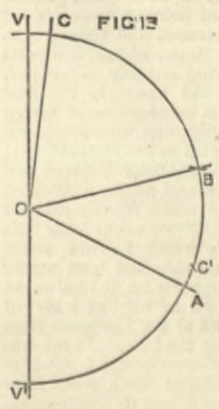
GRAPHICS, OR THE ART OF MAKING CALCULATIONS BY DRAWING LINES.

By Professor R. H. Smith.

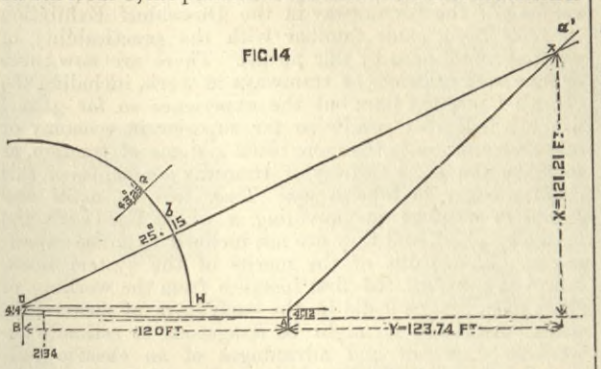
No. V.

Grapho-trigonometry.—We will deal here only with plane trigonometry. We have to make calculations regarding plane figures bounded by straight lines. In doing so we must frequently plot off angles. The instruments called "protractors" are nearly all of them very rough devices at the best, and are far too untrustworthy for accurate work. The vernier protractor made by Stanley with a silvered divided circle and two opposite arms is a trustworthy and accurate instrument, but it is costly. The cardboard protractor of 12in. diameter made by the same maker is also useful, although not so good as the other. But as any angle can be set off very easily with ordinary instruments with any desired degree of accuracy, the use of protractors is best wholly avoided. The method is the following, and requires the use of a table of natural sines, such as one finds in Chambers' or in most other mathematical tables. The table found in Molesworth is not sufficient for the plotting of angles taken in surveys, because it gives the sines for every degree only; whereas the angle is read in the field to minutes. First draw from the centre from which the angle is to be plotted a circle of, say, 5in. radius. On this circle the chord of the desired angle is evidently 5in. multiplied by double the sine of half the angle—that is, 10in. multiplied by the sine of half the angle. The angle can be halved mentally. This half angle is looked up in the table of natural sines; its sine is multiplied by 10, *i.e.*, the point removed one place, and this quantity in inches, taken in the dividers, is set off as the chord of the desired angle. For example, suppose the angle to be plotted is 94 deg. 48 min. We find 10 sin. 47 deg. 24 min. = 7·36, and set this off as the chord of 94 deg. 48 min. on a circle of 5in. diameter. Now, from the table we find that 7·37 = 10 sin. 47 deg. 29 min., and 2×47 deg. 29 min. = 94 deg. 58 min. Again, 7·35 = 10 sin. 47 deg. 19 min., and 2×47 deg. 19 min. = 94 deg. 38 min. Now, it is possible with ordinary care to set the compasses to $\frac{1}{100}$in., but much greater accuracy than this is not easily possible. Thus we cannot pretend to set off very accurately as a chord anything between 7·35 and 7·36, or between 7·36 and 7·37. These, as we have seen, correspond on a circle of 5in. radius to angles differing by 0 deg. 10 min. With this size of circle, then, we cannot pretend to plot angles to any greater accuracy than 10 min. With very small angles, indeed, the accuracy is increased to 7 min., but with angles larger than the above—94 deg. —it is considerably reduced. Thus it is advisable never to plot off by this method angles greater than 90 deg. The supplement of the angle—for instance, 180 deg. — 94 deg. 48 min. = 85 deg. 12 min.—should be plotted off instead. This is also the degree of accuracy obtainable with a circular protractor without vernier, with a divided circle of 10in. diameter. If a circle of 10in. radius is used, the sine of the half angle must be multiplied by 20, and an accuracy of 5 min. is obtainable. If 25in. is used as the radius, the sine of the half angle is multiplied by 50, or $\frac{100}{2}$, and an accuracy of 2 min. is obtainable in plotting. To make the construction on this large scale requires beam-compasses, and, of course, to maintain this accuracy throughout the diagram it requires to be drawn to a correspondingly large scale.

The "solution" of any triangle or other plane rectilinear figure is accomplished graphically by plotting it off accurately to scale, and measuring the quantities desired. If it is a length that is to be found, it is measured in the ordinary way; an angle is to be measured by a reversal of the above explained process; and the measurement of areas we will immediately proceed to explain. But it should first be observed that in plotting off, all the angles required should be set off in the first place upon one and the same circle, and the directions so obtained then transferred by the sliding set squares upon straight edges into the positions required in the drawing. That is, we are not to draw a new 5in. circle at each new point of the drawing where an angle is to be set off, because such a proceeding would involve the waste of time and labour, because it would cover the paper with unnecessary and confusing lines, and because at several of thes points it will usually be found that there is not room inside the limits of the paper to use a good sized circle—such as 5in. radius. The centre of the marking-off circle is conveniently chosen near the middle of the height of the paper and about 1in. or so from the left-hand side. A vertical line being drawn through this and a semicircle drawn, it is clear that this semicircle will suffice for the marking off of all possible angles. Thus in Fig. 13 let it be required to mark off from the line O A downwards the angle 140 deg. Instead of doing this directly, we mark off upwards 180 deg. − 140 deg. = 40 deg. from A to B, and thus get B O as the desired direction, which can now be transferred to any part of the drawing. Again, let it be required to mark off 70 deg. downwards from O A, the angle A O V¹ being less than 70 deg. We first mark off 70 deg. from V¹ to C¹, then take the chord A C¹ in the dividers and set it off from V to C. We thus obtain C O as the direction wanted. We now give two examples of plotting off. In Fig. 14 is shown the calculation of the height of a church spire from theodolite measurements. The theodolite is first placed at a station A. The height of its axis from the ground is measured 4·12ft. The angle of elevation to top of spire is measured 43 deg. 25 min. Another station B is chosen in line with A and top of spire. Distance A B on ground is measured 120ft. Difference of level of ground at B and A is measured by reading with theodolite at A placed with telescope level on surveyor's levelling staff



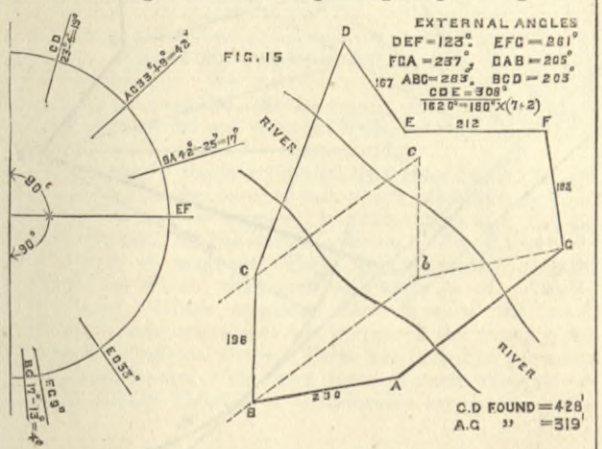
held at B, 2·34ft. Theodolite is now placed at B, and height of its axis above ground measured 4·47ft. The angle of elevation to top of spire is measured 25 deg. 15 min. The construction is so simple and so easily understood from the figure that no explanation is needed. The marking off circle is struck from O, the position of the theodolite axis at station B



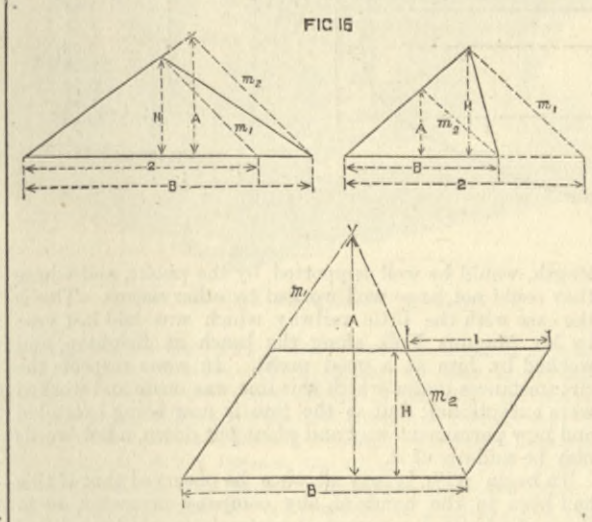
with radius O H = 5in. The line a^1 is drawn parallel to O a, the angle H O a being made 43 deg. 25 min. From x the intersection of a^1 with O b is measured X down to the ground line through station A. This is the height required. The distance Y from station A to centre of base of spire may also be directly measured from the diagram. The calculation of X by ordinary trigonometry involves the solution of the two following equations:—

$$(120 + Y) \tan. 25° 15' + 4·47 - 2·34 = Y \tan. 43° 25'$$
$$X = Y \tan. 43° 25' + 4·12.$$

The solution of these equations gives X = 121·207 and Y = 123·744. In Fig. 15 is shown the plotting of a piece of ground



surveyed with the theodolite, and through which flows a river, preventing the direct measurement of the two sides C D and A G. All the other five sides are measured in the field, and the external angles between each contiguous pair of sides are also measured. The sum of these external angles measured in semicircles is two more than the number of sides, so that, except as a check on the accuracy of the work, the measurement of one of these angles may be omitted. The sides C D and A G are measured on the plot and stated below the diagram. In plotting off the angles at the left-hand of the diagram, always the difference between the given angle and the nearest greater or less multiple of one right angles is made use of. After



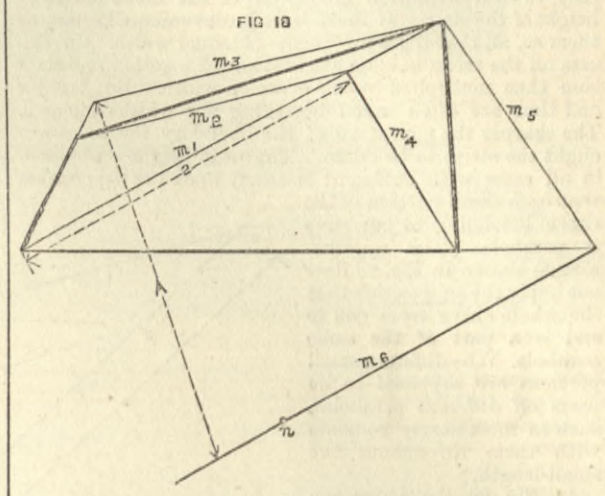
plotting D E F G, from G is drawn G b parallel to the direction of A B and equal to the known length of B A, namely, 230ft. Then $b\,c$ is drawn parallel to the direction of and equal in length to B C. Then c C is drawn ‖ G A, and D C in the known direction to meet c C in C. Finally C B is drawn ‖ cb to meet b B ‖ A G, and from the intersection B there is drawn B A ‖ to the known direction to meet G A in A. To find C D and A G by ordinary trigonometry involves a considerable amount of tedious preliminary trigonometrical calculation, and the solution of two not very easily formed equations.

Areas.—The areas of rectilinear figures already plotted can easily be calculated by taking one side as a base and multiplying it by the mean height of the area above that base. The following are amongst the most convenient constructions for this purpose. The proofs of the constructions are easily recognised and do not need formal demonstration here.

Fig. 16. *Area of Triangle* = A = Base $\times \frac{1}{2}$ Height = B $\times \frac{H}{2}$ or $\frac{A}{B} = \frac{H}{2}$. Calculate A. Mark off 2 or 20 or 200 or 2000 along B to scale of figure. Draw m_1 and $m_2 \| m_1$. The height of intersection of m_2 with opposite side measures the area; that is, A × 1, or A × 10, or A × 100, or A × 1000 = area of triangle = $\frac{1}{2}$ H B.

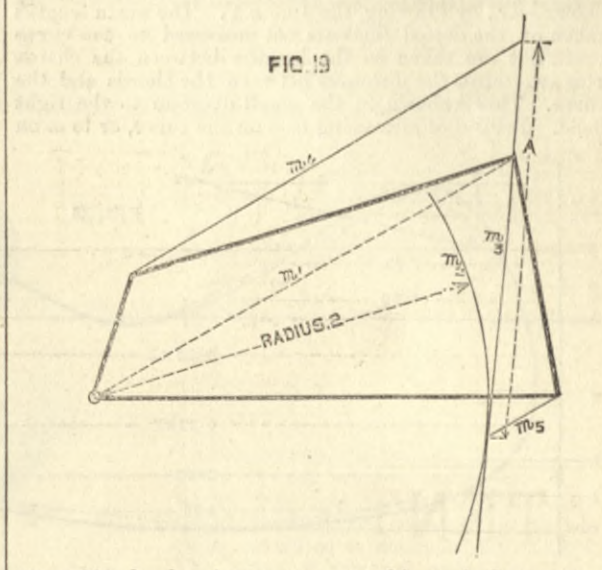
Fig. 17. *Area of Parallelogram* = A = H B. Mark off 1 or 10 or 100, &c. &c., along one side. A = height of intersection of m_1 and m_2, or of m_2 and m_3. Area = A, or 10 A, or 100 A, &c. &c.

Fig. 18. *Area of Quadrilateral with unequal sides* = A.—



The given quadrilateral is indicated by heavy black lines. It is split into two triangles by the diagonal m_1 along which is marked off 2, or 20, or 200, &c. &c. m_2 and m_4 are drawn from end of 2 on m_1; m_3 is drawn ‖ m_2 and $m_5 \| m_4$ to meet the two sides of the quadrilateral meeting at corner from which 2 was marked off; m_6 is drawn ‖ m_1. A is measured perpendicularly to m_1 or m_6. This line is incorrectly given in the diagram; it should extend from the point n in line m_6. The construction is equally good whether the diagonal m_1 is > or < 2. The area = A, or 10 A, or 100 A, &c. &c.

Another good construction is the following. The quadrilateral is divided into two triangles by the diagonal m_1, from one end of which a circular arc is struck with radius 2, or



20, or 200, &c. &c. A tangent m_3 to this arc is drawn from other end of m_1, and m_4 and m_5 are drawn ‖ m_1. They cut off A on m_3. The radius 2 in this construction must be less than the diagonal m_1. The area = A, or 10 A, or 100 A, &c. &c.

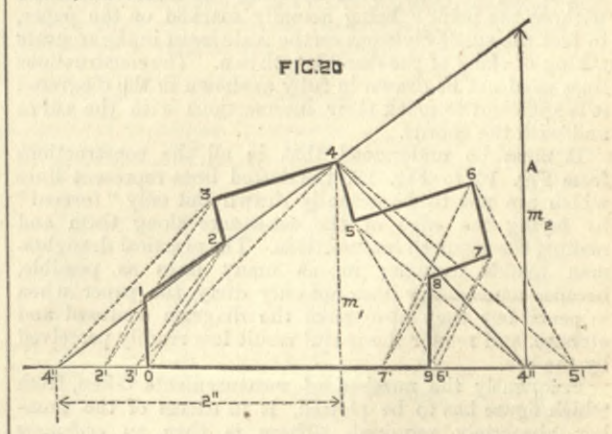


Fig. 20.—*Areas of irregular polygons.*—Reduce to a triangle, and proceed as in Fig. 16, or to a quadrilateral, and proceed as in Fig. 18 or Fig. 19. The given polygon is indicated by the heavy lines. The extension of the side 09 is chosen as base because it is the longest. Draw 12′ ‖ 20. Then the triangular area 92′29 equals the quadrilateral area 90129. Similarly draw 23′ ‖ 32′ and 34′ ‖ 43′. The triangular area 94′49 equals the area of the polygon 9012349. Also draw 87′ ‖ 79, and 76′ ‖ 67′, and 65′ ‖ 56′, and 54″ ‖ 45′. Then the triangular area 4″ 4′ 4 4″ equals the polygonal area to be calculated, namely, 90123456789. From 4′ mark off 2 or 20 or 2000, &c. &c., and from the end of this to 4 draw m_1 and draw m_2 from 4″ ‖ to m_1 to intersect 4′ 4 produced. The length of m_2 from 4″ to this

intersection measures the area; that is, the area equals A or 10 A or 100 A, &c. &c.

Fig. 21 shows the method of applying the construction of Fig. 19 to the polygon. It is somewhat shorter and neater than that of Fig. 20. It consists essentially in reducing the area to a triangle whose height is 2, the base of which therefore, of course, measures numerically the area. From any corner 6 describe arc m_1, with radius 2 or 20 or 200, &c. &c. To this arc draw a tangent m_2 from any other corner, such as O. Use m_2 as a base on which to reduce the polygon, in same manner as in Fig. 20. The polygonal area equals the triangular area 7′ 6′ 67′, of which the height is 2. Therefore the area = A or 10 A or 100 A, &c. &c.

Areas with curvilinear boundaries.—These are best calculated by dividing them into parallel strips, each of a width easy to deal with as a multiplier of the mean length or height of the strip. If there is no inconvenience in making them so, all the strips are made of equal width. In this case all the mean heights are first added together and their sum then multiplied by the common width. But trouble and time are often saved by taking the widths unequal. The sharper the curvature of the boundary the narrower ought the strips to be taken. The mean height is obtained in all cases with sufficient accuracy upon the supposition that each small portion of the curve belonging to one strip is parabolic. The approximation shown in Fig. 22 does not imply the supposition that the whole curve from end to end is a part of the same parabola. The different small portions are supposed to be parts off different parabolas, such as most nearly coincide with them throughout the small length.

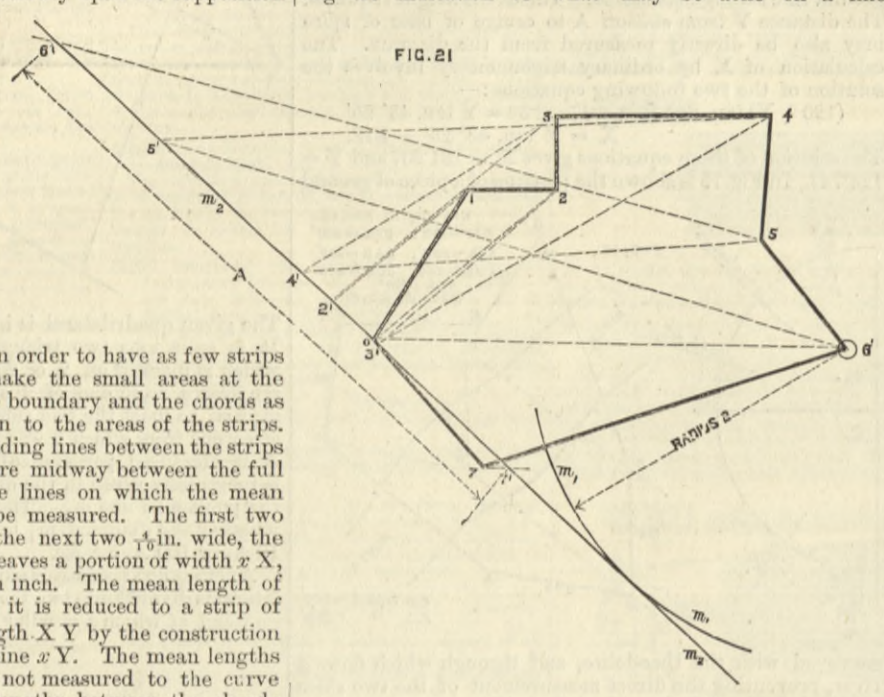


FIG. 21

In Fig. 22 the strips are ruled off in direction of the greatest length of the figure in order to have as few strips as possible, and in order to make the small areas at the ends of the strips between the boundary and the chords as small as possible in proportion to the areas of the strips. The full lines indicate the dividing lines between the strips taken, and the dotted lines are midway between the full lines, *i.e.*, they are the centre lines on which the mean lengths of the strips are to be measured. The first two strips are taken $\frac{2}{10}$in. wide, the next two $\frac{4}{10}$in. wide, the next two $\frac{2}{10}$in. wide, and this leaves a portion of width x X, which is an odd fraction of an inch. The mean length of this last portion is $x\ y$, and it is reduced to a strip of width $\frac{3}{10}$in. (=67), and of length X Y by the construction shown—*i.e.*, by drawing the line x Y. The mean lengths taken on the dotted lines are not measured to the curve itself, but are taken as the lengths between the chords plus two-thirds the distances between the chords and the curve. This is shown on the small diagram to the right hand. Instead of measuring to n on the curve, or to m on the chord, the mean length is measured to r, $m\ r$ being two-thirds of $m\ n$. The division of $m\ n$ into three parts can be accurately enough performed by the eye, and the points r need not actually be marked as in Fig. 22; the length can be read off on applying the scale to the line without the point r being actually marked on the paper, in fact the small divisions on the scale assist in the accurate taking of the $\frac{2}{3}$ of the small length $m\ n$. The constructions lines need not be drawn in fully as shown in the diagram; it is sufficient to mark their intersections with the curve and with the chords.

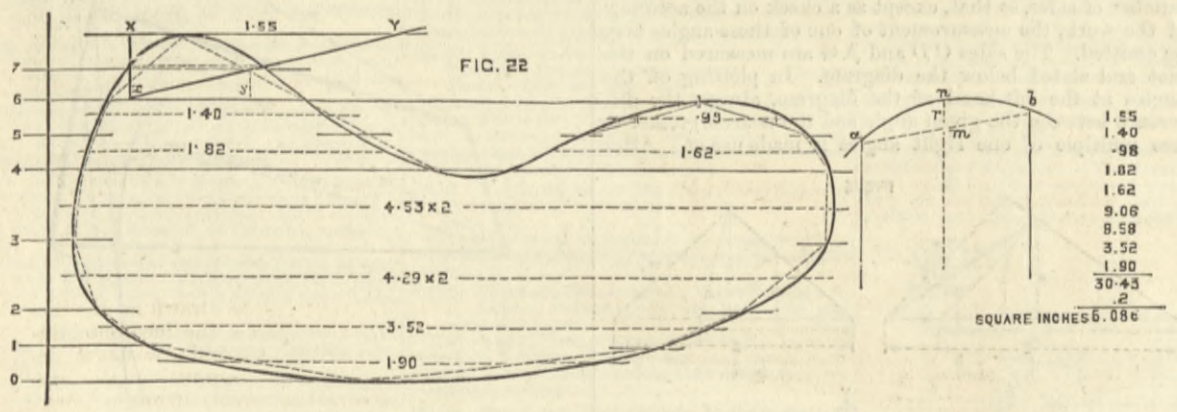


FIG. 22

It must be understood that in all the constructions from Fig. 16 to Fig. 22, the dotted lines represent lines which are not to be actually drawn but only "formed" by laying the edge of the set-square along them and making the required intersections. The practical draughtsman avoids drawing in as many lines as possible, because unnecessary lines not only dirty the paper when in pencil but they also make the diagram confused and obscure, and render the useful result less readily perceived by the eye.

Frequently the number of measurements taken, from which figure has to be plotted, is in excess of the number absolutely required, There is then an *embarras de richesse* of data for the calculation, and the results calculated from different sets of data may not exactly agree. The disagreement shows that small errors have been made in the measurements. In the beginning of our next article we will show how these errors are most equally distributed in the graphic constructions.

South Kensington Museum.—Visitors during the week ending March 1st, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,696; mercantile marine, Indian section, and other collections, 3307. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 5 p.m., Museum, 1545; mercantile marine, Indian section, and other collections, 164. Total, 15,712. Average of corresponding week in former years, 15,137. Total from the opening of the Museum, 20,810,747.

THE ELECTRIC RAILWAY AT BRIGHTON.

The application of electricity to the working of light railways has now been a subject of attraction to many for some years, and everyone has from time to time since the running of the toy railway in the Dusseldorf Exhibition in 1880 been made familiar with the practicability of working small lines by this means. There are now three or four such railways or tramways at work, including the Giant's Causeway line; but the experience so far gained has not indicated results so far superior in economy or other advantages to the more usual systems of traction, as to make the light railway or tramway companies of this country eager to take it up. They fear to make any extensive venture in providing a whole line with the necessary plant, and they are not inclined to make experiments. Knowledge of the merits of the system must, however, come in the first instance from the working of short lines, just as it did in the early days of steam railways. Although it might be dangerous to estimate the working expenses and advantages of an electric railway many miles in length by reference to the results obtained from a line a quarter of a mile long, these results must, nevertheless, be taken as affording an indication of what may be done on a line more than a quarter of a mile in length. There are many places in this country where tramways or light railways of under half a mile, or in sections of that length, would be well supported by the public, and where they could not be so well worked by other means. This is the case with the little railway which was laid last year by Mr. Magnus Volk along the beach at Brighton, and worked by him at a good profit. In some respects the circumstances under which this line was made and worked were exceptional; but as the line is now being extended and new permanent way and plant put down, a few words may be said about it.

To begin with, it may at once be observed that if this had been in the hands of any company promoter, or in those of a limited company, it certainly would have failed to have earned the profit which Mr. Volk booked to its credit, or any profit. It required but small capital, only a little of the time of a manager, few servants, and no offices or officers. In July last year the Brighton Corporation gave Mr. Volk permission to lay a small line along the beach from the Aquarium to the chain pier. This was done, and the little line of 24in. gauge carried nearly 300,000 passengers between the commencement of August and the 4th of January last. The rails were of the flat foot section, weighing 20 lb. per yard, and spiked to longitudinal sleepers of 9in. by 3in. deals, coated with tar, the sleepers being in 10ft. lengths, and having two cross pieces in each. These were laid on and packed by the shingle of the beach, close under the foot-path. To provide a current a 2-horse power gas engine was fixed in an arch under the roadway opposite the Aquarium, and this, working up to nearly or about 3-horse power, drove a Siemens D5 self-regulating generator, giving a current of 25 ampères and 50 volts, or about 1250 volt-ampères. Most of the time a machine of the same size, but with magnets and armature arranged in series, was used as a motor in the car. The resistance of the rails in the quarter mile of line was one-nineteenth, or about 0·05 of an ohm.; the whole resistance in the circuit—namely, along one rail—through the motor and through the return rail being 0·55 ohm. This would probably have been less if the rails had been more efficiently fished together. The loss by leakage was very small indeed—not more than 5 per cent., or about 1 ampère in the wettest weather. This seems very little; but the fact may be accounted for when it is remembered that the line rested on the shingle, which afforded the most perfect drainage. One car only was employed, and this carried ten passengers, the speed being about six miles per hour. The whole thing was, then, very small indeed as a railway; but small as it was, it was large enough to carry numbers of passengers, and to earn money in doing it. It was also enough to show that an electric railway may be a very simple thing. Thus encouraged, the Brighton Corporation gave Mr. Volk a farther concession, and he is now relaying and extending the line on a 2ft. 9in. gauge, but with the same size of rails. The latter will, however, be laid on creosoted transverse instead of longitudinal sleepers. They will be 4ft. 6in. in length, 9in. wide, and 3in. thick, placed 3ft. from centre to centre. The new car will be much larger than that used last year. It will carry thirty passengers, and will run on 24in. wheels. It will be fitted with a Siemens D2 motor, which will be the same size as the generator, which will be of the same mark. The generator will be driven by an 8-horse Otto gas engine, which will be fixed in an arch in the high sea wall under Madeira-road, and opposite the pier at Pastor-place. The engine will run continuously, as it will also have to drive a small centrifugal pump, by which a tank at the top of the sea wall, about 50ft. high, will be filled, for operating an inclined railway, which Mr. Volk is also erecting up the flight of steps between the Madeira-road at this place and the Marine Parade. The new railway is 1400 yards in length, or over three-fourths of a mile, and the calculated resistance of the rail circuit is only 0·25 ohms. The generator will be capable of giving about 3600 volt-ampères with about 7½-horse power. At the Pastor-place pier an excellent waiting room is being built. In passing the Chain Pier the line dips and rises by a gradient of 1 in 45.

There seems to be no reason to think that this line will not be as popular, and probably it will be much more popular, than that of last year. It will accommodate many more, and will ply between two well-known places.

Things of this kind must have a small beginning, and the experiment which is being made by Mr. Volk has this feature of interest, namely, that though a small affair, it is being constructed and conducted with the view to the profit it will earn. Last year's experiment proved to him that an electric railway might be worked at a profit which was worth obtaining. It has, therefore, shown what capitalists want to know; but it must be remarked that Mr. Volk has worked under conditions which have been favourable in every way to the railway. He has not had to buy land. He has not had to earn a dividend on a large capital, but has only had to get a profit on as many pounds, shillings, and pence as had to be paid for a very economical set of plant. The working staff was very small, and the charge for management was *nil*. The profit earned, however, was as much as would have paid a high rate of dividend, and, therefore, with similar relative receipts and capital on a much larger railway, a considerable dividend could be paid with a higher rate of working expenses. But it has to be remembered that only one set of plant—that is to say, only one engine and one generator—was employed. In a larger railway a double set would probably be thought necessary, though there was not a single hitch on the little line during its time of running, and we could point to several electric lighting stations whereat only one set of generating plant is in use. This one set, however, is relied upon just as is the one engine in a mill or a steamship; and with proper care and attention there is no reason why this should not be the case with light railways. Engine and machine can be looked to when trains have ceased running, and thus kept in repair. Under these conditions light railways may be very economically worked by electricity, and there is no doubt the experiment at Brighton will lead to many more under similar conditions.

The End of an Old Ship.—Between ten and eleven o'clock on Saturday morning, the 9th ult., says the *Nautical Gazette*, the old line-of-battle ship New Orleans, which has been on the stocks in Sackett's Harbour since 1815, and has been undergoing demolition the past three weeks, parted directly in the centre and fell to the ground, instantly killing a workman named John Oates, and seriously injuring Ralph Godfrey, M. Jeffrey, and a man named Hemens. Eight other workmen narrowly escaped. Oates was terribly mutilated, a spike being forced entirely through his head and a bolt through his back. The New Orleans was begun by Henry Eckford, of New York, about the 1st of January, 1815, under contract with the Government. Her name was fixed by the authorities after General Jackson's victory at New Orleans on January 8th, the same year. She was to be 3200 tons burden, 187ft. length of keel, 56ft. beam, and 40ft. depth of hold, pierced for 110 guns, but could carry 120. When Eckford was awarded the contract a large force of men was secured and timber was gathered from the surrounding forests. Nails, spikes, and bolts were forged on the ground, the bolts being entirely of copper. The timber was mostly cedar and oak, and beams in the keel being of an extraordinary size. The gun carriages were carted across the country from the Mohawk Valley, and were composed of mahogany and lignum vitæ, and are still in the storehouse at Sackett's Harbour. The Peace Commissioners from England and the United States met at Ghent, Belgium, and declared peace on December 24th, 1814. The news did not reach Washington till the February following, and it was not until two weeks later that Eckford received orders to cease work, which he did about March 1st. During sixty days the immense ship had been nearly finished, the main deck was laid and supports for the bulwarks raised. The New Orleans was intended to be used as a sort of floating battery, to be stationed at the head of St. Lawrence river to prevent the British fleet from entering the lake. As she was constructed entirely of green wood, it is an open question whether she could ever have been navigated. Eckford some years later accepted the position of superintendent of naval construction under the Turkish Government, and he died abroad. In 1823-4 he built several vessels for the United States, among others the Jefferson, whose hulk may now be seen during low water at Sackett's Harbour. The Government caused a house to be erected over the New Orleans several years ago, but that was finally destroyed, although the place was visited by hundreds of tourists and curiosity seekers each season. In 1882 Congress ordered the sale of the New Orleans at auction. Last August Alfred Wilkinson, of Syracuse, bid her in for 400 dols. While being demolished under his orders the accident occurred. Wilkinson, it is said, will net about 4000 dols. from his investment.

THE SCHUCKERT DYNAMO ELECTRIC MACHINE.

Fig. 1.

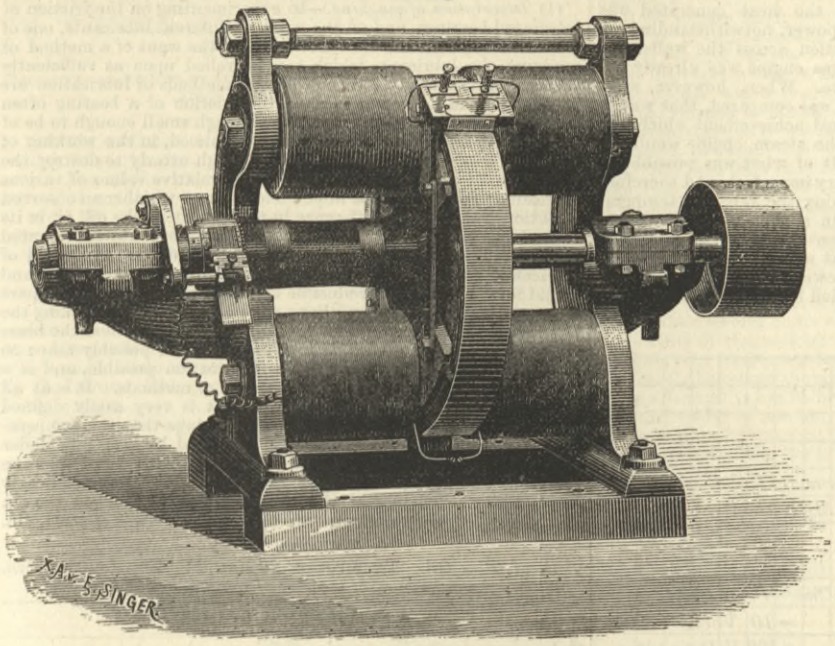
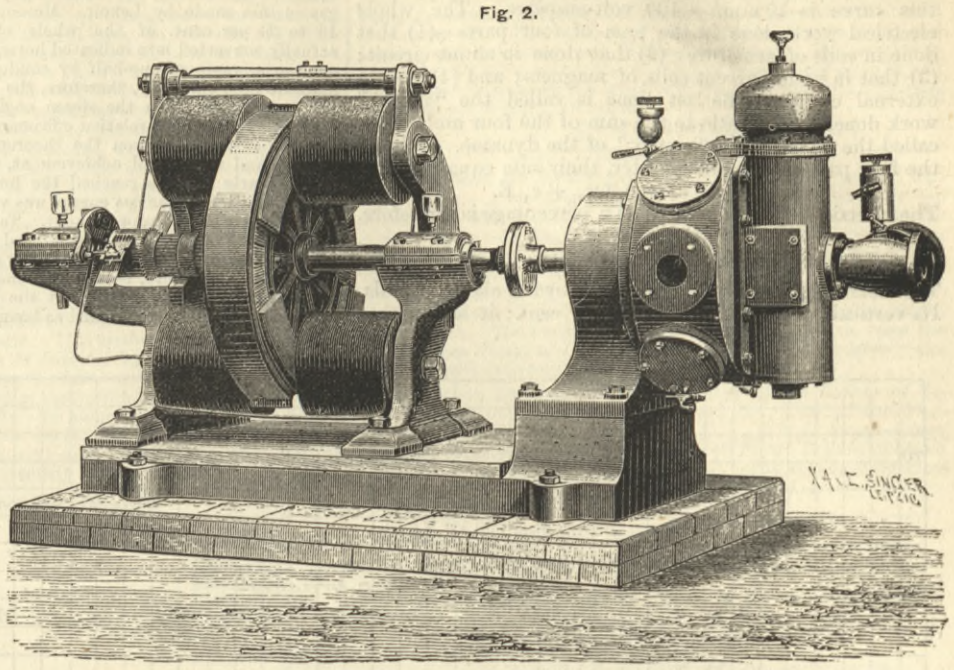


Fig. 2.



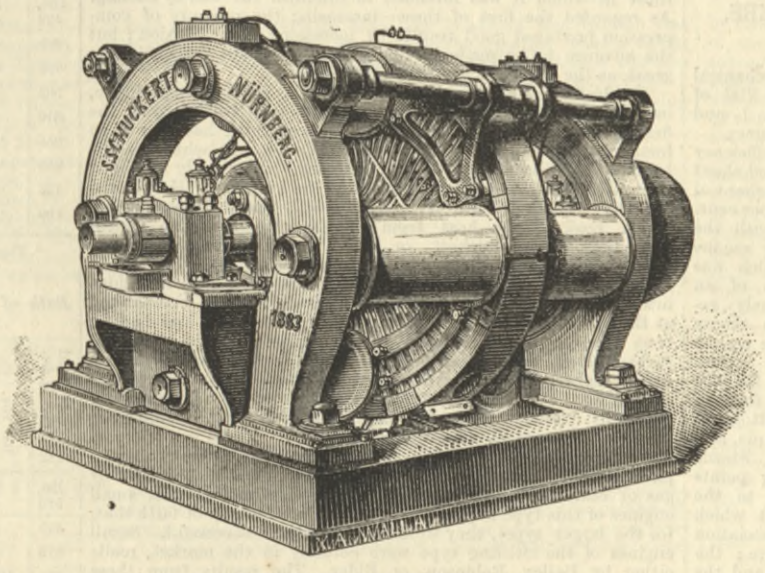
DYNAMO ELECTRIC MACHINES AT THE VIENNA EXHIBITION.

No. II.

AT the Vienna Electrical Exhibition few firms showed greater vigour and enterprise in their exhibits than did Messrs. S. Schuckert, of Nürnberg. Their display attracted as much attention as any in the machine hall. It was particularly rich in dynamos, a considerable number of which were always to be found at work. No fewer than ten machines were running at various periods, and a still larger number, although not driven, were there to be examined. There were several different types exhibited, and two or three sizes of each of most of these types. There has been at different dates very considerable modification in the designs adopted by Schuckert, and we understand that great attention has been paid to the various requirements of different trades using current electricity. It is to these varied needs that the numerous styles of design are due. In Figs. 1, 2, and 3 we illustrate by perspective views three of the most commonly used for electric lighting, charging accumulators, and transmission of power. Fig. 1 shows the older form. The cheeks of the frame are bound together at top by a stout cross-bar. In side view they have a peculiar curved and unsymmetrical shape, which leaves one side open, as in the letter C. In the recess are placed the main bearings. The shape of the standards makes these bearings especially accessible. The caps can be readily removed, the journals examined, and even the whole shaft and armature removed with great ease and without the necessity of disturbing any of the magnets, or in any way throwing the frame out of adjustment. No doubt this is a decided advantage; but we do not think it at all counterbalances the disadvantage of the want of steadiness it gives to the upper part of the machine where the upper pair of magnets are supported. It is too often not considered that there is a real mechanical force between the rotating armature and the magnet poles tending to drag the magnet along with the armature. This force is not a constant force; it oscillates rapidly between maxima and minima. To estimate roughly the magnitude of this force it is only necessary to remember that the whole horse-power delivered to the machine is expended in overcoming it with the exception of the very trifling amount spent in overcoming the friction of the bearings. Now this whole force in this machine is exerted half at the upper and half at the lower pair of magnets. The oscillation of the intensity of the force takes place as many times per revolution as there are segments in the commutator. It is only necessary to keep these facts in view to recognise the great importance of having every part of the frame that supports the magnets massive and stiffly designed in order to prevent vibration. That part of the frame that carries the main bearings is not the only part that requires solidity; in fact, so far as the internal stresses in the machine are concerned, this is the part that requires least solidity, because the internal forces on the bearing are pretty evenly balanced, and it is only the side pull of the belt and its variations that seriously strain these main journals. We cannot help thinking, therefore, that this most common of Schuckert's frame designs could be very simply improved in a large degree by extra front plates bolted on, which, when removed, as they could be removed without disturbing the rest of the frame or the magnets, would leave the armature free to be drawn out to one side as it is at present. We also fail to see any good reason why the bearings should not be put considerably closer together, which would further greatly promote steadiness in running. It seems to us that at least one decided advantage of the "flat ring armature" consists in its permitting the bearings to be brought much nearer each other than in any other style of dynamo. This apparent advantage is wholly thrown away.

Practically the same design of dynamo is shown in Fig. 2. It is here shown coupled to, and driven by, a four-cylinder steam engine of the Abraham patent. This engine ran very quietly at the Exhibition, notwithstanding its high speed, and no doubt four-cylinder as well as three-cylinder engines have a large future before them for dynamo driving. We have not seen as yet any engines of this class compounded, but we expect that it will not be long before we do see them so built, because the system offers special facilities for compounding.

Fig. 3 shows the latest design that Herr Schuckert had brought out at the date of last year's exhibition, but we believe he is now engaged in elaborating still further developments. In the machine shown in Fig. 3 there are four pairs of magnets. They are supported on side frames, in which the open side style is of necessity abandoned. These magnets, like those of the other machines, have cylindrical cast iron cores, the winding also being of cylindrical shape. These are bolted in the usual way to the frames. The pole piece of each extends circumferentially through a considerable arc, covering the



EIGHT MAGNET SCHUCKERT DYNAMO.

sides as well as the outer cylindric surface of the armature. All the pole pieces are bound together by brass bands, and through these derive extra support from the two heavy binding and stiffening bolts that pass from end to end of the machine between the side frames. The shaft bearings are globular swivel brasses, according to Seller's system. These bearings are placed in separate plummer blocks, partly, we presume, for convenience in manufacture, the construction of the Seller's swivel bearings being more complicated and requiring more handling than the simpler style, but chiefly in order to allow the shaft to be set so as to get the armature to run true with respect to the pole pieces of the magnets. The plummer blocks are set in position by keys, and bolted down to the frame in the ordinary manner. A large brass boss keyed about the middle of the length of the shaft carries the armature, the two being bound together by brass clamps and screws. The armature, like all those of Schuckert's various machines, is of the "flat ring" type. The core is made up of a large number of thin annular plates, round which the wire is coiled in the ordinary Gramme style. There are eight magnets altogether. All of them are wound compound—that is, they are each traversed by the main current through a coil of thick wire, and also by a shunt current through a coil of fine wire. The main current traverses the coils of each pair of opposite magnets in series, but the four such pairs are coupled in parallel circuit for the main current. The shunt current, on the other hand, traverses all eight magnets one after the other, *i.e.*, in series. The commutator is divided into sixty-four segments, the armature coil being divided into the same number of sections, each of which is joined to a corresponding commutator segment by a wire led parallel to the shaft at a short distance from its surface. The brushes are mounted on a pair of cast iron bridges firmly bolted to the side frames, and so arranged that they can be rotated into the position giving the maximum electrical efficiency. There are four brushes, and the currents between the two pairs can by suitable connections be combined either for quantity or for tension. The machine is intended to feed 500 Edison lamps. The annexed table gives the measured electro-motive force for different numbers of Edison A—16-candle—lamps put in circuit, the speed being taken as constant at 500 revolutions per minute.

The last three columns we have calculated on the approximate assumption that the resistance of the leads is inappreciable in comparison with the other resistances, and that the resistance of one lamp is 140 ohms. This machine is catalogued as F. L. 7.

The diagram, Fig. 4, gives in a series of curves the results of experiments on a smaller size of machine of the style shown in Fig. 1 running at 1200 revolutions per minute. It is catalogued as T. L. 3. The coil resistance of the armature when it is warm is 0·202 ohm. In the following formula this is called ρ. The resistance of the main current coils on the field magnets is 0·504 ohm and is called r_1 below. That of the shunt current coils on magnets is 75·5 ohms, and is called r_2 in the formula. The shunt is from brush to brush. Thus, if R represent the external resistance between the terminals of the machine beyond the magnets, the total resistance of the circuit is

$$\rho + \frac{1}{\frac{1}{r_2} + \frac{1}{R + r_1}} = \cdot 202 + \frac{75\cdot 5\,(R + \cdot 504)}{76\cdot 004 + R}$$

$$= \frac{53\cdot 4 + 75\cdot 7\,R}{76 + R}.$$

There are seven curves drawn in the diagram. In all of these the horizontal distances represent external resistance inserted between the terminals of the machine, measured to scale, 10 mm. = 1 ohm. The range of external resistance covered by the curves is from 5 to 33 ohms. There are three curves marked C_1 c_1 and c_2 giving (1) the current through the armature; (2) the current through the external resistance and through the main coils of magnets; and (3) the shunt current round the magnets. All these are plotted to a vertical scale of 10 mm. = 1 ampère. The

No. of Edison A lamps (16 candles) in multiple arc.	E.M.F. of machine, volts.	Calculated external resistance, ohms.	Calculated current, ampères.	Calculated useful electrical horse-power.
400	97	·350	277	36·0
380	98	·368	277	36·4
360	99	·389	255	33·8
340	100	·412	243	32·6
320	100	·437	228	30·5
300	101	·453	216	29·2
280	101	·500	202	27·3
260	101	·538	188	25·4
240	101	·583	175	23·7
220	101	·636	159	21·5
200	100	·700	143	19·1
180	100	·777	129	17·3
160	100	·875	114	15·3
140	100	1·000	100	13·4
120	99	1·166	85	11·3
100	99	1·400	71	9·42
80	98	1·750	56	7·36
60	97	2·333	42	5·46
40	96	3·500	27	3·47

height of the first (C) is at any point equal to the sum of the heights of the other two ($c_1 + c_2$). There are also two curves marked E_1 and E showing the electro-motive force between the brushes and the electro-motive force between the terminals. These two are plotted to the scale 10 mm. = 10 volts. The difference of height between these two curves is, of course, $C\rho$, which varies with C, but is always small because ρ = ·202 ohm only. The curve marked

$E c_1$, gives the electrical work done in the external circuit, being the product of the electro-motive force between the terminals and the external current. The vertical scale of this curve is 10 mm. = 100 volt-ampères. The whole electrical work done is the sum of four parts—(1) that done in coils of armature; (2) that done in shunt circuit; (3) that in main current coils of magnets; and (4) that in external circuit. The last alone is called the "useful" work done, and its ratio to the sum of the four amounts is called the "electrical efficiency" of the dynamo. Adding the four parts in the above order, their sum equals—

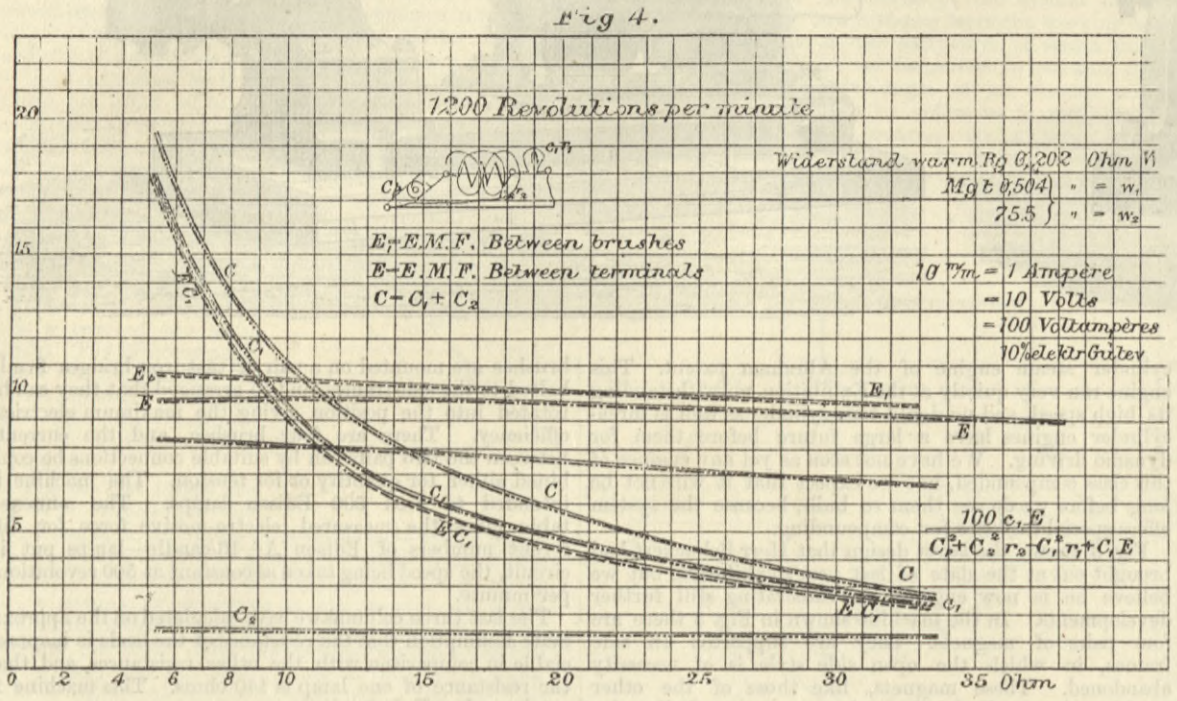
$$C^2 \rho + c_2^2 r_2 + c_1^2 r_1 + c_1 E.$$

The electrical efficiency stated as a percentage is, therefore,

$$\frac{100\, c_1 E.}{C^2 \rho + c_2^2 r_2 + c_1^2 r_1 + c_1 E.}$$

This curve is plotted off and marked by the above formula. Its vertical scale is 10 mm. = 10 per cent.; it shows that the electrical efficiency varies from 83 per cent. for R = 5 ohms to 67 per cent. for R = 33 ohms. The electro-motive force between the terminals keeps very constant, being 98 volts when R = 5 ohms, and 90 volts when R = 40 ohms.

Fig 4.



and two vertical lines, the theoretical efficiency of the gas engine with the temperature described would be about 48 per cent., and one-half of this had been attained, the other half being accounted for by the cooling of the walls. The lecturer then passed on to consider what possible means might be suggested for improvement, and divided these into two clases—those in which it was intended to lower the practical temperature of rejection, and those in which it was intended to diminish the loss by cooling. As regarded the first of these—increasing the pressure of compression produced good results by increasing the expansion; but the advance to be made in this direction was not expected to be great, as the pressures used were already large.

The lecturer next proceeded to describe the Stirling engine, invented in 1827, pointing out that Robert Stirling was the first inventor of the regenerator—a device which had not been fertile so far as heat engines were concerned, but which, in the hands of the late Sir William Siemens, had greatly modified several of the important industries in the kingdom. He pointed out that it was a natural idea to modify the Stirling engine, which received its heat from outside into an engine which, like the Cayley-Buckett or gas engines, received their heat inside, and explained in detail the difficulties that had been met with in several attempts to carry this idea into practical effect. The late Sir William Siemens had worked at the conception during the greater part of his life, and had he been spared a few years longer, there could be no doubt that complete success would have been attained. Professor Jenkin's experiments in the same direction had been chiefly directed to combating the difficulties introduced by the porosity of refractory materials, which was much greater than was usually supposed, even in the case of very dense fire-brick. These experiments had been given up temporarily, under the conviction that the complications involved in introducing internal combustion, whether by gas or coal, into a Stirling engine were such as to render small engines of this type impractical, but without any loss of faith that, for the larger types, they would ultimately be successful. Small engines of the Stirling type were actually in the market, made either by Bailey, Robinson, or Rider. The results from these engines were as good as could be expected from their small size and the low-pressure used. They could be made more efficient by raising the pressure, but the complication introduced would probably outweigh the advantage obtained in the saving of coal. The theoretical results to be obtained by the simple adoption of a regenerator, through which the mixture of gas and air passed on entering the cylinder, and repassed on leaving it, were then described, and seemed to show that this device might be serviceable in sensibly increasing the efficiency of engines, and finally some attempts were described by which it was hoped that the great conduction across the walls of the cylinder might be diminished. For this purpose, however, invention was required. In due time it would be forthcoming. In fact, the most interesting point connected with gas engines was this, that while in the steam engine the limit of improvement had almost been reached, with the gas engine the theoretical efficiency was already double that of the steam engine, and the cost of working comparable, especially when Dowson gas was used, and that in the case of the gas engine it was possible to look forward to double and triple the efficiency which had so far been actually obtained.

THE INSTITUTION OF CIVIL ENGINEERS.

GAS AND CALORIC ENGINES.

The fourth of the six lectures on "Heat in its Mechanical Applications" was delivered on Thursday evening, the 21st of February, by Professor Fleeming Jenkin, LL.D., F.R.SS., L. and E., M. Inst. C.E., the subject being "Gas and Caloric Engines."

The lecturer began by defining what he meant by the efficiency of an engine, and stated that the steam engine converted about 10 per cent. of the total heat generated by the coal into mechanical work, or, in other words, had an absolute efficiency of 10 per cent. It was his duty to compare hot air and gas engines with the results achieved by steam. The first important hot air engine was that devised by Sir George Cayley in 1807, which was fully described in his patent of 1837. A diagram of an engine, made by Buckett, was referred to as closely resembling Cayley's engine. Details were given of the theory of the Cayley-Buckett engine, which showed that the results so far were comparable with those obtained by steam, but that there was no great promise of improvement for the future. Gas engines were next treated of, being also a form of internal combustion engine. The engine designed by Otto, and improved by Crossley, was described as one typical example, and the other chosen was that made by Thomson and Sterne according to Mr. Dugald Clerk's plan. The following points were named as those of chief interest:—The limitation to the higher and lower limits of temperature; the rate at which combustion proceeded inside the cylinder; whether dissociation was a sure course of the limit to the higher temperature; the loss of heat by the cooling of the walls of the cylinder, and the loss of heat in the residual products rejected. Experiments specially made by Messrs. Crossley were described, showing that a change in speed with a constant charge had caused an alteration in the maximum pressure and maximum temperature; but that this change did not extend between wide limits. A change in the richness of the mixture produced a much greater change in pressure and temperature. A diagram was shown in which the pressure was almost uniform throughout the stroke, and another showing the modification produced in the indicator diagram when the charge introduced was not allowed to mix with the residual products. All these diagrams tended to prove that gradual combustion certainly took place in these engines, and that the rate of combustion was under control. A series of very interesting diagrams, illustrating experiments made by Mr. Clerk, was then explained, the rate of combustion in different mixtures of gas and air, and of hydrogen and air, being exhibited by a continuous curve. These experiments established, beyond a doubt, that the rate of combustion varied in proportion to the richness of the mixture, and that this rate was, in the poorer mixtures, such that a considerable portion of the stroke would be completed before the combustion was complete. In fact, Mr. Clerk's experiments and those of Messrs. Crossley nearly agreed, although these makers might differ in their explanation of the cause. The experiments further showed that whether dissociation acted as a limit to the temperature or not, practically the mean temperature of the contents of the cylinder in gas engines at the beginning of the stroke seldom rose above 1550 deg. Centigrade. The experiments of the makers further agreed in this:—That the loss by conduction through the walls of the cylinder was a little over 50 per cent., and that at the moment when the highest pressure was attained not much more than one-half of the total heat was developed, the rest being developed throughout the stroke. The lecturer pointed out that the true condition of the burning gases was one which it was extremely difficult to analyse or follow; that within the cylinder there must be an extremely hot kernel at a temperature greatly above the mean; that at the outside there must be a layer little above 150 deg. Centigrade, and between these limits layers at all temperatures; that part of the gases must expand receiving heat, and part give it up. But it was interesting to find that the practical result of these complicated actions did not differ widely from the adiabatic curve, although, in point of fact, one-half of the heat was being given up by conduction. Passing from these theoretical considerations to the practical results, the lecturer found a similar agreement. Both makers produced engines giving 1 indicated horse-power for 20 cubic feet of gas. This result corresponded to one-third, or one-fourth, of the consumption recorded for the early gas engines made by Lenoir. Moreover, they showed that from 16 to 24 per cent. of the whole of the heat generated was actually converted into indicated horse-power, notwithstanding the enormous waste of one-half by conduction across the walls. In absolute heat efficiency, therefore, the gas engine was already 100 per cent. better than the steam engine. When, however, what might be termed the relative efficiency was compared, that was to say, the relation between the theoretical achievement which was possible and the actual achievement, the steam engine would be found nearly to have reached the limit of what was possible or probable, whereas the gas engine was very imperfect, and therefore gave hopes of great improvement. Taking the range of temperatures as the highest and lowest used in a gas engine, the ideal efficiency might be spoken of as 77 per cent., but no real gas engine could reach this figure, because the heat was not wholly given at the higher nor wholly rejected at the lower temperature. If the indicator diagram were treated as bounded by two adiabatic curves

TENDERS.

PORTMADOC.—MAIN SEWER, &c.

For making main sewer and works connected therewith, at Glaslyn-street, for the Ynyscynhaiarn Local Board. Mr. Thomas Roberts, Assoc. M. Inst. C.E., engineer.

	£	s.	d.
Davies and Edwards, Aberystwith	170	14	0
Owen, Portmadoc	153	0	0
Hughes, Portmadoc	132	0	0
Davies, Portmadoc—accepted	104	1	6
Engineer's estimate	138	18	0

The Select Committee of the House of Commons on harbour accommodation is now entering upon its second year's labours. It was appointed to inquire into the harbour accommodation on the coasts of the United Kingdom, having regard to the laws and arrangements under which the construction and improvement of harbours may now be effected.

FRICTION OF LUBRICATED BEARINGS.

The following is the first report on friction experiments made under the auspices of the Institution of Mechanical Engineers. It is by Mr. Beauchamp Tower.

(1) *Description of machine.*—In experimenting on the friction of lubricated bearings, and on the value of different lubricants, one of the difficulties which is first met with is the want of a method of applying the lubricant, which can be relied upon as sufficiently uniform in its action. All the common methods of lubrication are so irregular in their action that the friction of a bearing often varies considerably. This variation, though small enough to be of no practical importance, and to pass unnoticed, in the working of an ordinary machine, would be large enough utterly to destroy the value of a set of experiments, say, on the relative values of various lubricants; for it would be impossible to know whether an observed variation was due to a difference in the quality of the oil, or in its rate of application. The first problem therefore which presented itself, in the present experiments, was to devise a method of lubrication such as would be perfectly uniform in its action, and would form an easily reproducible standard with which to compare other methods. These conditions were best fulfilled by making the bearing run immersed in a bath of oil. By this method the bearing is always supplied with as much oil as it can possibly take; so that it represents the most perfect lubrication possible, and is a good standard with which to compare other methods. It is at all times perfectly uniform in its action. It is very easily defined and reproduced; and it also has the advantage that the temperature of the bearing can be easily regulated by gas jets under the bath. Experiment showed that the bath need not be full; the results obtained were the same when it was so nearly empty that the bottom of the journal only just touched the oil. The journal experimented on—see Figs. 1 and 2—was of steel, 4in.

Table I.

Bath of Olive Oil. Temperature 90 deg. F. 4in. Journal, 6in. long. Chord of the Arc of Contact = 3·92in.

*Nominal load lbs. per sq. in.	Coefficients of friction, for speeds as below.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs. 520	—	·0008	·001	·0012	·0013	·0014	·0015	·0017
468	—	·0011	·(013	·0014	·0015	·0017	·0018	·002
415	—	·0012	·0014	·0015	·0017	·0019	·0021	·0024
363	—	·0013	·0016	·0017	·0019	·002	·0022	·0025
310	—	·0015	·0017	·0019	·0021	·0022	·0024	·0027
258	·0014	·0017	·002	·0023	·0025	·0026	·0029	·0031
205	·0018	·0021	·0025	·0028	·003	·0033	·0036	·004
153	·0023	·003	·0035	·004	·0044	·0047	·005	·0057
100	·0036	·0045	·0055	·0063	·(069	·0077	·0082	·0089

The above coefficients × the nominal load = nominal frictional resistance per square inch of bearing.

*Nominal load lbs. per sq. in.	Nominal frictional resistance per sq. inch of bearing.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs. 520	lb. —	lb. ·416	lb. ·520	lb. ·624	lb. ·675	lb. ·728	lb. ·779	lb. ·883
468	—	·514	·607	·654	·701	·794	·841	·935
415	—	·498	·580	·622	·705	·787	·870	·995
363	—	·472	·580	·616	·689	·725	·798	·907
310	—	·464	·526	·588	·650	·680	·742	·835
258	·361	·438	·515	·592	·644	·669	·747	·798
205	·368	·43	·512	·572	·613	·675	·736	·818
153	·351	·458	·535	·611	·672	·718	·764	·871
100	·36	·45	·55	·63	·69	·77	·82	·89

* The nominal load per sq. inch is the total load divided by (4×6).

Table II.

Bath of Lard Oil. Temperature 90 deg. F. 4in. Journal, 6in. long. Chord of Arc of Contact of Brass = 3·92in.

*Nominal load lbs. per sq. in.	Coefficients of friction, for speeds as below.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs. 520	—	·0009	·001	·0011	·0013	·0015	·0015	·0017
415	—	·0012	·0014	·0015	·0016	·0018	·0019	·0021
310	—	·0014	·0017	·002	·0022	·0025	·0026	·0029
205	·0017	·0020	·0023	·0028	·0031	·0034	·0039	·0042
153	·0022	·0027	·0032	·0037	·0041	·005	·0051	·0052
100	·0035	·0042	·005	·006	·0067	·0076	·0081	·009

The above coefficients × the load = nominal frictional resistance per sq. inch of bearing.

*Nominal load lbs. per sq. in.	Nominal frictional resistance per sq. inch of bearing.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs. 520	lb. —	lb. ·468	lb. ·52	lb. ·572	lb. ·675	lb. ·779	lb. ·779	lb. ·883
415	—	·498	·58	·621	·663	·746	·788	·870
310	—	·434	·526	·619	·680	·774	·804	·898
205	·348	·409	·47	·572	·634	·696	·798	·859
153	·336	·412	·489	·565	·626	·764	·779	·795
100	·35	·42	·5	·6	·67	·76	·81	·9

diameter and 6in. long, with its axis horizontal. A gun-metal brass A, embracing somewhat less than half the circumference of the journal, rested on its upper side. The exact arc of contact of this brass was varied in the different experiments, as will be seen by reference to the appended tables of results. Resting on this brass was a cast iron cap B, from which was hung by two bolts a cast iron cross-bar C carrying a knife-edge. The exact distance of the knife-edge below the centre of the journal was 5in. On this knife edge was suspended the cradle D, which carried the weight applied to the bearing. The cap, bolts, and cross-bar were put together in such a manner as to form a rigid frame, connecting the brass with the knife edge. If there had been no friction between the brass and the journal, the weight would have caused the knife-edge to hang perpendicularly below the axis of the journal. Friction, however, caused the journal to tend to carry the brass, and the frame to which it was attached, round with it, until the line through the centre of the journal and the knife-edge made such an angle with the perpendicular that the weight multiplied by the distance from the knife-edge to that perpendicular offered an opposing moment just equal to the moment of friction.

Suppose r = radius of the journal—Fig. 3,
s = distance of the knife-edge from the perpendicular,
w = the weight,
then, from above, $s \times w$ = the moment of friction.
Now, the friction at the surface of the journal
$$= \frac{\text{the moment}}{r} = \frac{w \times s}{r}.$$
Hence the coefficient of friction
$$= \frac{\text{Friction at surface of journal}}{w} = \frac{s}{r},$$
so that the coefficient of friction is indicated by s in terms of r, no matter what the weight is. As an example, suppose s was equal to r; the coefficient of friction would obviously be 1; or if s was $\frac{1}{10}$ of r, then the coefficient of friction would be $\frac{1}{10}$. In order to avoid the difficulty of determining accurately when the knife-edge was perpendicularly under the centre of the journal—a knowledge which was necessary in order to obtain a measurement of s, and which was very difficult to obtain owing to the considerable friction between the brass and the journal when at rest—each experiment was tried with the journal revolving in both directions, and the sum of the values of s on both sides was measured; and then the coefficient of friction was indicated by the chord of the whole angle, included between the two lines of inclination caused by the friction, with the rotation in the two directions, the chord being expressed in terms of the diameter of the journal—see Fig. 4. Each result was thus a mean of two experiments, one with the axle running in one direction, and the other with it running in the other direction. In order to read the value of the coefficients thus obtained, a light horizontal lever L was attached—as shown in Fig. 1—to the frame connecting the brass to the knife-edge. It was 62½in. long, or twelve and a-half times the distance between the centre of the journal and the knife-edge, so that at the end of the lever the chord indicating the coefficient of friction was magnified twelve and a-half times. As a chord of 4in. at the knife-edge represents a coefficient of 1, a chord of 50in. at the end of the lever also represents a coefficient of 1, while 5in. represents a coefficient of $\frac{1}{10}$, ½in. of $\frac{1}{100}$, and $\frac{1}{20}$in. of $\frac{1}{1000}$. The position of the end of the lever during each experiment was recorded by a tracing point attached to the end of the lever, and marking on metallic paper carried upon a revolving vertical cylinder P. The distance between the two lines obtained by running the axle both ways, when measured on the above scale, indicated the value of the coefficient.

TABLE III.

Bath of Mineral Grease. Temperature 90 *deg. F.* 4*in. Journal,* 6*in. long. Chord of Arc of Contact of Brass* = 3·92*in.*

Nominal load lbs. per sq. in.	Coefficients of friction, for speeds as below.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs.								
625	—	·001	·0012	·0014	·0014	·0016	·0018	·002
520	—	·0014	·0016	·0018	·0019	·002	·0021	·0022
415	—	·0016	·0019	·0021	·0023	·0025	·0026	·0027
310	·002	·0022	·0026	·0029	·0032	·0035	·0038	·004
205	·0026	·0034	·0040	·0047	·0053	·0058	·0062	·0066
153	·0028	·0038	·0048	·0057	·0065	·0071	·0077	·0083
100	·0054	·0076	·0094	·0109	·0123	·0133	·0142	·0151

The above coefficients × the nominal load = nominal frictional resistance per square inch of bearing.

Nominal load lbs. per sq. in.	Nominal frictional resistance per square inch of bearing.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
625	—	·625	·75	·875	·875	·999	1·125	1·25
520	—	·727	·831	·935	·987	1·04	1·091	1·143
415	—	·663	·787	·87	·953	1·036	1·074	1·12
310	·62	·682	·805	·899	·992	1·085	1·18	1·24
205	·531	·696	·818	·962	1·085	1·188	1·27	1·35
153	·428	·581	·734	·871	·994	1·085	1·177	1·27
100	·54	·76	·94	1·09	1·123	1·33	1·42	1·51

(2) *Method of Experimenting.*—Early in the experiments it was found that, immediately after the motion of the shaft was reversed, the friction was greater than it was when the shaft had been running in the same direction some time. The increase of friction, due to reversal, varied considerably. It was greatest with a new brass, and diminished as the brass became worn, so as to fit the journal more perfectly. Its greatest observed amount was at starting and was about twice the normal friction, and it gradually diminished until the normal friction was reached after about ten minutes' continuous running. This increase of friction was accompanied by a strong tendency to heat and seize, even under a moderate load. In the case of one brass, which had worked for a considerable time without accident, and had consequently become worn so as to fit the journal very accurately, this tendency to increase of friction after reversal almost entirely disappeared; and it could be reversed under a full load without appreciable increase of friction or a tendency to heat or seize. The phenomenon must be due to the surface fibres of the metal, which have been for some time stroked in one direction, meeting point to point and interlocking when the motion is reversed. The very perfectly fitting brass was probably entirely separated from the journal by a film of oil; and there being no metallic contact the phenomenon did not show itself. In consequence of the above facts, it was found necessary to proceed with the experiments in the following order. A complete series of experiments, with a gradually increasing load, was taken with the journal running in one direction; the load was then diminished by the same steps as it had been increased, and the experiments thus repeated, the shaft still running in the same direction, until the load had thus been reduced to 100 lb. per square inch, which was the load due to the unweighted cradle. The direction of motion was then reversed, and the shaft run for half-an-hour, so as to get it thoroughly used to going the other way; after this the load could be increased and the experiments taken without any difficulty. The experiments, as before, were taken at each step of both increasing and decreasing the load; so that each recorded result is really the mean of four experiments, which have in many instances been taken several hours apart. This method of obtaining a direct indication of the coefficient of friction, by the angular displacement of the frame connecting the brass and knife edge, would undoubtedly have been the best had the coefficient of friction been nearly as constant as it has hitherto been supposed to be. But as shown by the tables of results, the coefficient of friction was found, instead of being constant, to vary nearly inversely as the load, and also to be much smaller in quantity than was expected; the consequence was that with high loads the height of the diagram was very small. In the cases where with the greatest loads a coefficient of only $\frac{1}{1000}$ was observed, the distance between the two lines was only $\frac{1}{20}$in. The results shown in tables I., II., III., IV., were obtained in this way. Owing to these experiments showing

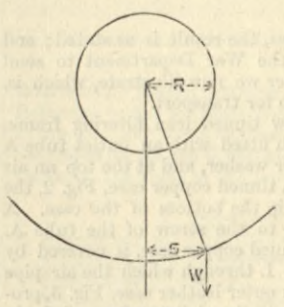


FIG. 3

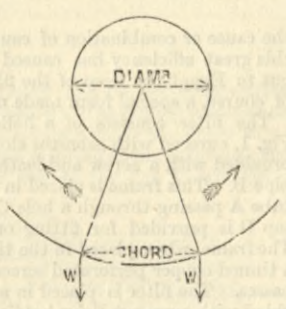


FIG. 4

that the moment of friction was much more nearly constant than the coefficient, it was resolved to alter the method of observation, and to measure the moment directly instead of the coefficient. For this purpose the paper cylinder was removed, and a small lever M—see Fig. 1A—was connected to the main indicating lever in such a manner that the motion of the end of the main lever was magnified five times at the end of the small lever. The end of the small lever was pointed, and when the machine was working this point was brought exactly opposite a fixed mark by putting weights into a scale pan on the end of the main lever. The main lever was so overbalanced that under all circumstances some weight was required to be added in the scale pan, in order to bring the end of the small lever to the mark, even when, in addition to the friction being greatest, the direction of motion of the journal tended most to depress it. The method of running in both directions, and loading and unloading, was followed as before. The weights in the scale pan being noted, the moment of friction was given by half the difference between the weights in the scale pan when running in one direction and in the other.

(*To be continued.*)

TABLE IV.

Bath of Sperm Oil. Temperature 90 *deg. F.* 4*in. Journal,* 6*in. long. Chord of Arc of Contact of Brass*=3·92*in.*

Nominal load lbs. per sq. in.	Coefficients of friction for speeds as below.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs.								
520	Seized.	—	—	—	—	—	—	—
415	—	·0015	·0017	·0018	·0019	·002	·0021	·0021
310	—	·0011	·0012	·0014	·0016	·0017	·0018	·0019
205	·0013	·0016	·0018	·0021	·0023	·0024	·0025	·0027
153	·0016	·0019	·0023	·0028	·0030	·0033	·0035	·0037
100	·0025	·003	·0038	·0044	·0051	·0057	·0061	·0064

The above coefficients × the nominal load = nominal friction resistance per square inch of bearing.

Nominal load lbs. per sq. in.	Nominal frictional resistance per square inch of bearing.							
	100 rev. 105ft. per min.	150 rev. 157ft. per min.	200 rev. 209ft. per min.	250 rev. 262ft. per min.	300 rev. 314ft. per min.	350 rev. 366ft. per min.	400 rev. 419ft. per min.	450 rev. 471ft. per min.
lbs.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
520	Seized	—	—	—	—	—	—	—
415	—	·621	·705	·746	·788	·829	·87	·87
310	—	·341	·372	·434	·495	·526	·557	·588
205	·266	·327	·368	·43	·471	·491	·512	·552
153	·244	·291	·352	·428	·459	·505	·535	·566
100	·25	·3	·38	·44	·51	·57	·61	·64

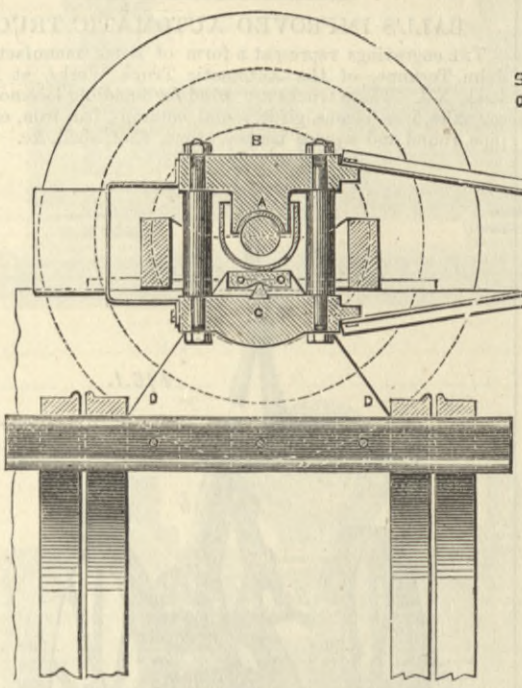


FIG. 1
SECTIONAL ELEVATION OF TESTING MACHINE

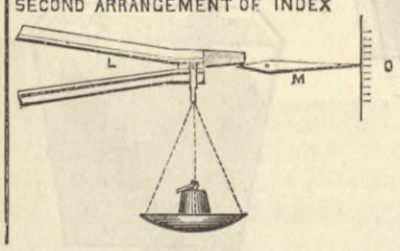


FIG. 1A
SECOND ARRANGEMENT OF INDEX

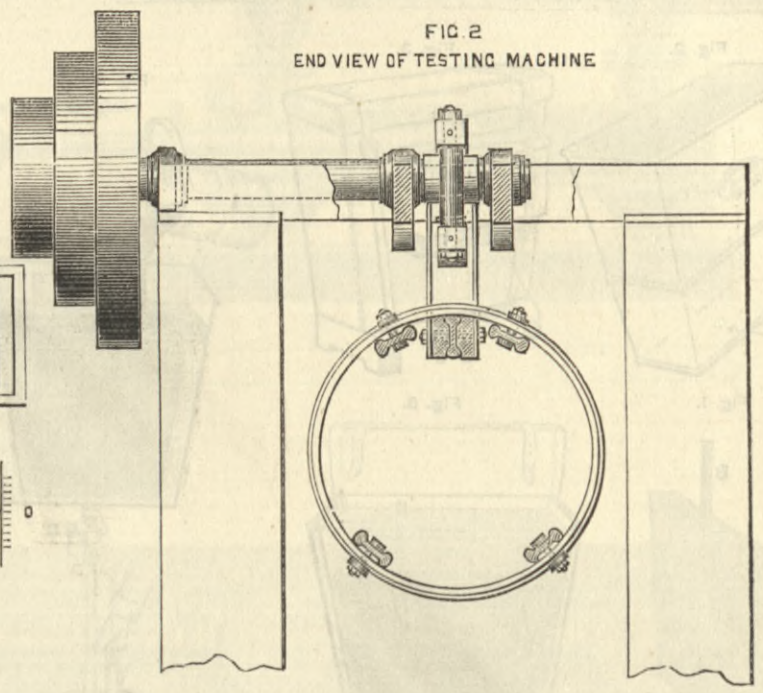


FIG. 2
END VIEW OF TESTING MACHINE

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.—A meeting will be held at Brighton, on Saturday, the 15th day of March, 1884. The members will assemble at twelve o'clock—noon—at the Town Hall, Hove, to receive tne resignation of the district hon. sec., and to appoint his successor. The following papers will be read and discussed:—"The Supervision of Private Buildings by Public Authority," by Mr. Ellice-Clark; "Jointing Sewer Pipes," by Mr. H. P. Boulnois, borough engineer, Portsmouth. The members will afterwards proceed to view the Sea Defence Works at Hove and Brighton, now in progress; also the Brighton intercepting sewer ventilating furnace.

SOCIETY OF ENGINEERS.—At a meeting of the Society of Engineers, held on Monday evening, March 3rd, 1884, at the Westminster Town Hall, Mr. Arthur Rigg, C.E., M.R.I., &c., president, in the chair, a paper on "The Defects of Steam Boilers and their Remedy," by Mr. A. C. Engert, was read. The author commenced by observing that boilers employed for raising steam were mostly of the Cornish and Lancashire type, which evaporated on an average only one-third of the water which, according to science, ought to be evaporated, and that, even with Galloway tubes, it was not possible to evaporate more than half the proper quantity on account of incrustation. The ash-pit, causing a cold draught, kept the bottom of the boiler cool, which caused non-circulation of the water, and unequal expansion. The worst evils in boilers were stated to be incrustation, imperfect combustion, and smoke. To prevent the latter, mechanical stokers had been introduced, many of which, after a few years' work, had been removed. Priming in boilers, the author stated, was but little understood, and caused great harm. Another evil arose from the accumulated gases and acids in boilers, which not only did mischief to the plates, but might cause great injury in case of an explosion. To remedy these defects a new construction of boiler had been designed by the author with flat flues, stayed with vertical tubes, affording more space for the water and steam, with a tank at the back end of the boiler for discharging all gases, and throwing down combinations of lime. By these means the feed-water was boiled, and as it was then almost pure, no scale was formed on the flue. This boiler being entirely bricked in, unequal expansion could not take place. There was an entire absence of smoke. No priming could take place in consequence of the shallow surface of water over the large heated flat flue below. Tests had been made by Mr. W. H. Maw and Mr. D. K. Clark, the former in his trials evaporating 11·3 lb. of water from 81·6 Fah., and the latter 11·85 lb. of water from 73·5 Fah., per pound of coal consumed.

ROLLING BOILER PLATE RINGS.—It will be remembered that in our annual article, published on January 4th, we referred to the production of weldless boiler plate. We said: "A company has been formed, and will start at Barrow-in-Furness, for the manufacture of rolled steel boiler shell hoops, without a weld, up to 16ft. in diameter, 1in. thick, and 4ft. 6in wide. This will at once augment the strength of boiler shells by 25 per cent. for a given thickness of plate; only transverse seams will then have to be rivetted. The machinery required is, we need hardly say, of a very heavy type, and is being made by a very eminent Manchester firm. There is therefore no reason to doubt that the scheme will be entirely successful." On Monday the Vulcan Works, Salthouse, Barrow, where the new process is to by carried on under Mr. Windle's patents, were opened. For the present the production of steel tires, forging, &c., only will be carried on. Mr. Thomas Barlow-Massicks and Mr. David Caird purchased the works at Salthouse, formerly owned and worked by Mr. S. J. Claye, as the Barrow Railway Rolling Stock Works. On Monday a large party first proceeded to visit the Bessemer department, where one of the converters was blown, the charge being about 5 tons weight, being composed of Millom and Askam iron, and tires were subsequently rolled. At luncheon subsequently, several speeches were made, and the chairman, in returning thanks to the Mayor of Barrow, said "they were not going to treat steel in the ordinary manufacture of that metal, but they had secured a patent from their works manager, Mr. John Windle, for the manufacture in the United Kingdom of cylindrical boiler plates without longitudinal seams. He believed this patent would work out very successfully, and it would be one of the features in the manufacture of steel which would be associated with the town of Barrow. These cylindrical rings of steel would add greatly to the strength of the boiler, as much as, he was told, 25 per cent., and they had it on the authority of Mr. Parker, one of Lloyd's chief engineers, that there would be a saving of something even more than this. Especially would this be a saving in the expense of Atlantic liners both by boiler space, boilers required, and even economy in fuel. They could produce these plates here and get almost what price they might ask for them, but they did not wish to be unreasonable, as they were thinking of granting licences to the East Coast, the Clyde, and elsewhere. They would see, however, that they were going to carry out a speciality at their works which would not place them exactly in an analogous position with their neighbours at Hindpool." This will no doubt be one of the most important improvements ever introduced in the manufacture of boilers.

MAIGNEN'S ARMY TRANSPORT FILTER.

Fig. 7.

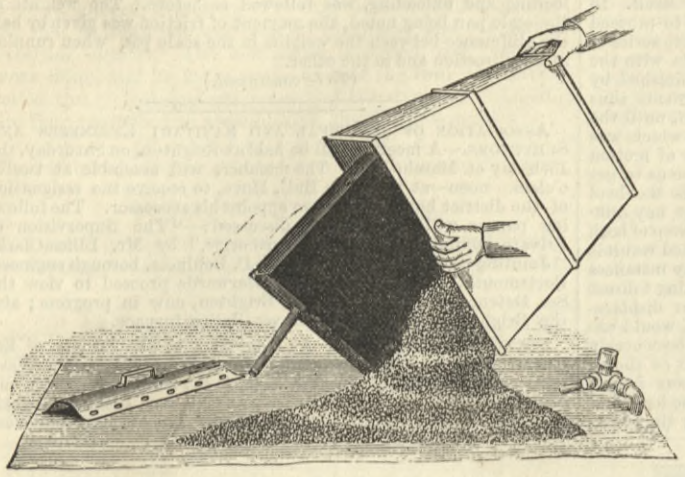


Fig. 9.

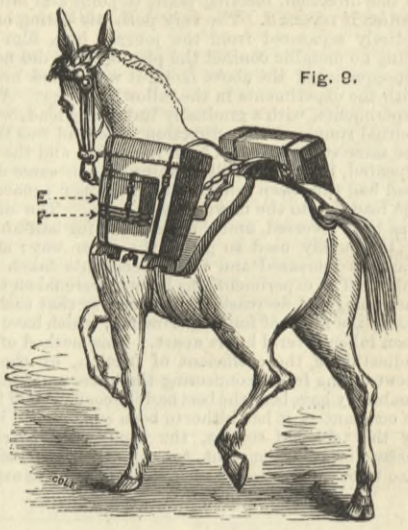


Fig. 2.

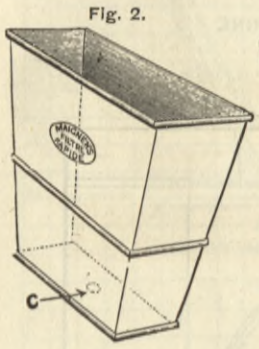


Fig. 3.

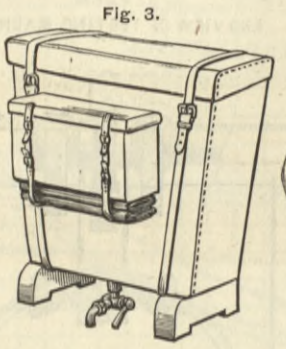


Fig. 4.

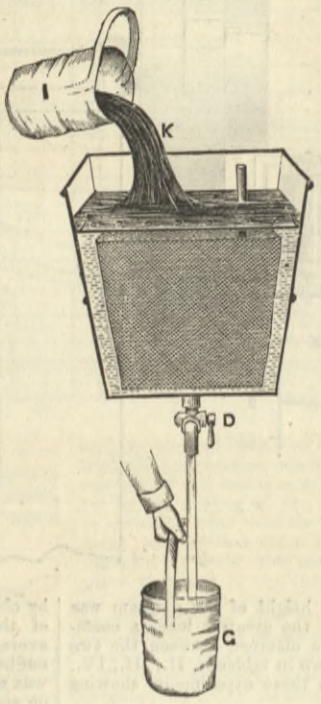


Fig. 5.

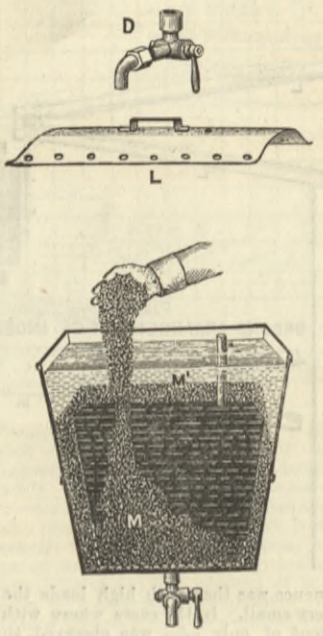


Fig. 1.

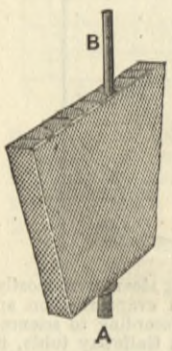
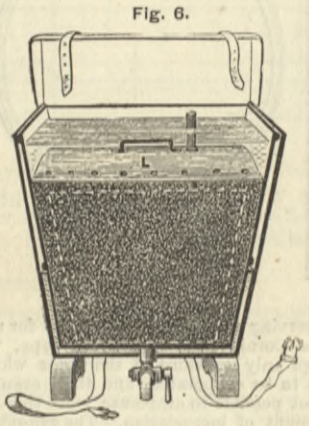


Fig. 6.

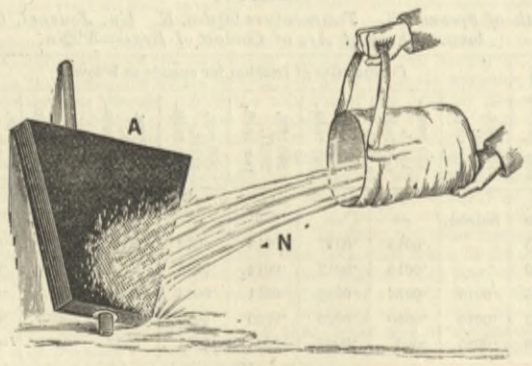


During the past few years the construction of filters for domestic and other small supply purposes has passed through so many phases that everybody is more or less accustomed to the claims put forward by the owners of the last new thing in apparatus of this kind, and if all have not arrived at the conclusion which seems to have been reached by our contemporary, *Punch*, namely, that the difficulty is to find the filter that will do the least harm, most, no doubt, have decided that all small filters are equally a troublesome necessary, which may do as much harm as good if kept in continued use without cleaning or renewal for more than three or four months. This, however, is not necessarily the case, as is shown by experience with the filter we are about to describe, though even this one will not recharge or renew itself with new filtering material. Maignen's filter is now so well known that in describing the field service filter recently sent out to Egypt by the Government for the use of the army a very brief explanation will be sufficient.

Assuming for the moment that all water filtering is only mechanical—that a filter is only a fine strainer—in this case the object must be to get the greatest possible amount of surface into a given unit space, or, in other words, to get a filtering medium which shall at the same time secure perfect porosity with the smallest pores. The most obviously practicable method of doing this is to use a very finely granular material. This has been the practice in the construction of filter beds with sand, of small filters with sand and fine charcoal, and with blocks of agglomerated charcoal. This method of construction has, however, prevented the employment of powdered charcoal, inasmuch as with a mass of this material, capillarity would prevent any but exceedingly slow percolation of water if under the pressure due to a small head, while a great pressure would cause the continual removal of the powder and its mixture in a finely divided state in the filtered water. To avoid the difficulties that would thus attend the use of fine powder charcoal, Mr. Maignen uses a combination. Over a supporting structure of canvas or asbestos cloth, he causes this powder to distribute itself from the water in which it is mixed, and put into the filter for filtration. The water passes through the asbestos cloth, and leaves the powder caught in its interstices, and a further quantity deposits itself over the whole surface of the supporting material. A thin film, or one of any necessary thickness, is thus obtained of very minutely porous charcoal. This forms the central part of a filter vessel, the space around it being filled with granular charcoal. The filter thus made up will intercept, not only the finest suspended inorganic matter, but will do the same with the small bacterium or bacillium. The filtering material thus used is not, however, simply a mechanical strainer. Carbon so finely divided has properties of a chemical or chemico-physical character, which enables it to act, as is proved by experiment upon organic and inorganic matter in solution. We have seen a solution of sulphate of iron, then a solution of acetate of lead, then of urine, passed through a filter of this kind, and exhibit afterwards in the test tube no trace, or scarcely any, when treated with the proper reagents. Through a similar filter, or rather the same one recharged in a few minutes with filtering material, a bottle of claret was passed, and this came out clear white, without the faintest taste of claret, but only a taste of water with a slight addition of spirit. All the colour was equally taken from a solution of permanganate of potash—Condy's fluid. Whatever the cause or combination of causes, the result is as stated; and this great efficiency has caused the War Department to send out to Egypt the form of the filter we now illustrate, which is, of course, a special form made up for transport.

The filter consists of a hollow tinned iron filtering frame, Fig. 1, covered with asbestos cloth fitted with an outlet tube A provided with a screw and leather washer, and at the top an air pipe B. This frame is placed in a tinned copper case, Fig. 2, the tube A passing through a hole C in the bottom of the case. A tap D is provided for fitting on to the screw of the tube A. The frame, when placed in the tinned copper case, is covered by a tinned copper perforated screen L through which the air pipe passes. The filter is placed in an outer leather case, Fig. 3, provided with a pocket E for holding twelve ½ lb. packets of finely powdered charcoal, and a brush. Two folded canvas buckets F are strapped underneath the pocket. When in use the filter should be raised from the ground by placing it on boxes, or by attaching it to the tail board of a wagon. Water should first be poured into the filter, until it is filled nearly to the top, Fig. 4.

Fig. 8.



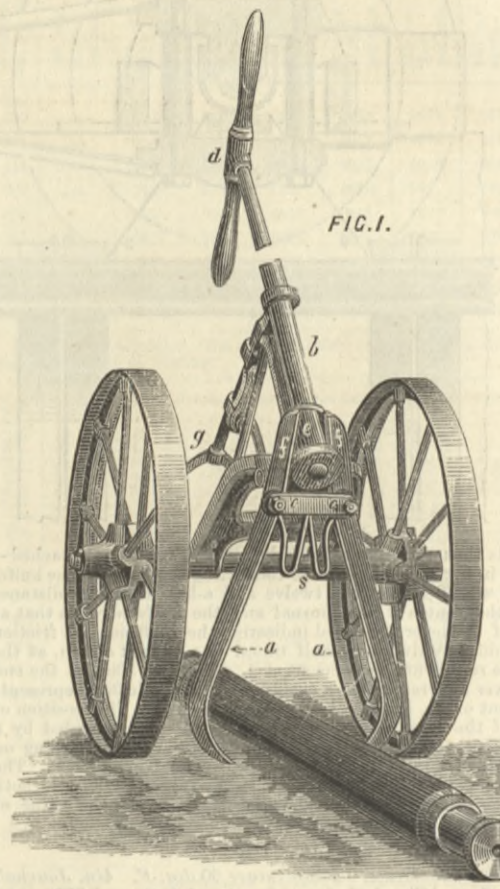
Half of one of the packets of finely powdered charcoal is to be put into an empty bucket G and placed underneath the tap D, and the other half of the packet is to be well stirred with the hand in the other bucket I filled with water, and, the tap D having been opened, poured into the filter K. The charcoal in the bucket G is to be stirred up with the water coming out of the filter, and again poured into the filter K. The water coming from the filter must be stirred in the bucket, so as to mix it with the charcoal which may have been left at the bottom, and again poured back into the filter. The object to be attained is to coat the whole of the surface of the asbestos cloth with an even layer of the finely powdered charcoal, and, to attain this object, it will be necessary to return to the filter the water that comes out until the whole of the charcoal is in the filter. The tinned copper screen L is now to be taken out whilst the filter is still full of water, and the space M, Fig. 5, round the frame and an inch or two over M^1, is to be filled with granulated charcoal; about 16 lb. would be required for this purpose. The screen is then to be put in its place, and the filter is now ready for use, Fig. 6. The water that has been used in starting the filter should be thrown away. The time during which a filter thus charged will continue to be in working order will depend upon the character of the water to be filtered. The filter should be cleaned once a month, or if the water is very bad, twice a month. The following is taken from the directions for cleaning issued on cloth to the men in Egypt:—Unscrew the tap and take it off; lift the filter out of its leather case. Take out the upper part of the granulated charcoal to the depth of about 2in. and throw it away. Turn the filter over on its edge, Fig. 7, and shake the filter until the frame and charcoal fall out. This should be done on clean ground, or upon a piece of canvas, or on a board, so as to be able to recover the granulated charcoal. The granulated charcoal should be placed in the two buckets and washed with filtered water several times, the charcoal to be stirred up by the hand, and the dirty water poured off. This washed charcoal, with a little additional new charcoal, can be used over again. If the charcoal is so dirty as not to be capable of being washed clean in the manner described, it should be thrown away, and fresh granulated charcoal substituted The filtering frame, Fig. 8, can be cleansed by dashing water N smartly against it.

Besides this special form, this filter is made for use by wine and spirit merchants, brewers, and, in a small form, for laboratory purposes. In breweries large sums are being saved by filtering cooler bottoms, which used to be squeegeed down into the drains, and in this way a wort of high gravity is obtained, which was previously considered worth nothing Wort is also filtered by it before fermentation.

BALL'S IMPROVED AUTOMATIC TRUCK.

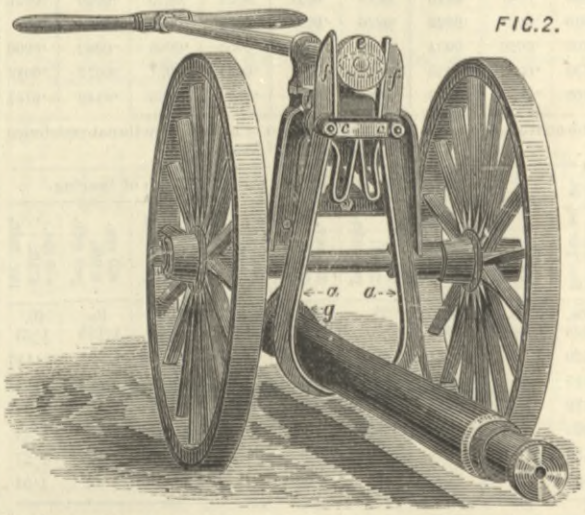
The engravings represent a form of truck, manufactured by John Terhune, of the Automatic Truck Works, at Midland Park, N.J. These trucks are used for handling locomotive and car axles, iron beams, girders and columns, bar iron, cast iron pipe, round and square timber, stone, shot, shell, &c. Various

FIG. 1.



forms of tongs suited for the purpose are used for lifting these different objects. In Fig. 1 the truck is represented in the position it occupies when about to take up a car axle. The tongs *a a* are pivotted at *c c* and are pressed apart by a spring *s*. The shaft or tongue *b b* has a handle *d* on its back end, by which it can be turned from the position shown in Fig. 1 to that in Fig. 2. The shaft, on its front end, has an elliptical shaped cam *e*. The shape of this is shown by the dotted lines at *e* in Fig. 2. This cam works between the upper ends *f f* of the tongs. When the handle *d* is turned into a vertical position, as shown in Fig. 1, the major axis of the cam is vertical, or it

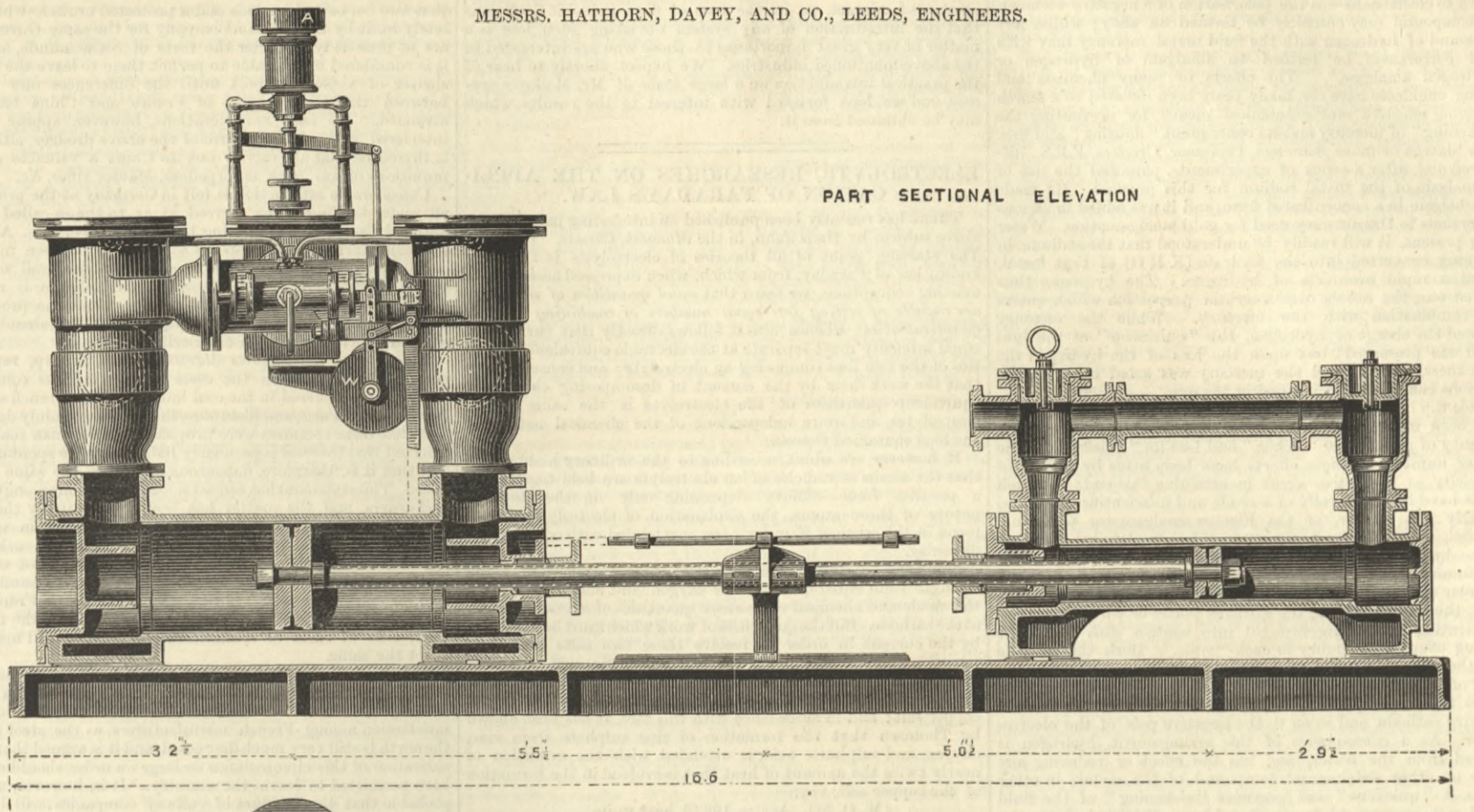
FIG. 2.



stands up edgewise, so that the spring *s* can throw the lower ends of the tongs apart, and then, by raising up the handle and thus lowering the tongs, the latter are in such a position that by simply turning the handle *d* and shaft *p*, the cam *e* is brought into a position with its major axis horizontal, as shown in Fig. 2; the upper ends of the tongs are thus spread apart and the lower ends brought together so as to grasp the axle or other object. At the back end of the truck is a forked bearing *g*. If now the tongs take hold of the axle somewhat back of its centre of gravity, the tendency will be, when it is raised, for the front end to tip downward. By bringing the handle down to the position in Fig. 2, the forked bearing *g* is brought down so as to rest on the axle, and thus prevent the back end from rising or the front end from drooping down. It is thus supported

PUMPING ENGINE, MARPLE WATERWORKS.

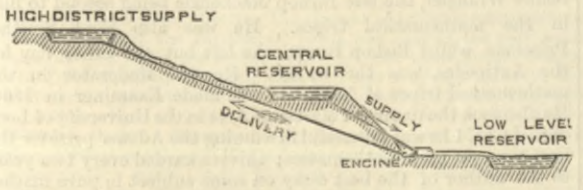
MESSRS. HATHORN, DAVEY, AND CO., LEEDS, ENGINEERS.



securely by the tongs and the forked bearing, and can be moved about anywhere that the truck can be rolled on its wheels. Axles and other objects can be picked up and laid down as quickly as this sentence can be read, and it is immaterial whether they are hot or cold. Two kinds of wheels are used for these trucks; one kind is made of iron, shown in Fig. 1, and the other is Sarven's patent wooden wheel, shown in Fig. 2. A special form of truck is also made for handling car axles with the wheels on them. It is claimed that in handling axles, &c., a great deal of labour is saved by the use of these trucks, and that one man can move loads of 800 lb. to 1000 lb. with them with ease and rapidity. They are used in some of the largest establishments in the country, including the Baldwin Locomotive Works in Philadelphia.—*Railroad Gazette.*

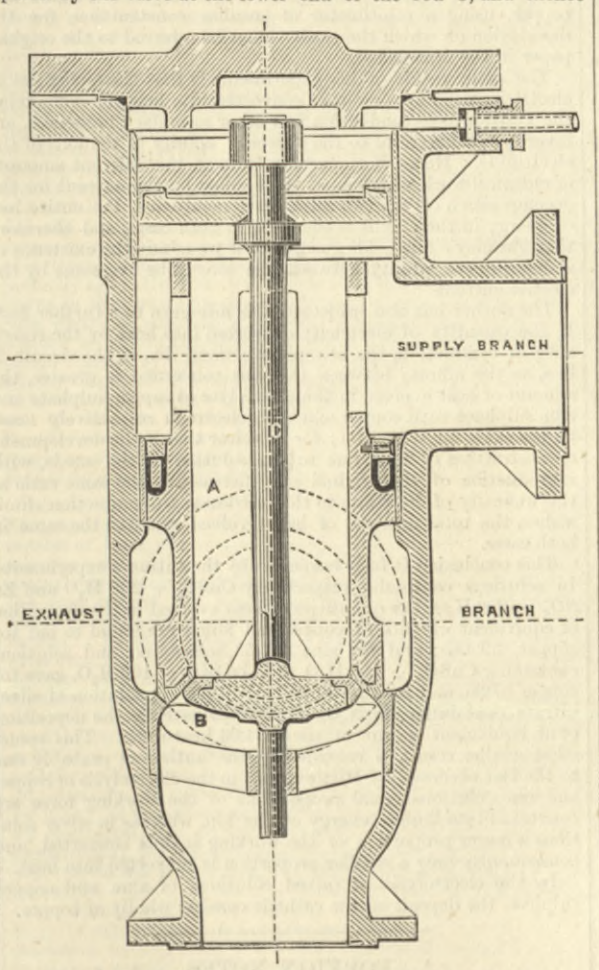
HYDRAULIC PUMPING ENGINE.

THE hydraulic pumping engine which we illustrate on this page affords an illustration of the way in which under certain circumstances pumping may be done at no cost for fuel. At Marple there existed two water supply reservoirs, one at a considerable elevation above the other which it supplied. To another and still higher part of Marple it was desired to force a supply of water. For this purpose the engine we illustrate is employed. It derives its power from the water falling from the central reservoir—see the annexed diagram—to the lowest, where the engine is situated. A part of this water it forces back to the higher reservoir. This scheme was devised by Mr. Alfred Moore, of Manchester.



The engine is provided with an adjustable self-acting apparatus by which it stops automatically when any predetermined quantity of water has been pumped to the highest reservoir. Referring to the drawings, it will be seen that a lever with a number of holes is worked by means of a rod from and operated by the pump piston-rod, and that this in its turn gives motion to a small connecting rod which actuates a lever provided with a pawl by which the ratchet wheel, seen at W, is moved a small part of a revolution for each double stroke of the pump. At the other end of the spindle carrying this ratchet disc is a worm which gears with another disc. This disc has one deep notch made in it, into which a catch drops when the notch is uppermost. This catch is connected with the dead weight piston in the dashpot, seen at A, so that when it drops into the notch referred to the supply of water is stopped. It will be seen that this arrangement makes the engine its own water meter.

The supply and exhaust valve here used is a modification of that used by Messrs. Hathorn, Davey, and Co., for other engines. Referring to the sectional view below: The supply water enters at one side, and when the water is admitted to the upper side of the piston on the rod C, this piston is forced down, and water then passes by the valve at the lower end of the rod C, and thence

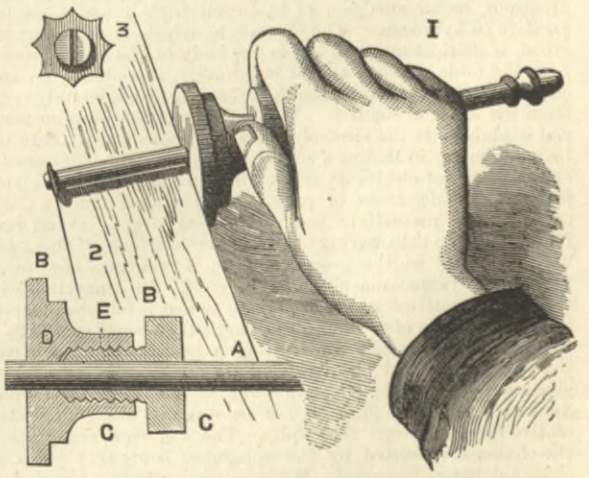


DAVEY'S PATENT SUPPLY AND EXHAUST VALVE.

into the engine. The small supply of water admitted to the top of the piston is controlled by the engine crosshead acting on a small slide valve. When the engine stroke is made the small supply is exhausted, and the piston goes up owing to its area being greater than that of the valve below it. Continuing to rise it lifts the exhaust valve, and allows the water to pass into the exhaust passage. The operation is then repeated. It will be observed that this very ingenious arrangement gets over all difficulty arising from the want of simultaneity between the closing of the supply and opening of the exhaust.

SCRATCH GAUGE.

THE gauge represented in the engraving can be used by carpenters and others for scratching or scribing, and is thus described by the *Scientific American*. People other than carpenters must have often thought that the gauge used by carpenters and joiners wanted altering so as to be just a little quicker; now it is done. The rod and other details of the device are preferably made of circular form, so that it may be used without restriction to any particular side being uppermost. Upon the rod A is fitted a slide B, forming the head of the gauge, and also a sliding thumb piece or clamp C, having pro-



jecting from one side a screw *b*, which is constructed with three longitudinal slits extending inward from the outer end of the screw. The end of the screw is tapered in order to bear against a taper socket *d*, at the inner end of a threaded portion in the slide B, so that when the thumb piece is screwed up the split hollow screw will clamp the rod, holding the slide at its proper position. If preferred, this construction of the thumb piece and slide may be reversed. The marker is a many pointed circular disc, Fig. 3, that may be screwed to the working end of the bar. By the circular construction of the gauge the marker is made more durable, since the different points may be used. This useful device has been recently patented by Mr. John E. Sherman, of North Attleborough, Mass.

HYDROGEN AMALGAM.

Hydrogen, although a gas, is recognised by chemists as a metal, and when combined with any solid metal—as in the case known to electricians—as the polarisation of a negative element, the compound may correctly be termed an alloy; whilst any compound of hydrogen with the fluid metal mercury may with equal correctness be termed an amalgam of hydrogen or "hydrogen amalgam." The efforts of many chemists and mining engineers have for many years been devoted to a search for some effective and economical means for preventing the "sickening" of mercury and its consequent "flouring" and loss. Some sixteen or more years ago, Professor Crookes, F.R.S., discovered and, after a series of experiments, patented the use of an amalgam of the metal sodium for this purpose. He made the amalgam in a concentrated form, and it was added in various proportions to the mercury used for gold amalgamation. Water being present, it will readily be understood that the sodium, in becoming converted into the hydrate (K H O) of that metal, caused a rapid evolution of hydrogen. The hydrogen thus evolved was the excess over a certain proportion which enters into combination with the mercury. While the mercury retained the charge of hydrogen, the "quickness" of the fluid metal was preserved; but upon the loss of the hydrogen the "quickness," ceased and the mercury was acted upon by the injurious components contained in the ore.

Since the introduction of the sodium amalgam, many attempts have been made, more especially in America, to overcome the tendency of mercury to "sicken" and lose its "quickness." The greater number of these efforts have been made by the use of electricity as the active agent in attaining this end; but such efforts have been generally of a crude and unscientific character. Latterly Mr. Barker, of the Electro-amalgamator Company, Limited, has introduced a system—already detailed in these pages—by which the mercury is "quickened." In his method the running water passing over the tables, or other apparatus of a similar character, is used as the electrolyte. In this arrangement, the mercury being the cathode, plates or wires of copper constituting anodes are brought into contact with the water passing over the mercury in each "riffle." Both the cathode and the anodes are, of course, maintained in contact with the poles of a suitable source of electrical supply. The current then passes from the copper anode through the running water to the mercury cathode, and so on to the negative pole of the electro-motor. As a consequence of this arrangement, hydrogen is evolved from the water, and has the effect of reducing any oxide or other detrimental compound of the metal; in other words, it "quickens" and prevents "sickening" of the fluid metal, and consequent "flouring" and loss. Whilst the hydrogen is evolved at the cathode, oxygen enters into combination with the copper constituting the anodes. This to some extent impairs the conductivity of the circuit.

The latest process, however, is that of Mr. Bernard C. Molloy, M.P., which we have already characterised as highly scientific and effective, the production of a suitable amalgam being obtained under the most economical and simple conditions. This process has the advantage of producing not only a hydrogen amalgam, but also at will an amalgam of hydrogen combined with any metal electro-positive to this latter. Thus hydrogen-potassium or hydrogen-sodium amalgam can be obtained, as will be seen by the following description.

Mr. Molloy's effort appears to have been, in the first place, directed to a system which could be adapted to any existing apparatus, and in certain cases where water was scarce to avoid altogether the use of that, in some districts, rare commodity. For the purpose of explanation we select an ordinary amalgamating table fitted with mercury riffles. The surface of the table is in no way interfered with or disturbed. The bed of the riffle, however, is constructed of some porous material, such as leather, non-resinous wood, or cement, which serves as the diaphragm upon which the mercury rests, and separates the fluid metal from the electrolyte beneath. Running the full length of the table is a thin layer of sand, supported and pressing against the diaphragm, and lying in this sand is the anode, formed preferably of lead. A peroxide of that metal is formed by the action of the currents, and may be readily reduced for use over and over again after working for from one to three months. The peroxide of lead, as is well-known, is a conductor of electricity, and this fact constitutes an important advantage in the working of the process. The thin layer of sand is saturated with an electrolyte, such as dilute sulphuric acid ($H_2 SO_4 + 20 H_2 O$) to give a simple hydrogen amalgam; ($Na_2 SO_4 + x H_2 O$) to give a hydrogen sodium amalgam; or ($K_2 SO_4 + x H_2 O$) to give a hydrogen potassium amalgam. Numerous other electrolytes constituted by acids, alkalies, and salts, can be used to form an amalgam permanently maintained in a condition of "quickness" and freed from all liability to "sicken," whatever the components of the ore may be. The mercury is connected with the negative pole of the voltaic battery or other electro-motor, and the lead made with the positive pole of the same source. When the current passes there is formed, according to the nature of the electrolyte, a hydrogen amalgam, or an amalgam of hydrogen with a metal electro-positive to hydrogen. The electrolyte, which, it will be understood, is distinct and apart from the body of the water passing over the table, will last almost indefinitely, there being no consumption of any of its constituents, excepting hydrogen and oxygen from the water of solution. The quantity of acid or saline material contained in the electrolyte is so very small that there can be no difficulty in finding a supply in any district. The question of the supply of electricity is one which in many mining districts involves considerations of practical importance, since a large supply would necessitate water or steam power. It has been found that two cells having an electro-motive force of about two volts each will in this process suffice; if preferred, however, a very small dynamo machine can be used. In connection with the electro-motive force it is requisite to use, it may be observed that an amalgam of sodium containing only a small quantity of this metal would, when constituting a positive element in conjunction with a lead negative and on an aqueous electrolyte, give an opposing electro-motive force of less than three volts. Such an amalgam could therefore be obtained under an electro-motive force of about four volts. The electrical resistance in the circuit constituted by the apparatus being very small, no electrical power is wasted. When water constitutes the electrolyte, as in Barker's system, then the electro-motive force required to obtain a given current would be very much greater than that above specified. The conditions assured under this process appear to be all that can be required, whilst the amalgams obtained are these most calculated to preserve the "quickness," and prevent the "sickening" of the mercury.

Mr. Molloy has designed a special form of amalgamating machine to be used in conjunction with the above process, and with or without the aid of water. By the employment of this machine, each particle of the ore is slowly rolled in the quickened mercury for from fifteen to thirty or more seconds.

When the extent of the gold and silver mining industries is considered, and when it is borne in mind that a considerable percentage of the precious metal present in the ore is, in the ordinary process of extraction, lost through defective amalgamation—due to insufficient contact with the mercury, or to a total absence of contact, as in the case of float gold—it is obvious that the introduction of any system obviating such loss is a matter of very great importance to those who are interested in the above-mentioned industries. We expect shortly to hear of the practical introduction on a large scale of Mr. Molloy's process, and we look forward with interest to the results which may be obtained from it.

ELECTROLYTIC RESEARCHES ON THE APPLICATION OF FARADAY'S LAW.

There has recently been published an interesting paper on the above subject by Hans Jahn, in the *Monatsh. Chemic.* He says: The starting point of all theories of electrolysis is the well-known law of Faraday, from which, when expressed according to existing conceptions, we learn that *equal quantities of electricity are capable of setting free equal numbers of combining units or quantivalencies*; whence also it follows directly that currents of equal intensity must separate at the electrode equivalent quantities of the two ions composing an electrolyte; and consequently, that the work done by the current in decomposing chemically equivalent quantities of the electrolyte is the same for all electrolytes, and quite independent of the chemical nature of the ions contained therein.

If, however, we admit, according to the ordinary assumption that the atoms or radicles of an electrolyte are held together by a peculiar force—affinity—depending only on the chemical nature of those atoms, the explanation of electrolytic phenomena in the sense of Faraday's law is attended with considerable difficulty.

Solutions of copper sulphate and zinc sulphate of equal strength yield equal quantities of oxygen and sulphuric acid at the anode and chemical equivalent quantities of zinc and copper at the cathode. But the quantities of work which must be expended by the current in order to resolve these two salts into their constituents, viz., metal, oxygen, and sulphuric acid, are very different, the zinc salt requiring the expenditure of nearly twice the amount of work that suffices for the decomposition of the copper salt; and in accordance with this fact, it has been shown by Thomsen that the formation of zinc sulphate from zinc, oxygen, and sulphuric acid, is attended with the evolution of nearly twice the amount of heat that is evolved in the formation of the copper salt, viz.:—

$$(M, O, SO_3. Aq) = 106{\cdot}01 \text{ heat units.}$$
$$(Cu, O, SO_3. Aq) = 55{\cdot}96 \text{ heat units.}$$

Granting, however, the existence of different *forces of affinity*, it follows that, in the electrolytic decomposition of a salt, the current must loosen these forces of affinity by restoring the component atoms and molecules to their original condition of movement; but since the decomposition of zinc sulphate requires the expenditure of an amount of working force nearly double of that required to decompose the copper salt, it seems to follow that equal quantities of electricity will decompose twice as much of the latter salt as of the former, a result which appears at first sight to be in direct contradiction to Faraday's law of electrolysis. The author, however, suggests that in the decomposition of equivalent quantities of the salts under consideration, part of the electric force is expended in the purely chemical work of neutralising the forces of affinity, and another part in overcoming the resistances to conduction and other antagonistic forces—a view which, indeed, was suggested by Faraday himself in his classic researches on electrolysis; and as the first of those amounts is directly, and the second inversely proportional to the affinity of the ions, the sum of the two components must remain constant for all electrolytes, and consequently the quantities of electricity required for the decomposition of equivalent quantities of different electrolytes must be the same in all cases,—which is Faraday's law.

With the view of throwing further light on this matter, the author has made a series of experiments on the quantities of heat evolved in the electrolysis of the sulphates of zinc and copper, using a calorimeter of peculiar construction, for the description of which the reader must be referred to the original paper in the *Monatsheft*.

The main result of his experiments is that the quantities of electricity used up, or rather converted into heat, in overcoming the resistance to conduction and other secondary influences, are inversely proportional to the forces of affinity of the ions of the electrolyte. Hence it appears, in spite of the different amounts of chemical work which must be supplied by the current for the decomposition of the two salts above mentioned, the entire loss of energy in the circuit is the same in both cases, and therefore that Faraday's law holds good, even if we admit the existence of a determinate affinity between the ions to be overcome by the electric current.

The author has also subjected this inference to a further test. If the quantity of electricity converted into heat by the resistance of conduction, the secondary actions, &c., in the circuit, is less, as the affinity between the ions concerned is greater, the amount of heat evolved in the electrolyte of copper sulphate and zinc sulphate with copper and zinc electrode respectively must be the same for both salts; for it is clear that if the development or abstraction of heat, due to the solution of the anode, with reproduction of the original salt, increases in the same ratio as the quantity of heat due to the resistance to conduction diminishes, the total amount of heat evolved must be the same in both cases.

This conclusion is fully borne out by the author's experiments. In solutions containing respectively $CuSO_4 + 200 H_2O$ and $Zn SO_4 + 200 H_2O$, the quantities of heat evolved in the deposition of equivalent weights of copper and zinc were found to be: for copper, 39·497; and for zinc 39·958 heat-units; and solutions containing $CuSO_4 + 100 H_2O$ and $Zn SO_4 + 100 H_2O$, gave for copper 37·95, and for zinc 39·39 heat-units. A solution of silver nitrate containing $Ag_2N_2O_6 + 200 H_2O$ gave for the deposition of an equivalent weight of silver 34·03 heat-units. This somewhat smaller result is regarded by the author as probably due to the fact observed by Hittorff, that in the electrolysis of copper and zinc solutions equal proportions of the working force are converted into kinetic energy of the ion, whereas in silver solutions a larger proportion of the working is thus converted, and consequently only a smaller proportion is converted into heat.

In the electrolysis of mixed solutions of zinc and copper sulphate the deposit on the cathode consists wholly of copper.

FOREIGN NOTES.

A powerful steam dredger, built for the Imperial Chinese Government by the Vulcan Shipbuilding Company, of Bredow, has just departed from Stettin on its voyage out to China. The work for which this craft was specially designed is the deepening of the channels leading to Port Arthur Harbour, on the north coast of China, but it is also proposed to employ the same at any point on the coast where its services may be required. The dredger has therefore been constructed in such a manner as to be able to keep the sea in all weather. It will be remembered that two barbette-ironclads and a protected cruiser, which were lately built by the Vulcan Company for the same Government, are at present lying under the forts of Swinemunde, and that it is considered unadvisable to permit them to leave the friendly shelter of a German port until the differences now existing between the Governments of France and China have been arranged. No such considerations, however, appear to have interfered with the departure of the above dredger, although it is rumoured that she carries out to China a valuable cargo of munitions of war, such as torpedoes, Mauser rifles, &c.

Considerable satisfaction is felt in Germany at the prospect of an understanding being arrived at as to the so-called "International Cartel" for regulating the price of steel rails. Although no definite arrangement appears as yet to have been made, the conclusion of such a treaty between the principal rail manufacturers of England, France, Germany, and Belgium, is regarded as almost certain by the trade in Germany, and the prospect of a successful termination to the negotiations has already made a favourable impression on the Berlin Bourse.

The *Journal des Intérêts Maritimes*, of Antwerp, reports at considerable length on the cases of spontaneous combustion which lately occurred in the coal bunkers of the French steamers Bordeaux and Paris, and maintains that this was mainly due to the fact that these steamers were provided with German coals. It is asserted that this coal is peculiarly liable to ignite spontaneously, and that it is, therefore, dangerous to employ the same on ship board. This statement has caused some commotion among German coalowners, and the matter has been taken up by the Westphalian Society for the Export of Coal, who maintain that the German fuel is no more liable to cause mishaps, such as the above, than English or Belgian coal. This affair is of considerable importance to the German trade, as many thousand tons of coal for marine purposes are annually exported to France from the Saarbrücken districts, and it is feared that the frequent occurrence of cases of spontaneous combustion will materially affect the same.

The Société John Cockerill, of Seraing, in Belgium, have concluded a contract with the Eastern Railway of France for the delivery of 1200 tons of steel tires. This has created some dissatisfaction among French manufacturers, as the steel trade in the north is still very much depressed, and it is argued that in consideration of this circumstance so large an order should not have been permitted to leave the country. It is, however, not very probable that the conduct of railway companies will be influenced by any such considerations, and French manufacturers will have to seek a remedy elsewhere against the recurrence of such *contretemps*.

A series of very successful experiments with 45-centimetre guns are at present being carried out at the Kummersdorf Range, near Berlin. A German military paper observes in reference to these trials that the projectiles thrown by the above guns weigh 350 kilos., and that the charge consists of 49 kilos. of prismatic powder.

It is reported that Messrs. J. and G. Thompson, of Glasgow, have obtained the contract for the construction of one or more ironclad vessels of war for the Greek Government. If this rumour proves to be correct, Messrs. Thompson may be congratulated on their success in securing a contract for which the competition has been almost without parallel in the annals of the shipbuilding trade. Well-informed persons on the Continent confidently anticipated that the above vessels would be built at either Stettin or Toulon, and the result has therefore taken them completely by surprise. It will be remembered that when the Government of China some time ago ordered several ships of war in Germany, the press of the latter country exulted in the supposed fact that foreign nations were at length prepared to acknowledge the great superiority of German naval architects. This triumph was, however, of but short duration, as it soon became apparent that the orders had only come to Germany in consequence of the ruinously low prices at which the contracts were taken—a fact which was known in England from the first.

On the 16th February there was launched at Cherbourg a gunboat for the French Navy. The vessel, which was named the Comète, is of the following dimensions, viz., length between the perpendiculars, 150ft.; beam, 23ft. 7in.; depth in hold, 10ft. 6in.; draught of water, 8ft. 6in. Her displacement is 450 tons, and she is supplied with engines of 100-horse power nominal. The hull is built of steel. She carries two 5½in. and two 4in. breech-loading guns of French make; and it is expected that she will realise a speed of at least eleven knots per hour.

DR. TODHUNTER, F.R.S.

It rarely falls to our lot to record the death of a man so skilled in teaching pure mathematical science as on the present occasion. It is stated, and with great justice, that considerable gloom was cast over University circles on Sunday last, at Cambridge, by the mournful intelligence, which spread over the town, that Mr. Isaac Todhunter had died on the previous evening. Mr. Todhunter, who had been in ailing health for some time, was universally known by his numerous mathematical publications. He took his degree in the year 1848, when he was Senior Wrangler, the late Bishop Mackenzie being second to him in the mathematical tripos. He was also First Smiths' Prizeman, whilst Bishop Barry, who left but the other day for the Antipodes, was the second. He was Moderator in the mathematical tripos of 1865, and was made Examiner in 1866. He also took the degree of Master of Arts in the University of London. In 1871 he was successful in winning the Adams' prize for the best essay on pure mathematics; this is awarded every two years to the author of the best essay on some subject in pure mathematics, astronomy, or other branch of natural philosophy. He was an Honorary Fellow of St. John's College, Cambridge, a Fellow of the Royal Society, and was last year made an Honorary Doctor of Science of the University of Cambridge. He was the author of several mathematical works, as has already been stated, including "The Theory of Equations," "Plane Trigonometry," "Spherical Trigonometry, "Plane Co-ordinate Geometry as Applied to the Straight Line and the Conic Sections," "The Differential Calculus and its Applications," "Examples of Analytical Geometry of Three Dimensions," and "Analytical Statics." The Rev. F. F. Goe, rector of St. George's, Bloomsbury, in preaching the University sermon last Sunday, made feeling allusion to the death of Dr. Todhunter, while the Dead March in *Saul* was played by Dr. Garratt at the conclusion of the service. Mr. Todhunter was Principal Mathematical Lecturer at St. John's, and for a long course of years was one of the most favourite "coaches" for the examination for the Mathematical Tripos.

RAILWAY MATTERS.

THE loop line to Weston-super-Mare, which has been recently completed, was opened for public traffic on Saturday last.

BY the fail of a tunnel on the Bangor and Bethesda Railway on the 5th inst., two navvies were killed and three others seriously injured. It is believed that heavy rain had loosened the top of the tunnel.

THE London and North-Western Railway Company opened a new station at Sandycroft, near Chester, on Saturday. The station has been erected, to a great extent, for the accommodation of the Sandycroft Foundry and Engine Works Company.

THE South-Eastern Railway Locomotive Works are to be removed to Sevenoaks. The Ashford establishment will be retained as a carriage building works. Is it too much to hope that there will soon be a sensible improvement in the passenger rolling stock of this line?

IT is not long since the Belgian State Railroads have published their report for the year 1882. At the close of the year the system included 1887 miles of road, ninety-four miles having been added to it during the year. This system had cost the Government £45,248,000, or at the rate of £23,974 per mile. The earnings of this system in 1882 were £44,454,111, which is £2491 per average mile worked, an increase of £10—or 0·4 per cent.—per mile over 1881. Of these earnings 64¾ per cent. was absorbed by the working expenses, leaving as net earnings £1,617,620, or £875 per mile of road.

RAILWAY extension in India seems likely to be strongly pressed upon the Government. The Bombay Chamber of Commerce has submitted a memorial to the Viceroy, urging that railway extension be prosecuted at the rate of 2000 or 3000 miles annually for the next ten years at a cost of £20,000,000 per annum. The following are the works most urgently needed:—(1) An extension, on the broad gauge, of the Bhopal State Railway, through Lalitpore and Jhansi to Gwalior, with a branch from Jhansi to Cawnpore. (2) The construction of a broad gauge Jhansi-Manikpore line. (3) Of a broad gauge line from Calcutta to Nagpore; and (4) of a broad gauge line from Godra to Rutlam. They suggest that in future agreements with guaranteed companies the Government should always reserve the right to fix rates and fares, and to receive a moiety of the excess of profit over the guaranteed interest.

THE Whitechapel extension of the East London Railway was inspected on Saturday by General Hutchinson, R.E., of the Railway Department of the Board of Trade. He was accompanied by Mr. Shaw, the secretary, Mr. Spagnoletti, Mr. John Robinson, resident engineer, Mr. Charles Barry's representative, Mr. Thos. Walker, the contractor, Mr. Banister, C.E., Mr. Williams, Traffic Superintendent of the London, Brighton, and South Coast Railway, and a number of other gentlemen. The inspector made a careful examination of the works, and the line is now certified as ready to be open for traffic. This extension branches from the East London Railway, under Cotton-street, passes under Ravenrow, East Mount-street, the London Hospital, and the Whitechapel-road, in front of the Pavilion Theatre, and terminates at St. Mary's Station, near the Volunteers' Drill Hall, where it joins the extension, now in course of construction, of the Metropolitan and District Railway.

THE passenger traffic on the Belgian State Railways in 1882 amounted to 47,986,402 passengers carried an average distance of 13·18 miles, which was an increase of 9·2 per cent. in passengers over the previous year, the average journey being almost identically the same. The increase was chiefly in the travel at lowest rates, and the passenger earnings increased only 7 per cent., the average receipt per passenger being about 8d., or 0·6d. per mile—the lowest in Europe, doubtless, but not as low as on some railroads in India. No less than 18 per cent. of all the travel was on commutation tickets, producing less than 5 per cent. of the passenger earnings, so that the average rates on this travel must have been extremely low. A large part of this travel is by workmen carried from villages near by to the places where the mines or factories are situated in which they work. The average fare paid by a commuter was 2·5d., by other classes of passengers, 9d. At these low rates the passenger earnings were 32½ per cent. of the total earnings. The whole passenger traffic amounted to 662,600,000 passenger miles on the 1887 miles of road, which the *Railroad Gazette* compares with the 432,000,000 on the 1000 miles of the New York Central. The Belgian travel is at the average rate of 450 passengers carried each way daily over the whole mileage. By the census of 1880 the number in this country was equivalent to ninety-eight passengers each way daily over every mile of road, but some of our roads, besides the New York Central, have much more than the Belgian State roads.

ON Sunday morning a serious railway collision, or a series of railway collisions, occurred on the north-eastern section of the Caledonian Railway. A goods train from Perth to Aberdeen had got as far as Kirriemuir Junction, about three miles from Forfar, when it was shunted from the down to the up line to let the mail train pass. Shortly afterwards another goods train from Forfar came up and collided with the Perth train, the result being that nine wagons were smashed and both lines were blocked. Some very large logs of wood which were thrown from the wagons fell upon the signal wires, so that the officials were unable to raise the signal against the mail train, which had before the collision occurred passed Glamis, the station to the south of the junction. It seems, however, that even had the signals been workable there would not have been time to avert the second collision which occurred. The mail train had reached the distance signal, but the thick weather prevented the driver of the mail seeing what had occurred. As soon as he did see the wrecked train he applied his brake, but it was too late; the engine struck one of the wagons and then came upon some of the logs of wood. In this way the engine was nearly overturned, and the permanent way torn up and destroyed. The scene was now one of great confusion; wagons, engines, and *débris* blocked both rails and covered the banks. In some miraculous way the officials in charge of the trains escaped almost without injury, as did also the Post-office officials, but some were shaken.

ANOTHER question affecting the charges of railway companies in connection with the carriage of goods has during the past week been brought under the attention of the coal trade in the North. The Town Clerk of Blackburn has sent out a circular note to the trade calling attention to the fact that the following clause appears in a Bill which is being promoted by the London and North-Western Railway Company in the present session of Parliament, viz.: "Section 60.—In lieu of any other payment, charge, or remuneration which under the Act (local and personal) 9th and 10th Vic., chap. 204, entitled the London and Birmingham Grand Junction and Manchester and Birmingham Railway Companies," the company is entitled "to demand and receive in respect of wagons or carriages provided by it for the conveyance of coal, cannel, slack, culm, coke, or cinders where the same are conveyed for any distance not exceeding 50 miles, the company may demand and receive any sum not exceeding 6d. per ton, and where the same are conveyed for any distance exceeding 50 miles, but not exceeding 150 miles, the company may demand and receive any sum not exceeding 1s. per ton, and where the same are conveyed for any distance exceeding 150 miles the company may demand and receive any sum not exceeding 1s. 3d. per ton." The circular was brought up for consideration at the meeting of the South-West Lancashire Coalowners' Association on Tuesday, and also at a special meeting of the committee of the Manchester Coal Exchange, held on Tuesday. As the passing of a clause such as the above was considered to be detrimental to the interests of the coal trade, it was decided by both associations that they should take such steps as were in their power to oppose the passing of the proposed clause referred to in the circular.

NOTES AND MEMORANDA.

DURING last year vessels having a total tonnage of 393,941 tons were returned as lost or broken up. Of these, 144,138 were of wood, 248,221 of iron, and 1582 of steel.

THE tonnage of new ships under construction or contracted for in the United Kingdom at the commencement of the year was 729,446. In 1883 it was 1,075,259, in 1882 it was 1,204,603, in 1881 it was 843,000. At the commencement of the current year it was then 345,813 tons less than 1883. The decrease in the tonnage of iron vessels under construction is 28 per cent., but of steel vessels 45 per cent.

THE *Moniteur Industrielle* gives as the composition of an "artificial gutta-percha," 50 parts by weight of copal, and 7·5 to 15 of sulphur, with 15 to 30 of turpentine, or 55 to 60 of petroleum. Mix well; heat to 100 deg. C.—212 deg. Fah.—until completely dissolved; let cool to 30 deg. to 35 deg. C.—86 deg. to 95 deg. Fah.; and a solution of 3 parts of caseine in weak ammonia, and a little methylene; re-heat to 100 deg. to 120 deg. C.—212 deg. to 248 deg. Fah.—until of weak consistence; then boil with a 15 to 20 per cent. solution of tannin, and about 15 parts of ammonia. After boiling several hours, wash and cool.

AT a recent meeting of the Chemical Society, a paper was read on the expansion of liquids, by D. Mendeléeff, translated from the Russian by B. Brauner. In this paper the author, principally from data furnished by Thorpe—*Chem. Soc. Journ. Trans.*, 1880, p. 141—gives the equation $V = \frac{1}{1 - \kappa t}$ as expressing approximately the expansion of liquids. κ is named the "determinator of expansion." It is a coefficient characterising each liquid, just as each liquid has a specific gravity, boiling point, &c. The author states that the above expression, although many liquids deviate slightly from it, is sufficient in the majority of physico-chemical investigations.

THE report of the American Commissioner of Patents has been published. From it we learn that the total receipts of the office for the year 1883 were 1,146,240 dols., and the expenses 675,234 dols. The total number of applications relating to patents was 34,576, of which 33,073 were for inventions, 1238 for designs, and 265 for reissues. There were 2741 caveats filed, 915 applications for registry of trade-marks, 834 for registry of labels, 18 disclaimers, and 640 appeals, making a total of 39,724 cases for investigation and action. The number of patents issued in 1883, including designs, was 22,216, and there were 167 reissues, or a total of 22,383, against 19,267 patents and reissues in 1882, and 16,584 in 1881. There were also 902 trade-marks registered in 1883, and 906 labels, while 8874 patents expired, and 2366 were withheld for non-payment of the final fee.

WRITING on "Brass Castings," the *Age of Steel* remarks:—"If what was put in a crucible came out of it, there would be less diversity in results. What with the volatility of some metals, and the varied melting points of others, in the same mix it is wonderful that anything like uniformity can be obtained in ordinary work. Zinc sublimes—burns away—at 773 deg. to 800 deg., while the heat of the metal with which it should be intimately mixed in making yellow brass—copper—is nearly 2000 deg. Zinc, tin, and lead enter into compositions of copper, to form alloys in varying proportions—always in definite quantity for a given alloy. It will be seen, therefore, from the ease with which the lesser metals are burned away, at comparatively low temperatures, that it is a very easy matter to make several kinds of metal with the same mix." We may add that copper often manifests a remarkable proclivity for leaving the casting house, which further complicates the question.

DURING 1883 there were registered four steamers of over 5000 tons gross They were:—Aurania, steel; length, 470ft.; breadth, 57·2ft.; depth, 37·2ft.; gross tonnage, 7269; registered horse-power, 1500. Built and engined by Messrs. J. and G. Thomson, of Glasgow, for the Cunard Company's line from Liverpool to the United States. Oregon, iron; length, 501ft.; breadth, 54·2ft.; depth, 38ft.; gross tonnage, 7375; registered horse-power, 2000. Built and engined by Messrs. John Elder and Co., of Glasgow, for the Guion Company's line from Liverpool to the United States. City of Chicago, iron; length, 430·6ft.; breadth, 45ft.; depth, 33·6ft.; gross tonnage, 5202; registered horse-power, 900. Built by Messrs. C. Connell and Co., Glasgow, and engined by Messrs. J. and G. Thomson, Glasgow, for the Inman Company's line from Liverpool to the United States. Bitterne, iron; length, 387·2ft.; breadth, 44·4ft.; depth, 33·3ft.; gross tonnage, 5085; registered horse-power, 700. Built and engined by Messrs. Oswald, Mordaunt, and Co., Southampton, for Messrs. Briggs, of Sunderland.

IN the last number of the *Journal of the Russian Chemical Society* is an interesting theory of solutions, by M. Alexeyeff, the forces of gravitation, cohesion, and chemical affinity being considered as three different degrees of one single force, which differ from one another only by the distances at which the action of the force is exercised. M. Alexeyeff asks, "Which of these two last forces, of cohesion or of chemical affinity, is manifested in solutions?" and pronounces himself for the former. The simplest cases of solutions are, in fact, those where there is no chemical affinity between the bodies dissolving and dissolved. Such cases were well known long since for gases and solid bodies. The solution of gases in solid bodies is quite analogous to imbibition of solids with liquids, and the much greater solubility of gases in liquids may be easily explained by the greater penetration of gases between the molecules of a liquid. The law of solubility of gases given by Dalton is perfectly agreeable with the supposition that the dissolved gases maintain their own aggregation when dissolved. The same is true with regard to solutions of liquids. The simplest of these is the solution of phenol and aniline in water. The stability of the compound formed by phenol with aniline shows that both have no affinity to water. Further, M. Alexeyeff discusses the applicability of his theory to bodies which easily pass from one state to another, and the relations of water to colloids, the solutions of liquids in liquids being, on his hypothesis, quite like emulsions. *Nature* mentions that he is engaged now in experiments intended to show that the common emulsions have the properties of solutions.

ACCORDING to Faraday's law and the experiments of M. Becquerel, a given current of electricity, traversing a series of salts capable of being electrolysed during a given time, separates at the negative pole weights of the different metals proportional to their equivalents; that is to say, that 107·9 gr. of silver being precipitated, the same current will precipitate, in the same time, 103·5 gr. of lead. It will also separate 39·1 gr. of potassium and 68·5 gr. of barium. As these latter metals decompose water they do not exist free, but are found as a free base round the pole. These different weights are proportional to the equivalents—that is, to the relative weights according to which the metals may be substituted the one for the other. In order that they should be proportional to the atomic weights we ought to obtain, in the same time as 107·9 gr. of silver, 206 gr. of lead—that is, double the weight actually precipitated; in the same time as it takes to obtain 39.1 gr. of potassium we ought to obtain 137 gr. of barium, which is not the case. In the same way with the electro-negative elements. If we electrolyse in a similar circuit the chloride and oxide of a similar metal, the weights of chlorine and oxygen set free in the same period are proportional to 35 gr., 5 gr. for chlorine and 8 gr. for oxygen—that is, to the equivalents. If they were proportional to the atomic weights, we ought to obtain for 35·5 gr. of chlorine 16 gr. of oxygen, which is not the case. Without entering into any discussion on the valency of bodies, the idea of which is anterior to the new atomic notation—since it is the result of the discovery of polybasic acids by Graham in 1835, of polyatomic alcohols by myself in 1854, and of glycol two years after by M. Wurtz—I confine myself, M. Berthelot, in the *Comptes Rendus*, says, to testifying that Faraday's law is more simply expressed, as a rule, by means of equivalents than by means of atomic weights, both as concerns electro-positive and electro-negative elements.

MISCELLANEA.

AN explosion occurred on the 27th ult. at a powder mill near Omaho, by which four boys were blown to atoms.

MESSRS. HAYWARD TYLER AND CO. have received the Gold Medal—highest award—for aërated water machinery, at the Calcutta Exhibition.

THE Preston Town Council have approved plans for an extensive system of dock accommodation devised by Mr. E. Garlick, the plans including wet and dry docks and extensive river diversion.

THE water committee of the Birmingham Corporation on Tuesday obtained the sanction of the Town Council to a considerable reduction in the charge to consumers, rendered possible mainly by improvements in plant.

MODERN gas apparatus, shown by the Corporation Gas Committee will be included in the third annual exhibition in connection with the National Trade Exhibition Association, to be opened by the Mayor of Birmingham—Alderman Cook—on April 28th in Bingley Hall.

ON Saturday, the 1st inst., Messrs. Earle's Shipbuilding and Engineering Company, Hull, launched a steel screw steamer for Messrs. Thos. Wilson, Sons, and Co., of the same town. The dimensions of the vessel are as follows:—Length, 175ft.; breadth, 25ft.; depth of hold, 14ft. Triple compound expansion engines of 90 nominal horse-power. Miss Mary Cameron named the ship the "Dynamo."

IN a lecture on Wednesday evening at the Society of Arts, Mr. W. H. Preece pronounced electric lighting a practical success. What had proved a disastrous failure was electric-company mongering and electric-lighting finance. People would pay a reasonable price for electric light, whatever might be the price of gas. At present it is a luxury, but the progress made was so rapid that the day was not so far distant when it will be demanded as a necessity.

THE New Zealand Shipping Company's new steamer Tongariro has performed the voyage from Lyttelton, N.Z., *vid* Cape Horn, in the remarkably short space of 38 days 3 hours. This means that in fair weather or foul the vessel has plodded its way through the ocean at an average of 12·8 knots per hour, or over 308 miles per day. The Tongariro is over 4000 tons register. Out and home the whole actual steaming time of the Tongariro was 78 days 12 hours 32 minutes, the total distance being 24,165 miles, being 12,410 miles out and 11,725 miles home.

EVERYONE must sympathise with the efforts of the London vestries, or their delegates, to stop the illegal or inequitable charges made by wealthy water companies; but the public, as well as their delegates, must be reminded that such unqualified denunciation and false statements respecting the quantity and quality of the water supplied by the water companies as those made by a Mr. Squire, at Camberwell, on Tuesday, must do the cause of reform much more harm than good, and could only proceed from unqualified absence of real knowledge of the subject discussed.

THE members of the Edinburgh Stock Exchange Association have forwarded a memorial to the Postmaster-General pointing out the inconvenience and loss resulting from the constantly recurring interruption of telegraphic communication caused by the frequent storms, and suggesting that at least the principal lines of communication throughout the country should be protected from atmospheric disturbance by wires being placed underground. It is not proposed that the underground system should supersede the present system. In ordinary circumstances it would act as an auxiliary, and in contingencies only as a substitute.

THE notice which has been served by the associated masters in the wire drawing trade for a reduction in wages of 25 per cent. is being resisted by the Shropshire operatives. These state that upon some sizes the notice means a reduction of from 30 to 40 per cent., but the masters aver that these are very fine sizes, of which a workman does not make more than, perhaps, 1 cwt. in a week, and that upon the ordinary class of work the drop is not more than 20 per cent. The men have come out on strike, but the masters state that they have no alternative but to enforce the notice consequent upon the increasing German competition, which has already brought prices down to a very low figure. How long the strike in Shropshire will continue depends mainly upon the Warrington operatives.

MR. ARNOLD MORLEY, M.P., has at length issued his report relating to the explosion at Wharncliffe Carlton Colliery on the 18th of October last. Mr. Morley states that the inquiry has not led to any practical results, mainly owing to the necessity for closing the mine in consequence of the apprehended conflagration. The inquiry, however, he thinks, proved conclusively that there are no grounds for believing that the disaster was in any way due to the bad management or misconduct of any person connected with the colliery, and he, therefore, reports that in his judgment there is no occasion for instituting proceedings against any one, either for an offence against the rules in relation to the management, or for criminal responsibility with reference to the loss of life resulting from the explosion.

AT a meeting of the Institute of Mining Engineers at Dudley on Monday, a letter was read from the Royal National Miners' Life-saving Institution, accompanied by a prospectus. This set out that the scheme was to be supported by voluntary contributions, and that powerful pumping machinery in case of sudden floodings would be provided, whilst colliers in all districts would be taught to give aid to sufferers and divided into parties of rescuers. The letter asked for a member of the Institute to be nominated as a vice-president, and two members to be on the Council. The President held that it was a carrying forward of the work of the Fleuss system, and that some of the objects of the Institution were already in progress, such as barometrical warnings and the teaching of ambulance drill and "first aid." It was determined to make further inquiries into the matter before consenting to the request of the Institution.

THE New British Iron Company, makers of the "Lion" brand of Staffordshire iron, has recently lighted its Corngreaves Works, near Birmingham, by electricity, the Maxim-Weston Company supplying the installation, which consists of eleven Weston arc lamps of 1400 candle-power each, supplied with current from a Weston dynamo. The dynamo is driven at a maximum speed of 1050 revolutions by one of Messrs. Tangye's vertical engines of ten nominal horse-power, the power being transmitted through a short length of shafting by means of ordinary leather belts running on special wrought iron pulleys supplied by Messrs. Hudswell, Clarke, and Co., of Leeds. The New British Iron Company is, we believe, the first of the South Staffordshire ironmasters to adopt the electric light. So far, the installation has worked well, and with the arrangements made is likely to give satisfaction and be economical.

A NEW Stroud reservoir was inaugurated last week. The board have constructed the reservoir with their own workmen without the aid of a contractor. The work has afforded employment to a large number of men for the past eighteen months, and the whole of those employed have carried out their duties in a very capable and satisfactory manner. Considering the nature of the work, and the quantity of powder used in blasting and removing the rock, few accidents have occurred to the men. The site of the reservoir was an old quarry, and the labour of forming and clearing the floor to the required level was a work of considerable difficulty; the total quantity of *débris* required to be moved being about 14,000 tons. The side walls and floor of the reservoir have been constructed entirely of concrete, and the roof, which consists of brick and concrete arches carried on iron girders, is supported by seventy-three brick pillars. The whole of the floor and side walls have been finished with cement rendering 1½in. in thickness. The capacity of the reservoir is about 2,100,000 gallons, and the cost amounts to £1 15s. per 1000 gallons, the area being about half an acre. Mr. J. P. Lofthouse is the engineer of the work.

SALTERHEBBLE VIADUCT, HULL AND BARNSLEY RAILWAY, HUDDERSFIELD AND HALIFAX EXTENSION.

MR. W. SHELFORD, M.I.C.E., ENGINEER-IN-CHIEF.

(*For description see page* 189.

FIG. 1. ELEVATION

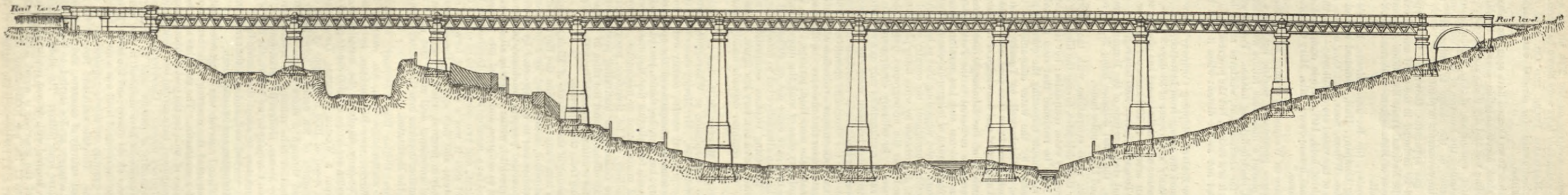
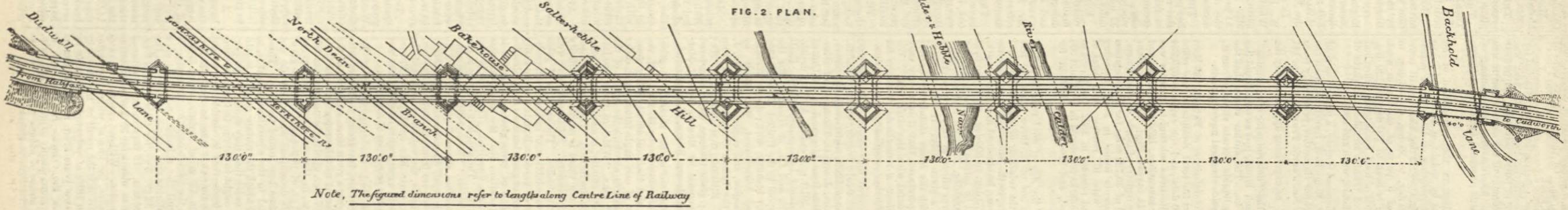


FIG. 2. PLAN.



Note, *The figured dimensions refer to lengths along Centre Line of Railway*

FIG. 3.

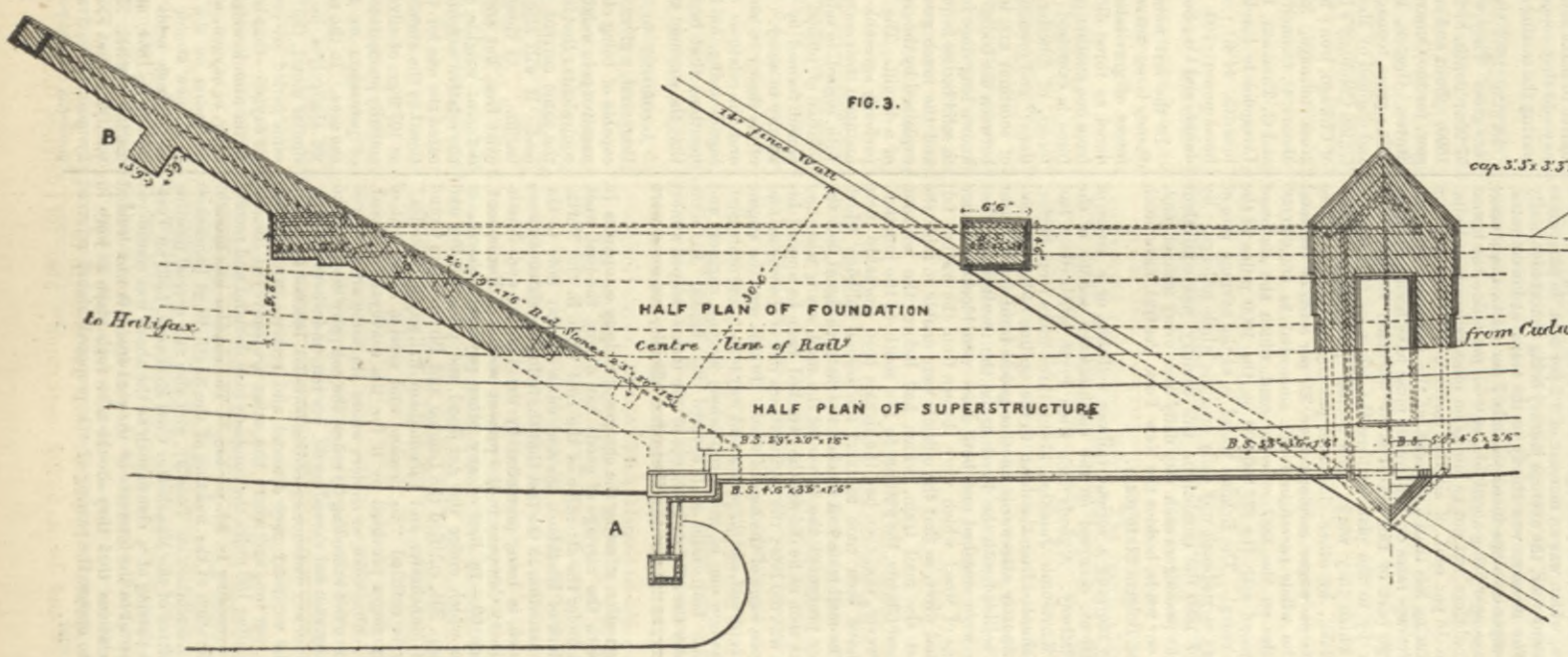


FIG. 4. CROSS SECTION

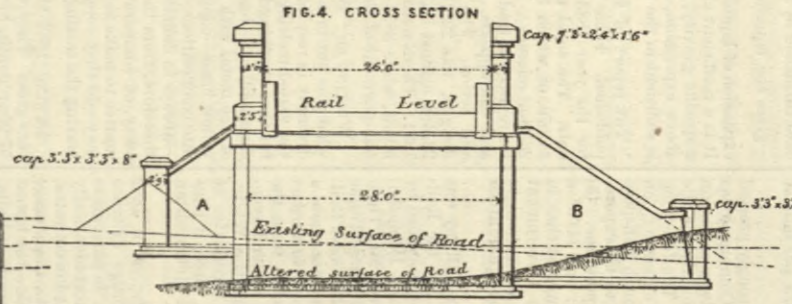


FIG. 5. CROSS SECTION

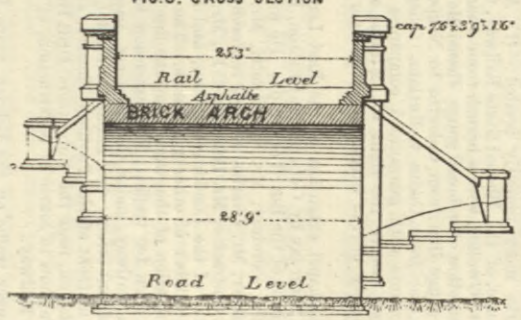
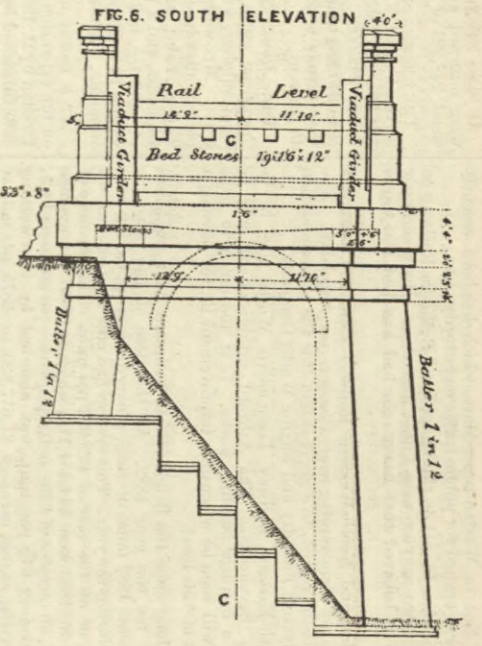


FIG. 6. SOUTH ELEVATION



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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.*

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

*** *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.*

ENQUIRER.—*We have not the least idea what you mean by an "air engine which draws its own air." Please explain.*

G. H. (Dublin).—*Balmain's luminous paint can be had from Messrs. Ihlee and Horne,* 31, *Aldermanbury, London, E.C.*

W. A. C. (Sheffield).—*Your letter does not contain any scientific statement throwing light on the subject. The merit of crucible steel castings of the best type is too well known to require notice in our correspondence column.*

A.—*When large, heavy belts are used, there is an advantage gained by putting the pulley axes nearly on the same level, in that the weight of the belt assists in securing adhesion. If the belt pulleys are put one over the other, then the weight will all be carried by the upper pulley, and the belt must be tighter than would otherwise be necessary in order to get adhesion to the lower pulley. In the case of small, light belts, the position of the pulley axes is of no consequence.*

D. B. H.—*If you have made and sold a machine you cannot get a valid patent for it. You may get a patent, but should you prosecute any one for infringement, if he finds out that you have made and sold a machine, he will have a perfect defence to your action. In other words, your patent would be worthless. But you may make improvements in your machines, and patent one containing these improvements. A new combination of old parts is a good subject for a patent. You can get the forms from the Law Courts, room No.* 6, *Strand.*

CHILLED CASTINGS.

(To the Editor of the Engineer.)

SIR,—In reply to the inquiry of "M. B." in your issue of 22nd ult., will you allow me to mention that the pig iron made by the Weardale Iron and Coal Company at Tow Law, Co. Durham, is used by most of the noted makers of chilled ploughshares in this country? F. D. P.

Spennymoor, March 4th.

ELASTIC BOILER CEMENT.

(To the Editor of The Engineer.)

SIR,—I should be greatly obliged by being informed through your correspondents column of the composition of an elastic cement for covering, inside, a leaky seam in a boiler, or maker's name would suffice. The cement was exhibited at the Engineering Exhibition recently held at Agricultural Hall. T. M.

Ipswich, February 28th.

STEAM TRICYCLES.

(To the Editor of The Engineer.)

SIR,—As a reader of your journal, I take the liberty to address these few lines to you. Desirous of being informed respecting the newest, best recommendable patent steam tricycle—*velocipède à vapeur*—so favourably mentioned at the last Bicycle and Tricycle Exhibition, I should feel much obliged by any reader giving me any information, or some addresses of English establishments furnishing the best and newest of that kind of machines. FRANZ CAMAGNI.

Lindau a Bodensee, Germany, February 29th.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 11th, at 8 p.m.: Ordinary meeting. Adjourned discussion upon the paper "On Hydraulic Propulsion," by Mr. Sydney W. Barnaby, Assoc. M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, March 13th: Paper to be read, "Notes on a Train Lighting Experiment," by Mr. W. H. Massey, Member.

SOCIETY OF ARTS.—Monday, March 10th, at 8 p.m.: Cantor Lectures, "The Alloys Used for Coinage," by Professor W. Chandler Roberts, F.R.S., Chemist to the Royal Mint. Lecture I. Gradual development of the processes of coining. The composition and "standards of fineness" of the alloys used for coinage in ancient and modern times. Wednesday, March 12th, at 8 p.m.: Fourteenth ordinary meeting. "Water Regulation in Regard to Floods, Drainage, and Transit," by Lieut.-General F. H. Rundall, R.E., C.S.I. Mr Thomas Salt, M.P., will preside. Thursday, March 13th, at 8 p.m.: Applied Chemistry and Physics Section. "The Upper Thames as a Source of Water Supply." by Dr. Percy F. Frankland. The Right Hon. Sir Lyon Playfair, K.C.B., M.P., F.R.S., will preside.

THE ENGINEER.

MARCH 7, 1884.

COLONIAL DEFENCE.

THE projected Federation of the Australian colonies will doubtless lead to the question of their defence being dealt with in a more satisfactory manner than has hitherto been possible. It would be a fitting opportunity also for clearly defining the responsibilities of this country towards the new Federation, and the duties of the latter in the event of our being involved in war with a maritime Power. It is obvious we could not largely increase the number of our vessels in various parts of the world at such a period; and therefore it is essential a colonial defence should be organised to repel any sudden attack an enterprising enemy might make if he evaded our cruisers, or was too powerful for them to cope with. We should be prepared for such expeditions as that of Admiral Missiessy, who, with a French squadron, in 1805, exacted contributions from certain of our possessions in the West Indies, and returned to France without encountering any of our ships. Can we assert now, after the lapse of nearly eighty years, the presence of a similar hostile force on the Australian coast would cause no fear in that region; and strong in a well-organised defence, a stout refusal would be the answer to a demand for half-a-million sterling. We are afraid that at the first shot the whole fabric of resistance would fall to pieces; terms would be made, and probably separation from the mother country follow a revulsion of feeling against a connection which had been productive of such a calamity. On the other hand, what power for defence might be developed by these colonies if all united in their resources and organisation! They might, indeed, defy any such detached force as just alluded to, and remove all uneasiness in this country as to their ability for self-defence. There are even some who look forward to the time when a more intimate connection with the colonies may enable the latter to augment our forces for offensive purposes, and by representation in our Parliament have some voice in the declaration of war which may affect them so deeply. But for some years to come an efficient defence is as much as we can ask for or expect. At a time, therefore, when we hear of certain measures being taken towards the provision of material for this purpose, we naturally look for some indication to show that the different colonies about to compose this federation have all more or less adopted the same means on some settled plan of procedure. Instead of such being apparent, we observe a diversity of action in this respect, which is much to be regretted. One colony invests in a number of small torpedo boats, and equips them with a weapon of the crudest nature. Another colony lays out a large sum in two gunboats, one large and several small torpedo boats. The value of the gunboats is a matter of opinion, but as in time of war, raids of detached ironclads may be expected, it is a question whether the money might not have been more judiciously laid out. As regards the torpedo boats, the two sizes are fitted for different patterns of torpedo; whereas all the boats should have been equipped alike, even if two types of boat were desirable. But all those with practical experience advocate the larger type as more suitable for coast and harbour defence.

Thus we find that a large sum in the aggregate is being spent, or, as some might term it, frittered away in these spasmodic efforts to provide local defence at the different ports. In some measure it already exists, because at Melbourne and Sydney fortifications, submarine mines, and vessels have been provided for this purpose; but organisation is lacking should they be required in earnest. At other points, as the New Zealand ports, little or no preparation has been made. It may be urged with some truth that the Imperial Government is not free from blame for not having initiated joint action years ago instead of proudly holding aloof, leaving the colonies to follow their own devices in this matter. It was certainly our duty to have advised them how best to utilise their limited resources. We thought, however, the gift of a ship cancelled further obligation and relieved us of future responsibility. Can we be surprised if the colonies now omit to seek that advice when they proceed to improve their defences in the manner already alluded to? Not only should our counsel and experience be at their service, but we should also encourage some of our best officers to enter the colonial service, which hitherto has certainly not been the case.

There would be but little use in referring to the past did we not indicate in some measure what seems needed for the defence of a united Australia against any hostile force that might appear off its coasts. First of all should be organised the local defence of each important port, to consist of fortifications, submarine mines, and large torpedo boats. The fortifications should be those most suited to the particular locality, the employment of earthworks being especially advocated. The submarine mines should, where practicable, be commanded by the guns, and the simpler the system employed the better. All elaborate methods of ascertaining the condition of the mines when in position should be discarded, and only the simplest tests retained. Experience has shown the former to be unreliable, and if any doubt exists as to the efficiency of a mine, the simplest plan is to raise and examine it. The type of mine to be employed depends much upon local conditions, as depth of water, rise and fall and strength of tide, rendering it impossible to formulate precise rules upon this point. Doubtless some plant of this nature already exists, but the staff for its use seems lacking in practical knowledge, as evidenced in an occurrence that took place at Melbourne a few years ago, when an officer and his boat's crew were blown up in some torpedo exercise. Though the actual cause was never clearly ascertained, the inquiry afterwards elicited facts showing an absence of certain precautions, which, if taken, would have rendered the disaster almost impossible. The torpedo boats should be large enough to go out and attack the enemy in moderately rough weather. The success of such operations much depends upon the attack being made from more than one quarter, according to a preconcerted plan. In this case locomotive torpedoes only should be used, the boats having no other armament; but when employed upon reconnoitring duties, or against other boats of similar character, a machine gun equipment should replace the torpedo. The small boats could only perform such services in calm weather. They could not keep the sea for any time, or proceed from port to port independently, so little reliance can be placed on them. In addition to the purely local defence, there should be one or two small but powerful ironclads that could proceed to any point threatened with attack. Timely warning would be flashed by cable to all parts of the Federation, every port put on the alert, and torpedo boats sent out as vedettes to give notice of the enemy's approach. Under such circumstances he should receive a warm welcome; but would probably find it more expedient to leave that part of the world undisturbed. We have in these cursory remarks pointed out the general principles upon which the material for colonial defence should be formed, details of which it would not be politic to make public. Neither will space permit us to deal with the *personnel* of such an organisation, though it is evident that this portion is of equal, if not greater importance, because the most elaborate machinery without a competent staff to work it is worse than useless. We must therefore reserve further observations on this subject for a future occasion.

OUR GUNS IN THE SOUDAN.

ATTENTION is naturally drawn to the subject of the guns which we found useless in the camel battery, and those drawn from our ships to replace them. There appears to be some difficulty in arriving at the truth. There has been a succession of light short guns employed in mountain batteries in our own service. So long as the gun had to be carried entire on the back of an animal its weight had to be limited to from 150 lb. to 200 lb. The piece was a short one discharging a 7-pounder projectile with a low velocity. Its trajectory was therefore curved, and though it carried a fair sized shrapnel shell, its effect was necessarily feeble. We have endeavoured to find out by inquiry what guns constituted the camel battery, but it is very difficult to obtain more than conjecture on the point. The guns from the ships are called 7-pounders, and they appear to have replaced a mountain equipment. On the whole we are inclined to think that our division of men had nothing at all so good as the weak 7-pounder mountain gun, but a 3-pounder Egyptian gun, which must, indeed, have been a "toy." By some means it might be that the guns from the navy which replaced the above, and which had to play the part of the artillery arm of the expedition until the Krupps were captured, were the 7-pounder mountain guns. We know, however, that ships generally have not these mountain equipments, but guns with boat carriages could not have been brought into the field, and the guns with carriages for working on shore are 9-pounders, not 7-pounders. The fact is mentioned, however, that the sailors dragged the field guns. This points to the conclusion that the guns employed were the 9-pounder guns, with field carriages and low wheels, which are often taken on shore and pulled by the men with drag-ropes. In the case before us this must have entailed much labour, and calls for strong praise. In this case, however, neither guns nor camels of the camel battery formed part of the naval equipment. It certainly is discouraging to think that it is possible that they were so absolutely useless as to be left behind. Be this as it may, the matter of importance is the absence of fairly powerful guns. Lord Wolseley is credited with the refusal to supply the expedition with field guns. Such a refusal can only be justified, we think, on the supposition that the guns could not move over the country. Supposing this to be correct, it reminds us of the necessity of having the only powerful mountain guns we possess more extensively issued, namely, the 7-pounder screw guns first made by Sir William Armstrong on a suggestion of Colonel Le Mesurier. These guns—which we fully described with cuts in THE ENGINEER of November 22nd, 1878—have the power of field guns. Being unscrewed and carried in halves on separate animals, they are able to be brought up to 400 lb. weight, and their trajectory and accuracy would enable them to hold their own fairly against field guns. We have made the supposition that the absence of field guns proper was due to the idea of difficulty in transport. If so, the idea appears to have been a mistaken one. Possibly, however, it may be due to another cause, namely, reluctance to expose British guns to risk of capture. We have heard of this idea gaining ground to what we think is an unhealthy extent. Happily, such British guns as have been taken in war have generally been recaptured; we know of none exhibited as trophies abroad. Guns are generally lost when an army has to fall back before an enemy. If this is likely to be a fundamental "strategic movement" of the campaign, surely the campaign is a mistake. If, on the other hand, the danger is due to fitful and sudden changes of position for temporary purposes, guns might be held in hand; but they are too useful to sacrifice the advantage of the arm altogether in all but very exceptional cases.

In this case it was certainly unfortunate that Baker's column should have had powerful guns, which were taken, and ours, only weak ones, to bring against them. This constituted the one complication that was thought likely to lead to loss in our ranks. Had the Arabs attacked us as they attacked Baker, or as the Zulus attacked us at Ulundi, our men would, in all human probability, have disposed of them almost without loss by holding their square formation and behaving with nerve and steadiness. Having guns, it was possible that the enemy might wait with them until our men approached ground where the Arabs lay hidden in great numbers. Then a sudden concentration of fire on the square might tempt our officers to deploy, and such a moment would be most favourable to the startling appearance and rush of Arab warriors. They did not manage, however, so to combine the advantages of guns with their peculiar way of fighting. Nor did we much expect it. It was far more likely that the presence of the guns and the lessons in making earthworks would tempt them to a compromise, which, if it caused more loss to our men than the rush of desperate Arabs, would be doomed to sudden failure eventually, even more certainly than the other.

SHIPOWNERS AND THE BOARD OF TRADE.

MR. CHAMBERLAIN'S Merchant Shipping Bill is not unnaturally exciting a great deal of attention among shipowners, and crowded meetings have demanded that before legislation shall take place affecting the interests of

many millions of capital, a Select Committee shall be appointed to inquire into the conditions under which our marine-carrying trade is conducted. But according to the latest reports the negotiations between Mr. Chamberlain and the shipowners have as yet failed to lead to any understanding in regard to the Merchant Shipping Bill. The shipowners will not consent to refer it to the Standing Committee on Trade ; and Mr. Chamberlain, on the other hand, believes that to send it to a Select Committee would be useless. But if the Government is right, it can have nothing to fear from such an inquiry, the results of which ought to strengthen Mr. Chamberlain's hands. On the other side, the shipowners are confident that by it their characters will be cleared, and that it will be proved that such sweeping measures as that proposed by the Board of Trade are not wanted. Concerning the provisions of the Bill we do not propose to say anything now. They are, beyond question, being fully discussed elsewhere. Our object at present is to consider the nature of the theory on which Mr. Chamberlain is acting, and the evidence which he is bringing up to prove the soundness of his views. We have already dealt rather fully with the whole subject, but it will bear rehandling. Indeed, it is impossible within the compass of a few articles to treat it exhaustively.

Mr. Chamberlain's thesis is, that because a ship and her cargo can be fully insured, shipowners do not take sufficient precautions to render their vessels and seamen safe. The President of the Board of Trade would not concern himself about the ships or their cargoes if no lives were lost; but his soul is harrowed as he reads of the shipwrecks and deaths which daily take place. He holds that the deaths are, for the most part, strictly preventible. He arrives at this conclusion from two points of departure. In the first place, our great ocean steamers make their voyages with the safety and regularity of railway trains; and in the second he has collected facts and opinions which prove, he thinks, that the ships which are lost go to the bottom as a result of the greed of the shipowner. We shall deal with the latter aspect of the question presently, but meanwhile we may point out that, if it were made imperative that our ocean carrying trade should be conducted as the mail and passenger trade is, then we should have to give it up altogether, simply because it could not be done at the price; and we would call special attention to the fact, often if not universally overlooked, that an increase in the cost of ocean transport will have precisely the same effect, in so far as the consumer is concerned, as an import duty; while, as regards our own manufacturers, it will have the effect of an export duty. Thus, for example, if the cost of importing grain were augmented, bread would rise in value; while if the cost of exporting, say, rails to India were raised, the ironmaster must suffer, and with him our rail trade. The head of a great Government department is expected to take a cosmopolitan view of affairs. It is beyond question in every way desirable that loss of life at sea should be brought down to the smallest possible limit ; but it must not be forgotten that there are even higher interests to be considered than the lives of men; and many people will hold that it would be unwise in the extreme to ruin our shipping trade in order to save sailors from risk. It would be as politic to shut up all coal pits lest men should be killed by explosions. We do not assert that every possible precaution should not be taken by the shipowner, but we do assert that Mr. Chamberlain should equally take all possible precautions to see that legislation may not have the effect of killing a great trade while aiming at saving the lives of a few men. We by no means deprecate legislation. We raise our voices against mischievous legislation ; and we assert that legislation in this case cannot fail to be mischievous, unless it is based on information elicited by a careful investigation before a Select Committee.

We may now turn to some of the statements on which Mr. Chamberlain supports his thesis. We have lying before us a return prepared by Mr. Rothery, the Wreck Commissioner, and entitled "Lives lost by drowning or other accident in British merchant ships in the United Kingdom, calendar years 1871 to 1882 inclusive." This return "contains," says Mr. Rothery, "a list of all the cases which have come before me since my appointment at the end of 1876, and show in each case the nature and cause of the casualty ; whether any, and if so, how many lives were lost ; whether blame attached to anyone, and if so to whom; whether it was due to causes beyond control; or whether there is nothing to show how it occurred. It will be seen that I have arranged the cases in four classes, cases of 'stranding,' cases of 'collision,' cases of 'foundered, missing, or abandoned vessels,' whilst the remaining cases, such as those relating to explosions of steam or coal gas, spontaneous combustion, &c., will form the fourth class. The total number of cases was 402, of which there were 163 cases of 'stranding,' 67 cases of 'collision,' 127 cases of 'foundered, missing, and abandoned vessels,' and 45 cases of 'vessels otherwise damaged.'" After explaining that he wants to set forth how many of these casualties are due to preventible causes, he goes on, "In looking at the returns, I find that, out of the 402 cases, there were 36 in which it may, perhaps, be said that the casualty was due to causes beyond control, and 40 in which there was nothing to show how it had occurred ; so that in the remaining 326, out of a total of 402 cases, there was blame to some one, sometimes to the master or other person on board the ship, sometimes to the owner or his agent on shore, sometimes to both ; cases, in fact, which may fairly be called preventible casualties. The returns also show that in 307 of these cases the master or some person on board was in a greater or less degree to blame, and in 94 the owner or his agent on shore." Having explained that he would extend the responsibility of the shipowner in many more cases than are set forth by the figures given above, he goes on, "When, however, we come to the cases of 'foundered, missing, and abandoned vessels,' we find that in no less than 67 cases out of the whole number of 127, that is to say, in more than one-half of them, the owners or their agents on shore were in a greater or less degree to blame, owing to the vessels having been sent or allowed to go to sea either in an unseaworthy condition, or overladen, or undermanned, or with insufficient fittings." This is, we think, a fair statement of Mr. Rothery's views in his own words, and at the first glance it will be seen that this is a very heavy charge against the shipowners of the United Kingdom. Let us, however, examine it a little more closely, and see what it really means.

In looking over the tables which constitute the major portion of the report, we find, first, that no information whatever is given as to the kind of ship which was lost ; we are told nothing of her size, class at Lloyd's, or the nature of the trade in which she was engaged. We have identified a few of these vessels, however, and find that they can in no sense or way be taken to represent sea-going ships in the proper sense of the term. In the year 1879, which we take at haphazard, we learn that forty-one out of a total of fifty-three casualties occurred from careless navigation. The number of lives lost in this way was twenty-eight, of whom fifteen perished on board one ship, the J. H. Lorentzen, of Newcastle. Six vessels were injured by the explosion of coal gas or spontaneous combustion of coal ; only one life was thus lost. In nine cases Mr. Rothery holds the owners responsible. The first of these was an "explosion of coal gas for lack of ventilators," one man killed ; the next case is one of "improper loading and careless navigation," eight men killed ; the next is an "explosion of coal gas," no one killed ; next we have "insufficient ballast and low power of engines," no one killed ; next "explosion of coal gas," no one killed ; then we have a case of "under manned and careless navigation," no one killed ; then "boiler exploded," four lives lost. Next "defective equipments and badly handled, two lives lost;" and last "breaking of a discharge pipe," no lives lost. Thus it will be seen that according to Mr. Rothery, owners are to blame for the loss of fifteen lives in one year out of a total counted by thousands. Of course it is to be clearly understood that these figures apply to the cases heard before Mr. Rothery alone, which represent only a moderate percentage of all the wrecks and losses that take place. But as far as the figures go, they appear to us to put the action of shipowners in a favourable light. Indeed, we have in the whole list but one of those cases which Mr. Chamberlain seems to think are the rule instead of the exception, namely, that of the Mesopotamia. In the following year the record is very much worse, because by the loss of the Borussia no fewer than 154 lives were sacrificed, and she was pronounced by Mr. Rothery to be unseaworthy, and her owners to blame. On one point, and that of great importance, Mr. Rothery is entirely silent. It is contended that existing legislation is quite competent to deal with abuses in the conduct of the shipping trade. Now it will be seen that Mr. Rothery holds that no fewer than sixty-seven foundered, missing, or abandoned vessels, foundered, were lost, or abandoned because of the greater or less misconduct of the owners or their agents who sent or allowed them to go to sea undermanned, or with insufficient fittings. Why, we ask, did not the Board of Trade surveyors use due diligence to prevent this? If we were dealing with old coasting craft we could understand this, but we cannot understand how large ships could get to sea from a British port in an unseaworthy condition if the Board of Trade did its duty. It will not do to say that the work is more than it can accomplish. When it thinks proper the Board is powerful enough. For example, one of the greatest evils of the shipping trade is that vessels are sent to sea insufficiently manned. On this point there can be no doubt whatever. It is in this respect that shipowners are more to blame than in any other. Lloyd's, in a recent letter to the President of the Board of Trade, say that where a ship is not provided with a proper and sufficient crew she shall be deemed unseaworthy. Now a given sailing ship goes on an ordinary trading voyage, say, to Australia, with a crew of thirty hands, all told. This is the minimum allowed by the Board. On the next voyage she takes 500 emigrants ; but before she will be permitted to sail in this latter case her crew must be doubled. How is it that the Government can take action in one case and not in another? Why should the existing minimum be fixed where it is? No one, we think, disputes that there are black sheep in the shipping trade as in all other trades. If the work of the Board of Trade was properly done, however, they would lead a very unpleasant life.

It appears that a very large proportion of the deaths and casualties that occur at sea are due to careless navigation, while a comparatively small proportion can be traced directly to the owner, and this is a point to which Mr. Chamberlain might with advantage devote his attention. It will not do to attempt to charge the owners with complicity in this respect. To what, then, is careless navigation owing? We opine that it must be attributed to the fact that the Board of Trade is not sufficiently careful in granting certificates to captains and mates. Much more is wanted than the power of working a day's reckoning, and a knowledge of "lunars" and "seamanship." To return, however, to Mr. Rothery's report, we repeat that it loses much of its value because it gives no clue whatever to the nature of the vessel concerned, and this is a point of the utmost importance. A very broad distinction must be drawn, but it is not drawn, between ships of various kinds and trades, and different classes of owners. There are coasting craft afloat now—little brigs and schooners, and such-like—which ought not to be entrusted with the life of a man. They are timber built, of great age, half rotten as regards sails, hull, and ropes. If these are caught in a gale they can have but one end. These vessels ought not to be used. It may be said that the law cannot be made which would touch them. We believe that the law as it stands, if it were properly administered, would effectually get rid of them. It is perfectly well known, for instance, that the Plimsoll legislation led to the breaking up of a great number of unseaworthy craft. It is the annual destruction of vessels of this type which swells the list of shipwrecks on our coasts, and runs up the deaths by accident at sea to the high percentage of one in seventy-five per annum. To class owners of great merchant steamers with those of 90-ton colliers, brigs, and such-like craft, is a gross injustice to the former. Mr. Chamberlain muddles up all classes together ; to him a ship is a ship, and an owner is an owner. The report of a Select Committee could not fail to set facts on this point at least before the world, and Parliament, instead of taking a leap in the dark, could legislate with advantage for the good of the whole community. The present moment is one in which the greatest caution is necessary in dealing with this question, because the shipping trade is rapidly falling into a disastrous condition. At the commencement of 1882 the gross tonnage under construction or contracted for was 1,264,603. Last year it was 1,075,259. At the beginning of 1884 it was only 729,446. Thus on the 1st of January there were 345,813 tons less of iron and steel shipbuilding under construction than at the corresponding period of 1883, being a decrease of 32 per cent. Furthermore, it is estimated that the number of vessels at present lying idle in the Tyne is 63 ; in the Wear, 25 ; at Hartlepool, 34 ; and in the Tees, 2 ; in all, 124, representing a gross tonnage of 130,136, or a capital of £910,952, and 1560 men out of employment. These figures speak for themselves.

GAS ENGINEERING IN BIRMINGHAM.

From the annual report of the Gas Committee presented to the Birmingham Town Council on Tuesday it is evident that the engineers of this department have done good work during the past year. In 1875 the private companies in whose hands the supply was then vested carbonised 296,000 tons of coal and sold of gas 2,319,000,000 cubic feet. Last year the corporation carbonised 312,000 tons, and sold 2,861,000,000 cubic feet of gas. Thus for an increase in coals of 16,000 tons there had been an additional production of 542,000,000 cubic feet of gas. Provided that the illuminating power did not suffer, and this, it appears, was the subject of special precautions, the chairman of the Committee, Mr. Maurice Pollack, was justified in terming it "a grand result." That an increase of 144½ million cubic feet of gas sold should have been made in face of the mild winter argues a considerable increase of day consumption for gas engines, gas fires, and cooking stoves. For these services, indeed, the Committee have found the demand increase rapidly. The net profit on the year of £55,389 is considered large enough—after £25,000 allotted to the improvement rate, £5000 to reserve fund, and £25,389 to the sinking fund for paying off loans and annuities—to justify a further considerable reduction in price. Of all the sixteen towns supplied with gas by their respective corporations only one will now be charging less than Birmingham. We refer to Leeds; but Leeds is exceptionally situated as to the cheap supply of gas-coal. And Leeds must look to its laurels, for the Gas Committee of Birmingham are determined, they announce, not to rest satisfied until their scale of prices is the lowest in the kingdom. The Committee make no secret of the fact that their progress is due in much part to improvements in plant. Nor is it to be regretted that they contemplate, failing a rise in the market value of residuals, the erection in the early future of extensive distilling plant. With these extended facilities they will be the better prepared, as to gas for power, to meet the competition threatened from, amongst others, the Compressed Air Company, to whose operations we last week directed attention.

LITERATURE.

Fuel and Water, with Special Chapters on Heat and Steam Boilers: A Manual of the Users of Steam and Water. From the German of Franz Schwackhöfer, Professor at the Imperial and Royal School of Agriculture, Vienna. Edited by Walter R. Browne, M.A. London: Charles Griffin and Co. 1884.

[Concluding Notice.]

We dealt in our last impression wholly with Mr. Browne's introductory chapter; we now proceed to the consideration of Mr. Schwackhöfer's portion of this volume, which occupies 233 pages. It is divided into two sections, the first Fuel, the second Water. So far as we are aware, this is the first time that fuel and water have been handled in anything like an exhaustive fashion in the same book, and the arrangement is in every way commendable. Professor Schwackhöfer writes far more like a professor than an engineer. It is easy to see when he writes in the light of his known knowledge and when he uses what may be termed second-hand information. Mr. Browne has, we make no doubt, done a great deal for the Professor; and his foot-notes, commenting on and correcting his German *collaborateur's* work, are pertinent and useful. It need hardly be said that the section dealing with the physical characteristics of heat is very well done indeed. Nothing less was to be expected from so competent an authority as Mr. Browne. We say this without in any way disparaging the work of Professor Schwackhöfer; but he is not known, in this country at least, as an authority, and Mr. Browne as the translator of "Clausius on Heat" is. A great deal of this section of the book will, however, we fear, be found far above the heads of the steam users for whom the volume is intended, and we think it will be for the best if we confine what we have to say concerning the volume as a whole to the more practical sections of it.

The fourth chapter is devoted to the consideration of steam boilers. It is well known in this country that on the Continent types of boilers are used which have found little or no favour in this country; and the section under consideration is peculiarly valuable and interesting, because it may be taken as an exposition of the reason of the faith there is in French, German, and Austrian steam users respecting steam boilers. Professor Schwackhöfer describes in more or less detail a large number of boilers. At the outset he gives rules for calculating the strength of cylindrical shells, which have the great advantage of putting in an intelligible form what does not seem to be fully understood by a good many people in this country. We may slightly modify the method of our author and reproduce his explanation. Let us suppose that any cylindrical shell is divided into a number of rings, each 1in. long. The force tending to tear these rings asunder—to burst them, in fact—must not be regarded as though the lines of force were radial—which they are—but as though they were all exerted at right angles to a diameter of the ring. For example, let us suppose that we have a ring 6ft. in.

diameter and 1in. long. The circumference of the ring will be 18·849ft., and the semi-circumference will be 9·424ft., or 113·1in. Any stress tending to burst the ring, or tear it into two parts, must operate on a line drawn through the centre. Now it can be proved mathematically that the pressure of any fluid tending to move any surface is not that due to the whole surface, but to that proper to the base on which the surface stands. Ignorance of this fact led a man many years ago to patent a corrugated piston. The augmentation of surface due to the corrugations, he held would be attended by a corresponding increase in the driving pressure of the steam, without any corresponding increase in the volume of steam used. Now our two half boiler rings are in just the same condition as two pistons opposed to each other, and with steam between them forcing them asunder. Their curvature plays no part. If it did the rending force—the pressure being 1 lb. per square inch—would be 113·1 lb.; as a matter of fact it is 72 lb., because the diameter of the boiler is 72in., and the ring is 1in. long. This bursting stress is resisted by both sides of the boiler, because the pressure is equally divided over the whole strip, which is in precisely the same condition as if it were a straight girder 72in. long carrying a distributed load, one half of which is held by the support at each end. In the case of the boiler, each ring acts as the support to the other. Let us suppose that the boiler is ½in. thick, then the stress of 72 lb. will be resisted by 2 × ·5 = 1in. of iron. If we take the strength of the iron to be equal to 44,800 lb. per square inch, and divide this by 72, we have 622 lb. as the bursting strength of the ring; that is to say, a boiler 72in. in diameter and ½in. thick would require 622 lb. to burst it. In practice, however, we have to deal with rivetted joints, and we must multiply 622 by ·56 for single rivetted, or ·75 for double rivetted joints to get the bursting strength. Hence, we get the rule: Multiply twice the thickness of the plate in inches by the strength of the iron in pounds per square inch, and divide by the diameter, to get the bursting stress. It is a common rule to assume the strength of good plates worked into a boiler at 6000 lb. per square inch. Then we get $\frac{2t\,6000}{d} = P$; where t is the thickness in inches, d the diameter in inches, and P the working pressure. Applying this to the boiler we have just cited, we have $2t = 1$, $d = 72$. Then $\frac{1 \times 6000}{72} = 83{\cdot}3$ lb. It may appear that we have occupied too much space in explaining a very simple matter; but we happen to know that a great deal of misapprehension exists regarding it which ought to be cleared away. The formula given by Professor Schwackhöfer for finding the thickness to withstand a given pressure is $d = D\,p\,\frac{5}{S} + 3$, which, in a foot-note, Mr. Browne puts into English shape, thus: $t = \frac{d\,p}{44{\cdot}80\,s}$; where t is the thickness, d the diameter in inches, p the pressure in pounds per square inch, and s the working stress in *tons* per square inch of plate. For the strength of flues, our author gives Professor Radinger's rule: $d = 1{\cdot}3\,D\,p + 0{\cdot}6\,L + 3$; where L is the length of flue between two stiffening rings, d the thickness of plate in millimetres, and p the pressure in atmospheres.

Professor Schwackhöfer describes, as we have said, in some detail various forms of boiler, beginning with the simple externally-fired cylindrical shell. This he does not like because it lacks heating surface, and he quite ignores the great objection to it—namely, the liability to transverse seam rips due to expansion and contraction. We cannot avoid smiling at the following statement:—"Fuel producing a sooty flame, such as bituminous coal, brown coal, and peat, must be burned in external furnaces where the flues are easily accessible for cleaning purposes." Internal furnaces are, according to our author, only suitable for coke and pit coal of the best quality. He is delightfully ignorant of English practice at sea and on land, it would appear. He seems to be unaware that simple externally-fired boilers are used by hundreds in this country for supplying steam to blowing engines, the fuel being gas; and he is also unaware that very good economical results can be got with plain cylindrical boilers set with flash flues. He is careful to tell his readers that for feed-water containing any considerable quantity of impurity an externally-fired cylindrical boiler only may be used. Again, we may remark that in this country we manage to rub along with bad water and Lancashire and other forms of internally-fired boiler.

Our author fairly describes various forms of elephant boiler used on the Continent; some of them excessively complicated. He gives an ingenious explanation of the pitting to which the lower tubes or *boileurs* are liable; the air is expelled from the water as it is heated, and clinging to the upper internal surface of the metal, oxidises it into little patches or pits, each of which forms a lurking hole for a new bubble of air. The only way to avoid this plague lies in sloping the tubes at such an angle that the air bubbles will run up the incline and escape with the steam, instead of lodging. We have said that he sets forth the reasons why many tubed boilers are so much in favour abroad, but we confess they do not appear very satisfactory. Thus, for example, speaking of the elephant boiler with two *boileurs*, he says, "The most striking advantage of the combination lies in the greatly increased heating surface, which results in a better utilisation of heat and facilitates forced working when necessary. At the same time corrosion occurs more frequently in the lower boilers than is the case in the double boiler. A further and not less important evil is the burning through of the top of the first lower boiler." This is faint praise, to say the least. Concerning Lancashire boilers, Professor Schwackhöfer attaches curious importance to the deposit of ashes in the internal flues, forgetting that as the bottoms of the flues are of no use whatever as evaporating surfaces, the ashes can have no effect on the economy of the boiler. Concerning the multitubular boiler he is silent; the water tube boiler—Bellville type, for example—he unhesitatingly condemns, and not without reason.

The section devoted to water is very good. It contains so much really useful matter that it is quite out of the question to attempt even to glance at it within the limits of space available to us. We must content ourselves with saying something concerning the Stingl-Bérenger process of purification, which is not much known in this country. Our author speaks of this in very high terms. It consists in using sodium hydroxide—caustic soda—either alone or in combination with calcium hydroxide—caustic cream of lime—or sodium carbonate. To prepare the reagents 2·3 kilogs. of 90 per cent. carbonate of soda are dissolved in twenty times the weight of warm water, and fresh burned lime or milk of lime is added to the extent of 1·09 kilogs. The caustic lime decomposes the soda; the carbonate of lime is thrown down while the caustic soda remains in solution. It appears that the water thus purified flows away perfectly clear. Its hardness is very slight and nearly constant. For a full description of the working of the process on a commercial scale we must refer our readers to the book itself. We have also descriptions, on the whole satisfactory, of De Haens chloride of barium and milk of lime process, and Bohlig's magnesium process. The work concludes with a chapter on the production of cold and preservation of ice, which contains a great deal of information in a small space.

We can confidently recommend this book to a class for whom it does not seem to have been intended. Indeed, it is far more likely to be of service to engineer students than it can ever be to the steam user. In this matter we are not quite in accord with Mr. Browne, we suppose because we do not regard the steam user and his requirements from the same point of view; but we quite agree with the statement in Mr. Browne's preface: "The original work forms the first part of an encyclopædic treatise of modern agriculture. . . Its value will be found to reside in the combined fulness and conciseness of the information imparted, and on the clearness with which the results of theory are stated, while the processes by which they have been arrived at are left, as becomes a practical treatise, in the background."

We have only to add that the publishers have done the work full justice; type, wood-cuts, printing, and paper are alike excellent.

A Bibliography of Electricity and Magnetism, 1860 to 1883; with special reference to Electro-technics. Compiled by G. May, with an index by O. Salle, Ph. D. London: Trubner and Co. Leipzig: A. Hartleben. 1884. 203 pp.

THIS little book will, no doubt, be of great use to students in electricity and magnetism; and to those whose studies are intended to take the more practical turn, it will be the more useful that its pages contain only the titles of those books which may be considered of modern date. The book seems to contain the title of every work having any claim to notice in German, French, Italian, English, Danish, and Spanish; but valuable as the little volume is, it would, of course, be more so if it contained the titles of the papers read before the leading technical societies in the different countries. But this would be, perhaps, an almost impossible thing. The book will, no doubt, find many purchasers, as no technical library should be without it.

BOOKS RECEIVED.

Practical Geometry, Perspective and Engineering. Drawing by George Sydenham Clark, Captain Royal Engineers. Second edition. London: E. and F. N. Spon. 1884.

A new System of Laying out Railway Turnouts instantly, by Inspection from Table. By Jacob M. Clark. New York: D. van Nostrand, 23, Murray-street.

The Railway Companies' Directory; Directors, Officers, and Chief Agents of the Railways of the United Kingdom, with a Digest of Capital, Dividends, Mileage, Receipts, and Expenditure, &c. 1884. Publishing Office: 123-5, Fleet-street, London.

Handbook to the Patents, Designs, and Trade Marks Act, 1883. Containing the Act and Rules; also an Explanatory and Practical Treatise thereon, and the Procedure thereunder for the use of Inventors, Manufacturers, &c., with a copious Index to the Act and Rules. By Bristow Hunt. London: Waterlow and Sons, Ltd. 1884.

A Concise Treatise on the Law and Practice of Patents for Inventions. By Clement Higgins, Barrister-at-law. London: William Clowes and Sons, Ltd., 27, Fleet-street. 1884.

PRIVATE BILLS IN PARLIAMENT.

THE General Committee on Railway and Canal Bills met on Thursday and made the following appointments:—

Group 1.—The consideration of this group was fixed for April 29th. The group consists of the East London Railway Bill, the London Central Electric Railway Bill, the London, Tilbury, and Southend Railway Bill, the Metropolitan District Railway Bill, the Metropolitan Outer Circle Railway Bill, the Metropolitan Railway (Park Railway and Parliament-street Improvement) Bill, and the Metropolitan Railway (Various Powers) Bill.

Group 4.—This group will also be considered on April 29th. The Bills forming the group are the Aldershot, Farnham, and Petersfield Railway Bill, the Basingstoke, Alton, and Petersfield Railway Bill, the Easton and Church Hope Railway Bill, the London and South-Western Railway Bill, London, South-Western and Metropolitan District Railways Bill, London, Brighton, and South Coast Railway Bill, Oxted and Groombridge Railway Bill.

Group 5.—The following constitute this group:—The Cleveland Extension Mineral Railway Bill, Ennerdale Railway Bill, Hull, Barnsley, and West Riding Junction Railway and Dock Bill, North-Eastern Railway Bill, Scarborough and East Riding Railway Bill, Scarborough and Whitby Railway Bill, Skipton and North-Eastern Junction Railway Bill, Stockton Carrs Railway Bill, and Halifax High Level and North and South Junctions Railway Bill. The group will come before a committee, of which Mr. Bourke is to be chairman, on March 18th.

Group 7.—Sir John Kennaway will preside over the sittings of the Committee before which this group will come on March 20th. The group consists of the Dore Chinley Railway Bill, the Great Northern Railway Bill, the Lincoln Railway Bill, the Midland Railway Bill, the Northampton and Daventry Railway Bill, the Sutton and Willoughby Railway Bill.

Group 8.—This group will be considered on April 29th. The following Bills are in the group:—Dublin (City) Steam Packet Company Bill, Eastern and Midlands Railway Bill, London and North-Western Railway Bill, Sutton Bridge Dock Bill, Swansea Harbour Bill, Wirral Railway Bill, Wisbech Dock and Railways Bill.

Group 9.—Admiral Egerton will preside over the Committee which meets to consider this group on March 11th. The group consists of the Anglesea and Carnarvon Direct Railway (No. 2) Bill, Bishop's Castle Extension and Montgomery Railway Bill, Denbighshire and Shropshire Junction Railway Bill, Leominster and Bromyard Railway Bill, Manchester, Sheffield, and Lincolnshire Railway (Chester to Connah's Quay) Bill, Porthdinlleyn Railway Bill, Ruthin and Cerrig-y-Druidion Railway Bill.

Group 10.—The Committee on this group will meet on March 18th under the presidency of Mr. Lowther. The Bills to be considered are the Avonmouth and South Wales Junction Railway Bill, Central Wales and Caermarthen Junction Railway Bill, Great Western Railway (No. 2) Bill, Henley-in-Arden and Great Western Junction Railway Bill, Milford Docks (Junction Railway) Bill, Swindon and Cheltenham Extension Railway Bill, Swindon, Marlboro', and Andover Railway Bill, Swindon, Marlboro', and Andover and Swindon and Cheltenham Extension Railway Companies Amalgamation Bill, Usk and Towry Railway Bill.

Group 10.—On March 18th a Committee, presided over by Mr. Hardcastle, will meet to consider the Barrmill and Kilwinning Railway Bill, the Caledonian Railway (No. 1) and (No. 2) Bills, and the Glasgow and South-Western Railway Bill.

On Tuesday the Select Committee of the House of Lords on Standing Orders considered the Examiner's report of non-compliance in the case of the London, Reigate, and Brighton Railway Bill. Mr. Robinson had elected six grounds of non-compliance, the first three being neglect to include names in the book of reference. As to the statement of the number of persons belonging to the neighbouring classes required to be furnished according to Standing Orders, the Examiner had held that it was not in conformity with the rules, inasmuch as every two children under the age of twelve years had been counted as one adult. This, according to the report, made a difference of 58 in the total, though the promoters admitted that the actual deficit was 111; while the London, Brighton, and South Coast Company, who appeared in opposition to the Bill, contended that the number was much larger than even this latter figure. The last point of non-compliance was as to the list of occupiers, which, the Examiner ruled, ought to contain the names of occupying lessees and occupying owners, though these persons might be included in the separate lists of lessees and owners respectively. Mr. W. Bell, on behalf of the promoters, called the attention of their Lordships to the fact that in this railway, extending over seventy miles, only six matters of non-compliance had been proved, and of these three were as regards instances in which the promoters had been unable to obtain information, while two other points arose from the particular view taken by the Reference Clerk as to the requirements of the Standing Orders. He contended that there was no possibility of any one being deceived or injured by the failure of the promoters, and under these circumstances he submitted to their Lordships that this was not a case in which the progress of the Bill should be interfered with. On the part of the Brighton Company, Mr. Cripps urged that the fact of any non-compliance relative to the Book of Reference not being found was in itself a matter of suspicion, for it was quite likely that there might be many others, the rule being that no allegation of that nature could be sustained unless the party affected made complaint. With regard to the other matters of non-compliance, he submitted that they were of so serious a character that the Bill ought not to be allowed to proceed. After consultation in private, Lord Redesdale, as Chairman of the Committee, announced that it had been decided not to dispense with the Standing Orders.

The Committee also dispensed with the Standing Orders in the cases of the Metropolitan Outer Circle Railway Bill, the Tooting, Balham, and Brixton Railway Bill, and the Basingstoke, Alton, and Petersfield Railway Bill.

The Standing Orders Committee of the House of Commons held a meeting on Tuesday, and declined to dispense with the Standing Orders in the case of the Rhondda and Bristol Channel Railway Bill.

SALTERHEBBLE VIADUCT.

AT page 186 we give a general elevation and plan of the Salterhebble Viaduct, which will form a part of the Huddersfield and Halifax extension of the Hull, Barnsley, and West Riding Junction Railway. The viaduct is of fine proportions and has several features of much interest, which will be fully illustrated by engravings to be published in succeeding impressions. The construction of the railway is at present deferred, but so important a line will no doubt be proceeded with at an early date.

HOW THE FIRE SCENE IN "THE STREETS OF LONDON" IS MANAGED.—It was suggested some little time back by one of our most popular theatre managers, that if the public were to have an opportunity of seeing the arrangement made for their security against fires in theatres, it would tend greatly to allay those spasmodic attacks of fear resulting in fatal "rushes," which we read of, and we should hear less of the danger of audiences being roasted alive. Having this in mind, a visit behind the scenes at the Pavilion Theatre, to witness the manipulation of the "fire scene" proved most interesting. In the East London theatres nothing is done by halves, and Mr. Fred. Abrahams has produced at the Pavilion, in "The Streets of London," a performance which has not been excelled at any of the West End theatres. Viewed from the auditorium, the whole stage appears to be in flames from top to bottom, and the destruction of the theatre itself seems to be imminent. There is in reality, however, very little chance of this taking place, less in fact than the danger caused by wads from discharged guns in some performances. The *modus operandi* is this:—The house to be destroyed is placed towards the front of the stage, and peforated gas pipes are attached to the framework to increase the flames. At a convenient distance behind the scene an iron frame is set up, and covered with loosely bound tow, saturated with a light spirit, such as naphthaline; a gallery, upon which are pans containing coloured fire, runs across the upper part of the doomed house. A "lycopodium" pot is used to kindle the fire. The pot is made in the shape of a large pepper-box, and contains a piece of sponge—saturated with spirit—attached to a wire. This "fire-pot" is jerked about at different points of the stage, and a very good representation of an outbreak of fire is produced. The tow on the iron screen is now ignited, and in a few minutes the stage presents the appearance of a building which has succumbed to the fiery element. The windows fall out—being hinged on iron frames—the gas brackets flare, and the coloured fire completes the effect. It is at this juncture that one of Merryweather and Sons' London Brigade steam fire engines, with a full complement of firemen, dashes upon the scene, drawn by a couple of horses, with steam at full-pressue, and whistle blowing. Two lines of hose are run out, the firemen attack the flames, which are rapidly extinguished, and the curtain drops. The staff immediately proceed to wipe down the iron screen with wet mops, the smoke finding its way out through the roof. In order to obviate all chance of danger, firemen are stationed in the wings throughout the performance with hose attached to the high-pressure main in the building. 30,000 people have witnesseed this production during the past week, every part of the house being crowded.

LETTERS TO THE EDITOR.

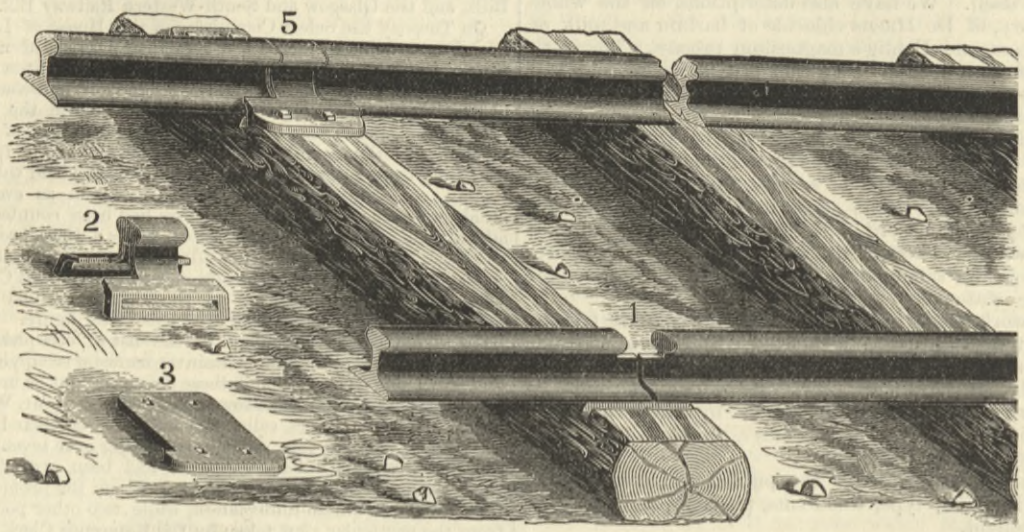
[*We do not hold ourselves responsible for the opinions of our correspondents.*]

BOLTLESS RAIL JOINTS.

Sir,—At the request of the *Railway Age* and other scientific papers of this country, I have compiled the tests—of the Gibbon Boltless Rail Joints Fastener—of stress and deflections, and beg to send you copies of same, with curtailed comments of Mr. A. V. Abbot, engineer, who made the tests. I do this thinking that your engineers would like to know what we are devising to remove the curse to track, *i.e.*, low joints, as we are to know what they are doing, tending to the same object.

It is well known to engineers in all parts of the world, the joint is the cause of at least 40 per cent. of the expense of track maintenance and rolling stock repairs; the army of bolts, nuts, and washers are ever to be watched, and low joints to be raised. These evils have caused much thought, and many expensive methods have been adopted with a view to their removal, but as yet with little avail; low joints and loose bolts still exist.

It is but natural to ask why there should be any low joints, when so much additional material is used. The joint has two plates



weighing from 30 lb. to 50 lb., four bolts, four nuts, and four washers, to connect the rails together; and it would appear at first sight the joints should be at least as strong if not stronger than the rail itself; but it is not, as English and American tests prove. The reason is, too many pieces constitute the joint, and these pieces cannot be screwed together so firmly—allowing for expansion and contraction—as to make them one; hence the joint is the weakest part of the track, and must go down under the pressure of the iron horse; the constant irritation, and which is intensified by every passing train, shortens the life of the very best of rails and their connections.

My method for the removal of these and other serious evils to track is, use no bolts, then you won't weaken the weakest part of the rail by drilling holes in the neck of them. To do this, I have taken 2in. of the head from each end of rail, and cast them with the fish and angle plate in one piece. The angle plate is extended downward—which is boxed into the tie, to act as a brace to prevent spreading of track—and is slotted to allow a ¾in. plate 8in. square to slide through the fastener and under the rail, and resting on the sleeper. The plate when spiked to the sleeper covers the ends of rail at top, bottom, and sides, thereby breaking joints and making a smooth continuous track.

Please permit me to add in conclusion the practical results of the above method. In September last about 200ft. of track was laid with these joints in the main track of the D. and H. C. Co., and it is estimated that from 300 to 400 engines pass over them every twenty-four hours, switching, &c. Not an hour's work has been performed on this portion of the track since it was laid, so as to illustrate the impossibility of low joints, spreading and creeping of the track, &c. The condition of the track at this writing demonstrates, after five months' trial, these facts—(1) It makes a smooth and continuous rail; (2) has removed low joints; (3) the track cannot spread nor creep; (4) the spikes are as firm as when first driven; (5) removes all labour attending low joints, and screwing up loose bolts; (6) estimated that two miles of track can be laid with this joint in less time than one mile with fish and angle plate; (7) the joint fastener is lighter, cheaper, and stronger than any other joint fastener in use. I would respectfully refer to Mr. C. D. Peters, Moorgate Works, Moorfields, and Mr. Charles Adams, of Messrs. Adams and Co., engineers and constructors, both of London, who, when in this country, saw the joint and spoke highly of it, at the Chicago Exposition. I trust this description of the joint has interest enough to warrant you laying it before your readers.

Having charge of testing and inspecting steel rails for the above named company for fourteen years, I find there is no difficulty in cutting the head of the rail for this joint. Simply an addition of two saws on same shafts, which will cut the heads of rails at the same time as the larger saws cut the ends. When cool and straightened, the punching machine used for slotting the flange of rail for spikes, is used for taking the head from the neck, thus saving the expense of drilling, and also saves 1500 lb. of steel per mile when purchasing rails at the mills.

Thos H. Gibbon,
Lately Assist. Eng., D. and H. C. Co.
26, North Pearl-street, Albany, N.Y., U.S.A.,
December 21st.

Conclusions of Mr. A. V. Abbot's Report.

The heaviest locomotives of the present day rarely, if ever, are built to give a load of more than 10,000 lb. on a single driver; if this load be doubled to allow for a severe case of impact due to high speeds, a load of 20,000 lb. is obtained as the maximum stress that can be placed on a rail joint at any time. An inspection of the foregoing tests gives the following factors of safety under different conditions. In the case of the Gibbon joint used as a suspended joint, with the ties placed 20in. apart, a load of 104,000 lb.—52 tons—was retained without any signs of failure of the joint, thus giving a factor of over 5.

In experiment 487, with ties 20in. apart, and the middle tie supported on a yielding foundation of sand, a load of 75,000 lb. was supported without failure, giving a factor of nearly 4. (Test discontinued.)

In experiment 488B, the joint with a span of 40in.—no tie under the joint—failed under a load of 67,000 lb., giving a factor of over 3, under circumstances as unfavourable to the joint as may be supposed to occur when the ballast of the track has been washed away from the ties adjacent to the joint. Furthermore in this test the rails themselves failed at the same time as the joint, showing that under such circumstances at least the joint was as strong as the rest of the track.

From the above conclusions it may be safely asserted that the Gibbon joint is strong enough to do all the work that may be expected from a railway splice under even very adverse circumstances. The steel castings that were used in these tests were remarkably soft and ductile, so that there need be no apprehension that such castings would wear unequally with the rails. The joint, therefore, would seem to be eminently adapted to the work for which it was designed, and to obviate many of the objections of the present systems.

Results of Experiments of the Gibbon Boltless Rail Joint, to Ascertain the Resistance to Deflection and Rupture under a Gradually Increased Bending Stress.

Test No.	Weight of joint.	Stress in lbs., deflection in inches, and decimals of inches. 1,000	5,000	10,000	15,000	20,000	25,000	30,000	35,000	37,600 40,000	45,000	50,000	55,000	60,000	65,000	70,000	75,000	80,000	100,000	Ultimate stress—lbs.	Span in inches.	Remarks.
449	23 lb.		·106	·200	·257	·335	·525	·600	·810	Casting cracked, and pressure increased to										42,700	28in.	Revealing blow-holes in casting.
487A	29 lb.		·102	·185	·228	·300	·410	·500	·625	·720	·825	·965	1·040	1·150	1·275	Gauge removed, and pressure increased to				75,000	tie in sand.	No sign of failure of joint. Test discontinued.
487B	29 lb.		·150	·300	·335	·425	·475	·550	·600	·800	Gauge removed, and pressure increased to									66,500	20in.	When joint cracked slightly
488A	29 lb.	set.	·155	·267	·330	·390	·465	·530	·530	·600	·625	·656	·700	·735	·780	·835	·950	1·025	1·45	104,000	20in.	Test discontinued; no failure of joint.
488B	29 lb.	Gauge	·125	·225	·330	·440	·535	·620	·666	·765	·875	1·020	1·135	1·600	2·800	Gauge removed, and pressure increased to				*67,090 4)280,290 70,072lb	40in.	No tie under the joint. Joint failed by tearing the bottom of the rail from the web, and by cracking both rails thro' the head at a distance of 17½in.
														As a suspended joint							
	Steel rail, 62 lb. per yard		·160	·200	·230	·280	·320	·450	1·020	2·350	Gauge removed, and pressure increased to									42,550	40in.	Rail completely failed.

Messrs. Fairbank and Co., Department of Tests and Experiments, New York. Mr. A. V. Abbott, engineer in charge. November 20th, 183[illegible].

* Thus proving this joint strengthens the rail 25,000 lb. at its weakest part, viz., the joint.

THE COST OF DREDGING.

Sir,—Some months ago I saw some remarks in your paper on the different kinds of dredging plant. You then invited engineers and others to give some information on the subject. There is one class of dredgers you did not then notice, which in my opinion, as a dredging master of many years' experience, is the most efficient class of the present time. That is the hopper dredger, patented by Messrs. Simons, of Renfrew, for bar and harbour work. They do the work the cheapest, as I hope to show you.

For the last five years I have been employed on the Newhaven Harbour works, in the Neptune, a hopper dredger of 500 tons. I will give you the working expenses of that vessel, and I challenge any engineer or dredger master to show the same amount of work done by any other class of dredgers at the same cost, and with the same number of hands—a crew of eleven men. Not in Newhaven alone, but in every port these hold the foremost place. I at present will confine myself to giving you a few figures from the log of the Neptune. If you think it will be of any interest to you, I will give you the expenses of all the ports that they are employed in. They act very well in a sea if properly handled, as will be seen from the fine passages some of them have made out to the colonies. At the same time a great deal depends on the dredging master in knowing the nature of the soil he is working in, and in keeping his vessel in a proper position. The engineer does the scientific part of the work, but the dredging master has the practical part of it to do. I am at present employed on board the dredger Forth, a vessel of 900 tons, one of the most powerful hopper dredgers afloat. We can lift, and deposit at a distance of eighteen miles a cargo of 900 tons, and get back to our moorings in seven hours. She belongs to the Caledonian Railway Company, and is manned by thirteen hands.

Amount of mud taken out of Newhaven Harbour by dredger Neptune for six months, January 1st to June 30th, 1880			91,650 tons.
Number of trips			195
Amount per trip			470 tons.
Amount of coals			112 tons.
		£	s. d.
Expenses for coals		97	0 0
Wages for crew		421	8 0
Stores		39	12 9
Repairs		212	16 5
Total		673	17 2
Cost per trip		3	19 1
Cost per ton mud			2¼

Dredger Forth, Grangemouth, February 16th. John Ward.

WHO IS THE INVENTOR OF THE CLOSE FIRE RANGE, OR KITCHENER?

Sir,—During the last twenty-five years there has been an increasing demand for close fire ranges, or, as they are usually termed, kitcheners, and which are manufactured by a number of different firms, most of them of a similar description. My object in writing this letter is to ascertain who is considered the inventor. They were introduced to the general public at the Exhibition in 1851; but many years previous to that date my father invented and made a similar description to those now made by some of the best makers. It was during the year 1814 that he made the first of the kind, and it gave such satisfaction that it was with difficulty he could supply them sufficiently quickly to meet the demand. The greater number were fixed in Suffolk and Norfolk, and some in London. The last I recollect his making was fixed at the house of a wholesale jeweller and silversmith, in St. John's-square, London. At this time he had some difficulty in getting the castings made to his satisfaction, as there were but few ironfounders in this part sixty years ago, and some difficulty was experienced in casting the boilers. Many of those then made were fitted with strong, square, copper boilers, tinned inside, and with the draw-off cock in front as at present. I have the wood patterns now by me from which the castings were made; they are of similar dimensions in all parts to those now made by the Leamington makers, of 4ft. 3in. and 4ft. 6in. wide. There were many other arrangements in the stoves made by my father than are contained in any of those since made. Some of those parts have been introduced, and either registered or patented by others since. The bottom grate was made to rise or fall, so as to reduce or increase the capacity for the fuel, and some others of a minor description.

My father has been dead sixteen years, having attained the age of eighty-eight, and the person who made the patterns has been dead eight years. One firm now advertise as patent a close and open fire cooking range, with the ovens above the fire-place. A range of this description was made partly in my shops twenty-four years ago, by a former workman of mine, and after his death was sold by his brother to an ironmonger, and was sent into the midland counties.

G. E. Child,
Southwold, Suffolk, Feb. 27th. Engineer and Ironfounder.

A NEW LEARNED SOCIETY.

Sir,—May I ask your aid in the double object of giving world-wide publicity to an institution which appears not to have met as yet with the success the perseverance of its promoters deserves, and, next, of making to these promoters a slight request. This institution calls itself "the Society of Science, Letters, and Art of London;" but though of London, it nevertheless appears to be of

the application came from or was authorised by the Society of Arts. I do not think the money thus paid was in any case refunded, though in one or two its return was promised. An institution offering such attractions cannot be too widely known, and it is a pity that it should run the risk of being confounded with any other. The request with which I would conclude this letter is, that in return for my endeavours to secure publicity to its objects, the institution will choose a name somewhat less likely to be confounded with that of the Society of Arts, which I can assure you is by no means anxious to deprive of its due credit what might fairly be content to be known as the "Society of Letters."

The legitimate aims of any such undertaking cannot fail to be promoted by publicity, and it is in the hope that this enterprise may be induced to shine without the aid of borrowed light, and may eventually obtain the full measure of its real deserts, that I have ventured to address this letter to you.

H. TRUEMAN WOOD,
Secretary of the Society of Arts.

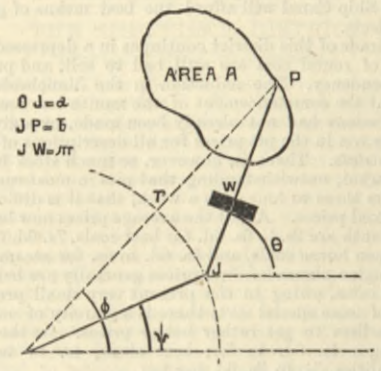
Society of Arts, Adelphi, W.C., February 21st.

THE PLANIMETER.

SIR,—In THE ENGINEER of December 28th, 1883, I find what Mr. Fisher claims to be a "general proof of the action of the planimeter." Mr. Fisher considers that $\int b^2 d\theta$ is that which is given by the reading of the wheel. This is evidently not the case, since b is a constant, and for a complete circuit of the point P this integral is equal to zero in a case such as shown by his figure. Pursuing a line partly suggested by this article, I have reached the following, which perhaps you may see fit to give a place in your columns.

In simple rotation of the arm b about J the number recorded by

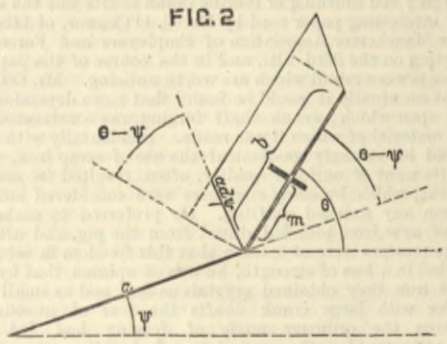
FIG. 1



the wheel W, will be a measure of the change of the angle θ. Let us designate this number by R. Then the change of θ for simple rotation is $\theta - \theta_0 = \frac{c}{m} R$, wherein c is a constant depending on the graduation, &c. Whenever J moves there results a translation of the line b, and let us designate by T the number recorded by the wheel, due to this translation. T will then measure the component of the translation normal to b, and the area swept over by translation is $b\,(c\,T)$.

From Fig. 2, $d\,(c\,T) = a\,d\,\psi \cos.\,(\theta - \psi)$. We have then for the

FIG. 2



algebraic sum S of the areas swept over by the arm b.

$$S = \frac{b^2}{2}\left(\frac{c}{m} R\right) + b(cT) = \tfrac{1}{2}\int b^2 d\theta + ab\int \cos.\,(\theta - \psi)\,d\psi \quad . \quad . \quad . \quad (1)$$

From Fig. 1, we have area $A = \frac{1}{2}\int r^2 d\phi$

$$r^2 = a^2 + b^2 + 2ab\cos.\,(\theta - \psi)$$

$$\tan.\,\phi = \frac{b \sin.\,\theta + a \sin.\,\psi}{b\cos.\,\theta + a\cos.\,\psi} = Q$$

$$d\phi = \frac{dQ}{1+Q^2} = \frac{b^2 d\theta + a^2 d\psi + ab\cos.\,(\theta-\psi)(d\theta + d\psi)}{a^2 + b^2 + 2ab\cos.\,(\theta-\psi)}$$

$$r^2 d\phi = b^2 d\theta + a^2 d\psi + ab\cos.\,(\theta-\psi)(d\theta + d\psi)$$

(See Mr. Fisher's article.)

$$ab\cos.\,(\theta-\psi)(d\theta + d\psi) = 2ab\cos.\,(\theta-\psi)d\psi + ab\cos.\,(\theta-\psi)(d\theta - d\psi)$$

$$\int \cos.\,(\theta-\psi)(d\theta - d\psi) = \int \sin.\,\theta\,d(\cos.\,\psi) + \cos.\,\psi\,d(\sin.\,\theta)$$

$$-\cos.\,\theta\,d(\sin.\,\psi) - \sin.\,\psi\,d(\cos.\,\theta) = \sin.\,\theta\cos.\,\psi - \cos.\,\theta\sin.\,\psi + C,$$
$$= \sin.\,(\theta - \psi) + C$$

and for a complete circuit of P this is in all cases = 0 (zero)—

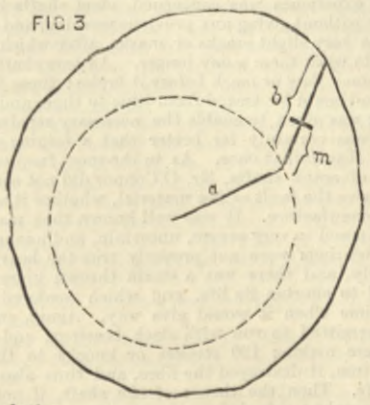
Hence, $A = \frac{1}{2}\int b^2 d\theta + \frac{1}{2}\int a^2 d\psi + ab\int \cos.\,(\theta-\psi)\,d\psi \quad . \quad . \quad (2)$

In a case such as given in Fig. 1, where neither b nor a makes a complete revolution $\frac{1}{2}\int b^2 d\theta = 0$, also $\frac{1}{2}\int a^2 d\psi = 0$.

By comparison of equations (1) and (2) then, we find, $A = S = b\,(c\,T)$, *i.e.*, the number recorded by the wheel is a measure of the area A, whatever be the value of m.

In a case such as shown in Fig. 3, where both b and a make a

FIG 3



complete revolution—

$$A = \tfrac{1}{2}\int_{\theta_0}^{\theta_0 + 2\pi} b^2 d\theta + \tfrac{1}{2}\int_{\psi_0}^{\psi_0 + 2\pi} a^2 d\psi + ab\int \cos.\,(\theta - \psi)\,d\psi$$

$$A = S + \pi a^2$$

The wheel record is $(R + T)$ and since $R = \frac{2\pi m}{c}$

$$S = \frac{b^2}{2}\left(\frac{c}{m} R\right) + b\,(c\,T) = \pi b^2 + bc\left(R + T - \frac{2\pi m}{c}\right)$$

if then $m = \frac{b}{2}$ we have $S = bc\,(R + T)$.

In this case, the number recorded by the wheel is a direct measure of S only when $m = \frac{b}{2}$.

ROSS E. BROWNE.

Berkeley, California, January 26th.

HADFIELD'S PATENT MANGANESE STEEL.

SIR,—Referring to a letter in your issue of 23rd February from Messrs. Geo. Bennett and Co. with reference to our patent manganese steel, at foot please find copy of letter received from this firm with reference thereto, from which you will see they were mistaken in their statements. We need not add anything further, seeing that the letter will speak for itself, but we may say that apart from direct commercial interest, we cannot understand why Sheffield firms should be at all jealous of our discovery and success, seeing that it is believed that many of the hitherto unexplained phenomena now being widely discussed in metallurgical circles with reference to the honeycombs in steel, and to the gases absorbed and given off therefrom, may eventually be solved by means of the curious results obtained and noticed by us in the manufacture of this new steel, and thus ultimately prove a benefit to Sheffield trades at large. Another very interesting fact connected therewith, proving its new character, is its non-magnetic properties.

We should not have troubled to take any notice of Messrs. B.'s letter except in self-defence and in order to prevent any false impressions being circulated, for we fully intend to protect our patent rights in this matter.

HADFIELD'S STEEL FOUNDRY COMPANY.

Newhall-road, Attercliffe, 1st March.

P.S.—We notice in your issue of February 29th a very practical letter on this subject signed "M. E. W.," for which we are obliged, especially as your correspondent is at present unknown to us.

From Geo. Bennett and Co., Foundling Works,
Rockingham-street, Sheffield, February 29th.

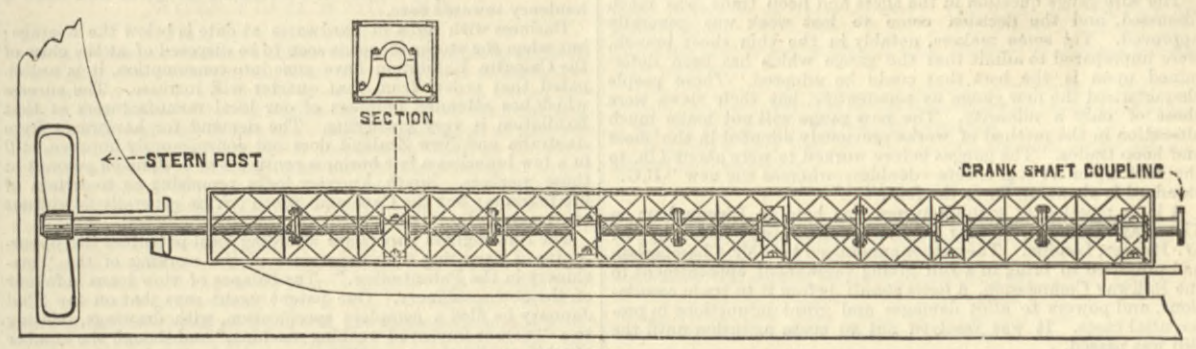
To Messrs. Hadfield's Steel Foundry Company,
Attercliffe, Sheffield.

DEAR SIRS,—With reference to our letters in the *Sheffield Daily Telegraph* and ENGINEER of Saturday last, February 23rd, 1884, in which we stated that there was nothing new in your patent manganese steel, we find on making further inquiries and seeing the steel in question that we were and are mistaken, and that your material is totally distinct and possesses entirely different qualities from any steel that we ever saw or heard of before. We were under the impression that it was similar to our self-hardening, planing, and turning tool steel, but find this is not the case. We therefore beg to withdraw the said letters and apologise for same, and for having caused you any annoyance or loss thereby.

(Signed) GEO. BENNETT AND CO.

THE BREAKAGE OF SCREW SHAFTS.

SIR,—I beg to submit to the readers of THE ENGINEER he following scheme for preventing the breakage of screw shafts:—The object of the invention is to prevent all bending and straining of the framework of a steamship being communicated to its screw shaft as it is known to do at present, it being allowed that these strains are more prejudicial in producing fractures of the shaft than



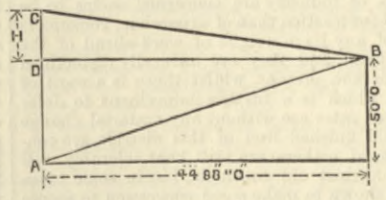
any working strain to which it could be put. I propose to remedy this by laying a tubular lattice girder as shown in sketch, through which would be laid the shafting supported by light plummer blocks, the girder to be of sufficient size to answer the purpose of a shaft tunnel—to call it a tubular bridge would be a better description—it would have to be enclosed at sides and top to prevent anything weighing against it, such as cargo, &c. The sketch shows the general appearance of it. N.B.—The above is not drawn to scale.

W.

Chiswick.

THE FRICTION OF WATER IN PIPES.

SIR,—Would any of your correspondents kindly enlighten me on the following question of the power necessary to overcome the friction of water in long pipes. I will take an imaginary case as an example, and hope to make my meaning quite clear by the sketch. Supposing A to be a pumping station, I want to know the power necessary to overcome the friction of 3000 gallons of water per minute flowing in a 12in. main—I do not take any coefficient of friction into consideration; presumably the pipes are of cast iron—up the slight inclination of 50ft. in the horizontal distance of 44,880ft., *i.e.*, along A B; and further, on the supposition that the water is forced plumb up from A through D to C (D C = H), what must be the head H to get a discharge of 3000 gallons per minute at the outflow B?



According to Molesworth's tables, page 186, the inclination for the flow of this quantity under these conditions is $\frac{1}{1\,3\,4}$ or 448 × 3 = 1344ft.; add to this the original lift of 50ft. = 1394ft. for A C in the diagram. To force the above quantity through this head will require something like 1200-horse power, but the net horse-power to raise 3000 gallons per minute through 50ft. is only about 45-horse power. Allowing ·66 for modulus, we have a total of something like 75-horse power. According to the method of forcing the water plumb up as through A D C to B, allowing for modulus, we obtain about 2000-horse power. Does this mean that it takes the difference between 2000 and 75-horse power to overcome the friction alone, and if so, what would be the power to overcome friction alone supposing the water to be forced direct from A to B?

Sunderland, March 3rd. C. A. C.

THE NEW PATENT ACT.

SIR,—It cannot be denied that the new Patent Act, 1884, is of great advantage to inventors making applications for patents for the same or similar inventions. Four applications for improved letter-boxes, to prevent the abstraction of letters, &c., viz., 2142, 2417, 2566, 2591, were made within eight days, between the 25th of January and the 2nd of February, followed by several similar applications. In less than one month applicants received from the Comptroller progressive notices that each applicant has been anticipated by a prior applicant. One of the three notices I received and enclose. In every one it is pointed out that an appeal to the law officers against the Comptroller's decision is open to the applicant whose application has been accepted. When the four specifications, 2142, 2417, 2566, 2591, are published, it will be seen in what way the Comptroller has exercised the power given under Sub-section 6 of Section 7. Myself believing that that right will be fairly and justly exercised, I cannot but approve of the working of this part of the new Act, when at a trifling outlay the inventor is placed at once in possession of facts that were impossible for him to get at under the old Act, and not before he had completed his valueless patent at an expense of over £50. C. L. H. LAMMERS.

2, Roseworth-terrace, Gosforth, Newcastle-on-Tyne,
March 3rd.

WATER POWER.

SIR,—Having noticed in your columns for the last week or two some valuable information on the above subject, allow me to offer further something which may add to or help to solve or come nearer the truth of motive power derived by high falls of water. Having had experience in turbines, I find each maker naturally looks for and claims the best result. I find opinions theoretically differ, but help, whatever point is advanced, to throw a new light on the subject. The remarks of Messrs. Hett and Ramsbottom, and their ingenious plans of determining the force of the stream and power of water, I have read with much interest, but fail to see the water engine most suitable for high falls, or any engine, or turbine, or what not that has an internal discharge. Any water motor that discharges inwardly must of necessity check its velocity, consequently its power is lost. For low falls where the wheel is enlarged to a proportionate diameter, and sufficient space is given to the "natural vent" of the water, those kind of wheels may be applied. But in high falls where the pressure is so great, the velocity must be correspondingly great; therefore, those wheels of the Fourneyron type, or outward flow, are far the best. The quantity of water for a turbine of this principle is important to decide, as many have been condemned and thrown out as useless when the fault has not been the turbine at all, but not enough water to work it. Moreover, a full weir and taper pipes leading to wheel, or so many pipes a certain size, and so many larger till it is deemed sufficient to maintain a full supply of water when the turbine is in motion. The size of pipe required for a turbine of this description would be:

Q = quantity of water in cube feet;
P = horse-power;
H = head of water in feet;
Sectional area of supply pipe = 0·42;

$$Q = 12{\cdot}67\,\frac{P}{H} \times 0{\cdot}4$$

A. REYNOLDS.

Truro, February 28th.

HILL CLIMBING TRICYCLES.

SIR,—I was much gratified to notice in your issue of the 22nd that one of your correspondents, who is evidently a writer of no ordinary ability, was pleased to confirm my own conviction, that direct action is undoubtedly the best, both for bicycles and tricycles, and I think, Sir, that this must be patent to all your readers who have any knowledge of mechanics. I was somewhat amused, therefore, by the dictatorial tone of a letter in opposition to the above, which appeared in your last issue. Your learned correspondent of that date favours rather a semi-direct action with stirrups, but thinks there are many others, with the enormous friction of chains and cogs, that are better hill climbers. He is also good enough to inform us that simplicity is not everything. Perhaps, Sir, in your next he will try and convince your readers that a complicated arrangement, with plenty of friction, is everything that can be desired. Now, Sir, as a rider of somewhat wide experience, I am thoroughly convinced, not only in theory, but by practice too, that it is impossible to improve upon the action of a bicycle, which one gets, with all its advantages, in the National Royal Direct Action Tricycle. I have ridden this machine myself for about two years, and can assure you that no other form of tricycle will bear any comparison with it as a hill climber, and that there is no kind of machine over which the rider gets more complete control. This being my favourite steed, after well testing all the best makes, I could not see it abused without taking the liberty of troubling you with a word in its favour. And in conclusion, allow me to remind your correspondent that abuse proves nothing, and is not likely, I think, to meet with a ready acceptance by the readers of such a high-class paper as THE ENGINEER. CYCLIST.

Frindsbury, Rochester, Kent, March 4th.

SIR,—I should be glad if you would allow me space for a few remarks on the extraordinary letter from "H. A." which appeared in last week's ENGINEER. This gentleman seems to be much exercised in his mind at the article which occasioned his communication, but surely it would have been of much greater advantage to your readers if, instead of expending his invective against the National machine, he had favoured them with a few words explaining what in his opinion its defects really are.

Now, Sir, as a practical tricyclist, I beg to differ altogether from "H. A." I do not wish to run down the "Monarch," but to my mind it is decidedly inferior to the "National," for though it is certainly not so complicated as many machines, its treadles are very awkwardly arranged in case the rider has to jump suddenly out, or is pitched out, while the seat is far too low for proper comfort. Of course, extreme lightness does not necessarily mean ease in propulsion; but the dynamometer trial which you quoted sets this matter at rest in the case of the "National," as I am not aware that any other machine can be drawn along with so little as 4 lb. with the rider seated. In conclusion, I would just like to say that I think tricyclists should as a body be greatly indebted to you for calling their attention to a really good machine—one capable of steady, every-day work, and capable of not only travelling at a good pace along fairly level roads, but of ascending any ordinary hill that one is likely to meet in a day's journey. M. I. J.

London, March 5th.

SIR,—I read with much pleasure your article on "Climbing Tricycles" which appeared on the 22nd February, and seemed to me to deal very ably with the description of the "National" tricycle. I fail to see why your correspondent, "H. A.," writing in your issue of the 29th ult., dealt in such a slashing style with it, and I think, in the interests of the tricycle-riding public, he ought to mention why "the laurels should be given to the 'Monarch' instead of the 'National.'" I have had the curiosity to inspect the

latter machine, and I must say in my opinion—as an old bicycle and tricycle rider—it seemed to be a simple and light one, well adapted for hill work, and as such will surely come to the front, in spite of your correspondent's sneer at simplicity. Simplex.

March 5th.

CLOTHING STEAM PIPES.

Sir,—Referring to the article on "Non-conducting Coatings for Steam Pipes," we beg that you will give publicity in your next issue to the following:—(1) The statement regarding our non-conducting incombustible composition is incorrect. (2) Mr. Clark, testing engineer, never got any composition from us. (3) We have, since the article appeared, requested Mr. Clark to inform us where he obtained the composition, which is said to be ours, and he has referred us to the secretary of the National Smoke Abatement Institution. (4) We have applied through our agents to the said secretary, but have not been able to get a reply.

114, Hydepark-street, Glasgow, Reid, McFarlane, and Co.
February 28th.

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

(*From our own Correspondent.*)

On 'Change in Birmingham this—Thursday—afternoon, and in Wolverhampton yesterday, the reports of last week concerning an improvement in the export orders for finished iron were confirmed. Manufacturers, especially of sheets, announced an increased number of enquiries from merchants, but not all at satisfactory prices. Indeed not a few orders were refused this afternoon, makers preferring to let them pass on to other districts, than to accept prices which mean a loss.

Makers were the less prepared to indiscriminately take all contracts, consequent upon the proposals which are now again being made to reduce the output of sheets, and to which reference is made farther on. The effect of the proposition to-day was to slightly stiffen prices. Still singles were to be had at £7 10s. upwards, doubles at £8, and lattens at £9. Rather than work at a loss, makers are allowing some mills to stand. Instances were cited to-day in which sheet mills had been idle for three weeks.

Prices of superior—thin—sheets for working up and stamping purposes were strong upon the basis of £10 to £11 for the former, and £13 for the latter. These manufacturers are full of orders, and inquiries are still reaching them. The home demand is very fair, and the export demand is good on account of Canada, the United States, Australia, New Zealand, India, Russia, Italy, Spain, Germany, and other markets. The Baltic and Canadian ports being now open is favourable to the condition of these makers. The East Worcestershire tin-plate makers reported themselves active.

Merchant sections of iron such as bars, hoops, strips, nail rods, and the like, were in demand to-day for the satisfaction of early necessities, but there were not many large orders for forward delivery. Such as they were, hoops had the advantage over the other descriptions named. The mills which are producing merchant classes of iron are irregularly employed, four days a week being the full average.

The Earl of Dudley's bars were quoted at £8 2s. 6d. nominal, and other best bars at £7 10s. to £7. Second quality bars were £6 15s. to £6 10s., and common £6 5s. to £6. Hoops were £6 10s. to £6 15s., and "list" qualities £8 per ton nominal. Strip iron was £6 2s. 6d. to £6 5s. for gas tube sorts, and £6 10s. to £6 15s. for other purposes requiring a better quality.

The wire-gauge question in the sheet and hoop trade was much discussed, and the decision come to last week was generally approved. Yet some makers, notably in the thin sheet branch, were unprepared to admit that the gauge which has been determined upon is the best that could be adopted. These people characterised the new gauge as unscientific, but their views were those of only a minority. The new gauge will not make much alteration in the method of works previously adopted in the sheet and hoop trades. The gauges before worked to were about 1 lb. to the foot upon 24 w.g. sheets—doubles—whereas the new "B.G." standard is about ·98 lb. to the foot.

A large meeting of manufacturers was held in Birmingham on Thursday afternoon, to hear an address on Railway Rates, by Mr. W. Hunter, London. The author announced that Mr. Chamberlain had promised to bring in a Bill giving permanent appointment to the Railway Commission, a *locus standi* before it to trade associations, and powers to allot damages and grant injunctions in preferential cases. It was resolved not to cease agitation until the Bill was passed.

Mail advices from Melbourne show that when the mail left galvanised iron was in better demand, but only one or two parcels had changed hands, prices varying from £20 to £21, according to brand.

Bar and rod iron was moving quietly at £9. Sheet iron had been sold at from £10 10s. to £11 10s. for Nos. 8 to 18, while hoop iron had been quitted at up to £10 10s.

Fair sales were taking place in fencing wire, at from £11 10s. to £12 10s., according to brand and number.

The demand for pig iron is restricted, but in two or three weeks' time vendors anticipate making some good forward quarterly sales. Representatives of makers in outside districts reported this afternoon that principals grumble at the prices at which present sales are being made, and absolutely refuse to allow any further concessions. Northampton pigs are quoted 44s.; Derbyshires, 45s. to 46s.; and Lincolnshires, 47s. Native all-mines are 80s. for cold blast, and 60s. for hot blast. Part-mines are 47s. 6d. to 45s., and cinder pigs 42s. 6d. to 37s. 6d., made in the Dudley district.

Much interest is expressed in the returns of the make of pig iron in the past year, and in the computation touching the stocks of pigs in hand in this part of the kingdom. Bearing in mind how large has now become the consumption at the mills and forges of the crude iron of the adjoining fields, it is deemed no cause for surprise that the make in South Staffordshire and in Shropshire has fallen off, in the former district 4443 tons, and in the latter 9475 tons, leaving the make in South Staffordshire at 394,000 tons, and that in Shropshire at 71,000 tons. The great reduction of 31,760 tons in the outturn of the furnaces of North Staffordshire is in most part explained by the late prolonged and unsuccessful strike of miners in that district, which has an almost illimitable supply of stone, and whose outturn of 285,357 tons upon the year is much within its easy capability. Of the 200,996 tons smelted in Northamptonshire, a conspicuous proportion has been used up in South Staffordshire. The increase of 8881 tons in the Northamptonshire make is no more than had been expected.

At the same time that Northamptonshire and Derbyshire iron has been coming into South Staffordshire and Shropshire, to take the place of the declining supplies of the native stone, the rich hematites have too been delivered in quantities which have told upon the consumption of the famous all-mine pigs from which the well-known "marked" bars of Staffordshire were once exclusively manufactured. There is consequently no room for surprise that present stocks of pigs in South Staffordshire should be 55,660 tons, or an increase of 16,798 tons. But for the importation for forge and mill purposes of coal from other districts during the miners' strike, which stopped blast furnaces, the consumption of pigs in the year in North Staffordshire would have been so diminished as to make the stocks there more than 52,495 tons, or an increase on the twelvemonth of 4972 tons. The Shropshire stocks have grown by only 500 tons, and are now a total of 22,000 tons; but the Northamptonshire stocks have become heavier by 13,172 tons, yet leave the existing accumulation at 31,892 tons.

Manufacturing coal is very abundant, and cheaper than ever. Steam coal is priced this week at 4s. 6d. to 5s. per ton; Cannock Chase common forge coal, 5s. to 5s. 6d.; and mill coal, 6s. to 7s. Staffordshire forge coal is 6s. to 6s. 6d.; mill, 7s. to 7s. 6d.; and furnace, 9s. 6d. to 10s. The colliers are only working an average of from three to four days a week.

Much satisfaction has been occasioned in Shropshire by the fact that the Coalbrookdale Iron Company have seen their way to withdraw for the present the notice which I last week stated had been served upon the operatives at their Horsehay Ironworks to close the establishment. Some 3000 people are, directly or indirectly, largely dependent upon the Horsehay Works for their existence; and so glad were the tradespeople around Dawley and Horsehay at the withdrawal of the notice, that they set the church bells ringing. The threat to close the works arose from no misunderstanding between employers and employed, but was in consequence of the extreme difficulties of receiving minerals and sending manufactured iron by rail on such terms as would pay the shareholders and justify the directors in carrying on the works; and unless more favourable rates are conceded, it is extremely doubtful whether the works will not be closed ultimately. What I have said of railways in this action refers chiefly to the Great Western Railway Company, who appear to have an exclusive right of transit.

Complaints are still heard from the hardware manufacturers, as well as the ironmasters, concerning the excessive railway rates. Only this week a case is mentioned in which a department of trade in the ironfounding line has been lost to Wolverhampton consequent upon the carriers having persevered in imposing such exorbitant charges that Scotch competitors have taken the business. Now that the mischief is done, the carriers have lowered the rates; but to the prayers that were made to them at a time when there would have been a chance of preventing trade from going into other channels they were deaf.

Activity continues at certain of the constructive engineering works. At some establishments where shipping contracts are in hand, the makers are, I know, rather behind with their work, and customers are now pressing for delivery. The result is that an increased number of operatives has been set on in some of the yards. Manufacturers note with interest that the contracts just now upon the public market include a wrought iron lattice girder bridge in four spans of 50ft. each, to be erected across the river Moy at Cloonacannana, in the county of Mayo; a small bridge of 60ft. span to cross the river Idle at West Stockwith; and a supply of wrought iron girders for bridge work needs by the Southern Mahratta Railway Company, Limited. Further, a telescopic gasholder, 170ft. diameter, is needed by the Corporation of Leicester at their Arlestone-road Works.

I am informed by some of the largest constructive engineers hereabouts, that civil engineers are now, much more than heretofore, insisting upon the literal carrying out of their specifications. This circumstance has both its satisfactory and its unsatisfactory side. While it will assist in clearing the trade of unworthy competitors, it necessarily makes present low prices even still less satisfactory, consequent upon the extra care which is needed in the execution of the contracts alike in the actual workmanship and the supervision entailed.

Heavy iron pipe founders state that although there could be no more favourable time than the present for placing large contracts, viewed from the standpoint of cost, yet that our large corporations and public companies, who are the principal distributors of large pipe contracts, are not putting much new work upon the market. Manufacturers believe that the chief reason to be found for this lies in the present quietude of trade the kingdom through, which naturally deters public authorities from incurring heavy expense and increasing the rates. The Midland Railway Company is seeking a supply of cast iron pipes for a new culvert at Brigsworth, on the northern division of its system.

In the wrought iron tube trade business is quiet and the works have nothing like full employment. Prices, which till lately were maintained pretty well, are now becoming irregular and show a tendency towards ease.

Business with India in hardwares at date is below the average; but when the stocks of goods soon to be disposed of at the close of the Calcutta Exhibition have gone into consumption, it is anticipated that orders from that quarter will increase. The success which has attended numbers of our local manufacturers at that Exhibition is very gratifying. The demand for hardwares from Australia and New Zealand does not conspicuously improve, still in a few branches a fair business continues to be done on account of these markets. South America looks promising as to certain of her markets; but the Cape and South Africa generally is without any revival.

The Birmingham papers are affording local patentees the opportunity of narrating their experience of the working of the "machinery in the Patent-office." The balance of view leans in favour of the new machinery. One patent agent says that on the 22nd January he filed a complete specification, with drawings, relating to a "new or improved washing machine," and though the number of this application was 1876, he received official notice of the acceptance of the specification on the 23rd of February—a period of only one month after filing. Another inventor applied for provisional protection on the 12th February. His application was acknowledged by return of post. On the 26th February he received notice that the title of his invention must be amended. He returned it amended on the 28th. On March 4th he got notice that protection was completed. "Considering," he says, "that my application is numbered 3122, I do not think that a complaint of lack of promptitude is justified." Doubtless ill-advised, imperfect, and badly prepared specifications and drawings must inevitably lead to delays whoever may be the examiners.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business throughout the iron trade of this district continues dull and depressed, with practically nothing to look forward to in the immediate future to encourage any definite expectation of improvement. The tendency of requirements so far as the large iron-using branches of industry are concerned seems to be rather in the direction of contraction than of expansion; consumers see very little prospect of any large weight of work ahead of the orders they have now in hand, and they are naturally disinclined to buy at all heavily for the present, whilst there is a want of strength in the market, which is a further inducement to defer buying. Nominally quoted rates are without any material change so far as both the pig and finished iron of this district are concerned, as most of the local makers are still kept tolerably well employed with deliveries against old contracts, but in some cases more disposition is being shown to make some concession to secure orders, and generally there is an easier tone in the market.

There was only a very dull iron market at Manchester on Tuesday. Lancashire makers of pig iron reported very little new business coming forward, and the orders booked during the past week have been confined to a few small parcels of foundry quality to local consumers at prices based upon 44s. 6d., less 2½, delivered equal to Manchester, which remains the minimum figure that Lancashire makers are open to take. In district brands the business doing is also extremely small, with quoted prices averaging 44s. 4d. for forge and 44s. 10d. for foundry Lincolnshire, less 2½, delivered equal to Manchester.

The hematite trade continues extremely dull. Nominally quotations remain at about 56s. to 56s. 6d. for good foundry qualities delivered into this district, but there is practically little or nothing doing to actually test values.

In the manufactured iron trade the weight of new business coming forward is still exceedingly small, and works in some cases have had to go on short time. For good local and North Staffordshire bars quotations nominally remain at £6 per ton delivered equal to Manchester, but this is a figure which is now only being obtained in special cases and for small quantities. North country makers are competing in this district at as low as £5 12s. 6d. to £5 15s. per ton for bars, and local makers, when they have to seek orders, are compelled in the face of the low price of Middlesbrough bars to offer some concession to buyers. The competition is felt most keenly in the orders for shipment, as the Middlesbrough makers have a more favourable rate to Liverpool than to Manchester, and for shipping orders they are quoting extremely low figures. Cleveland plates are also being offered in this district at excessively low prices, which rule about the same as those quoted for North-country bars, but in these no very large business appears to be doing. For other descriptions of finished iron prices are also low, hoops averaging about £6 7s. 6d., and good ordinary qualities of sheets £7 10s. per ton delivered into this district.

I have previously referred to the general feeling of dissatisfaction amongst the hoop and sheet iron makers in this district with regard to the new standard wire gauge, in the framing of which they consider that the interests and requirements of their branch of industry have been practically ignored. The new standard gauge came into force last week, but from what I can learn there is a general disposition not to work under the new gauge but to adhere to the old so-called Birmingham wire gauge.

In the engineering trades leading firms in this district who have special facilities are, with a good deal of keen competition at low prices, able to keep themselves fairly supplied with work, but generally the prospects of trade can scarcely be said to be very cheering, and as a rule the orders in hand are running out more rapidly than they are being replaced.

The question of the proposed Manchester Ship Canal is to be taken up at the quarterly meeting of the Manchester Association of Employers and Foremen to be held on Saturday, when the president, Mr. Thos. Ashbury, C.E., will move a resolution to the effect that it is essential in the growing interests of the increasing commerce and population of Lancashire that greater facilities be afforded and cheaper means adopted beyond those at present existing, for the transport and handling of merchandise, minerals, manufactured goods, &c., both for import and export to and from the commercial centres of Lancashire to the sea coast and places beyond, and that in the opinion of the meeting the proposed Manchester Ship Canal will afford the best means of giving effect to these objects.

The coal trade of this district continues in a depressed condition. All classes of round coal are still bad to sell, and prices have a downward tendency. The reduction in the Manchester list rates announced at the commencement of the month has been followed, where concessions had not already been made, by a giving way of about 6d. per ton in the pit prices for all descriptions of round coal in other districts. There is, however, so much stock being forced upon the market, notwithstanding that pits in most cases are only working from three to four days a week, that it is difficult to give any really fixed prices. About the average prices now being quoted at the pit mouth are 9s. to 9s. 6d. for best coals, 7s. 6d. for seconds, 6s. for common house coals, and 5s. 6d. to 6s. for steam and forge coals. In engine classes of fuel prices generally are being kept up to fully late rates, owing to the present very small production of slack; and of some special sorts there is a scarcity of supplies that is enabling sellers to get rather better prices. At the pit mouth burgy averages 4s. 6d. to 5s.; best slack, 4s. to 4s. 3d.; and ordinary qualities, 3s. to 3s. 6d. per ton.

Shipping is very quiet, and very low prices are being quoted to secure orders, Lancashire steam coal delivered at the high level, Liverpool, or the Garston Docks, being offered at 7s. 3d. to 7s. 6d. per ton.

The persistent downward movement in the price of coal, and the probability that during the ensuing summer business will only be possible on an extremely low basis of prices, is tending to bring forward the question of a reduction of wages. The matter has already been seriously talked of, and although no actually definite action has yet been decided upon, there is very little doubt but that some steps in that direction will be taken before very long.

The forging and finishing of marine crank shafts was the subject of a very interesting paper read by Mr. C. O'Connor, of Liverpool, before the Manchester Association of Employers and Foremen at their meeting on the 23rd ult., and in the course of the paper one or two points were raised which are worth noticing. Mr. O'Connor urged that eventually it would be found that more depended upon the mode upon which a crank shaft forging was constructed than upon the material of which it was made. Incidentally with regard to material he strongly condemned the use of scrap iron, which, owing to its want of uniform quality, often resulted in seams or black marks, which by many engineers were considered sufficient to condemn any finished shafting. He preferred to make such forgings of new iron puddled direct from the pig, and although some forge masters were of opinion that this freedom in using new iron resulted in a loss of strength, he was of opinion that by using cold blast iron they obtained crystals as fine and as small as in steel. For with large crank shafts the fear of unsoundness arising from the ordinary mode of forging had led some engineers to consider the propriety of building the cranks in separate pieces. One advantage in a built-up crank was that should there be a flaw it might be confined to one part only, whereas in a solid crank it might necessitate the condemnation of the whole shaft. His impression was that large shafts would still have to be dealt with in pieces, not because it was a question of being able to make large forgings sound, but because marine engineers would not care to run the risk of anything going wrong with large shafts, and ships having to wait until another could be finished. The building up of large shafts if they had capable tools presented no difficulty whatever, and in the mechanical engineering of the future they would have to rely upon their tools for putting large pieces together much better than had been done in the past. He would find no difficulty in dealing with crank shafts up to 100 tons, which he thought would have to be made within the next few years. Taking into consideration the vastly accelerated speed of the marine engine in late years, and the many disastrous effects which followed the breaking of a shaft at sea, also that the tendency of the age was still towards much higher pressures of steam and further lengthening of stroke, it was not surprising that improvements in such an important part as the crank should be eagerly sought after, but it had hitherto been sought in the direction of material alone. Cast steel had been advocated and to some extent brought into use, but its expense rendered such shafts costly out of all proportion to the other parts of the engine, whilst in the event of their heating when at work—a not unfrequent occurrence—and having the water hose directed on the crank pin or journals, it could not be expected that the material would behave any better than, or even so well as, tough wrought iron. So far as his experience was concerned, steel shafts had broken very suddenly without giving any previous warning, and others had exhibited some very slight cracks or marks, after which it was not thought safe to work them a day longer. An iron shaft, however, would show some flaw or mark before it broke: these flaws could be watched and could be traced from time to time, and thus sufficient warning was given to enable the necessary repairs to be put in hand. It was certainly far better that a forging should give notice rather than fail at once. As to the most frequent cause of the breaking of crank shafts, Mr. O'Connor did not consider that it was in all cases the fault of the material, whether it was steel or iron, or the manufacture. It was well known that marine crank shafts were exposed to very severe, uncertain, and unequal strains. If the shaft bearings were not properly true the bearings would work unequally, and there was a strain thrown upon the shaft which tended to shorten its life, and which rendered it only a question of time when it would give way. Again, cranks were very often permitted to run with slack bearings, and supposing an engine were making 120 strokes or knocks to the minute on a piece of iron, it destroyed the fibre, and thus also tended to shorten its life. Then the thrust of the shaft, if not properly attended to, brought a side action upon the after web, which tended to bend it backward and forward, and in the course of time there was a fracture either at the neck of the journal or through the web of the crank. In reply to several questions, Mr. O'Connor said that where cranks most frequently gave way was through some flaw in the pin or across the neck. With regard to hollow shafts, he considered that, whether they were made of steel or iron, they

had a much stronger shaft when they were made solid. In the course of the discussion on the paper, a general opinion was expressed that, however good iron cranks were made, the time would come when they would have to give way to those made of steel.

Barrow.—The hematite pig iron trade of North Lancashire is in a very quiet condition. The slight improvement which I reported a few weeks ago still continues. There appears to be a feeling amongst makers that the worst is past, and they now look hopefully forward for a revival in the course of a few months. I hear that the present sales fall far short of the production even now that the output has been so considerably reduced, and the consequence is that the weight of metal warehoused at makers is increasing and has become very heavy. The business doing on home account is considerably restricted, but I notice that on continental account greater activity is displayed. The contracts booked from American consumers are practically *nil*. Prices are slightly weaker. No. 1 Bessemer qualities are slowly changing hands at 49s. per ton net at works for prompt delivery; No. 2, at 48s.; and No. 3, 47s. per ton; and No. 3 forge is also selling at 47s. per ton net. Business in the steel trade is unsatisfactory, yet the manufacturers quote higher prices, as former quotations did not leave any margin for profit. Buyers are slow in coming forward, and offer lower prices than those now ruling for large concessions. The merchant department is fairly well employed, but the demand for rails is inconsiderable. Prices are unchanged for ordinary parcels of steel rails, quotations being from £4 10s. to £5 per ton net at works. The manufacture of tires and axles has been recommenced at Barrow, and it is expected a fair trade will be done, orders being well in hand at present. The shipbuilding trade is quiet, and I cannot hear of any new orders being booked. Iron ore is in limited request at from 9s. 6d. per ton and upwards. Heavy banks of ore are held at the mines. Coal and coke quiet, and prices for shipments slightly reduced. Shipping dull.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A STRIKE at the Thybergh Hall Colliery has caused some talk among trammers or "putters." The Thybergh Hall workmen of that class have asked for an advance of wages. The owners, Messrs. Charlesworth, declined to accede to the request on the ground that the rates they were paying for that class of work were rates they had found in existence when the owners purchased the colliery. Thereupon the men instituted inquiries at several neighbouring collieries with a view to ascertain the rates paid for similar work. A petition embodying the results was placed before the owners, who again declined to comply with the request, adding that they were paying considerably higher rates for coal-getting and tramming combined than were being paid at any other colliery in South Yorkshire. About ninety of the trammers have consequently struck work, leaving thirty or forty still engaged. A suggestion to refer the dispute to arbitration was rejected, and the men decided to adhere to their claim for 7d. per score. The miners have not given in their notice, but the action of the trammers will cause them great inconvenience.

The present quotations of house coal in Sheffield are:—Hand-picked Silkstone brands, 13s. 6d. per ton; best Silkstone "hards," 12s. 1d.; best Silkstone screened, 11s. 3d.; second Silkstone screened, 10s.; screened Silkstone nuts, 7s. 11d.

An interesting dispute was recently referred to arbitration. It concerned the winding of men against men at the Barrow Collieries, near Barnsley. This is a practice to which the Union officials object; and as the late arbitration has been decided against them, the Executive Committee of the Yorkshire Miners' Association passed a strongly-worded resolution, thus:—"That this Executive Committee strongly protests against the recent decision of the arbitrators in the Barrow winding men against men case, as we believe the decision is against the weight of evidence; and, further, we must record our strong protest at purely interested persons connected with mining dealing with such important questions, and ask the Home Secretary in all future cases to appoint some person or persons neither directly nor indirectly connected with mining to deal with them as arbitrators." It will be hard to find persons neither directly or indirectly connected with mining who have practical knowledge sufficient to deal with such subjects as winding men against men.

Messrs. Tasker, Sons, and Co., of Sheffield, have just completed the application of the telephone to a dynamite factory in Ayrshire, where the various widely-isolated magazines and nitro-glycerine sheds of Nobel's Explosives Company are buried amongst the sandhills near the sea beach. These have been grouped together by telephonic circuits on the Exchange principle, and placed in direct communication—by the Johnson-Bell combination telephone—with the manager's office.

Messrs. Bolckow, Vaughan, and Co., Limited, in their nineteenth annual report state that during the past year prices in every department of the company's operations have continued rapidly to fall, and especially so as regards rails and pig iron. Considering the deep depression and the complicated circumstances arising therefrom, the directors express pleasure at the results in the balance-sheet, where is shown a profit available for distribution of £229,596 16s. 7d. After paying, as interest on debentures, £22,471 7s. 4d., as dividend on preference shares £21,332 7s. 1d., and £137,313 dividend at the rate of 5 per cent. on ordinary shares, £40,554 3s. 5d. is proposed to be written off capital, the remaining balance of the profits, £7925 18s. 5d., being carried forward.

In addition to the Calcutta honours already noted, Messrs. Robert Sorby and Sons, of Carver-street, have obtained a first-class certificate and gold medal for saws, edge tools, steel, files, and horticultural tools. A second-class certificate and bronze medal have been awarded to Messrs. W. K. Peace and Co., Eagle Works, Mowbray-street, for files, steel, edge-tools, and hammers, and engineers' tools. Messrs. Turner, Naylor, and Marbles, Messrs. Easterbrook, Allcard, and Wild, Messrs. Taylor Brothers, and Messrs. Austin and Dodson have also secured honours.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market held at Middlesbrough on Tuesday last was well attended, and though the amount of business actually done was not large, the tone was fairly satisfactory, and prices were somewhat firmer than they have been during the last two or three weeks. Sixteen of the eighteen condemned blast furnaces have now been blown out, and the other two will be out of blast by the end of the month. The monthly output will be reduced about 30,000 tons, and the consumption of ironstone by about 100,000 tons. On Tuesday the usual quotation for No. 3 g.m.b for March delivery was 37s. per ton, and that price was paid in all cases where business was done. Those makers who are well supplied with orders have raised their price to 38s. per ton. Forge iron is becoming scarce, as the production thereof has been more than proportionately reduced. The price is consequently firmer, and it can scarcely be bought from either makers or merchants for less than 35s. per ton.

The demand for warrants does not improve; the nominal price is 37s. per ton.

The stocks of Cleveland iron in Messrs. Connal and Co.'s Middlesbrough stores decreased only 35 tons during the week ending Monday last.

The shipments of pig iron from the Tees last month were above the average, amounting as they did to 69,860 tons. The principal items were as follows: Scotland, 25,176 tons; France, 9225 tons; Spain, 6189 tons; Germany, 6009 tons; and Holland, 6045 tons. Of manufactured iron and steel 24,414 tons were exported.

There is no improvement in the finished iron trade, most of the mills working very irregularly. Prices remain about the same. In large quantities ship plates are offered at £5 2s. 6d. per ton, angles £4 15s., and common bars £5, all cash 10th, less 2½ per cent. discount, on trucks at makers' works. For small lots 2s. 6d. per ton more is asked. Steel rails are quoted at £4 12s. 6d. per ton at works.

The employers connected with the North of England Iron Manufacturers' Association have given notice that they will claim a reduction of 1s. per ton on puddling and 10 per cent. on all other forge and mill wages, to take effect from the 29th of March. A meeting of the Board of Arbitration will be held shortly to consider the matter.

The platers' helpers are still out on strike at Stockton, and at a meeting held on Monday, unanimously decided not to submit to a reduction of more than 1s. per week. The platers demanded 2s. 9d. per week reduction at first, but it is said they would now be satisfied with 1s. 6d.

The shipbuilding industry is exceedingly depressed both on the Tyne and the Wear. An arrangement has just been come to whereby the wages of platers will be reduced 10 per cent., and of rivetters 7½ per cent. Joiners' wages have also been reduced, and will now become uniformly 33s. per week.

Messrs. J. L. Thompson and Sons, of Sunderland, discharged about eighty of their joiners last week, owing to scarcity of work.

Messrs. Raylton Dixon and Co.'s joiners, numbering about 150, are out on strike against a reduction of 3s. per week. They have offered to resume work at 2s. per week reduction, and it is thought the firm will agree to this compromise.

Messrs. Bolckow, Vaughan, and Co.'s West Auckland, Whitelee, and Woodfield Collieries were laid in on Saturday last, and will remain idle for an indefinite period. Some 1500 to 2000 men and boys are thus thrown out of work.

Messrs. Bolckow, Vaughan, and Co.'s annual report and balance-sheet was issued last week. It appears that the nominal capital of the company is £4,000,000, and the assets are valued at £4,363,585. The profit on last year's working was £229,596, which will be disposed of as follows:—Interest on debentures, £22,471; dividend on preference shares, £21,332; dividend on fully paid-up shares, £81,486; dividend on shares with £12 paid, £55,827; written off capital account, £40,554; and balance carried forward, £7926.

A meeting of the Cleveland Institution of Engineers was held at Middlesbrough on Monday last. There was a discussion on Mr. W. F. Hall's paper read at the previous meeting on the "Haswell Mechanical Coal-getter," after which the secretary read a paper by Mr. D. Adamson, of Manchester, on "The Wheelock Direct-acting Steam Engine." Unfortunately Mr. Adamson was unable himself to be present, owing to indisposition. Nevertheless the paper excited great interest, and an animated discussion ensued. Mr. Charles Wood afterwards exhibited and described a vertical steel gun, mounted on wheels, for effecting explosions of gunpowder inside Cowper's stoves, with the object of freeing the flues from dust. The novelty in Mr. Wood's gun consists in the mode of discharging it, after its introduction within the stove. One end of a long india-rubber tube is connected with the breech and nipple of the gun; the other end terminates in an elastic ball which can be squeezed by the operator. The pressure of air so created acts at the inner end on a small metallic-headed wooden piston, driving it against the nipple aforesaid, and discharging a percussion cap previously placed upon it. The gun was fired off several times in the room without difficulty.

The Chamber of Commerce, and of Shipping, at the sea ports on the north-east coast, are everywhere passing resolutions in favour of Mr. C. M. Palmer's motion to refer the new shipping Bill to a Select instead of to a Grand Committee.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

IN the Glasgow warrant market there has been comparatively little doing in the course of the week, the excitement occasioned by the controversy as to the quality of certain g.m.b. iron having now almost died away. The fluctuations in prices have been comparatively small, but the figures are steadily maintained at 42s. and upwards. There are ninety-seven furnaces in blast, as compared with 112 at the same date last year, and the curtailment of output is already telling upon stocks, which show a decrease on the week of from 200 to 300 tons. The week's shipments of pigs were 7974 tons, as compared with 10,217 in the preceding week, and 10,217 in the corresponding week of 1883.

Business was done in the warrant market on Friday at 42s. 4d. cash, the price declining on Monday to 42s. 1d. On Tuesday forenoon business was done at 42s. 1d. to 42s. 1½d. cash and 42s. 3½d. one month, there being no change in the quotations in the afternoon. Business was done on Wednesday at 42s. 1½d. to 42s. 4½d. cash. To-day—Thursday—transactions took place at 42s. 3d. to 42s. 6d. cash, and 42s. 7d. one month.

The market values of makers' iron are as follow:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 53s.; No. 3, 51s.; Coltness, 57s. 6d. and 51s.; Langloan, 54s. 6d. and 51s.; Summerlee, 52s. 6d. and 48s. 6d.; Calder, 53s. 6d. and 48s.; Carnbroe, 52s. 6d. and 48s. 6d.; Clyde, 48s. and 45s. 6d.; Monkland, 44s. and 41s. 6d.; Quarter, 43s. 6d. and 41s.; Govan, at Broomielaw, 44s. and 41s. 6d.; Shotts, at Leith, 53s. 6d. and 52s.; Carron, at Grangemouth, 48s. 6d.—specially selected, 54s.—and 47s. 6d.; Kinneil, at Bo'ness, 46s. and 45s. 6d.; Glengarnock, at Ardrossan, 52s. 6d. and 46s. 6d.; Eglinton, 46s. 6d. and 43s.; Dalmellington, 48s. 6d. and 45s. 6d.

There have been considerable imports of iron ore in the Clyde during the week, both from Bilbao and Cumberland. For hematite the inquiry is steady, but comparatively limited, the prices being 47s. per ton for Nos. 1, 2, and 3.

Imports of Cleveland pig iron keep well up, and they now amount in the aggregate to 44,825 tons, or 7418 tons more than at the same date last year.

The malleable iron department of the trade, instead of manifesting any improvement, is becoming decidedly quieter, and all accounts agree in the anticipation of duller times than have been experienced for several years. The past week's shipments of iron goods from the Clyde embrace £40,700 worth of machinery, £6620 steel manufactures, £37,000 iron goods, and sewing machines to the value of £6500.

There has been a rather better demand for coals for domestic consumption, due, of course, to the wintry weather. The inquiry for coals for shipment is quiet, but there is still a fair business doing in this department. The shipments from Glasgow have included 1500 tons for Constantinople, 1300 for Lisbon, 1442 for Bordeaux, 1460 for Odessa, 1230 for Savannah, and smaller cargoes for other places. There were 6266 tons of coals shipped at Ayr, 5737 at Troon, and 1581 tons at Grangemouth. The prices at all points are flat at present.

The miners of the hematite district held a mass meeting a few days ago to consider the reductions of wages just made. A long discussion took place as to the course to be pursued. All were agreed that there was little chance of a strike producing any good result. It was agreed, however, to restrict the output, so that wages should not exceed 3s. a day. This resolution, it may be pointed out, was really not wanted, as at some of the pits it has for a considerable time been almost impossible for the miners to obtain full time.

The colliers of Fife and Clackmannan held a meeting on Monday, when their agent, Mr. Weir, made a serious accusation against the employers. They had, he said, introduced two reductions of wages in as many weeks, dismissed a number of men simply because they were trying to vindicate their rights, had forced on the men the Billy Fair-play system of weighing, which was most unjust and contrary to the spirit of the Mines' Regulation Act, and had taken means of preventing miners leaving Fife and Clackmannan obtaining employment elsewhere. This he considered highly tyrannical. Resolutions were passed condemning the action of the masters as above described.

In the course of the past month twenty vessels, with an aggregate tonnage of 29,537, were launched from Clyde shipbuilding yards, as compared with twenty-three vessels of 33,650 tons in the same month last year.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

ABANDONMENT of promising Bills is becoming a feature. I hope to see it followed by the abandonment of unpromising Bills, such as the Barry. Rumour has it that should this Bill become law the traffic rate to Barry from the Rhondda will be so much more than that of the Taff Vale to Cardiff, that none but the promoters, who would get a threefold profit, would figure as freighters. Those coalowners who will, in addition to their collieries, own rail and docks, will of course find it pay as regard themselves. As to the profitable character of the undertaking, I am like the Scotsman—"I have my doubts."

The other Bill that will probably be abandoned will be the Bute Docks Water Supply Bill. It is stated that now the Marquis of Bute has acquired the Glamorgan Canal, there is less need for getting a supply from the river Rumney. While on the subject of Bills, I may add that opposition to the Government Shipping Bill is very great at Newport and Cardiff. The leading shipowners denounce many of Mr. Chamberlain's statements as unfounded, particularly those having reference to Cardiff vessels. I must confess, however, to having heard of one or two shady cases, and it would have been remarkable in the great rush for steamers, and zeal for profit, that some should not have occurred. No one doubts the leading shipowners, but there is a strong impression outside the shipping interest that inspection and insurance should be more rigid.

An excellent step has been taken by the South Wales University College. It has been decided to appoint a Professor of Engineering. This has been done at the suggestion of the South Wales Institute of Engineers.

There is little or no change in the staple trade. A few good iron orders are floating about, but they do not appear to settle down in Wales. I hear of a substantial rail order going to Cammel's, which will take four years to execute. Tredegar has had 4000 tons of fish-plates for the same order. Most of our orders are running out, say the managers, and the best of them will only last a few months, by which time, I hope, spring booking will have made up for winter depression. The slackness of the iron trade has had a depressing effect all around; the only places where a good deal of vitality is shown is at Cyfarthfa and at Troedyrhiw Crucible Steel Works. Both places are being pushed on with vigour. I expect that Cyfarthfa will be ready some time in April, but before that time will endeavour to give my readers some notion of the elaborate arrangements and great outlay incurred. A gentleman, formerly manager of one of the old-fashioned ironworks in Wales, visited the place this week, and expressed his wonder at the colossal structures and entire novelty of arrangements. "It is all new," said he; "I saw none of the old tools with which we used to get our iron. They were all new. It was like a mason finding Egyptian implements instead of his old chisel and mallet."

There is nothing encouraging about the tin-plate trade. Makers are fairly well off with orders, but buyers are doing their best to pull down prices.

In coal equal briskness continues at Cardiff, from which 156,000 tons were exported last week. At Newport steam is not quite so firm, and house coal is unsteady in price. The Swansea coal trade is good, though second descriptions are weaker in the market. There is some likelihood of one or two of the tin-plate works in this quarter being restarted. In the Rhondda Valley the coal development continues as lively as ever. This week the Mountain Ash colliers joined the Rhondda Union, and now form a compact body, but, I am glad to see, animated with the best of feelings towards their employers.

The movement to obtain life-preserving stations is gathering ground; and now that the South Wales Association propose to take it up, the project will very likely be carried.

I am glad to note that Mr. W. T. Lewis has been appointed High Sheriff of Breconshire.

VIENNA CITY RAILWAYS.—Mr. J. Fogerty, the *concessionnaire* of the Vienna City Railways, writing with reference to a recent statement of our Vienna correspondent, observes:—"When the concession was applied for in the year 1882, the railway committee of the corporation suggested that a portion of the proposed system on the Franz Josef Quay should be constructed as a 'double railway' with four lines of rails, on account of the great traffic to be expected on that section, connecting several of the existing main lines of the country with the proposed central station near the Bourse, and this suggestion was adopted by the Government, although objected to by the promoters on the gronnd of extra expense. Now that the working plans of this section of the railway, with four lines of rails, along the bank of the Danube Canal have been approved by the authorities, and the official order to commence the works is about to be issued, the Vienna Corporation suddenly reconsider the question, and withdraw their previous suggestion by asking that only two lines of rails, as originally proposed by me, shall be constructed. The decision rests with the Government, who merely receive the opinions or suggestions of the municipal authorities, and, as communicated recently to me, it is 'that for the present two lines will suffice if so laid that the additional width of structure for a double railway with four lines of rails can be added at a future date when requisite for the traffic,' which, it is certainly expected, will require the extra accommodation at this point at no distant date. Had the Vienna Corporation decided at an earlier date to agree to the inevitable, or understood as clearly as the railway officials of the Government did from the outset that no 'underground' or 'tunnel' system of railways was practicable in Vienna, the works of the proposed elevated railway would in all probability be now in active progress. As it is, from want of knowledge, or from the obstinacy peculiar to corporations, they have merely hindered for a period of two years the execution of a great public work of admitted necessity."—*Times.*

TRACTION ENGINES IN AUSTRALIA.—Traction engines are, it seems, almost unknown in Victoria, and the advent of one creates almost as great a sensation as the locomotive did in years gone by. We find in the Melbourne *Argus*, of the 20th December, 1883, the following passage:—"A fine traction engine, made by Messrs. M'Laren, of Leeds, was exhibited at the National Agricultural Society's show-ground yesterday. The engine was shown drawing three trucks laden with 30 tons wire, firewood, and implements. This great weight it drew up hill on the grass as easily as a dray horse would draw a moderate load. When separated from the trucks the engine went along on the turf at over six miles an hour. It steered very easily, and was taken round to the water tap with as little difficulty as would be experienced in driving a pair of horses. The engine is 8-horse power, guaranteed to work up to 35-horse power. When in full work the pressure in the boiler is 120 lb. to the square inch. It can be used for ploughing, for sawing and hauling timber, for pumping water, for thrashing grain, and for the many uses to which a traction engine can be put. Though so powerful, it has a very light appearance, the weight of the engine being 8 tons. All the castings are of crucible steel, so as to combine lightness with strength. It is fitted with a spring drawing hook by which violent jerks at starting are avoided. The engine was started from Spencer-street Station yesterday morning drawing the three loaded trucks, and reached the Agricultural Society's ground in about two hours' time. On the way some deep newly-laid metal was met with, but it was easily surmounted. Traction engines are much used in New Zealand, but as yet they have not come into favour in Victoria, notwithstanding the many useful purposes to which they can be put. Such an engine and plant as that exhibited yesterday can be purchased in bond at £1000. The importers are Messrs. Gibbs, Bright, and Co."

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.

26th February, 1884.

3911. Bottle Soaking and Washing Machines, T. Hill, Kingston-upon-Hull.
3912. Feed Mechanism for Circular Knitting Machines, H. Clarke, Leicester.
3913. Double Syphon for Flushing Water-closets, W. Devoll, Erdington.
3914. Marking Lawn Tennis Courts, W. Hampson, Rock Ferry, Cheshire.
3915. Compound Engines, H. Guy, West Cowes.
3916. Lubricators, W. P. Thompson.—(*S. Reid and J. C. Thayer, Chicago, U.S.*)
3917. Lubricators, W. P. Thompson.—(*S. Reid, Chicago, U.S.*)
3918. Lubricators, W. P. Thompson.—(*J. C. Thayer, Chicago, U.S.*)
3919. Pressure Gauges, J. Burden, Birmingham.
3920. Potato Planters, J. Mellor, Cheadle-Hulme.
3921. Basic Linings for Open-hearth Furnaces, W. F. Batho, London.
3922. Flap Brackets, R. Stone, Wellington.
3923. Stoves, A. Acaster, Rotherham.
3924. Watches, D. Edwards, Coventry.
3925. Indicating Plates for Public Gas Lamps, C. A. Doran, London.
3926. Turning Balusters, &c., J. and J. Leeming, Halifax.
3927. Holdfasts for Carpenters, &c., W. Hayhurst, Burnley.
3928. Tennis Bats, H. W. Brewtnall, Thelwall.
3929. Cutting off the Ends of Eggs, G. Woodhall, Birmingham.
3930. Self-acting Escape Valve, F. Barklam, Wellingborough.
3931. Damping and Oiling Thread or Yarn, S. J. A. Laing, Hawick.
3932. Pulleys and Drums, J. Shepherd, Manchester.
3933. Propeller for Vessels, &c., H. H. Werninck, Plymouth.
3934. Cutting Drain Trenches, J. Forster, St. Helen's.
3935. Cigarette Machines, H. J. Allison.—(*J. Burns, Brooklyn, A. Buckman, F. P. Harder, J. R. Downer, A. L. Schermerhorn, and J. S. Baker, New York.*)
3936. Combs, W. Crabb, Newark, U.S.
3937. Sole and Heel, H. Cooper, Bristol.
3938. Curling Silk, &c., H. Polak and H. Lowe, Hyde.
3939. Producing Gas, L. D. York, Portsmouth.
3940. Smoking Pipes, &c., J. E. Walsh.—(*A. Burkard and P. Galmart, Belgium.*)
3941. Bracelets, J. Cook, Birmingham.
3942. Neckties, W. D. Ross, Aberdeen.
3943. Reaping Machines, J. Gibson, Clackmannan.
3944. Hollow Rims for the Wheels of Velocipedes, &c., A. B. Woakes, London.
3945. Ventilating Rooms, &c., E. Robinson, Dukinfield.
3946. Mounting Bearings, P. Subit, London.
3947. Chimneyless Lamps, E. de Pass.—(*R. Lasky, Paris.*)
3948. Body Belts, J. H. Brierley, London.
3949. Children's Cots, R. Beldam, London.
3950. Medicinal Preparation, H. Withers, London.
3951. Trombones, C. A. Goodison, London.
3952. Discharging Fire-arms by Electricity, J. Andrews, London.
3953. Boots and Shoes, C. Bathias, Chalons, France.
3954. Yarns, W. C. Whitehead, Leicester, and L. J. Crossley, Halifax.
3955. Potato Diggers, J. S. Warburton, Preston.
3956. Fire-escapes, J. Friborg, London.
3957. Wood Screws, A. J. Boult.—(*G. A. Stiles, U.S.*)
3958. Causing Striking Clocks to Repeat, A. J. Boult.—(*J. Blot, Bourmont, France.*)
3959. Felted Fabrics, A. J. Boult..—(*L. W. Whipple, New York.*)
3960. Equalising Valves, A. J. Boult.—(*I B. Davis, Hartford, U.S.*)
3961. Folding Velocipedes, J. T. Hircock, Birmingham.
3962. Producing the Circulation of Water in Steam Boilers, A. W. L. Reddie.—(*W. Craig, U.S.*)
3963. Locomotives, S. Fox.—(*A. Mitchell, U.S.*)
3964. Glucose, L. Barbier, Paris.
3965. Cutting Metal Sheets, J. Tuin, Bristol.
3966. Cartridges, H. J. Haddan.—(*O. F. Seibold and E. G. Selchow, U.S.*)
3967. Miners' Safety Lamps, H. J. Haddan.—(*V. Fumal, France.*)
3968. Distilling Ammoniacal Fluids, G. W. v. Nawrocki.—(*Dr. P. Seidler, Elberfeld, Prussia.*)
3969. Section Blocks, J. C. Sewell, E. Hulton, and J. Bethel, Pendleton.
3970. Electric Light Arc Lamp, H. F. Joel, London.
3971. Water-closets, E. Pearson, London.
3972. Chimney-pots, G. A. Harvey, Lewisham.
3973. Collars for the Neck, A. Watson, London.
3974. Glove Fastenings, A. Watson, London.
3975. Steam Traps, P. Jensen.—(*Schmidt and Zorn, Berlin.*)
3976. Figured Lace, H. B. Payne, Nottingham.
3977. Siphon-bottle, W. R. Lake.—(*La Société J. Vidie et fils, France.*)
3978. Freezing Machines, H. A. Fleuss, New Town, Isle of Wight.
3979. Railway Joints, F. Lightfoot, Media, U.S.
3980. Circuit Closers for Telegraphic Keys, J. Neifing, Dyer, U.S.
3981. Sensitive Electric Fuses and Detonators, P. Ward, Greenwich.
3982. Combination Locks, A. M. Clark.—(*C. Tregoning and W. Hodge, United States.*)
3983. Shears, W. and W. R. Bradley, Grimesthorpe.
3984. Gas Burners, J. Lewis, Brockley.
3985. Pens, W. H. Dalton, jun.—(*S. H. Crocker, Melbourne, Australia.*)
3986. Gas Engines, J. H. Johnson.—(*E. Delamare-Debouteville and L. P. C. Malandin, France.*)
3987. Condensing Apparatus, W. T. Walker, London.

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3988. Chimney-tops, &c., T. Whitehead, Liverpool.
3989. Advertising, M. Ziegler, Liverpool.
3990. Tilting Apparatus, J. Grimes, Leicester.
3991. Propelling Ships, &c., I. W. Boulton, Ashton-under-Lyne.
3992. Windlass, J. Bremner, Hull.
3993. Sleeve Links, &c., T. Davison, Newcastle-upon-Tyne.
3994. Plough-cutting Gauges, &c., T. and W. Dixon, Walsall.
3995. Treating Textile Materials, &c., J. Sandeman, Glasgow.
3996. Artificial Manure, F. G. Redman, Peterborough, and J. Butt, Newark.
3997. Harness Hames, G. Craddock, London.
3998. Stoves, &c., C. J. Henderson, Edinburgh.
3999. Filaments for Incandescent Lamps, J. Swinburne, Brockley.
4000. Filaments for Incandescent Lamps, J. Swinburne, Brockley.
4001. Rack Pulleys for Window Blinds, E. S. Norcombe, Birmingham.
4002. Explosives, R. Hannan, Glasgow.
4003. Rendering Linen, &c., Impervious to Water and Heat, L. A. Brode, Glasgow.
4004. Bowl Caster, J. Barlow and F. Kirkman, Bolton.
4005. Pistons, A., J., and T. Oldham, and T. Perrin, Dukinfield.
4006. Preparing, &c., Fibrous Substances, T. Flitcroft, Middleton.
4007. Iron Fencings, &c., N. Hix, Devizes.
4008. Fire grates, J. M'I. Shaw, Glasgow.
4009. Combination Garment, H. B. Ashford, South Penge Park.
4010. Carding Engines, J. Elce, Manchester.
4011. Looms, J Sillavan and J. Belicard, Manchester.
4012. Steaming and Fixing Textile Goods, D. Whitaker, Newlay.
4013. Forging Machines, R. Busek and W. Fischer, Vienna.
4014. Oxyhydrogen or Lime-lighting, R. White, London.
4015. Securing, &c., Jacks Employed in Knitting Machines, F. F. Mellor, Nottingham.
4016. Pumping, &c., Apparatus, J. A. Wade and J. Cherry, Hornsea.
4017. Suspended Stomach Belt, L. A. White, Manchester.
4018. Silk Twisting and Throwing, E. Trafford, Leek.
4019. Stair-rod Fasteners, G. F. Thompson, Chester.
4020. Velocipedes, W. Scantlebury, Lower Clapton.
4021. Roofing Tiles, F. I. Nibbs, London.
4022. Drying Wool, J. A. Thackray, Pontefract.
4023. Safety Lamp, E. G. Rivers, Rosslyn.
4024. Button, R. Owen, London.
4025. Electrical Conductors, E. T. Truman, London.
4026. Slides of Steam and other Engines, W. Schmidt, Brunswick.
4027. Washing Machines, T. Fletcher, Warrington.
4028. Bichromate of Soda, W. J. Chrystal, Glasgow.
4029. Breech-loading Fire-arms, G. Jeffries, Norwich.
4030. Cee Springs for Carriages, J. Allen, London.
4031. Constructing, &c., Urinals, T. Waller, London.
4032. Galvanic Battery, H. Fairfax, London.
4033. Cocks and Valves, L. Dove, London.
4034. Securing Bolts in Railway, &c., Rails, H. J. Saunders, Tondu, near Bridgend.
4035. Globes, F. Wirth.—(*A. Brix, Germany.*)
4036. Embossed Fabrics, A. Whittall, Kidderminster.
4037. Opening, &c., Window Sashes, G. Holmes, sen., Derby.
4038. Separating Dust from Air, W. R. Lake.—(*McIntyre Manufacturing Company, New York.*)
4039. Bedsteads, L. Dutriez, London.
4040. Ventilating, J. Gilmore, Lower Norwood, and W. R. Clark, Peckham.
4041. Weighing Scales, W. R. Lake.—(*J. O'Grady, Newton, U.S.*)
4042. Enabling Electric Arc Lamps to be Used in Parallel Circuit with one another, J. E. H. Gordon, London.
4043. Lamp Chimneys, &c., W. F. Lotz.—(*Messrs. Berthold and Hirsch, Germany.*)
4044. Springs for the Saddles of Seats of Bicycles, &c., J. Harrington, Coventry.
4045. Cooking Ranges, C. Lawrence, Southampton.
4046. Umbrella Notches, &c., J. Sambrook, Birmingham.
4047. Smoke Extractors, C. Lawrence and E. J. Searle, Southampton.

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4048. Umbrellas and Parasols, J. B. Sell, Urmston.
4049. Steam Trap, F. W. Dick, Glasgow, and J. Fleming, Renfrew, N.B.
4050. Arc Lamp, J. A. Bowen, Lancashire.
4051. Frames for Constructing Concrete Foundations, W. Thompson, Stratford-upon-Avon.
4052. Grave Tablets, R. Priest, Birmingham.
4053. Attaching Door Handles to their Spindles, G. W. Davis, Birmingham.
4054. Sizing Machines, A. Hitchon, Accrington.
4055. Cleaners used in Machinery for Preparing, &c., Cotton, J. Heginbottom, Oldham.
4056. Stopping Apparatus for Twist Lace Machines, S. Tanzer, Long Eaton.
4057. Safety Apparatus for the Cages of Hoists, W. Kearsley, Dodworth.
4058. Compass Caps, H. S Piers, Liverpool.
4059. Air Pumps, J. C. Baker, Liverpool.
4060. Printing Telegraphs, W. P. Thompson.—(*H. van Hoevenbergh, Elizabeth, U.S.*)
4061. Match Boxes, E. Banton, Aston Manor.
4062. Wheel Guard for Vehicles, A. Hills, London.
4063. Gully Tank, &c., J. Phillips, London
4064. Railway Signalling, W. Hopkin, Pendleton.
4065. Preparing Nitro-aniline, &c., I. Levinstein, Manchester.
4066. Feeding Paper to Printing Machines, H. J. Salmon, J. Capper, and W. H. Duffett, Manchester.
4067. Showing Views in Panoramic Shape upon a Table, E. Roden, Wightwick, near Wolverhampton.
4068. Fish Ova Hatching Apparatus, J. Watkins, Headingley, Leeds.
4069. Feeding Steam Boilers, G. Weston, Sheffield.
4070. Governors for Dynamo Machines, &c., J. Swinburne, Brockley.
4071. Velocipedes, A. W. Hirst, West Croydon.
4072. Whisk or Mixing Machine, R. Morton, Wishaw.
4073. Boots, &c., G., W. H., and T. T. Lindrea and G. Lane, Bristol.
4047. Railway Buffers, R. Hill and J. Darling, Glasgow.
4075. Gas Producers, J. McFarlane, Motherwell.
4076. Flushing Water-closets, W. Dawes, Leeds.
4077. Teaching Elementary Arithmetic, F. Bosshardt.—(*R. Arnault, père, Morthemer, France.*)
4078. Bars, Sheets, &c., G. V. Frankish and J. T. Brufton, Sheffield.
4079. Gas Exhausters, &c., T. Nicholson, Chester.
4080. Securing Corn, &c., J. Briggs, Bradford.
4081. Case for Holding Stationery, E. Wilson, Derby.
4082. Slide Valves, J. H. Proctor, Bolton.
4083. Stopping Steam Engines, J. Parker, Farnworth.
4084. Studs, &c., A. W. Hammond, Aston.
4085. Navigable Vessels, J. and H. Lawson, Hotham Brough, and E. Lawson, Cottingham.
4086. Folding, &c., Book-holders, A. Mann, London.
4087. Drum Guard of Thrashing Machines, E. Evans, Walton.
4088. Railway Signals and Points, E. Tyer, London.
4089. Belts, &c., for the Spine, H. Riviere, Upper Woolhampton.
4090. Pumping Machinery, &c., G. Shann, London.
4091. Utilising the Flow of Streams, &c., D. Champion, Shepperton.
4092. Balance or Weighing Machine, E. G. Kempe, Heaton.
4093. Rafts, T. A. F. Hall, Millbrook, and H. T. Clanchy, Shirley.
4094. Ventilators, A. Sweet, London.
4095. Supporting, &c., Electrical Wires, T. O. Windsor, Melbourne.
4096. Portable Towel Rail, H. Wright and T. C. Coles, London.
4097. Pumps, G. W. von Nawrocki.—(*J. A. Jacobsen, Germany.*)
4098. Mouldings, &c., for Decorative Purposes, S. Albu, London.
4099. Type Writers, F. T. Ball, London.
4100. Two-wheeled Vehicles, G. H. Morgan, London.
4101. Pianofortes, A. Uhlig, Germany.
4102. Bichromate of Potassa, &c., S. Pitt.—(*H. Pemberton, Philadelphia, U.S.*)
4103. Preventing Animals from Running away, W. R. Lake.—(*S. J. C. Ferrando, Spain.*)
4104. Valves, F. Morris and C. W. Tolkard, Brentford.
4105. Curbing, &c., Horses, &c., R. Winder, Farningham.
4106. Metallic Screws, &c., J. Sheldon, Birmingham.
4107. Compound Magnets, S. H. Parkes, Birmingham.
4108. Raising and Lowering, A. J. Boult.—(*J. A. Caldwell, New York.*
4109. Mincing Machines, A. M. Clark.—(*Collin et Cie., Paris.*)
4110. Gulley Trap, B. Giles, Blackheath.
4111. Grates for Gas Fires, W. T. Sugg, London.
4112. Commutators, &c., J. H. Johnson.—(*Z. T. Grumme, Paris.*)

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4113. Regulating the Flow of Liquids, J. Landlers, Burnley.
4114. Drying, &c., Washed or Wet Grain, J. Ritchie, Liverpool.
4115. Making Salt, H. Whitehead and R. Hodgson, Ettiley Heath, near Sandbach.
4116. Horse Rake, T. H. Ramsden, Leeds.
4117. Horse Rake Teeth, T. H. Ramsden, Leeds.
4118. Top for Bottles, J. H. Alexander, Birmingham.
4119. Photographers' Lamp, G. Wilson, Manchester.
4120. Calculating &c., Apparatuses, J. J. Raggett, Aston, near Birmingham.
4121. Incandescent or Glow Lamps, J. Swinburne, Brockley.
4122. Coke Ovens, J. McCulloch, Airdrie, and T. Reid, Glasgow.
4123. Safety Stirrup Bar, A. Damarell, Exeter.
4124. Drying Damp Walls, J. Hartill, Dudley.
4125. Lock Nuts, W. P. Kelly, Mount Brandon, near Graigue.
4126. Stair-eyes for Holding Stair-rods, J. Walker, Birmingham.
4127. Waterproof Fabrics, H. H. Waddington, Manchester.
4128 Gulley Trap, C. Hill, Heywood, and G. H. Wilkes, West Bromwich.
4129. Stair-eye, C. Hill, Heywood, and G. H. Wilkes, West Bromwich.
4130. Settling, &c., the Bodies of Felt Hats, J. and O. Oldham, Denton.
4131. Waterproof Cloth, E. S. Helwitz, Cheetham.
4132. Detached Household Furniture, C. H. Wood, Sheffield.
4133. Drying Machines, J. Wilkinson, Birmingham, and S. Puplett, Westmoors, Knowle.
4134. Fishing Hooks, S. Allcock, Redditch.
4135. Safety Valves, F. Bosshardt.—(*A. Guyou, Montreuil sous Bois, France.*)
4136. Handles of Cutlery, &c., C. Ibbotson, Sheffield.
4137. Mould Candles, W. Wigfield, Rotherham.
4138. Lawn Billiards, W. Benbow, Wallington.
4139. Rock Drill, W. Teague, jun., Cornwall.
4140. Burning Gas from a United Holder, H. C. Clements, London.
4141. Injector, R. B. Sanson, London.
4142. Heating Smoothing Irons, R. Sanson, London.
4143. Combined Pressure Regulator & Economiser, S. Bowden.—(*I. Raff, R. S. Eastham, and J. A. Kay, Melbourne, Australia.*)
4144. Colouring Photographic Prints, W. B. Anderson, Aberdeen.
4145. Button, J. Boam, London.
4146. Hoop Iron, &c., Pipes, G. W. von Nawrocki.—(*W. Tillmanns, Remscheid, Prussia.*)
4147. Flushing Apparatus, J. and T. I. Day, London.
4148. Bottle Opener, J. Appleyard, Bradford.
4149. Hydraulic Balance, M. D. y Gost, Barcelona.
4150. Drying Hides, &c., H. J. Haddan.—(*O. Lumpp, France.*)
4151. Cartridges, W. S. Simpson and G. Smith, London.
4152. Lamps, A. D. Turner and W. Flatau, London.
4153. Finishing, &c., Printing Rollers, &c., A. Barrett, London.
4154. Boxes, E. S. B. Tombs, London.
4155. Magazine Fire-arms, B. Burton, London.
4156. Magazine Fire-arms, B. Burton, London.
4157. Adjustable Tables and Seats, J. Glendenning, Norwich.
4158. Thermo-electric Piles, H. H. Lake.—(*D. Lautensack, A. Kohn, and O. Laske, Vienna.*)
4159. Files for Letters, &c., F. Wirth.—(*H. Zeiss, Frankfort-on-the-Maine.*)
4160. Moulds and Matrices, C. F. Hilder, Newcastle-on-Tyne, and S. J. A. Cotterell, near Rotherham.
4161. Chain Wheels, R. J. Smith, Sunderland.
4162. Suspending Carriage Bodies, &c., H. W. Mason, London.
4163. Condensing Exhaust Steam, &c., J. Goucher, London.
4164. Opening and Closing Window Sashes, &c., H. Tosh, Glasgow, and S. Preston, Barrhead.
4165. Starting Gas Engines, P. Jensen.—(*C. Winslöw, Copenhagen.*)
4166. Detaching Gear for Ships' Boats, T. Woodhouse, South Shields.
4167. Contact Arms between Telpher Trains, &c., F. Jenkin, Edinburgh.
4168. Holders for Supporting Boxes, S. B. Stevens, Reading.
4169. Self-acting Foot Brakes for Bicycles, &c., J. Watkins, Saltley.
4170. Motive Power, G. W. Jones, London.
4171. Lamp Glasses, J. H. Johnson.—(*W. Hirsch, Radeberg, Saxony.*)
4172. Winding Mechanism of Automatic Atmospheric Clocks, J. Sainsbury, London.

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4173. Millinery Trimmings, J. Sidley, Nottingham.
4174. Cooling the Atmosphere in Smiths' Shops, &c., W. Morgan, New Swindon.
4175. Steam Power Loom, J. Wilson, Blackburn.
4176. Applying Blocks of Concrete, &c., to Building and other Purposes, W. R. Cornell, Grays.
4177. Solitaires, &c., W. Burnett, Jarrow-on-Tyne.
4178. Removing Lead from Water, J. B. Hannay, Loch Long.
4179. Stitching Cord or Fabric to Hat Bands, &c., F. W. Cheetham, Hyde.
4180. Printed Felt Carpets, &c., R. J. C. Mitchell, Waterford.
4181. Corrugated Spring for Carriages, &c., F. Kreisler, Crookhaven.
4182. Brewing, E. T. Pemberton, Liverpool.
4183. Hydraulic Apparatus, A. Higginson, Liverpool.
4184. Extinguishing, &c., Gas Lamps, J. Freestone and G. Kyle, Geddington.
4185. Combined Racks and Berths, J. Cochrane, Barrhead.
4186. Coupling Apparatus, W. W. Burland, York.
4187. Barbed Fence Wire, J. S. Taylor, Clayton.
4188. Bottle Stopper, T. Kilner, Thornhill.
4189. Hatching Eggs, W. Muir, Thornliebank.
4190. Drying Oats, J. Duncan, Macduff.
4191. Strengthening Sheet-metal Forks for Umbrella Stretchers, J. Edmonds, Balsall Heath.
4192. Communicating in Railway Trains, J. Maguire, Kingstown.
4193. Cyclometer, T. N. Harwood, Northolt.
4194. Treating Domestic Refuse, &c., J. C. Morrell, Wrexham.
4195. Bichromate of Soda, C. S. Gormon, Irvine.
4196. Covered Box, T. and J. Toogood, London.
4197. Iro-nazal Steam Inhaler, T. and J. Toogood, London.
4198. Bichromate of Soda, C. S. German, Irvine.
4199. Removing Sandbanks, &c., E. Foulger, Liverpool.
4200. Holders for Ever-pointed Pencils, &c., J. Appleby, Birmingham.
4201. Fibre Stuffs, A. Fiegel, Berlin.
4202. Solidifying Substances and Liquids, &c., J. Foulis, Musselburgh.
4203. Chimney Cowls, T. G. Dorning, Manchester.
4204. Gas Supply Pipes, H. Devine, Manchester.
4205. Fumigating Carpets, &c., C. Hinksman, London.
4206. Rotary Motors, H. L. Bennison, London.
4207. Supplying Steam and Air to Furnaces, R. H. Hepburn, London.
4208. Incandescent Electric Lamps, C. H. Benton and H. H. Grubbe, London.
4209. Securing Place Rods, C. F. Archer, London.
4210. Screening or Dressing Machine, R. Boby, Bury St. Edmunds.
4211. Safety Valves, W. N. Nicholson and A. T. Allcock, Newark-upon-Trent.
4212. Regenerators of Furnaces, G. Winstanley, Coventry.
4213. Key Rings, J. Horwitz, London.
4214. Pianofortes, E. W. Brinsmead, London.
4215. Playing a Novel Game, J. Ram, Upper Norwood.
4216. Recording Number of Passengers, E. Patterson, Liverpool.
4217. Steering Ships, J. Donaldson, Chiswick.
4218. Fastenings for Window Sashes, T. Smith, Brockley, and J. Drewitt, Peckham.
4219. Clipping Horses, A. Martin, Woolwich.
4220. Converters, W. R. Lake.—(*C. Walrand, Belgium, and A. Delattre, France.*)
4221. Iron Tanks, &c., J. Walsh and G. Share, London.
4222. Sockets for Poles, W. S. Codner, London.
4223. Regulating &c., Temperature, D. T. Gordon Dundee.
4224. Mixing Apparatus, &c., C. Schlickeysen, Berlin.
4225. Raising, &c., Ships' Boats, D. Pattison, Limehouse.
4226. Electric Circuit Closers, J. T. Bucknill, Thornfield.
4227. Curling Bag Protectors, V. Brown, Denton.
4228. Boring Wells, W. Lake.—(*A. Fauck, Austria.*)
4229. Tram Rails, J. Bidder, London, and W. R. Lodge, Croydon.
4230. Shuffling Playing Cards, M. Neale, London.
4231. Fittings for Water-closet Doors, H. N. Crellin Richmond.
4232. Knitting Machinery, H. Skelton, Norwich.
4233. Combined Rails and Chairs, W. J. Shepherd, West Croydon.
4234. Cutting out Putty from Window Sashes, T. Le Poidevin, Guernsey.
4235. Measuring Devices, A. M. Clark, London.—(*A. Atkins, Wanganui, New Zealand.*)
4236. Gas-lighting Apparatus, A. M. Clark.—(*V. Popp, Paris.*)
4237. Treatment of Wheat, &c., M. D. Penney, Kingston-upon-Hull.
4238. Suspending Pictures, F. S. Hawke, Cornwall.
4239. Domestic Fire-escapes, J. C. Bauer, Brockley.
4240. Gas-lighting Apparatus, A. M. Clark.—(*V. Popp, Paris.*)
4241. Rings and Travellers of Spinning Frames, A. M. Clark.—(*J. J. Bourcart, Zurich.*)

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4242. Looms for Weaving, W. H. Hacking, Bury.
4243. Bottle Stoppers, H. G. Hellier, London.
4244. Purifying Metallic Copper, F. W. Pittuck, Hebburn, and J. M. Hucklebridge, Jarrow.
4245. Motors Worked by Fluid Pressure, G. Crowe, Chester.
4246. Protecting the Mouths of Horses, A. E. Webb, Bloxwich.
4247. Fireproof Floors, E. Potts, Oldham.
4248. Opening and Cleaning Cotton, L. Wild, Bolton, and J. Greenhalgh, Oldham.
4249. Treating Clay, T. H. Sharpe, Ruabon.
4250. Ironing, Machines, W. Norman, Nottingham.
4251. Wheels, T. Pye, Mansfield.
4252. Steam Washing Machine, H. Devine, Manchester, and J. Shaw, Lockwood.
4253. Covering Rollers for Worsted Spinning, P. and S. Calvert, Keighley.
4254. Automatic Signal Wire Compensators, F. R. Clarke and J. Horsfall, Derby.
4255. Tram-car Tickets, T. B. Garrad, London.
4256. Match-boxes, B. May, Moseley.
4257. Nozzles of Oil Cans, J. Neale and T. H. Price, Birmingham.
4258. Photographic Camera Clip Support, L. B. Pillin, Anerley.
4259. Preventing Smoky Chimneys, E. G. Wright, Landport.
4260. Frying-pan Handles, J. W. Sankey, Bilston.
4261. Safes, &c., H. R. Antcliff, Birmingham.
4262. Block Carts, R. and S. Wadsworth, Halifax.
4263. Carts for Conveying Water, R. and S. Wadsworth, Halifax.
4264. Spring Carts, R. and S. Wadsworth, Halifax.
4265. Attaching Fish-plates to Rails, J. Glover, Birkdale, and C. Walton, London.
4266. Respirators, E. Capitaine.—(*F. M. von Donat, Gleiwitc, Germany.*)
4267. Metallic Wagons, &c., W. Cook, jun., Glasgow.
4268. Alkalies, &c., S. G. Thomas, London.
4269. Swing Looking-glasses, J. E. Floyd, London.
4270. Removable Key Switches, G. Richardson and W. Raworth, London.
4271. Incandescent Lamps, J. Swinburne, Brockley.
4272. Casting Gas Threads, P. Barry, Tottenham.
4273. Producing Biphosphates, S. Bowden.—(*R. Schliwa, Waldeck, Germany.*)
4274. Self-revolving Hair-brush, W. Edwards, London.
4275. Shirts and Shirt Cuffs, E. Walker, Leeds.
4276. Cut Pile Fabrics, A. Hind, Wyke.
4277. Fire-grates, J. Smith, Leeds.
4278. Cooking-ranges, W. Telfer, Kinning Park, N.B.
4279. Spinning Tobacco, A. Caldow and J. Burnett, Kilmarnock.
4280. Points or Switches, A. C. Jameson, London.
4281. Fuel, J. Barnett, London.
4282. Artists' Palettes, S. H. S. Inglefield, Southsea.
4283. Tricycles, W. Bouttell, Colchester.
4284. Envelope Machines, R. H. Brandon.—(*J. Ball, U.S.*)
4285. Ships' Bows, H. J. Haddan.—(*J. B. B. Vautré, Toulouse, France.*)
4286. Lavatories, F. J. Candy, Fen Ditton.
4287. Preventing Vibrations, J. Moseley, Manchester
4288. Lithographic Machine, W. Simmons, London.
4289. Bending and Shaping Metal Pipes, W. Smeaton, sen., London.
4290. Safety Lamps, H. Pieper, Belgium.
4291. Retaining a Scarf in its Proper Position, G. A. Brown, London.
4292. Breech-loading Hammerless and other Guns and Rifles, W. Anson, Birmingham.
4293. Railway Couplings, H. H. Lake.—(*Grainger Automatic Car Coupling Company (Incorporated), New York.*)
4294. Traps to Sewers, A. C. Henderson.—(*C. Hinksman and J. T. Titus, San Francisco, U.S.*)
4295. Generating Steam by Chemical Agents, H. H. Lake.—(*H. Grüneberg and E. Hardt, Germany.*)
4296. Microphones, A. J. Boult.—(*K. S. Dembinski, Brussels.*)
4297. Capstan Apparatus, W. Elliott, Beccles, and W. Garrood, Wheatacre.
4298. Regenerative Coke Furnaces, A. J. Boult.—(*Schlesische Kohlen and Cokeswerke, Silesia.*)
4299. Shirts, &c., T. Walker, Leicester.
4300. Spile or Vent Peg, A. J. Boult.—(*J. P. Schonig, France.*)
4301. Steamships, T. W. Phinney, Chicago, U.S
4302. Dynamo-electric Machines, R. E. B. Crompton, London.
4303. Measuring Distances, A. M. Clark.—(*Dany and Lepage, Paris.*)
4304. Agitating the Liquid in Liming Vats, A. M. Clark.—(*J. B. McEnally, Clearfield, U.S.*)

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for The Engineer *at the office of Her Majesty's Commissioners of Patents.*

2303. Producing Mural Ceiling and other Architectural Hangings, Decorations, or Ornaments, *S. A. Overton, London.—7th May*, 1883. 4*d.*

Relates to the combination of wood pulp or paper pulp, asbestos, and selenitic cement.

2723. Indexing of Books, *J. H Johnson, London.—31st May*, 1883.—(*A communication from H. A. de Silvera, New York.*)—(*Provisional protection not allowed.*) 2*d.*

Concave niches are cut into the body of the leaves of the book, the said niches forming two walls, on the

surface of either of which walls index characters may be impressed, and be seen from two points of view when the volume lies open to the reader.

2717. PLAYCARDS, *H. J. Haddan, London.*—31*st May*, 1883.—(*A communication from A. Doherty, Brooklyn.*) —(*Provisional protection not allowed.*) 2*d*.

Consists in providing the cards with certain indicating devices in the corners.

2815. PATTERNS FOR MAKING VESTS OR WAISTCOATS, *H. J. Haddan, London.*—6*th June*, 1883.—(*A communication from J. M. C. Chenivesse, France.*)—(*Provisional protection not allowed.*) 2*d*.

Relates to the employment of a set of pattern sheets.

2891. MANUFACTURE OF COTTON OR LINEN HANDKERCHIEFS, SCARVES, &c., *J. Edelston, Preston.*—9*th June*, 1883.—(*Provisional protection not allowed.*) 2*d*.

Relates to the means of producing novel effects.

3008. GALVANIC BATTERIES, *J. Oliphant, E. B. Burr, and J. W. H. R. Gowan, London.*—16*th June*, 1883. 6*d*.

This relates to a battery having a series of cells connected together by suitable pipes, a continuous circulation of the liquid being maintained by a pump driven by an electric motor.

3228. CLUTCH COUPLINGS, &c., *A. J. Boult, London.*—29*th June*, 1883.—(*A communication from M. Haas, Baden.*) 6*d*.

Relates partly in the clutch coupling for motors to the combination of a sliding toothed sleeve with a loose excentric sleeve, brake spring, and carriers.

3294. PACKINGS FOR STUFFING-BOXES OF STEAM ENGINES, &c., *C. Schnerzel, Berlin.*—3*rd July*, 1883. 6*d*.

Relates to a packing cord made of cork pieces or particles (with or without the admixture of other particles of suitable non-conducting nature), which are highly compressed into the form required, for the purpose of acquiring a high elasticity, and enclosed in a flexible covering.

3331. RAILWAY KEYS, *R. D. Sanders, Glasgow.*—5*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Refers to means for preventing the keys used for securing rails in their chairs from shaking out by the vibration of passing trains.

3344. VENTILATING CASEMENTS, *A. J. Boult, London.*—5*th July*, 1883.—(*A communication from Messrs. Bouquet and Bulle, Besançon.*—(*Not proceeded with.*) 2*d*.

Relates to a casement or window having movable flaps or strips of glass in place of the single flap or door employed in the casement or ventilators heretofore constructed, and thus obviating all the disadvantages attending the latter arrangement.

3350. TREATMENT AND UTILISATION OF TIN AND LEAD DROSS AND OF THE SLAG RESULTING THEREFROM, *T. Lloyd, Aberdylais.*—6*th July*, 1883. 4*d*.

The object is to avoid all waste by an improved method of treating the scruff or oxide, and the slag resulting therefrom.

3351. APPARATUS APPLICABLE TO BLEACHING KIERS, &c., *J. K. J. Foster, Bolton.*—6*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates, First, to forming or creating a vacuum in the kier for bleaching cotton, linen, or other goods; Secondly, to a method of clearing the water that percolates through the cloth or otherwise, and falls through the false bottom into the vacuum cavity and to the bottom of the kier.

3352. SMALLWARE LOOMS, &c., *T. Hirst, Manchester.*—6*th July*, 1883. 6*d*.

Relates, First, to the method of mounting and operating the healds of a smallware or other loom whereby the opening of the shed is divided, one half opening upwards and the other downwards; Secondly, the improved taking-up motion for smallware looms; Thirdly, the combination and arrangement of mechanism for blocking the woven material in a smallware loom direct.

3356. JOINTS OR FASTENINGS FOR THE CORNERS OF FRAMES OF SCHOOL SLATES, &c., *E. M. Owen, Festinog.*—6*th July*, 1883. 4*d*.

Relates to the employment of a metallic corner cast or stamped to the shape and inlaid so as to flush with the surface of the slate.

3358. PISTONS, *J. Elliot, J. S. Jeffery, and T. Kerman, Cardiff.*—6*th July*, 1883. 6*d*.

The inventors place between the body of the piston and the junk ring or top of the piston two metallic open piston rings, which by tongue and groove or otherwise are so connected as to expand and contract together and to recede from and approach each other as required.

3359. APPARATUS FOR CARBURETTING GAS AND AIR FOR LIGHTING AND HEATING PURPOSES, *T. Thomas, London.*—6*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in constructing a reservoir of any suitable form to contain the mineral oil or hydrocarbon to be used for carburetting, and in connection and communicating with this reservoir—called the carburetter—in which asbestos cloth or other suitable material is arranged so as to present as large a surface as possible to the current of gas and air mixture passing through the carburetter.

3360. WORKING RAILWAY POINTS AND SIGNALS, *S. Pitt, Sutton.*—6*th July*, 1883.—(*A communication from J. Prince, Paris.*) 6*d*.

The entire action is concentrated in a single cam, which on either side presents a groove of a special form; these grooves occupy an arc of 120 deg., and control rollers upon two bent levers actuating rods, the to-and-fro movement of which determines the position of the tongue rails, the locking of the tongue rails, and the placing of the signal disc to give a corresponding indication.

3361. COOLING OR QUENCHING THE LINING TUBES FOR ARTILLERY AND OTHER TUBES, *S. Pitt, Sutton.*—6*th July*, 1883.—(*A communication from H. Harmet, France.*)—(*Void.*) 4*d*.

The heated tube is fixed between two pipes, one of which is connected with a water supply, and a current of water is caused to flow through the lining tube.

3362. PRODUCING PLATES BY PHOTOGRAPHY TO BE USED FOR PRINTING PURPOSES, *F. Wirth, Germany.*—6*th July*, 1883.—(*A communication from Benecke and Fischer, St. Louis, U.S.*)—(*Not proceeded with.*) 2*d*.

The object is to produce a plate from which a picture can be printed, the shades of which are formed by a number of points or dots, the design being engraved upon a zinc or other plate, from which impressions may be taken. A small negative is taken of the picture by photography—special chemicals being used—and the representation is enlarged, so as to produce a design, which consists of a number of points or dots, which is then engraved on the plate.

3364. BOOTS AND SHOES, &c., *J. Drakeford, Northampton.*—6*th July*, 1883. 6*d*.

An elastic lining is applied to the front of the boot or shoe in place of the tongue at present used for closing the opening under the laced up portion of the same.

3366. DOOR LOCKS, *W. R. Lake, London.*—6*th July*, 1883.—(*A communication from F. A. Chameroy, Paris.*)—(*Not proceeded with.*) 2*d*.

The object is to construct a lock so that false keys will turn therein, but will not operate the lock, although it may be freely turned to the left or right.

3369. MACHINES FOR MOWING AND REAPING, *J. Whitaker and J. E. and R. J. Powell, Wrexham.*—6*th July*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to facilitate the control of the position of the finger-bar by the driver.

3370. APPARATUS FOR GETTING COAL, &c., WITHOUT THE USE OF EXPLOSIVES, &c., *W. F. Hall and W. Low, Durham.*—6*th July*, 1883. 6*d*.

This relates to apparatus to be inserted into holes drilled in the coal for the purpose of breaking down the mass, and it consists of two bars capable of being separated at their ends when actuated by a conical piece between them, to which a longitudinal movement is imparted by connecting its outer end to screws or levers.

3373. CARPETS, &c., *T. Tempest-Radford, Kidderminster.*—7*th July*, 1883.—(*Not proceeded with.*) 2*d*.

A printed warp is employed in combination with one, two, or more frames of dyed or other warp, and arranged in a Jacquard loom, so that the printed warp produces the body, and the other warp the outline of the pattern.

3376. CONDUCTORS FOR ELECTRICAL RAILWAYS, *H. E. M. D. C. Upton, London.*—7*th July*, 1883.—(*Not proceeded with.*) 2*d*.

The conductor is only exposed at intervals equal to the length of the train. Contact is made by a bar extending the length of the train.

3380. TELEGRAPHIC AND TELEPHONIC APPARATUS, *D. Sinclair, Glasgow.*—7*th July*, 1883. 6*d*.

This relates to arrangements whereby the branch exchanges may be worked automatically from a central exchange.

3382. APPARATUS TO BE USED FOR COOLING OR VENTILATING HAY AND OTHER RICKS, *W. H. Baylies, Welford.*—7*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Consists of a perforated tube open at top, and made preferably of iron. The lower end is provided with a conical point.

3383. GAS ENGINES, *W. R. Lake, London.*—7*th July*, 1883.—(*A communication from C. F. L. Gardie, Paris.*) 6*d*.

Relates principally to the construction of the cylinder and the piston.

3384. BOOTS TO SERVE AS SUBSTITUTES FOR OVERSHOES AND LEGGINGS, *W. R. Lake, London.*—7*th July*, 1883.—(*A communication from P. M. Torrisani, Paris.*) 6*d*.

Relates to a boot which entirely protects the ordinary boots and trousers without creasing the latter.

3385. MACHINERY FOR THE MANUFACTURE OF RAILWAY SLEEPERS, *G. Gilchrist, Glasgow.*—9*th July*, 1883. 6*d*.

Refers to the forming and embossing of sleepers out of strong sheet iron or sheet steel for supporting and securing the rails of railways, or the chairs of such rails by a new or improved rolling machine or machinery.

3386. MANUFACTURE OF NAIL PLATES TO BE USED IN MAKING NAILS FOR SHOEING HORSES, &c., *T. Stanford and H. Payne, Birmingham.*—9*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in rolling the iron with a flange on both of its sides, so that the cross section of the plate is of a T-form, thus providing sufficient metal to shape the head evenly and of any size required.

3387. APPARATUS FOR BAKING BY STEAM, *H. E. Newton, London.*—9*th July*, 1883.—(*A communication from E. Yäger, Germany.*) 6*d*.

This consists in baking dough or paste in moulds round which steam is caused to circulate, passages being formed in their walls for this purpose.

3388. MANUFACTURE OF COMPOUNDS OF ALUMINA, *T. L. G. Bell, Stratford.*—9*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the direct utilisation of the minerals known as Carnalite and kainit in the manufacture of potash alum.

3389. MOUNTING AND LUBRICATING THE SPINDLES OF TEXTILE MACHINERY, *J. Marsh, Ashton-under-Lyne.*—9*th July*, 1883.—(*Not proceeded with.*) 2*d*.

The improvement in mule spindles consists in mounting each spindle in a long bolster carried by an outer shell screwed upon a bracket secured to the under side of the top rail, the lower end of the bolster being formed with an oil cup from which oil flows to the bottom bearing, and is lifted to the top one by a screw groove.

3390. APPARATUS FOR RECEIVING AND COUNTING NEWSPAPERS AS THEY ARE DELIVERED BY THE FOLDING SECTION OF THE MACHINE THAT PRINTS THEM, *J. E. Taylor, P. Allen, and C. P. Scott, Manchester.*—9*th July*, 1883. 6*d*.

Relates to the construction and use of mechanism for counting and delivering newspapers in piles containing any desired fixed number.

3393. MANUFACTURE OF GASEOUS HYDROCHLORIC ACID, *C. D. Abel, London.*—9*th July*, 1883.—(*A communication from R. Hasenclever, Aix la Chapelle.*) 2*d*.

Consists in the production of gaseous hydrochloric acid for the manufacture of chlorine from aqueous hydrochloric acid by admixture therewith of sulphuric acid.

3395. COMPOSITION FOR PREVENTING INCRUSTATION OF BOILERS, *S. Pitt, Sutton.*—9*th July*, 1883.—(*A communication from A. A. Rosenberg, O. K. Hoberg, and V. V. Zoubkoff, Russia.*) 2*d*.

The composition consists of a mixture of raw (not peeled) potatoes, sweet peeled chestnuts, and common mashed or soaked peas.

3398. GAS GENERATORS, *H. P. Holt, Manchester.*—10*th July*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to the manufacture of "water gas," produced by passing air and steam through incandescent fuel, and it consists in heating the air and steam by causing it to pass through a jacket surrounding the fire before they pass through the fire. The fire for the boiler is preferably placed below the ash-pit of the gas generator, and the waste heat from it is caused to pass outside the jacket. An escape for a portion of the steam and air is controlled by the gasometer, so as to regulate the gas produced, without altering the pressure in the gasometer. Other improvements are described.

3400. MACHINERY FOR OILING AND SOFTENING HEMP AND OTHER FIBROUS MATERIALS, *A. V. Newton, London.*—10*th July*, 1883.—(*A communication from J. Good, Brooklyn, U.S.*) 6*d*.

This consists in the combination, with a train of fluted softening rolls, of a pair of feeding rolls, an oil tank and oil distributing roll in contact with the lower feeding roll, a supply roll adapted to dip into the oil in the tank and bearing against the distributing roll, and mechanism for rotating the rolls.

3403. APPARATUS TO BE EMPLOYED IN THE REFINING OF SUGAR, *C. E. Van Haesendonck, Brussels.*—10*th July*, 1883. 6*d*.

A number of vertical screws work in nuts secured to a bed on a frame, and are tubular throughout, their upper ends being fitted with loose funnels to receive the sugar moulds, which, by turning the screws, can be raised or lowered. Above the moulds is a horizontal pipe from which branches descend, and can be secured to the top of the moulds to close the same. Tubes in the horizontal pipes are provided for the escape of air and the introduction of the washing liquor, cold air, and of hot air or gas.

3406. APPARATUS FOR THE MANUFACTURE AND TREATMENT OF GAS, &c., *J. E. Dowson, Westminster.*—10*th July*, 1883. 6*d*.

This relates chiefly to a special combination of a steam producer, a gas generator, a washer, and a scrubber or scrubbers placed inside the tank of a gasholder.

3409. APPARATUS FOR KNEADING DOUGH, *J. H. Johnson, London.*—10*th July*, 1883.—(*A communication from L. Dathis, Paris.*)—(*Not proceeded with.*) 2*d*.

The dough is acted upon by pins, bars, or teeth projecting from the surfaces of two parallel discs, one caused to rotate, and the other either fixed or rotating in the opposite direction.

3411. BREECH-LOADING REPEATING RIFLES AND FIREARMS, *G. Baron de Overbeck, London.*—10*th July*, 1883. 10*d*.

Relates to, First, the chamber with its breech bolt; Secondly, the repeating mechanism; Thirdly, the loading contrivance.

3414. BUCKLE OR COUPLING DEVICE FOR REINS, STRAPS, AND BANDS, *J. Nicholls, Penzance.*—11*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Consists essentially of a plate or rod having at each end a loop or eye, and at the middle a fixed stud or knob projecting at right angles to the plate or rod.

3415. MANUFACTURE OF BANDS OR HOOPS FOR CANNONS, CAST STEEL WHEELS, &c., *W. Brierley, Halifax.*—11*th July*, 1883.—(*A communication from La Société Anonyme des Acieres et forges de Firminy, Paris.*—(*Not proceeded with.*) 4*d*.

Consists in improvements in the manufacture of bands for cannons, cast steel wheels called full centres, and other forged pieces, by means of a special system of dies or matrices by steam hammers.

3417. STEAM BOILER TUBES, *T. Riley, London.*—11*th July*, 1883.—(*Not proceeded with.*) 2*d*.

The boiler tubes are constructed of a larger diameter at the base and upwards, nearly to the level of the water-line, where they assume a conical shape, and thence extending with a lessened diameter nearly to the boiler plate, when they are again enlarged in a conical form, so that their diameter at the top is similar to their diameter at the base.

3420. ARTIST'S COMBINED EASEL AND SEAT, *H. F. H. Newington, Ticehurst.*—11*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the general arrangement, so that the whole may be folded up compactly.

3424. GALVANIC BATTERIES, *J. Gray, Gateshead.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

The exciting liquid consists of sulphuric acid, bichromate of potash, and nitric acid, incorporated in a peculiar manner.

3425. APPARATUS FOR THE MANUFACTURE OF CIGARETTES, *F. Hipgrave, London.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to produce cigarettes by a machine which automatically draws in its supply of paper, encloses tobacco therein, and sticks the edges, leaving only for other machinery or manual labour the feeding in of the tobacco and the cutting level of the ends.

3426. MACHINERY FOR COMBING WOOL, COTTON, &c., *J. H. Whitehead, Leeds.*—12*th July*, 1883.—(*A communication from A. Prouvost, Lille.*) 6*d*.

Consists in the application of one or more thin plates—preferably of steel or iron—which are attached to the heel of the dabbing brush, where the wool first comes in contact therewith, and in such a manner that they are surrounded by the teeth or bristles of the dabbing brush.

3427. MACHINERY FOR DRYING, CLEANING, AND DRESSING GRAIN, &c., *E. Keighley, Scarborough.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates, First, to forming the lifters double and hollow, thus superseding the necessity of steam coil and cylinder; Secondly, to an arrangement of steam box; Thirdly, arrangements for supplying a blast of air.

3428. MANUFACTURE OF STEAM BOILERS, *J. Burlinson, Sunderland.*—12*th July*, 1883. 6*d*.

Relates to the manufacture of the front or back ends or tube or tube plates, or other analogous parts of boilers, in which a number of holes or openings are required, or have to be made by casting them in steel or other homogeneous metal in one or more parts complete, or each part complete with all their or its required projecting parts, flanges, and openings.

3429. STOPPERING OR CLOSING BOTTLES, &c., *J. Sceats, Norbiton.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to an outside stopper which is hinged to the bottle.

3431. INDICATOR FOR CONTROLLING THE SPEED OF CARRIAGES, &c., *L. J. de Mesmaeker, Brussels.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the construction of a registering apparatus, and of transmitting devices for working it.

3432. VELOCIPEDES, *F. W. Jones, Exeter.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in the construction of the treadles and cranks of velocipedes.

3433. APPARATUS FOR WORKING AND INTERLOCKING RAILWAY POINTS AND SIGNALS, *W. Buck, London.*—12*th July*, 1883. 10*d*.

Consists partly in the combination with a point lever, and its connections to two sets of simultaneously moved points and to signals therefor, a setting lever determining whether the movement is communicated by a push or a pull, and intermediate apparatus whereby either the push or the pull is made to actuate the points, but only one of these movements is made to actuate a signal. Other improvements are claimed.

3436. VENT PEGS, *W. E. T. Dawson, London.*—12*th July*, 1883. 6*d*.

The vent peg is formed with a chamber separated from the outer air by a caoutchouc tube or diaphragm with slits in it, which remain closed until opened by pressure of air or gas either from without or within.

3437. MANUFACTURE OF MALTOSE, AND ITS APPLICATIONS, *J. Imray, London.*—12*th July*, 1883.—(*A communication from L. Cuisinier, Paris.*) 4*d*.

According to one process, starch has added to it from 5 to 10 per cent. of infusion or liquid extracted from germinating grain, the whole being mixed in a vessel heated slowly to about 80 deg. Cent. during about one hour, when the liquid is poured into a close vessel, in which it is agitated and heated for about half an hour, till the pressure is about an atmosphere and a-half. The liquid is then cooled by surfaces kept cool by the circulation of water, to about 48 deg. Cent., and then has added to it 5 to 20 per cent. of infusion. When saccharifaction has continued about an hour, the juice is filtered, and the liquid product kept at about 48 deg. Cent. The liquid is then concentrated and filtered through animal charcoal.

3438. MANUFACTURE OF PLASTER OF PARIS, *J. Thomlinson, Carlisle.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to make the process continuous.

3439. LOOMS FOR WEAVING, *T. Hanson, Bradford.*—12*th July*, 1883. 8*d*.

This relates to "loose reed" looms, the object being to construct the same so that the reed shall be "fast reed" except when a "trap," or when from any cause the shuttle fails to box. The apparatus consists of the ordinary fast reed stop rod and finger, and a movable frog carried on studs to admit of a sliding, rising, or partial rotary motion when acted upon by the finger of the fast reed stop rod.

3440. MACHINERY FOR COATING METAL PLATES WITH TIN, LEAD, &c., *T. James, Swansea.*—12*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to improvements in the general construction of the machinery.

3441. APPARATUS OR MACHINERY FOR THE MANUFACTURE OF MATCH-BOXES, *P. Jensen, London.*—12*th July*, 1883.—(*A communication from F. Lundgreen, Stockholm.*) 10*d*.

The inventor claims partly the machine for making the drawer or inner case of a match-box having the following essential parts or features, viz., a receptacle for superposed side veneers which one by one are pushed in order, together with the paper, to form the sides of the case, the paper being folded down over them by advancing same over a form; an arrangement for retaining the bottom veneer against the end of a non-rotating form, the sides of the case being transferred thereto; the means for folding the paper and pressing it against under side of bottom of case, and the means for releasing the pushed box from the non-rotating form. Machines for making the outer case and labelling are described and claimed.

3442. LOOMS, *J. S. Park, Southport, and J. Park, Manchester.*—12*th July*, 1883. 6*d*.

This relates chiefly to looms for weaving pile or looped fabrics, and it consists, First, in the use of a pile gauge, having divided ends or prongs; and Secondly, in the use of clips or scales, containing a series of holes, in which are inserted the ends of the pile gauges.

3443. MOVABLE GUIDE WHEELS, ENABLING ANY VEHICLE TO UTILISE THE RAILS OF ROAD RAILWAYS, &c., *A. J. Boult, London*—12*th July*, 1883.—(*A communication from J. M. Terras, France.*) 6*d*.

This consists in the application to vehicles of guide wheels, capable of being lowered by the driver from his seat, so as to allow them to run in the grooves of tramway rails.

3444. ELECTRIC LIGHTING APPARATUS, &c., *J. L. Clerc, London.*—13*th July*, 1883. 10*d*.

The cores of the armature coils are made of insulated annealed iron wire wound in the direction of rotation. The armature is preferably stationary, the field magnets rotating. An arc lamp consists of a number of pairs of "pencils." A rocking carbon-rod is so actuated by a shunt magnet that when one pair of "pencils" burns out it touches the tops of the next pair and establishes an arc. A "safety switch" interposes a resistance equal to the arc should a pair of pencils fail. An "intensity regulator" interposes resistance as the current strength increases.

3445. IMPLEMENTS FOR PLANTING POTATOES, *W. Dewar, Dundee.*—13*th July*, 1883. 6*d*.

The machine may be constructed to plant two rows of potatoes simultaneously, the potatoes being lifted from a hopper by scoops or projections on discs and levers, which are actuated so as to direct the potatoes into a channel which conveys them to the earth.

3447. VACUUM BOXES FOR PAPER-MAKING MACHINERY, *H. Marsden and H. Schofield, Sheffield.*—13*th July*, 1883. 6*d*.

The object is to increase the duration of the wire gauze used in connection with vacuum boxes of paper-making machinery, and it consists in forming against the inner sides of the box two water troughs, in each of which is supported a roller, revolving in bearings, the tops of the rollers being high enough to bear the gauze clear of the sides. The troughs are kept full of running water, reaching nearly to the tops of the rollers. The sides of the troughs next to the vacuum chamber are hinged, so that they can be moved towards the rollers by the action of springs. The rollers are driven by chain or other gearing.

3448. PICKERS FOR LOOMS, &c., *J. Holding, Lower Broughton.*—13*th July*, 1883. 6*d*.

To prevent the shuttle flying out of the race a conical recess is formed to receive the shuttle tip by pressing a die into the face of the picker. To guide the picker two rectangular bars are used, and the picker is moulded with a groove on each side to receive these bars.

3449. COUPLING AND UNCOUPLING OF RAILWAY CARRIAGES, TRUCKS, &c., *J. Darling, Glasgow.*—13*th July*, 1883. 6*d*.

This relates to improvements on patent No. 331, A.D. 1883, and it consists in providing in the shanks of the vertical coupling hooks vertical hinged joints outside the buffer beams, so that the hooks are hinged together. Springs bear on the backs of the hooks, and stops are provided at the front of the shanks to prevent the hooks being uncoupled in any but a vertical direction, but enabling them to couple themselves automatically when two vehicles come together.

3450. FLOWER-HOLDING BROOCH, &c., *D. MacGregor, Perth.*—13*th July*, 1883.—(*Not proceeded with.*) 2*d*.

This consists of a brooch similar in form to a doo bolt, the bolt itself working in a tube, and being mad hollow to receive a flower.

3451. ELECTRIC BATTERIES AND LIGHTING APPARATUS, *P. de Villiers and E. F. Rey, London.*—13*th July*, 1883. 6*d*.

Relates to the construction of a primary battery for electric lighting purposes and to a portable incandescent lamp.

3452. SECONDARY BATTERIES OR ACCUMULATORS, *F. M. Lyte, London.*—13*th July*, 1883. 4*d*.

The electrodes are made by casting the supporting material around studs of spongy lead of such form as to be retained in place. Two of these plates may be placed back to back, the studs projecting from their outer faces.

3453. BOTTLES FOR PRODUCING A NEW KIND OF BEVERAGE, &c., *J. H. Lindsey, London.*—13*th July*, 1883.—(*Not proceeded with.*) 4*d*.

This relates to an apparatus whereby two separate beverages or gas and beverage may be mixed.

3454. SOAP, *B. Seemann, Bromley.*—13*th July*, 1883.—(*Not proceeded with.*) 2*d*.

This consists in making soap direct from seeds containing oil, and consists in crushing the seeds and placing them in a pan with alkali lye or potash lye, the mixture being boiled until the oil is extracted in a saponaceous state, when it is separated from the husks.

3455. CONSTRUCTION AND MANUFACTURE OF TIN AND OTHER METAL CANS, &c., *J. Maconochie, Lowestoft.*—13*th July*, 1883. 6*d*.

This relates to the method of fitting the lid to cans or boxes, and it consists in turning in the upper edge of the body all round to form a V-groove and forming a rim or flange on the underside of the lid, which fits into the groove and is secured by soldering.

3456. SEWING OR EMBROIDERING MACHINES, *W. E. Gedge, London.*—13*th July*, 1883.—(*A communication from E. Cornely, Paris.*) 6*d*.

This relates to the application to sewing and embroidering machines of an automatic cutting apparatus to cut the thread of each single stitch after it has been drawn by the needle above the cloth, thus producing a velvet or peluche-like surface when the threads are laid sufficiently close together one to another. The cutter consists of a pair of blades operated by the machine.

3457. ELECTRIC MACHINES, *W. S. Frost, London.*—13*th July*, 1883.—(*Not proceeded with.*) 2*d*.

A machine fixed on the axle of the generator derives from an accumulator sufficient power to start it "then, when the current from the accumulator is cut off therefrom, shall be continuously driven by the current generated."

3458. PORTABLE PLATFORM FOR SHEEP, *J. Hornby, Watton, Yorks.*—13*th July*, 1883. 6*d*.

A platform is mounted on wheels and has hinged extension pieces, the whole being readily portable from place to place, for the purpose of providing a dry resting place for sheep.

3459. VOLTAIC BATTERIES, *A. Clark, Glasgow.*—13*th July*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to double and single fluid batteries, having corrugated plates.

3460. STEAM GENERATORS, &c., *C. C. S. Knap, London.*—13*th July*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to sectional or tubular boilers, and consists in forming the connections between the ends of the tubes and the caps to which they are secured by rectangular collars on the tubes, which are fastened to the stem of the caps or T-heads. The invention also relates to the connections and joints between the caps themselves for the circulation of water from or to the adjacent tubes.

3461. FASTENINGS FOR GLOVES, BOOTS, &c., *T. R. Baker, Birmingham.*—13*th July*, 1883. 6*d*.

This consists in the use of a pivotted lever which, when passed through the button-hole, is turned back and causes the edge of the glove to pass behind a shoulder on the lever, thus closing the opening in the glove.

3462. CYLINDERS FOR PICKING OR BURRING MACHINES, *W. R. Lake, London.*—13*th July*, 1883.—(*A communication from F. G. and A. C. Sargent, Massachusetts.*) 6*d*.

This consists of picking or burring cylinders in

which the teeth are secured to a strip of metal, which is then wound spirally on the cylinder body, the sides of the strip being formed with grooves in them, into which wires are inserted to hold the coils in place. The surface of the cylinder body is covered with solder, as is also the strip carrying the teeth, and gas-burners are arranged so as to melt the solder as the strip is being wound on the body.

3463. Bakers' Ovens, &c., *R. A. Gilson and W. J. Booer, Southwark.*—13*th July*, 1883. 6*d.*

The object is to heat bakers' ovens by gas and so render them smokeless, and it consists in the use of two rows of burner tubes introduced through the oven wall and at one of the front corners below the roof, the tubes in each row diverging radially from one another, and the inner ends of the two rows being brought into line with one another. Air openings are provided both above and below the burners, and outlets at the back of the oven open into a flue.

3464. Electric Current Switches and Cut Outs, *H. J. Haddan London.*—13*th July*, 1883.—(*A communication from L. G. Perkins, New York, U.S.*)—(*Not proceeded with.*) 4*d.*

This invention relates to twenty-four different arrangements of switches and cut outs.

3465. Electric Incandescent Lamps, &c., *H. J. Haddan, London.*—13*th July*, 1883.—(*A communication fron C. G. Perkins, New York, U.S.*)—(*Not proceeded with.*) 4*d.*

This invention relates to twenty-six different combinations in an incandescent lamp and its fittings.

3466. Apparatus for Treating Carbon Filaments, *H. J. Haddan, London.*—13*th July*, 1883.—(*A communication from C. G. Perkins, U.S.*)—(*Not proceeded with.*) 2*d.*

Relates to hydro-carbonising carbon filaments by aid of hydro-carbon fumes and heat.

3467. Grates, *H. J. Haddan, Kensington.*—13*th July*, 1883.—(*A communication from E. Breslauer, Berlin.*) 4*d.*

The object is to afford an abundant supply of air and to facilitate stirring the fire; and it consists in forming the grate of disc-shaped, polygonal, or spherical sections mounted on shafts, which are adapted to receive rotary motion on their axes.

3468. Spanners, *H. J. Haddan, Kensington.*—13*th July*, 1883.—(*A communication from G. Gontier, France.*)—(*Not proceeded with.*) 2*d.*

This relates to an arrangement of ratchet teeth and a pin which allow the handle of the spanner to be turned back independently of the part embracing the nut, so that the spanner need not be removed after each turn.

3469. Cord Fastener for Window Blinds, &c., *H. J. Haddan, Kensington.*—13*th July*, 1883.—(*A communication from D. W. Ernsting, Germany.*) 4*d.*

To a bracket secured to the window frame is pivotted a vertically movable lever forming a channel or guide for the cord, and to which a second lever is pivotted, and is also movable in a vertical plane and provided with a guide or channel, so that when the cord is pulled sideways the levers are caused to turn and clip the cord between them.

3471. Fastenings for the Hames of Horses, &c., *F. B. Goodman, Birmingham.*—13*th July*, 1883.—(*A communication from F. O. Minor, New Orleans, U.S.*) 6*d.*

The object is to facilitate the unfastening of the hames of horses, and it consists in the use of a hook fastened to one hame, and composed of two parts pivotted together, and over which a chain attached to the other hame is passed, and which chain can be released by opening the hook.

3472. Boots and Shoes, *H. W. H. and E. R. W. Lulham, Brighton.*—13*th July*, 1883.—(*Not proceeded with.*) 2*d.*

This consists in making boots and shoes waterproof by inserting a piece of sheet metal as a middle or inner sole.

3476. Producing Designs upon Paper or other Fibrous or Soft Material or upon Metallic Surfaces, *R. Brow, R. W. Barnes, and J. Bell, Liverpool.*—14*th July*, 1883. 4*d.*

From a gelatine photographic picture in relief is formed a mould, and a plate is cast from it and used for printing on paper or other soft material or for pressing the design into thin sheet metal, such as tinfoil.

3477. Fastenings for Purses, Pouches, &c., *A. M. Clark, London.*—14*th July*, 1883.—(*A communication from Alexander and Co., Paris.*) 8*d.*

This consists essentially in utilising the elasticity of the purse or pouch, and it consists in making the frame of two bows—one having projections which enter recesses in the other bow and lock the frame in the closed position, while to open the pouch the curve of one of the bows must be distorted sufficiently to allow the projections to leave the recesses.

3479. Constructing Sub-aqueous Structures, such as Tunnels, &c., and Apparatus therefor, *W. J. Bentley, Leeds.*—14*th July*, 1883. 6*d.*

This consists in the use of caissons, the end portions of which are made with an upper fixed part and a lower part movable or removable.

3480. Apparatus for the Reception and Removal of House and Street Refuse, *W. K. Sidgwick, Surbiton.*—14*th July*, 1883.—(*Partly a communication from G. A. Sidgwick, Colorada.*) 6*d.*

Consists of two boxes, one within the other, the outer box having a hinged lid attached thereto.

3481. Apparatus for Governing and Regulating the Flow of Gases and Liquids from Gasholders or other Reservoirs, *J. Lewis, London.*—14*th July*, 1883. 6*d.*

Consists in the arrangement and construction of apparatus for governing and regulating the outflow of gases and liquids from gasholders or other reservoirs in which the same are confined under pressure, by causing the pressure of the confined gas or liquid to act against a spring or other varying resistance or equivalent contrivance, and thus open or close a discharge orifice automatically to an extent directly proportioned to the pressure of the escaping gas or liquid so as to ensure an equal outflow thereof.

3482. Construction of Bicycles, &c., *W. A. Rudling and J. F. Coffin, Southsea.*—14*th July*, 1883. 8*d.*

The object as applied to bicycles is to lower the position of the rider so that his feet shall always be within a few inches of the ground, thereby facilitating the mounting into the saddle, thus lessening the height from which a man would fall.

3483. Apparatus for Screening Coal, *R. D. Thomson, Motherwell, Lanarkshire.*—14*th July*, 1883. 6*d.*

Comprises a cylinder or barrel composed of rods, which is carried by a rotating shaft. Outside the barrel is a cylinder of wire cloth.

3484. Manufacture of Noiseless Tires for Carriage Wheels, &c., *W. H. Carmont, Manchester.*—16*th July*, 1883. 6*d.*

Consists, First, of a method and apparatus for welding together the ends of undercut grooved tires; and, Secondly, in a method of and apparatus for forcing and compressing the india-rubber band into the undercut grooved metal tire.

3485. Soap Tablets, *G. H. Ellis, London.*—16*th July*, 1883.—(*Not proceeded with.*) 2*d.*

Consists in making the tablets hollow and inserting into the hollow a core or body of glass, porcelain, or other suitable material.

3486. Valves, *J. Kroog, Halle-on-the-Saale.*—16*th July*, 1883. 6*d.*

This consists in a valve in which both the seat and valve proper are provided with duplicate horizontal seating surfaces, so that they can be reversed. The valve seat is held in place by a removable valve cage, which serves as a guide for the valve, and is held in place by a plate fastened across the top.

3488. Water-closets, &c., *J. Fairbairn, Edinburgh.*—16*th July*, 1883. 6*d.*

This relates specially to syphon traps for water-closets, urinals, &c., and it consists in providing the basin with a syphon trap, to which is connected a discharge pipe fitted with a second lower syphon trap, a small pipe for the admission and outlet of air being provided in the discharge pipe between the two traps. By these means the valves and fittings usually employed are abolished.

3489. Shears or Apparatus for Cutting Round and Flat Metal, *J. Seligman, London.*—16*th July*, 1883.—(*A communication from G. Josephs, Philadelphia.*) 6*d.*

The stationary jaw is formed with an arm, on the end of which is mounted a pinion gearing with a toothed segment formed on an arm connected with the movable jaw. The pinion is actuated by a handle for cutting flat metal. A rotatable die having holes of different gauge is fitted in the arm of the fixed jaw, and in inner face of the movable arm is inserted a shearing plate, so that round metal, when inserted through one of the openings in the die, will be cut upon the movable jaw being actuated. A gauge is provided, and can be adjusted to suit different widths of metal to be cut.

3490. Indicating Level for Artificers, *A. J. Boult, London.*—16*th July*, 1883.—(*A communication from H. W. Knieper, Berlin.*)—(*Not proceeded with.*) 2*d.*

The level consists of a straight edge with a chamber in the middle, in which is mounted a pointer, to the spindle of which is connected a weight, such pointer moving over a dial plate.

3491. Blue Colouring Matters suitable for Dyeing and Printing, *H. J. Haddan, London.*—16*th July*, 1883.—(*A communication from Lembach and Schleicher, Germany.*)—(*Not proceeded with.*) 2*d.*

Diamethylaniline azo-benzol prasulpho acid is dissolved in an excess of ammonia, and zinc powder introduced into the solution until it is completely discoloured, when the solution is heated and separated from the zinc powder by filtration, and the solution then acidulated with sulphuric acid. The liquid when cool is treated with sulphuretted hydrogen, and by adding ferric chloride the liquid assumes a deep blue colour, the colouring matter being then precipitated by adding zinc chloride.

3492. Raising Sunken Vessels and Preventing Vessels from Sinking, *H. J. Haddan, London.*—16*th July*, 1883.—(*A communication from G. A. Kessel, Berlin.*)—(*Not proceeded with.*) 2*d.*

This relates to the use of elastic air receptacles placed in the interior of the vessel, and which can be filled with air or light gases, such as hydrogen.

3493. Machine or Battery Guns, *H. S. Maxim, London.*—16*th July*, 1883. 8*d.*

This relates to the application to machine or battery guns of the system described in patent No. 3178, A.D. 1883, whereby the recoil of the gun is utilised to effect the operation of feeding, firing, extracting, and ejecting devices, and it consists in causing the recoil to withdraw the breech block from the barrel and eject the empty cartridge shell, and also store energy in springs which by their reaction effect the insertion and discharge of another cartridge. The improvements in cartridges consist in making the shells without the ordinary rim or flange, and forming partly or wholly around the shell a series of grooves which permit the extractor of the gun to take a firm grasp of the shell. The base of the shell is cup-shaped and fits tightly within the tubular part thereof a short distance from the end, so that when driven back by the explosion it acts on the breech moving mechanism, and as the breech block moves backward the shell is grasped by the extractor.

3496. Registering and Checking the Receipt of Fares in Omnibuses and Tram-cars, *H. H. Lake, London.*—16*th July*, 1883.—(*A communication from G. Margari, Italy.*) 6*d.*

The number of passengers travelling on each section of a line is caused to be printed or registered on different coloured sections of a disc of paper.

3497. Land-roll, *E. Otto, G. Peisker, and A. Rittner, Germany.*—16*th July*, 1883. 6*d.*

This relates particularly to land rollers actuated by a portable steam engine, and consists in means for facilitating the turning of such rollers to the right or left when being drawn across a field. The roller preferably consists of two rolls mounted side by side on a shaft, and to the outer head of one of which a friction wheel is secured, and can be brought to bear against one of two friction pinions, by which means the hooks to which the hauling ropes are secured are moved in opposite directions on the frame of the roller, and the latter is thus turned in the desired direction.

3500. Horse Rakes, *J. Howard and E. T. Bousfield, Bedford.*—17*th July*, 1883. 6*d.*

This relates to improvements on patents No. 3437, A.D. 1869, No. 2363, A.D. 1875, and No. 4827, A.D. 1876, in which the rakes are provided with frictional drums fixed on the travelling wheels, the tine frames being fitted with means for tightening bands on the outsides of the drums, whereby the tines are raised from the ground and relieved of the load, and the objects of this invention are to provide a more direct action of the lifting appliances; to protect the frictional surfaces from grit; and to simplify the adjustment of the rake. A friction ring which is capable of contraction and expansion is placed within each of the drums. When the rings are expanded the wheels are locked, and the onward movement of the implement rocks the tine frame and raises the tines.

3502. Rotary Web Printing Machines, *G. A. Wilson, Liverpool.*—17*th July*, 1883. 6*d.*

The inventor claims, First, stereotype cylinders with reduced ends cut or formed with screw threads, and provided with a flanged nut or its equivalent; Secondly, folding cylinders with internal cam shafts, and cams giving motion to blade carriers; Thirdly, folding cylinders fitted internally with cams and shafts carried in bearings in the cylinder ends, and actuated by toothed gearing; Fourthly, cam shafts fitted in folded cylinders provided with driving wheels, and connected thereto by pawls or catches; Fifthly, folding cylinders fitted with folding and gripping blades.

3503. Rotary Web Printing Machines, for Facilitating Folding, Delivery, and Counting Sheets of Paper, *G. A. Wilson, Liverpool.*—17*th July*, 1883. 6*d.*

Relates to collecting, folding, and delivering in piles or batches of any desired number, sheets of paper from a rotary web printing machine after they have received one or more transverse folds—usually two—by means of folding cylinders or equivalent devices.

3507. Packing for Stuffing-boxes of Piston Rods, &c., *J. H. Smith and R. Marshall, London.*—17*th July*, 1883.—(*Not proceeded with.*) 2*d.*

The inventors construct packing for the stuffing-boxes of piston and other rods of rings or coils of either metal or other packing material, whether hard or soft, through which rings or coils the rod passes, and they encircle such packing rings with helical springs in tension, so that they tend to keep the rings or coils pressed tightly against the rod as the packing wears.

3508. Decorating Glass Articles and Sheet or Plate Glass, *C. D. Abel, London.*—17*th July*, 1883.—(*A communication from A. Schierholz, Germany.*) 4*d.*

The articles are decorated by coating them with an enamel of a syrupy consistency, and while still sticky, strewing small glass beads thereon, the articles being then subjected to heat, so as to melt the enamel and cause the beads to be cemented to the surface of the article.

3510. Construction of Weighing Machines, *R. Thomas, Aberdare.*—17*th July*, 1883. 8*d.*

The principal objects are to ensure the accurate weighing of the screened small coal or other matter under all usual circumstances, to prevent any tampering with the machine in the absence of the weigher, and a considerable saving and avoidance of damage to the indicating dials.

3511. Closing or Stoppering Bottles, &c., *J. A. Bowles, London.*—17*th July*, 1883.—(*Not proceeded with.*) 2*d.*

Consists in the use of a stopper composed of a wooden or other stem or cylinder, within which works a valve or slide rod having an elastic packing at its lower end, and at its upper end a lever; an elastic ring or pad may also be placed beneath a flange upon the upper end of the stopper, to come between it and the top of the bottle.

3512. Water-closets, *E. and A. E. Gilbert, Dundee.*—17*th July*, 1883. 6*d.*

Refers to a mode of constructing the seats so as to avoid the necessity of bringing the person into contact with the usual wood framework.

3513. Washing, Wringing, and Mangling Machines, *T. Woolfall and T. T. Mercer, Blackburn.*—17*th July*, 1883. 6*d.*

Relates to washing machines in which a dolly is employed, working in an upright position, and which dolly is actuated by a hand lever at the side of the machine.

3517. Apparatus for the Manufacture of Fodder from Certain Waste Products, *H. J. Haddan, London.*—17*th July*, 1883.—(*A communication from H. Hencke and Co., Greneck, Germany.*) 6*d.*

The object is to convert the residual products of the distillation of spirits, or the returns, into loose, more or less fine-grained fodder, which may be easily transported or preserved and will not get mouldy if stored in a dry place,

3519. Rolling Mills and Rolls therefor, *A. W. L. Reddie, London.*—(*A communication from W. Hobbs and Co., Bridgeport, Conn., U.S.*) 6*d.*

One of the objects is to provide a convenient and accurate means for adjusting the bearings of the upper working roller in a rolling mill correspondingly upwards and downwards, and for "rocking" said roller, or simultaneously increasing the pressure on one bearing and easing or relieving the other bearing of pressure when the metal is slightly thicker on one edge than the other or has a tendency to run crooked; also to prevent the metal, which is often thinner than paper, from roughing as it is fed between the rollers, and to take out any wrinkles and smooth the metal, and to guide and confine it as close as possible to the point of contact between the working rollers.

3535. India-rubber Assistant Bearing Springs for Use in Railway Engines, &c., *G. Spencer, London.*—18*th July*, 1883. 4*d.*

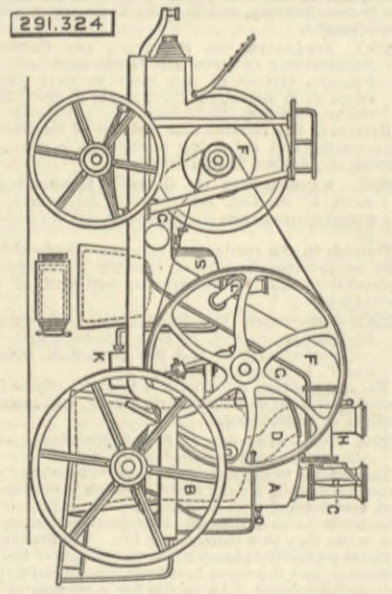
This relates to improvements on patents No. 2145, A.D. 1863, and No. 1435, A.D. 1873, and it consists in forming india-rubber springs for railway and other engines, of blocks of india-rubber, through which transverse channels or passages are provided.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

291,324. Apparatus for Extinguishing Fires, *John Kissack Joshua Foster, Bolton, County of Lancaster, England.*—*Filed April* 18*th*, 1883.

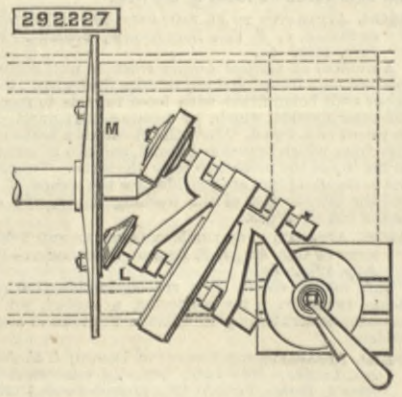
Claim.—(1) The combination, with a fan blower, of the steam boiler S, pipe L, connected throttle valves L^1 L^2, pipe F, throttle valves H H^1, uptake D, and furnace B, as shown and described. (2) The combination of a fire-box and boiler provided with separate uptakes, pipes connected to said uptakes for the conveyance of vitiated air and steam respectively, a fan blower or pump connected to said pipes, throttle valves to control the thoroughfare through the pipes



and a boiler and steam engine for driving the fan blower or pump, substantially as herein described and shown in the drawings, for the purpose specified. (3) The combination of the boiler A, fire-box B, uptakes C and D, pipes F and G, fan blower or pump E, coupled pairs of throttle valves H H^1 I I^1, steam engine K, and high-pressure steam boiler S, substantially as shown and described, and for the purpose specified.

292,227. Lathe Centre Grinding Machine, *Darius Houghton, Skowhegan, Me.*—*Filed May* 31*st*, 1883.

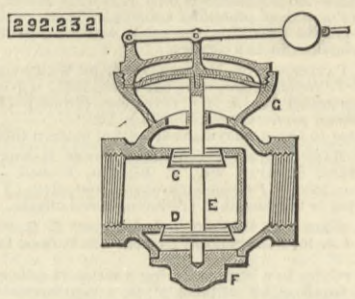
Claim.—In a lathe centre grinding machine, the combination, with the face plate of the lathe, of the



plane-faced friction wheel M, secured thereto, and the friction wheel L and its shaft, with means for transmitting the motion therefrom to the grinding wheel, as and for the purpose set forth.

292,232. Regulator Valve, *Timothy J. Kieley, New York, N.Y.*—*Filed February* 17*th*, 1883.

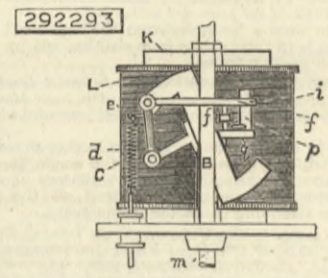
Claim.—The combination, in a regulator valve, of the diaphragm G, provided with a continuous pressure plate upon its upper surface, the said plate being connected with a weighted lever by the anti-friction-roller journal M, the valves C and D, the valve D and its valve seat being greater in diameter than the valve C, the cap F serving as a guide for the lower end of the stem E, and itself being greater in diameter than



either the valve C or D, and the spider guide located between the valve C and the diaphragm G, thereby insuring the accurate seating of the valves and preventing the lateral movement of the diaphragm, substantially as described.

292,293. Electric Arc Lamp, *Frederick J. Fitch, New York, N.Y.*—*Filed May* 16*th*, 1883.

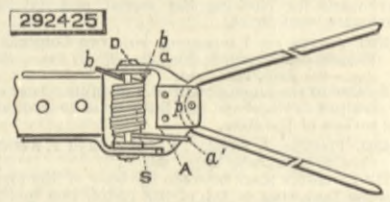
Claim.—(1) In an electric arc lamp, a split annular clutch *f*, adapted to normally grip and lift the carbon rod when tilted, in combination with suitable means adapted to spread the split clutch and release said rod, substantially as described. (2) In an electric arc lamp, the combination, with a split annular clutch adapted by tilting to grip and lift the carbon rod, of an electro-magnetic device in the arc-circuit operating to elevate said clutch, and an electro-magnetic device in a derived circuit around the arc operating to spread



the clutch and release the carbon rod, substantially as described. (3) In an electric-arc lamp, the combination of the rod B, clutch *f*, link *e*, arm *d*, oscillating armature D, and spring *c*, substantially as described. (4) In an electric arc lamp, the combination, with the clutch *f*, adapted to grip and lift the carbon rod, and having fork *i*, of the derivation magnet K, armature L, shaft *m*, finger *n*, having forks *o*, cam *p*, having lever *q*, and spring *r*, substantially as described.

292,425. Fork for Hay Tedders, *Jacob R. Fry, Jun., Springfield, Ohio.*—*Filed October* 9*th*, 1883.

Claim.—(1) In a fork for hay tedders, the combination, with the arm provided with the hinge portion B, having lugs *b*, and the hinge portion A, having lugs *a*, alternating with the lugs *b*, of the spiral spring S, having oppositely-extended ends a^1 b^1, and the bolt D, passed through the aligned lugs and the spring S,



substantially as specified. (2) In a fork for hay tedders, the combination, with the tines T, made of a single piece of material bent as shown and described, of the recessed hinged portion A, the clamping plate *p*, and the three bolts *c c c*, arranged in triangular form, two above and one below the bend of the tine piece, substantially as specified.

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