide band with equal pressure, so that it does not impede the circulation, and thereby prevents varicose veins, &c.

3262. APPARATUS FOR DYEING COTTON, &c., *E. Heppenstall, Huddersfield.—10th July,* 1882. 4d.
This relates to a series of troughs having self-acting raking and lifting apparatus, conveying tables, squeezing rollers, and doffers for dyeing loose cotton—either in the raw state or in the waste—aniline black or other colours.

3263. BLOCKS OR CYLINDERS FOR INCANDESCENT LIGHTS, *E. Davies, High Holborn.—10th July,* 1882.—*(Not proceeded with.)* 2d.
This relates to the construction of cylinders for use with oxyhydrogen and similar lamps. The inventor prefers to make them of the following materials:—Magnesia, 3 parts; precipitate of chalk, 16 parts; plaster of Paris, 6 parts; oxide of calcium, 1 part; phosphide of calcium, 1 part; prepared chalk, 6 parts; well mixed with clear water, subjected to hydraulic pressure, and baked to expel the moisture.

3264. APPARATUS FOR EFFECTING THE TRANSPORT OF LIVE FISH, *E. L. Sheldon, London.—10th July,* 1882.—*(Not proceeded with.)* 2d.
The object is to provide means for aërating and maintaining at a fixed low temperature the water in which live fish are to be transported.

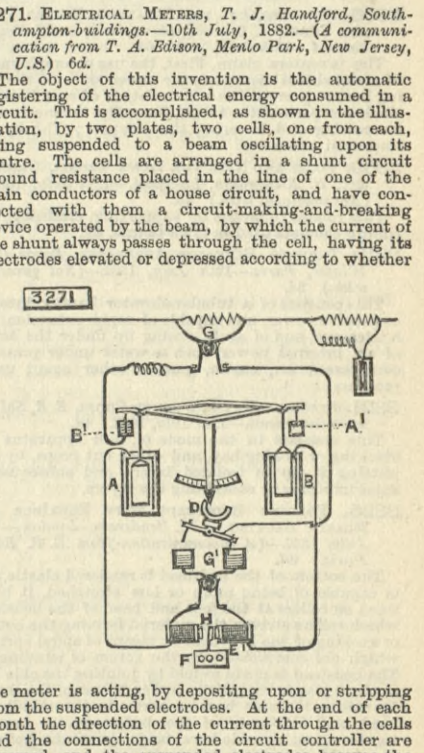
3266. PARING THE CURLS OF HAT BRIMS, *J. Cree, Denton.—10th July,* 1882.—*(Void.)* 2d.
This relates to the general construction of the machine.

3267. MANUFACTURE OF HEELS FOR BOOTS AND SHOES, *J. J. Gascoine, Leicester.—10th July,* 1882. 6d.
The object is to produce a heel for a shoe or boot by fashioning a piece of leather or other suitable material into a hollow heel-shaped shell or cup without joint or seam, which is afterwards filled with a suitable material or composition, so that a firm and solid heel is produced.

3269. FILLET CARD-SETTING MACHINES, &c., *W. E. Blackburn, Cleckheaton.—10th July,* 1882.—*(Not proceeded with.)* 2d.
The clothing feed rollers are mounted in adjustable bearings so constructed as to admit the rollers being placed at such an angle as to present the clothing to the setting motion of the machine.

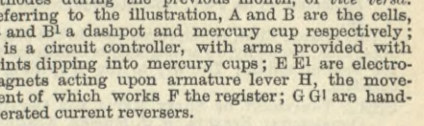
3270. ROTARY ENGINES AND PUMPS, *J., F. W., and W. W. Brierley, Kensal Green.—10th July,* 1882.—*(Not proceeded with.)* 2d.
This relates to the construction of the blade of the piston.

3271. ELECTRICAL METERS, *T. J. Handford, Southampton-buildings.—10th July,* 1882.—*(A communication from T. A. Edison, Menlo Park, New Jersey, U.S.)* 6d.
The object of this invention is the automatic registering of the electrical energy consumed in a circuit. This is accomplished, as shown in the illustration, by two plates, two cells, one from each, being suspended to a beam oscillating upon its centre. The cells are arranged in a shunt circuit around resistance placed in the line of one of the main conductors of a house circuit, and have connected with them a circuit-making-and-breaking device operated by the beam, by which the current of the shunt always passes through the cell, having its electrodes elevated or depressed according to whether



the meter is acting, by depositing upon or stripping from the suspended electrodes. At the end of each month the direction of the current through the cells and the connections of the circuit controller are reversed, and the suspended electrodes become the anodes of the cells if they have been acting as the cathodes during the previous month, or *vice versâ*. Referring to the illustration, A and B are the cells, A^1 and B^1 a dashpot and mercury cup respectively; D is a circuit controller, with arms provided with points dipping into mercury cups; E E^1 are electro-magnets acting upon armature lever H, the movement of which works F the register; G G^1 are hand-operated current reversers.

3274. DRIVING GEAR FOR LOCOMOTIVE ENGINES, *J. H. Johnson.—11th July,* 1882.—*(A communication from G. S Strong, Philadelphia.)* 6d.
The inventor claims the combination in a locomotive of two guided crossheads connected to each



other and to the piston-rod, two driving wheels A and B, and two rods, one connecting one crosshead to the crank pin of one driving wheel, and the other connecting the other crosshead to the crank pin of the other driving wheel.

3280. TAPS AND VALVES, *A. Wightman, Sheffield.—11th July,* 1882.—*(Not proceeded with.)* 2d.
This relates partly to a tap, in which is formed a circular chamber, open at the top, and having an annular recess round the bottom, for the purpose of receiving and holding a disc of rubber or other suitable material, also a circular opening in the bottom, which forms the inlet, and is connected with the water supply.

3284. LOCKING SCREW NUTS ON FISH-PLATES, *W. R. Lake, London.—11th July, 1882.—(A communication from J. F. Goodridge, Boston.)* 6d.

The object is the production of a lock-plate, which may be so applied to the four nuts of a fish-plate as to lock them all, and yet require the temporary removal of but a single nut from the fish-plate during the process of its application.

3286. PREVENTING CORROSION IN BOILERS, *A. R. Bennett, Kilbarchan, Renfrew.—11th July, 1882.—(Not proceeded with)* 2d.

This relates partly to means for rendering impossible voltaic action between the iron and steel of the boiler, and the copper and brass, or other dissimilar metal, of the fittings.

3287. AUTOMATIC APPARATUS FOR REGULATING THE SUPPLY OF GAS TO A GAS FLAME, &c., *W. Cheyne, South Wales.—11th July, 1882.* 6d.

The object is to provide an apparatus that can adjust itself to the varying pressures of gas in the mains, and automatically light and extinguish the gas flame.

3289. HAME PLATES OF HARNESS, &c., *R. and B. Garrington, Darlaston, Stafford.—11th July, 1882.—(Not proceeded with.)* 2d.

This relates to the method of making the leader and shafter hame plates.

3297. BREECH-LOADING GUNS AND CARTRIDGES, *A. N. Gavard and H. Millon, Paris.—12th July, 1882.* 6d.

The improvements refer to needle guns, and in permanent cartridge cases therefor, into which the powder and shot or ball, and priming or fulminating composition, is added.

3299. SECURING GLOBES TO THEIR GALLERIES, *H. T. Harvey, Wandsworth.—12th July, 1882.—(Not proceeded with.)* 2d.

This relates to the employment of a concoidal-shaped cam.

3300. HOIST, LIFT, OR WINCH-WINDING GEAR, &c., *B. Williams, Cardiff.—12th July, 1882.—(Not proceeded with.)* 2d.

The object is to so construct the gear as to readily put the going parts into and out of action, to wind rapidly, lower, or sustain the load or weight at any desired point without danger of breakage or straining of the mechanism.

3301. PRESERVING FROM CORROSION THE SURFACES OF SHIPS, PIERS, BRIDGES, &c., *T. S. Webb, New Kent-road.—12th July, 1882.* 4d.

The invention consists in fixing by fusion on the surfaces a coating of glass or enamel practically insoluble in water, and not affected by the action of the atmosphere, without necessitating the enclosure of the structures or constructions in an oven, muffle or heating chamber.

3302. ROLLER MILLS, *T. Bouwens and T. Voss, London.—12th July, 1882.* 4d.

This consists in effecting the grinding of the material by the direct downward pressure of the upper roller, aided by the use in combination therewith of additional weights.

3304. APPARATUS FOR PROMOTING CIRCULATION OF WATER IN STEAM BOILERS, *J. P. Halket, Millwall.—12th July, 1882.—(Not proceeded with.)* 2d.

Within the boiler, around or partly around the furnace tubes or flues, channels are formed communicating below with the lower parts of the boiler, and having their upper mouths, which may be carried up to a greater or less height, and directed as required by the positions of the tubes or flues above.

3305. MANUFACTURE OF AMMONIA, *J. P. Richman and J. B. Thompson, New Cross.—12th July, 1882.* 6d.

This consists in the process for manufacturing ammonia by the treatment of urine and excreta, that is to say, fermenting the liquid matter, distilling the fermented liquor, and absorbing in suitable acids the ammonia evolved in the distillation.

3306. SCRAPERS, &c., FOR CLEANSING BOILER FLUES AND TUBES, *A. Lowcock, Shrewsbury, and J. Taylor, Salford.—12th July, 1882.* 6d.

The inventors claim, First, the use or employment of metal sheets secured to the under sides of the lifting bars to prevent the accumulation of soot between the lower parts of the tubes; Secondly, the mechanism for raising and lowering the scrapers; Thirdly, an improved worm box.

3309. POLES AND NETS FOR LAWN TENNIS, CRICKET, &c., *H. Richardson, Liverpool.—12th July, 1882.—(Not proceeded with.)* 4d.

This relates to means for supporting, straining, and coiling the nets used in lawn tennis, &c.

3310. TUBULAR ELEVATOR APPARATUS, *Baron C. de Winter, Paris.—12th July, 1882.—(Not proceeded with.)* 2d.

This consists of a tubular elevator having internal expansive power, and capable of rapid extension like a telescope, and of again closing up under the action of an internal power, such as water under pressure, compressed air, steam, gas, or other agent under pressure.

3321. STACKING HAY AND OTHER CROPS, *E. R. Salwey, near Gravesend.—12th July, 1882.* 4d.

This consists in the mode of, and apparatus for, stacking or ricking hay, and other cut crops, by first putting it up in isolated layers, and subsequently superimposing or combining the layers.

3325. FOLDING BEDSTEADS WITH FLEXIBLE AND ELASTIC SACKING, *A. C. Henderson, London.—13th July, 1882.—(A communication from E. F. Boyer, Paris.)* 6d.

The bottom of the bedstead is rendered elastic, and is capable of being more or less stretched, it being fixed on rollers at the foot and head of the bedstead, which rollers stretch the material forming the bottom or sacking of the bedstead by means of spiral springs, which are compressed by the action of winding up. The bedstead is made to fold by jointing the side bars in three places, viz., at the two ends and in the centre. By raising the side bars or beams in the middle the head and foot-posts of the bedsteads are brought together, and the side bars rise in the centre between these rests.

3326. TRICYCLES, VELOCIPEDES, &c., *F. Beauchamp, Edmonton.—13th July, 1882.—(Not proceeded with.)* 2d.

This relates, First, to improvements in the steering apparatus; Secondly, to arrangements connected with the seat or saddle; Thirdly, to the propelling mechanism.

3327. TREATMENT OF SHEET METAL FOR OBTAINING ORNAMENTAL EFFECTS, *H. J. Baddan, Kensington.—13th July, 1882.—(A communication from K. H. Schmid, Bern.)—(Not proceeded with.)* 2d.

This relates to the treatment of tin-plate for the purpose of obtaining a substitute for mother-of-pearl.

3329. REPRODUCING DESIGNS FOR THE ILLUSTRATION OF BOOKS, &c., *W. P. Bruce, Kinleith Currie.—13th July, 1882.* 4d.

The artist draws with the etching needle on a grounded metal plate the lines or spaces which are to light in the proof. These are then excavated by means of a chemical mordant, and the plate is printed like a woodcut.

3332. MAKING BOXES, &c., *A. Millar, Glasgow.—13th July, 1882.* 6d.

This consists partly in forming the top, bottom, and sides of boxes from two or more sheets of cardboard, millboard, scaleboard, or other similar material, which have an extra degree of stiffness imparted to them by any of the processes known as "rishing," "beading," and corrugating.

3333. PURIFYING METALS, *A. M. Clark, London.—13th July, 1882.—(A communication from C. Edwards, Paris.)* 4d.

The inventor claims the method of heating metals, especially wrought, cast, and malleable iron and steel, and which consists in annealing or heating the said metals in an atmosphere of hydrogen gas, produced in any convenient way, and purified by one or more washings.

3336. HARVEST-SAVING APPLIANCES, &c., *E. O. Greening and E. D. Barker, London.—14th July, 1882.—(Not proceeded with.)* 2d.

This relates, First, to the fan used to exhaust air from a stack of hay or corn, and relates to the method of driving the said fan; Secondly, to the combination of a steam injector with a steam engine or boiler for the purpose of exhausting the hot air from the stack of hay or corn through pipes.

3338. CLAY PRESS TRAYS, *J. Brindley, Burslem.—14th July, 1882.* 6d.

This consists partly in the construction of clay press trays of fluted boards or sides fitted with top and bottom-grooved strengthening or binding pieces.

3340. APPLIANCES FOR SECURING GLASS TO ASTRAGALS AND SASH BARS, *A. Drummond, Edinburgh.—14th July, 1882.* 6d.

This relates to the arrangement and combination of parts of sash bars or astragals with glass-retaining ridge, caps or strips, and devices for retaining the panes at their joints and lower edges.

3342. PRODUCTION OF ALKALI SALTS FROM SULPHO ACIDS, *F. Wirth, Frankfort.—14th July, 1882.—(A communication from the Farbfabrik vormals Brönner, Frankfort.)* 4d.

The inventor claims the method of preparing the alkali salts from sulpho acids by the action thereon of the halogen and sulphate compounds of the alkalies.

3344. SELF-ACTING WINDOW BLIND APPARATUS, *W. S. Laycock, Sheffield.—14th July, 1882.* 6d.

This consists chiefly in the combination of a roller, to which is attached a coiled spring or weight, which in either case is wound up by the action of drawing down the blind, and a ratchet friction wheel and catch, connected with the roller by the friction also of two or more surfaces, caused by the adjustable pressure upon them of a spiral or other shaped spring, which prevents the weighted blind from running down, but allows it to be drawn down by hand, or otherwise, when sufficient power is applied to overcome the frictional resistance.

3345. ATTACHING THE BOLSTERS AND HANDLES OF CUTLERY, *J. E. Beal, Sheffield.—14th July, 1882.* 6d.

This relates to means for attaching the bolsters and handles of cutlery without the use of pins.

3358. BELL TRAPS FOR DRAINS, *A. W. White and J. H. Evans, London.—14th July, 1882.—(Not proceeded with.)* 2d.

The object is to produce a self-acting apparatus whereby when an excessive quantity of liquid is required to pass away quickly, the bell trap is raised and held up while such excessive quantity is passing, and closes again automatically after it has passed.

3369. PREVENTING ACCIDENTAL EXTINCTION OF EXPOSED GAS LIGHTS, &c., *J. B. Thompson, New Cross.—15th July, 1882.—(Not proceeded with.)* 2d.

This relates to a construction and arrangement of the burner for the small, which lights the main flame, with an appliance to prevent the extinction as much as possible, and should it be accidentally extinguished, to rekindle it.

3378. RAISING APPARATUS, &c., *H. Meinecki, Breslau.—17th July, 1882.—(Not proceeded with.)* 2d.

This relates to improvements in raising apparatus, also applicable to steering apparatus, and consists principally in a brake or catch arrangement, which said brake or catch arrangement causes the weight to remain stationary in any position when the crank or handle is involuntarily let go.

3379. SEWING MACHINES, &c., *J. Forbes, New York.—17th July, 1882.—(Not proceeded with.)* 2d.

This invention consists of a machine which is capable of being applied by the substitution of different sets of cams to either plain stitching or hem stitching, and which in so far as regards hem stitching produces the hem stitch by means of a combination of lock and loop or chain stitches.

3384. APPARATUS FOR CUTTING HELICAL GROOVES IN TWIST DRILLS, RIMERS, &c., *H. J. Haddan, Kensington.—17th July, 1882.—(A communication from J. Martignoni, near Frankfort-on-the-Main.)* 6d.

The helical grooves are cut by mounting the article to be cut on the slide of the lathe, and producing a simultaneous longitudinal and rotary motion of the same, while the cutting or milling tool is fixed to the mandril.

3386. COMBINATION POCKET-KNIFE, FORK, AND SPOON, *L. A. Groth, London.—17th July, 1882.—(A communication from C. Praunegger, Graz, Austria.)—(Not proceeded with.)* 2d.

This consists essentially in certain arrangements whereby a fork and knife, and in some cases a spoon, are so combined together in a compendious form in the handle of the knife that they form a whole, in which only the bowl of the spoon, when such is used, remains outside the handle; each of these eating instruments can, however, be used separately from either of the others.

3389. UTILISATION OF TIDAL POWER, *T. D. Gaman, San Francisco.—17th July, 1882.—(Not proceeded with.)* 2d.

A pit or pond is excavated called the dry pond, with levees or banks sufficiently high to keep out the highest tides. On a race from the tidal water entering into this pond the mill wheel for obtaining motive power is placed, the race is provided with sluice gates, and other self-acting sluice gates empty the pond at low water.

3392. MANUFACTURE OF FIRE-BRICKS, *F. C. Glaser, Berlin.—17th July, 1882.—(A communication from F. Burgers, Bulmke, and Dr. C. Otto, Dahlhausen, Germany.)—(Not proceeded with.)* 2d.

Coal or coke are ground fine and sifted, and mixed with fire-clay or other refractory binding material, such as milk of lime, the mixture being kneaded together with water and made into bricks, which are then dried on heating flues or kilns until they are sufficiently hard for building purposes.

3397. APPARATUS FOR DRYING CROPS, *J. Hooper, Great Torrington, Devon.—17th July, 1882.—(Not proceeded with.)* 2d.

This relates to the employment of a fan and system of pipes.

3398. PRODUCING TRANSPARENT PATTERNS ON GROUND GLASS, *D. Reich, Berlin and Vienna.—17th July, 1882.* 4d.

This consists in the method or process of producing transparent patterns on ground glass, by burning in an easily melting composition or paste which has been applied to the surface of the glass.

3399. PREPARING ABSORBENT PAPER FOR USE IN COPYING LETTERS, *A. Gutensohn, London.—17th July, 1882.—(Not proceeded with.)* 2d.

This relates to the chemical treatment of the paper.

3401. PEELING MACHINE, *H. J. Gehlsen, London.—18th July, 1882.—(A communication from H. Baaser and F. Schulte, Kalk, Germany.)—(Not proceeded with.)* 2d.

This relates to improvements in the general construction of the machine.

3402. MACHINERY FOR DRAWING, SPINNING, AND TWISTING FIBROUS SUBSTANCES, *F. W. Fox, Burley-in-Wharfdale, and T. Coulthard, Preston.—18th July, 1882.—(Complete.)* 4d.

This consists in a peculiar form of adjustable ring-holder for double-flanged rings, and has for its object the more effectual protection of the traveller from projecting fibres and other foreign substances.

3407. APPARATUS FOR DECORTICATING OR SCOURING RICE, &c., *J. H. C. Martin, Walthamstow.—18th July, 1882.—(Not proceeded with.)* 2d.

A drum or cylinder is provided with a keen cutting or scouring surface, and mounted on a vertical shaft or spindle revolving within a perforated cover or case.

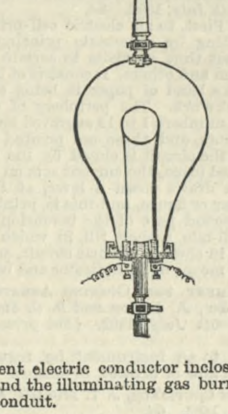
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

271,140. COMBINED ELECTRIC LIGHT AND GAS BURNER, *William A. Shaw, Brooklyn, N.Y.—Filed May 3rd, 1882.*

Claim.—The combination substantially as hereinbefore set forth of the gas conduit or chamber, the

[271.140]

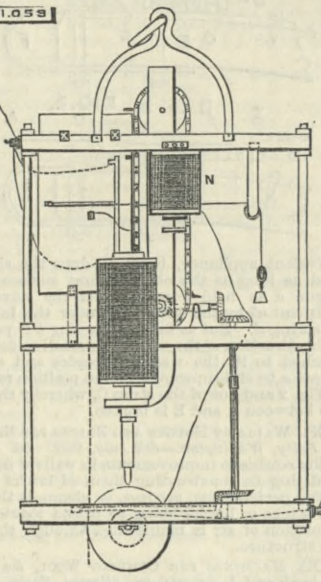


incandescent electric conductor inclosed within said conduit, and the illuminating gas burner attached to the said conduit.

271,059. MAGAZINE ELECTRIC LAMP, *Alenza T. Gifford, Providence, R.I.—Filed January 12th, 1882.*

Claim.—(1) In an electric arc lamp, the combination with the magazine provided with devices for discharging single pencils successively therefrom, of the endless chain provided with projections for striking the pencils discharged and forcing them toward the opposite electrode, and suitable devices for operating said chain automatically as the result of increased resistance in the lamp circuit, substantially as described. (2) The combination with the magazine provided with the automatically closing doors and automatic means for discharging the pencils through the doorway, of the endless chain provided with means for opening said doors and driving the discharged pencils forward longitudinally, substantially as described. (3) The magazine provided with the automatically closing doors, means for automatically

[271.059]

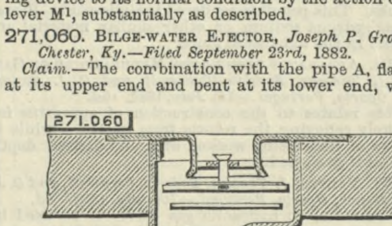


discharging the pencils, and a guide for a single pencil outside of said doors, substantially as described. (4) The combination with the magazine provided with a guide for single pencils, and with automatically closing doors, of the travelling chain provided with means for driving the pencils longitudinally, and automatic devices for opening the doors to permit a fresh pencil to pass, substantially as described. (5) In an electric arc lamp, the combination, with the electro-magnets for lifting a carbon pencil from an opposite electrode to establish the arc, of an electro-magnet of higher resistance in a derived circuit around such magnets, a feed operating magnet in a shunt circuit, and shunting devices operated by said magnet of higher resistance for shunting the main current through said feed operating magnet, substantially as described. (6) The combination with the electro-magnets N[1], arranged in a shunt circuit for operating the pencil feed and the electro-magnet N of higher resistance, arranged in a derived circuit of the levers M and M[1] carrying armatures for such magnets respectively, a circuit breaking or shunting device operated by the first-named lever to direct the main current over the coil of magnet N[1], and means for restoring said shunting device to its normal condition by the action of the lever M[1], substantially as described.

271,060. BILGE-WATER EJECTOR, *Joseph P. Graham, Chester, Ky.—Filed September 23rd, 1882.*

Claim.—The combination with the pipe A, flanged at its upper end and bent at its lower end, which

[271.060]

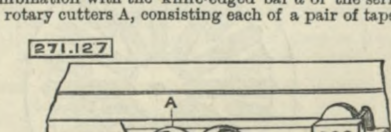


extends towards the stern of a boat below the bottom of the latter of the downwardly-opening automatic check valve arranged in the upper end of the pipe, substantially as described.

271,127. CUTTER BAR FOR HARVESTERS, *Sylvan R. Robbins, Lawrenceburg, Ind.—Filed June 10th, 1882.*

Claim.—(1) In a finger bar for mowers, &c., the combination with the knife-edged bar *a* of the series of rotary cutters A, consisting each of a pair of taper-

[271.127]

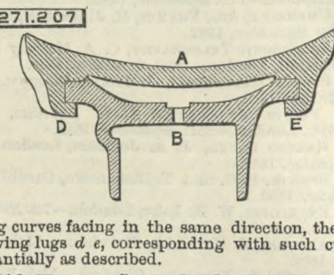


ing, curved, sharpened hooks or sickles, having shanks made of plates projecting inwardly from the heels of the sickles at a right angle to the tangent of the curve of the sickle backs and having rounded outer ends, the said shanks being secured to the end of a common shaft, with the sickles pointing in opposite directions, as shown and described and for the purpose set forth. (2) In a finger bar for mowers, the combination with the knife-edged bar *a*, with its bevelled edge fitted within the undercut rear edges of the fingers, and having an oblique downwardly extending projection h^1 of the adjusting screw *h*, substantially as shown, and for the purpose set forth.

271,207. BRAKE-SHOE, *Hubert A. B. Banning, New York, N.Y.—Filed May 31st, 1882.*

Claim.—In combination with the brake-head B,

[271.207]

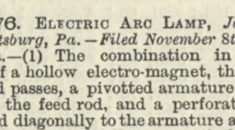


having curves facing in the same direction, the shoe A, having lugs *d e*, corresponding with such curves, substantially as described.

271,210. WEIGHING SCOOP, *Issacher L. Bevis, St. Louis, Mo.—Filed September 15th, 1882.*

Claim.—In combination with the scoop having handle B, the later having slot at b^1 and numbered

[271.210]

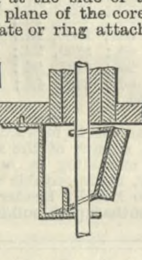


scale at b^2, the spring D and the sleeve C having pin *d*, all constructed to operate as and for the purpose set forth.

271,576. ELECTRIC ARC LAMP, *Joseph R. Finney, Pittsburg, Pa.—Filed November 8th, 1882.*

Claim.—(1) The combination in an electric arc lamp, of a hollow electro-magnet, through which the feed rod passes, a pivotted armature arranged at the side of the feed rod, and a perforated plate or ring attached diagonally to the armature and encircling the feed rod, substantially as and for the purposes described. (2) The combination in an electric arc lamp, of an electro-magnet, a feed rod, a pivotted armature arranged at the side of the feed rod and aeyond the vertical plane of the core of the magnet, bnd a perforated plate or ring attached diagonally to

[271.576]



the armature and encircling the feed rod, substantially as and for the purposes described. (3) The combination in an electric arc lamp of an electro-magnet, an armature capable of an axial movement, and having a slotted projection to encircle the feed rod to keep it from falling, and a circular clamp to grasp the feed rod, and a stirrip or support to sustain the armature, substantially as and for the purposes described. (4) The combination in an electric arc lamp of an electro-magnet, an armature capable of a radial and an axial movement, and a stirrup or support for the armature, having a guide pin to guide the armature in its movements, substantially as and for the purposes described.

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THE ENGINEER, March 2nd, 1883. PAGE

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Feb. 24th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,887; mercantile marine, Indian section, and other collections, 2871. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1509; mercantile marine, Indian section, and other collections, 210. Total, 16,477. Average of corresponding week in former years, 14,615. Total from the opening of the Museum, 21,727,593.